Massachusetts Water Resources Authority

Metropolitan Water Tunnel Program

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Existing Conditions by Community

Table B-1 Populations with Health Vulnerabilities in Belmont (Fernald Property)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
2015 - 2019	Elevated Blood Lead Prevalence[1]	Statistically significantly lower	Stable	5	7.3	4.3-10.3	16.1	17.7	No
2011 - 2015	Low Birth Weight	Statistically significantly lower	Unstable	3	121.1	59.8-182.3	216.8	238.5	No
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[2]**
2013 - 2017	Heart Attack	Statistically significantly lower	Stable	29	16.5	13.9-19.2	26	29	No
2013 - 2017	Pediatric Asthma ED[3] Visits	Statistically significantly lower	Unstable	11	30.4	22.38.5	83.1	91.4	No

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.

3 ED – Emergency Department

Table B-2 Populations with Health Vulnerabilities in Boston (American Legion, Newton Street Pumping Station, Southern Spine Mains)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
2015 - 2019	Elevated Blood Lead Prevalence[1]	**Statistically significantly higher**	Stable	296	17.7	16.8-18.6	16.1	17.7	**No**
2011 - 2015	Low Birth Weight	**Statistically significantly higher**	Stable	197	282.4	264.8-300.1	216.8	238.5	**Yes**
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[2]**
2013 - 2017	Heart Attack	Statistically significantly lower	Stable	719	23.8	23-24.5	26	29	**No**
2013 - 2017	Pediatric Asthma ED[3] Visits	**Statistically significantly higher**	Stable	1059	172.8	168.2-177.5	83.1	91.4	**No**

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.

3 ED – Emergency Department

Table B-3 Populations with Health Vulnerabilities in Brookline (Newton Street Pumping Station and Southern Spine Mains)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
2015 - 2019	Elevated Blood Lead Prevalence[1]	Statistically significantly lower	Stable	7	5.2	3.5-6.9	16.1	17.7	No
2011 - 2015	Low Birth Weight	Not statistically significantly different	Stable	13	214.6	162-267.2	216.8	238.5	No
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[2]**
2013 - 2017	Heart Attack	Statistically significantly lower	Stable	46	13.3	11.6-15	26	29	No
2013 - 2017	Pediatric Asthma ED[3] Visits	Statistically significantly lower	Stable	26	40.3	33.3-47.3	83.1	91.4	No

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.

3 ED – Emergency Department

Table B-4 Populations with Health Vulnerabilities in Needham (Highland Avenue Northwest/Southwest, Highland Avenue Northeast/Southeast, Hegarty Pumping Station, and St. Mary Street Pumping Station)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
2015 - 2019	Elevated Blood Lead Prevalence[1]	Statistically significantly lower	Stable	2	2.7	1.2-4.2	16.1	17.7	No
2011 - 2015	Low Birth Weight	Statistically significantly lower	Unstable	3	138.2	72.5-203.9	216.8	238.5	No
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[2]**
2013 - 2017	Heart Attack	Statistically significantly lower	Stable	43	18.9	16.21.4	26	29	No
2013 - 2017	Pediatric Asthma ED[3] Visits	Statistically significantly lower	Stable	12	25.7	19.2-32.2	83.1	91.4	No

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.

3 ED – Emergency Department

Table B-5 Populations with Health Vulnerabilities in Newton (Bifurcation, Tandem Trailer and Park Road East, Park Road West, Highland Avenue Northwest/Southwest sites, Highland Avenue Northeast/Southeast, Cedarwood Pumping Station, Hegarty Pumping Station, St. Mary Street Pumping Station, Newton Street Pumping Station, and Hultman Aqueduct Isolation Valve)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
2015 - 2019	Elevated Blood Lead Prevalence[1]	Statistically significantly lower	Stable	13	6.3	4.8-7.8	16.1	17.7	No
2011 - 2015	Low Birth Weight	Not statistically significantly different	Stable	12	174.7	131.2-218.2	216.8	238.5	No
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[2]**
2013 - 2017	Heart Attack	Statistically significantly lower	Stable	114	18.2	16.7-19.7	26	29	No
2013 - 2017	Pediatric Asthma ED[3] Visits	Statistically significantly lower	Stable	44	40	34.7-45.3	83.1	91.4	No

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.

3 ED – Emergency Department

Table B-6 Populations with Health Vulnerabilities in Waltham (Fernald Property, Bifurcation, Tandem Trailer and Park Road East, Park Road West, School Street, Cedarwood Pumping Station, and Hultman Aqueduct Isolation Valve)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
2015 - 2019	Elevated Blood Lead Prevalence[1]	Not statistically different	Stable	25	16	13.2-18.8	16.1	17.7	No
2011 - 2015	Low Birth Weight	Not statistically significantly different	Stable	16	216.2	168.8-263.6	216.8	238.5	No
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[2]**
2013 - 2017	Heart Attack	Not statistically significantly different	Stable	84	24.4	22.1-26.8	26	29	No
2013 - 2017	Pediatric Asthma ED[3] Visits	Statistically significantly lower	Stable	32	66.1	55.8-76.4	83.1	91.4	No

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.

3 ED – Emergency Department

Table B-7 Populations with Health Vulnerabilities in Watertown (Fernald Property)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
2015 - 2019	Elevated Blood Lead Prevalence[1]	Statistically significantly lower	Stable	11	12.4	9.1-15.7	16.1	17.7	No
2011 - 2015	Low Birth Weight	Not statistically significantly different	Unstable	8	175.1	119.230.8	216.8	238.5	No
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[2]**
2013 - 2017	Heart Attack	Not statistically significantly different	Stable	52	24.2	21.3-27.1	26	29	No
2013 - 2017	Pediatric Asthma ED[3] Visits	Statistically significantly lower	Unstable	9	36.9	26.47.5	83.1	91.4	No

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.

3 ED – Emergency Department

Table B-8 Populations with Health Vulnerabilities in Wellesley (Bifurcation, Tandem Trailer and Park Road East, Park Road West, Highland Avenue Northwest/Southwest sites, Highland Avenue Northeast/Southeast sites, Hegarty Pumping Station, St. Mary Street Pumping Station, and Hultman Aqueduct Isolation Valve)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
2015 - 2019	Elevated Blood Lead Prevalence[1]	Statistically significantly lower	Unstable	2	3.4	1.5.4	16.1	17.7	No
2011 - 2015	Low Birth Weight	Not statistically significantly different	Unstable	4	196.5	105.7-287.3	216.8	238.5	No
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[2]**
2013 - 2017	Heart Attack	Statistically significantly lower	Stable	26	13.8	11.16.2	26	29	No
2013 - 2017	Pediatric Asthma ED[3] Visits	Statistically significantly lower	Stable	16	36.8	28.7-44.9	83.1	91.4	No

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.

3 ED – Emergency Department

Table B-9 Populations with Health Vulnerabilities in Weston (Bifurcation, Tandem Trailer and Park Road East, Park Road West, and Hultman Aqueduct Isolation Valve)

Year Range	Health Topic	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[3]
2016 - 2020	Elevated Blood Lead Prevalence[1]	NS[2]	NS[2]	NS[2]	NS[2]	NS[2]	15.0	16.5	No
2011 - 2015	Low Birth Weight	Not statistically significantly different	Unstable	1	237.2	47.4-426.9	216.8	238.5	No
Year Range	**Health Topic**	**Statistical Significance**	**Stability**	**Case Count**	**Rate per 10,000 Label**	**Confidence Intervals**	**Statewide Rate per 10,000**	**110% Statewide Rate per 10,000**	**>110% Statewide Rate?[3]**
2013 - 2017	Heart Attack	Statistically significantly lower	Stable	16	17.4	13.6-21.2	26.4	29	No
2013 - 2017	Pediatric Asthma ED[4] Visits	Statistically significantly lower	Unstable	5	26.7	15.8-37.6	83.1	91.4	No

Source: DPH EJ Tool, 2021.

1 For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children.
2 NS – Not Stable
3 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 or 10,000 to the 110% statewide rate per 1,000 or 10,000.
4 ED – Emergency Department

Existing Conditions by Site

Table B-10 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Fernald Property

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3576.00	Belmont	Not statistically different	Unstable	1	17.1	3.30.8	16.1	17.7	No
3577.00	Belmont	Statistically significantly lower	Unstable	0	0	0-13.6	16.1	17.7	No
3688.00[1]	Waltham	Not statistically different	Stable	4	27.3	15-39.6	16.1	17.7	Yes
3689.02[1]	Waltham	Not statistically different	Unstable	1	14.6	3.8-25.4	16.1	17.7	No
3701.01[1]	Watertown	Statistically significantly lower	Unstable	1	9	2.3-15.7	16.1	17.7	No
3702.02	Watertown	Not statistically different	Stable	3	30.1	15.44.8	16.1	17.7	Yes

Source: DPH EJ Tool, 2021.

Notes: Year Range 2015-2019.

For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)

1 EJ block group present within.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-11 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Fernald Property

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3576.00	Watertown	Not statistically significantly different	Unstable	2	243.3	92.5-394.1	216.8	238.5	Yes
3577.00	Watertown	Not statistically significantly different	Unstable	2	243.3	92.5-394.1	216.8	238.5	Yes
3688.00[1]	Watertown	Not statistically significantly different	Unstable	2	243.3	92.5-394.1	216.8	238.5	Yes
3689.02[1]	Waltham	Not statistically significantly different	Unstable	2	268.7	93.1-444.2	216.8	238.5	Yes
3701.01[1]	Watertown	Not statistically significantly different	Unstable	2	243.3	92.5-394.1	216.8	238.5	Yes
3702.02	Watertown	Not statistically significantly different	Unstable	2	243.3	92.5-394.1	216.8	238.5	Yes

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-12 Sources of Pollution Within 1 Mile of Fernald Property

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	4 (Duffy Bros Construction Inc., Lockheed Martin Advance Energy Storage, CVS 0148, Beaver Visitec International Inc.)
Large Quantity Toxic Users	1 (Light Metal Platers LLC)
MassDEP Tier Classified 21E Sites	1 (Waverly Oaks Wooded Area)
MassDEP Tier II Facilities	6 (Frederick C Murphy Federal Center, McLean Hospital, Light Metal Platers LLC, Lockheed Martin Advanced Energy Storage, Beaver Visitec International, Bentley University)
MassDEP Sites with Activity and Use Limitations (AUL)	11 (Murphy Federal Ctr Boiler Plant, Shell Product Dist Plant FMR, Duffy Brothers Construction, Power Plant Near Waverly Oaks Entrance, Murphy Federal Center – Boiler Plant UST, George More Facility FMR, FMR Heating Plant, Dana Athletic CTR Off Field Road, three selected “No Location Aid”)
Underground Storage Tanks	7 (Sycamore Auto Repair, Shell Service Station, Ellison Park Property Holding LLC, Getty Petroleum Marketing Inc., Waverly Square Service Inc., Shell Service Station 137873, AAA Auto Clinic)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-13 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Bifurcation Site

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3684.00[1]	Waltham	Not statistically different	Unstable	1	9.9	2.6-17.2	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-14 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Bifurcation Site

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3684.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-15 Sources of Pollution Within 1 Mile of Bifurcation Site

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	1 (MA Bay Transportation Authority)
Large Quantity Toxic Users	0
MassDEP Tier Classified 21E Sites	0
MassDEP Tier II Facilities	0
MassDEP Sites with Activity and Use Limitations (AUL)	1 (“No Location Aid”)
Underground Storage Tanks	3 (MDC Leo J Martin Memorial Golf Course, Hess 21231, MW Highway Department DBA 128 Newton Gas)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-16 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Tandem Trailer and Park Road East Sites

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3684.00[1]	Waltham	Not statistically different	Unstable	1	9.9	2.6-17.2	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-17 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Tandem Trailer and Park Road East Sites

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3684.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-18 Sources of Pollution Within 1 Mile of Tandem Trailer and Park Road East Sites

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	1 (MBTA)
Large Quantity Toxic Users	0
MassDEP Tier Classified 21E Sites	0
MassDEP Tier II Facilities	0
MassDEP Sites with Activity and Use Limitations (AUL)	2 (Two selected with no facility names, located at 275 Grove Street and 2078 Commonwealth Avenue)
Underground Storage Tanks	3 (MDC Leo J Martin Memorial Golf Course, Hess 21231, Mobil R/S 12384)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-19 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Park Road West Sites

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
3684.00	Waltham	Not statistically different	Unstable	1	9.9	2.6-17.2	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-20 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Park Road West Sites

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
3684.00	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-21 Sources of Pollution Within 1 Mile of Park Road West Sites

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	1 (MBTA)
Large Quantity Toxic Users	0
MassDEP Tier Classified 21E Sites	0
MassDEP Tier II Facilities	0
MassDEP Sites with Activity and Use Limitations (AUL)	2 (Two selected with no facility names, located at 275 Grove Street and 2078 Commonwealth Avenue)
Underground Storage Tanks	3 (MDC Leo J Martin Memorial Golf Course, Hess 21231, Mobil R/S 12384)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-22 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Highland Avenue Northwest/Southwest Site

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
3740.00	Newton	Statistically significantly lower	Unstable	0	0	0-13.9	16.1	17.7	No
3742.00	Newton	Statistically significantly lower	Unstable	0	0	0-14.1	16.1	17.7	No
4031.00	Needham	Statistically significantly lower	Unstable	0	0	0-6.4	16.1	17.7	No

Source: DPH EJ Tool, 2021.

Notes: Year Range 2015-2019.

For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)

1 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-23 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Highland Avenue Northwest/Southwest Site

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
3740.00	Needham	Not statistically significantly different	Unstable	1	194.8	38.9-350.7	216.8	238.5	No
3742.00	Newton	Not statistically significantly different	Unstable	1	329.7	65.9-593.5	216.8	238.5	Yes
4031.00	Needham	Not statistically significantly different	Unstable	1	194.8	38.9-350.7	216.8	238.5	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)

1 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-24 Sources of Pollution Within 1 Mile of Highland Avenue Northwest/Southwest Site

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	7 (Caris Life Sciences DBA Cohen Dermatopatho, Muzi Motors Inc., HC Starck Inc., Muzi Motors, CVS 2128, Harvard Vanguard Medical Associates, Coca Cola Refreshments USA Inc.)
Large Quantity Toxic Users	4 (Master Finishing & Restoration Inc., HC Starck Inc., Poly One Engineering Films, Coca Cola Refreshments USA Inc.)
MassDEP Tier Classified 21E Sites	4 (Regalite Plastics Corporation, Former Industrial Property, Microwave Development Labs, Needham Fire Station No. 2)
MassDEP Tier II Facilities	11 (Microwave Development Labs Inc., Coca-Cola of Northern New England, Comcast of Needham Inc. – Needham Headend and FFO, Digital 105 Cabot LLC, Digital 128 First Avenue LLC, AT&T MA3438, Bigelow Oil Company Inc., H.C. Starck Inc., Muzi Motors, WBZ Transmitter Site, Needham Company – LTPF9 USID10572)
MassDEP Sites with Activity and Use Limitations (AUL)	3 (Highland Service Station, two selected "No Location Aid")
Underground Storage Tanks	9 (Echo Bridge Service Station Inc., Indresano Oil Company, Motiva Enterprises LLC, Biegelow Oil Company Incorporated, Highland Car Care Center Inc., Hess 21326, Sentinel Data Center, Muzi Motors Inc., Kerivan-Lane Inc.)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-25 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Highland Avenue Northeast/Southeast Site

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
3740.00	Newton	Statistically significantly lower	Unstable	0	0	0-13.9	16.1	17.7	No
3742.00	Newton	Statistically significantly lower	Unstable	0	0	0-14.1	16.1	17.7	No
4031.00	Needham	Statistically significantly lower	Unstable	0	0	0-6.4	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-26 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Highland Avenue Northeast/Southeast Site

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
3740.00	Needham	Not statistically significantly different	Unstable	1	194.8	38.9-350.7	216.8	238.5	No
3742.00	Newton	Not statistically significantly different	Unstable	1	329.7	65.9-593.5	216.8	238.5	Yes
4031.00	Needham	Not statistically significantly different	Unstable	1	194.8	38.9-350.7	216.8	238.5	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-27 Sources of Pollution Within 1 Mile of Highland Avenue Northeast/Southeast Site

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	7 (Caris Life Sciences DBA Cohen Dermatopatho, Muzi Motors Inc., HC Starck Inc., Muzi Motors, CVS 2128, Harvard Vanguard Medical Associates, Coca Cola Refreshments USA Inc.)
Large Quantity Toxic Users	4 (Master Finishing & Restoration Inc., HC Starck Inc., Poly One Engineering Films, Coca Cola Refreshments USA Inc.)
MassDEP Tier Classified 21E Sites	5 (Regalite Plastics Corporation, City of Newton DPW Yard, Former Industrial Property, Microwave Development Labs, Needham Fire Station No. 2)
MassDEP Tier II Facilities	11 (Microwave Development Labs Inc., Coca-Cola of Northern New England, Comcast of Needham Inc. – Needham Headend and FFO, Digital 105 Cabot LLC, Digital 128 First Avenue LLC, AT&T MA3438, Bigelow Oil Company Inc., H.C. Starck Inc., Muzi Motors, WBZ Transmitter Site, Needham Company – LTPF9 USID10572)
MassDEP Sites with Activity and Use Limitations (AUL)	4 (Community Service Station Inc., Highland Service Station, two selected "No Location Aid")
Underground Storage Tanks	9 (Echo Bridge Service Station Inc., Indresano Oil Company, Motiva Enterprises LLC, Biegelow Oil Company Incorporated, Newton Tire & Auto Inc., Hess 21326, Sentinel Data Center, Muzi Motors Inc., Kerivan-Lane Inc.)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-28 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of American Legion Site

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
0924.00[1]	Boston	Not statistically different	Stable	4	22.2	12.9-31.5	16.1	17.7	Yes
1001.00[1]	Boston	Not statistically different	Stable	4	22.8	13.3-32.3	16.1	17.7	Yes
1002.00[1]	Boston	Not statistically different	Stable	3	25.8	11.8-39.8	16.1	17.7	Yes
1010.01[1]	Boston	Not statistically different	Stable	4	21.3	11.5-31.1	16.1	17.7	Yes
1011.01[1]	Boston	Not statistically different	Unstable	2	19.1	6.6-31.6	16.1	17.7	Yes
1011.02[1]	Boston	Statistically significantly higher	Stable	5	29.7	18.1-41.3	16.1	17.7	Yes
1101.03[1]	Boston	Not statistically different	Stable	4	22.5	12.1-32.9	16.1	17.7	Yes
1102.01[1]	Boston	Not statistically different	Unstable	2	26.6	9.2-44	16.1	17.7	Yes
1104.01[1]	Boston	Not statistically different	Unstable	2	14.5	4.5-24.5	16.1	17.7	No
1202.01[1]	Boston	Not statistically different	Unstable	2	18.8	7.7-29.9	16.1	17.7	Yes
9803.00[1]	Boston	Not statistically different	Unstable	0	0	0-799.4	16.1	17.7	No
9810.00	Boston	Not statistically different	Unstable	0	0	0-3197.4	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-29 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of American Legion Site

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
0924.00[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
1001.00[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
1002.00[1]	Boston	Not statistically significantly different	Unstable	3	448.3	204.6-692	216.8	238.5	Yes
1010.01[1]	Milton	Not statistically significantly different	Unstable	1	179.1	35.8-322.4	216.8	238.5	No
1011.01[1]	Boston	Not statistically significantly different	Unstable	3	448.3	204.6-692	216.8	238.5	Yes
1011.02[1]	Boston	Not statistically significantly different	Unstable	3	448.3	204.6-692	216.8	238.5	Yes
1101.03[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
1102.01[1]	Boston	Not statistically significantly different	Unstable	2	226.1	78.373.9	216.8	238.5	No
1104.01[1]	Boston	Not statistically significantly different	Unstable	2	274.4	95.1-453.7	216.8	238.5	Yes
1202.01[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
9803.00[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
9810.00	Boston	Not statistically significantly different	Unstable	2	274.4	95.1-453.7	216.8	238.5	Yes

Source: DPH EJ Tool, 2021.

Notes: Year Range 2011-2015.

For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)

1 EJ block group present within.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-30 Sources of Pollution Within 1 Mile of American Legion Site

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	4 (Gas Emporium Inc., Autozone 5076, Valvoline Instant Oil Change, MBTA Arborway Bus Facility)
Large Quantity Toxic Users	0
MassDEP Tier Classified 21E Sites	11 (Residential Property – 12 Ashton Street, Warehouse, Northeastern Petroleum, 19-21 Stratton St, 820-828 Blue Hill Avenue, Multi-family residential dwelling, commercial property, proposed development, Boulevard Cleaners, Boston Assessor's parcel, one selected "No Location Aid")
MassDEP Tier II Facilities	4 (Lemuel Shattuck Hospital, Dorchester MA ODAS – Inbuilding DAS/Rptr, MPCS Dorchester DAS NEH0001A, UMass Medical School)
MassDEP Sites with Activity and Use Limitations (AUL)	13 (Arborway Yard, BO Housing Authority, Mobil Station 01-362, MWRA Facility at corner of Morton Street, FMR Boston Street Hospital, Apartment complex near Stellman Road, Paine Street, Department of Youth Services, Nail Salon, Former Administration Building, School, Engine 52, one selected "No Location Aid")
Underground Storage Tanks	10 (Mobil 01-362 12671, Boston Police Department District B-3, ALH Petro LLC, ExxonMobil, Northeastern Petroleum Service and Supply, Gas Emporium Inc., Boston Pre Release Center, Franklin Park Maintenance Yard, Mount Hope Cemetery, Massachusetts Biologic Labs)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-31 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of School Street Site

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3682.00[1]	Waltham	Not statistically different	Unstable	1	11.1	2.9-19.3	16.1	17.7	No
3683.00[1]	Waltham	Not statistically different	Stable	2	17.9	7.8-28	16.1	17.7	Yes
3684.00[1]	Waltham	Not statistically different	Unstable	1	9.9	2.6-17.2	16.1	17.7	No
3685.00[1]	Waltham	Not statistically different	Unstable	2	23.1	7.1-39.1	16.1	17.7	Yes
3686.00[1]	Waltham	Statistically significantly higher	Stable	4	30.7	17.2-44.2	16.1	17.7	Yes
3687.00[1]	Waltham	Statistically significantly higher	Stable	3	39.3	18.7-59.9	16.1	17.7	Yes
3688.00[1]	Waltham	Not statistically different	Stable	4	27.3	15-39.6	16.1	17.7	Yes
3689.02[1]	Waltham	Not statistically different	Unstable	1	14.6	3.8-25.4	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-32 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of School Street Site

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3682.00[1]	Waltham	Not statistically significantly different	Unstable	1	231.8	60.1-403.5	216.8	238.5	No
3683.00[1]	Waltham	Not statistically significantly different	Unstable	2	268.7	93.1-444.2	216.8	238.5	Yes
3684.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No
3685.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No
3686.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No
3687.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No
3688.00[1]	Watertown	Not statistically significantly different	Unstable	2	243.3	92.5-394.1	216.8	238.5	Yes
3689.02[1]	Waltham	Not statistically significantly different	Unstable	2	268.7	93.1-444.2	216.8	238.5	Yes

Source: DPH EJ Tool, 2021.

Notes: Year Range 2011-2015.

For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)

1 EJ block group present within.

2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-33 Sources of Pollution Within 1 Mile of School Street Site

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	6 (CVS 0148, Plating for Electronics Inc., Waltham Express Service, Bob’s Equipment Repair, CVS 0114, Valvoline Instant Oil Change)
Large Quantity Toxic Users	4 Bird Precision, Plating for Electronics Inc., Nova Biomedical, Acton Metal Processing Corporation)
MassDEP Tier Classified 21E Sites	7 (Commercial Property, Property-Intersection of Prospect/Felton, Basement of 52 Bacon Street, 17 Yetten Terrace-McBrites’s Court Route, 216R Newton Street-B&L Realty Trust, Longview Fibre Company, one selected “No Location Aid”)
MassDEP Tier II Facilities	8 (Acton Metal Processing Corporation, Boston Children’s Hospital Waltham, Verizon Waltham Company MA622307, Waltham Moody Street USID41847, Nova Biomedical, NSTAR Station 33, Plating for Electronics Inc., Taylor & Murphy Inc.)
MassDEP Sites with Activity and Use Limitations (AUL)	30 (Two selected “Exxon,” FMR Waltham Hospital, Lenza Oil, Waltham Industrial Labs (FMR), Fabtron, Arco Station 11337, Tom Lyons Tire, Longview Fibre Company, Gasoline Station FMR, Veronica’s Spa, Between Main Building & Railroad Track, FMR Waltham Watch Factory, Former City Incinerator Site, Watch Factory – Buildings 21 and 25, Waltham Watch Factory FMR Building 22, Property, Johnny’s Service FMR, Boston and Main Easement, Austin Rhodes Municipal Center, Watch Factory – Phase 3, Boston & Maine Rail Easement, Behind Fire Station, 135 Elm Street DPS Filing, Dana Athletic Center Off Field, five selected “No Location Aid”)
Underground Storage Tanks	13 (Taylor and Murphy, New World Gas & Variety, Ellison Park Property Holding LLC, Watch City Petroleum Inc., Waltham Police Fire DPW Headquarters, High Street Express, Colvins Inc., City of Waltham, Shell Service Station 137872, Hess 21340, Getty 30712, New England Tele, Waltham Exxon Tiger Mart)
EPA Facilities	
Toxic Release Inventory sites 2017	1 (Plating for Electronics Inc.)
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-34 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Cedarwood Pumping Station

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3682.00[1]	Waltham	Not statistically different	Unstable	1	11.1	2.9-19.3	16.1	17.7	No
3683.00[1]	Waltham	Not statistically different	Stable	2	17.9	7.8-28	16.1	17.7	Yes
3684.00[1]	Waltham	Not statistically different	Unstable	1	9.9	2.6-17.2	16.1	17.7	No
3685.00[1]	Waltham	Not statistically different	Unstable	2	23.1	7.1-39.1	16.1	17.7	Yes
3686.00[1]	Waltham	Statistically significantly higher	Stable	4	30.7	17.2-44.2	16.1	17.7	Yes
3687.00[1]	Waltham	Statistically significantly higher	Stable	3	39.3	18.7-59.9	16.1	17.7	Yes
3688.00	Waltham	Not statistically different	Stable	4	27.3	15-39.6	16.1	17.7	Yes
3689.02	Waltham	Not statistically different	Unstable	1	14.6	3.8-25.4	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-35 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Cedarwood Pumping Station

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3682.00[1]	Waltham	Not statistically significantly different	Unstable	1	231.8	60.1-403.5	216.8	238.5	No
3683.00[1]	Waltham	Not statistically significantly different	Unstable	2	268.7	93.1-444.2	216.8	238.5	Yes
3684.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No
3685.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No
3686.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No
3687.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No
3688.00	Watertown	Not statistically significantly different	Unstable	2	243.3	92.5-394.1	216.8	238.5	Yes
3689.02	Waltham	Not statistically significantly different	Unstable	2	268.7	93.1-444.2	216.8	238.5	Yes

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-36 Sources of Pollution Within 1 Mile of Cedarwood Pumping Station

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	4 (Brandeis University, Waltham Express Service, CVS 0114)
Large Quantity Toxic Users	3 (Bird Precision, Aggregate Industries Northeast, Nova Biomedical)
MassDEP Tier Classified 21E Sites	4 (Property-Intersection of Prospect and Felton, Basement of 52 Bacon Street, 838 Moody Street Trust, one selected "No Location Aid")
MassDEP Tier II Facilities	6 (Aggregate Industries Northeast Region Inc., Boston Children's Hospital Waltham, Brandeis University, Verizon Waltham Company MA622307, Waltham Moody Street – USID41847, Nova Biomedical)
MassDEP Sites with Activity and Use Limitations (AUL)	21 (Pantos Family Trust, FMR Waltham Hospital, Parker Hannifin Corporation, Waltham Industrial Labs (FMR), Property, Brandeis University, FMR Incinerator Building, Gasoline Station FMR, Veronica's Spa, FMR Waltham Watch Factory, Watch Factory – Buildings 21 and 25, Rumford and Riverview, Waltham Watch Factory FMR Building 22, two selected "Commercial Office Building," Property, Wadsworth Street, Watch Factory – Phase 3, three selected "No Location Aid")
Underground Storage Tanks	9 (Watch City Petroleum Inc., Woodside Service, Brandeis University, Colvins Inc., Shell Service Station 137872, Hess 21340, Getty 30712, New England Tele, Waltham Exxon Tiger Mart)
EPA Facilities	
Toxic Release Inventory sites 2017	2 (Two selected "Aggregate Industries Northeast Region Inc.")
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-37 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Hultman Aqueduct Isolation Valve Site

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3684.00[1]	Waltham	Not statistically different	Unstable	1	9.9	2.6-17.2	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-38 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Hultman Aqueduct Isolation Valve Site

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
3684.00[1]	Waltham	Not statistically significantly different	Unstable	2	224.4	77.8-371.1	216.8	238.5	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-39 Sources of Pollution Within 1 Mile of Hultman Aqueduct Isolation Valve Site

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	1 (MA Bay Transportation Authority)
Large Quantity Toxic Users	0
MassDEP Tier Classified 21E Sites	0
MassDEP Tier II Facilities	0
MassDEP Sites with Activity and Use Limitations (AUL)	1 (“No Location Aid”)
Underground Storage Tanks	3 (MDC Leo J Martin Memorial Golf Course, Hess 21231, MW Highway Department DBA 128 Newton Gas)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-40 Sources of Pollution Within 1 Mile of Hegarty Pumping Station (1)

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	1 (Newton Wellesley Hospital)
Large Quantity Toxic Users	0
MassDEP Tier Classified 21E Sites	0
MassDEP Tier II Facilities	3 (WBZ Transmitter Site, Newton-Wellesley Hospital, Sun Life Executive Park)
MassDEP Sites with Activity and Use Limitations (AUL)	2 (MA DPW, one selected “No Location Aid”)
Underground Storage Tanks	5 (Exxon Division of CFI 70054, Newton Wellesley Hospital, Medaglia Brothers Mobil, Sunoco 005 3819, MA Highway Department DBA 128 Newton)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-41 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of St. Mary Street Pumping Station

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
3742.00	Newton	Statistically significantly lower	Unstable	0	0	0-14.1	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

(1) At the time that the vulnerable health criteria analysis was conducted using the DPH EJ Tool, no "vulnerable health EJ by census tract" data were identified within 1 mile of the site. This includes data for both EJ and non-EJ census tracts. It is important to note that the DPH EJ Tool and its data are updated as new health data becomes available.

Table B-42 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of St. Mary Street Pumping Station

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
3742.00	Newton	Not statistically significantly different	Unstable	1	329.7	65.9-593.5	216.8	238.5	Yes

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-43 Sources of Pollution Within 1 Mile of St. Mary Street Pumping Station

DPH Source	Number of Areas within One Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	4 (Caris Life Sciences DBA Cohen Dermatopatho, Muzi Motors Inc., Muzi Motors, Harvard Vanguard Medical Associates)
Large Quantity Toxic Users	1 (Poly One Engineering Films)
MassDEP Tier Classified 21E Sites	3 (Regalite Plastics Corporation, Former Industrial Property, Needham Fire Station No.2)
MassDEP Tier II Facilities	9 (Comcast of Needham Inc. – Needham Headend and FFO, Digital 105 Cabot LLC, Digital 128 First Avenue LLC, AT&T MA3438, Bigelow Oil Company Inc., Muzi Motors, WBZ Transmitter Site, Needham Company – LTPF9 USID10572, Sun Life Executive Park)
MassDEP Sites with Activity and Use Limitations (AUL)	3 (MA DPW, two selected “No Location AID”)
Underground Storage Tanks	8 (Echo Bridge Service Station Inc., Indresano Oil Company, Biegelow Oil Company Inc., Hess 21326, Sentinel Data Center, Muzi Motors Inc., Kerivan-Lane Inc., Medaglia Brothers Mobil)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-44 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Newton Street Pumping Station

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
1301.00[1]	Boston	Not statistically different	Unstable	2	12.6	4.8-20.4	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-45 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Newton Street Pumping Station

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[1]
1301.00[1]	Dedham	Not statistically significantly different	Unstable	1	274.7	33.9-515.5	216.8	238.5	Yes

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-46 Sources of Pollution Within 1 Mile of Newton Street Pumping Station

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	0
Large Quantity Toxic Users	0
MassDEP Tier Classified 21E Sites	0
MassDEP Tier II Facilities	1 (Jack Kirrane Ice Skating Rink at Larz Anderson Park)
MassDEP Sites with Activity and Use Limitations (AUL)	1 (Ash Landfill FMR)
Underground Storage Tanks	4 (MWRA Newton Street Pump Station, JD Auto Center Inc., Larz Anderson Parkyard Garage, Shell Service Station 137886)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Table B-47 Elevated Blood Lead Prevalence by Census Tract Within 1-Mile of Southern Spine Mains

Census Tract	Municipality	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
1101.03[1]	Boston	Not statistically different	Stable	4	22.5	12.1-32.9	16.1	17.7	Yes
1104.01[1]	Boston	Not statistically different	Unstable	2	14.5	4.5-24.5	16.1	17.7	No
1106.07	Boston	Not statistically different	Stable	3	20.5	10.5-30.5	16.1	17.7	Yes
1202.01[1]	Boston	Not statistically different	Unstable	2	18.8	7.7-29.9	16.1	17.7	Yes
1203.01[1]	Boston	Not statistically different	Stable	3	21.7	10.7-32.7	16.1	17.7	Yes
1204.00[1]	Boston	Not statistically different	Stable	4	20.3	10.9-29.7	16.1	17.7	Yes
9803.00[1]	Boston	Not statistically different	Unstable	0	0	0-799.4	16.1	17.7	No
9810.00	Boston	Not statistically different	Unstable	0	0	0-3197.4	16.1	17.7	No
9818.00[1]	Boston	Not statistically different	Unstable	0	0	0-492	16.1	17.7	No

Source: DPH EJ Tool, 2021.
Notes: Year Range 2015-2019.
For determining prevalence, children can be counted only once per year, but can appear in multiple years. Prevalence is the number of tests in a given blood lead level category out of all the children screened in that year within specific age ranges, per 1,000 children. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Childhood Lead Poisoning. https://matracking.ehs.state.ma.us/Health-Data/Childhood_Blood_Lead_Levels.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-48 Low Birth Weight Rate per 1,000 by Census Tract Within 1-Mile of Southern Spine Mains

Census Tract	Community	Statistical Significance	Stability	Case Count	Rate per 1,000	Confidence Intervals	Statewide Rate Per 1,000	110% Statewide Rate per 1,000	>110% Statewide Rate?[2]
1101.03[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
1104.01[1]	Boston	Not statistically significantly different	Unstable	2	274.4	95.1-453.7	216.8	238.5	Yes
1106.07	Boston	Not statistically significantly different	Unstable	2	274.4	95.1-453.7	216.8	238.5	Yes
1202.01[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
1203.01[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
1204.00[1]	Boston	Not statistically significantly different	Unstable	1	241.4	62.6-420.2	216.8	238.5	Yes
9803.00[1]	Boston	Statistically significantly lower	Unstable	0	0	0-0	216.8	238.5	No
9810.00	Boston	Not statistically significantly different	Unstable	2	274.4	95.1-453.7	216.8	238.5	Yes
9818.00[1]	Brookline	Not statistically significantly different	Unstable	1	292.9	75.9-509.9	216.8	238.5	Yes

Source: DPH EJ Tool, 2021.
Notes: Year Range 2011-2015.
For determining prevalence, low birth weight is measured among singleton births only. Prevalence is the number of babies born weighing less than 5.5 pounds per 1,000 singleton births. (Source: Commonwealth of Massachusetts. 2021. Massachusetts Environmental Public Health Tracking, Low Birth Weight. https://matracking.ehs.state.ma.us/Health-Data/Reproductive-Outcomes/Low_Birth_Weight.html)
1 EJ block group present within.
2 The determination of greater than 110% statewide rate was made by comparing the rate per 1,000 to the 110% statewide rate per 1,000.

Table B-49 Sources of Pollution Within 1 Mile of Southern Spine Mains

DPH Source	Number of Areas within 1 Mile
MassDEP Major Air and Waste Facilities	
Air Operating Permits	0
Hazardous Waste Treatment, storage/disposal	0
Hazardous waste recycler	0
Large quantity generators	3 (Gas Emporium Inc., MBTA Arborway Bus Facility, Faulkner Hospital)
Large Quantity Toxic Users	0
MassDEP Tier Classified 21E Sites	8 (Brigham and Women's Faulkner Hospital, Keegan's Service Station, Northeastern Petroleum, 2-Family Residential Building, 3371 Washington Owner LLC, Gasoline Station, Property, one selected "No Location Aid")
MassDEP Tier II Facilities	6 (Hebrew Rehabilitation Center, Faulkner – USID54451, Lemuel Shattuck Hospital, Division of Capital Asset Management and Maintenance, Harvard University – Arnold Arboretum, NSTAR Station 284)
MassDEP Sites with Activity and Use Limitations (AUL)	0
Underground Storage Tanks	1 (Pico Ave Sewage Pump Station)
EPA Facilities	
Toxic Release Inventory sites 2017	0
Superfund Site Boundaries	0

Source: DPH EJ Tool, 2021.

Appendix C: Alternatives Analysis Supporting Documentation

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C Alternatives Analysis Supporting Documentation

C.1 Introduction

The Authority plans to construct two new deep rock water supply tunnels (north and south alignments). Known as the Metropolitan Water Tunnel Program (the Program), this important new infrastructure will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (19636) and Dorchester Tunnel (1976). The Metropolitan Tunnel System delivers 60 percent of the water that travels eastward from the Quabbin Reservoir, through a series of tunnels and aqueducts to the Authority's state-of-the-art John J. Carroll Water Treatment Plant in Marlborough, to serve 53 communities. Treated water is conveyed from the plant through the MetroWest Water Supply Tunnel (MWWST) and the Hultman Aqueduct to the western end of the existing Metropolitan Tunnel System.

The new, redundant deep rock tunnels would originate at a site located at the western most portion of the Metropolitan Tunnel System roughly in the vicinity of the Interstate I90/I95 (I90/I95) interchange. The tunnels would be constructed such that water flows in two directions, with one tunnel traversing north towards Waltham and the other south towards Boston/Dorchester. Each tunnel will connect to existing water supply infrastructure at key locations to achieve redundancy goals.

C.2 Tunnel Alignment Elements Considered in DEIR

The Metropolitan Water Supply Program (the Program) Environmental Notification Form (ENF) alternatives analysis determined that a deep rock tunnel to the north and south would be the preferred engineering solution to provide the required redundancy east of Shaft 5/5A. Both tunnels are proposed to begin in the Town of Weston, Massachusetts near the eastern terminus of the Hultman Aqueduct and MetroWest Water Supply Tunnel. The North Tunnel Alternative would extend approximately 4.5 miles to the north, ending near the Waltham/Belmont line with a connection to the existing 60-inch diameter Weston Aqueduct Supply Main Number Three (WASM3), and the South Tunnel Alternative would extend approximately 10 miles to the south, with a connection to the distribution pipes near Shaft 7C of the Dorchester Tunnel, and ending in Boston.

The Secretary's Certificate on the ENF requested a description of Program changes since the filing of the ENF. While the Program intent has not changed since the ENF, the alternatives analysis has advanced to ultimately identify a preferred alternative, as well as two back-up alternatives, in this Draft Environmental Impact Report (DEIR). Prior to the ENF, a series of preliminary steps were completed to identify the type and size of the tunnels. The ENF built upon the previous studies and identified 13 north alternatives and 15 south alternatives, screening 28 alternatives using two tiers of screening criteria. The alternatives analysis in the ENF concluded that a deep rock tunnel to the north and south would be the preferred engineering solution to advance for further evaluation. Each tunnel alternative would include tunnel boring machine (TBM) launching shafts at the starting point for the tunnels and TBM receiving shafts at the tunnel terminus.

In the ENF, the Authority's original qualitative analysis of these 28 alternatives can be generally broken down into three general project schemes; 1) operational changes of the Authority's existing water distribution system, 2) increase the capacity of the existing system by rehabilitating and/or replacing surface mains with larger piping, 3) increasing capacity through construction of a new deep rock tunnel. These 28 alternatives were screened through a two tier process. To meet Tier 1 requirements, an alternative must have been able to meet program goals of meeting future high day water demand and achieve system reliability and resilience. Tier 2 assessed preliminary feasibility, potential construction related impacts, and an initial constructability assessment.

Responding to comments from the ENF Certificate of the Secretary (EEA #16355), the Authority returned to the original 28 alternatives presented in the ENF and conducted further supplemental high level analysis of these alternatives utilizing available GIS data. During this analysis the Authority estimated the total disturbed area for each of the 28 alternatives based on an assumed trench width and shaft construction requirements. Those alternatives that passed the Tier 1 program requirements were then further evaluated to gauge impacts to the following resources; open space, wetlands, rare species, and historic and cultural areas. This supplemental analysis, which is summarized in **Table C-1** and **Table C-2**, reached the same conclusion as the original qualitative analysis which is that the deep rock tunnel alternatives 8N and 20S, found in the ENF are the Authority's preferred alternatives, and that their impacts to the above resources are equal to or less than that of the other 26 alternatives.

Since the ENF filing, potential launching, receiving, and connection point locations were identified and evaluated, to determine the alternatives that would advance into the DEIR (the DEIR Alternatives). Since the DEIR Alternatives are made up of different combinations of launching, receiving, and connecting sites and different tunnel segments, a multi-criteria decision tool was developed to consistently apply the evaluation criteria and sub-criteria to each site or tunnel segment, and to score the alternative components to develop a mechanism for comparing one against the other and in combination. The DEIR Alternatives are comprised of two or three deep rock tunnel segments each with a launching shaft site (for the TBMs), receiving shaft sites (at the terminus of the tunnel boring), connection shaft sites (where the tunnels are connected to the existing water distribution system) and deep rock tunnel segments (connecting the various shaft sites). Together these shaft sites and tunnel segments comprise a tunnel alignment.

The next step of the tunnel alignment alternatives to support the DEIR alternatives analysis, was to set the general location of the tunnel alignments and associated launching, receiving, and connection shaft sites.

Table C-1 Summary of Supplemental Screening Analysis for 28 Alternatives Presented in the ENF: North Alternatives

Alternative Number	Category	Tier 1	Tier 2	Total Disturbed Area (Acres)[1]		Total " Open Space" Disturbed Area (Acres)[1]		Total " Wetland" Disturbed Area (Acres)[1]		Total "Rare Species" Disturbed Area (Acres)[1]		Total "Historic" Disturbed Area (Acres)[1]		Category Description
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
1N	1	Fail	Fail	-	-									Operational Changes to Existing System
2N	2	Fail	Fail	9	17									Replace WASM 3 with Larger Surface Pipeline and/or Add Pumping Station
3N	2	Fail	Fail	7	13									Replace WASM 3 with Larger Surface Pipeline and/or Add Pumping Station
4N	2	Pass	Fail	11	22	8	16	1	2	-	-	8	17	Replace WASM 3 with Larger Surface Pipeline and/or Add Pumping Station
5N	2	Pass	Fail	16	32	11	23	1	3	-	-	12	26	Replace WASM 3 with Larger Surface Pipeline and/or Add Pumping Station
6N	2	Fail	Fail	18	36									Replace WASM 3 with Larger Surface Pipeline and/or Add Pumping Station
7N	2	Pass	Fail	18	36	5	9	2	3	-	-	9	18	Replace WASM 3 with Larger Surface Pipeline and/or Add Pumping Station
8N	3	Pass	Pass	11	11	1	1	-	-	-	-	-	-	Deep Rock Tunnel to the North
9N	3	Pass	Fail	16	16	6	6	1	1	-	-	9	9	Deep Rock Tunnel to the North
10N	3	Pass	Fail	16	16	6	6	1	1	-	-	8	8	Deep Rock Tunnel to the North
11N	3	Pass	Fail	11	11	1	1	-	-	-	-	-	-	Deep Rock Tunnel to the North
12N	3	Pass	Fail	11	11	1	1	-	-	-	-	-	-	Deep Rock Tunnel to the North
13N	3	Pass	Fail	10	10	6	6	1	1	-	-	5	5	Deep Rock Tunnel to the North

Notes:

1) *Totals rounded to the nearest acre*

Table C-2 Summary of Supplemental Screening Analysis for 28 Alternatives Presented in the ENF: South Alternatives

Alternative Number	Category	Tier 1	Tier 2	Total Disturbed Area (Acres)[1]		Total " Open Space" Disturbed Area (Acres)[1]		Total " Wetland" Disturbed Area (Acres)[1]		Total "Rare Species" Disturbed Area (Acres)[1]		Total "Historic" Disturbed Area (Acres)[1]		Category Description
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
5S	1	Fail	Fail	6	12									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
6S	1	Fail	Fail	6	12									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
7S	1	Fail	Fail	5	9									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
9S	1	Fail	Fail	7	15									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
11S	1	Fail	Fail	11	12									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
12S	1	Fail	Fail	11	12									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
14S	1	Fail	Fail	11	11									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
15S	1	Fail	Fail	11	13									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
16S	1	Fail	Fail	11	11									Pipeline to Sudbury Aqueduct/Slipline Sudbury Aqueduct or Deep Rock Tunnel to CHEPS
8S	2	Fail	Fail	12	24									Replacement Pipeline to Surface Mains with or without New Pumping Station
10S	2	Fail	Fail	16	32									Replacement Pipeline to Surface Mains with or without New Pumping Station
17S	3	Pass	Fail	11	11	4	4	-	-	-	-	5	5	New Deep Rock Tunnel to Dorchester Tunnel Shaft 7C
18S	3	Pass	Fail	12	12	4	4	-	-	-	-	5	5	New Deep Rock Tunnel to Dorchester Tunnel Shaft 7C
19S	3	Pass	Fail	11	11	7	7	-	-	-	-	5	5	New Deep Rock Tunnel to Dorchester Tunnel Shaft 7C
20S	3	Pass	Pass	11	11	4	4	-	-	-	-	5	5	New Deep Rock Tunnel to Dorchester Tunnel Shaft 7C

Notes:
1) Totals rounded to the nearest acre

Ten candidate DEIR Alternatives identified, evaluated and ranked through a series of site combinations, to ultimately identify the preferred alternative and two back-up alternatives (in the event the preferred alternative is determined to no longer effectively meet the Program goals). This appendix documents the process undertaken to identify the tunnel alignments that make up the candidate DEIR alternatives and get to the DEIR alternatives.

C.3 Candidate DEIR Alternatives Evaluation and Methodology

The candidate DEIR Alternatives are comprised of deep rock tunnels with launching shaft sites (for the TBMs), receiving shaft sites (at the terminus of the tunnel boring), connection shaft sites (where the tunnels are connected to the existing water distribution system) and deep rock tunnel segments (connecting the launching and receiving shaft sites). Together these shaft sites and tunnel segments comprise a tunnel alignment. The assessment identified alternatives for each of the shaft site locations, as well as the tunnel alignments as a whole.

These candidate DEIR Alternatives were evaluated using a thorough and transparent methodology that built on the alternatives analysis conducted prior to and in support of the ENF.

The alternatives screening approach used to identify the candidate DEIR Alternatives was an iterative process that used a similar set of evaluation criteria that were applied in greater and greater detail as the alternatives' identification and evaluation process proceeded, and the alternatives moved from engineering concepts to site specific options.

C.3.1 Methodology

Building on the alternatives' concepts evaluation in the ENF, the deep rock tunnel concept was the focus of alternatives development with the goal of identifying a small set of tunnel alignment alternatives that proceeded through detailed environmental review and assessment in the DEIR.

Since the candidate DEIR Alternatives are made up of different combinations of launching, receiving, and connecting sites and different tunnel segments, a multi-criteria decision tool was developed to consistently apply the evaluation criteria and sub-criteria to each site or tunnel segment, and to score the alternative components were then scored to compare one alternative against the other. This Appendix describes how the multi-criteria decision tool was used to evaluate and score the alternatives' components and alignments.

The multi-criteria decision tool allows for:

- Objective assessment based on defined criteria
- Logical process for assessing and scoring alternatives
- Tradeoffs among evaluation criteria
- Differentiation among similar alternatives
- Repeatable and transparent process
- Input from stakeholders and decision makers
- Iterative review of alternatives

Key elements of the candidate DEIR Alternatives' evaluation and scoring, and selection methodology include a combination of the following elements as shown in **Table C-3**.

Table C-3 Candidate DEIR Alternatives Evaluation Methodology Features

Features	**Purpose**
High-level evaluation criteria categories such as Environmental or Engineering Considerations consistent with the ENF evaluation criteria categories	To identify key factors with respect to alternative implementation and impact that allows for differentiation among alternative elements and alignments
Sub criteria for Environmental Considerations for wetlands, cultural resources, hazardous waste sites, and Article 97 applicability	To provide more detailed consideration of the factors that contribute to the high-level evaluation criteria
Scoring mechanism for comparing each criteria category/sub criteria	To compare the relative impacts of each category and sub criterion for each alternative
Selection process	To provide transparent method for selecting the Preferred Alternative and two backup alternatives
Reporting format	To share recommendations and process for alternative(s) selection
Stakeholder input	To allow participation by decision-makers through the iterative alternatives' selection process

C.3.1.1 Candidate DEIR Alternatives Evaluation Steps

The candidate DEIR Alternatives are comprised of two or three deep rock tunnel segments each with a launching shaft site (for the TBMs), receiving shaft sites (at the terminus of the tunnel boring), connection shaft sites (where the tunnels are connected to the existing water distribution system) and deep rock tunnel segments (connecting the various shaft sites). Together these shaft sites and tunnel segments comprise a tunnel alignment. Six points were identified that are the locations of critical connections to the water supply system or to facilitate tunnel construction.

The candidate DEIR Alternatives assessment identified alternatives for each of the shaft launching and receiving site locations, as well as the corresponding tunnel segments. Together the launching and receiving sites with the tunnel connecting segments are considered to be a tunnel alignment. Each of the tunnel alignments are made up of at least five launching or receiving sites, and at least two segments. All of the tunnel alignments will connect to the same pumping stations or existing distribution pipelines located between the launching and receiving sites, to facilitate the distribution of the water supply.

Consistent application of the screening criteria to the alternatives has led to the selection of three alternatives that proceeded into the detailed DEIR environmental impact assessment. One of the three alternatives will be identified as the Preferred Alternative, and the two other alternatives will serve as back up alternatives.

The steps in the candidate DEIR Alternatives development process to ultimately identify a Preferred Alternative and two back-up alternatives include the following:

1. Within each Node, identify launching and receiving sites
2. Eliminate infeasible sites by function
3. From short list of suitable sites, compile tunnel alignments made up of Launching, Receiving and Connection Sites, and corresponding Tunnel Segments
4. Identify Evaluation Criteria by Category and sub-criterion
5. Evaluate each shaft site/function and tunnel alignment for each criterion and score according to Favorable/Neutral/Unfavorable
6. Score the tunnel alignments as a whole by summing up scores for sites and segment
7. Compare tunnel alignments alternatives' scores by category and as a whole
8. Identify three top scoring tunnel alignments for further analysis in the DEIR

C.3.1.2 Candidate DEIR Alternatives Evaluation Criteria

The process for developing and applying criteria was to first identify high level criteria categories and sub-criteria, identify the information needed to meaningfully evaluate and compare the alternatives with respect to those categories, and to identify the sources of that information. The granularity of the criteria aligns with the level of detail that is required for the DEIR environmental analysis. **Figure C-1** shows the high-level evaluation categories and their sub-criteria which are more detailed than those applied in the ENF alternatives evaluation process.

Table C-4 provides a tabulation of the candidate DEIR Alternatives' evaluation criteria categories and sub-criteria. For each criterion, the table provides:

- An evaluation question to clarify the intent of the criterion
- Scoring framework based on a three-level comparison

The candidate DEIR Alternatives screening evaluates and scores each of the DEIR tunnel alignment shaft and connection sites individually, and then cumulatively for the entire tunnel alignment. High-level DEIR evaluation criteria include:

- Engineering/Constructability
- Land Availability
- Environmental
- Social/Community
- Operations
- Cost
- Schedule

Compared to the ENF alternatives evaluation criteria, the candidate DEIR evaluation criteria are more detailed to be able to differentiate among site specific options and conceptual tunnel alignments. The Engineering/Constructability category was expanded to specific constructability issues such as availability of power, ability to discharge construction dewatering, and proximity to geologic fault lines. The Environmental/Social category was broken into two areas, with Environmental focusing on natural resources, and the Social/Community Category considering communities and the built environment. Costs are defined as relative construction costs, comparing each alternative against the other, and a category that addresses the construction schedule and flexibility of implementation was added to the DEIR Alternatives evaluation criteria.

Figure C-1 Candidate DEIR Alternatives' Evaluation Categories and Sub-Criteria

3.1.3 Scoring and Ranking the Candidate DEIR Alternatives

To consistently compare the alternatives' components across various combinations of sites and segments, as well as the alignments in their entirety, among differing categories of criteria, a simple mechanism was developed. A three-level scoring framework with: Favorable (1), Neutral (0) and Unfavorable (-1) was defined and documented. **Table C-4** shows the scoring framework by evaluation category and sub-criterion, and also includes the key evaluation questions asked in each case.

Having a numerical score allows one to total up the score for each alternative component, to derive a total score for the overall alternative alignment.

Table C-4 Evaluation Criteria and Scoring

Category	Evaluation Criteria	Evaluation Question	Score		
			Favorable (1)	**Neutral (0)**	**Unfavorable (-1)**
Engineering/ Constructability	Proximity to Connection Point	How far are existing surface piping or facilities from the connection shaft locations?	Existing piping or facilities are very close to the connection shaft, with few potential conflicts.	Existing piping or facilities are moderately close or is close but construction of connections complex.	Existing piping or facilities are further away and/or construction has significant complexity and risk.
	Hydraulics	Does the proposed alternative meet the hydraulic performance goals?	Meets hydraulic performance goals	Meets or marginally meets hydraulic performance goals	Does not meet hydraulic performance goals
	Underground Utilities Conflicts	Will there need to be significant relocations of underground utilities to make a corridor for surface piping or connections?	No underground utilities on site.	Underground utilities exist and can be protected without temporary relocations	Requires temporary underground utility relocation.
	Flood Zones	Are there flood zones mapped on or adjacent to parcels to be used for permanent facilities or construction?	No flood zone on site.	Flood zone on site and is away from construction easement.	Flood zone on site and is adjacent to construction easement.
	Groundwater and construction water discharge point	Does a feasible groundwater and construction water discharge point exist?	Construction water discharge point immediately adjacent to the site	Construction water discharge point exists, but requires additional surface pipeline route to final discharge point	Construction water discharge point doesn't exist and requires further engineering solution to meet the discharge demand through detention on site and parcel size is inadequate for solution.
	Potential Impact on Adjacent Surface Infrastructure	What are risks/impacts on nearby surface infrastructure?	No crossing of existing MWRA near surface transmission lines, and no public/private infrastructures on site.	Crossing MWRA existing near surface pipelines only once and expects no impact to public/private infrastructures on site.	Crossing MWRA existing near surface pipelines more than one time, or impact is expected during construction to existing public/private infrastructures.
	Flushing/Disinfection Dewatering	What is the concept(s) for flushing and disinfection during commissioning?	Minor infrastructure investment and permitting are required for dewatering/disinfection connection.	Moderate infrastructure investment and permitting are required for dewatering/disinfection connection.	Major infrastructure investment and permitting are required for dewatering/disinfection connection.
	Construction Dewatering Capacity	Can construction dewatering treatment and discharge be accommodated at the mining sites (for a specific tunnel alignment)?	Site is relatively close to receiving water and existing conveyance systems appear to have capacity	Site relatively close to receiving water, but existing conveyance capacity appears limited	Site would require construction of significant conveyance system to reach receiving water
	Accessibility to Supporting Power Utilities and Capacity	Are the sites near existing power utilities that can be used for construction activities and the permanent facilities?	Power grid, that can support TBM power demand, can be connected to the site with minimal new infrastructure and utility has rated as favorable.	Power grid, that can support TBM power demand requires moderate infrastructure and utility has rated as possible.	Power grid, that can support TBM power demand, requires a major infrastructure investment and the utility has rated as unfavorable.
	Proximity to Major Highway	What is the proximity to major highway for the transportation of construction materials and muck?	Estimated travel time less than 10 minutes and travel distance less than 5 miles.	Estimated travel time 10-30 minutes and travel distance less than 10 miles.	Estimated travel time greater than 30 minutes or travel distance greater than 10 miles.
	Proximity to Geologic Fault Lines	Does the alignment cross major known geologic faults?	Alignment avoids major known geologic faults to the extent practical.	Alignment crosses or parallels a known major geologic fault to reach an alternate site for a connection site property.	Alignment crosses or parallels multiple major geologic faults to reach multiple alternate connection site properties.

Table C-4 Evaluation Criteria and Scoring

Category	Evaluation Criteria	Evaluation Question	Score		
			Favorable (1)	**Neutral (0)**	**Unfavorable (-1)**
Engineering/ Constructability	Long TBM tunneling risk in hard and abrasive ground	Is the tunnel segment greater than 7-mile or 10-mile?	All tunnel segments less than 7 miles.	Includes tunnel segments between 7 miles but less than 10 miles.	Includes tunnel segments 10 miles or greater.
	Proximity to Sensitive Underground Infrastructure	Is the TBM tunnel alignment near MWRA existing tunnels?	No crossing of existing MWRA tunnels.	Crossing MWRA existing tunnels only once.	Crossing MWRA existing tunnels more than one time.
	Groundwater control, leakage assessment, and tunnel stability during and after construction	Have the geological, geotechnical, and hydro-geotechnical risks along the proposed tunnel alignment been vetted?	Major adverse geologic conditions have been identified and can be mitigated.	Adverse geologic conditions have been observed and have plans to be mitigated.	Adverse geologic conditions along a segment of the proposed tunnel alignment are unknown at this stage.
Land Availability	Land and Right-of-Way Availability - Construction	Can the land and rights-of-way required to construct this alignment be feasibly acquired?	The Authority has partial or full ownership or control of the land and number of sites impacted.	State or municipal entity has ownership or control of the land with no planned conflicting projects and number of sites impacted.	State or municipal entity has ownership or control of the land with planned projects and uses; or private property ownership and number of sites impacted.
	Land and Right-of-Way Availability – Permanent Facilities	Can the land and rights-of-way required for the permanent facilities for this alignment be feasibly acquired?	The Authority has partial or full ownership or control of the land and number of sites impacted.	State or municipal entity has ownership or control of the land with no planned conflicting projects and number of sites impacted.	State or municipal entity has ownership or control of the land with planned projects and uses; or private property ownership and number of sites impacted.
	Preclusion of other beneficial uses	Would the completed facilities preclude using the land for other beneficial purposes?	Minimal impacts on future use.	Moderate impacts on future use.	Major impacts on future use.
Environmental	Wetlands/Water Resources	What is the proximity of new infrastructure/construction activities to wetlands or other water bodies?	In wetland resource or buffer zone, Notice of Intent (NOI) required, no variance required, meets United States Army Corps of Engineers (USACE) General Permit or Pre-Construction Notification (PCN).	NOI and wetlands variance (WPA and/or Bylaw), and USACE PCN required.	NOI and wetlands variance required, and/or USACE Individual Permit required.
	State & Federal Listed Species Habitats	What is the proximity of new infrastructure/construction activities to state or federally listed endangered species habitats?	No mapped priority/critical habitat polygons on the site.	Mapped priority/critical habitat polygons near or on the site but will result in 'No Take'.	Work is within a mapped priority/critical habitat polygon, will result in a 'Take' and a Conservation Management Plan and/or Section 7 Consultation.
	Article 97 Conservation Land, Parklands or Areas of Critical Environmental Concern (ACECs)	Are there sites on or adjacent to designated Conservation Land, Parkland, ACECs, open water bodies, or listed public water supply wells and in dense urban areas?	No Article 97 properties or ACECs within or adjacent to site.	Article 97 properties and/or ACECs are adjacent to site.	Site is within Article 97 property and/or ACEC and/or listed public water supply well, and/or adjacent to an open water body, and/or in a dense urban area.

Table C-4 Evaluation Criteria and Scoring

Category	Evaluation Criteria	Evaluation Question	Score		
			Favorable (1)	**Neutral (0)**	**Unfavorable (-1)**
	Massachusetts Contingency Plan / Hazardous Materials	What is the proximity of new infrastructure/construction activities to identified hazardous materials sites?	No nearby disposal sites or only disposal sites that are unlikely to impact the site are identified on or within 500 feet of the project site.	Disposal sites identified on-site have the potential to impact but do not require a Release Abatement Measure (RAM) for construction. Nearby disposal sites are identified within 500 feet that have the potential to impact soil and/or groundwater within the site.	Existing on-site active disposal site or Activity Use Limitation (AUL) boundary requiring a Remedial Action Measures (RAM) Plan submittal prior to project construction.
Social/ Community	Cultural Resources	What are the physical and non-physical potential adverse effects on resources on, or eligible to be listed on, the National Register of Historic Places?	No properties listed in, or determined eligible for listing in, the State/National Register of Historic Places at or adjacent to the site.	Properties listed in, or determined eligible for listing in, the State/National Registers are present on or adjacent to the site. This may result in further historic evaluation and project mitigation to avoid or minimize adverse effects to historic properties to the maximum extent practicable. If adverse effects to historic properties cannot be avoided or minimized, the Authority can develop a mitigation plan with the Mass Historical Commission to resolve and mitigate.	Even if a project results in an adverse effect to a historic site, it cannot prevent use of the site. Development of a mitigation plan will be needed to resolve and mitigate adverse effects.
	Community Impacts Environmental Justice	How will use of community resources or programs be affected during construction? Is the project in close proximity to densely settled urban areas?	There are no community receptors (recreational, churches, schools) within the limit of disturbance of the site, nor within 500 feet of the site.	There are no sensitive community receptors (recreational, churches, schools) within the limit of disturbance of the site, BUT there are sensitive community receptors within 500 feet of the site.	There are sensitive community receptors (recreational, churches, schools) within the limit of disturbance of the site, OR there is a sensitive community receptor directly abutting the site.
	Construction Period Air Quality Impacts	How will construction activity affect air quality based on the sensitive receptors within a 500-foot buffer around the working site area?	Temporary: There are no sensitive receptors (residential, recreational, churches, schools) on or within 500 feet of the site (i.e., isolated). There are receptors along the anticipated construction vehicle routes to the site and/or construction period impacts are < 2 years.	Temporary: There are sensitive receptors (i.e., residential, recreational, churches, schools) within 500 feet of the project site (i.e., not isolated). There are receptors along the anticipated construction vehicle routes to the site and/or construction period impacts are between 2-3 years.	There are sensitive receptors (i.e., residential, recreational, churches, schools) within 500 feet of the project site and/or sensitive receptors abutting the Alternative site (i.e., not isolated) and has considerable construction impacts (i.e., launching or receiving sites) or there are considerable sensitive receptors along the anticipated access routes to the site and/or construction period impacts are more than 4 years.
	Commercial Disruption	How will construction activity or new permanent facilities impact commercial businesses both operationally, for deliveries, and access from the public during construction?	There are no commercial businesses within the limit of disturbance of the site or construction period impacts are < 2 years.	There are no commercial businesses within limit of disturbance of the site, AND there are no main shared access ways for commercial businesses within the limit of disturbance of the project site or construction period impacts are between 2-3 years.	There are commercial businesses within area of disturbance of the site OR there are main shared access ways for commercial businesses within the limit of disturbance of the site OR there is a business directly abutting the site OR

Table C-4 Evaluation Criteria and Scoring

Category	Evaluation Criteria	Evaluation Question	Score		
			Favorable (1)	**Neutral (0)**	**Unfavorable (-1)**
Social/ Community					construction period impacts are more than 4 years.
	Traffic Impacts	What is the extent roadway closures, detours, congestion, and disruptions will be required during construction?	All roadways to be utilized by construction vehicles are freeways or arterials, land use along the roadways is predominantly commercial or industrial, and there are no major intersections along the truck route.	Some segments of the truck routes are local roads and/or there are some major signalized intersections along the truck route.	There are many major signalized intersections along the truck route.
	Construction Period Noise and Vibration Impacts	Are there any particularly sensitive receptors within a 500-foot buffer around the working site area (that that could be affected by noise or vibration?	Temporary: There are no sensitive receptors (residential, recreational, churches, schools) on or within 500 feet of the site (i.e., isolated). There are few receptors along the anticipated construction vehicle routes to the site. OR Construction period impacts are < 2 years.	Temporary: There are sensitive receptors (i.e., residential, recreational, churches, schools) within 500 feet of the project site (i.e., not isolated). There are few receptors along the anticipated construction vehicle routes to the site. OR Construction period impacts are between 2-3 years.	There are sensitive receptors (i.e., residential, recreational, churches, schools) within 500 feet of the project site AND/OR sensitive receptors abutting the Alternative site (i.e., not isolated) AND has considerable construction impacts (i.e., launching or receiving sites) OR there are sensitive receptors along the anticipated access routes to the site or construction period impacts are more than 4 years.
Operations	Flexibility of Operations	Are there any unique issues or benefits associated with this alternative such as isolation flexibility, operational dewatering options or future redundancy extension considerations?	Site offers added flexibility for isolation, ease of operational dewatering or future redundancy extension considerations (2 of 3 are possible).	Site offers added flexibility for isolation, ease of operational dewatering or future redundancy extension considerations (1 of 3 are possible).	Site offers no added flexibility for isolation, ease of operational dewatering or future redundancy extension considerations.
	Maintenance / Maintainability	Are there any unique issues associated with this alternative, such as maintenance access for routine or non-routine service that would make maintenance more or less complex than another alternative?	The Authority will have unshared access to the site.	The Authority will have new access that will be shared with other entities.	The Authority will have new access that will be shared with other entities and crosses other agency restricted lands or easements that require special permission for work beyond routine maintenance.
	Security/Risk	Are there any unique issues or features of this alternative related to security or impacts to other infrastructure?	Site has adequate separation distance from other major MWRA infrastructure.	Site is adjacent to other major MWRA infrastructure that has redundancy.	Site is adjacent to other major MWRA infrastructure that has no redundancy.

Table C-4 Evaluation Criteria and Scoring

Category	Evaluation Criteria	Evaluation Question	Score		
			Favorable (1)	**Neutral (0)**	**Unfavorable (-1)**
Cost	Relative construction cost of major tunnel and shaft elements	How does the cost of major elements compare to the other alternatives?	Relative construction cost differential is less than 10%.	Relative construction cost differential is 10 - 20%.	Relative construction cost differential is greater than 20%.
Schedule	Timing to Achieve Beneficial Use	How does the projected beneficial use date compare to other alternatives?	Shortest time to beneficial use; and shortest overall tunnel program.	Shorter time to beneficial use for one tunnel, but longest overall program.	Longest time to beneficial use.
	Flexibility of Implementation	Does the Alternative offer more than one construction package flexibility and the ability to shorten construction duration?	Tunnel can be implemented in three construction packages and offers the greatest flexibility and potential for shortest overall construction duration.	Tunnel can be implemented in two construction packages and offers flexibility for construction duration due to moderate tunnel segment lengths.	Tunnel can be implemented in two construction packages and there is limited flexibility for construction duration due to longer tunnel segment lengths.

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C.3.1.3 Implementation of the Methodology

Section C.3.1 describes how the alternative sites were identified within each node, and how the sites were evaluated, and infeasible sites eliminated. It also documents how the alignment alternatives were compiled combining selected sites by node, linking tunnel segments, and launching and receiving TBM locations. Once compiled, they were then evaluated and scored following these steps:

For each candidate DEIR Alternative, the process included:

1. **Scoring each site and tunnel segment by sub-evaluation criterion:** Score the effects of each alternative by sub-criterion using a three-tier scoring system for assessing relative impacts of alternatives by sub-criterion. The Three-tier scoring system was favorable (+1), neutral (0), and unfavorable (-1). (See **Figure C-4**)
2. **Developing score for evaluation category:** Sum up the total scores of the sub-criteria and average them to develop a total score for each evaluation category.
3. **Conduct step 1 and 2 for all alignment alternatives:** Develop a summary table showing scores by Evaluation criteria.
4. **Comparing alternatives and developing relative scores by evaluation criteria:** Also using a Favorable (1), Neutral (0) and Unfavorable (-1) framework where in this case the score is based on the relative spread of scoring across each category where 100-75% is Favorable, <75% - 40% is Neutral, and < 40% is Unfavorable. These ranges provide further granularity in a category.
5. **Developing Total Scores and Rank alternative alignments**: Having a numerical score allows one to total up the score for each alternative component, to derive a total score for the overall alternative alignment.
6. **Identifying the three highest ranked alternative alignments** to proceed to the DEIR detailed analysis.
7. **Confirm alternative components:** A final step in the process was to confirm that the sites included in the three alternatives to be analyzed in the DEIR include all the desired component sites and implementation elements in various combinations that could, if necessary, be combined to develop a back-up or other alternative that has been fully analyzed. This would allow for maximum flexibility in construction and implementation so, if necessary, the sites could be combined to develop a back-up or other alternative that has been fully analyzed in the DEIR.

The results of the evaluation studies for each site and tunnel segment, and alternative alignments, were documented. This method was used to systematically evaluate each site and score it according to the categories, sub-criteria, in a consistent three-part scoring framework.

Section C.6 shows how the evaluation methodology was applied and led to the identification of the three alternatives that are further assessed in the DEIR.

C.4 Candidate Tunnel Alignment Alternatives Evaluated in the DEIR

The tunnel alignment evaluation process described in this section began with identifying nodes, and shaft sites and functions within each node. A node is defined as an area with attributes that could serve to allow for construction and hydraulic operation. Defining these nodes aided in the identification of specific site locations to develop the tunnel alignments. For example, from a construction perspective, a site within a node could be proposed as a TBM launching site, a TBM receiving site, an intermediate construction support shaft site for a TBM, or construction of a connecting shaft. Hydraulically, a node could provide a critical connection point to the distribution system, a secondary connection point, or no connection point **Figure C-2** depicts a summary of the nodes and the connection sites along the tunnel alignment.

A viable alignment alternative must, above all else, make hydraulic connections at locations that will achieve the primary purpose of the tunnel system: redundancy. Based on the hydraulic analysis and planning conducted to date, the required connection points are understood to be:

- The WASM3 pipeline near the Waltham-Belmont town line
- The Hultman Aqueduct in the vicinity of the I-90/I-95 interchange
- At or near the Newton Street Pumping Station in Brookline
- Near the Southern Spine Main in Boston
- Near Shaft 7C of the Dorchester Tunnel

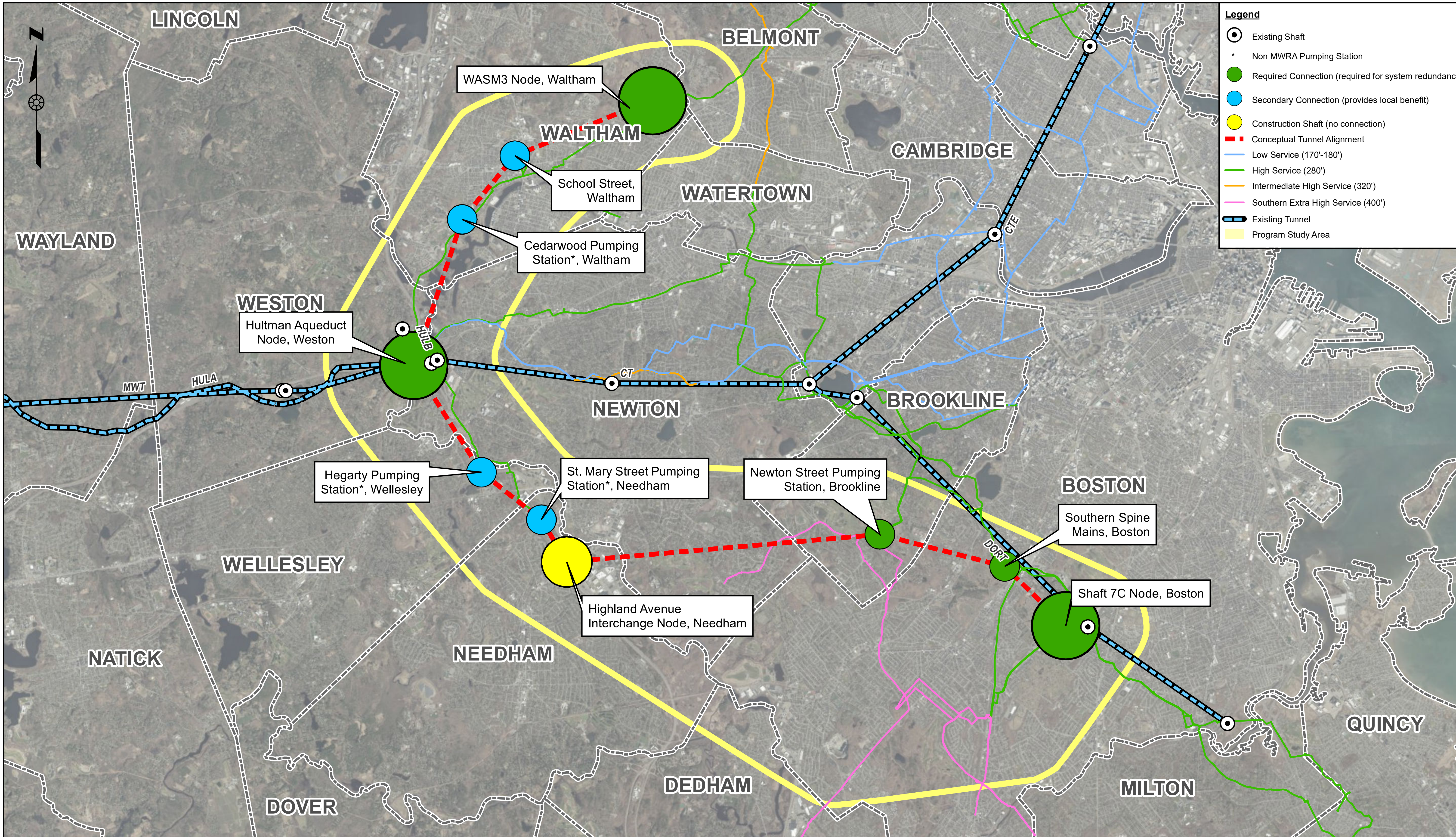
Construction can also be supported from other shaft work sites where a hydraulic connection is not required. To facilitate tunnel construction of the longer southern tunnel, an additional connection point was identified. While not a critical connection point to the MWRA water supply system, it is critical to the feasibility of efficiently executing the tunnel construction project. The Authority has identified such a potential construction shaft location at:

- Highland Avenue Interchange on I-95 in Needham

The Authority has identified secondary connection points that will provide benefit to its customers and reinforcement to its transmission network. These locations are:

- School Street to connect to the Lexington Street Pumping Station in Waltham
- The Cedarwood Pumping Station in Waltham
- The Hegarty Pumping Station in Wellesley
- The St. Mary Street Pumping Station in Needham

Ideally, construction shafts and connection shafts would be as close as practicable to the connection points identified above.



Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb
Jacobs GREEN INTERNATIONAL AFFILIATES, INC.

0 3,000 6,000 9,000 Feet
SCALE IN FEET
SCALE: 1" = 6,000'

Figure C-2 Nodes and Connection Sites

Source: MWRA, CDM Smith, VHB, Jacobs, MassGIS, USGS

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C.4.1 Identify Nodes and Identify Shaft Sites by Function in Vicinity of Nodes

To identify suitable sites to the key connection points to the water supply distribution system, and to facilitate construction**, nodes** were delineated in the following areas:

- **Hultman Aqueduct Node (Weston):** selected as a node because it provides access to the Hultman Aqueduct critical connection point, east of which the MWRA tunnel system required redundancy.
- **WASM3 Node (Waltham):** located in the project northern terminus within the northern alignment vicinity and selected as a node because it provides access to critical connection point at WASM3.
- **Highland Avenue Interchange (Needham)**: located within the project southern alignment vicinity and selected as a node to create an interim location along a long tunnel route to facilitate construction.
- **Shaft 7C Node (Boston)**: located within the project southern terminus within the southern alignment vicinity selected as a node because it provides a critical connection point to Shaft 7C of the Dorchester Tunnel.

Sites that offered a variety of functions were considered within each node. Functions included launching, receiving, double launching, launching and receiving, and large connection. This initial level of analysis focused on available space needs to support the planned operations, logistical issues, and confidence in the ability to acquire rights to the land. This was intended to be an exercise to identify any “fatal flaws” that would advise against further analysis of the site and location for that use, so as not to spend the resources and effort required to develop a preliminary conceptual design on an alternative that would have no or very low likelihood of receiving serious consideration.

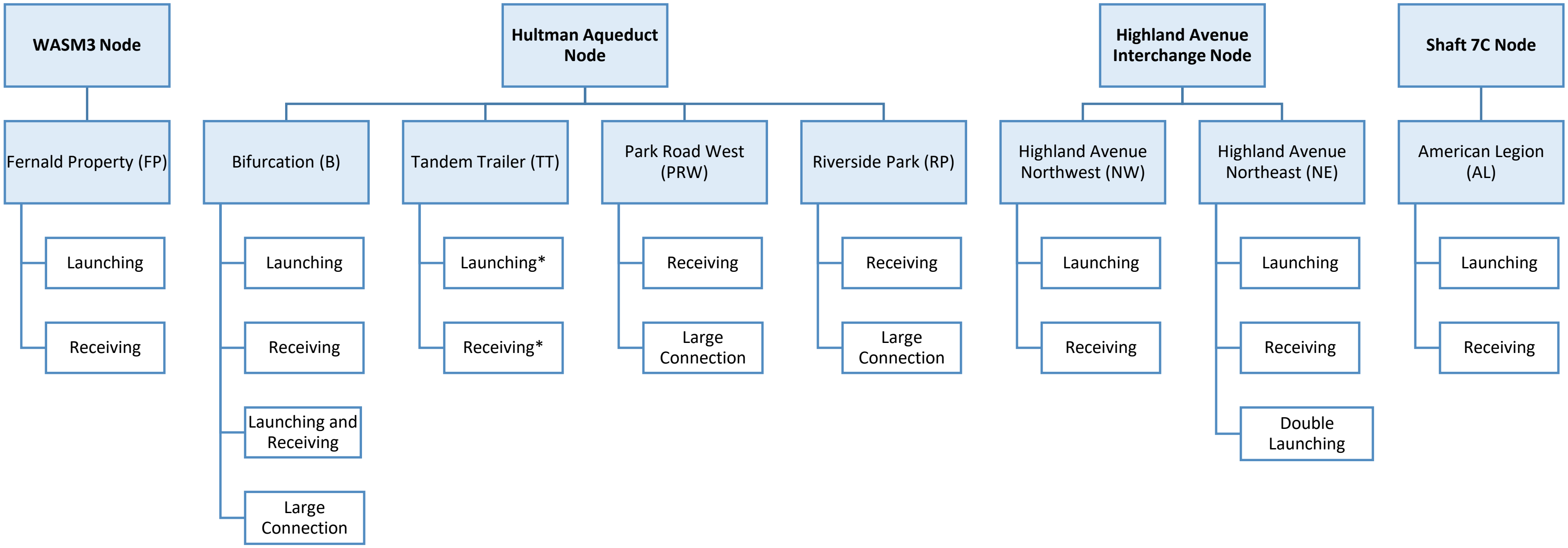
Factors that were initially considered when identifying sites included the following:

- Sufficient acreage to serve the evaluated function
- Proximity to highways
- Land ownership
- Availability of land
- High level environmental screening

This process resulted in the delineation of ten candidate DEIR Alternatives that were then further screened to identify three alternatives that proceeded into more detailed environmental impact assessment in the DEIR.

Figure C-3 summarizes the sites and functions within each node that progressed to be compiled into the ten candidate DEIR Alternatives. Conceptual layouts were then developed for each site and function that advanced to assist in the evaluation of these candidate DEIR Alternatives. These conceptual layouts include the limits of temporary and permanent work, and how the tunnel would connect.

Figure C-3 Sites and Functions within each Node Advanced in the Candidate DEIR Alternatives Analysis



*Includes a connection tunnel to Park Road East site for a connection to the Hultman Aqueduct.

C.5 Assemble Candidate DEIR Tunnel Alignments

Through the evaluation of several site within each node, and their potential functions, ten candidate DEIR Alternatives were developed. **Table C-**5 summarizes the ten DEIR Alternatives. The following subsections summarize these alternatives.

Table C-5 Candidate DEIR Alternative Alignments

Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Alternative 9	Alternative 10
Fernald Property	Fernald Property	Fernald Property	Fernald Property	Fernald Property	Fernald Property	Fernald Property	Fernald Property	Fernald Property	Fernald Property
↑		↑	↑	↓	↑	↑	↑	↑	↑
Tandem Trailer	↑	Tandem Trailer	Tandem Trailer	Tandem Trailer	Tandem Trailer	Tandem Trailer	Tandem Trailer	Bifurcation	**Park Road West**
Bifurcation	**Bifurcation**	Bifurcation	Park Road West	Bifurcation	Bifurcation	Bifurcation	Riverside Park	Bifurcation	↑
	↑	↓	↑	↑	↓	↑	↑	↑	
	Highland Avenue NW	Highland Avenue NW	Highland Avenue NW	Highland Avenue NW	Highland Avenue NW	Highland Avenue NE	Highland Avenue NW	Highland Avenue NW	Highland Avenue NW
↓									
	Highland Avenue NE	Highland Avenue NE	Highland Avenue NE	Highland Avenue NE	Highland Avenue NE	Highland Avenue NE	Highland Avenue NE	Highland Avenue NE	Highland Avenue NE
	↓	↓	↓	↓	↑	↓	↓	↓	↓
American Legion	American Legion	American Legion	American Legion	American Legion	American Legion	American Legion	American Legion	American Legion	American Legion

Notes: WASM3 node, Hultman Aqueduct node, Highland Avenue Interchange node, Shaft 7C node

Direction of tunnel, and site function, are identified by arrows. The site that the arrow is pointed to is a receiving site. The site that the arrow starts with is the launching site.

***Bold sites** are large connection shafts.*

Alternatives with the Tandem Trailer include a connection tunnel to the Park Road East site for the connection to the Hultman Aqueduct.

For all ten alternatives, the permanent tunnel facilities will function as an independent north tunnel from the Hultman Aqueduct north to the Fernald Property site and an independent south tunnel from the Hultman Aqueduct south to the American Legion site. The variations discussed in the alternatives on the following pages break theses tunnels into various construction segments for evaluation.

C.6 Candidate DEIR Alignment Alternatives Evaluation and Scoring Findings

The ten candidate DEIR Alternatives differ in the combination of sites, direction of mining of the TBMs, and the lengths of the tunnel segments. They also have several common characteristics where all alignment alternatives, the most northern point of the north tunnel is the Fernald Property in Waltham, located on the site of the former Fernald School. For all south tunnel alignment alternatives, the most southern point is the American Legion site, which is under the care, custody and control of the Department of Conservation and Recreation (DCR).

All alternatives that include the Tandem Trailer site, include a connection tunnel to the Park Road East site to provide the critical Hultman Aqueduct connection. For the Highland Avenue Northeast site, conceptual plans all include use the southeast parcel; and similarly, all Highland Avenue Northwest site options include use of the southwest parcel at Highland Avenue. The Highland Avenue Northwest, Southeast and Southwest parcels will be used for staging during construction only, with no permanent infrastructure.

Neither Alternatives 2 nor 10 include TBM launching or receiving sites within MassDOT-owned parcels within the Hultman Node. Alternative 8 is the only option that includes the Riverside Park site, which is under the care, custody and control of DCR; Alternative 5 is the only option that launches a TBM from the Fernald Property; and Alternative 6 is the only option that launches a TBM from the American Legion site.

The Authority is engaged in conversations with MassDOT regarding securing easements on MassDOT parcels within the Hultman Node (Bifurcation, Tandem Trailer/Park Road East, and Park Road West) located at the I-90 and I-95 Weston Interchange. MassDOT is planning to upgrade the bridges and ramps at the I-90/I-95 interchange, in the 2023 – 2027 (timeframe, although the specific design and final construction timing of the MassDOT interchange project is not yet confirmed. The uncertainly of the timing of this project was taken into consideration when evaluating and comparing the Alternatives. The Authority is working with MassDOT to secure easements to construct portions of the Tunnel Program at the I-90/I-95 Interchange. The Authority also is working with MassDOT to secure easements within the clover leaf of the I-95 Needham Highland Avenue Interchange. MassDOT does not have known future plans for these parcels.

In addition, the Authority has had preliminary discussions with DCR for accommodating work on the American Legion parcel. Conversations are proceeding to secure easements or ownership of this parcel. The Authority also has initiated discussions with the City of Waltham regarding using a portion of the Fernald Property, the site of a former school.

C.7 Comparing the Alternatives and Identifying DEIR Alternatives

After evaluating the ten candidate alternative alignments individually, the next step in the process was to compare the alternatives to one another by the evaluation criteria of engineering, land availability, environmental, social/community, operations, cost, and schedule. Using the scoring framework described above, a score of favorable (green), neutral (yellow) or unfavorable (red) was developed for each category for each alternative as summarized in **Figure C-4**. All of the categories were considered equally important and were not weighted.

Figure C-4 Alternatives Scoring

Alternative	1	2	3	4	5	6	7	8	9	10
Tunnel Alignment (1)	TT>FE B>AL	NW>FE (B) NE>AL	TT>FE B>NW NE>AL	TT>FE NW>PW NE>AL	FE>TT NW>B NE>AL	TT>FE B>NW AL>NE	TT>FE NE>B NE>AL	TT>FE NW>RP NE>AL	B>FE NW>B NE>AL	NW>FE (PW) NE>AL
Engineering / Constructability	🟡	🟡	🟢	🟢	🟢	🔴	🟢	🟢	🟡	🟡
Land Availability	🟡	🟡	🟡	🟡	🔴	🔴	🟡	🟡	🟡	🟢
Environmental	🟡	🟡	🟡	🟢	🟡	🟡	🟡	🔴	🟡	🟢
Social / Community	🔴	🟢	🟡	🟡	🔴	🔴	🟡	🔴	🟡	🟢
Operations	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢
Cost (2)	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Schedule (tunnel(s) in service)	🔴	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡
Retain Alternative	N	N	Y	Y	N	N	N	N	N	Y

(1) Site Abbreviations: TT – Tandem Trailer; FE – Fernald Property; B – Bifurcation; NW – Highland Avenue Northwest; NE – Highland Avenue Northeast; AL – American Legion; RP – Riverside Park; PW – Park Road West; (B) or (PW) indicates Large Connection Shaft in that tunnel segment: > indicates tunnel mining direction

(2) Construction cost only for the differential in capital construction costs among the alternatives.

When applying the same scoring rubric of Unfavorable (-1), Neutral (0), and Favorable (1) to the entire alternative alignment, it was possible to rank the alternatives numerically from highest to lowest.

Top ranked alternatives were Alternatives 4 and 10, followed closely by Alternatives 3 and 7. Although Alternative 7 was scored similarly to Alternative 3, the schedule for its implementation would take slightly longer with two TBM drives from the same shaft and was therefore eliminated from moving forward in favor of Alternative 3. Therefore, the three DEIR Alternatives are Alternatives 3, 4 and 10. Among these alternatives, all of the likely sites will be analyzed in detail, with the intent of identifying a Preferred Alternative.

The three top alternatives will, among them, evaluate the following sites and functions:

- Tandem Trailer - Launching (requires large connection to Park Road East)
- Fernald Property - Receiving
- Bifurcation - Launching
- Highland Avenue Northeast – Launching
- Highland Avenue Northwest – Launching and Receiving (separate functions)

- Park Road West - Receiving and Large Connection (separate functions)
- American Legion - Receiving

Alternative 10 is the only alternative that has only two tunnel segments, and also avoids sites that could be impacted by the MassDOT Project No. 606783 which limits the risk of delaying the Program but is limited in flexibility for contracting with only 2 construction packages. Alternatives 3 and 4 have the added flexibility for contracting with 3 tunnel segments and the potential for 2 or 3 construction packages. If the risk surrounding MassDOT Project No. 606783 can be mitigated, the additional flexibility for contract packaging offered in Alternatives 3 and 4 is a substantial benefit to the Authority. All three alternatives include launching from Highland Avenue Northeast, receiving at the American Legion site, receiving at the Fernald Property site and the same six intermediate connection sites.

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Appendix D: Wetlands and Waterways

- Appendix D.1 Wetlands and Waterways Delineation Supporting Documentation
- Appendix D.2 USGS StreamStats Reports

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Appendix D.1: Wetlands and Waterways Delineation Supporting Documentation

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Wetland Delineation Narrative

Launching and Receiving Sites

Fernald Property Receiving

On April 7, April 8, and July 11, 2022, William E. Kuriger, Ph.D. and a CDW Consultants, Inc. (CDW) technical assistant inspected and delineated wetland resource areas at the Fernald Property Receiving site in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and U.S. Army Corps of Engineers (USACE) wetlands criteria.

Five locations were flagged with tapes labeled “Wetland Boundary” at the locations labeled A-1 to A-14, B-1 to B-19, C-1 to C-41, and D-1 to D-28. At each location soils, vegetation and hydrological indicators were examined.

Location A was a marsh dominated by reeds (Phragmites spp.). The delineation started at the edge of Waverley Oaks Road at the outer edge of bordering vegetated wetlands (BVW), which were also the edge of the estimated mean annual high-water line to the Clematis Brook, a perennial stream. The delineation ended when the edge of the marsh was greater than 200 feet from the work area along Chapel Road. This BVW is contiguous with the separately delineated BVW (within proposed work area) to the northwest that consisted of tree and shrub BVW within wetland flags C-26 to C-41.

Location B was probably BVW to Clematis Brook before the installation of railroad tracks adjacent to this part of the site. Today this area is an isolated wetland with dominant plants including Red Maple (Acer rubrum, facultative plant [FAC]), Green Ash (Fraxinus penyslvanicum, facultative wetland plant [FACW]), American Elm (Ulmus americana, FACW), Glossy Buckthorn (Frangula alnus, FAC), and Tartarian Honeysuckle (Lonicera tartarica, facultative upland plant [FACU]). While it meets the physical characteristics of “Isolated Land Subject to Flooding”, on April 7 and 8, 2022 portions of the surface of the land were wet, but there was no accumulation of surface water present.

Location C was an intermittent drainage channel that flowed through some wetland vegetation including American Elm, Red Maple, and Silky Dogwood (Cornus amomum, FACW) that started to the north of the former boiler building along Chapel Road and drained to a culvert at the former boiler building. The C series continued to the west to Clematis Brook.

Location D (Clematis Brook) was identified as “Riverine”, interpreted as perennial, from the United States Fish and Wildlife Service “Wetlands Inventory” map of the site. This stream system, the upper reaches of which appear to be a first order stream, is identified as an intermittent stream on Massachusetts Geographic Information System (MassGIS) and United States Geological Survey (U.S.G.S.) maps of the site. Surface water was flowing in April when observations were made. Based on the location and characteristics the upper reaches of this stream are intermittent. Observations made later in the growing season (during the summer months) based on Massachusetts Wetlands Regulations criteria, when drought conditions are not present, could be used to confirm the flow regime of this stream. The Location D delineation included top of bank with some BVW including Silky Dogwood, Red Maple, and Skunk Cabbage (Symplocarpus foetidis, obligate wetland plant [OBL]). The edge of these wetlands was considered the mean annual high-water line. The stream from Location D drained to a culvert at the former boiler building which then combined with the culverted drainage from the C intermittent stream to the Clematis Brook BVW.

Tandem Trailer Launching/Park Road East

On April 5, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource areas at the Tandem Trailer Launching/Park Road East site in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

CDW inspected and delineated wetland resource areas at the Tandem Trailer Launching/Park Road East site. On the southern portion of the Tandem Trailer Launching site, flags A-1 to A-6 were used to mark the top of bank and mean annual high-water level of the perennial stream Seaverns Brook. The brook entered a culvert at A-6.

Flags B-1 to B-9 were used to mark an isolated wetland in the northeaster portion of the Tandem Trailer site that could be characterized as a BVW to two roadway culverts that drain from significantly higher elevations to the north. Other features at the Tandem Trailer site were examined (ditches and depressed areas) and determined to not be wetland resource areas due to lack of hydric soils and/or wetland vegetation and wetland hydrology characteristics.

The F series of flags F-1 to F-38 began at flag F-1 which was located to the east of Park Road starting in an upland banking to the roadway. Flag F-1 marked the start of a channel that was above all wetlands, and thus not jurisdictional by Massachusetts Wetlands Regulations. The channel contained wetland vegetation at flag F-2/F-3 including Smartweed (Polygonum pensylvanicum, FACW). The intermittent stream continued through culverts and through Red Maple BVW at location F-14. At location F-33 and F-34 the intermittent stream when under a former exit ramp at the site through a culvert. After an expanse of upland, the F series continues at a concrete culvert on the Bifurcation site with flags F-35 and F-36 to F-37 and F-38.

Bifurcation Launching

On March 31 and April 5, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource areas at the Bifurcation Launching site in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

The wetland flag B series (B-1 to B-9) to the north of the Bifurcation site included a concrete intermittent stream with some BVW to the east.

The D series on the southern portion of the Bifurcation site appears to receive drainage from the A series of flags at the intermittent stream at the Park Road West site. The D series to the south of the Park Road East site appears to receive drainage from the A intermittent stream at the Park Road West site. The D series flags start at the exit from a under roadway culvert. On April 5, 2022, water was flowing through the culvert into the D intermittent stream. Water Cress (Nasturtium officinale, OBL), Common Reed (Phragmites australis, FACW), and Black Elderberry (Sambucus nigra, FACW) were observed within the first section of the D intermittent stream. At flags D-12 and D-13 a corrugated metal open culvert was present to the end of the D series flags (D-19) at the start of the C series flags.

The C series (C-1 to C16) included the top of bank to an intermittent stream, where the bank included asphalt side walls. The C series drains to the A series of wetland flags at the Bifurcation site (A-1 to A-10), which included BVW to an intermittent stream. Bordering vegetated wetland vegetation at flag A-3 included White Pine (Pinus strobus, FACU), Glossy Buckthorn, Jewelweed (Impatiens capensis, FACW), and unidentified (no flowering or fruit available) sedges and grasses. Wetland soils were hydric, and soils were saturated to the surface near flag A-3.

The E series (E-1 to E-22) on the northern portion of the Bifurcation site delineated an intermittent stream which appeared to drain to the B series to the north of the Bifurcation site through an under-roadway culvert. Purple Loosestrife (Lythrum salicaria, OBL) was observed along the E series intermittent stream. The B series (B-1 to B-9) to the north of the Bifurcation site included a concrete bottomed intermittent stream.

The F series on the northwestern portion of the Bifurcation site is a continuation of an intermittent stream from the Park Road East site that went under a former exit ramp and ended at F-37 and F-38 on the Bifurcation site.

Park Road West Receiving/Large Connection

On March 31, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource areas at the Park Road West Receiving/Large Connection site in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

Wetland areas at the Park Road West site were flagged with tapes labeled “Wetland Delineation” at the locations labeled A-1 to A-12 (intermittent stream with some bordering vegetated wetland or BVW within) on the southern portion of the site and B-1 to B-5 (BVW to intermittent stream) on the northern portion of the site. Wetland vegetation at A-12 included Common Cattail (Typha latifolia, OBL), and Purple Loosestrife. Hydric soils were present, and soils were saturated to the surface. Thus, a BVW was present at the highest elevations of this intermittent stream.

The B series delineated a stone walled bordered intermittent stream that included wetland species including Common Cattail, Red Maple, and Purple Loosestrife. This intermittent stream drained to a culvert that appeared to be oriented towards the highway and also received possible roadway drainage.

Highland Avenue Northwest Receiving

On April 12, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource areas at the Highland Avenue Northwest Receiving site. The Highland Avenue Northwest site did not appear to have any wetland features.

Highland Avenue Northwest/Southwest Launching

On April 12, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource areas at the Highland Avenue Northwest/Southwest Launching sites in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

The Highland Avenue Northwest site did not appear to have any wetland features.

The Highland Avenue Southwest site appeared to be all upland, with what appeared to be a dried swale along the east side of the site, oriented north to south. Water from this area may drain under the highway to the central portion of land between the Highland Avenue Southwest and Southeast sites, and then drain to the drainage feature in the Highland Avenue Southeast site.

Highland Avenue Northeast/Southeast Launching

On April 12, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource areas at the Highland Avenue Northeast/Southeast Launching sites in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

An area outside of the Highland Street Northeast site near Highland Avenue was under construction and did have a constructed wetland feature and overfill outfall for roadway drainage in the southern portion of the Highland Street Northeast site work area. The mapped location of this wetland area is approximate.

A linear drainage feature on the Highland Avenue Southeast site was delineated with flags A-1 through A-12. This area contained Cattails (Typha spp.), Soft Rush (Juncus effusus), Elderberry (Sambucus canadensis), and other species. Soils were hydric within the channel, and water was present on April 12, 2022. This drainage area is either non-jurisdictional based on the date of construction or could be considered an intermittent stream.

A constructed wetland feature and overfill outfall for roadway drainage was also present outside of the northeastern portion of the Highland Avenue Southeast site and near Highland Avenue. Roadside drainage that may be an intermittent stream is also located outside to the southeast of the Highland Avenue Southeast site on the opposite side of the off ramp. The mapped locations of these wetland areas are approximate.

Water from the Highland Avenue Southwest site may drain under the highway to the central portion of land between the Southwest and Southeast sites, and then drain to the drainage feature in the Highland Avenue Southeast site.

On May 10, 2022, CDW inspected and delineated a section of the Charles River off the end of Fremont Street where the proposed discharge pipeline will discharge into the Charles River. The wetlands delineated included top of inland bank which was also the estimated mean annual high-water line. The Charles River is classified as a Riverine wetland area. Orange “Wetland Boundary” tapes B-1 to B-8 were placed at the top of bank starting at approximately 100 feet to the south of Fremont Street to approximately 100 feet to the north at the railroad bridge.

American Legion Receiving

On April 1 and April 4, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource at the American Legion Receiving site in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

Five locations were flagged with tapes labeled “Wetland Delineation” at the locations labeled A-1 to A-16, B-1 to B-12, C-1 to C-12, D-1 to D-22, and E-1 to E-16. At each location the soils, vegetation and hydrological indicators were examined.

Location A was to the south of the proposed work area off the south side of the American Legion Highway. Location A is an intermittent stream that drains to the east and then south. Location A begins immediately south of the American Legion Highway and may receive roadway drainage. It begins at an elevation and location that is above and separate from Canterbury Brook (location B) which flows into the site from the west and under the American Legion Highway. The top of bank included some BVW within the flags including Spotted Touch Me Not (Impatiens capensis, FACW) and American Elm. Water flow began at flags A10 and A11. The intermittent stream appears to drain to Canterbury Brook to the south, outside of the area delineated. USACE wetland delineation forms were completed for location A-16. This was a disturbed area with much fill material along the banks of the stream.

Location B was off the north side of the American Legion Highway and to the west starting near a cemetery and extending east to land that is currently occupied by the “Landscape Express” company. Various sources have been examined to determine if the stream is perennial or intermittent. In April 2022, typically a wet time of year, water flowed in portions of the stream. A MassGIS map of the site showed the stream as an intermittent stream throughout its course, from the cemetery to the west to the east. The U.S. Fish & Wildlife Wetlands Inventory map of the site showed the water course as “Riverine”. The 1987 U.S.G.S. map of “Boston South” shows the stream throughout its course as intermittent (thin blue line). This was compared to a thicker blue line that represented a perennial stream that flows through the Arnold Arboretum nearby. At this time, it appears the stream is intermittent throughout its course through the site. Further investigation can be done following Massachusetts Wetlands Regulations 310 CMR 10.00 criteria to confirm the status of the stream. As a conservative measure for this project, Canterbury Brook will be considered a perennial stream.

The top of bank of Canterbury Brook was delineated with flags B-1 through B-12. Poison Ivy (Toxicodendron radicans, FAC), Red Maple, and Water Cress plants were observed at the top of bank, within areas of BVW, and within the channel, respectively. The soils in this area and throughout the site on the northern side of the highway are Udorthents or disturbed or filled soils with wet substratum. The B delineation ended where the stream was culverted under American Legion Highway. Canterbury Brook then continues east to the south of location A.

Location C is an intermittent drainage channel that drains from the west to the east that was separated from the B delineation and stream by an area of upland.

Location D was further east off the northern side of American Legion Highway and drained from the west to the east. A portion of this channel to the west appeared to be above all wetlands and thus did not appear to be jurisdictional based on Massachusetts regulations. Flags D-1 to D-10 were placed further to the east, where wetland vegetation including Spotted Touch Me Not was present within the channel. This area appeared to be an intermittent stream. Further east past upland that separated location D, location E was delineated.

Location E was BVW to intermittent stream drainage. The E wetland delineation, including flags E-1 to E-16 was separated from D by an expanse of upland. Wetland vegetation within location E included American Elm, Water Cress, Common Buckthorn (Rhamnus cathartica, FAC), Glossy Buckthorn, and Silky

Dogwood. Soils were hydric and low chroma to a depth of 20 inches, and soils were saturated to or near the surface.

Connection/Isolation Valve Sites

School Street Connection

CDW did not perform a site visit to the School Street Connection site. No wetlands or certified vernal pools are mapped within 100-feet of the site, and no surface water bodies are located within 200 feet of the site.

Cedarwood Pumping Station Connection

On April 14, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource areas at the Cedarwood Pumping Station Connection site in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

BVW to intermittent streams that drain to the Charles River were flagged with tapes labeled “Wetland Boundary” at the locations labeled A-1 to A-25, from east to west, ending at an intermittent channel to the north. The BVW was a red maple and shrub swamp. Wetlands vegetation at flags A-7 to A-8 included Red Maple, Sugar Maple (Acer saccharum, FACU), and Black Walnut (Juglans nigra, FACU, note – at edge) trees; Silky Dogwood shrubs and Spotted Touch Me Not and White Avens (Geum canadense, FAC) herbaceous plants. An unidentified grape vine was also present at flags A-7 to A-8.

Two existing detention ponds were also observed at the site. These had previously been delineated (top of bank) with red tapes. The delineations appeared to be accurate. The school at the site, the William F. Stanley Elementary School, opened in 2003. Based on presumed recent construction, the detention basins, being constructed after 1996, would not be considered a regulated wetland resource area per 310 CMR 10.00 as long as they were properly maintained, which they appeared to be.

Hegarty Pumping Station Connection

On April 14, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected and delineated wetland resource areas at the Hegarty Pumping Station Connection site in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

The top of bank and mean annual high-water line to Rosemary Brook (perennial stream) was flagged with tapes labeled “Wetland Boundary” at the locations labeled A-1 to A-6, and then directly from A-6 to A-12. An area of BVW was also delineated from A-6 through A-12. The BVW was a green ash and skunk cabbage swamp. Vegetation observed within the wetland delineation flag A-10 included Green Ash, White Ash (Fraxinus americana, FACU), saplings of American Elm, Apple (Malus domestica, UPL), and herbaceous Skunk Cabbage.

St. Mary’s Street Pumping Station Connection

CDW did not perform a site visit to the St. Mary’s Street Pumping Station Connection site. No wetlands or certified vernal pools are mapped within 100-feet of the site, and no surface water bodies are located within 200 feet of the site.

Newton Street Pumping Station Connection

On April 1, 2022, William E. Kuriger, Ph.D. and a CDW technical assistant inspected the Newton Street Pumping Station Connection site in relation to the Commonwealth of Massachusetts Wetlands Regulations 310 CMR 10.00 and USACE wetlands criteria.

The open land to the rear (north) of the building at the site was walked, vegetation was observed, and soil samples were collected. The soils in the middle of the open land included upland soils, with a surface horizon with a Munsell rating of 10YR 3/2 to about 10 inches deep, below which was a “B” horizon rated 10YR 4/3. The soil was not hydric. Based on CDW’s observations there were no wetland resource areas at the site.

Southern Spine Mains Connection

CDW did not perform a site visit to the Southern Spine Mains Connection site. No wetlands or certified vernal pools are mapped within 100-feet of the site, and no surface water bodies are located within 200 feet of the site.

Hultman Aqueduct Isolation Valve

CDW did not perform a site visit to the Hultman Aqueduct Isolation Valve site. No wetlands or certified vernal pools are mapped within 100-feet of the site. The Charles River is located within 200 feet to the north of the site.

Wetland Determination Data Forms

Wetland determination forms are included for the following sites:

- Launching and Receiving Sites
    - Fernald Property Receiving
    - Bifurcation Launching
    - Highland Avenue Northwest Receiving
    - American Legion Receiving
- Connection/Isolation Valve Sites
    - Cedarwood Pumping Station Connection
    - Hegarty Pumping Station Connection

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Fernald Property Receiving City/County: Waltham/Middlesex Sampling Date: 04/08/2022

Applicant/Owner: MWRA State: MA Sampling Point: Upland C-37

Investigator(s): W. E. Kuriger Section, Township, Range: ______

Landform (hillside, terrace, etc.): Perennial stream bed Local relief (concave, convex, none): Concave Slope %: 0-3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 318228 Long: 4695038 Datum: 1983

Soil Map Unit Name: Freetown Muck / Canton fine sandy loam NWI classification: Riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No x
Hydric Soil Present?	Yes ___	No x
Wetland Hydrology Present?	Yes ___	No x

Is the Sampled Area within a Wetland? **Yes** ___ **No** X

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No x	Depth (inches): ___
Water Table Present?	Yes ___	No x	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No x	Depth (inches): ___

Wetland Hydrology Present? **Yes** ___ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Upland C-37

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Fraxinus americana*	25	Yes	FACU
2. *Acer platanoides*	25	Yes	UPL
3. *Ulmus americana*	10	No	FACW
4. *Quercus rubra*	10	No	FACU
5.			
6.			
7.			
	70	=Total Cover	

Sapling/Shrub Stratum (Plot size: 15)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Ulmus americana*	20	Yes	FACW
2. *Lindera benzoin*	15	Yes	FACW
3.			
4.			
5.			
6.			
7.			
	35	=Total Cover	

Herb Stratum (Plot size: 5)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alliaria petiolata*	35	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	35	=Total Cover	

Woody Vine Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Celastrus orbiculatus*	15	Yes	UPL
2.			
3.			
4.			
	15	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.3% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	45	x 2 =	90
FAC species	0	x 3 =	0
FACU species	70	x 4 =	280
UPL species	40	x 5 =	200
Column Totals:	155 (A)		570 (B)

Prevalence Index = B/A = 3.68

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Upland C-37

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 3/2	100						
5-16	10YR 4/3	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** x

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Fernald Property Receiving City/County: Waltham/Middlesex Sampling Date: 04/08/2022

Applicant/Owner: MWRA State: MA Sampling Point: Wetland C-37

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): Perennial stream bed Local relief (concave, convex, none): Concave Slope %: 0-3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 318228 Long: 4695038 Datum: 1983

Soil Map Unit Name: Freetown Muck / Canton fine sandy loam NWI classification: Riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes x No ___ Hydric Soil Present? Yes x No ___ Wetland Hydrology Present? Yes x No ___	**Is the Sampled Area within a Wetland?** **Yes** x **No** ___ If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- x Surface Water (A1)
- x High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- x Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes x	No ___	Depth (inches): 4
Water Table Present?	Yes x	No ___	Depth (inches): 8
Saturation Present? (includes capillary fringe)	Yes x	No ___	Depth (inches): 2

Wetland Hydrology Present? **Yes** x **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wetland C-37

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Fraxinus pennsylvanica*	35	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
	35	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Cornus amomum*	15	Yes	FACW
2. *Rosa multiflora*	20	Yes	FACU
3. *Crataegus spp.*			
4. *Ulmus americana*	10	Yes	FACW
5. *Lindera benzoin*	5	No	FACW
6.			
7.			
	50	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Alliaria petiolata*	15	Yes	FACU
2. *Impatiens capensis*	20	Yes	FACW
3. *Symplocarpus foetidus*	15	Yes	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	50	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1. *Celastrus orbiculatus*	15	Yes	UPL
2.			
3.			
4.			
	15	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 62.5% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	15	x 1 =	15
FACW species	85	x 2 =	170
FAC species	0	x 3 =	0
FACU species	35	x 4 =	140
UPL species	15	x 5 =	75
Column Totals:	150 (A)		400 (B)

Prevalence Index = B/A = 2.67

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Wetland C-37

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 2/2	100					Sandy	
18-22	10YR 5/2	80	10YR 5/6	20	C	M	Sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
x Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):
Type: ______
Depth (inches): ______

Hydric Soil Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Bifurcation Launching City/County: Weston/Middlesex Sampling Date: 03/31/2022

Applicant/Owner: MWRA State: MA Sampling Point: Bi Upland A-3

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): BVW, Intermittent Stream Local relief (concave, convex, none): Concave Slope %: 0-3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 313545 Long: 4690111 Datum: 1983

Soil Map Unit Name: Udorthents, urban land complex NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation x , Soil x , or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___

Are Vegetation ___ , Soil ___ , or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No x	**Is the Sampled Area within a Wetland?** **Yes** ___ **No** X
Hydric Soil Present?	Yes ___	No x	If yes, optional Wetland Site ID: ____
Wetland Hydrology Present?	Yes ___	No x	

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
___ Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No x	Depth (inches): ___
Water Table Present?	Yes ___	No x	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No x	Depth (inches): ___

Wetland Hydrology Present? Yes ___ No x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: Bi Upland A-3

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Pinus strobus*	30	Yes	FACU
2. *Picea abies*	15	No	UPL
3. *Rhamnus cathartica*	20	Yes	FAC
4. *Fraxinus pennsylvanica*	15	No	FACW
5. *Carya laciniosa*	10	No	FACW
6.			
7.			
	90	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Rhamnus cathartica*	25	Yes	FAC
2. *Frangula alnus*	15	Yes	FAC
3.			
4.			
5.			
6.			
7.			
	40	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Reynoutria japonica*	10	Yes	FACU
2. *Frangula alnus*	10	Yes	FAC
3. *Alliaria petiolata*	20	Yes	FACU
4. *Onoclea sensibilis*	5	No	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	45	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1. *Celastrus orbiculatus*	15	Yes	UPL
2.			
3.			
4.			
	15	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	4	(A)
Total Number of Dominant Species Across All Strata:	8	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	50.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	30	x 2 =	60
FAC species	70	x 3 =	210
FACU species	60	x 4 =	240
UPL species	30	x 5 =	150
Column Totals:	190 (A)		660 (B)

Prevalence Index = B/A = 3.47

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Bi Upland A-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-5	10YR 2/2	100						
5-15	10YR 4/3	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** _x_

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Bifurcation Launching City/County: Weston/Middlesex Sampling Date: 03/31/2022

Applicant/Owner: MWRA State: MA Sampling Point: Bi Wetland A-3

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): BVW, Intermittent Stream Local relief (concave, convex, none): Concave Slope %: 0-3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 313545 Long: 4690111 Datum: 1983

Soil Map Unit Name: Udorthents, urban land complex NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks.)

Are Vegetation x , Soil x , or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____ , Soil ____ , or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes x No ____	**Is the Sampled Area within a Wetland?** **Yes** X **No** ____
Hydric Soil Present?	Yes x No ____	
Wetland Hydrology Present?	Yes x No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

x Surface Water (A1)	x Water-Stained Leaves (B9)
x High Water Table (A2)	___ Aquatic Fauna (B13)
x Saturation (A3)	___ Marl Deposits (B15)
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)
___ Sparsely Vegetated Concave Surface (B8)	

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes x	No ____	Depth (inches): 4
Water Table Present?	Yes x	No ____	Depth (inches): 10
Saturation Present? (includes capillary fringe)	Yes x	No ____	Depth (inches): 5

Wetland Hydrology Present? **Yes** x **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Bi Wetland A-3

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Pinus strobus*	30	Yes	FACU
2. *Robinia pseudoacacia*	10	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	40	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Frangula alnus*	25	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	25	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Impatiens capensis*	15	Yes	FACW
2. *Carex spp.*	35	Yes	
3. *Graminiae*	20	Yes	
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	70	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1. *Celastrus orbiculatus*	15	Yes	UPL
2.			
3.			
4.			
	15	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 28.6% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	15	x 2 =	30
FAC species	25	x 3 =	75
FACU species	40	x 4 =	160
UPL species	15	x 5 =	75
Column Totals:	95 (A)		340 (B)

Prevalence Index = B/A = 3.58

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

_x_ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** _x_ **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)
Sedges, Carex spp. Are typically FAC, FACW or OBL wetland species. No flowers or fruit prevents positvie ID.

SOIL

Sampling Point Bi Wetland A-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-15	10YR 3/1	100						
15-20	5GY 5/1	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- x Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** x **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Highland Avenue Northwest Receiving - Charles River City/County: Needham/Essex Sampling Date: 05/10/22

Applicant/Owner: MWRA State: MA Sampling Point: Upland B-5

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): Valley, Riverine Local relief (concave, convex, none): Concave Slope %: 3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 316689 Long: 4686282 Datum: 1983

Soil Map Unit Name: Urban Land NWI classification: Upland to Riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil x, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No x	**Is the Sampled Area within a Wetland?**	**Yes** ___ **No** X
Hydric Soil Present?	Yes ___ No x	If yes, optional Wetland Site ID:	____
Wetland Hydrology Present?	Yes ___ No x		

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No x	Depth (inches): ___
Water Table Present?	Yes ___	No x	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No x	Depth (inches): ___

Wetland Hydrology Present? **Yes** ___ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Upland B-5

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer platanoides*	10	Yes	UPL
2. *Morus alba*	20	Yes	FACU
3. *Malus spp.*	10	Yes	
4.			
5.			
6.			
7.			
	40	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Rosa multiflora*	15	Yes	FACU
2. *Ailanthus altissima*	20	Yes	UPL
3. *Frangula alnus*	15	Yes	FAC
4.			
5.			
6.			
7.			
	50	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Solanum nigrum*	20	Yes	FACU
2. *Alliaria petiolata*	25	Yes	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	45	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1. *Toxicodendron radicans*	15	Yes	FAC
2.			
3.			
4.			
	15	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 9 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 22.2% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	30	x 3 =	90
FACU species	80	x 4 =	320
UPL species	30	x 5 =	150
Column Totals:	140 (A)		560 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Upland B-5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 4/2	100						Fill soils
5-8	10YR 5/3	100						
8-18	10YR 4/3	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** x

Remarks:
Fill soils.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Highland Avenue Northwest Receiving - Charles River City/County: Needham/Norfolk Sampling Date: 04/01/2022

Applicant/Owner: MWRA State: MA Sampling Point: Wetland B-5

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): Valley, Riverine Local relief (concave, convex, none): Concave Slope %: 3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 316689 Long: 4686282 Datum: 1983

Soil Map Unit Name: Water NWI classification: Riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes x No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes x No ___	
Wetland Hydrology Present?	Yes x No ___	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- x Surface Water (A1)
- x High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes x	No ___	Depth (inches): 12
Water Table Present?	Yes x	No ___	Depth (inches): 6
Saturation Present? (includes capillary fringe)	Yes x	No ___	Depth (inches): 1

Wetland Hydrology Present? **Yes** x **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wetland B-5

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *None*			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	

Sapling/Shrub Stratum (Plot size: 15)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Frangula alnus*	20	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	20	=Total Cover	

Herb Stratum (Plot size: 5)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Reynoutria japonica*	5	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	5	=Total Cover	

Woody Vine Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Toxicodendron radicans*	10	Yes	FAC
2.			
3.			
4.			
	10	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

	Total % Cover of:	Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	30	x 3 =	90
FACU species	5	x 4 =	20
UPL species	0	x 5 =	0
Column Totals:	35 (A)		110 (B)

Prevalence Index = B/A = 3.14

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Wetland B-5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 5/3	100						Sands
6-8	10YR 2/1	100						
8-15	10YR 3/2	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
_x_ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** _X_ **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: American Legion Receiving City/County: Boston/Essex Sampling Date: 04/01/2022

Applicant/Owner: MWRA State: MA Sampling Point: Upland A-16

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): Swale, intermittent stream Local relief (concave, convex, none): Concave Slope %: 3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 326912 Long: 4684195 Datum: 1983

Soil Map Unit Name: Udorthents, wet substratum NWI classification: Upland to riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil x, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____ No x	**Is the Sampled Area within a Wetland?** **Yes** ____ **No** X
Hydric Soil Present?	Yes ____ No x	
Wetland Hydrology Present?	Yes ____ No x	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No x	Depth (inches): ____
Water Table Present?	Yes ____	No x	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No x	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Upland A-16

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Populus deltoides*	30	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	30	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Rosa multiflora*	15	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	15	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Reynoutria japonica*	15	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	15	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1. *Celastrus orbiculatus*	10	Yes	UPL
2.			
3.			
4.			
	10	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	30	x 3 =	90
FACU species	30	x 4 =	120
UPL species	10	x 5 =	50
Column Totals:	70 (A)		260 (B)

Prevalence Index = B/A = 3.71

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Upland A-16

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-15	10YR 3/2	80	7.5YR 3/2	20				Fill with gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____

Depth (inches): ____

Hydric Soil Present? **Yes** ___ **No** x

Remarks:
Fill soils.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: American Legion Receiving City/County: Boston/Essex Sampling Date: 04/01/2022

Applicant/Owner: MWRA State: MA Sampling Point: Wetland A-16

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): Swale, intermittent stream Local relief (concave, convex, none): Concave Slope %: 3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 326912 Long: 4684195 Datum: 1983

Soil Map Unit Name: Udorthents, wet substratum NWI classification: Upland to riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil x , or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes x No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes x No ___	
Wetland Hydrology Present?	Yes x No ___	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- x Surface Water (A1)
- ___ High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- x Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes x	No ___	Depth (inches): 3
Water Table Present?	Yes x	No ___	Depth (inches): 0
Saturation Present? (includes capillary fringe)	Yes x	No ___	Depth (inches): 0

Wetland Hydrology Present? **Yes** x **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wetland A-16

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Ulmus americana*	20	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
	20	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Rosa multiflora*	15	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	15	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Rumex crispus*	15	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	15	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	20	x 2 =	40
FAC species	15	x 3 =	45
FACU species	15	x 4 =	60
UPL species	0	x 5 =	0
Column Totals:	50 (A)		145 (B)

Prevalence Index = B/A = 2.90

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Wetland A-16

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-6	10YR 2/2	100					Loamy/Clayey	
6-12	10YR 3/2	100					Loamy/Clayey	
12-16	10YR 4/1	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
_x_ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
_?_ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** _X_ **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Cedarwood Pumping Station Connection City/County: Waltham/Middlesex Sampling Date: 04/14/2022

Applicant/Owner: MWRA State: MA Sampling Point: Upland A7&A8

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): Valley Local relief (concave, convex, none): Concave Slope %: 0-3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 314616 Long: 4692928 Datum: 1983

Soil Map Unit Name: Udorthents, sandy NWI classification: Emergent, Forested

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No x
Hydric Soil Present?	Yes ____	No x
Wetland Hydrology Present?	Yes ____	No x

Is the Sampled Area within a Wetland? **Yes** ____ **No** X

If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)
___ High Water Table (A2)	___ Aquatic Fauna (B13)
___ Saturation (A3)	___ Marl Deposits (B15)
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)
___ Sparsely Vegetated Concave Surface (B8)	

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No x	Depth (inches): ____
Water Table Present?	Yes ____	No x	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No x	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Upland A7&A8

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Malus sylvestris*	30	Yes	UPL
2. *Juglans nigra*	30	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	60	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Rosa multiflora*	15	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	15	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Alliaria petiolata*	30	Yes	FACU
2. *Geum canadense*	10	No	FAC
3. *Graminiae*	15	Yes	
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	55	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1. *Celastrus orbiculatus*	10	Yes	UPL
2. *Vitis spp.*	25	Yes	
3.			
4.			
	35	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	10	x 3 =	30
FACU species	75	x 4 =	300
UPL species	40	x 5 =	200
Column Totals:	125 (A)		530 (B)

Prevalence Index = B/A = 4.24

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Upland A7&A8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 2/2	100					Loamy/Clayey	
3-14	10YR 3/2	100					Loamy/Clayey	
14-20	10YR 4/3	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** x

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Cedarwood Pumping Station Connection   City/County: Waltham/Middlesex   Sampling Date: 04/14/2022

Applicant/Owner: MWRA   State: MA   Sampling Point: Wetland A7&A8

Investigator(s): W. E. Kuriger   Section, Township, Range: ____

Landform (hillside, terrace, etc.): Valley   Local relief (concave, convex, none): Concave   Slope %: 3-8

Subregion (LRR or MLRA): LRR R, MLRA 144A   Lat: 314616   Long: 4692928   Datum: 1983

Soil Map Unit Name: Udorthents, sandy   NWI classification: Emergent, Forested

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed?   Are "Normal Circumstances" present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic?   (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes x No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes x No ___	
Wetland Hydrology Present?	Yes x No ___	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- x Surface Water (A1)
- x High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- x Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes x	No ___	Depth (inches): 4
Water Table Present?	Yes x	No ___	Depth (inches): 10
Saturation Present? (includes capillary fringe)	Yes x	No ___	Depth (inches): 0

Wetland Hydrology Present? **Yes** x **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wetland A7&A8

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	15	Yes	FAC
2. *Juglans nigra*	20	Yes	FACU
3. *Acer saccharum*	20	Yes	FACU
4.			
5.			
6.			
7.			
	55	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Cornus amomum*	40	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
	40	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Alliaria petiolata*	10	Yes	FACU
2. *Geum canadense*	20	Yes	FAC
3. *Impatiens capensis*	20	Yes	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	50	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1. *Vitis spp.*	10	Yes	
2.			
3.			
4.			
	10	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	60	x 2 =	120
FAC species	35	x 3 =	105
FACU species	50	x 4 =	200
UPL species	0	x 5 =	0
Column Totals:	145	(A)	425 (B)

Prevalence Index = B/A = 2.93

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Wetland A7&A8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 3/1	100					Loamy/Clayey	
20-24	10YR 5/2	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
x Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hegarty Pumping Station Connection City/County: Wellesley/Middlesex Sampling Date: 04/14/2022

Applicant/Owner: MWRA State: MA Sampling Point: Upland A-10

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): Valley Local relief (concave, convex, none): Concave Slope %: 0-3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 314885 Long: 4687716 Datum: 1983

Soil Map Unit Name: Hinckley Loamy Sand NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No x	**Is the Sampled Area within a Wetland?** **Yes** ____ **No** X
Hydric Soil Present?	Yes ____	No x	
Wetland Hydrology Present?	Yes ____	No x	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No x	Depth (inches): ____
Water Table Present?	Yes ____	No x	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No x	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Upland A-10

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Fraxinus americana*	30	Yes	FACU
2. *Pinus strobus*	40	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	70	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Rosa multiflora*	15	Yes	FACU
2. *Frangula alnus*	10	Yes	FAC
3.			
4.			
5.			
6.			
7.			
	25	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Chelidonium majus*	10	Yes	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	10	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1. *Hedera helix*	20	Yes	FACU
2.			
3.			
4.			
	20	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 16.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	10	x 3 =	30
FACU species	105	x 4 =	420
UPL species	10	x 5 =	50
Column Totals:	125 (A)		500 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Upland A-10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 2/2	100					Loamy/Clayey	
3-6	10YR 3/2	100					Loamy/Clayey	
6-15	10YR 5/4	60	10YR 3/2	40	D		Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? **Yes** ____ **No** x

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hegarty Pumping Station Connection City/County: Wellesley/Middlesex Sampling Date: 04/14/2022

Applicant/Owner: MWRA State: MA Sampling Point: Wetland A-10

Investigator(s): W. E. Kuriger Section, Township, Range: ____

Landform (hillside, terrace, etc.): Valley Local relief (concave, convex, none): Concave Slope %: 0-3

Subregion (LRR or MLRA): LRR R, MLRA 144A Lat: 314885 Long: 4687716 Datum: 1983

Soil Map Unit Name: Swansea muck NWI classification: Riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes x No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes x No ___	
Wetland Hydrology Present?	Yes x No ___	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Filled land; disturbed, filled-in soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
x Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No x	Depth (inches): ___
Water Table Present?	Yes x	No ___	Depth (inches): 20
Saturation Present? (includes capillary fringe)	Yes x	No ___	Depth (inches): 16

Wetland Hydrology Present? **Yes** x **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wetland A-10

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Fraxinus americana*	15	Yes	FACU
2. *Fraxinus pennsylvanica*	20	Yes	FACW
3.			
4.			
5.			
6.			
7.			
	35	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Ulmus americana*	20	Yes	FACW
2. *Pyrus calleryana*	20	Yes	UPL
3.			
4.			
5.			
6.			
7.			
	40	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Symplocarpus foetidus*	20	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	20	=Total Cover	
Woody Vine Stratum (Plot size: 30)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	20	x 1 =	20
FACW species	40	x 2 =	80
FAC species	0	x 3 =	0
FACU species	15	x 4 =	60
UPL species	20	x 5 =	100
Column Totals:	95 (A)		260 (B)

Prevalence Index = B/A = 2.74

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point Wetland A-10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 2/2	100					Loamy/Clayey	
6-16	2.5Y 5/2	80	10YR 5/6	20			Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
_x_ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? **Yes** _X_ **No** ___

Remarks:

Soil Maps

Soil maps are included for the following sites:

- Launching and Receiving Sites
  - Fernald Property Receiving
  - Bifurcation Launching
  - Highland Avenue Northwest Receiving
  - American Legion Receiving
- Connection/Isolation Valve Sites
  - Cedarwood Pumping Station Connection
  - Hegarty Pumping Station Connection
  - Newton Street Pumping Station Connection

It should be noted that the soil map for Highland Avenue Northwest Receiving is also representative for Highland Avenue Northwest/Southwest Launching and Highland Avenue Northeast/Southeast Launching. Additionally, the soil map for Bifurcation Receiving is also representative for Tandem Trailer Launching/Park Road East and Park Road West Receiving/Large Connection.

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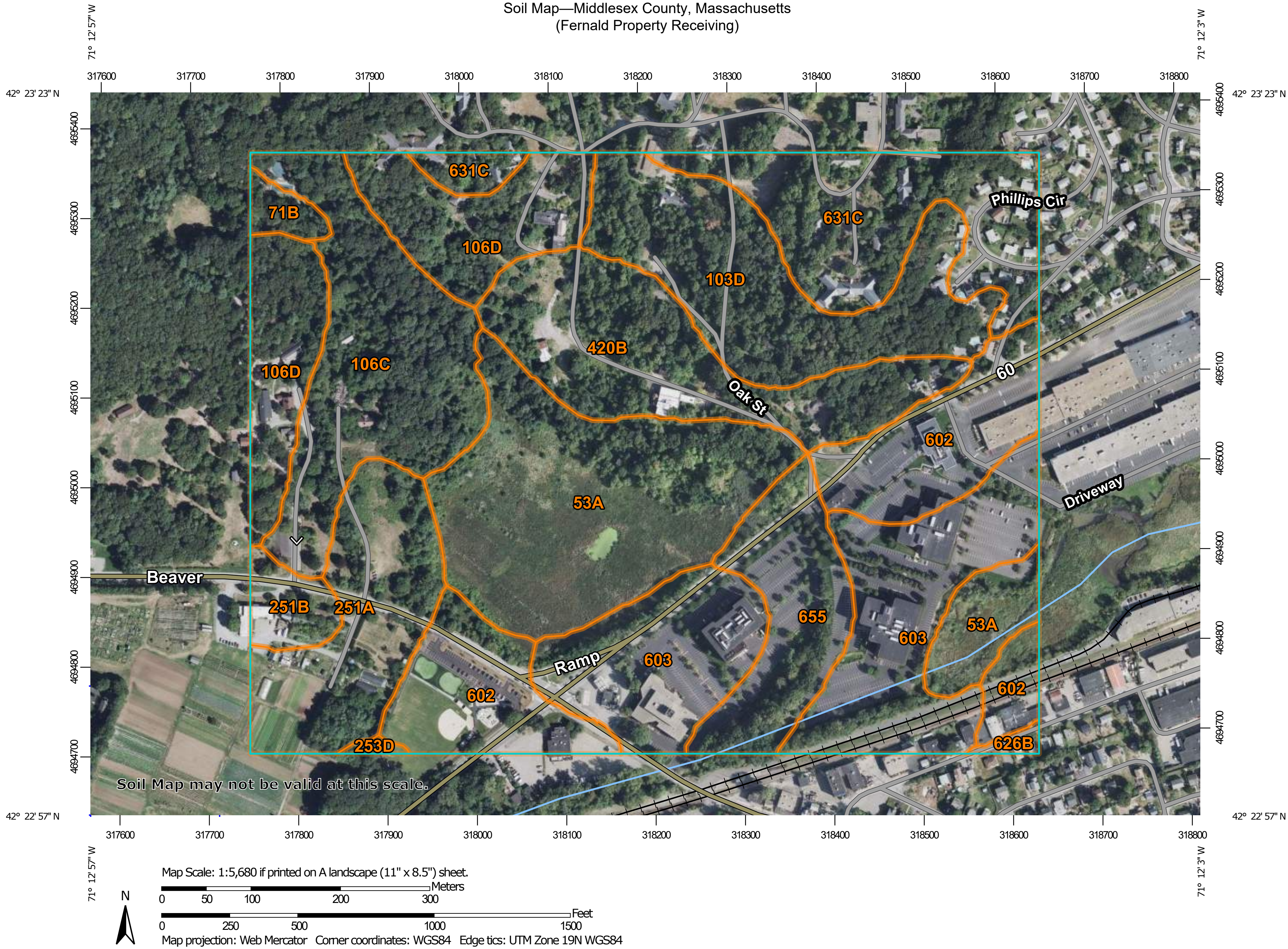
Soil Map—Middlesex County, Massachusetts
(Fernald Property Receiving)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 21, Sep 2, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 13, 2020—Sep 15, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
53A	Freetown muck, ponded, 0 to 1 percent slopes	22.2	15.2%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	1.1	0.7%
103D	Charlton-Hollis-Rock outcrop complex, 15 to 25 percent slopes	14.2	9.6%
106C	Narragansett-Hollis-Rock outcrop complex, 3 to 15 percent slopes	14.4	9.8%
106D	Narragansett-Hollis-Rock outcrop complex, 15 to 25 percent slopes	12.0	8.2%
251A	Haven silt loam, 0 to 3 percent slopes	10.1	6.9%
251B	Haven silt loam, 3 to 8 percent slopes	2.1	1.4%
253D	Hinckley loamy sand, 15 to 25 percent slopes	0.2	0.2%
420B	Canton fine sandy loam, 3 to 8 percent slopes	13.3	9.0%
602	Urban land	15.5	10.5%
603	Urban land, wet substratum	20.4	13.9%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	0.4	0.3%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	13.2	9.0%
655	Udorthents, wet substratum	7.8	5.3%
Totals for Area of Interest		**146.7**	**100.0%**

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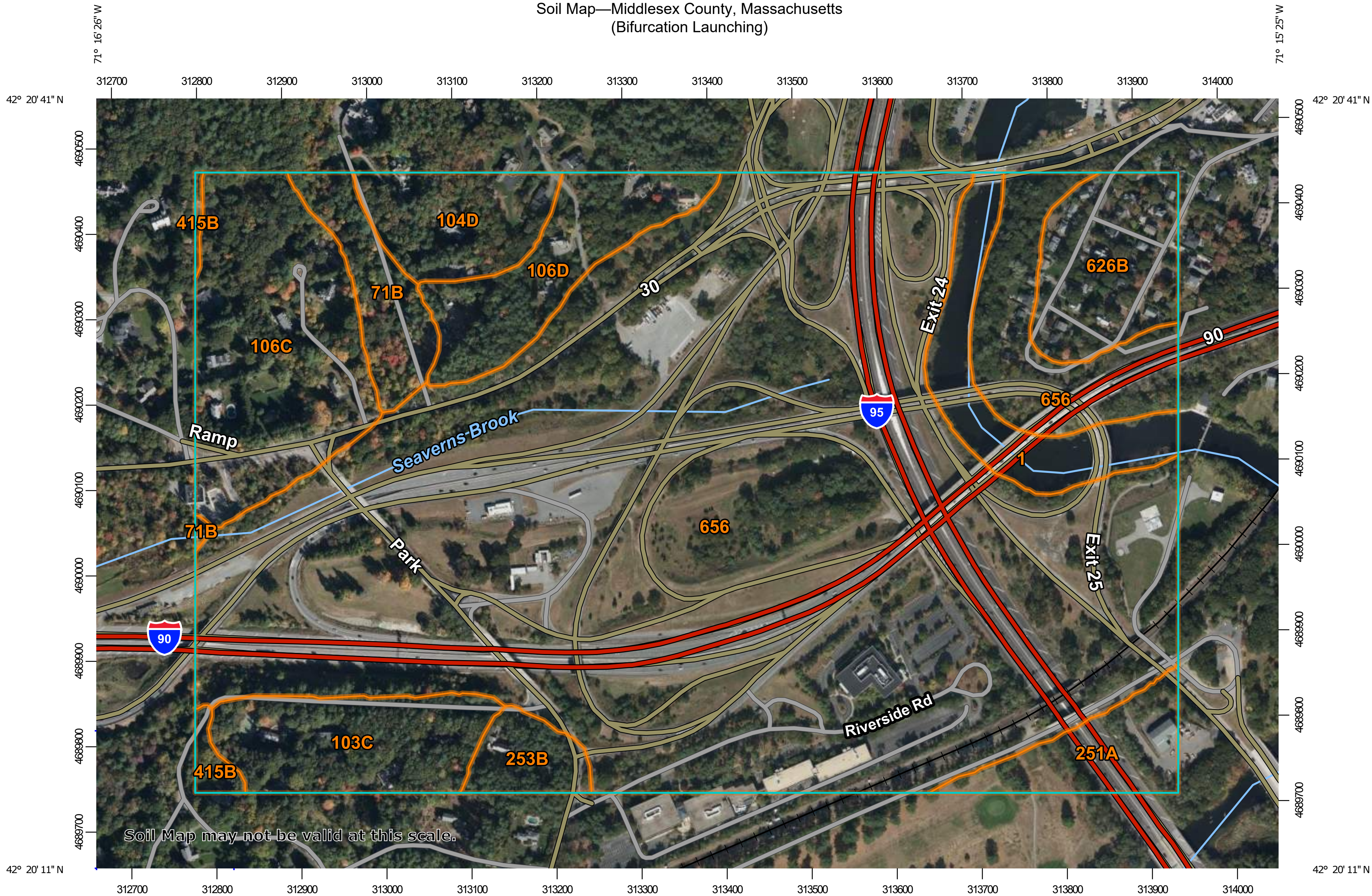
Soil Map—Middlesex County, Massachusetts
(Bifurcation Launching)



Map Scale: 1:6,350 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
Area of Interest (AOI)

Soils
Soil Map Unit Polygons
Soil Map Unit Lines
Soil Map Unit Points

Special Point Features
Blowout
Borrow Pit
Clay Spot
Closed Depression
Gravel Pit
Gravelly Spot
Landfill
Lava Flow
Marsh or swamp
Mine or Quarry
Miscellaneous Water
Perennial Water
Rock Outcrop
Saline Spot
Sandy Spot
Severely Eroded Spot
Sinkhole
Slide or Slip
Sodic Spot

Spoil Area
Stony Spot
Very Stony Spot
Wet Spot
Other
Special Line Features

Water Features
Streams and Canals

Transportation
Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background
Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 21, Sep 2, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 4, 2020—Oct 19, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	7.2	3.5%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	4.8	2.3%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	8.5	4.1%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 25 percent slopes	6.0	2.9%
106C	Narragansett-Hollis-Rock outcrop complex, 3 to 15 percent slopes	16.6	8.0%
106D	Narragansett-Hollis-Rock outcrop complex, 15 to 25 percent slopes	8.0	3.8%
251A	Haven silt loam, 0 to 3 percent slopes	5.0	2.4%
253B	Hinckley loamy sand, 3 to 8 percent slopes	2.7	1.3%
415B	Narragansett silt loam, 3 to 8 percent slopes	1.0	0.5%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	7.9	3.8%
656	Udorthents-Urban land complex	140.6	67.5%
Totals for Area of Interest		**208.4**	**100.0%**

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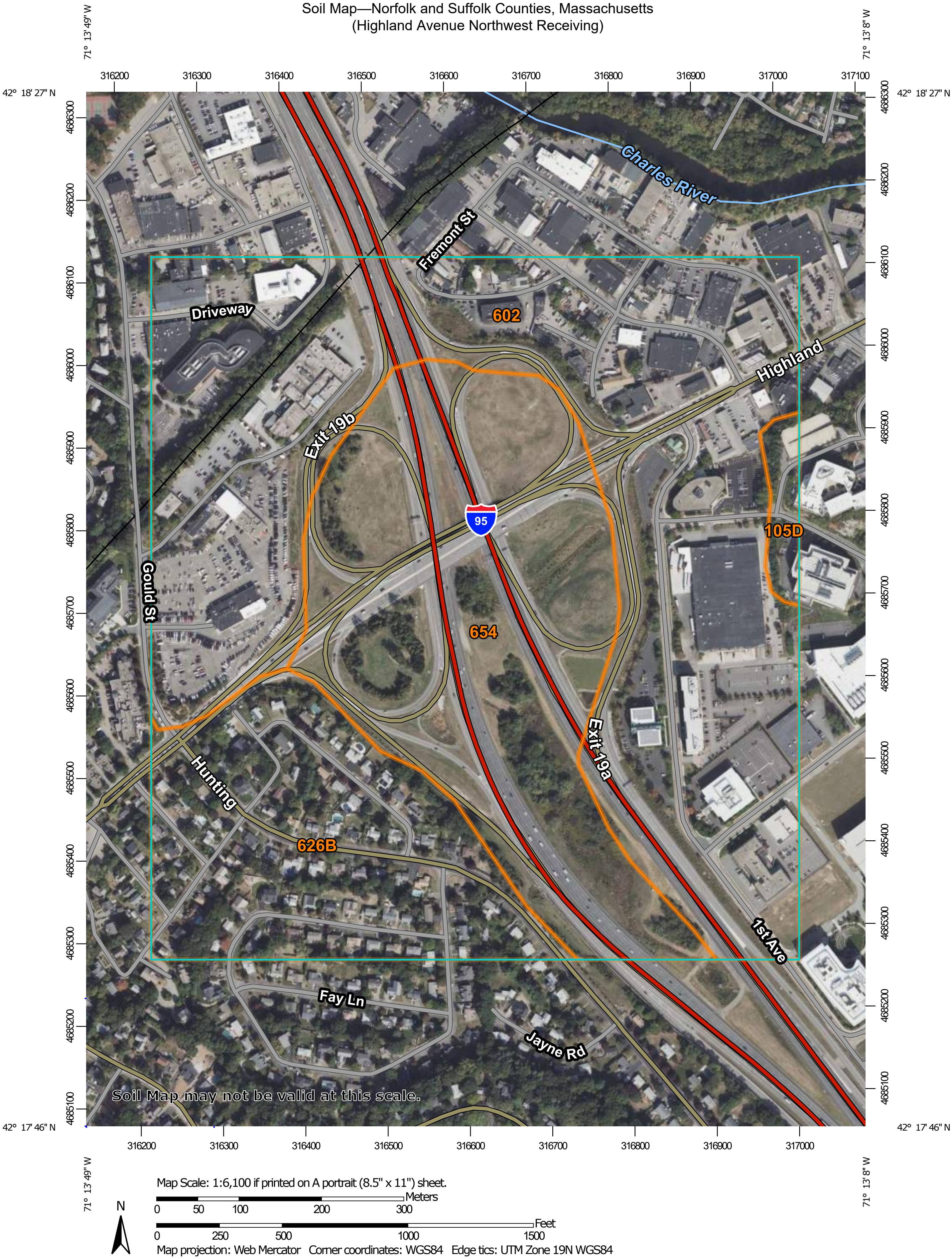
Soil Map—Norfolk and Suffolk Counties, Massachusetts
(Highland Avenue Northwest Receiving)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 17, Sep 3, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 25, 2020—Oct 4, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
105D	Rock outcrop-Hollis complex, 3 to 25 percent slopes	2.1	1.3%
602	Urban land, 0 to 15 percent slopes	85.4	51.4%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	29.8	17.9%
654	Udorthents, loamy	48.8	29.4%
Totals for Area of Interest		**166.2**	**100.0%**

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Soil Map—Middlesex County, Massachusetts, and Norfolk and Suffolk Counties, Massachusetts
(Highland Avenue Northwest Receiving - Charles River)

Map Scale: 1:4,770 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 21, Sep 2, 2021

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 17, Sep 3, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 25, 2020—Oct 4, 2020

MAP LEGEND

MAP INFORMATION

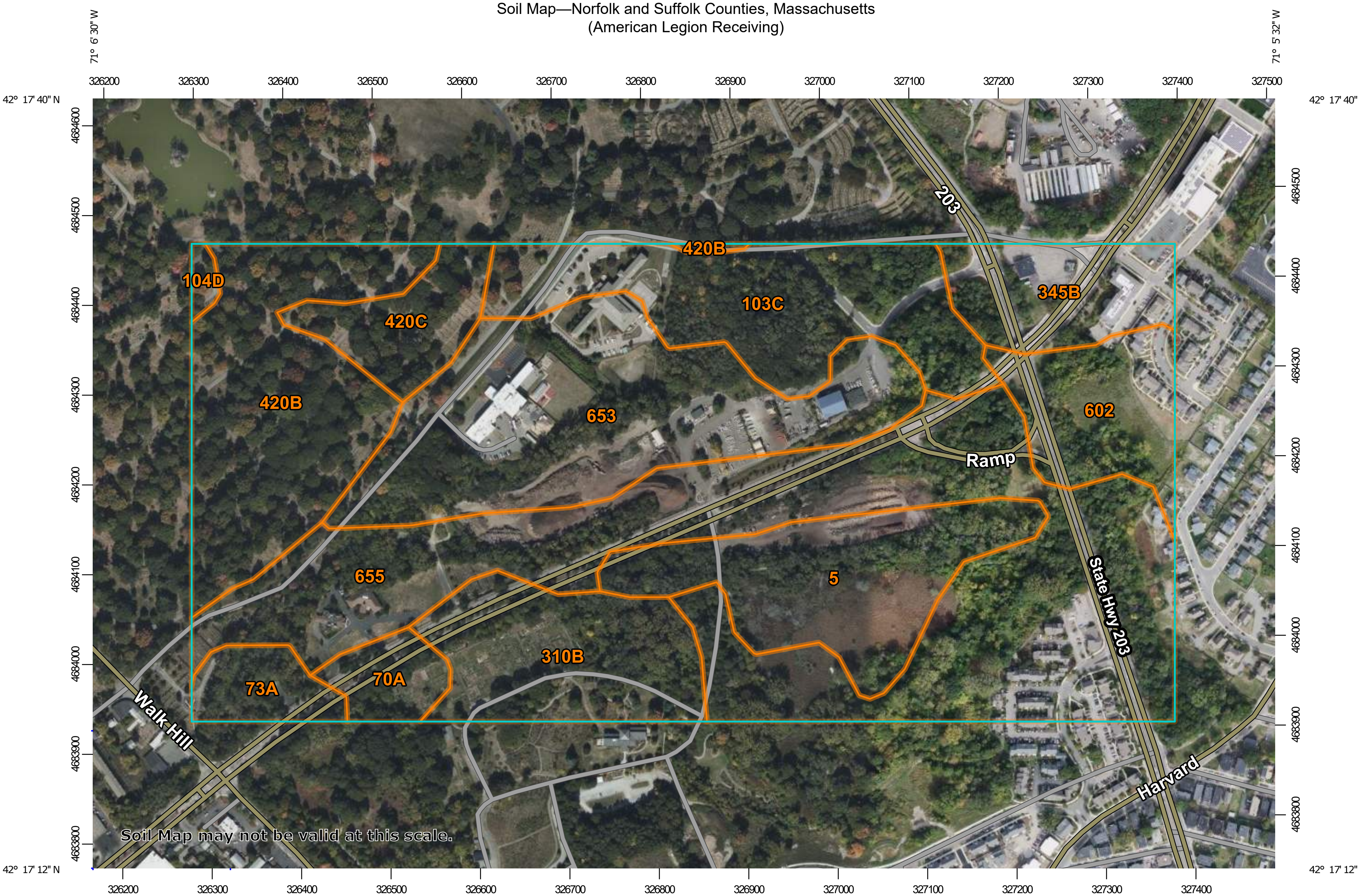
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

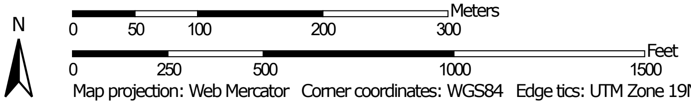
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	1.9	2.0%
602	Urban land	0.1	0.1%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	15.4	16.2%
654	Udorthents, loamy	2.3	2.4%
Subtotals for Soil Survey Area		**19.8**	**20.7%**
Totals for Area of Interest		**95.3**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	5.4	5.7%
105D	Rock outcrop-Hollis complex, 3 to 25 percent slopes	3.3	3.5%
245B	Hinckley loamy sand, 3 to 8 percent slopes	0.0	0.0%
602	Urban land, 0 to 15 percent slopes	53.1	55.8%
654	Udorthents, loamy	13.6	14.3%
Subtotals for Soil Survey Area		**75.5**	**79.3%**
Totals for Area of Interest		**95.3**	**100.0%**

Soil Map—Norfolk and Suffolk Counties, Massachusetts
(American Legion Receiving)



Map Scale: 1:6,040 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 17, Sep 3, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 13, 2020—Oct 18, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
5	Saco silt loam, frequently ponded, 0 to 1 percent slopes, frequently flooded	12.7	8.7%
70A	Ridgebury fine sandy loam, 0 to 3 percent slopes	2.7	1.8%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	3.0	2.0%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	14.7	10.1%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 35 percent slopes	0.5	0.3%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	10.7	7.4%
345B	Pittstown silt loam, 2 to 8 percent slopes	6.7	4.6%
420B	Canton fine sandy loam, 3 to 8 percent slopes	16.8	11.6%
420C	Canton fine sandy loam, 8 to 15 percent slopes	4.8	3.3%
602	Urban land, 0 to 15 percent slopes	7.1	4.9%
653	Udorthents, sandy	23.0	15.8%
655	Udorthents, wet substratum	42.5	29.3%
Totals for Area of Interest		**145.1**	**100.0%**

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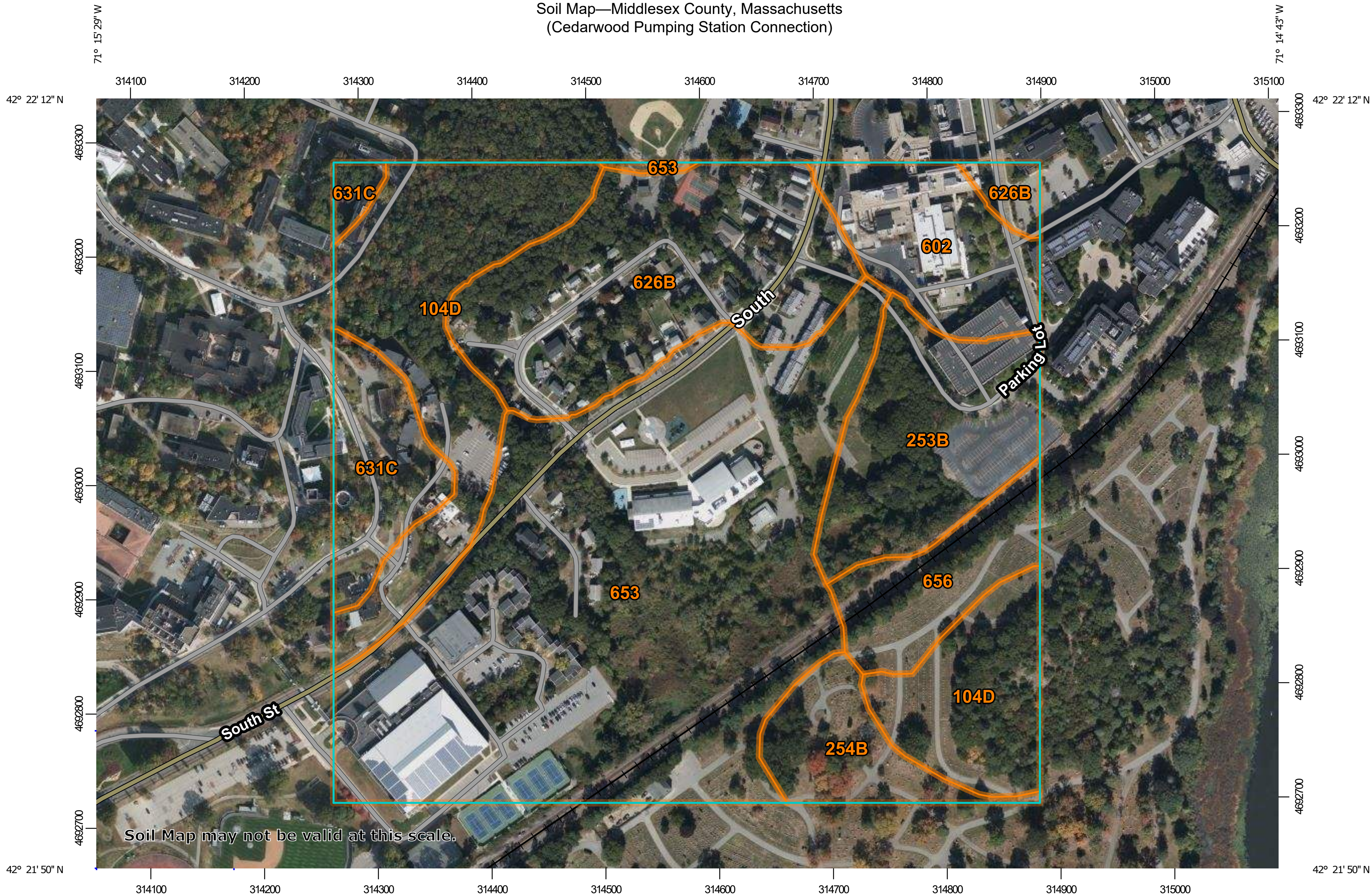
Soil Map—Middlesex County, Massachusetts
(Cedarwood Pumping Station Connection)



Map Scale: 1:4,750 if printed on A landscape (11" x 8.5") sheet.

N

0 50 100 200 300 Meters

0 200 400 800 1200 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 21, Sep 2, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 4, 2020—Oct 19, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
104D	Hollis-Rock outcrop-Charlton complex, 15 to 25 percent slopes	14.8	17.1%
253B	Hinckley loamy sand, 3 to 8 percent slopes	7.6	8.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	3.4	3.9%
602	Urban land	5.2	6.0%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	13.5	15.7%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	4.5	5.2%
653	Udorthents, sandy	33.5	38.8%
656	Udorthents-Urban land complex	3.9	4.5%
Totals for Area of Interest		**86.3**	**100.0%**

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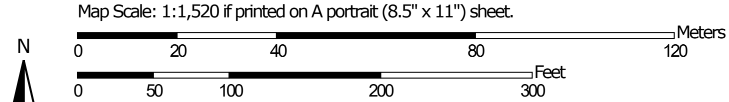
Soil Map—Norfolk and Suffolk Counties, Massachusetts
(Hegarty Pumping Station Connection)

Map Scale: 1:1,520 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 17, Sep 3, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 4, 2020—Oct 19, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
51	Swansea muck, 0 to 1 percent slopes	5.1	42.3%
251A	Haven silt loam, 0 to 3 percent slopes	0.0	0.3%
253D	Hinckley loamy sand, 15 to 35 percent slopes	0.4	3.2%
602	Urban land, 0 to 15 percent slopes	3.7	30.9%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	2.8	23.3%
Totals for Area of Interest		**12.0**	**100.0%**

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Soil Map—Norfolk and Suffolk Counties, Massachusetts
(Newton Street Pumping Station Connection)

Map Scale: 1:2,700 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 17, Sep 3, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 25, 2020—Oct 4, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	0.7	2.1%
51	Swansea muck, 0 to 1 percent slopes	3.7	11.2%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	1.6	4.9%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	8.9	27.0%
260B	Sudbury fine sandy loam, 2 to 8 percent slopes	1.5	4.6%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	0.2	0.6%
420B	Canton fine sandy loam, 3 to 8 percent slopes	0.0	0.0%
630C	Charlton-Hollis-Urban land complex, 3 to 15 percent slopes	16.3	49.6%
Totals for Area of Interest		**32.9**	**100.0%**

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Wetland Inventory Maps

Wetland inventory maps are included for the following sites:

- Launching and Receiving Sites
  - Fernald Property Receiving
  - Bifurcation Launching
  - Highland Avenue Northwest Receiving
  - American Legion Receiving
- Connection/Isolation Valve Sites
  - Cedarwood Pumping Station Connection
  - Hegarty Pumping Station Connection
  - Newton Street Pumping Station Connection

It should be noted that the wetland inventory map for Highland Avenue Northwest Receiving is also representative for Highland Avenue Northwest/Southwest Launching and Highland Avenue Northeast/Southeast Launching. Additionally, the wetland inventory map for Bifurcation Receiving is also representative for Tandem Trailer Launching/Park Road East and Park Road West Receiving/Large Connection.

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U.S. Fish and Wildlife Service

National Wetlands Inventory

Fernald Property Receiving

April 20, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

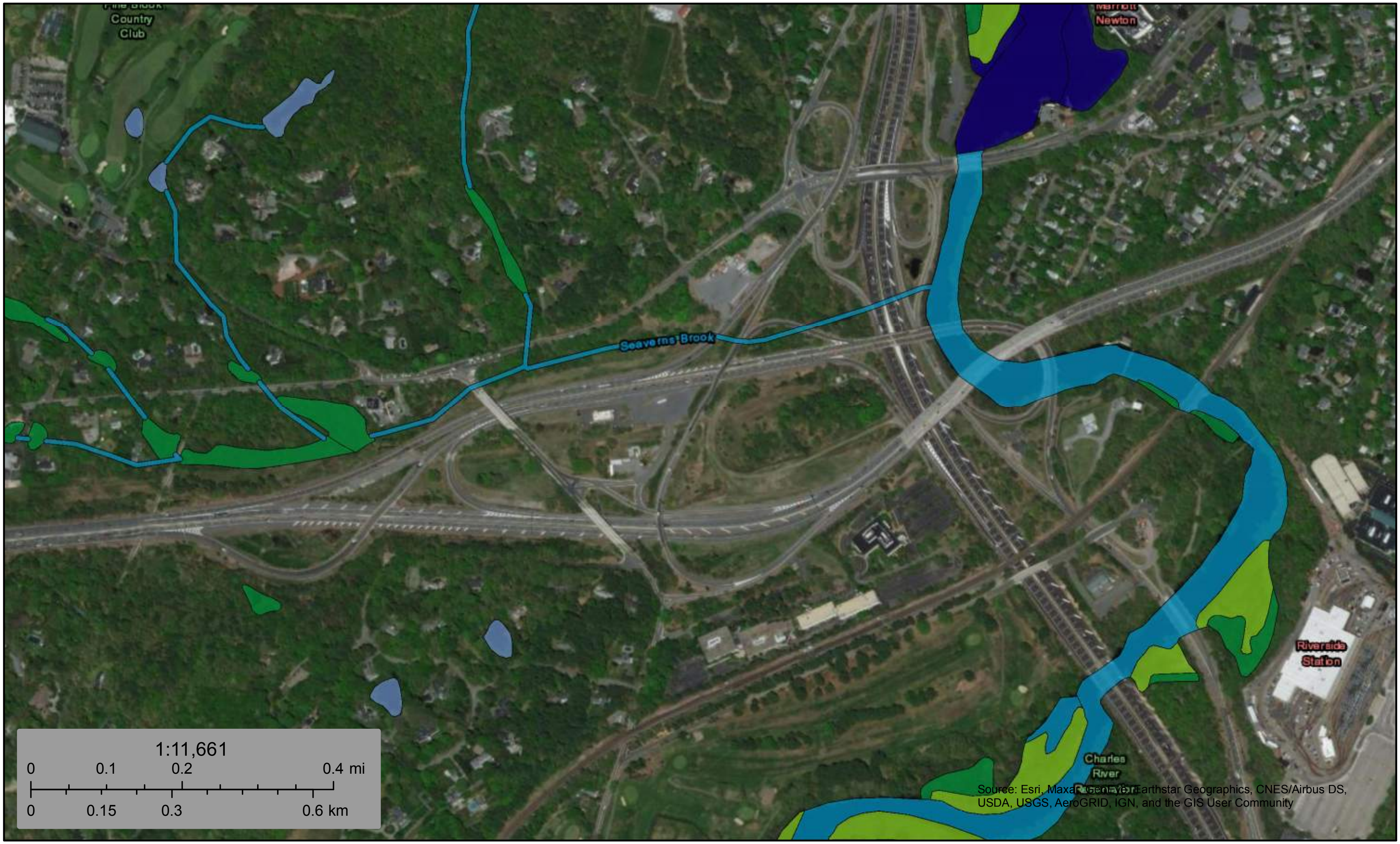
This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

U.S. Fish and Wildlife Service

National Wetlands Inventory

Bifurcation Launching



April 18, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

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National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

U.S. Fish and Wildlife Service

National Wetlands Inventory

Highland Avenue Northwest Receiving

April 20, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

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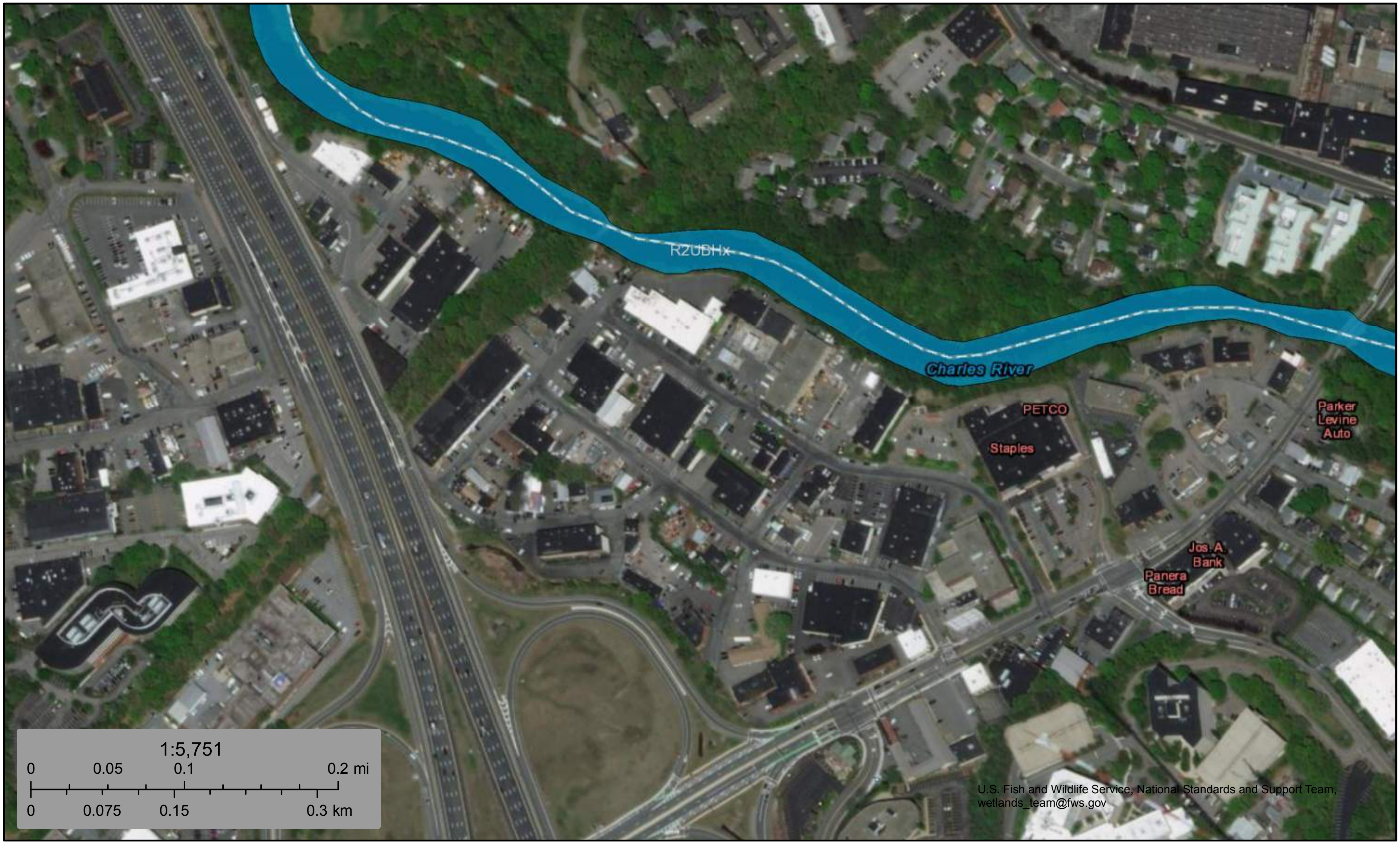
National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

U.S. Fish and Wildlife Service

National Wetlands Inventory

Highland Avenue Northwest Receiving - Charles River



May 7, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

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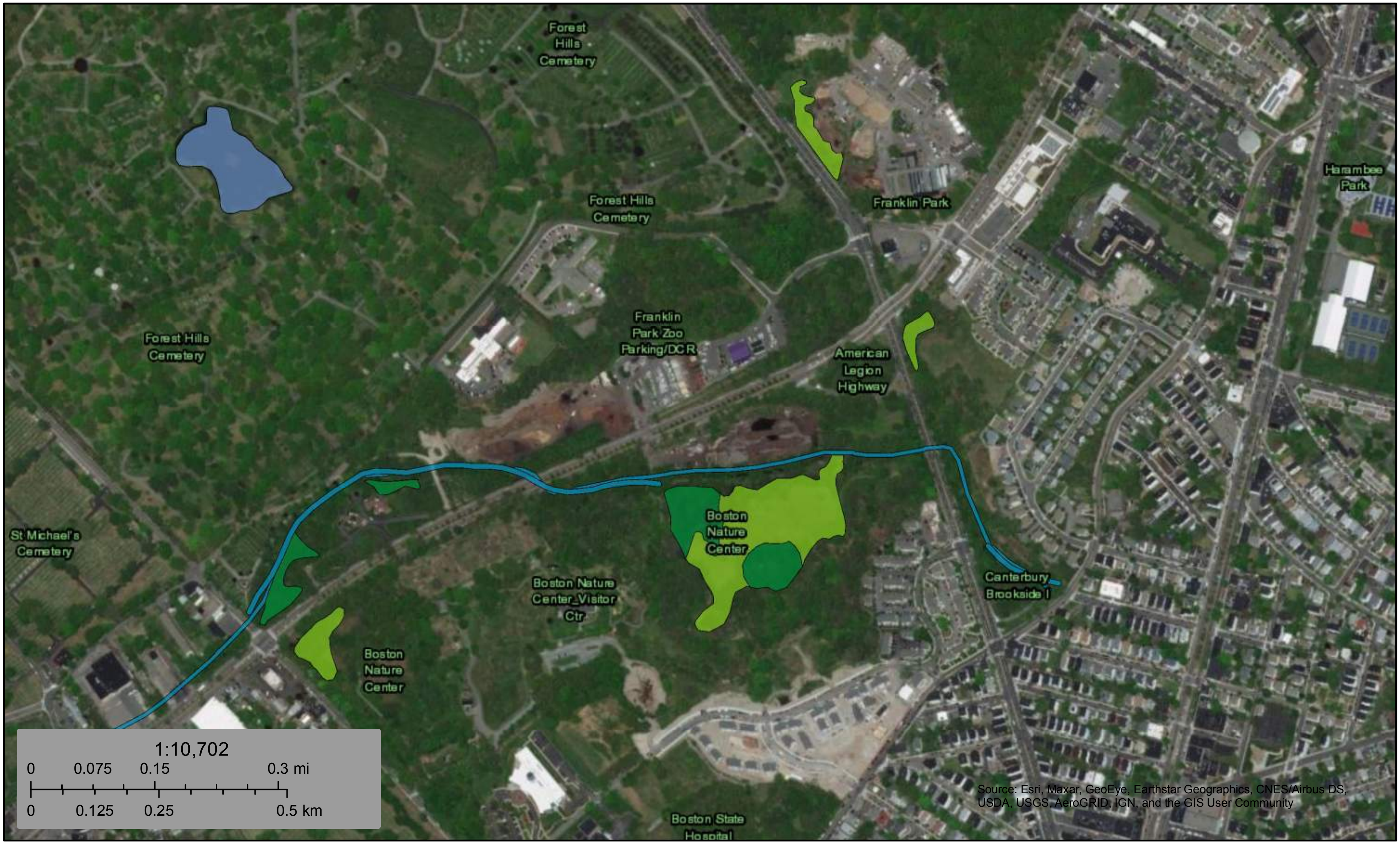
National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

U.S. Fish and Wildlife Service

National Wetlands Inventory

American Legion Receiving



April 11, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

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National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

U.S. Fish and Wildlife Service

National Wetlands Inventory

Cedarwood Pumping Station Connection

April 11, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

U.S. Fish and Wildlife Service

National Wetlands Inventory

Hegarty Pumping Station Connection

April 18, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

U.S. Fish and Wildlife Service

National Wetlands Inventory

Newton Street Pumping Station Connection

April 23, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

Wetland Flagging Maps

Wetland flagging maps are included for the following sites:

- Launching and Receiving Sites
    - Fernald Property Receiving
    - Tandem Trailer Launching/Park Road East
    - Bifurcation Launching
    - Park Road West Receiving
    - Highland Avenue Northwest Receiving
    - Highland Avenue Northwest/Southwest Launching
    - Highland Avenue Northeast/Southeast Launching
    - American Legion Receiving
- Connection/Isolation Valve Sites
    - Cedarwood Pumping Station Connection
    - Hegarty Pumping Station Connection

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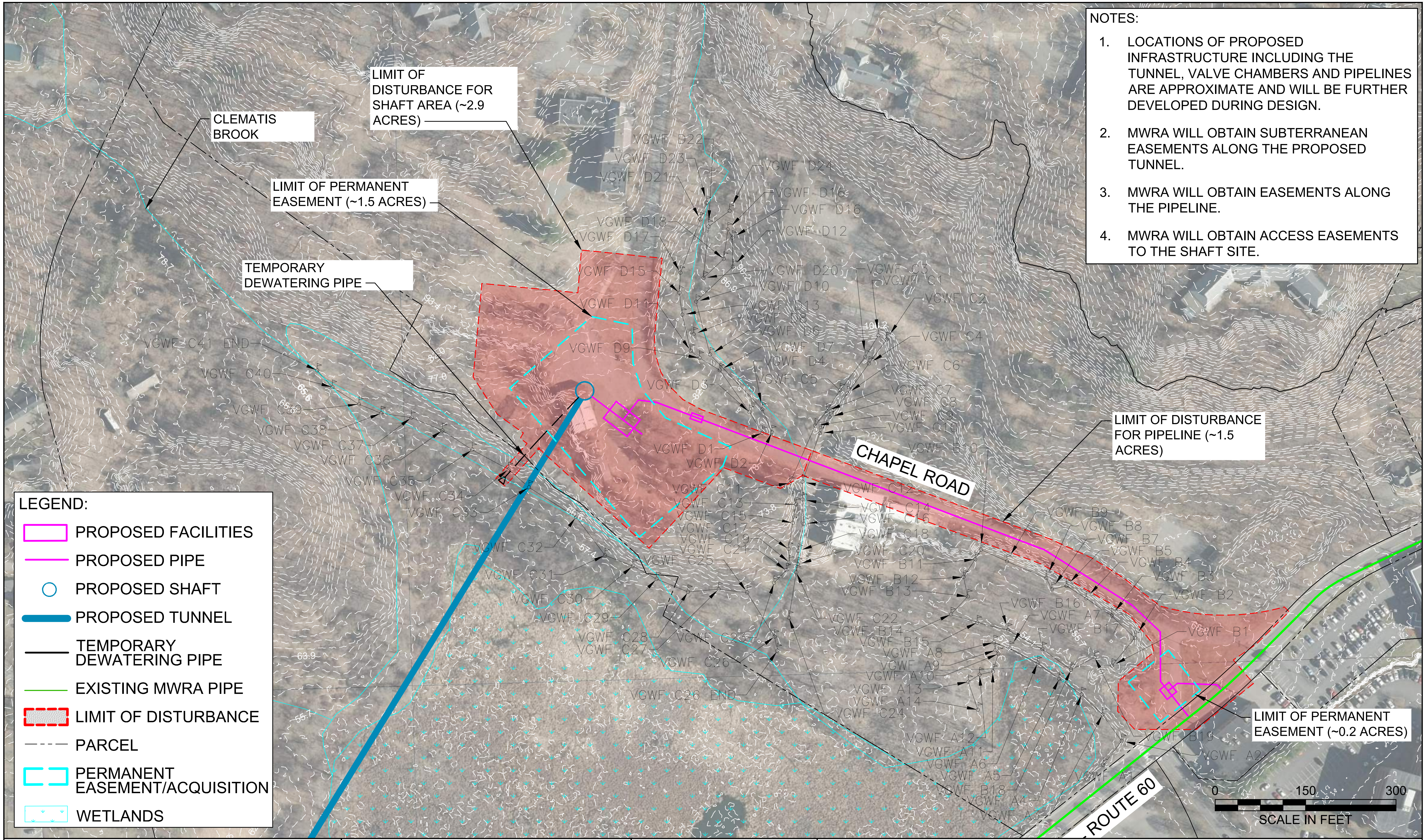

Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb
Jacobs GREEN INTERNATIONAL AFFILIATES, INC.

Waltham, MA

Wetland Figure
Fernald Property-Receiving Shaft
Alternatives 3, 4 & 10
MassGIS Ortho Imagery 2019

C:\cdmext\pkeenan@cdmconsultants.com\d0754850\S-2 Fernald-Receiving Shaft-05.2022.dwg
PLOTTED: October 5, 2022

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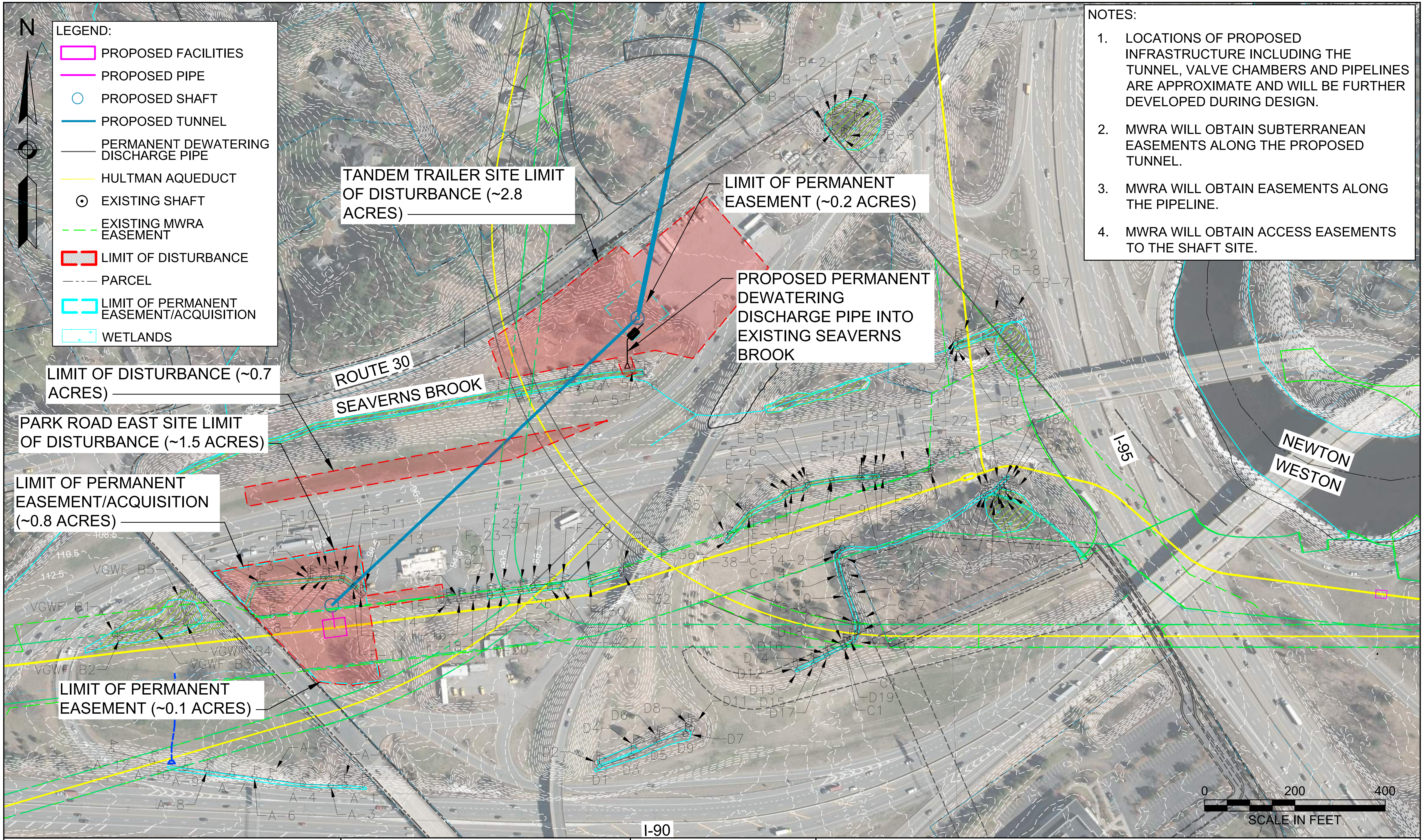
C:\cdmext\pkeenan@cdwconsultants.com\d0754850\S-6.1 Tandem Trailer and Park Road East-Launch Shaft-05.2022.dwg
PLOTTED: October 5, 2022



Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb
Jacobs GREEN INTERNATIONAL AFFILIATES, INC.

Weston, MA

Wetland Figure
Tandem Trailer and Park Road East-Launching Shaft
Alternatives 3 and 4

MassGIS Ortho Imagery 2019

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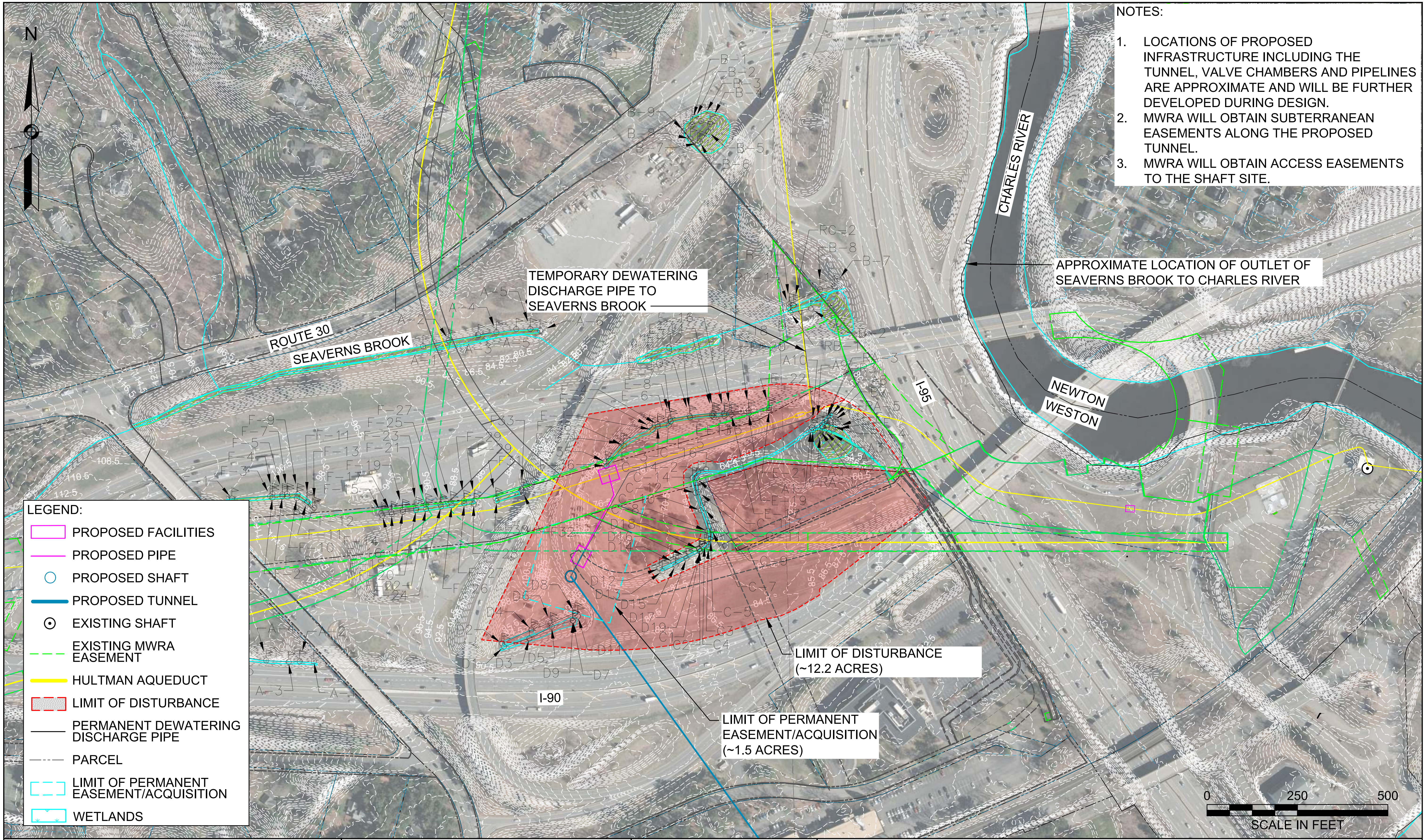
C:\cdmext\pkeenan@cdwconsultants.com\d0754850\S-6.2 Bifurcation-Launch Shaft-05.2022.dwg
PLOTTED: October 4, 2022



Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith | in association with vhb | Jacobs | GREEN INTERNATIONAL AFFILIATES, INC.

Weston, MA

Wetland Figures
Bifurcation-Launching Shaft
Alternative 3

MassGIS Ortho Imagery 2019

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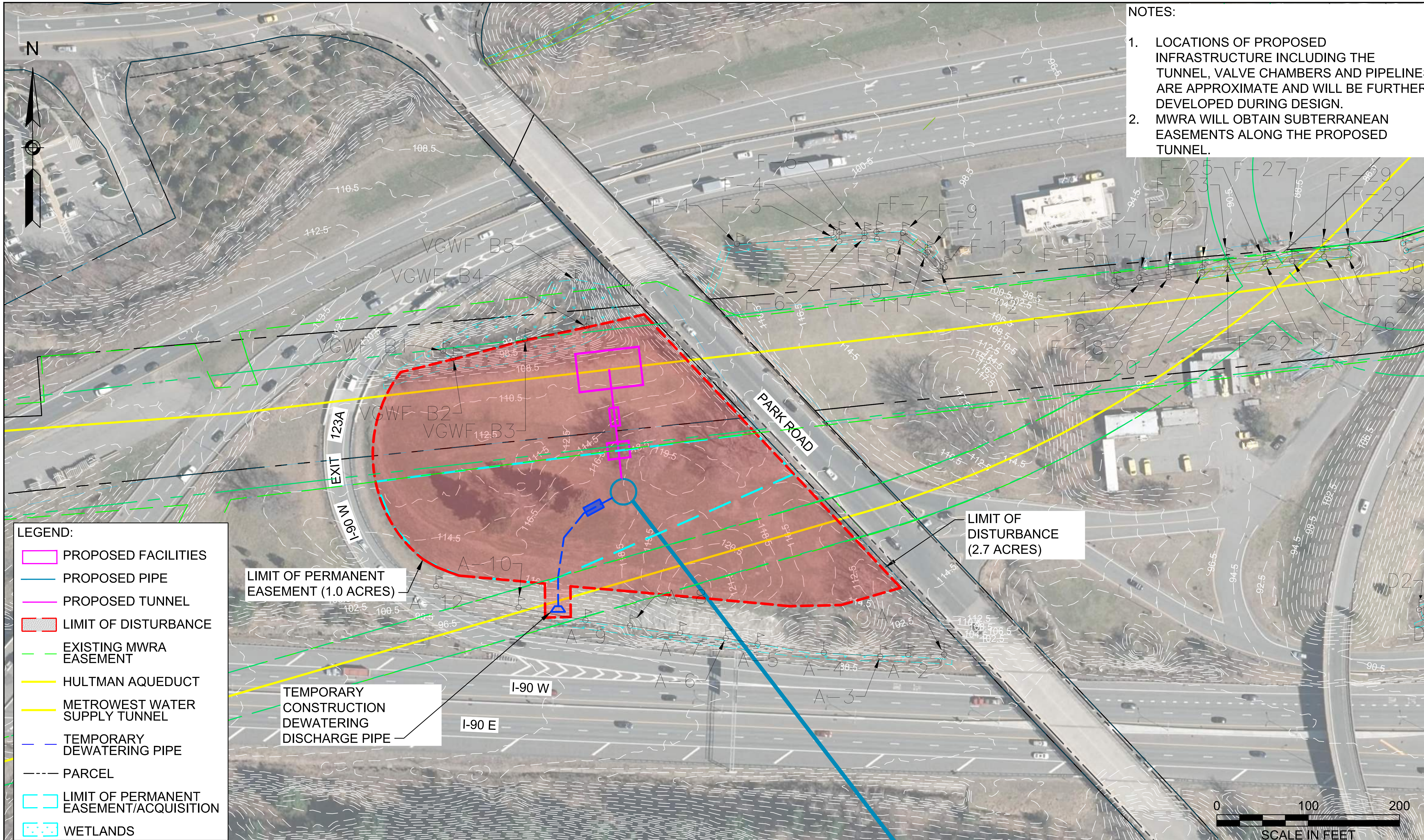

NOTES:

1. LOCATIONS OF PROPOSED INFRASTRUCTURE INCLUDING THE TUNNEL, VALVE CHAMBERS AND PIPELINES ARE APPROXIMATE AND WILL BE FURTHER DEVELOPED DURING DESIGN.
2. MWRA WILL OBTAIN SUBTERRANEAN EASEMENTS ALONG THE PROPOSED TUNNEL.

LEGEND:

- PROPOSED FACILITIES
- PROPOSED PIPE
- PROPOSED TUNNEL
- LIMIT OF DISTURBANCE
- EXISTING MWRA EASEMENT
- HULTMAN AQUEDUCT
- METROWEST WATER SUPPLY TUNNEL
- TEMPORARY DEWATERING PIPE
- PARCEL
- LIMIT OF PERMANENT EASEMENT/ACQUISITION
- WETLANDS

Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb
Jacobs
GREEN INTERNATIONAL AFFILIATES, INC.

Wetland Figure
Park Road West-Receiving Shaft
Alternative 4

Weston, MA

MassGIS Ortho Imagery 2019

C:\cdmext\pkeenan@cdwconsultants.com\d0754850\S-36 Park Road West-Receiving Shaft-05.2022.dwg
PLOTTED: October 5, 2022

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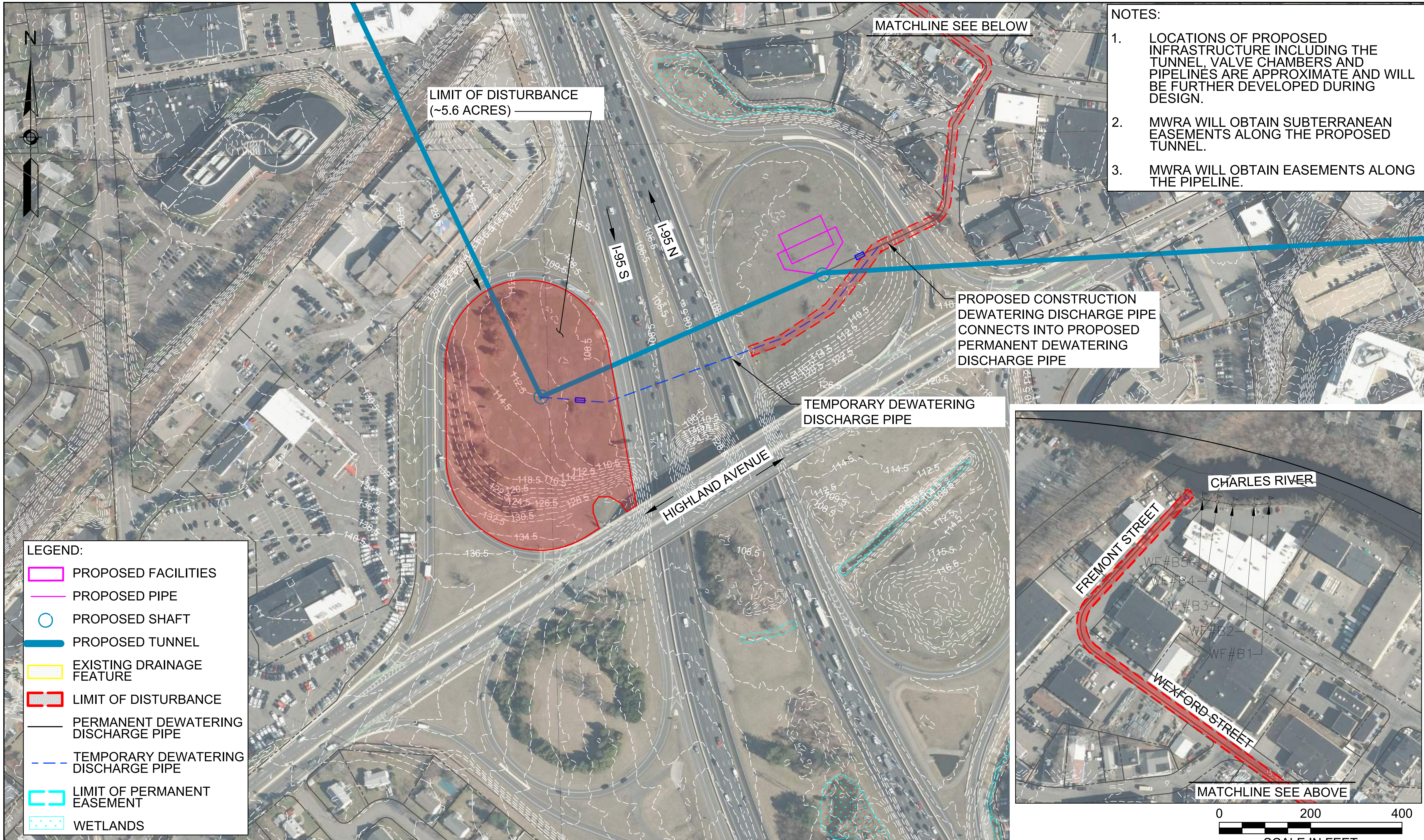

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PLOTTED: October 5, 2022

Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb
Jacobs
GREEN INTERNATIONAL AFFILIATES, INC.

Wetland Figure
Highland Avenue Northwest-Receiving Shaft
Alternative 3

Needham, MA

MassGIS Ortho Imagery 2019

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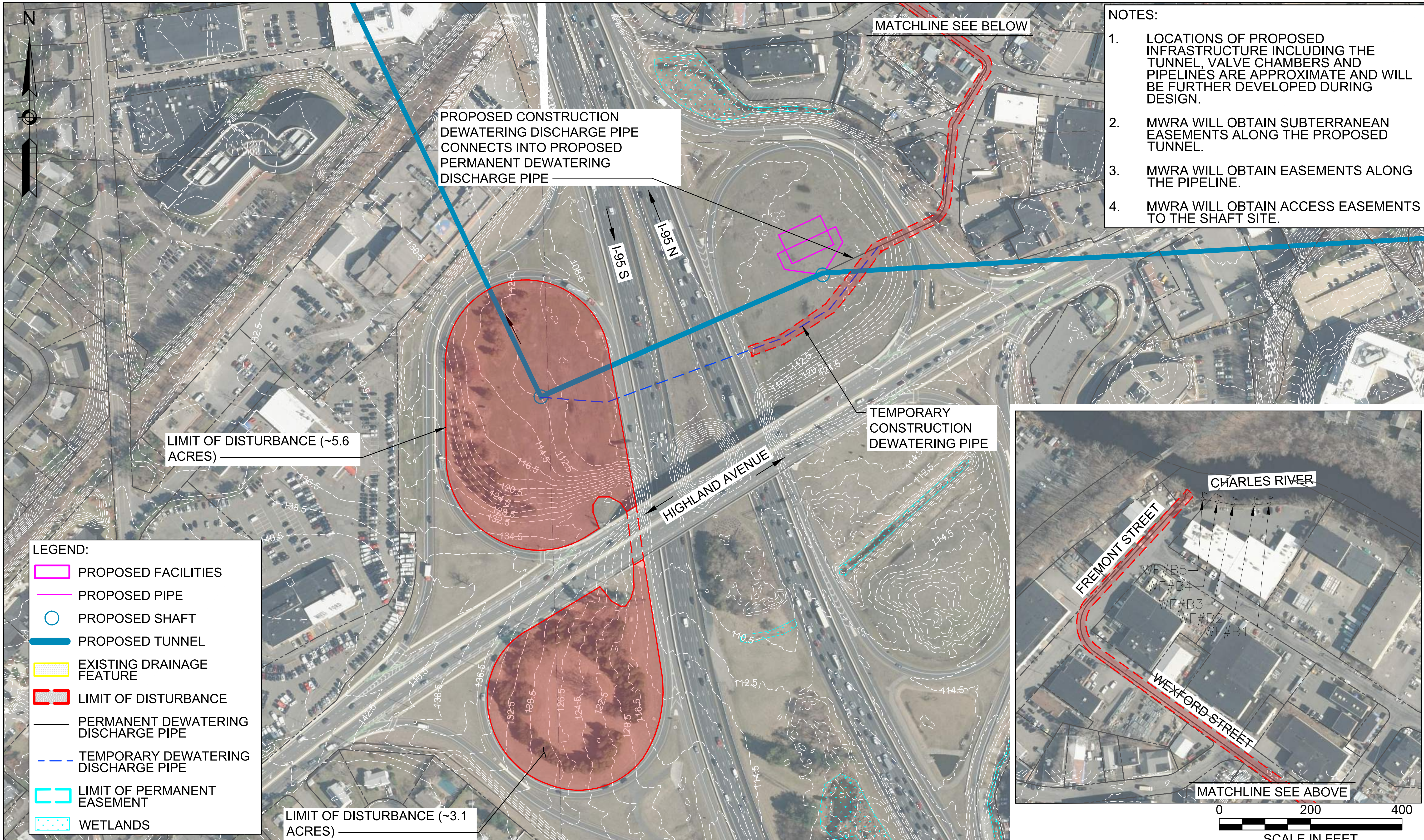

Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb
Jacobs GREEN INTERNATIONAL AFFILIATES, INC.

Wetland Figure
Highland Avenue Northwest/Southwest-Launching Shaft
Alternatives 4 and 10

Needham, MA

MassGIS Ortho Imagery 2019

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PLOTTED: October 5, 2022

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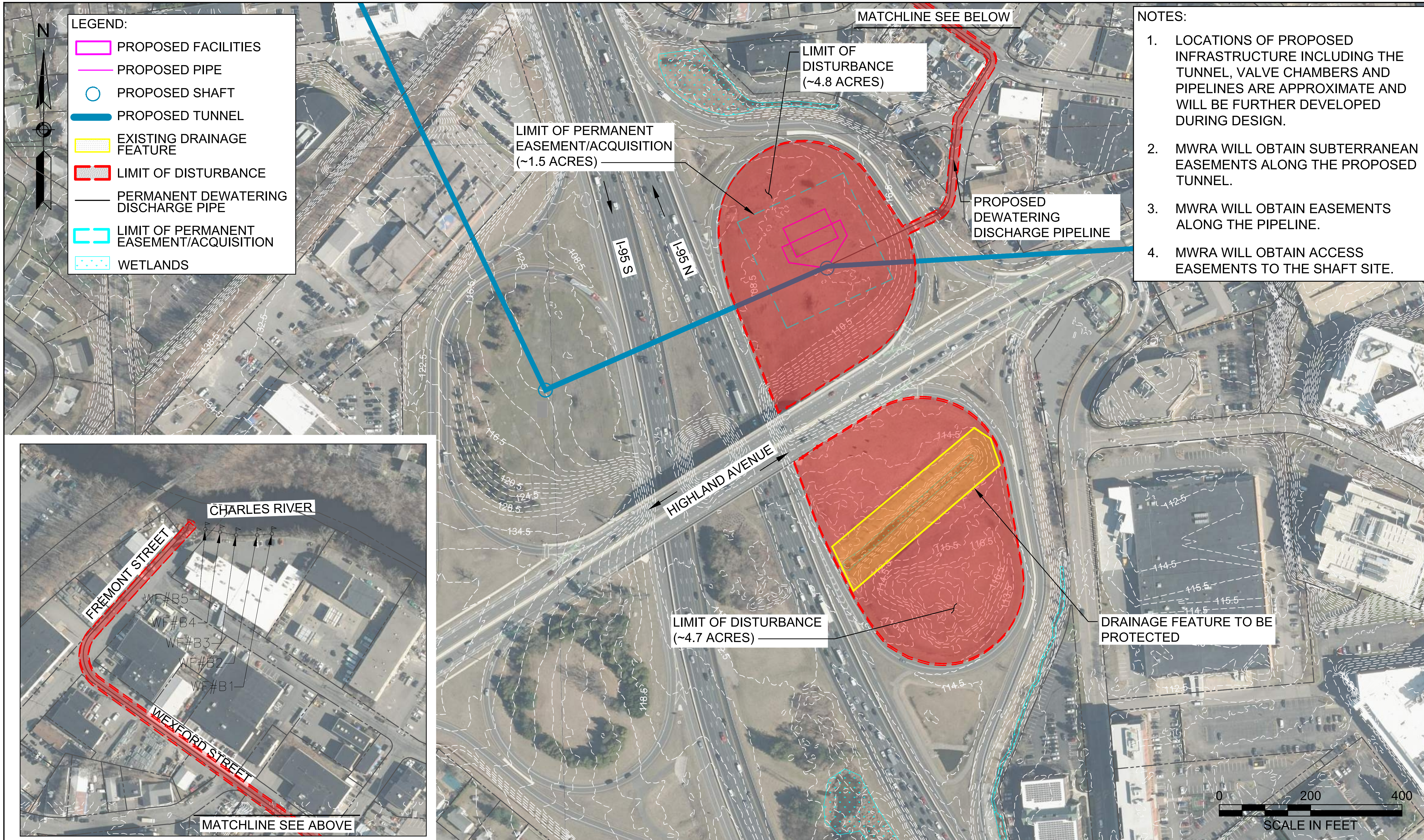

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PLOTTED: October 5, 2022

Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb
Jacobs
GREEN INTERNATIONAL AFFILIATES, INC.

Wetland Figure
Highland Avenue Northeast/Southeast-Launching Shaft
Alternatives 3, 4 & 10

Needham, MA

MassGIS Ortho Imagery 2019

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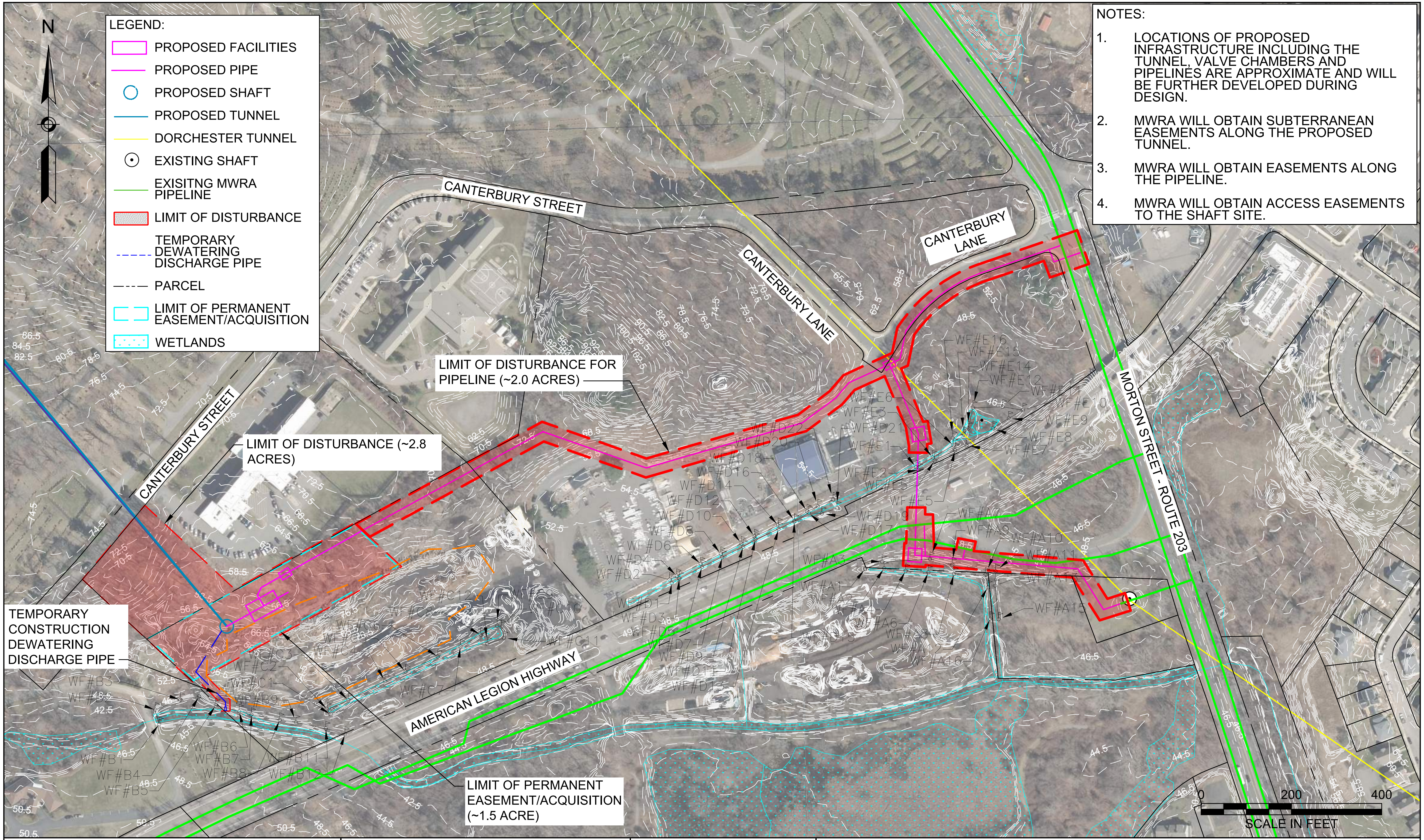

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PLOTTED: October 5, 2022

Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith | in association with vhb | Jacobs | GREEN INTERNATIONAL AFFILIATES, INC.

Boston, MA

Wetland Figure
American Legion-Receiving Shaft
Alternatives 3, 4 & 10

MassGIS Ortho Imagery 2019

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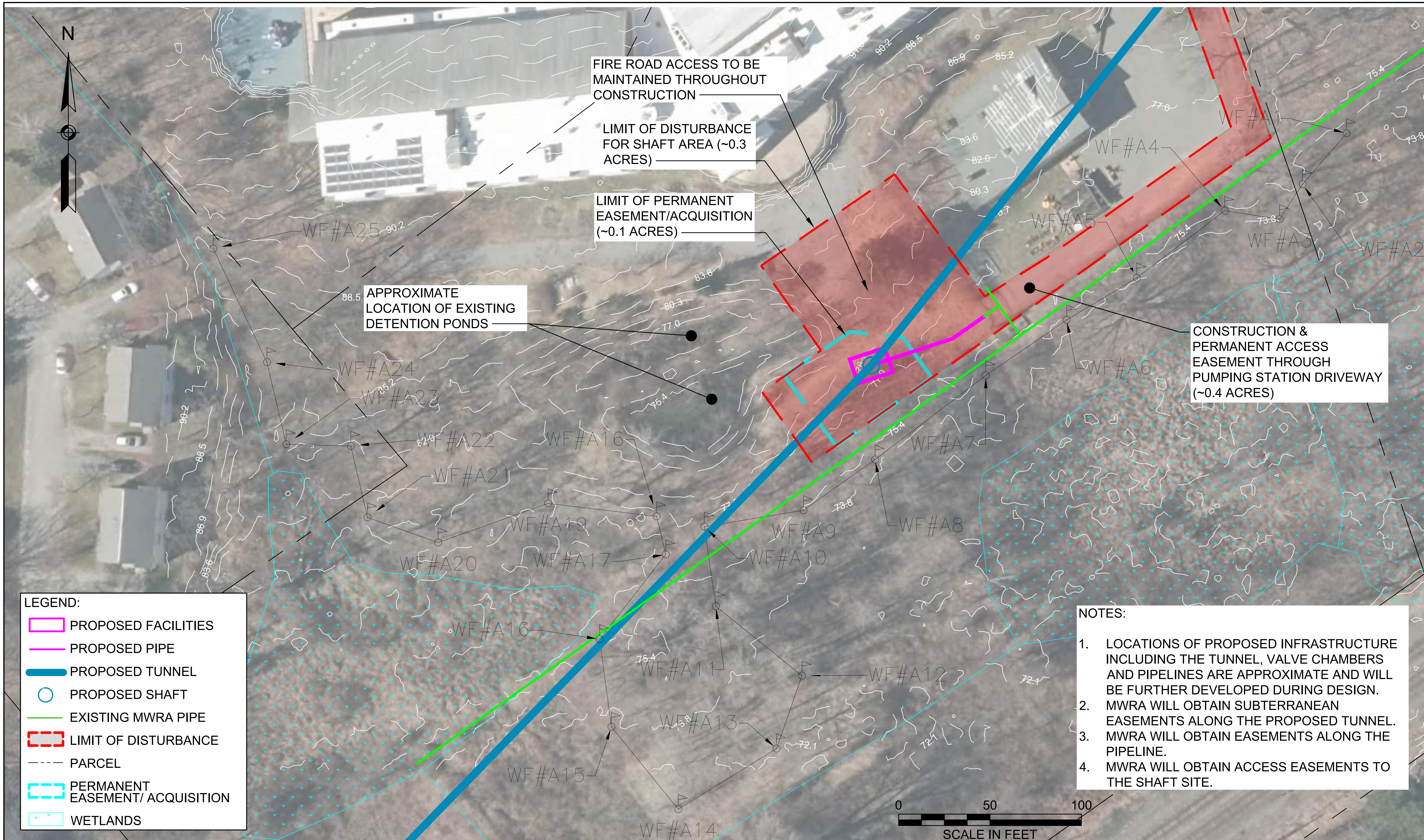

C:\cdmext\pkeenan@cdwconsultants.com\d0754850\S-5 Cedarwood Pumping Station-Connection Shaft-05.2022.dwg
PLOTTED: October 4, 2022

Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb, Jacobs, Green International Affiliates, Inc.

Wetland Figure
Cedarwood Pumping Station-Connection Shaft
Alternatives 3, 4 & 10

Waltham, MA

MassGIS Ortho Imagery 2019

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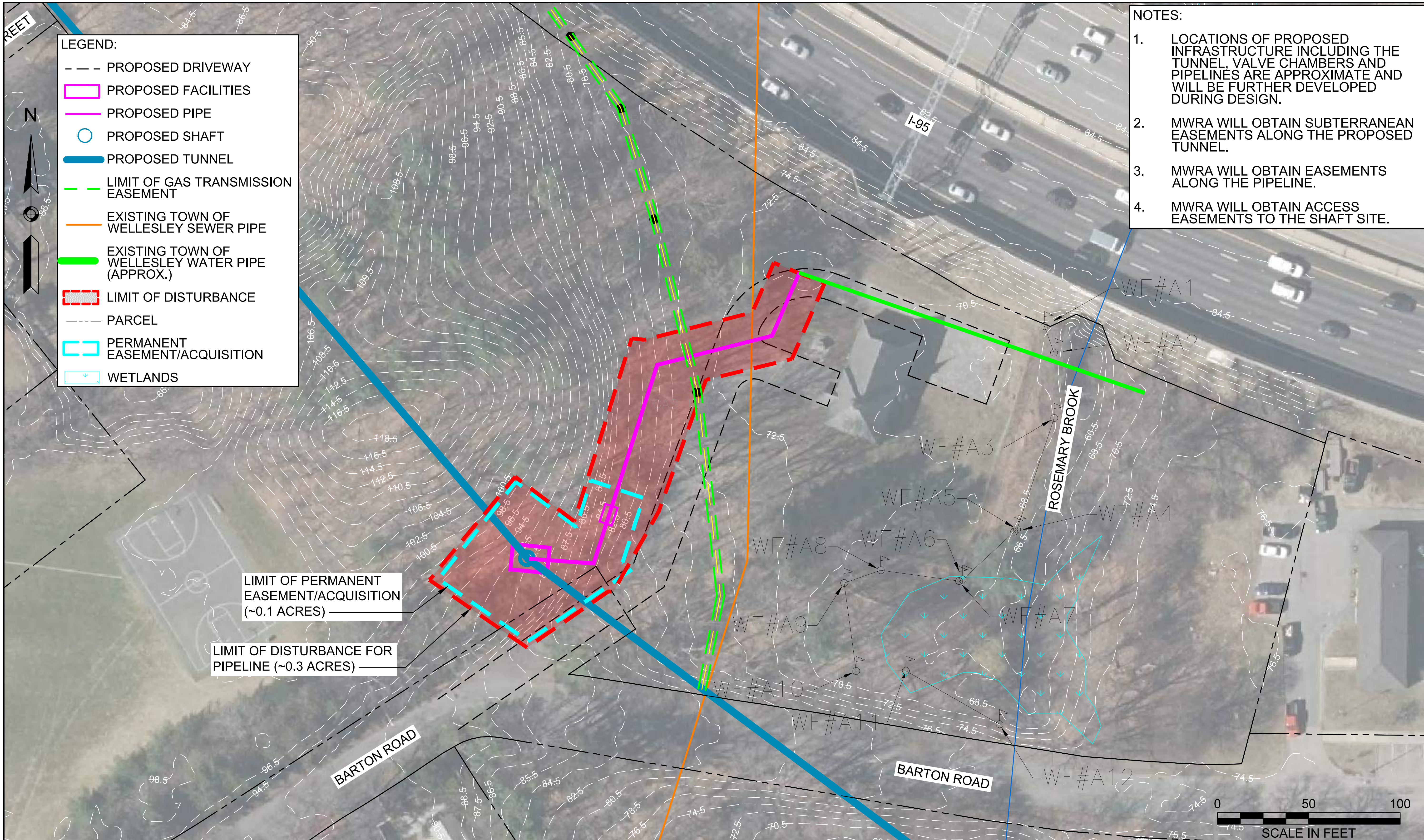

Metropolitan Water Tunnel Program

MWRA Contract No. 7159
Draft Environmental Impact Report

CDM Smith in association with vhb
Jacobs
GREEN INTERNATIONAL AFFILIATES, INC.

Wetland Figure
Hegarty Pumping Station-Connection Shaft
Alternatives 3, 4 & 10

Wellesley, MA

MassGIS Ortho Imagery 2019

C:\cdmext\pkeenan@cdwconsultants.com\d0754850\S-8 Hegarty Pumping Station-Connection Shaft-05.2022.dwg
PLOTTED: October 4, 2022

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Appendix D.2: USGS StreamStats Reports

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Table of Contents

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Fernald Property - Clematis Brook

Region ID: MA
Workspace ID: MA20210817172743134000
Clicked Point (Latitude, Longitude): 42.38539, -71.20695
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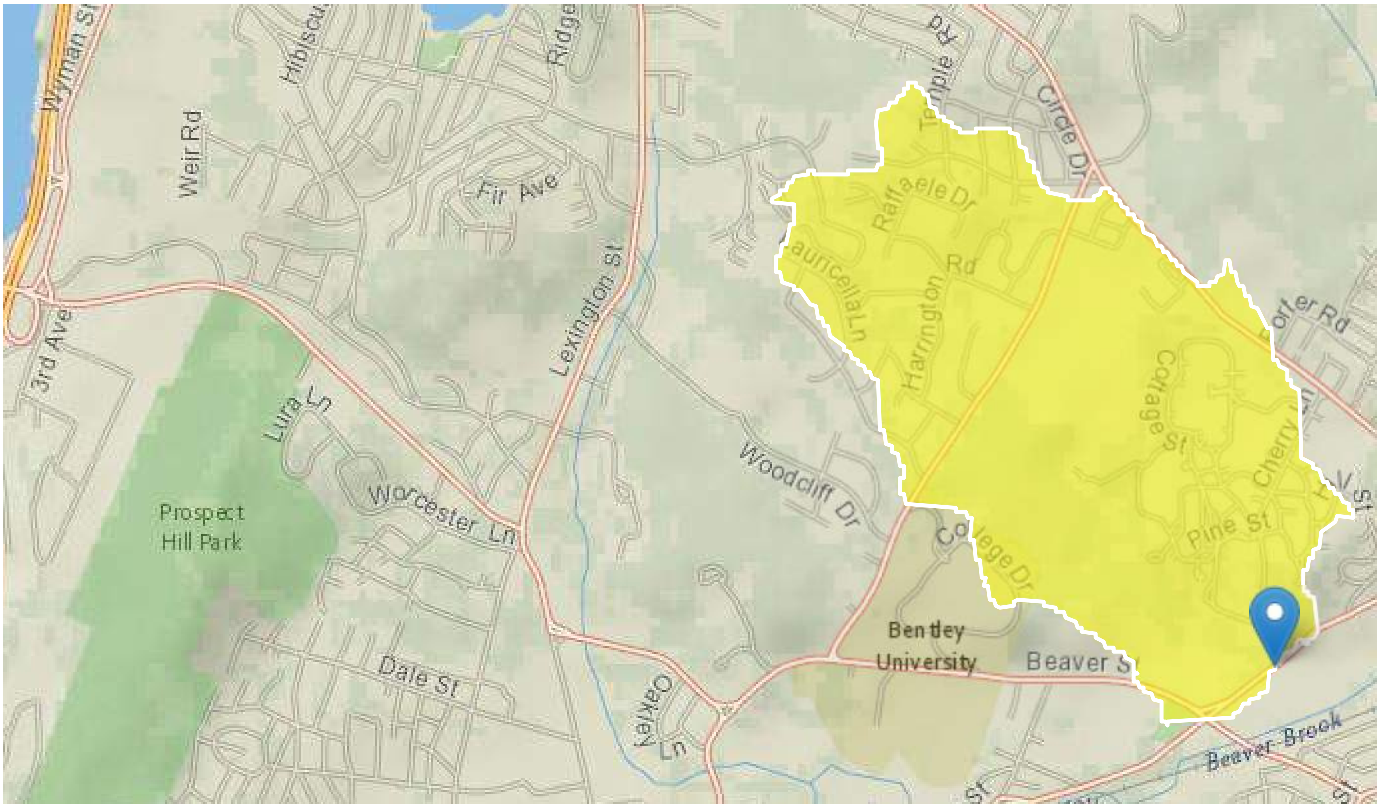

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.93	square miles
ELEV	Mean Basin Elevation	186	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	0.26	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	3.658	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0.0203	square mile per mile
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	7.165	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	5.25	percent
FOREST	Percentage of area covered by forest	20.52	percent

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	0.16	512
ELEV	Mean Basin Elevation	186	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	0.26	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	ASEp
50-percent AEP flood	43.3	ft^3/s	21.9	85.6	42.3
20-percent AEP flood	72.4	ft^3/s	36.1	145	43.4
10-percent AEP flood	95.5	ft^3/s	46.4	197	44.7
4-percent AEP flood	129	ft^3/s	60.5	275	47.1
2-percent AEP flood	158	ft^3/s	71.7	348	49.4
1-percent AEP flood	188	ft^3/s	82.6	428	51.8
0.5-percent AEP flood	221	ft^3/s	94.1	519	54.1
0.2-percent AEP flood	269	ft^3/s	109	663	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	3.658	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.0203	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Disclaimers [Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
7 Day 2 Year Low Flow	0.0369	ft^3/s
7 Day 10 Year Low Flow	0.0118	ft^3/s

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.0203	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	3.658	percent	0.32	24.6

Flow-Duration Statistics Disclaimers [Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
50 Percent Duration	0.887	ft^3/s
60 Percent Duration	0.545	ft^3/s
70 Percent Duration	0.264	ft^3/s
75 Percent Duration	0.189	ft^3/s
80 Percent Duration	0.139	ft^3/s
85 Percent Duration	0.0968	ft^3/s
90 Percent Duration	0.0631	ft^3/s
95 Percent Duration	0.0344	ft^3/s
98 Percent Duration	0.0206	ft^3/s
99 Percent Duration	0.0142	ft^3/s

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	3.658	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.0203	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Disclaimers [Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
August 50 Percent Duration	0.1	ft^3/s

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	7.165	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	14.6	ft	21.3
Bankfull Depth	0.931	ft	19.8
Bankfull Area	13.5	ft^2	29
Bankfull Streamflow	35.3	ft^3/s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	14.7	ft
Bieger_D_channel_depth	1.1	ft
Bieger_D_channel_cross_sectional_area	16.4	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	7.55	ft
Bieger_P_channel_depth	0.413	ft
Bieger_P_channel_cross_sectional_area	33.4	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	3.68	ft
Bieger_USA_channel_depth	0.362	ft
Bieger_USA_channel_cross_sectional_area	16.4	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp

Statistic	Value	Unit	ASEp
Bankfull Width	14.6	ft	21.3
Bankfull Depth	0.931	ft	19.8
Bankfull Area	13.5	ft^2	29
Bankfull Streamflow	35.3	ft^3/s	55
Bieger_D_channel_width	14.7	ft	
Bieger_D_channel_depth	1.1	ft	
Bieger_D_channel_cross_sectional_area	16.4	ft^2	
Bieger_P_channel_width	7.55	ft	
Bieger_P_channel_depth	0.413	ft	
Bieger_P_channel_cross_sectional_area	33.4	ft^2	
Bieger_USA_channel_width	3.68	ft	
Bieger_USA_channel_depth	0.362	ft	
Bieger_USA_channel_cross_sectional_area	16.4	ft^2	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_can

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.93	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	5.25	percent	0	100
FOREST	Percent Forest	20.52	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Flow Report [Perennial Flow Probability]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PC
Probability Stream Flowing Perennially	0.91	dim	71

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

Fernald Property - Beaver Brook

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Workspace ID: MA20210817173420444000
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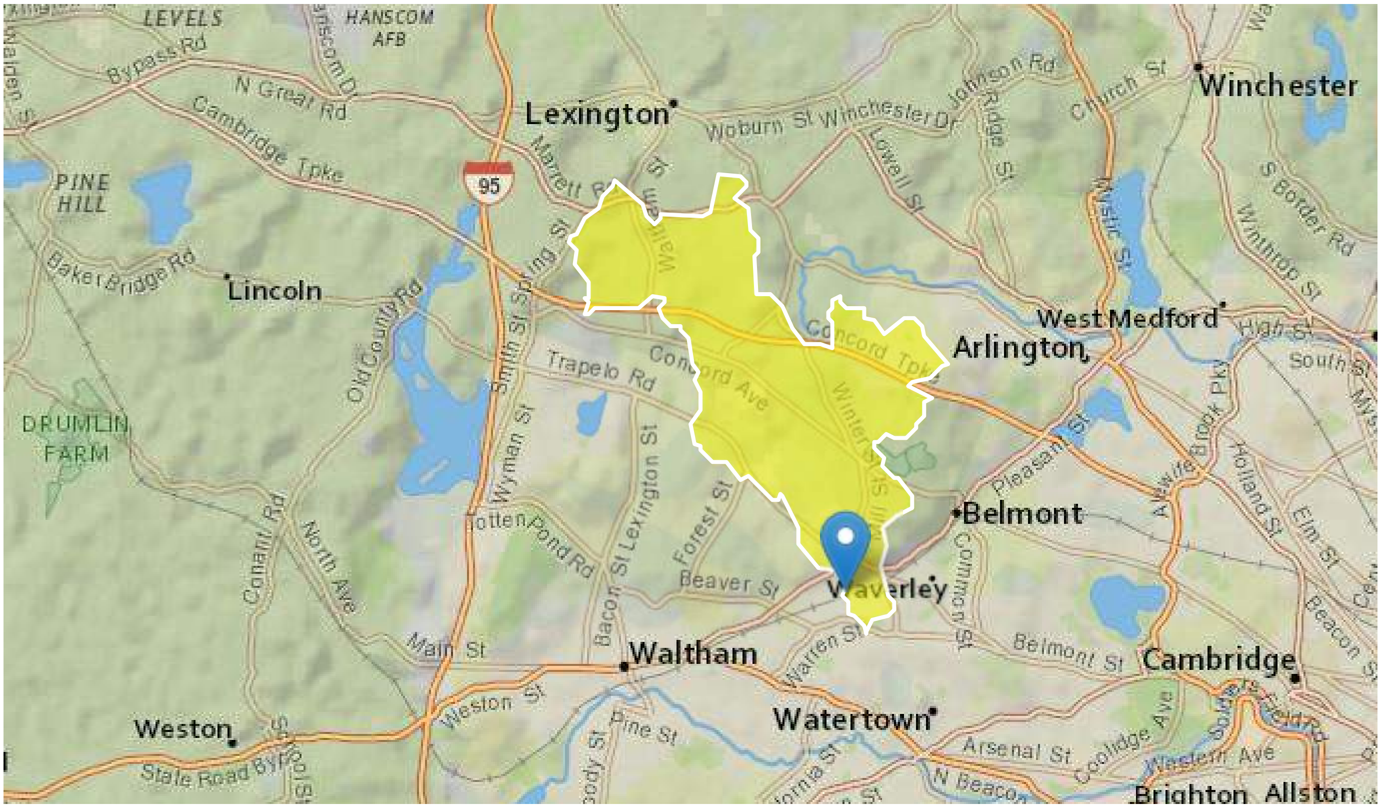

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.02	square miles
ELEV	Mean Basin Elevation	220	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	6.33	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	2.337	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0.11	square mile per mile
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	5.99	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	24.23	percent
FOREST	Percentage of area covered by forest	24.26	percent

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	0.16	512
ELEV	Mean Basin Elevation	220	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	6.33	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	ASEp
50-percent AEP flood	144	ft^3/s	73.6	282	42.3
20-percent AEP flood	237	ft^3/s	119	470	43.4
10-percent AEP flood	310	ft^3/s	153	630	44.7
4-percent AEP flood	415	ft^3/s	197	872	47.1
2-percent AEP flood	503	ft^3/s	232	1090	49.4
1-percent AEP flood	595	ft^3/s	266	1330	51.8
0.5-percent AEP flood	696	ft^3/s	302	1600	54.1
0.2-percent AEP flood	840	ft^3/s	348	2030	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.337	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.11	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	SE	ASEp
7 Day 2 Year Low Flow	0.354	ft^3/s	0.128	0.941	49.5	49.5
7 Day 10 Year Low Flow	0.13	ft^3/s	0.0364	0.433	70.8	70.8

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.11	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	2.337	percent	0.32	24.6

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of

Statistic	Value	Unit	PIl	PIu	SE	ASEp
50 Percent Duration	4.95	ft^3/s	2.45	9.93	17.6	17.6
60 Percent Duration	3.43	ft^3/s	1.79	6.54	19.8	19.8
70 Percent Duration	1.95	ft^3/s	0.919	4.09	23.5	23.5
75 Percent Duration	1.48	ft^3/s	0.694	3.12	25.8	25.8
80 Percent Duration	1.12	ft^3/s	0.519	2.38	28.4	28.4
85 Percent Duration	0.808	ft^3/s	0.355	1.81	31.9	31.9
90 Percent Duration	0.565	ft^3/s	0.235	1.33	36.6	36.6
95 Percent Duration	0.323	ft^3/s	0.121	0.831	45.6	45.6
98 Percent Duration	0.204	ft^3/s	0.0658	0.598	60.3	60.3
99 Percent Duration	0.149	ft^3/s	0.0452	0.462	65.1	65.1

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.337	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.11	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	SE	ASEp
August 50 Percent Duration	0.866	ft^3/s	0.378	1.95	33.2	33.2

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	5.99	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	27.5	ft	21.3
Bankfull Depth	1.48	ft	19.8
Bankfull Area	40.3	ft^2	29
Bankfull Streamflow	110	ft^3/s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	29.7	ft
Bieger_D_channel_depth	1.78	ft
Bieger_D_channel_cross_sectional_area	53.7	ft^2

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	12.1	ft
Bieger_P_channel_depth	0.598	ft
Bieger_P_channel_cross_sectional_area	78.8	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	6.66	ft
Bieger_USA_channel_depth	0.518	ft
Bieger_USA_channel_cross_sectional_area	40.8	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	27.5	ft	21.3
Bankfull Depth	1.48	ft	19.8
Bankfull Area	40.3	ft^2	29
Bankfull Streamflow	110	ft^3/s	55
Bieger_D_channel_width	29.7	ft	
Bieger_D_channel_depth	1.78	ft	
Bieger_D_channel_cross_sectional_area	53.7	ft^2	
Bieger_P_channel_width	12.1	ft	
Bieger_P_channel_depth	0.598	ft	
Bieger_P_channel_cross_sectional_area	78.8	ft^2	
Bieger_USA_channel_width	6.66	ft	
Bieger_USA_channel_depth	0.518	ft	

Statistic	Value	Unit	ASEp
Bieger_USA_channel_cross_sectional_area	40.8	ft^2	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)
Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_can

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	5.02	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	24.23	percent	0	100
FOREST	Percent Forest	24.26	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.984	dim

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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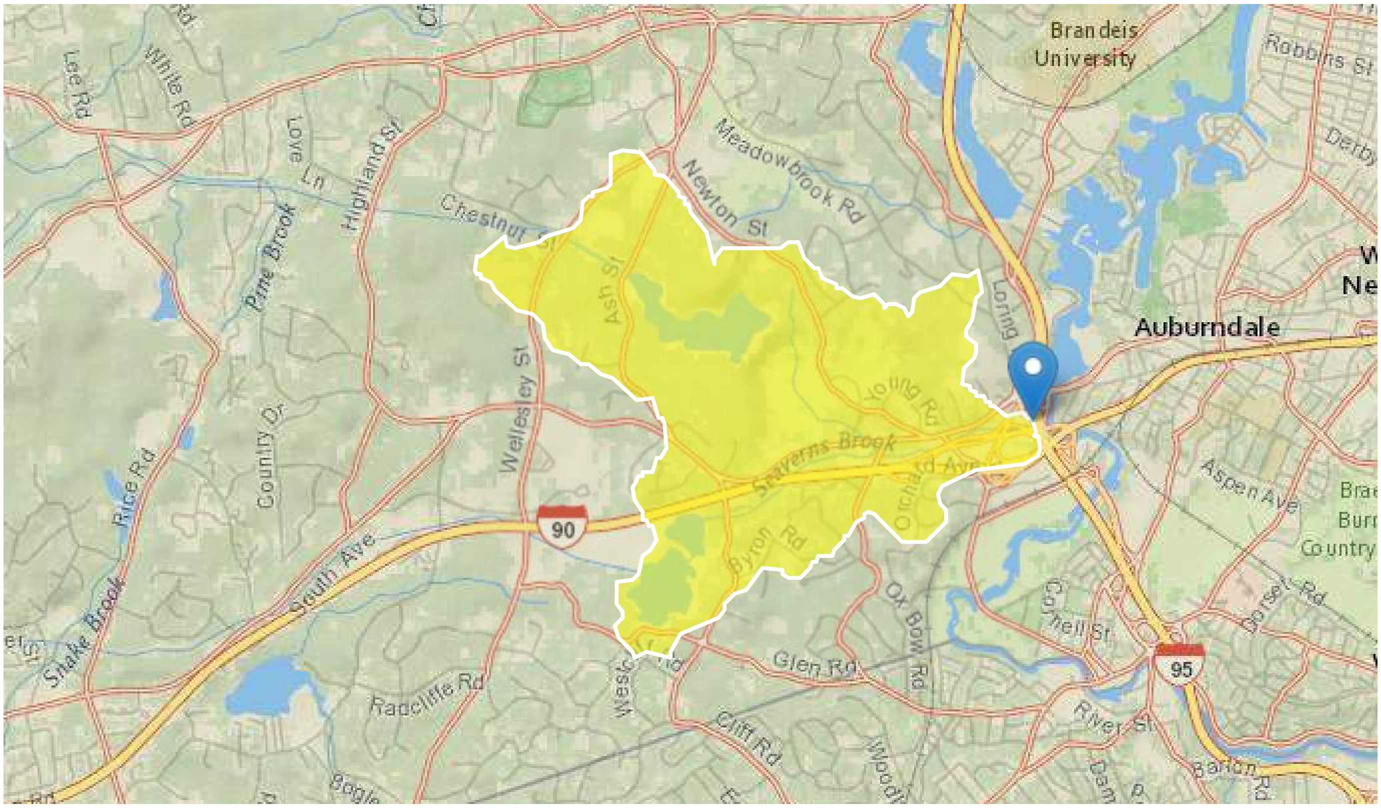
Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

Tandem Trailer and Bifurcation Sites - Seaverns Brook

Region ID: MA
Workspace ID: MA20210817175313491000
Clicked Point (Latitude, Longitude): 42.34193, -71.26326
Time: 2021-08-17 13:53:38 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.46	square miles
ELEV	Mean Basin Elevation	207	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	10.6	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	3.475	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0.0892	square mile per mile
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	6.972	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	23.94	percent
FOREST	Percentage of area covered by forest	51.55	percent

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	0.16	512
ELEV	Mean Basin Elevation	207	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	10.6	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	ASEp
50-percent AEP flood	72.6	ft^3/s	37.1	142	42.3
20-percent AEP flood	120	ft^3/s	60.4	238	43.4
10-percent AEP flood	158	ft^3/s	77.7	321	44.7
4-percent AEP flood	212	ft^3/s	101	446	47.1
2-percent AEP flood	258	ft^3/s	119	561	49.4
1-percent AEP flood	306	ft^3/s	136	686	51.8
0.5-percent AEP flood	358	ft^3/s	155	827	54.1
0.2-percent AEP flood	432	ft^3/s	178	1050	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	3.475	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.0892	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	SE	ASEp
7 Day 2 Year Low Flow	0.161	ft^3/s	0.0499	0.501	49.5	49.5
7 Day 10 Year Low Flow	0.061	ft^3/s	0.0151	0.23	70.8	70.8

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.0892	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	3.475	percent	0.32	24.6

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of

Statistic	Value	Unit	PIl	PIu	SE	ASEp
50 Percent Duration	2.39	ft^3/s	0.981	5.79	17.6	17.6
60 Percent Duration	1.6	ft^3/s	0.697	3.65	19.8	19.8
70 Percent Duration	0.878	ft^3/s	0.36	2.12	23.5	23.5
75 Percent Duration	0.655	ft^3/s	0.268	1.58	25.8	25.8
80 Percent Duration	0.527	ft^3/s	0.207	1.32	28.4	28.4
85 Percent Duration	0.383	ft^3/s	0.149	0.967	31.9	31.9
90 Percent Duration	0.276	ft^3/s	0.103	0.727	36.6	36.6
95 Percent Duration	0.157	ft^3/s	0.052	0.458	45.6	45.6
98 Percent Duration	0.0965	ft^3/s	0.0277	0.319	60.3	60.3
99 Percent Duration	0.069	ft^3/s	0.0186	0.241	65.1	65.1

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	3.475	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.0892	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	SE	ASEp
August 50 Percent Duration	0.398	ft^3/s	0.154	1.01	33.2	33.2

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	6.972	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	21.4	ft	21.3
Bankfull Depth	1.23	ft	19.8
Bankfull Area	26	ft^2	29
Bankfull Streamflow	72	ft^3/s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	22.1	ft
Bieger_D_channel_depth	1.45	ft
Bieger_D_channel_cross_sectional_area	32.5	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	9.91	ft
Bieger_P_channel_depth	0.511	ft
Bieger_P_channel_cross_sectional_area	54.8	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	5.18	ft
Bieger_USA_channel_depth	0.445	ft
Bieger_USA_channel_cross_sectional_area	27.8	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	21.4	ft	21.3
Bankfull Depth	1.23	ft	19.8
Bankfull Area	26	ft^2	29
Bankfull Streamflow	72	ft^3/s	55
Bieger_D_channel_width	22.1	ft	
Bieger_D_channel_depth	1.45	ft	
Bieger_D_channel_cross_sectional_area	32.5	ft^2	
Bieger_P_channel_width	9.91	ft	

Statistic	Value	Unit	ASEp
Bieger_P_channel_depth	0.511	ft	
Bieger_P_channel_cross_sectional_area	54.8	ft^2	
Bieger_USA_channel_width	5.18	ft	
Bieger_USA_channel_depth	0.445	ft	
Bieger_USA_channel_cross_sectional_area	27.8	ft^2	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_can

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.46	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	23.94	percent	0	100
FOREST	Percent Forest	51.55	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.941	dim

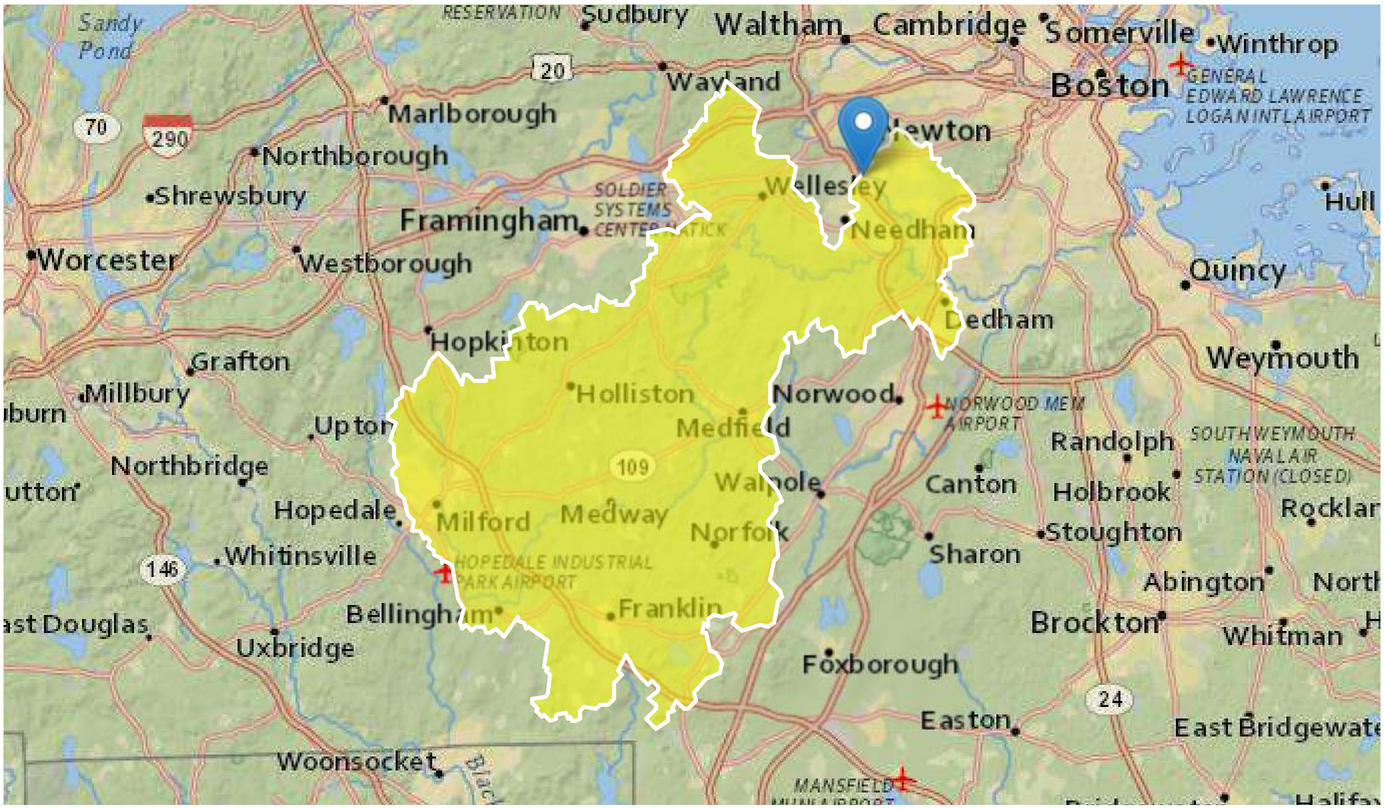
Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

Highland Avenue Sites - Charles River

Region ID: MA
Workspace ID: MA20220203155002326000
Clicked Point (Latitude, Longitude): 42.30729, -71.22389
Time: 2022-02-03 10:50:38 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	211	square miles
ELEV	Mean Basin Elevation	217	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	14.62	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	2.207	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0.21	square mile per mile
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	5.343	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	46.62	percent
FOREST	Percentage of area covered by forest	48.42	percent

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	0.16	512
ELEV	Mean Basin Elevation	217	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	14.62	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	ASEp
50-percent AEP flood	2320	ft^3/s	1190	4530	42.3
20-percent AEP flood	3650	ft^3/s	1840	7220	43.4
10-percent AEP flood	4650	ft^3/s	2300	9420	44.7
4-percent AEP flood	6060	ft^3/s	2890	12700	47.1
2-percent AEP flood	7220	ft^3/s	3340	15600	49.4
1-percent AEP flood	8410	ft^3/s	3770	18700	51.8
0.5-percent AEP flood	9700	ft^3/s	4230	22300	54.1
0.2-percent AEP flood	11500	ft^3/s	4790	27600	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.207	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.21	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Disclaimers [Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
7 Day 2 Year Low Flow	33.2	ft^3/s
7 Day 10 Year Low Flow	15.8	ft^3/s

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.21	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	2.207	percent	0.32	24.6

Flow-Duration Statistics Disclaimers [Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
50 Percent Duration	224	ft^3/s
60 Percent Duration	182	ft^3/s
70 Percent Duration	123	ft^3/s
75 Percent Duration	99.4	ft^3/s
80 Percent Duration	76.2	ft^3/s
85 Percent Duration	60.4	ft^3/s
90 Percent Duration	46	ft^3/s
95 Percent Duration	30.6	ft^3/s
98 Percent Duration	20.4	ft^3/s
99 Percent Duration	16.7	ft^3/s

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.207	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.21	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Disclaimers [Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
August 50 Percent Duration	65	ft^3/s

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	5.343	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	117	ft	21.3
Bankfull Depth	4.27	ft	19.8
Bankfull Area	502	ft^2	29
Bankfull Streamflow	1690	ft^3/s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	140	ft
Bieger_D_channel_depth	5.21	ft
Bieger_D_channel_cross_sectional_area	746	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	113	ft
Bieger_P_channel_depth	4.46	ft
Bieger_P_channel_cross_sectional_area	530	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	81.5	ft
Bieger_USA_channel_depth	3.77	ft
Bieger_USA_channel_cross_sectional_area	307	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp

Statistic	Value	Unit	ASEp
Bankfull Width	117	ft	21.3
Bankfull Depth	4.27	ft	19.8
Bankfull Area	502	ft^2	29
Bankfull Streamflow	1690	ft^3/s	55
Bieger_D_channel_width	140	ft	
Bieger_D_channel_depth	5.21	ft	
Bieger_D_channel_cross_sectional_area	746	ft^2	
Bieger_P_channel_width	113	ft	
Bieger_P_channel_depth	4.46	ft	
Bieger_P_channel_cross_sectional_area	530	ft^2	
Bieger_USA_channel_width	81.5	ft	
Bieger_USA_channel_depth	3.77	ft	
Bieger_USA_channel_cross_sectional_area	307	ft^2	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_can

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	211	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	46.62	percent	0	100
FOREST	Percent Forest	48.42	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.999	dim

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
FOREST	Percent Forest	14.48	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.973	dim

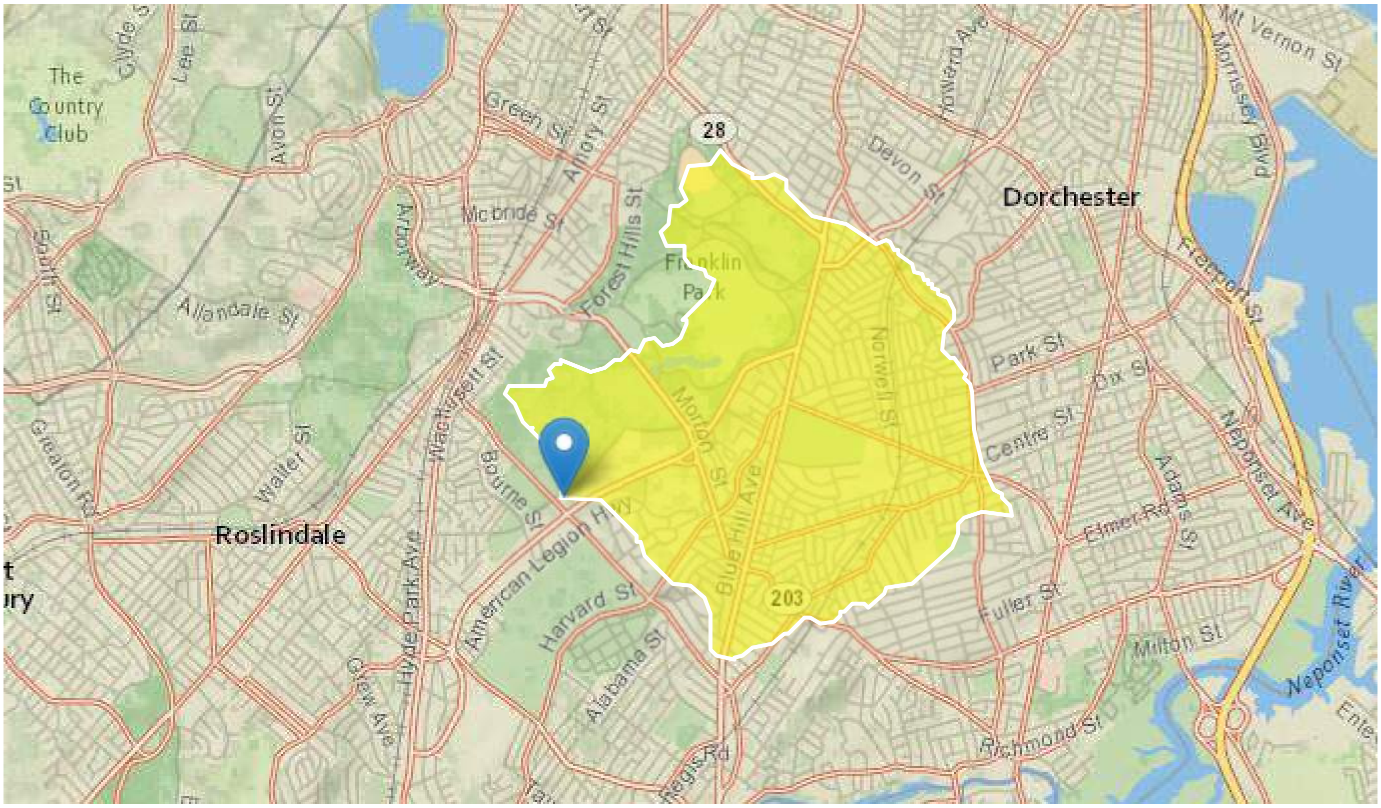
Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

American Legion Site - Canterbury Brook

Region ID: MA
Workspace ID: MA20210817180621036000
Clicked Point (Latitude, Longitude): 42.28874, -71.10718
Time: 2021-08-17 14:06:43 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.61	square miles
ELEV	Mean Basin Elevation	86.5	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	1.38	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	1.849	percent

Parameter Code	Parameter Description	Value	Unit
DRFTPERSTR	Area of stratified drift per unit of stream length	-100000	square mile per mile
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
BSLDEM10M	Mean basin slope computed from 10 m DEM	4.263	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	14.88	percent
FOREST	Percentage of area covered by forest	14.48	percent

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	0.16	512
ELEV	Mean Basin Elevation	86.5	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	1.38	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	ASEp
50-percent AEP flood	92.2	ft^3/s	46.7	182	42.3
20-percent AEP flood	152	ft^3/s	75.9	304	43.4
10-percent AEP flood	198	ft^3/s	96.5	406	44.7
4-percent AEP flood	266	ft^3/s	125	565	47.1
2-percent AEP flood	322	ft^3/s	147	707	49.4
1-percent AEP flood	381	ft^3/s	168	863	51.8
0.5-percent AEP flood	446	ft^3/s	191	1040	54.1
0.2-percent AEP flood	538	ft^3/s	220	1320	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	1.849	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	-100000	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit

Low-Flow Statistics Citations

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	-100000	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	1.849	percent	0.32	24.6

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit

Flow-Duration Statistics Citations

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	1.849	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	-100000	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit

August Flow-Duration Statistics Citations

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	4.263	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	20.1	ft	21.3
Bankfull Depth	1.17	ft	19.8
Bankfull Area	23.2	ft^2	29
Bankfull Streamflow	51.6	ft^3/s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	22.6	ft
Bieger_D_channel_depth	1.48	ft
Bieger_D_channel_cross_sectional_area	33.9	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	10.1	ft
Bieger_P_channel_depth	0.518	ft
Bieger_P_channel_cross_sectional_area	56.5	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	5.29	ft
Bieger_USA_channel_depth	0.451	ft
Bieger_USA_channel_cross_sectional_area	28.7	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	20.1	ft	21.3
Bankfull Depth	1.17	ft	19.8
Bankfull Area	23.2	ft^2	29
Bankfull Streamflow	51.6	ft^3/s	55
Bieger_D_channel_width	22.6	ft	
Bieger_D_channel_depth	1.48	ft	
Bieger_D_channel_cross_sectional_area	33.9	ft^2	
Bieger_P_channel_width	10.1	ft	
Bieger_P_channel_depth	0.518	ft	
Bieger_P_channel_cross_sectional_area	56.5	ft^2	
Bieger_USA_channel_width	5.29	ft	
Bieger_USA_channel_depth	0.451	ft	
Bieger_USA_channel_cross_sectional_area	28.7	ft^2	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_can

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.61	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	14.88	percent	0	100

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
FOREST	Percent Forest	14.48	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.973	dim

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

Appendix E: Historic/Cultural Resources Supporting Documentation

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Appendix E.1: Agency Correspondence

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The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

September 9, 2022

Rebecca Weidman
Director, Environmental and Regulatory Affairs
Massachusetts Water Resources Authority
Charlestown Navy Yard
100 First Avenue, Building 39
Boston, MA 02129

RE: Metropolitan Water Tunnel Program; MHC# RC.69562; EEA #16355

Dear Ms. Weidman:

Thank you for submitting information for the project referenced above, which was received at this office on August 9, 2022. The staff of the Massachusetts Historical Commission (MHC) have reviewed the information submitted and have the following comments.

The MHC understands that the MWRA is preparing to submit a Draft Environmental Impact Report (DEIR).

Staff of the MHC reviewed the draft Cultural Resources and Archaeological Assessments. Based on the information provided in the assessments, all three potential alternatives propose the demolition of buildings within the Walter E. Fernald State School Historic District. Some of the buildings proposed for demolition, including a Stucco Shed (WLT.742), Barn Foundation (WLT.927), and wooden shed are listed in the State and National Registers of Historic Places as contributing elements to the Walter E. Fernald State School Historic District. The proposed demolition of these buildings would be an "adverse effect" on the Walter E. Fernald State School Historic District. The MHC would consult with the MWRA to identify ways to eliminate, minimize or mitigate the adverse effects to the Walter E. Fernald State School Historic District.

The MHC looks forward to commenting on the preferred alternative identified in the DEIR.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800), M.G.L. Chapter 9, sections 26-27C (950 CMR 71.00), and MEPA (301 CMR 11). Please do not hesitate to contact Elizabeth Sherva of my staff if you have any questions.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
Massachusetts Historical Commission

xc: Katherine Ronan, MWRA
Waltham Historical Commission

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

April 27, 2021

Kathleen Murtagh
Director, Tunnel Redundancy Program
Massachusetts Water Resources Authority
Chelsea Facility
2 Griffin Way
Chelsea, MA 02150

RE: Metropolitan Water Tunnel Program; MHC# RC.69562; EEA #16355

Dear Ms. Murtagh:

Staff of the Massachusetts Historical Commission (MHC), office of the State Historic Preservation Officer, have reviewed the Environmental Notification Form (ENF) prepared for the project referenced above.

The ENF indicates that the project will require both federal and state agency permitting, and is proposed for funding from the Massachusetts Water Resources Authority. The MHC proposes to coordinate its review in compliance with both federal and state historic preservation law and regulations (see 950 CMR 71.04 (2) and (3)).

The ENF (Attachment C-19) indicates that as part of the project planning study, geotechnical investigations are proposed that include the drilling of 10 deep rock borings and installation of monitoring instrumentation. The deep rock boring and instrumentation installations, because they involve surface and subsurface disturbance, have the potential to affect historic and archaeological resources.

The MHC has requested and anticipates receiving information about the locations and boundaries of the geotechnical investigation areas, so that the MHC can provide comments to assist to avoid, minimize, or mitigate any adverse effects to historic and archaeological resources.

The information requested include USGS topographic quadrangle locus maps showing the locations of the geotechnical investigation areas, which are keyed to larger-scale plans showing the locations and boundaries of the impact areas in relation to parcel boundaries. Oversize materials such as plans should be sized no larger than 11" x 17".

The MHC request that potential shaft sites and surface connection sites are provided to MHC for review and comment on their impacts to historic and archaeological resources before the final shaft and surface connection sites are chosen. Please provide this information to MHC with maps and plans. The MHC advises that planners should consider locating project impacts including staging, equipment storage, and vehicle access areas at previously impacted locations or on paved surfaces, to the extent feasible, which would assist to avoid impacting historic and archaeological resources.

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www.sec.state.ma.us/mhc

If you have any questions or need any additional information, please contact me or Elizabeth Sherva, Director of Architectural Review at the MHC. These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800), M.G.L. c. 9, ss. 26-27C (950 CMR 71), and MEPA (301 CMR 11).

Sincerely,

Edward L. Bell
Deputy State Historic Preservation Officer
Massachusetts Historical Commission

xc: Katherine Ronin, MWRA
Wendy Pearl, DCR
Secretary Kathleen Theoharides, Attn. Erin Flaherty, MEPA office
Tammy R. Turley, Regulatory Branch, US Army Corps of Engineers

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

May 20, 2021

Beth Card
Director, Environmental and Regulatory Affairs
Massachusetts Water Resources Authority
101 First Avenue, Building 39
Charlestown, MA 02129

RE: Metropolitan Water Tunnel Program; MHC# RC.69562; EEA #16355.

Dear Ms. Card:

Staff of the Massachusetts Historical Commission (MHC), office of the State Historic Preservation Officer, have reviewed the additional information provided about the proposed geotechnical investigations for the project referenced above.

The information provided indicates that MWRA will implement protective measures for the Hegarty Street Pumping Station in Wellesley (MHC #WEL.311) during the geotechnical investigations for B-PD-004. The MHC believes that the geotechnical investigations for B-PD-004 will have no adverse effect (36 CFR 800.5(b); 950 CMR 71.07(2)(b)(2)) on the historic property.

The MHC considered the comments of the Department of Conservation and Recreation about the effects of the geotechnical investigations for B-PD-003 in Weston. The MHC believes that the geotechnical investigations for B-PD-003 will have no adverse effect (36 CFR 800.5(b); 950 CMR 71.07(2)(b)(2)) on the Charles River Reservation parklands within the Metropolitan Park System of Greater Boston (WSN.AF); on Norumbega Road (WSN.951) as part of the Charles River Reservation Parkways (WSN.AG) and the Metropolitan Park System (WSN.AF); and on Norumbega Tower (WSN.912).

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800), M.G.L. c. 9, ss. 26-27C (950 CMR 71), and MEPA (301 CMR 11). If you have any questions or need additional information, please contact Edward L. Bell at the MHC.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc:
Kathleen Murtagh, MWRA
Wendy Pearl, DCR
Secretary Kathleen Theoharides, Attn. Erin Flaherty, MEPA office
Tammy R. Turley, Regulatory Branch, US Army Corps of Engineers
Wellesley Historical Commission
Weston Historical Commission

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128

MASSACHUSETTS WATER RESOURCES AUTHORITY
Charlestown Navy Yard
100 First Avenue, Building 39
Boston, MA 02129

Frederick A. Laskey
Executive Director

Telephone: (617) 242-6000
Fax: (617) 788-4899
TTY: (617) 788-4971

RC. 69562

April 1, 2022

Ed Bell, Deputy State Historic Preservation Officer
Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, MA 02125

Subject: Metropolitan Water Tunnel Program
Phase 1B Subsurface Investigation
Boston, Brookline, Needham, Newton, Waltham, Wellesley and Weston, Massachusetts

Dear Mr. Bell:

Following on our previous correspondence in May 2021 regarding the geotechnical subsurface investigation programs for the Metropolitan Water Tunnel Program (Program), the Massachusetts Water Resources Authority (MWRA) and its Preliminary Design Engineer (PDE) have completed the first phase of geotechnical subsurface investigation. Nine (9) of the ten (10) deep rock borings previously presented were completed between June and November 2021. Recommendations from the Massachusetts Historical Commission (MHC) on protection of existing historical structures and site restoration were implemented.

The MWRA and its PDE are planning the Program's second geotechnical subsurface investigation and would like to submit information on the proposed locations to the MHC, similarly as did for the first phase investigation. The purpose of this investigation is to gather geotechnical information at key locations to aid in refining the appropriate alignment for the proposed deep rock tunnels.

At this time ten (10) test borings are proposed in this second phase (Phase 1B), including one (1) test boring, B-PD-006, at Highland Avenue and I-95 interchange from previous phase that has not been completed. Each of the test borings will be approximately four inches in diameter and approximately 410 feet deep on average. Upon completion, borehole testing will be conducted within bedrock. Instruments will be installed at selected borehole locations to measure groundwater level. At those locations, an approximately 12-inch diameter roadbox will be installed flush to ground surface. All boreholes will be backfilled with grout and surface be restored.

The ten (10) proposed test boring locations are shown on the attached plans. Figures showing the location of each individual test boring locations with aerial image and address are also included. Most of the locations are in developed areas previously disturbed.

MWRA aims to begin this work in early May and each test boring is estimated to take approximately eight weeks to complete.

As always, thank you for your continued support on all MWRA projects. Please do not hesitate to contact Katie Ronan of my staff at (857) 289-1742 with any questions or concerns.

Sincerely,

Rebecca Weidman

Director
Environmental and Regulatory Affairs

Attachments: Test Boring Location Plans

cc: Katie Ronan, MWRA
Wendy Pearl, DCR

After review of MHC files and the materials you submitted, it has been determined that this project is unlikely to affect significant historic or archaeological resources.

MHC#RC.69562

Edward L. Bell 03 May 2022 Date
Deputy State Historic Preservation Officer
Massachusetts Historical Commission

Appendix E.2: Photographic Documentation

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1. View south to Fernald Property Site, showing (from left) concrete block garage (WLT.744), metal shed (WLT.743), and stucco shed (WLT.742)

2. Fernald Property Site - north-facing façade of metal shed (WLT.743)

3. Fernald Property Site – rear (west) elevations of metal shed (WLT.743) and concrete block garage (WLT.744)

4. Fernald Property Site – south elevation of concrete block garage (WLT.744)

5. Fernald Property Site – south and east elevations of stucco shed (WLT.742)

6. Fernald Property Site – view south toward barn foundation (WLT.927)

7. Fernald Property Site – view east toward barn foundation (WLT.927)

8. Fernald Property Site – north and east elevations of wood shed (no MHC number)

9. Fernald Property Site – north and west elevations of wood shed (no MHC number)

10. Fernald Property Site – south elevation of shed (WLT.788)

11. Fernald Property Site – south-facing façade and west elevation of greenhouse (WLT.739)

12. Fernald Property Site – rear of greenhouse (WLT.739)

13. Fernald Property Site – view west along rear of greenhouse (WLT.739)

14. Fernald Property Site – view northwest toward electric substation (WLT.740)

15. Fernald Property Site – view west toward maintenance building (WLT.738)

16. Fernald Property Site – south and west elevations of engineer's storage building (WLT.741)

17. Fernald Property Site – north and west elevations of power plant (WLT.935)

18. Fernald Property Site – east and south elevations of power plant (WLT.935)

19. Fernald Property Site – north (rear) and east elevations of Lavers Hall (WLT.737)

20. Fernald Property Site – west elevation of Lavers Hall (WLT.737)

21. Fernald Property Site – south-facing façade and west elevation of Cottage #17 – Staff Residence (WLT.731)

22. Fernald Property Site – rear (north) and west elevations of Cottage #18 – Staff Residence (WLT.732)

23. Fernald Property Site – south-facing façade of Cottage #19 – Staff Residence (WLT.733)

24. Fernald Property Site – south-facing façade of Cottage #19 – Staff Residence (WLT.734)

25. Fernald Property Site – south-facing façade and east elevation of garage (WLT.769)

26. Fernald Property Site – east-facing façade and north elevation of Tarbell Hall (WLT.745)

27. Fernald Property Site – west (rear) and south elevations of Tarbell Hall (WLT.745)

28. Fernald Property Site – view south toward cast iron fence (WLT.929)

29. View southwest at Tandem Trailer Site

30. View south at Tandem Trailer Site

31. View northeast at Tandem Trailer Site

32. View east at Park Road East Site

33. View northwest at Park Road East Site

34. View east to Bifurcation Site

35. View south to Bifurcation Site

36. Bifurcation Site – view south to Hultman Aqueduct (WSN.O) below grade

37. View southeast to American Legion Site

38. American Legion Site – view southeast down Morton Street (BOS.YB)

39. View south at School Street Site

40. School Street Site – south-facing façade of St. Mary's Catholic Church (WLT.205)

41. School Street Site – south-facing façade and east elevation of St. Mary's Rectory (WLT.206)

42. School Street Site – south-facing façade of St. Mary's Rectory Carriage House (WLT.696)

43. School Street Site – east-facing façade of St. Mary's High School (WLT.693)

44. School Street Site – east-facing façade and south elevation of St. Mary's Religious Education Center (WLT.695)

45. School Street Site – south-facing façade of brick garage (WLT.237) in St. Mary's Roman Catholic Church Complex (WLT.AM)

46. View west to Hegarty Pumping Station Site

47. Hegarty Pumping Station Site – west-facing façade of Pumping Station #1 (WEL.311)

48. Hegarty Pumping Station Site – south elevation of Pumping Station #1 (WEL.311)

49. Hegarty Pumping Station Site – north and west (front) elevations of Pumping Station #1 (WEL.311)

50. Hegarty Pumping Station Site – rear (east) elevation of Pumping Station #1 (WEL.311)


51. View east to east section of St. Mary Street Pumping Station Site


52. View east to west section of St. Mary Street Pumping Station Site

53. St. Mary Street Pumping Station Site - view south along Sudbury Aqueduct Linear District (NEE.F)

54. View north to Newton Street Pumping Station Site

55. View northeast to Southern Spine Mains site

56. Southern Spine Mains Site - view southwest down path in Arnold Arboretum (BOS.MF)

57. Southern Spine Mains Site - view northeast into trees at edge of Arnold Arboretum (BOS.MF)

58. Southern Spine Mains Site - view northeast across the Arborway within the Olmsted Park System (BOS.IO)

59. View west to Hultman Aqueduct Isolation Valve Site

Appendix F: Transportation Supporting Documentation

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Appendix F.1: Study Roadways

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Study Roadways

Roadways to/from Fernald School Site

Trapelo Road between I-95 and Waverley Oaks Road is on the Program's truck route for vehicles and equipment accessing the Fernald Property from I-95. Trapelo Road starts at Bedford Road in Lincoln and runs in a generally southeast direction until it intersects Belmont Street/Pine Street in Belmont. Trapelo Road segment on the truck route is functionally classified as an urban minor arterial. The roadway segment between I-95 and Smith Street is under the jurisdiction of MassDOT and provides two travel lanes in each direction. From Smith Street to Waverley Oaks Road, the roadway is maintained by the City of Waltham and provides one travel lane in each direction. The Trapelo Road segment from Lexington Street to Smith Street is on MBTA Bus Route 61 inbound route. Sidewalks are present along both sides of road segments between I-95 northbound off-ramp to the Trapelo Road east ramp, between Sherwood Lane and Woburn Street, between Marguerite Avenue and Hobbs Road, and between Shade Street and Alderwood Road. Sidewalks are present only on north side of roadways between Circle Drive and Marguerite Avenue, and between Porter Road and Alderwood Road. Sidewalks are provided only on south side of segments between Clocktower Drive and Sherwood Lane, between Woburn Street and Circle Drive, and between Hobbs Road and Shade Street. The posted speed limit on Trapelo Road is 35 mph in both directions. No bicycle accommodation is provided along the road. Land use along Trapelo Road in the Study Area is mainly residential along with some commercial use.

Waverley Oaks Road (Route 60) in Waltham is on the Program's truck route between the Fernald Property and I-95. The road begins at Trapelo Road in the north and runs in a southwest direction until it intersects with Linden Street. It is classified as an urban principal arterial and is under the jurisdiction of City of Waltham. One lane in each direction is provided, and sidewalks are present on both sides of the road. There is no bicycle accommodation along the road. Posted speed limit is 35 mph in both directions. The land use along the road include residential, recreational, commercial, and school uses.

Linden Street is on the Program's truck route between the Fernald Property and I-95. It is a short road in Waltham. The street begins at Beaver Street in the north, runs in a southwest direction and ends at Main Street. The segment between Waverley Oaks Road and Main Street is classified as an urban principal arterial and is under the jurisdiction of the City of Waltham. It has one travel lane in each direction with sidewalks on both sides. No bicycle accommodation is provided on the road. The posted speed limit is 30 mph in both directions. Land uses along Linden Street between the Waverley Oaks Road and Main Street segment include residential and commercial uses.

Main Street in Waltham begins at Weston/Waltham border and runs to east in general and ends at Galen Street in Watertown. The segment between Weston Street and Linden Street is on the Program's truck route between the Fernald Property and I-95. It is an urban principal and maintained by the City of Waltham. The short segment between Weston Street and Prospect Street consists of two travel lanes in each direction, and the segment between Prospect Street and Linden Street provides one travel lane in each direction. Main Street is on MBTA Bus 70, 553 and 556 Routes. Roadside parking is provided on both sides for the majority of the street, and sidewalks are present on both sides. Shared lane markings (sharrows) are provided in both directions. There is no posted speed limit on the street. The existing travel speeds along Main Street are approximately 35 mph in both directions. Land uses along Main Street are a mix of commercial and residential uses.

Weston Street in Waltham is a short urban principal arterial. The street begins at the east of I-95/Route 20 interchange, runs to the east and ends at its intersection with Main Street. The street is on the Program's truck route between the Fernald Property and I-95. The segment between I-95/Route 20 interchange and Cabot Street/Eddy Street is under the jurisdiction of MassDOT, and the short segment between Cabot Street/Eddy Street and Main Street is under the jurisdiction of the City of Waltham. Between I-95/Route 20 interchange and Stow Street, two travel lanes are provided in each direction, and sidewalks are present only on south side of the roadway. Between Stow Street and Main Street, one travel lane is provided in each direction, and sidewalks are provided on both sides of the street. Posted speed limit is 35 mph in both directions. Sharrows are present in both directions on Weston Street. Weston Street is part of Route 20 which is a truck route for heavy vehicles to access adjacent towns/cities in the area. Land uses along the street are mainly residential use with commercial use in the vicinity of intersection with South Street.

Roadways to/from School Street Site

School Street in Waltham is a short urban collector that runs from Hammond Street in the west, to east Lyman Street in the East. The segment between Bacon Street and Spring Street/Macks Ct is on the Program's truck route between School Street Site and I-95. The street is under the jurisdiction of the City of Waltham. Sidewalks are present on both sides of the road. The segment between Hammond Street and Lexington Street consists of one travel lane in each direction, and the segment between Lexington Street and Lyman Street is under one way control (westbound only). There is no posted speed limit on the street, so the prima facie speed limit is 30 mph. Land uses along School Street are a mix of residential, commercial and educational uses.

Bacon Street in Waltham is an urban minor arterial under the jurisdiction of the City of Waltham. The street begins at Main Street in south, runs to north and ends at Lexington Street. The segment between Main Street and School Street is on the Program's truck route between School Street Site and I-95. The roadway consists of one travel lane in each direction. Sidewalks are present on both sides of the road. Posted speed limit is 30 mph for both directions. The street is on MBTA Bus 61 route. Land use along Bacon Street is primarily residential and institutional, with Thomas R. Plympton Elementary School located along the west side of the street to the north of Plympton Street, Drake Playground located along west side of Bacon Street to the north of the school, and Leary Field situated along east side of Bacon Street to the north of Athletic Field Road.

Main Street's segment between Weston Street and Bacon Street is on the Program's truck route between School Street Site and I-95. It is also on the Program's truck route between Fernald School Site and I-95. Please refer to the description in Roadways to/from Fernald School Site section.

For the **Weston Street** segment, please refer to the description in Roadways to/from Fernald School Site section.

Roadways to/from Cedarwood Pumping Station Site

South Street is an urban minor arterial under the jurisdiction of Waltham. Starting at the Weston Street, the road runs south in general and ends at the Waltham/Weston border. The segment between Weston Street and Shakespeare Road is on the Program's truck route between Cedarwood Pumping Station Site and I-95. The street is on MBTA Bus 553 Route. One travel lane is provided in each direction, and sidewalks are presented on both sides. No bicycle accommodation is provided on the street. There is no posted speed limit on both directions, so the assumed speed limit is 25 mph. It is a main roadway to Brandeis University and Boston Children's Hospital at Waltham. Land uses along the street include residential, educational, and hospital (Boston Children's Hospital at Waltham) use.

The description for **Weston Street** can be seen in Roadways to/from Fernald School Site section and is not repeated here.

Roadways to/from Park Road West and Bifurcation Sites

South Avenue (Route 30) is an urban minor arterial with the majority under the jurisdiction of Weston and its segment in Route 30/I-95 interchange under MassDOT jurisdiction. Starting at the Natick/Weston border, the road runs east in general and ends at the Weston/Newton border. Its segment between River Road and Park Road is on Program's truck route between Park Road West Site and I-95. In typical one travel lane is provided in each direction, and no sidewalk is presented on either side. No bicycle accommodation is provided along the road. Posted speed limits on the study segment are 35 mph and 40 mph for eastbound and westbound respectively. Land use along the study segment is primarily residential along its north side.

Park Road is an urban collector under the jurisdiction of DCR. Starting at South Avenue (Route 30) in Weston, the road runs south in general and ends at Weston/Wellesley border. The segment between South Avenue and I-90 west Exit 123B off to Route 30 ramp is on the Program's truck route between Park Road West Site and I-95. One travel lane is provided in each direction. No sidewalk is presented on either side. No bicycle accommodation is provided along the road. Posted speed limit is 30 mph in both directions.

Roadways to/from Tandem Trailer and Park Road East Site

South Avenue (Route 30) segment between River Road and Tandem Trailer parking lot exit is on the Program's truck route between Tandem Trailer Site and I-95. Please refer to Roadways to/from Park Road West Site section.

The I-95 south to I-90 west ramp is on the Program's truck route between Tandem Trailer site and I-95. The 2-lane ramp is under the jurisdiction of the Town of Weston. The ramp provides a right-in-right out to the Tandem Trailer site located to its northwest side. No pedestrian and bicycle accommodation are provided along the ramp.

The I-90 to I-95 ramp is on the Program's truck route between Park Road East site and I-90. The ramp is under the jurisdiction of the Town of Weston. The ramp provides a right-in-right out to the Tandem Trailer parking lot located to the east of Weston Maintenance Facility along south side of the ramp. The Park Road East site can be accessed from the parking lot. No pedestrian and bicycle accommodation are provided along the ramp.

Roadways to/from Saint Mary Street Pumping Station Site

Saint Mary Street is on the Program's truck route between Saint Mary Pumping Station Site and I-95. The street starts at Central Avenue in Needham. It runs parallel to I-95 in northwest direction for approximately 1700 feet, turns to east to a dead end. It is a local two-lane road under the jurisdiction of the Town of Needham. No pavement markings are presented. Sidewalks are provided on the west side only. No bicycle accommodation is provided along the street. Land use along the street is residential.

Central Avenue begins at the Needham/Dover town line, and runs in a northeast direction in Needham until it ends at the town line with Newton. It is an urban minor arterial with the majority under the jurisdiction of the Town of Needham, except the short segment between River Park Street and Reservoir Street that belong to MassDOT. The segment between Saint Mary Street and Cedar Street is on the Program's truck route between Saint Mary Pumping Station Site and I-95. The road is on MBTA Bus 59 route. One lane in each direction is provided, and sidewalks are provided on both sides of the road. There is no bicycle accommodation along the road. Posted speed limit is 25 mph in both directions. Land uses along the road include a mix of residential and commercial uses.

Cedar Street is an urban minor arterial. The road begins at Walnut Street in Wellesley, runs to southeast direction in general and ends at Central Avenue in Needham. Its segment between Redwing Road and Worcester Street (Route 9) is under MassDOT jurisdiction, and the remaining is under the jurisdiction of Wellesley or Needham. Cedar Street between Route 9 and Central Avenue is on the Program's truck route between Saint Mary Pumping Station Site and I-95. One travel lane is provided in each direction. Sidewalks are provided on both sides of the road between Walnut Street and Hastings Street, and sidewalk presents on east side only for the remaining segment. No bicycle accommodation is provided along the road. Posted speed limit is 30 mph in both directions except the posted 20 mph speed limit in school zone. There is exclusion for trucks 2.5 tons and over on Cedar Street between Walnut Street and Route 9. Land use along the street is primarily residential.

Route 9, which is called Worcester Street in Natick and Wellesley, runs in general an east-west direction. Worcester Street between Cedar Street and I-95 is on the Program's truck route between Saint Mary Street Pumping Station Site and I-95. Route 9 is classified as urban principal arterial and under jurisdiction of MassDOT. It is median separated. Two lanes are provided in each direction. Sidewalks are provided on both sides in the study segment. There are no clear dedicated bicycle accommodations along Worcester Street. Bicycles are accommodated through wide shoulders, or share travel lanes with vehicles when the shoulders are narrow. The road is not on bus route. Posted speed limit is 50 mph in both directions. Land uses along the street include retail, commercial, office, and residential uses.

Roadways to/from Hegarty Pumping Station Site

Cedar Street segment between Barton Road and Worcester Street (Route 9) is on the Program's truck route between Hegarty Pumping Station Site and I-95. Please refer to Roadways to/from Saint Mary Pumping Station Site section.

Worcester Street, between Cedar Street and I-95, is also on Program's truck route between Hegarty Pumping Station Site and I-95. Please refer to Roadways to/from Saint Mary Pumping Station Site section.

Roadways to/from Newton Street Pumping Station Site

Newton Street in Brookline runs in northeast direction and median separated between Grove Street and Clyde Street, and two lanes and wide shoulder are provided in each direction. This segment is classified as urban minor arterial and under the jurisdiction of Boston. The short segment between Newton Street Pumping Station driveway and Grove Street is on Program's truck route between Newton Street Pumping Station Site and I-95. Sidewalk is present on both sides. Wide shoulders are present on both directions in the vicinity of study segment, but no formal bicycle accommodation is provided along the street. The posted speed limit is 25 mph in eastbound direction in the vicinity of study road segment. Land uses along the street are a mix of residential and recreational uses.

Clyde Street, between Newton Street and Lee Street in Brookline, runs in north direction and median separated; two lanes are provided in each direction. It is classified as urban minor arterial and under the jurisdiction of City of Boston. It is on the Program's truck route between Newton Street Pumping Station Site and I-95. Sidewalks are present on both sides. Bike lanes are provided on each direction of the street. The posted speed limit is 35 mph in both directions. Land uses along the street are a mix of residential and recreational uses.

Lee Street in Brookline is a short street that begins in Clyde Street in the south, runs in north direction, changes to northwest direction at Warren Street and ends at the intersection with Boylston Street. The street is median separated, and two lanes are provided in each direction. This segment is classified as urban minor arterial and under the jurisdiction of Boston. It is on the Program's truck route between Newton Street Pumping Station Site and I-95. Sidewalk is present on both sides. Bike lanes are provided on west side of the street and east side between Clyde Street and Warren Street. Sharrows are present on east side between Warren Street and Boylston Street. The posted speed limits are 20 or 35 mph in both directions. Land uses along the street are residential.

Route 9, which is called Boylston Street in Newton and Brookline, runs in general an east-west direction. Boylston Street between I-95 and Lee Street is on the Program's truck route between Newton Street Pumping Station Site and I-95. Route 9 is classified as urban principal arterial and under jurisdiction of MassDOT. It is median separated. Typically two lanes are provided in each direction. Posted speed limit is 50 mph in both directions. Sidewalks are provided on both sides along majority of study road segment.

Bicycles are accommodated through wide shoulders. Land uses along the street include retail, commercial, office, and residential uses.

Roadways to/from Southern Spine Mains Site

Arborway starts at Pond Street and Francis Parkman Drive in Jamaica Hills, runs south and soon changes its direction at its rotary with Centre Street to southeast and ends at its intersection with Circuit Drive. Its segment between Centre Street and Circuit Drive is on the Program's truck route between Southern Spine Mains Site and I-93. Classified as an urban principal arterial, its segment between Francis Parkman Drive and its rotary with Centre Street is under the jurisdiction of DCR, and the remaining segment is under MassDOT jurisdiction. Typically two travel lanes are presented in each direction, and segment between rotary and Circuit Drive is median separated. A one-lane one-way parallel service road is provided on the south side to the east of Washington Street between Orchardhill Road and Morton Street. Bike lane or separate bike path is presented on both sides of the street. The segment between South Street and Circuit Drive is on multiple MBTA Bus routes. Posted speed limit in both direction is 30 mph. Land uses along the street include a mix of residential and commercial uses.

Morton Street in Boston starts at its intersection with the Arborway, runs in southeast direction until it meets Washington Street and Richmond Street. Its segment between Circuit Drive and Gallivan Boulevard is on Program's truck route between Southern Spine Mains Site and I-93. The street is classified as urban principal arterial. Its short segment between Gallivan Boulevard and Washington Street is under jurisdiction of the City of Boston. The remaining segment is under jurisdiction of MassDOT. The majority of the roadway is median separated, and two travel lanes are presented in each direction. Sidewalks are present on both sides on segment between West Main Street and Gallivan Boulevard. There is no bicycle accommodation along the street. Many bus stops for MBTA Bus Routes 21, 26, 28, 29, and 31 are located along Morton Street. Posted speed limit ranges from 30 mph to 45 mph in both directions in different segments. Land uses along the street include a mix of recreational, residential and commercial uses.

Gallivan Boulevard in Boston starts at its intersection with Morton Street. It runs in northeast direction in general until it reaches I-93. It is an urban principal arterial under MassDOT jurisdiction. The street segment between Morton Street and I-93 is on Program's truck routes between the Southern Spine Mains Site. Typically, two travel lanes are provided in each direction, sidewalks are present on both sides. The road is on MBTA Bus 21, 26, 201 and 205 routes. Its segment between Granite Avenue and I-93 is median separated. No bicycle accommodation is provided along the road. The posted speed limit is 30 mph in both directions. Land uses along the roadway include residential, commercial, and retail uses.

Roadways to/from American Legion Site

Roadways to/from the American Legion Site are described under Southern Spine Mains Site section.

Appendix F.2: Study Intersections

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Study Intersections

Intersections associated with Fernald School Site

Trapelo Road at Lexington Street (Waltham). Trapelo Road intersects with Lexington Street to form a four-leg signalized intersection. Trapelo Road eastbound approach and westbound approach each consists of an exclusive left-turn lane, a through-only lane, and an exclusive right-turn lane, while Lexington Street northbound approach and southbound approach each provides an exclusive left-turn lane, a through-only lane, and a shared through-right lane. Crosswalks and pedestrian signal equipment are provided at all the approaches. The intersection is under the jurisdiction of City of Waltham. The intersection is located in a predominantly business and residential neighborhood.

Trapelo Road at Waverley Oaks Road (Waltham)

The signalized T-intersection is located near Waltham-Belmont border and is under the jurisdiction of City of Waltham. Trapelo Road provides eastbound and westbound approaches of the intersection, and Waverley Oaks Road (Route 60) is the northbound approach. The Trapelo Road eastbound approach includes one shared through-right lane, and the westbound approach provide an exclusive left-turn lane and a through-only lane. Northbound approach includes an exclusive left-turn lane and a channelized right-turn lane. Crosswalk, pedestrian countdown signal and pushbutton are provided on the northbound approach. The intersection is in a residential neighborhood.

Beaver Street at Waverley Oaks Road (Waltham)

This four-approach signalized intersection is under the jurisdiction of the City of Waltham. Waverley Oaks Road northbound approach consists of an exclusive left-turn lane, a through-only lane and an exclusive right-turn lane. Waverley Oaks Road southbound provides an exclusive left-turn lane, a through lane and a channelized right-turn lane under yield control. Beaver Street eastbound approach consists of an exclusive left-turn lane and a shared through-right lane. Beaver Street westbound approach includes an exclusive left-turn lane, a through lane and a shared through-right lane. Crosswalks, pedestrian countdown signals and pushbuttons are presented at all the approaches. The intersection is located in a predominately business neighborhood.

Main Street at Linden Street and Ellison Park (Waltham)

This five-leg signalized intersection is under the jurisdiction of City of Waltham. Main Street eastbound approach includes an exclusive left-turn lane, a through-only lane and a channelized right-turn lane. Main Street westbound approach provides a shared left-through lane and a shared through-right lane. Directional flow on these two approaches is separated by a raised asphalt median. Linden Street northbound approach is very short and presents one lane only. Linden Street southwestbound approach includes a shared left-through lane and an exclusive right-turn lane. As southbound approach, Ellison Park is a one-way street and provides an exclusive left-turn lane and a shared through-right lane. There are No-Turn-on-Red (NTOR) restrictions on the Linden Street southwestbound approach and Ellison Park southbound approach. Crosswalks and pedestrian signals are provided at all approaches except Main

Street westbound approach. MBTA Bus Route 70 bus stops locate on both side of Main Street eastbound approach. The intersection is in a predominantly residential and commercial area.

Main Street at Elm Street and Church Street (Waltham)

This four-leg signalized intersection is located in a majorly commercial area and is under the jurisdiction of City of Waltham. City Hall is situated to the southwest of the intersection. Main Street eastbound approach includes an exclusive left-turn lane, a through lane and an exclusive right-turn lane. Main Street westbound approach provides an exclusive left-turn lane and a shared through-right lane. Elm Street northbound approach consists of a shared left-through lane and a shared through-right lane. Church Street is a one-way street and has two receiving lanes to the intersection. Crosswalks and pedestrian signal equipment are present to all these four approaches.

Main Street at Common Street and Moody Street (Waltham)

This four-leg signalized intersection is located in a predominantly commercial area and under the jurisdiction of City of Waltham. Main Street eastbound approach includes two through lanes and an exclusive right-turn lane. This approach is restricted by NTOR. Main Street westbound approach provides an exclusive left-turn lane and a shared through-right lane. Moody Street northbound approach consists of an exclusive left-turn lane, a through lane and a channelized right-turn lane. Common Street is a one-way street with one departing lane from the intersection. Crosswalks, pedestrian countdown signals and pushbuttons are present on all the approaches.

Main Street at Bacon Street (Waltham)

This is a signalized T-intersection under the jurisdiction of Waltham. Bacon Street provides southbound approach which consists of a left-turn lane and a right-turn lane. There is a NTOR restriction on the approach. Main Street eastbound approach consists of a short exclusive left-turn lane and a shared through-right lane. Opposite the Bacon Street across the intersection is the entrance to the Wendy's restaurant. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. The intersection is located in a primarily commercial neighborhood.

Main Street at Weston Street (Waltham)

This is a three-leg T intersection under the jurisdiction of Waltham. Weston Street provides northeast bound approach. While unmarked it functions as a shared left-through lane and a right-turn only lane. Main Street eastbound approach consists of a through lane and a shared through-right lane. Main Street westbound approach provides two exclusive left-turn lanes and a through lane. There are NTOR restrictions on the Main Street westbound approach and Weston Street northeastbound approach. MBTA Route 70 has bus stops at the Main Street eastbound approach. Crosswalks, pedestrian countdown signals and pushbuttons are provided on Main Street westbound approach only. The intersection is located in a primarily commercial neighborhood.

South Street at Weston Street (Waltham)

This is a three-leg signalized intersection and is located right to the southwest of intersection of Main Street at Weston Street. Weston Street northeast bound approach provides a through lane and a shared through-right lane. Weston Street southwest bound approach includes an exclusive left-turn lane and a through lane. The South Street northbound approach consists of an exclusive left-turn lane and an exclusive right-turn lane. There is a NTOR restriction on the South Street northbound approach. Sharrows are presented on both sides of South Street. MBTA Bus Route 553 has bus stops at the South Street approach. Crosswalks, pedestrian countdown signals and pushbuttons are provided on Weston Street southwest bound approach and South Street approach. The intersection, along with closely spaced intersection of Main Street at Weston Street to its north, provide a major connection to Brandeis University via South Street.

Intersections associated with School Street Site

Main Street at Bacon Street (Waltham). See the previous description of this intersection.

Main Street at Weston Street (Waltham). See the previous description of this intersection.

South Street at Weston Street (Waltham). See the previous description of this intersection.

Intersections associated with Cedarwood Pumping Station Site

South Street at Weston Street (Waltham). See the previous description of this intersection.

South Street at Shakespeare Road (Waltham)

The four-leg unsignalized intersection is located to the north of Stanley Elementary School and Waltham City Pumping Station, and to the east of the intersection is Roberts Crossing townhouse compound. It is under the jurisdiction of Waltham. Shakespeare Road eastbound approach and school driveway westbound approach are both STOP controlled. Crosswalks are provided to these two approaches. Each approach of the intersection provides one travel lane. MBTA Bus Route 553 has two bus stops at the intersection along South Street.

Intersections associated with Tandem Trailer and Park Road East Site

South Avenue at River Road (Weston)

River Road and I-95 South Exit 39A to Route 30 off ramp intersect South Avenue to form a four-leg signalized intersection. River Road southbound approach consists of an exclusive left-turn lane, a through lane and a channelized right-turn lane under YIELD control. Directional flow along River Road is separated by a raised median. South Avenue eastbound and westbound approaches each consists of an exclusive left-turn lane, two through lanes and a channelized right-turn lane under YIELD control. Directional flow along South Avenue is separated by a raised median and guardrail. The off-ramp approach consists of a shared left-through lane and a channelized right-turn lane under YIELD control. Directional flow along the ramp approach is separated by a raised median.

I-95 Northbound Exit 39A Off Ramp at Commonwealth Avenue (Route 30) (Weston)

The I-95 North Exit 39A to Route 30 off-ramp intersects Commonwealth Avenue (Route 30) to form a signalized intersection. I-95 north Exit 39A off ramp approach consists of an exclusive left-turn lane and a short channelized right-turn lane under YIELD control. Commonwealth Avenue eastbound and westbound approaches each consists of two through lanes and a channelized right-turn free flow lane. Directional flow along Commonwealth Avenue is separated by raised median and guardrail.

Intersections associated with Park Road West and Bifurcation Sites

South Avenue at River Road (Weston) See the previous description of this intersection.
I-95 Northbound Exit 39A Off Ramp at Commonwealth Avenue (Route 30) (Weston) See the previous description of this intersection.

South Avenue at Park Road (Weston)

Park Road intersects South Avenue (Route 30) from south to form a three-leg signalized intersection. Park Road northbound approach consists of an exclusive left-turn lane and a shared left-right lane. South Avenue eastbound approach provides a through lane and an exclusive right lane, and westbound approaches consists of an exclusive left-turn lane and a through lane. Both the northbound and eastbound approaches are under NTOR restriction.

Intersection associated with Hegarty Pumping Station Site

Cedar Street at Worcester Street (Wellesley)

Cedar Street intersects Worcester Street to form a four-leg signalized intersection. The Worcester Street eastbound approach and Cedar Street approaches have one left-turn lane and a shared through-right lane in each approach. Worcester Street westbound approach provides one lane. All the approaches are under NTOR restriction. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. The intersection is located to the south of Route 9 in a mix of commercial and residential area.

Intersections associated with Saint Mary Street Pumping Station Site

Cedar Street at Worcester Street (Wellesley) See the previous description of this intersection.

Cedar Street at Central Avenue (Needham)

Cedar Street intersects Central Avenue from north to form a three-leg unsignalized intersection. Each approach has one lane. The Cedar Street southeast bound approach is under STOP control. Crosswalks are provided on Cedar Street approach and Central Avenue westbound approach. Solar powered rectangular rapid flashing beacons (RRFBs) are provided on crosswalk across Central Avenue westbound approach. The intersection is located in a residential area. Eliot Elementary School is located in the close vicinity to the west of the intersection, with its main access point via Wellesley Avenue, which is approximately 330 feet to the north of the intersection along Cedar Street.

Intersections associated with Newton Street Pumping Station Site

Boylston Street (Route 9) at Woodward Street/Elliot Street (Newton)

Woodward Street and Elliot Street intersect Boylston Street (Route 9) from north and south respectively to form a four-leg signalized intersection. The Woodward Street southbound approach consists of a left-turn lane and a shared through-right lane. Elliot Street northbound approach provides a left-turn lane, a through lane and a short, channelized YIELD controlled right-turn lane. Boylston Street approaches are median separated. Each Boylston Street approach consists of a left-turn lane, a through lane and a shared through-right lane. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all approaches except Boylston Street eastbound approach. MBTA Bus Route 59 is along Woodward Street and Elliot Street and has bus stops on both sides of Woodward Street southbound approach. The intersection is located in a mix of commercial and residential area.

Newton Street at Grove Street (Brookline)

Newton Street intersects Grove Street to form a three-leg signalized intersection. The Newton Street eastbound approach consists of a left-turn only lane and a short right-turn only lane. The Newton Street southbound approach provides two through lanes and a right-turn only lane. Grove Street northbound approach consists of a shared left-through lane and a through lane. Northbound left turn is prohibited during 7AM-9AM in weekdays. Crosswalks, countdown pedestrian signals and pushbuttons are provided on Newton Street eastbound and southbound approaches. MBTA bus route 51 bus stops locate on both sides of Newton Street southbound approach. The intersection is located in a residential area.

Newton Street at Clyde Street (Brookline)

Newton Street intersects Clyde Street to form a three-leg signalized intersection. The Newton Street eastbound approach consists of a left-turn only lane, a shared left-through lane and a through lane. Newton Street westbound approach provides a through lane and a shared through-right lane. The Clyde Street southbound approach consists of a left-turn lane and two channelized right-turn lanes. Crosswalks, countdown pedestrian signals and pushbuttons are provided on Newton Street eastbound and Clyde Street southbound approaches. The intersection is located in a residential area.

Dudley Street at Lee Street and Warren Street (Brookline)

Lee Street intersects Warren Street to form a three-leg unsignalized intersection that configures and functions as a two-lane roundabout. Lee Street northeastbound approach consists of a left-turn only lane and a shared through-right lane. Lee Street southbound approach provides a shared left-through lane and a through lane. The Warren Street westbound approach includes a single, wide lane under YIELD control. Trucks 2.5 tons or over are prohibited on Warren Street. Crosswalks and flashing beacons are provided on all the approaches. MBTA bus route 51 bus stops locate on both sides of Newton Street northeastbound approach. The intersection is located in a residential area.

Boylston Street (Route 9) at Lee Street (Brookline)

Lee Street intersects Boylston Street to form a three-leg signalized intersection. Boylston Street eastbound approach consists of two through lanes and a right-turn only lane, and is restricted by NTOR. The Boylston Street westbound approach provides a left-turn lane and two through lanes. The Lee Street northbound approach consists of a left-turn lane and a shared left-right lane. Crosswalks, countdown pedestrian signals and pushbuttons are provided on Boylston Street eastbound and Lee Street northbound approaches. The intersection is located in a residential area.

Boylston Street (Route 9) at Chestnut Hill Avenue (Brookline)

Chestnut Hill Avenue intersects Boylston Street to form a skewed three-leg signalized intersection. Boylston Street eastbound approach consists of a left-turn lane and two through lanes. The Boylston Street westbound approach provides a left-turn lane, two through lanes, a right-turn lane, and under restriction of NTOR. The Chestnut Hill Avenue southbound approach consists of a left-turn lane, a through lane (to Heath Street across the intersection), and a short, channelized right-turn lane under YIELD control. Crosswalks, countdown pedestrian signals and pushbuttons are provided on Boylston Street eastbound and Chestnut Hill Avenue southbound approaches. The intersection is located in a residential area.

Boylston Street (Route 9) at Hammond Street (Brookline)

Hammond Street intersects Boylston Street to form a four-leg signalized intersection. The Boylston Street eastbound approach consists of a left-turn lane, a through lane and a shared through-right lane. Boylston Street westbound approach provides a left-turn lane, two through lanes and a right-turn lane. Hammond Street northbound approach consists of a shared left-through lane and a shared through-right lane. The Hammond Street southbound approach provides a shared left-through lane, a through lane and a right-turn lane. Crosswalks, countdown pedestrian signals and pushbuttons are provided on all the approaches. The intersection is located in a commercial area. The intersection is on the list of 2017-2019 HSIP Cluster.

Intersections associated with American Legion Site

Centre Street at Arborway Rotary (Boston)

The rotary serves as the intersection of Centre Street and Arborway. It is approximately 270 feet in diameter with a circulation width of approximately 34 feet. Although the circulation lane is unmarked, the rotary was observed to operate with two circulation lanes at peak hour congestion with queues. The Centre Street northeast bound approach consists of two general purpose travel lanes. The Centre Street westbound approach provides a wide travel lane. Arborway southbound approach actually consists of two approaches separated by median island, and each approach provide two general purpose travel lanes. Trucks over 2.5-ton capacity are prohibited on Centre Street to the southwest of the rotary. Sidewalks are provided on the outer peripheral of the rotary. There are crosswalks across rotary legs except Centre Street west leg. The rotary is in the jurisdiction of DCR and is located in a primarily residential area.

Centre Street at Arborway (Boston)

The Arborway intersects Centre Street from southeast to form a skewed signalized intersection. The intersection locates next to the east of the previous Centre Street/Arborway rotary. The Centre Street eastbound approach consists of two through only lanes, Centre Street westbound approach provides one lane and under NTOR restriction. Arborway (Route 203) northwest bond approach provides a shared left-through lane and a shared through-right lane. No trucks and buses are allowed on Arborway departing lane to the intersection. Crosswalk, pedestrian countdown signals and pushbuttons are provided on Arborway southeast leg. MBTA Bus Route 35 and 38 bus stop is located in the southeast corner of the intersection.

South Street at Arborway (Boston)

South Street intersects Arborway to form a skewed signalized intersection. South Street provides north and south legs, and Arborway provides west and east legs. Arborway eastbound approach provides three through lanes and one right-turn only lane, Arborway westbound approach provides one right-through lane, one through lane and one left-turn only lane. The South Street northbound approach consists of a left-turn only lane, a through lane and a through-right lane. The South Street southbound approach provides a left-turn only lane and a through-right lane. Sharrows are present on both sides of South Street, and bike lane/path are provided along Arborway. Bicyclist crosswalks, pedestrian crosswalks, pedestrian/bicyclist countdown signals and pushbuttons are provided on all approaches. On-street parking spaces are provided on South Street northbound approach and Arborway westbound approach.

Washington Street at Arborway (Boston)

Washington Street intersects Arborway from south and north to form a skewed signalized intersection. The Arborway eastbound approach provides two through lanes and a through-right lane, and the westbound approach provides one left-turn only lane, two through lanes and one through-right lane. Each Washington Street approach provides a left-turn only lane, a through lane and one through-right lane. Two separate striped two-way bike paths run parallel to Arborway at the north and south and enter the intersection. Roadside parking spaces are provided on the south side of Arborway eastbound approach. Forest Hills transit station locates to the southwest of the intersection. Bicyclist crosswalks, pedestrian crosswalks, pedestrian/bicyclist countdown signals and pushbuttons are provided on all approaches. Approximately 3,000 feet to the east of the intersection is the Lemuel Shattuck Hospital along Route 203 (Morton Street).

Arborway at Circuit Drive/Morton Street (Boston)

Circuit Drive and Morton Street intersect Arborway to provide a four-way, signalized intersection. Arborway eastbound approach provides two left-turn lanes, a through-right lane and a shared through-right lane. Morton Street westbound approach provides one left-turn only lane, one through lane and one through-right lane. The Circuit Drive southbound approach presents a right-only lane and a through-right lane with a bike lane between the travel lanes. The Morton Street northbound approach provides one lane. NTOR restriction is enforced to all the approaches. Trucks are prohibited on Circuit Drive. Bicyclist crosswalks, pedestrian crosswalks, pedestrian/bicyclist countdown signals and pushbuttons are provided on all approaches. MBTA Bus Routes 21 and 31 bus stations are located on both sides of Morton Street westbound approach.

Morton Street at Canterbury Lane (Boston)

Canterbury Lane intersects Morton Street (Route 203) from west to form a three-leg signalized intersection. Canterbury Lane eastbound approach consists of a single lane. Morton Street is median separated. The northbound approach provides a left-turn lane and two through lanes. The southbound approach includes a through lane and a shared through-right lane. Crosswalks, pedestrian countdown signals and pushbuttons are provided on Morton Street southbound approach. There are buffered bike lanes on both sides of Morton Street to the north of Canterbury Street, which is approximately 100 feet to the north of Morton Street/Canterbury intersection. MBTA Bus Routes 21 and 31 bus stops locate on both sides of Morton Street southbound approach. The intersection is located in a recreational area.

Morton Street at Harvard Street (Boston)

Harvard Street intersects Morton Street (Route 203) to form a four-leg signalized intersection. Harvard Street provides east-west approaches and Morton Street provides north-south approaches. Each Harvard Street approach consists of a left-turn lane and a shared through-right lane. Morton Street is median separated, and each approach provides a shared left-through lane and a shared through-right lane. There is NTOR restriction on Morton Street northbound approach. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. Sharrow pavement markings are presented on Morton Street northbound approach. MBTA Bus Routes 21 and 31 bus stops locate on both sides of Morton Street southbound approach. The intersection is located in a residential area.

Morton Street at Blue Hill Avenue (Boston)

Blue Hill Avenue (Route 28) intersects Morton Street (Route 203) to form a four-leg signalized intersection. Morton Street provides east-west approaches and Blue Hill Avenue provides north-south approaches. Blue Hill Avenue is median separated. Bike lanes are presented on both sides. Northbound approach consists of a left-turn lane, a through lane and a shared through-right lane. Southbound approach provides a left-turn lane, two through lanes and a short, channelized STOP controlled right-turn lane. Each Morton Street approach consists of a through lane and a shared through-right lane, and westbound approach is restricted by NTOR. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. MBTA bus stops locate on northeast and southwest corners of the intersection. The intersection is located in a mix of residential and commercial area.

Morton Street at Norfolk Street (Boston)

Norfolk Street intersects Morton Street (Route 203) to form a four-leg signalized intersection. Morton Street provides east-west approaches and Norfolk Street provides north-south approaches. Morton Street is median separated. Each approach consists of a left-turn lane, a through lane and a shared through-right lane. Norfolk Street northbound lane consists of a shared left-through lane and a right-turn lane. Sharrows are present on both lanes. A bike lane is provided on west side of the northbound approach. The Norfolk Street southbound approach provides a lane, and bike lanes are provided on both sides. Each approach of the intersection is restricted by NTOR. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. MBTA bus stops locate on northwest and southwest corners. The intersection is located in a mix of residential and commercial area.

Morton Street at Corbet Street/Selden Street (Boston)

Morton Street (Route 203) intersects Corbet Street, Selden Street and West Selden Street to form a five-leg signalized intersection. Morton Street provides east-west approaches and each approach consists of a shared left-through lane and a shared through-right lane. The West Selden Street northeastbound approach provides a single lane, and trucks are prohibited on the street. Corbet Street is a one-way street with a single lane approaching the intersection. Selden Street is also a one-way street with a single lane departing the intersection. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. MBTA Bus Routes 21 and 26 bus stops locate on both sides of Morton Street westbound approach. The intersection is located in a mix of commercial and residential area.

Morton Street at Gallivan Boulevard/Woodmere Street (Boston)

This is a skewed signalized intersection. Morton Street northwestbound approach provides a shared left-through lane and a shared through-right lane. Morton Street southeastbound approach provides two through lanes to Gallivan Boulevard and a median separated shared through-right lane. Gallivan Boulevard westbound approach consists of two through lanes to Morton Street. The Woodmere Street northeastbound approach consists of one lane. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all legs. Bike lanes are provided on all legs except Woodmere Street. MBTA

Bus Routes 21 and 26 bus stops locate on Morton Street southeastbound approach and Gallivan Boulevard approach. The intersection is located in a mix of commercial and residential area.

Gallivan Boulevard at Washington Street (Boston)

Washington Street intersects Gallivan Boulevard (Route 203) to form a four-leg signalized intersection. Gallivan Boulevard eastbound approach consists of a shared left-through lane, a through lane and a short, channelized right-turn lane. Gallivan Boulevard westbound approach provides a shared left-through lane and a shared through-right lane. Washington Street southbound and northbound approaches each consists of a single lane. Sharrows are present on both sides of Washington Street southbound approach. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. MBTA Bus Route 26 bus stop locates on northeast corner of the intersection. The intersection is located in a residential area.

Gallivan Boulevard at Dorchester Avenue (Boston)

Dorchester Avenue intersects Gallivan Boulevard (Route 203) to form a skewed four-leg signalized intersection. Gallivan Boulevard provides eastbound and westbound approaches, and each approach consists of a shared left-through lane and a shared through-right lane with channelized right-turn. Dorchester Avenue provides northbound and southbound approaches, and each approach consists of a single lane with sharrows present on both directions. Each approach of the intersection is restricted by NTOR. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. MBTA bus stop of multiple routes locates on west side of Dorchester Avenue southbound approach. The intersection is located in a residential area.

Gallivan Boulevard at Granite Avenue/Adams Street (Boston)

Granite Avenue and Adams Street intersect Gallivan Boulevard (Route 203) from south and north respectively to form a four-leg signalized intersection. Gallivan Boulevard provides eastbound and westbound approaches, and each approach consists of a left-turn lane, a through lane and a shared through-right lane. There is NTOR restriction on Gallivan Boulevard eastbound approach. Granite Avenue northbound approach consists of a left-turn lane and a shared through-right lane. Adams Street southbound approach provides a left-turn lane and a shared through-right lane with channelized right-turn under signal control. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. MBTA bus stops of multiple routes locates on west side of Adams Street southbound approach and both sides of Granite Avenue northbound approach. The intersection is located in a commercial area.

Gallivan Boulevard at Hallet Street (Boston)

Hallet Street intersects Gallivan Boulevard (Route 203) to form a skewed four-leg signalized intersection. Gallivan Boulevard, which is median separated, consists of a through lane and a shared through-right lane. Gallivan Boulevard westbound approach provides two through lanes. Hallet Street northbound approach consists of a left-turn lane and a right-turn lane, and is restricted by NTOR. The Hallet Street southbound approach is a one-way street entering the intersection. It is striped as a wide single general purpose lane, but was observed to operate as two lanes (an exclusive left lane and a shared through-right lane). Crosswalks, pedestrian countdown signals and pushbuttons are provided on all the approaches. MBTA

Bus Routes 201 and 202 have a bus stop on north side of Gallivan Boulevard eastbound approach and east side of Hallet Street northbound approach respectively. The intersection is located in a commercial area.

Gallivan Boulevard NB at Neponset Avenue EB (Boston)

Neponset Avenue eastbound intersects Gallivan Boulevard northbound to form a four-leg signalized intersection. Gallivan Boulevard northbound approach is one-way entering the intersection with the opposite Morrissey Boulevard northbound one-way departing from the intersection. The Gallivan Boulevard northbound approach consists of two through only lanes and two channelized right-only lanes under the restriction of NTOR. Neponset Avenue eastbound approach consists of a channelized left-turn lane and three through lanes. The opposite Neponset Avenue eastbound is one-way departing from the intersection. Crosswalks are provided on northbound approach and departing Neponset Avenue eastbound. The intersection is located in a commercial area.

Neponset Avenue at Morrissey Boulevard SB (Boston)

Neponset Avenue intersects Gallivan Boulevard and Morrissey Boulevard southbound to form a four-leg signalized intersection. Morrissey Boulevard southbound approach is one-way entering the intersection with the opposite Gallivan Boulevard one-way departing from the intersection. The Morrissey Boulevard approach consists of a left-turn only lane, a shared left-through lane, two through-only lanes and a channelized right-only free flowing lane. Neponset Avenue eastbound approach consists of a through lane and a shared through-right lane. The opposite Neponset Avenue is one-way departing from the intersection. Crosswalks are provided on southbound and eastbound approaches. The intersection is located in a commercial area.

Intersections associated with Southern Spine Mains Site

Centre Street at Arborway Rotary (Boston) See the previous description of this intersection.
South Street at Arborway (Boston) See the previous description of this intersection.

South Street at Washington Street (Boston)

This is a signalized T-intersection. South Street provides north and west legs, and Washington Street provides south leg. South Street eastbound approach consists of one lane, southbound approach provides a through lane and a shared through-right lane, and Washington Street northbound approach provides a shared left-through lane and a through lane. Both the South Street approaches are under NTOR restriction. No trucks are allowed on South Street. Sharrows are present on both sides of northbound and southbound approaches. Crosswalks, pedestrian countdown signals and pushbuttons are provided on all approaches. A southbound bike path and a two-way bike path are provided along west and east side of the intersection respectively. The intersection is located in a primarily commercial area, the Forest Hills transit station is situated to the right of the intersection.

Washington Street at Arborway (Boston) See the previous description of this intersection.

Arborway at Circuit Drive/Morton Street (Boston) See the previous description of this intersection.

Morton Street at Canterbury Lane (Boston) See the previous description of this intersection.

Morton Street at Harvard Street (Boston) See the previous description of this intersection.

Morton Street at Blue Hill Avenue (Boston) See the previous description of this intersection.

Morton Street at Norfolk Street (Boston) See the previous description of this intersection.

Morton Street at Corbet Street/Selden Street (Boston) See the previous description of this intersection.

Morton Street at Gallivan Boulevard/Woodmere Street (Boston) See the previous description of this intersection.

Gallivan Boulevard at Washington Street (Boston) See the previous description of this intersection.

Gallivan Boulevard at Dorchester Avenue (Boston) See the previous description of this intersection.

Gallivan Boulevard at Granite Avenue/Adams Street (Boston) See the previous description of this intersection.

Gallivan Boulevard at Hallet Street (Boston) See the previous description of this intersection.

Gallivan Boulevard NB at Neponset Avenue EB (Boston) See the previous description of this intersection.

Neponset Avenue at Morrissey Boulevard SB (Boston) See the previous description of this intersection.

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Appendix F.3: Intersection Operational Analysis

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Intersection Operational Analysis Results

Intersection Operational Analysis Results: Morning Peak Hour	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Trapelo Road at Lexington Street (Waltham)																									
Trapelo Rd EB L	50.2	D	0.49	68	110	50.5	D	0.50	70	113	50.5	D	0.50	70	113	50.5	D	0.50	70	113	50.5	D	0.50	70	113
Trapelo Rd EB T	33.0	C	0.54	147	182	33.8	D	0.56	152	187	35.1	D	0.60	168	204	35.1	D	0.60	168	204	35.0	D	0.60	168	204
Lexington St NB L	56.0	E	0.71	128	227	57.2	E	0.73	133	239	57.2	E	0.73	133	239	57.2	E	0.73	133	239	57.2	E	0.73	133	239
Lexington St NB T	36.6	D	0.75	178	253	37.3	D	0.76	186	260	37.3	D	0.76	186	260	37.3	D	0.76	186	260	37.3	D	0.76	186	260
Trapelo Rd WB L	55.3	E	0.61	85	143	56.1	E	0.62	88	147	56.1	E	0.62	88	147	56.1	E	0.62	88	147	56.1	E	0.62	88	147
Trapelo Rd WB T	46.8	D	0.76	233	369	49.4	D	0.70	241	383	49.4	D	0.79	241	383	49.4	D	0.79	241	383	49.4	D	0.80	241	383
Trapelo Rd WB R	11.4	B	0.26	16	61	11.8	B	0.27	18	63	11.8	B	0.27	18	63	11.8	B	0.27	18	63	11.8	B	0.27	18	63
Lexington St SB L	45.4	D	0.46	81	133	45.8	D	0.47	84	137	45.8	D	0.47	84	137	45.8	D	0.47	84	137	45.8	D	0.47	84	137
Lexington St SB T	33.3	C	0.51	124	164	33.6	C	0.52	128	168	33.6	C	0.52	128	168	33.6	C	0.52	128	168	33.6	C	0.52	128	168
Overall Intersection	**38.9**	**D**	**0.76**	**-**	**-**	**39.8**	**D**	**0.79**	**-**	**-**	**40.0**	**D**	**0.79**	**-**	**-**	**40.0**	**D**	**0.79**	**-**	**-**	**40.0**	**D**	**0.79**	**-**	**-**
Trapelo Road at Waverley Oaks Road (Waltham)																									
Trapelo Rd EB T	33.9	C	0.86	140	284	35.8	D	0.87	147	295	44.5	D	0.94	162	323	44.5	D	94.00	162	323	45.0	D	0.94	162	323
Waverley Oaks Rd NB L	15.7	B	0.74	39	83	16.4	B	0.75	42	121	16.4	B	0.75	42	121	16.4	B	0.75	42	121	16.4	B	0.75	42	121
Trapelo Rd WB L	259.7	F	1.49	220	115	283.2	F	1.54	230	439	283.2	F	1.54	230	439	283.2	F	1.54	230	439	283.2	F	1.54	230	439
Trapelo Rd WB T	6.2	A	0.24	30	428	6.3	A	0.24	32	86	6.3	A	0.24	32	86	6.3	A	0.24	32	86	6.3	A	0.24	32	86
Overall Intersection	**90.0**	**F**	**1.49**	**-**	**-**	**97.6**	**F**	**1.54**	**-**	**-**	**99.1**	**F**	**1.54**	**-**	**-**	**99.1**	**F**	**1.54**	**-**	**-**	**97.6**	**F**	**1.54**	**-**	**-**
Beaver Street at Waverley Oaks Road (Waltham)																									
Beaver St EB L	47.3	D	0.59	55	123	48.4	D	0.61	58	128	48.4	D	0.61	58	128	48.4	D	0.61	58	128	48.4	D	0.61	58	128
Beaver St EB T	4.9	C	0.59	162	302	25.8	C	0.61	170	313	25.8	C	0.61	170	313	25.8	C	0.61	170	313	25.8	C	0.61	170	313
Waverley Oaks Rd NB L	38.2	D	0.06	3	17	38.3	D	0.07	3	17	38.3	D	0.06	3	17	38.3	D	0.06	3	17	38.3	D	0.06	3	17
Waverley Oaks Rd NB T	40.0	D	0.62	88	156	40.3	D	0.63	91	160	40.3	D	0.63	91	160	40.3	D	0.63	91	160	40.3	D	0.63	91	160
Waverley Oaks Rd NB R	8.3	A	0.26	0	35	8.6	A	0.27	0	37	8.6	A	0.27	0	37	8.6	A	0.27	0	37	8.6	A	0.27	0	37
Beaver St WB L	42.5	D	0.42	33	77	43.0	D	0.43	34	79	43.0	D	0.43	34	79	43.0	D	0.43	34	79	43.0	D	0.43	34	79
Beaver St WB T	18.3	B	0.51	113	192	18.8	B	0.52	118	199	18.8	B	0.52	118	199	18.8	B	0.52	118	199	18.8	B	0.52	118	199
Waverley Oaks Rd SB L	45.0	D	0.65	147	147	45.5	D	0.66	78	152	45.5	D	0.66	78	152	45.5	D	0.66	78	152	45.5	D	0.66	78	152

Intersection Operational Analysis Results: Morning Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Waverley Oaks Rd SB T	21.3	C	0.30	130	130	21.3	C	0.30	64	132	21.3	C	0.30	65	133	21.3	C	0.30	64	132	21.3	C	0.30	65	133
Waverley Oaks Rd SB R	5.6	A	0.17	34	34	5.5	A	0.17	0	34	5.5	A	0.17	0	34	5.5	A	0.17	0	34	5.5	A	0.17	0	34
Overall Intersection	**25.7**	**C**	**0.65**	**-**	**-**	**26.2**	**C**	**0.66**	**-**	**-**	**26.2**	**C**	**0.66**	**-**	**-**	**26.2**	**C**	**0.66**	**-**	**-**	**26.2**	**C**	**0.66**	**-**	**-**
Main Street at Ellison Park/Linden Street (Waltham)																									
Main St EB L	380.6	F	1.73	214	388	398.2	F	1.77	223	398	352.9	F	1.67	200	96	352.9	F	1.67	200	396	352.9	F	1.67	200	396
Main St EB T	67.4	E	0.94	260	449	72.1	E	0.97	269	463	58.9	E	0.91	246	461	58.9	E	0.91	246	461	59.0	E	0.91	246	461
Linden St NB LTR	0.0	A	0.02	0	0	0.0	A	0.02	0	0	0.0	A	0.02	0	0	0.0	A	0.02	0	0	0.0	A	0.02	0	0
Main St WB T	43.4	D	0.88	134	134	46.1	D	0.90	140	161	40.3	D	0.86	129	160	40.3	D	0.86	129	160	40.0	D	0.90	129	160
Linden St SWB L	42.3	D	0.46	74	181	42.6	D	0.47	76	135	39.9	D	0.44	71	135	39.9	D	0.44	71	135	40.0	D	0.44	71	165
Linden St SWB R	107.4	F	1.04	133	339	114.7	F	1.06	190	350	97.5	F	1.01	165	349	97.5	F	1.01	165	349	98.0	F	1.01	135	349
Ellison Park SB L	20.5	C	0.23	49	69	20.5	C	0.24	50	70	21.5	C	0.25	50	70	21.5	C	0.25	50	70	22.0	C	0.25	50	70
Ellison Park SB T	20.4	C	0.22	49	69	20.5	C	0.23	50	71	21.5	C	0.25	50	71	21.4	C	0.25	50	71	21.0	C	0.25	50	71
Overall Intersection	**99.4**	**F**	**1.73**	**-**	**-**	**104.5**	**F**	**1.77**	**-**	**-**	**104.5**	**F**	**1.67**	**-**	**-**	**91.3**	**F**	**1.67**	**-**	**-**	**104.5**	**F**	**1.77**	**-**	**-**
Main Street at Elm Street (Waltham)																									
Main St EB L	4.4	A	0.19	15	23	4.0	A	0.19	14	24	4.0	A	0.19	14	24	4.0	A	0.19	14	24	4.0	A	0.19	14	24
Main St EB T	19.7	B	0.68	264	323	18.8	B	0.68	259	338	18.8	B	0.68	259	338	18.8	B	0.68	259	338	18.8	B	0.68	259	338
Main St EB R	52.1	D	0.97	179	323	68.5	E	1.03	209	344	68.5	E	1.03	209	344	68.5	E	1.03	209	344	68.5	E	1.03	209	344
Elm St NB T	45.6	D	0.57	111	174	48.8	D	0.64	116	181	48.8	D	0.64	116	181	48.8	D	0.64	116	181	48.8	D	0.64	116	181
Main St WB L	4.2	A	0.16	8	16	3.9	A	0.16	8	16	3.9	A	0.16	8	16	3.9	A	0.16	8	16	3.9	A	0.16	8	16
Main St WB T	11.3	B	0.44	131	191	10.7	B	0.44	128	199	10.7	B	0.44	128	199	10.7	B	0.44	128	199	10.7	B	0.44	128	199
Overall Intersection	**28.1**	**C**	**0.97**	**-**	**-**	**31.8**	**C**	**1.03**	**-**	**-**	**31.8**	**C**	**1.03**	**-**	**-**	**31.8**	**C**	**1.03**	**-**	**-**	**31.8**	**C**	**1.03**	**-**	**-**
Main Street at Moody Street (Waltham)																									
Main St EB T	17.4	B	0.55	75	117	17.6	B	0.56	78	121	17.6	B	0.56	78	121	17.6	B	0.56	78	121	17.6	B	0.56	78	121
Main St EB R	15.3	B	0.25	25	57	15.3	B	0.25	26	58	15.3	B	0.25	26	58	15.3	B	0.25	26	58	15.3	B	0.25	26	58
Moody St NB L	15.9	B	0.31	36	75	16.0	B	0.32	37	76	16.0	B	0.32	37	76	16.0	B	0.32	37	76	16.0	B	0.32	37	76
Moody St NB T	15.1	B	0.25	30	64	15.1	B	0.26	31	65	15.1	B	0.26	31	65	15.1	B	0.26	31	65	15.1	B	0.26	31	65
Moody St NB R	16.0	B	0.62	0	64	16.0	B	0.62	0	65	16.0	B	0.62	0	65	16.0	B	0.62	0	65	16.0	B	0.62	0	65
Main St WB L	373.1	F	1.17	118	232	391.4	F	1.76	122	238	391.4	F	1.76	122	238	391.4	F	1.76	122	238	391.4	F	1.76	122	238
Main St WB TR	15.0	B	0.64	100	188	15.5	B	0.66	104	194	15.5	B	0.66	104	195	15.5	B	0.66	104	194	15.5	B	0.66	104	194

Intersection Operational Analysis Results: Morning Peak Hour																									
	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Overall Intersection	**62.5**	**E**	**1.17**	-	-	**65.1**	**E**	**1.76**	-	-	**65.1**	**E**	**1.76**	-	-	**65.1**	**E**	**1.76**	-	-	**65.1**	**E**	**1.76**	-	-
Main Street at Bacon Street (Waltham)																									
Main St EB L	5.2	A	0.35	10	23	5.4	A	0.37	11	24	5.9	A	0.41	12	27	6.1	A	0.43	13	28	5.9	A	0.41	12	27
Main St EB T	28.7	C	0.87	119	286	31.3	C	0.89	124	296	31.3	C	0.89	124	296	31.3	C	0.89	124	296	31.3	C	0.89	124	296
Main St WB T	9.4	A	0.45	44	74	30.4	C	0.53	22	63	9.6	A	0.46	45	76	30.4	C	0.53	22	63	30.4	C	0.53	22	63
Bacon St SB L	29.5	C	0.51	21	59	9.6	A	0.46	45	76	30.4	C	0.53	22	63	9.6	A	0.46	45	76	9.6	A	0.46	45	76
Bacon St SB R	15.0	B	0.50	44	86	15.3	B	0.52	45	88	15.3	B	0.52	45	89	15.3	B	0.52	45	89	15.3	B	0.52	45	89
Overall Intersection	**17.9**	**B**	**0.87**	-	-	**19.0**	**B**	**0.89**	-	-	**18.9**	**B**	**0.89**	-	-	**18.8**	**B**	**0.89**	-	-	**18.9**	**B**	**0.89**	-	-
Main Street at Weston Street/ South Street (Waltham)																									
Main St EB T	29.1	C	0.50	104	147	29.2	C	0.50	108	151	29.2	C	0.50	108	151	29.2	C	0.50	108	151	29.2	C	0.50	108	151
Weston St NEB L	26.4	C	0.36	64	138	43.2	D	0.62	99	153	43.3	D	0.62	99	153	43.3	D	0.62	99	153	43.3	D	0.62	99	153
Weston St NEB R	13.0	B	0.32	31	96	48.5	D	0.68	101	156	48.5	D	0.69	101	156	48.5	D	0.69	101	156	48.5	D	0.69	101	156
Main St WB L1	539.7	F	2.07	150	269	575.1	F	2.13	159	277	575.1	F	2.13	159	277	575.1	F	2.13	159	277	575.1	F	2.13	159	277
Main St WB L2	29.4	C	0.57	150	280	30.4	C	0.59	159	289	30.5	C	0.59	160	291	30.5	C	0.59	160	291	30.5	C	0.59	160	291
Main St WB T	39.8	D	0.74	169	277	40.2	D	0.75	175	285	40.2	D	0.75	175	285	40.2	D	0.75	175	285	40.2	D	0.75	175	285
South St NB HL	42.8	D	0.61	95	148	27.4	C	0.38	67	141	28.2	C	0.42	77	158	28.3	C	0.35	78	160	28.2	C	0.42	77	158
South St NB L	48.1	D	0.69	97	154	13.5	B	0.33	34	101	14.8	B	0.36	43	116	15.2	B	0.35	45	122	14.8	B	0.36	43	116
Overall Intersection	**75.9**	**E**	**2.07**	-	-	**79.6**	**E**	**2.13**	-	-	**78.7**	**E**	**2.13**	-	-	**78.4**	**E**	**2.13**	-	-	**78.7**	**E**	**2.13**	-	-
Shakespeare Road at South Street (Waltham)																									
South St NEB LTR	0.0	A	-	-	0	0.0	A	-	-	0	0.0	A	-	-	0	0.0	A	-	-	0	0.0	A	-	-	0
Pump Station Drwy NB LTR	25.2	D	0.65	-	5	27.1	D	0.67	-	5	29.3	D	0.70	-	5	29.4	D	0.70	-	5	29.3	D	0.70	-	5
South St SWB LTR	8.2	A	0.00	-	0	8.2	A	0.00	-	0	8.3	A	0.02	-	0	8.3	A	0.02	-	0	8.3	A	0.02	-	0
Shakespeare Rd SB LTR	34.5	D	0.32	-	0	37.1	E	0.03	-	0	40.3	E	0.04	-	0	40.6	E	0.04	-	0	40.3	E	0.04	-	0
River Road at South Avenue (Weston)																									
South Ave NEB L	286.7	F	1.53	139	263	303.7	F	1.57	144	269	305.6	F	1.58	144	269	305.6	F	1.58	144	269	306.0	F	1.58	144	269
South Ave NEB T	16.1	B	0.74	109	168	16.9	B	0.76	113	174	17.2	B	0.77	114	176	17.3	B	0.77	115	176	17.0	B	0.76	113	174
I-95 S Exit 39A Off Ramp LT	43.4	D	0.81	69	12	46.3	D	0.84	71	175	167.0	F	1.26	135	263	273.8	F	1.52	176	312	72.0	D	0.97	83	206
I-95 S Exit 39A Off Ramp R	10.4	B	0.66	169	77	11.5	B	0.67	15	91	11.4	B	0.67	15	91	11.4	B	0.67	15	91	11.0	B	0.67	15	91
South Ave WB L	99.7	F	1.03	67	175	106.8	F	1.06	74	179	107.7	F	0.59	74	179	107.7	F	1.06	74	179	108.0	F	1.06	74	179

Intersection Operational Analysis Results: Morning Peak Hour																				
	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
South Ave WB T	15.9	B	0.98	99	174	17.3	B	1.02	105	210	17.3	F	1.06	105	210	17.3	B	1.02	105	210	17.0	B	1.02	105	210
River Rd SB L	25.8	C	0.45	21	48	27.0	C	0.47	21	50	39.0	C	1.02	22	69	39.0	C	0.59	22	65	34.0	C	0.54	22	61
River Rd SB T	20.3	C	0.38	35	67	20.4	C	0.20	36	69	20.3	C	0.38	36	69	20.3	C	0.38	36	69	20.0	C	0.38	36	69
River Rd SB R	4.7	A	0.29	0	19	4.8	A	0.29	0	20	4.8	A	0.29	0	20	4.8	A	0.29	0	20	4.8	A	0.29	0	20
Overall Intersection	**47.7**	**D**	**1.53**	**-**	**-**	**50.7**	**D**	**1.57**	**-**	**-**	**62.6**	**E**	**1.58**	**-**	**-**	**76.0**	**D**	**1.58**	**-**	**-**	**53.0**	**D**	**1.58**	**-**	**-**
I-95 N Off Ramp at South Avenue/Commonwealth Ave (Weston)																									
South Ave EB T	16.2	B	0.86	55	139	9.6	A	0.67	44	74	17.9	B	0.89	57	145	18.0	B	0.89	58	146	18.0	B	0.89	58	146
I-95 N Off Ramp L	33.9	C	0.90	74	183	12.5	B	0.55	35	70	68.3	E	1.05	100	222	56.9	E	1.01	90	212	48.0	D	0.98	84	203
I-95 N Off Ramp R	10.5	B	0.55	27	63	13.1	B	0.66	32	74	10.9	B	0.57	29	65	10.9	B	0.88	52	142	11.0	B	0.57	29	65
Commonwealth Ave WB T	15.0	B	0.87	50	137	22.8	C	0.92	71	165	16.2	B	0.88	142	142	16.2	B	0.57	29	65	22.8	C	0.88	52	142
Commonwealth Ave WB TR	0.0	C	0.00	0	0	0.0	C	0.00	0	0	0.0	C	0.00	0	0	0.0	C	0.00	0	0	0.0	C	0.00	0	0
Overall Intersection	**18.1**	**A**	**0.90**	**-**	**-**	**16.2**	**B**	**0.92**	**-**	**-**	**25.9**	**C**	**1.05**	**-**	**-**	**23.6**	**B**	**1.01**	**-**	**-**	**16.2**	**B**	**0.98**	**-**	**-**
Park Road at South Avenue (Weston)																									
South Ave EB T	38.5	D	0.82	649	833	39.5	D	0.84	677	869	39.5	D	0.84	677	869	39.5	D	0.84	677	869	39.5	D	0.84	677	869
South Ave EB R	1.5	A	0.22	29	40	1.5	A	0.23	30	41	1.5	A	0.23	30	41	1.5	A	0.23	30	41	1.5	A	0.23	30	41
Park Rd NB L	36.7	D	0.38	168	234	37.4	D	0.39	175	240	37.4	D	0.39	175	240	37.4	D	0.39	175	240	37.4	D	0.39	175	240
Park Rd NB LR	40.1	D	0.69	413	602	41.7	D	0.72	433	622	42.4	D	0.73	444	639	41.8	D	0.72	435	626	41.7	D	0.72	435	626
South Ave WB L	57.1	E	0.73	52	230	61.0	E	0.76	53	146	61.0	E	0.76	53	146	161.6	E	1.18	115	283	115.0	E	1.02	73	233
South Ave WB T	30.0	C	0.43	138	347	30.5	C	0.44	241	356	30.5	C	0.44	241	356	30.5	C	0.44	241	356	30.5	C	0.44	241	356
Overall Intersection	**33.4**	**C**	**0.82**	**-**	**-**	**34.4**	**C**	**0.84**	**-**	**-**	**34.5**	**C**	**0.84**	**-**	**-**	**40.5**	**C**	**1.18**	**-**	**-**	**37.3**	**C**	**1.02**	**-**	**-**
Central Avenue at Cedar Street (Needham)																									
Central Ave EB L	8.7	A	0.08	-	-	8.7	A	0.09	-	0	8.7	A	0.09	-	0	8.7	A	0.09	-	0	8.7	A	0.09	-	0
Central Ave WB L	0.0	A	-	-	-	0.0	A	-	-	-	0.0	A	-	-	-	0.0	A	-	-	-	0.0	A	-	-	-
Cedar St SB LTR	514.5	F	2.02	-	-	588.4	F	2.18	-	33	661.2	F	2.35	-	36	668.4	F	2.36	-	37	661.2	F	2.35	-	36
Worcester Street at Cedar Street (Wellesley)																									
Worcester St EB L	47.5	D	0.65	74	133	47.8	D	0.66	76	135	47.7	D	0.66	76	135	47.7	D	0.66	76	135	47.7	D	0.66	76	135
Worcester St EB T	39.8	D	0.52	68	121	39.9	D	0.53	69	124	39.9	D	0.53	69	124	39.9	D	0.53	69	124	39.9	D	0.53	69	124
Cedar St NB L	9.5	A	0.07	8	22	95.0	A	0.07	8	23	9.6	A	0.08	8	23	9.6	A	0.08	8	23	9.6	A	0.08	8	23
Cedar St NB T	23.4	C	0.82	380	679	25.1	C	0.84	403	707	25.2	C	0.85	405	710	25.2	C	0.85	405	710	25.2	C	0.85	405	710

Intersection Operational Analysis Results: Morning Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Worcester St WB LTR	30.0	C	0.05	5	7	30.0	C	0.05	5	7	30.0	C	0.05	5	7	30.0	C	0.05	5	7	30.0	C	0.05	5	7
Cedar St SB L	5.8	A	0.23	9	22	6.1	A	0.26	10	22	6.2	A	0.26	10	22	6.2	A	0.26	10	22	6.2	A	0.26	10	22
Cedar St SB T	7.0	A	0.50	130	212	7.2	A	0.51	137	220	7.4	A	0.53	143	231	7.5	A	0.53	145	232	7.4	A	0.52	143	231
Overall Intersection	**20.1**	**C**	**0.82**	-	-	**20.9**	**C**	**0.84**	-	-	**20.9**	**C**	**0.85**	-	-	**20.9**	**C**	**0.85**	-	-	**20.9**	**C**	**0.85**	-	-
Route 9 at Woodward Street/Elliot Street (Newton)																									
Rt 9 EB L	176.0	F	1.00	71	182	179.0	F	1.01	73	184	179.0	F	1.01	73	184	179.0	F	1.01	73	184	179.0	F	1.01	73	184
Rt 9 EB T	141.4	F	1.22	1192	1328	145.9	F	1.23	1231	1366	151.2	F	1.24	1252	1387	151.7	F	1.25	1254	1390	151.2	F	1.24	1252	1387
Elliot St NB L	31.4	C	0.09	25	54	30.1	C	0.09	25	54	30.1	C	0.09	25	54	30.1	C	0.09	25	54	30.1	C	0.09	25	54
Elliot St NB T	49.7	D	0.82	416	580	50.0	D	0.83	436	610	50.0	D	0.83	436	610	50.0	D	0.83	436	610	50.0	D	0.83	436	610
Rt 9 WB L	126.1	F	0.88	98	213	265.5	F	1.31	127	255	256.5	F	1.31	127	255	265.5	F	1.31	127	255	265.5	F	1.31	127	255
Rt 9 WB T	156.7	F	1.26	1356	1488	186.6	F	1.33	1439	1571	186.9	F	1.33	1440	1571	186.6	F	1.33	1440	1571	186.9	F	1.33	1440	1571
Woodward St SB L	242.2	F	1.36	222	380	228.3	F	1.33	224	384	228.3	F	1.33	224	384	228.3	F	1.33	224	384	228.3	F	1.33	224	384
Overall Intersection	**138.5**	**F**	**1.36**	-	-	**154.9**	**F**	**1.33**	-	-	**157.0**	**F**	**1.33**	-	-	**157.2**	**F**	**1.33**	-	-	**157.0**	**F**	**1.33**	-	-
Grove Street at Newton Street (Brookline)																									
Newton St EB L	414.4	D	0.70	204	295	39.6	D	0.73	208	302	39.4	D	0.72	209	303	36.4	D	0.72	209	303	39.4	D	0.72	209	303
Newton St EB R	15.9	B	0.11	13	40	15.7	B	0.11	13	40	15.7	B	0.11	13	40	15.7	B	0.11	13	40	15.7	B	0.11	13	40
Grove St NB T	19.6	B	0.81	389	545	22.3	C	0.85	420	580	22.4	C	0.86	422	580	22.4	C	0.86	422	580	22.4	C	0.86	422	580
Newton St SB T	9.7	A	0.27	81	120	10.3	B	0.28	85	125	10.3	B	0.28	85	125	10.3	B	0.28	85	125	10.3	B	0.28	85	125
Newton St SB R	0.4	A	0.27	0	0	0.4	A	0.28	0	0	0.5	A	0.29	0	0	0.5	A	0.29	0	0	0.5	A	0.29	0	0
Overall Intersection	**17.6**	**B**	**0.81**	-	-	**19.0**	**B**	**0.85**	-	-	**18.9**	**B**	**0.86**	-	-	**18.9**	**B**	**0.86**	-	-	**18.9**	**B**	**0.86**	-	-
Newton Street at Clyde Street (Brookline)																									
Newton St EB L	109.1	F	1.12	575	840	134.6	F	1.19	610	873	135.3	F	1.19	612	875	135.3	F	1.19	612	875	135.3	F	1.19	612	875
Newton St EB T	94.9	F	1.11	595	757	122.1	F	1.18	632	792	122.1	F	1.18	632	792	122.1	F	1.18	632	792	122.1	F	1.18	632	792
Newton St WB T	60.3	E	0.93	262	320	62.0	E	0.94	271	335	62.7	E	0.94	271	335	62.7	E	0.94	271	335	62.7	E	0.94	271	335
Clyde St SB L	42.3	D	0.61	182	236	41.4	D	0.61	186	242	41.4	D	0.61	186	242	41.4	D	0.61	186	242	41.4	D	0.61	186	242
Clyde St SB R	7.2	A	0.27	69	83	7.3	A	0.27	72	85	7.4	A	0.29	76	90	7.4	A	0.29	76	90	7.4	A	0.29	76	90
Overall Intersection	**73.9**	**E**	**1.12**	-	-	**89.6**	**F**	**1.19**	-	-	**89.2**	**F**	**1.19**	-	-	**89.2**	**F**	**1.19**	-	-	**89.2**	**F**	**1.19**	-	-
Lee Street at Route 9 (Brookline)																									
Rt 9 EB T	30.2	C	0.91	288	498	40.2	D	0.94	309	516	41.8	D	0.94	297	517	41.8	D	0.94	297	517	41.8	D	0.94	297	517

Intersection Operational Analysis Results: Morning Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Rt 9 EB R	2.7	A	0.34	28	57	2.8	A	0.35	29	62	3.0	A	0.36	31	68	2.4	A	0.36	31	68	3.0	A	0.36	31	68
Lee St NB L	36.5	D	0.86	298	355	37.4	D	0.88	302	354	37.5	D	0.88	302	355	37.4	D	0.88	302	355	37.5	D	0.88	302	355
Rt 9 WB L	118.9	F	0.99	98	214	123.6	F	1.01	101	218	123.6	F	1.01	101	218	123.6	F	1.01	101	218	123.6	F	1.01	101	218
Rt 9 WB T	50.3	D	0.66	291	341	69.2	E	0.68	311	368	69.2	E	0.68	311	368	69.2	E	0.68	311	368	69.2	E	0.68	311	368
Overall Intersection	**38.5**	**D**	**0.99**	-	-	**47.7**	**D**	**1.01**	-	-	**47.7**	**D**	**1.01**	-	-	**48.0**	**D**	**1.01**	-	-	**48.0**	**D**	**1.01**	-	-
Chestnut Hill Avenue at Route 9 (Brookline)																									
Rt 9 EB L	91.2	F	0.99	190	359	97.7	F	1.01	199	371	97.7	F	1.01	199	371	97.7	F	1.01	199	371	97.7	F	1.01	199	371
Rt 9 EB T	27.5	C	0.75	323	408	30.1	C	0.77	336	423	31.4	C	0.78	344	434	31.6	C	0.78	345	435	31.4	C	0.78	344	434
Rt 9 WB L	43.6	D	0.13	40	56	43.4	D	0.29	41	56	43.4	D	0.29	41	56	43.4	D	0.29	41	56	43.4	D	0.29	41	56
Rt 9 WB T	59.4	E	0.42	417	503	34.0	E	0.87	432	518	69.9	E	0.87	432	518	34.0	E	0.87	432	518	69.9	E	0.87	432	518
Rt 9 WB R	8.3	A	0.53	107	184	7.6	A	0.59	113	189	8.6	A	0.59	113	190	7.6	A	0.59	113	190	8.6	A	0.59	113	190
Chestnut Hill Ave SB L	92.3	F	0.25	301	490	98.9	F	1.06	314	505	98.9	F	1.06	314	505	98.9	F	1.06	314	505	98.9	F	1.06	314	505
Chestnut Hill Ave SB R	9.4	A	0.25	17	99	9.6	A	0.60	18	102	9.6	A	0.60	18	102	9.6	A	0.60	18	102	9.6	A	0.60	18	102
Overall Intersection	**44.1**	**D**	**1.04**	-	-	**49.1**	**D**	**1.06**	-	-	**49.5**	**D**	**1.06**	-	-	**49.5**	**D**	**1.06**	-	-	**49.5**	**D**	**1.06**	-	-
Hammond Street at Route 9 (Brookline)																									
Rt 9 EB L	124.7	F	0.99	141	287	130.3	F	1.01	146	298	130.3	F	1.01	146	298	130.3	F	1.01	146	298	130.3	F	1.01	146	298
Rt 9 EB T	66.2	E	0.99	506	665	72.1	E	1.01	538	693	76.7	E	1.03	572	713	77.1	E	1.03	574	714	76.7	E	1.03	572	713
Hammond St NB T	380.7	F	1.75	403	441	401.1	F	1..80	420	456	401.1	F	1..80	420	456	401.1	F	1..80	420	456	401.1	F	1..80	420	456
Rt 9 WB L	243.1	F	1.37	254	420	254.5	F	1.40	263	429	254.5	F	1.40	263	429	254.5	F	1.40	263	429	254.5	F	1.40	263	429
Rt 9 WB T	89.2	F	1.08	642	781	98.8	F	1.10	673	814	99.1	F	1.10	674	814	99.1	F	1.10	674	814	99.1	F	1.10	674	814
Rt 9 WB R	0.2	A	0.05	0	0	0.2	A	0.05	0	0	0.2	A	0.05	0	0	0.2	A	0.05	0	0	0.2	A	0.05	0	0
Hammond St SB L	173.3	F	1.16	153	258	190.1	F	1.21	160	265	190.1	F	1.21	160	265	190.1	F	1.21	160	265	190.1	F	1.21	160	265
Hammond St SB T	36.3	D	0.54	101	133	36.8	D	0.55	104	137	36.8	D	0.55	104	137	36.8	D	0.55	104	137	36.8	D	0.55	104	137
Overall Intersection	**135.7**	**F**	**1.75**	-	-	**145.2**	**F**	**1.80**	-	-	**146.3**	**F**	**1.80**	-	-	**146.4**	**F**	**1.80**	-	-	**146.3**	**F**	**1.80**	-	-
Canterbury Lane at Morton Street (Boston)																									
Canterbury Ln EB LR	27.7	C	0.45	42	57	31.3	C	0.49	48	63	30.1	C	0.51	48	65	30.3	C	0.51	48	65	30.1	C	0.51	48	65
Morton St NB L	5.2	A	0.07	3	12	5.0	A	0.08	3	12	6.9	A	0.21	9	32	6.8	A	0.21	9	32	6.9	A	0.21	9	32
Morton St NB T	10.3	B	0.73	219	464	10.0	B	0.74	237	422	10.6	B	0.75	246	470	10.7	B	0.75	248	476	10.6	B	0.75	246	470
Morton St SB T	5.6	A	0.44	86	148	5.4	A	0.44	92	156	5.5	A	0.43	90	154	5.5	A	0.43	90	153	5.5	A	0.43	90	154

Intersection Operational Analysis Results: Morning Peak Hour																									
	Existing					**No-Build**					**Build Alternative 3**					**Build Alternative 4**					**Build Alternative 10**				
	Delay (SEC)	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**
Overall Intersection	**9.2**	**A**	**0.73**	**-**	**-**	**9.2**	**A**	**0.74**	**-**	**-**	**9.6**	**A**	**0.75**	**-**	**-**	**9.7**	**A**	**0.75**	**-**	**-**	**9.6**	**A**	**0.75**	**-**	**-**
Morton Street at Harvard Street (Boston)																									
Harvard St EB L	3228.8	F	8.13	737	954	3337.3	F	8.35	759	977	3337.3	F	8.35	759	977	3337.3	F	8.35	759	977	3337.3	F	8.35	759	977
Harvard St EB T	30.9	C	0.38	185	264	31.1	C	0.39	190	272	31.3	C	0.39	190	272	31.3	C	0.39	190	272	31.1	C	0.39	190	272
Morton St NB L	71.2	E	0.22	18	46	71.2	E	0.22	18	46	71.2	E	0.22	18	46	71.2	E	0.22	18	46	71.2	E	0.22	18	46
Morton St NB T	56.6	E	0.96	645	803	60.0	E	0.97	671	837	70.9	E	1.02	766	905	72.1	E	1.03	772	912	70.9	E	1.02	766	905
Harvard St WB L	53.9	D	0.19	28	60	54.1	D	0.19	29	60	54.1	D	0.19	29	60	54.1	D	0.19	29	60	54.1	D	0.19	29	60
Harvard St WB T	113.7	F	1.03	307	451	122.2	F	1.06	324	468	122.2	F	1.06	324	468	122.2	F	1.06	324	468	122.2	F	1.06	324	468
Morton St SB L	9.3	F	0.73	75	159	101.4	F	0.74	77	160	101.4	F	0.74	77	160	101.4	F	0.74	77	160	101.4	F	0.74	77	160
Morton St SB T	31.1	C	0.56	326	407	31.3	C	0.57	337	420	31.4	C	0.58	342	426	31.4	C	0.57	342	425	31.4	C	0.58	342	426
Overall Intersection	**449.6**	**F**	**8.13**	**-**	**-**	**465.8**	**F**	**8.35**	**-**	**-**	**461.4**	**F**	**8.35**	**-**	**-**	**461.3**	**F**	**8.35**	**-**	**-**	**461.4**	**F**	**8.35**	**-**	**-**
Morton Street at Blue Hill Avenue (Boston)																									
Morton St EB T	31.8	C	0.52	176	232	32.2	C	0.53	182	238	32.1	C	0.53	185	242	32.0	C	0.52	185	242	32.1	C	0.53	185	242
Morton St EB R	5.3	A	0.42	0	58	5.3	A	0.43	0	59	5.2	A	0.42	0	59	5.2	A	0.42	0	59	5.2	A	0.42	0	59
Blue Hill Ave NB L	69.0	E	0.89	232	298	73.1	E	0.92	240	413	76.0	E	0.93	240	413	76.0	E	0.93	240	413	76.0	E	0.90	240	413
Blue Hill Ave NB T	46.3	D	0.86	299	380	47.1	D	0.87	309	396	47.2	D	0.87	309	396	48.0	D	0.87	309	396	48.0	D	0.87	309	396
Morton St WB T	42.1	D	0.85	321	1550	43.5	D	0.87	332	417	47.2	D	0.90	367	491	47.7	D	0.91	371	497	47.2	D	0.93	367	491
Blue Hill Ave SB L	484.4	F	1.91	144	268	516.7	F	1.98	149	237	536.0	F	2.02	149	273	536.1	F	2.02	149	273	536.0	F	2.02	149	273
Overall Intersection	**55.1**	**E**	**1.91**	**-**	**-**	**57.3**	**E**	**1.98**	**-**	**-**	**59.1**	**E**	**2.02**	**-**	**-**	**59.2**	**E**	**2.02**	**-**	**-**	**59.1**	**E**	**2.02**	**-**	**-**
Morton Street at Norfolk Street (Boston)																									
Morton St EB L	45.8	D	0.51	110	196	45.4	D	0.51	54	94	45.4	D	0.51	54	94	45.4	D	0.51	54	94	45.4	D	0.51	54	94
Morton St EB T	40.0	D	0.81	196	315	62.9	E	0.98	215	358	65.9	E	0.99	218	365	65.5	E	0.99	218	365	65.9	E	0.99	218	365
Norfolk St NB T	23.3	C	0.43	126	193	20.8	C	0.41	124	185	20.8	C	0.41	124	185	20.8	C	0.41	124	185	20.8	C	0.41	124	185
Norfolk St NB R	8.2	A	0.15	34	47	6.8	A	0.14	31	44	6.8	A	0.14	31	44	6.8	A	0.14	31	44	6.8	A	0.14	31	44
Morton St WB L	38.2	D	0.63	94	136	40.6	D	0.64	99	128	39.5	D	0.64	99	122	39.5	D	0.64	99	122	39.5	D	0.64	99	122
Morton St WB T	39.9	D	0.82	185	373	80.1	F	1.05	214	401	107.6	F	1.13	237	414	110.3	F	1.14	241	419	107.6	F	1.13	237	414
Norfolk St SB LTR	23.3	C	0.43	126	193	22.6	C	0.48	131	202	22.6	C	0.48	131	202	22.6	C	0.48	131	202	22.6	C	0.48	131	202
Overall Intersection	**35.0**	**D**	**0.82**	**-**	**-**	**54.3**	**D**	**1.05**	**-**	**-**	**65.3**	**E**	**1.13**	**-**	**-**	**66.3**	**E**	**1.14**	**-**	**-**	**65.3**	**E**	**1.13**	**-**	**-**
Morton Street at Corbet Street (Boston)																									

Intersection Operational Analysis Results: Morning Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Morton St EB L	26.6	C	0.39	43	59	24.7	C	0.39	44	53	24.6	C	0.39	44	52	24.5	C	0.39	44	52	24.6	C	0.39	44	52
Morton St EB T	33.4	C	347.00	218	265	33.5	C	0.51	230	254	33.6	C	0.52	227	254	33.6	C	0.52	227	255	33.6	C	0.52	227	254
W Selden St NB LTR	28.2	C	0.44	107	143	26.3	C	0.41	107	143	26.3	C	0.41	107	143	26.3	C	0.41	107	143	26.3	C	0.41	107	143
Morton St WB L	54.2	D	0.23	18	43	52.9	C	0.24	19	43	52.3	D	0.24	19	43	52.1	C	0.24	19	42	52.3	C	0.24	19	43
Morton St WB T	20.7	C	0.79	233	368	26.8	D	0.87	253	407	32.4	C	0.93	281	453	33.2	D	0.93	284	458	32.4	D	0.93	281	453
Morton St WB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Corbet St SB LTR	28.3	C	0.39	58	85	26.1	C	0.36	58	84	26.1	C	0.36	58	84	26.1	C	0.36	58	84	26.1	C	0.36	58	84
Overall Intersection	**26.6**	**C**	**0.79**	-	-	**29.2**	**C**	**0.87**	-	-	**31.8**	**C**	**0.93**	-	-	**32.2**	**C**	**0.93**	-	-	**32.0**	**C**	**0.92**	-	-
Morton Street at Woodmere Street/Gallivan Boulevard (Boston)																									
Morton St SEB L	20.8	C	0.69	189	129	19.5	B	0.71	193	93	19.9	B	0.72	197	95	19.8	B	0.72	197	94	19.9	B	0.41	197	95
Morton St SEB T	23.3	C	0.67	186	162	22.5	C	0.69	183	114	22.3	C	0.69	175	109	22.3	C	0.69	175	111	22.3	C	0.69	175	109
Woodmere St NEB LTR	7.2	A	0.42	0	3	7.9	A	0.43	0	6	7.9	A	0.43	0	6	7.9	A	0.43	0	6	7.9	A	0.43	0	6
Morton St NWB LT	13.8	B	0.30	83	110	13.9	B	0.31	85	113	13.9	B	0.31	85	113	13.9	B	0.31	85	113	13.9	B	0.31	85	113
Gallivan Blvd WB T	0.7	A	0.70	0	0	0.7	A	0.36	0	0	0.8	A	0.41	0	0	0.8	A	0.41	0	0	0.8	A	0.41	0	0
Overall Intersection	**13.6**	**B**	**0.69**	-	-	**13.2**	**B**	**0.71**	-	-	**13.0**	**B**	**0.72**	-	-	**12.9**	**B**	**0.72**	-	-	**13.0**	**B**	**0.72**	-	-
Gallivan Boulevard at Washington Street (Boston)																									
Gallivan Blvd EB LT	16.4	B	0.60	91	173	17.2	B	0.62	99	179	17.3	B	0.63	102	183	17.3	B	0.63	102	183	17.3	B	0.63	102	183
Gallivan Blvd EB R	4.4	A	0.06	0	15	4.5	A	0.06	0	15	4.5	A	0.06	0	15	4.5	A	0.06	0	15	4.5	A	0.06	0	15
Washington St NB LTR	19.0	B	0.63	100	211	19.0	B	0.62	106	473	19.2	B	0.63	108	217	19.2	B	0.63	108	217	19.2	B	0.63	108	217
Gallivan Blvd WB LTR	13.7	B	0.45	60	121	14.3	B	0.47	65	980	15.0	B	0.52	77	142	15.1	B	0.52	78	144	15.0	B	0.52	77	142
Washington St SB LTR	29.7	C	0.80	98	238	30.4	C	0.80	105	498	31.5	C	0.81	107	267	31.5	C	0.81	107	267	31.5	C	0.81	107	267
Overall Intersection	**18.4**	**B**	**0.80**	-	-	**18.9**	**B**	**0.80**	-	-	**19.2**	**B**	**0.81**	-	-	**19.3**	**B**	**0.81**	-	-	**19.2**	**B**	**0.81**	-	-
Gallivan Boulevard at Dorchester Avenue (Boston)																									
Gallivan Blvd EB T	12.2	B	0.65	67	130	13.1	B	0.68	71	136	13.8	B	0.69	73	145	13.8	B	0.69	73	144	13.7	B	0.69	73	144
Dorchester Ave NB LTR	20.0	C	0.70	65	128	20.2	C	0.70	67	131	20.2	C	0.70	67	131	20.2	C	0.70	67	131	20.2	C	0.59	67	131
Gallivan Blvd WB T	10.4	B	0.52	48	95	10.8	B	0.54	51	98	11.4	B	0.59	58	111	11.5	B	0.60	58	113	11.4	B	0.60	57	111
Dorchester Ave SB LTR	21.5	C	0.70	55	115	22.3	C	0.71	57	123	22.3	C	0.71	57	123	22.3	C	0.71	57	123	22.3	C	0.71	57	123
Overall Intersection	**14.3**	**B**	**0.70**	-	-	**14.9**	**B**	**0.71**	-	-	**15.2**	**B**	**0.71**	-	-	**15.2**	**B**	**0.71**	-	-	**15.2**	**B**	**0.71**	-	-
Gallivan Boulevard at Granite Avenue/Adams Street (Boston)																									

Intersection Operational Analysis Results: Morning Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Gallivan Blvd EB L	25.4	C	0.49	66	126	27.9	C	0.52	71	135	28.4	C	0.56	69	130	28.6	C	0.56	69	130	28.4	C	0.56	69	130
Gallivan Blvd EB T	35.8	D	0.87	388	594	41.0	D	0.91	423	646	38.8	D	0.90	413	635	38.7	D	0.90	412	634	38.8	D	0.90	413	635
Granite Ave NB L	26.1	C	0.71	167	241	25.3	C	0.71	173	247	26.7	C	0.73	173	249	26.7	C	0.73	173	249	26.7	C	0.73	173	249
Granite Ave NB TR	35.9	D	0.69	242	367	38.0	D	0.71	259	389	36.5	D	0.70	251	379	36.5	D	0.70	251	379	36.5	D	0.70	251	379
Gallivan Blvd WB L	88.6	F	0.73	32	103	96.2	F	0.76	34	108	92.5	F	0.75	33	107	92.5	F	0.75	33	107	92.5	F	0.75	33	107
Gallivan Blvd WB T	34.7	C	0.56	147	206	36.4	D	0.58	157	218	37.5	D	0.65	181	248	37.7	D	0.66	184	251	37.5	D	0.65	181	248
Adams St SB L	20.1	C	0.37	44	77	19.6	B	0.37	45	78	20.4	C	0.39	45	79	20.4	C	0.39	45	79	20.4	X	0.39	45	79
Adams St SB T	40.2	D	0.50	125	218	42.2	D	0.52	132	229	40.9	D	0.51	129	224	40.9	D	0.51	129	224	40.9	D	0.51	129	224
Adams St SB R	4.9	A	0.19	0	40	5.1	A	0.20	0	41	4.9	A	0.20	0	41	4.9	A	0.20	0	41	4.9	A	0.20	0	41
Overall Intersection	**33.3**	**C**	**0.87**	-	-	**36.1**	**D**	**0.91**	-	-	**35.4**	**D**	**0.90**	-	-	**35.4**	**D**	**0.90**	-	-	**35.4**	**D**	**0.90**	-	-
Gallivan Boulevard at Hallet Street (Boston)																									
Gallivan Blvd EB T	24.2	C	0.70	194	403	29.5	C	0.80	210	419	26.3	C	0.81	213	425	26.2	C	0.81	213	424	26.3	C	0.81	213	425
Hallet St NB L	37.5	D	0.33	21	61	38.2	D	0.35	22	62	38.2	D	0.35	22	62	38.2	D	0.48	22	62	38.2	D	0.35	22	62
Hallet St NB R	36.2	D	0.87	182	442	35.5	D	0.42	87	148	35.5	D	0.87	188	458	35.5	D	0.35	104	173	35.5	D	0.87	188	458
Gallivan Blvd WB T	17.1	B	0.40	81	531	17.6	B	0.87	188	458	18.3	B	0.48	102	171	18.4	B	0.87	188	458	18.3	B	0.48	102	171
Hallet St SB L	33.0	C	0.09	6	22	33.2	C	0.09	6	22	33.2	C	0.09	6	22	33.2	C	0.09	6	22	33.2	C	0.09	6	22
Hallet St SB T	17.1	B	0.22	36	62	16.9	B	0.21	37	63	16.9	B	0.21	37	63	16.9	B	0.21	37	63	16.9	B	0.21	37	63
Overall Intersection	**25.3**	**C**	**0.87**	-	-	**26.1**	**C**	**0.87**	-	-	**26.1**	**C**	**0.87**	-	-	**26.1**	**C**	**0.87**	-	-	**26.1**	**C**	**0.87**	-	-
Gallivan Boulevard at Neponset Avenue (Boston)																									
Neponset Ave EB L	11.1	B	0.38	11	43	11.4	B	0.39	12	44	11.4	B	0.39	12	44	11.4	B	0.39	12	44	11.6	B	0.40	12	44
Neponset Ave EB T	19.3	B	0.66	45	69	19.7	B	0.67	46	70	19.7	B	0.67	46	70	19.7	B	0.67	46	70	19.7	B	0.67	46	70
Gallivan Blvd NB T	9.6	A	0.69	95	148	9.9	A	0.71	100	155	9.9	A	0.71	100	155	9.9	A	0.71	101	156	9.9	A	0.71	101	156
Gallivan Blvd NB R	8.3	A	0.62	61	106	8.5	A	0.63	64	111	8.5	A	0.63	64	111	8.5	A	0.63	64	111	8.5	A	0.63	64	111
Overall Intersection	**11.2**	**B**	**0.69**	-	-	**11.5**	**B**	**0.71**	-	-	**11.5**	**B**	**0.71**	-	-	**11.5**	**B**	**0.71**	-	-	**11.5**	**B**	**0.71**	-	-
Neponset Avenue at Morrissey Boulevard (Boston)																									
Neponset Ave EB T	9.7	A	0.46	27	52	9.8	A	0.47	27	53	9.8	A	0.47	27	53	9.8	A	0.47	27	53	9.8	A	0.47	27	53
Morrissey Blvd SB L	9.8	A	0.31	27	75	9.9	A	0.32	29	76	10.1	B	0.34	32	83	10.2	B	0.35	32	83	10.1	B	0.34	32	83
Morrissey Blvd SB T	8.3	A	0.32	29	56	8.4	A	0.33	31	58	8.5	A	0.35	33	62	8.5	A	0.35	33	62	8.5	A	0.35	34	63
Morrissey Blvd SB R	3.0	A	0.25	0	25	3.0	A	0.65	0	26	3.0	A	0.26	0	26	3.0	A	0.26	0	26	3.0	A	0.26	0	26

Intersection Operational Analysis Results: Morning Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Overall Intersection	**8.3**	**A**	**0.46**	**-**	**-**	**8.3**	**A**	**0.47**	**-**	**-**	**8.4**	**A**	**0.47**	**-**	**-**	**8.5**	**A**	**0.47**	**-**	**-**	**8.4**	**A**	**0.47**	**-**	**-**
South Street at Washington Street (Boston)																									
South St EB L	64.8	E	0.88	285	363	64.7	E	0.89	291	374	64.7	E	0.89	292	375	64.7	E	0.89	292	375	64.7	E	0.89	292	375
Washington St NB T	13.3	B	0.50	181	261	14.0	B	0.90	192	271	14.1	B	0.53	194	272	14.0	B	0.53	192	273	14.1	B	0.53	194	272
South St SB T	10.0	B	0.36	68	83	10.1	B	0.30	70	86	10.4	B	0.39	74	91	11.0	B	0.39	76	93	10.4	B	0.39	74	91
Overall Intersection	**22.6**	**C**	**0.88**	**-**	**-**	**23.0**	**C**	**0.89**	**-**	**-**	**23.1**	**C**	**0.89**	**-**	**-**	**23.0**	**C**	**0.89**	**-**	**-**	**23.1**	**C**	**0.89**	**-**	**-**
South Street at Arborway/New Washington Street (Boston)																									
Arborway EB T	17.5	B	0.27	108	152	17.9	B	0.28	113	156	18.0	B	0.29	117	161	17.9	B	0.28	113	156	18.0	B	0.29	117	161
Arborway EB R	1.9	A	0.25	30	45	1.9	A	0.26	31	46	1.9	A	0.26	31	46	1.9	A	0.28	34	50	1.9	A	0.26	31	46
South St NB L	53.7	D	0.92	164	240	56.2	E	0.94	159	257	56.1	E	0.94	158	255	56.1	E	0.94	159	254	56.1	E	0.94	158	255
South St NB T	45.4	D	0.93	321	376	47.6	D	0.84	328	387	47.9	D	0.84	330	387	47.9	D	0.84	330	387	47.9	D	0.84	330	387
New Washington St WB T	23.3	C	0.71	365	465	25.2	C	0.73	407	508	26.6	C	0.74	423	521	26.9	C	0.74	427	525	26.6	C	0.74	423	521
South St SB L	91.3	F	0.95	77	154	100.2	F	0.99	11	162	100.2	F	0.99	77	162	100.2	F	0.99	77	162	100.2	F	0.99	77	162
South St SB T	42.5	D	0.58	176	234	42.3	D	0.58	179	241	42.3	D	0.58	179	241	42.3	D	0.58	179	241	42.3	D	0.58	179	241
Overall Intersection	**30.5**	**C**	**0.95**	**-**	**-**	**32.4**	**C**	**0.99**	**-**	**-**	**32.8**	**C**	**0.99**	**-**	**-**	**32.8**	**C**	**0.99**	**-**	**-**	**32.8**	**C**	**0.99**	**-**	**-**
Washington Street at Arborway (Boston)																									
New Washington St EB T	50.7	D	0.85	316	416	53.0	D	0.80	339	431	53.3	D	0.88	341	432	53.0	D	0.88	341	432	53.3	D	0.88	341	432
Washington St NB L	35.8	D	0.32	62	96	36.1	D	0.48	62	99	36.1	D	0.48	62	99	36.1	D	0.48	62	99	36.1	D	0.48	62	99
Washington St NB TR	41.2	D	0.32	280	314	41.3	D	0.76	284	323	41.3	D	0.76	284	323	41.3	D	0.76	284	323	41.3	D	0.76	284	323
Arborway WB L	149.6	F	0.22	63	100	172.3	F	1.16	70	103	171.5	F	1.16	71	102	172.0	F	1.16	71	102	171.5	F	1.16	71	102
Arborway WB T	12.8	B	0.58	176	263	13.5	B	0.53	193	274	13.9	B	0.53	201	283	13.5	B	0.55	202	284	13.9	B	0.54	201	283
Washington St SB L	54.6	D	0.22	38	75	56.0	E	0.52	39	79	56.7	E	0.52	39	79	56.0	E	0.52	39	79	56.7	E	0.52	39	79
Washington St SB TR	43.7	D	0.22	143	173	43.5	D	0.54	145	178	43.5	D	0.54	145	178	43.5	D	0.54	145	178	43.5	D	0.54	145	178
Overall Intersection	**36.0**	**D**	**1.09**	**-**	**-**	**37.5**	**D**	**1.16**	**-**	**-**	**37.6**	**D**	**1.16**	**-**	**-**	**37.5**	**D**	**1.16**	**-**	**-**	**37.6**	**D**	**1.16**	**-**	**-**
Arborway at Morton Street/Circuit Drive (Boston)																									
Arborway EB L	64.1	E	0.84	187	225	63.4	E	0.85	191	222	63.1	E	0.85	191	222	63.0	E	0.84	191	222	63.1	E	0.85	191	222
Arborway EB T	12.3	B	0.29	78	137	12.8	B	0.30	95	136	12.8	B	0.30	96	136	12.8	B	0.30	96	136	12.8	B	0.30	96	136
Morton St NB T	37.4	D	0.27	50	50	37.4	D	0.27	50	50	37.4	D	0.27	50	50	37.4	D	0.27	50	50	37.4	D	0.27	50	50
Morton St WB L	58.7	E	0.19	14	38	58.7	E	0.19	14	38	58.7	E	0.19	14	38	58.7	E	0.19	14	38	58.7	E	0.19	14	38

Intersection Operational Analysis Results: Morning Peak Hour																									
	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Morton St WB T	30.3	C	0.73	390	476	32.6	C	0.75	405	495	34.5	C	0.76	416	507	35.0	C	0.77	420	513	34.5	C	0.76	416	507
Circuit Dr SB T	48.7	D	0.28	53	79	52.2	D	0.29	54	80	43.3	D	0.29	54	80	53.0	D	0.29	54	80	43.3	D	0.29	54	80
Overall Intersection	**35.7**	**D**	**0.91**	**-**	**-**	**37.4**	**D**	**0.94**	**-**	**-**	**38.1**	**D**	**0.94**	**-**	**-**	**38.0**	**D**	**0.94**	**-**	**-**	**38.1**	**D**	**0.94**	**-**	**-**

Intersection Operational Analysis Results: Evening Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Trapelo Road at Lexington Street (Waltham)																									
Trapelo Rd EB L	56.3	E	0.55	108	187	57.4	E	0.56	112	191	57.4	E	0.56	112	191	57.4	E	0.56	112	191	57.4	E	0.56	112	191
Trapelo Rd EB T	27.9	C	0.50	139	206	28.5	C	0.51	145	213	29.6	C	0.52	155	224	28.7	C	0.51	146	214	29.6	C	0.52	155	224
Lexington St NB L	61.9	E	0.66	123	197	63.5	E	0.68	126	201	63.5	E	0.68	126	201	63.5	E	0.68	126	201	63.5	E	0.68	126	201
Lexington St NB T	39.5	D	0.62	188	263	40.2	D	0.62	194	270	40.2	D	0.62	194	270	40.2	D	0.62	194	270	40.2	D	0.62	194	270
Trapelo Rd WB L	64.6	E	0.71	144	262	66.9	E	0.74	149	274	66.9	E	0.74	149	274	66.9	E	0.74	149	274	66.9	E	0.74	149	274
Trapelo Rd WB T	47.1	D	0.75	296	444	48.3	D	0.76	307	457	48.3	D	0.76	307	457	48.3	D	0.76	307	457	48.3	D	0.76	307	457
Trapelo Rd WB R	15.5	B	0.31	38	101	16.0	B	0.32	41	105	16.0	B	0.32	41	105	16.0	B	0.32	41	105	16.0	B	0.32	41	105
Lexington St SB L	57.3	E	0.57	107	175	58.5	E	0.59	110	180	58.5	E	0.59	110	180	58.5	E	0.59	126	201	58.5	E	0.59	110	180
Lexington St SB T	44.0	D	0.71	233	318	44.9	D	0.72	247	327	44.9	D	0.72	241	327	44.9	D	0.72	241	327	44.9	D	0.72	241	327
Overall Intersection	**42.6**	**D**	**0.75**	-	-	**42.6**	**D**	**0.75**	-	-	**43.7**	**D**	**0.76**	-	-	**43.6**	**D**	**0.75**	-	-	**43.7**	**D**	**0.76**	-	-
Trapelo Road at Waverley Oaks Road (Waltham)																									
Trapelo Rd EB T	28.8	C	0.77	118	234	29.3	C	0.78	123	246	30.8	C	0.80	128	260	29.3	C	0.78	123	245	31.0	C	0.80	128	260
Waverley Oaks Rd NB L	118.4	F	1.19	307	505	134.6	F	1.23	325	524	136.0	F	1.23	325	524	134.6	F	1.23	325	524	136.0	F	1.23	325	524
Trapelo Rd WB L	220.4	F	1.39	219	371	238.8	F	1.43	227	380	241.6	F	1.44	227	380	238.8	F	1.43	227	380	242.0	F	1.44	227	380
Trapelo Rd WB T	9.7	A	0.43	80	136	9.8	A	0.43	83	140	9.7	A	0.43	83	140	9.8	A	0.43	83	140	10.0	A	0.43	83	140
Overall Intersection	**99.9**	**F**	**1.39**	-	-	**110.1**	**F**	**1.43**	-	-	**110.8**	**F**	**1.44**	-	-	**110.1**	**F**	**1.43**	-	-	**111.0**	**F**	**1.44**	-	-
Beaver Street at Waverley Oaks Road (Waltham)																									
Beaver St EB L	0.8	E	0.75	79	189	61.8	E	0.77	83	196	61.8	E	0.77	83	207	61.8	E	0.77	83	196	61.8	E	0.77	83	196
Beaver St EB T	0.6	C	0.63	199	389	28.8	C	0.65	207	405	28.8	C	0.65	207	405	28.8	C	0.65	207	405	28.8	C	0.65	207	405
Waverley Oaks Rd NB L	0.2	D	0.14	11	29	41.5	D	0.18	11	29	41.5	D	0.18	11	29	41.5	D	0.18	11	29	41.5	D	0.18	11	29
Waverley Oaks Rd NB T	0.7	D	0.72	127	168	44.0	D	0.73	130	172	44.0	D	0.73	130	172	44.0	D	0.73	130	172	44.0	D	0.73	130	172
Waverley Oaks Rd NB R	0.2	A	0.19	0	13	5.1	A	0.20	0	13	5.1	A	0.20	0	13	5.1	A	0.20	0	13	5.1	A	0.20	0	13
Beaver St WB L	0.4	D	0.43	34	77	46.0	D	0.45	35	78	46.0	D	0.45	35	78	46.0	D	0.45	35	78	46.0	D	0.45	35	78
Beaver St WB T	0.7	C	0.69	167	262	24.2	C	0.71	174	271	24.2	C	0.71	174	271	24.2	C	0.71	174	271	24.2	C	0.71	174	271
Waverley Oaks Rd SB L	0.8	D	0.76	103	199	54.3	D	0.77	106	205	54.3	D	0.77	106	205	54.3	D	0.77	106	205	54.3	D	0.77	106	205
Waverley Oaks Rd SB T	0.4	A	0.40	188	167	24.5	C	0.41	91	170	25.0	C	0.44	99	184	24.5	C	0.47	107	196	25.0	C	0.44	99	184
Waverley Oaks Rd SB R	0.3	A	0.32	0	41	4.8	A	0.32	0	42	4.8	A	0.32	0	42	4.8	A	0.32	0	42	4.8	A	0.33	0	42

Intersection Operational Analysis Results: Evening Peak Hour																									
	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Overall Intersection	**29.6**	**C**	**0.76**	**-**	**-**	**30.3**	**C**	**0.77**	**-**	**-**	**30.4**	**C**	**0.77**	**-**	**-**	**30.3**	**C**	**0.77**	**-**	**-**	**30.0**	**C**	**0.77**	**-**	**-**
Main Street at Ellison Park/Linden Street (Waltham)																									
Main St EB L	1327.4	F	3.83	307	477	416.4	F	1.83	247	441	416.4	F	1.83	247	441	416.4	F	1.83	247	441	416.4	F	1.83	247	441
Main St EB T	47.5	D	0.84	236	426	50.4	D	0.87	246	445	50.4	D	0.87	246	445	50.4	D	0.87	246	445	50.4	D	0.87	246	445
Linden St NB LTR	32.4	C	0.06	8	14	0.2	A	0.04	0	0	0.2	A	0.04	0	0	0.2	A	0.04	0	0	0.2	A	0.04	0	0
Main St WB T	33.5	C	0.79	127	180	35.1	D	0.81	134	192	35.1	D	0.81	134	192	35.1	D	0.81	134	192	35.1	D	0.81	134	192
Linden St SWB L	37.1	D	0.43	72	135	21.3	C	0.21	38	73	21.3	C	0.21	38	73	21.1	C	0.20	37	72	21.3	C	0.21	75	139
Linden St SWB R	211.9	F	1.35	298	490	38.7	D	0.45	75	139	38.7	D	0.45	75	139	38.7	D	0.45	75	139	38.7	D	0.45	335	535
Ellison Park SB L	21.2	C	0.20	37	71	228.3	F	1.39	312	507	256.0	F	1.46	335	535	281.1	F	1.52	356	558	21.3	C	1.39	312	507
Ellison Park SB T	21.2	C	0.20	37	71	21.2	C	0.20	37	72	21.1	C	0.20	37	72	21.3	C	0.21	38	73	21.2	C	0.21	38	73
Overall Intersection	**251.1**	**F**	**3.83**	**-**	**-**	**126.9**	**F**	**1.83**	**-**	**-**	**133.2**	**F**	**1.83**	**-**	**-**	**126.9**	**F**	**1.83**	**-**	**-**	**126.9**	**F**	**1.83**	**-**	**-**
Main Street at Elm Street (Waltham)																									
Main St EB L	5.2	A	0.18	24	25	5.2	A	0.19	23	25	5.2	A	0.19	23	25	5.2	A	0.20	22	25	5.2	A	0.19	23	25
Main St EB T	16.6	B	0.61	313	315	17.0	B	0.63	314	330	17.6	B	0.63	314	330	17.5	B	0.63	306	330	18.0	B	0.63	314	330
Main St EB R	32.9	C	0.86	96	324	33.8	C	0.86	107	342	34.3	C	0.87	107	342	34.8	C	0.87	109	342	34.0	C	0.87	107	342
Elm St NB T	44.0	D	0.60	107	192	43.4	D	0.59	113	199	43.7	D	0.60	113	199	44.0	D	0.60	114	199	44.0	D	60.00	113	199
Main St WB L	5.1	A	0.14	13	16	5.1	A	0.15	13	16	5.0	A	0.15	13	16	4.9	A	0.15	13	16	5.0	A	0.15	13	16
Main St WB T	12.2	B	0.43	182	188	127.0	B	0.45	183	196	12.8	B	0.47	193	206	13.0	B	0.48	198	216	13.0	B	0.47	193	206
Overall Intersection	**23.0**	**C**	**0.86**	**-**	**-**	**23.6**	**C**	**0.86**	**-**	**-**	**23.6**	**C**	**0.87**	**-**	**-**	**23.7**	**C**	**0.87**	**-**	**-**	**24.0**	**C**	**0.87**	**-**	**-**
Main Street at Moody Street (Waltham)																									
Main St EB T	17.2	B	0.54	76	117	17.4	B	0.55	78	121	17.4	B	0.55	78	121	17.4	B	0.55	78	121	17.4	B	0.55	78	121
Main St EB R	17.1	B	0.38	43	88	17.2	B	0.39	44	90	17.2	B	0.39	44	90	17.2	B	0.39	44	90	17.2	B	0.39	44	90
Moody St NB L	17.8	B	0.33	59	104	18.0	B	0.46	60	107	18.0	B	0.46	60	107	18.0	B	0.46	60	107	18.0	B	0.46	60	107
Moody St NB T	15.9	B	0.33	44	81	16.0	B	0.34	45	82	16.0	B	0.34	45	82	16.0	B	0.34	45	82	16.0	B	0.34	45	82
Moody St NB R	17.0	B	0.09	0	67	17.0	B	0.72	0	68	17.0	B	0.72	0	68	17.0	B	0.72	0	68	17.0	B	0.72	0	68
Main St WB L	560.3	F	0.09	169	297	582.0	F	2.21	175	304	584.2	F	2.21	175	304	584.2	F	2.21	175	304	584.0	F	2.21	175	304
Main St WB TR	17.3	B	0.50	123	234	18.1	B	0.73	128	252	19.4	B	0.76	135	298	20.6	C	0.78	141	310	19.0	B	0.76	135	298
Overall Intersection	**91.8**	**F**	**2.15**	**-**	**-**	**95.4**	**F**	**2.21**	**-**	**-**	**95.1**	**F**	**2.21**	**-**	**-**	**94.9**	**F**	**2.21**	**-**	**-**	**95.0**	**F**	**2.21**	**-**	**-**
Main Street at Bacon Street (Waltham)																									

Intersection Operational Analysis Results: Evening Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50^{th} Q (FT)	95^{th} Q (FT)	Delay (SEC)	LOS	v/c	50^{th} Q (FT)	95^{th} Q (FT)	Delay (SEC)	LOS	v/c	50^{th} Q (FT)	95^{th} Q (FT)	Delay (SEC)	LOS	v/c	50^{th} Q (FT)	95^{th} Q (FT)	Delay (SEC)	LOS	v/c	50^{th} Q (FT)	95^{th} Q (FT)
Main St EB L	8.6	A	0.57	18	37	9.5	A	0.59	19	40	10.1	A	0.60	19	42	10.7	B	0.55	19	44	10.2	B	0.60	19	42
Main St EB T	29.0	C	0.88	123	294	31.7	C	0.90	128	304	31.7	C	0.90	128	304	31.7	C	0.90	128	304	31.7	C	0.90	128	304
Main St WB T	9.6	A	0.47	50	82	9.7	A	0.48	52	85	9.8	A	0.49	53	87	10.0	A	0.50	55	90	9.8	A	0.49	53	87
Bacon St SB L	36.5	D	0.63	27	85	37.7	D	0.64	29	87	37.7	D	0.64	28	87	37.7	D	0.64	28	87	37.7	D	0.64	28	87
Bacon St SB R	13.3	B	0.41	36	77	13.5	B	0.42	37	79	14.1	B	0.46	41	87	14.4	B	0.47	42	89	14.1	B	0.46	41	87
Overall Intersection	**18.1**	**B**	**0.88**	**-**	**-**	**19.3**	**B**	**0.90**	**-**	**-**	**19.4**	**B**	**0.90**	**-**	**-**	**19.4**	**B**	**0.90**	**-**	**-**	**19.4**	**B**	**0.90**	**-**	**-**
Main Street at Weston Street/ South Street (Waltham)																									
Main St EB T	38.3	D	0.68	136	185	38.8	D	0.70	140	190	38.8	D	0.70	140	190	38.8	D	0.70	140	190	38.8	D	0.70	140	190
Weston St NEB L	21.0	C	0.41	75	30	21.0	C	0.36	76	133	21.8	C	0.38	77	135	22.1	C	0.39	76	135	21.8	C	0.38	77	135
Weston St NEB R	8.7	A	0.41	131	81	9.0	A	0.33	33	86	9.3	A	0.33	34	88	9.4	A	0.33	35	90	9.3	A	0.33	34	88
Main St WB L1	388.4	F	1.71	121	195	407.0	F	1.75	124	200	407.0	F	1.75	124	200	407.0	F	1.75	124	200	407.0	F	1.75	124	200
Main St WB L2	21.7	C	0.42	123	194	22.0	C	0.44	127	199	23.0	C	0.49	146	227	23.7	C	0.52	158	244	23.0	C	0.49	146	227
Main St WB T	72.8	E	0.96	213	386	78.0	E	0.98	219	398	78.0	E	0.98	219	398	78.0	E	0.98	219	398	78.0	E	0.98	219	398
South St NB HL	57.8	E	0.83	150	249	59.0	E	0.84	155	259	69.2	E	0.91	170	289	70.3	E	0.92	172	292	69.2	E	0.91	170	289
South St NB L	72.2	E	0.92	151	266	74.5	E	0.93	156	275	74.5	E	0.93	156	275	74.5	E	0.93	156	275	74.5	E	0.93	156	275
Overall Intersection	**65.8**	**E**	**1.17**	**-**	**-**	**68.4**	**E**	**1.75**	**-**	**-**	**69.0**	**E**	**1.75**	**-**	**-**	**68.8**	**E**	**1.75**	**-**	**-**	**69.0**	**E**	**1.75**	**-**	**-**
Shakespeare Road at South Street (Waltham)																									
South St NEB LTR	8.8	A	0.01	-	0	8.8	A	0.01	-	0	8.8	A	0.01	-	0	8.8	A	0.01	-	0	8.8	A	0.01	-	0
Pump Station Drwy NB LTR	21.3	C	0.15	-	1	22.0	C	0.16	-	1	19.3	C	0.23	-	1	19.2	C	0.24	-	1	19.3	C	0.23	-	1
South St SWB LTR	8.6	A	0.00	-	0	8.7	A	0.00	-	0	8.7	A	0.00	-	0	8.7	A	0.00	-	0	8.7	A	0.00	-	0
Shakespeare Rd SB LTR	32.0	D	0.11	-	0	33.5	D	0.11	-	0	37.1	E	0.12	-	0	37.4	E	0.13	-	0	37.1	E	0.12	-	0
River Road at South Avenue (Weston)																									
South Ave NEB L	40.6	D	0.68	40	106	42.1	D	0.70	42	110	42.1	D	0.70	42	110	42.1	D	0.70	42	110	42.1	D	0.70	42	110
South Ave NEB T	10.2	B	0.38	41	68	10.5	B	0.39	43	71	11.7	B	0.48	57	90	12.5	B	0.54	66	103	11.0	B	0.40	46	75
I-95 S Exit 39A Off Ramp LT	170.1	F	1.20	55	144	178.5	F	1.22	57	147	372.7	F	1.71	103	209	375.8	F	1.72	104	211	218.0	F	1.33	68	161
I-95 S Exit 39A Off Ramp R	7.0	A	0.59	0	54	7.1	A	0.59	0	50	7.1	A	0.59	0	54	7.1	A	0.59	0	54	7.1	A	0.59	0	54
South Ave WB L	81.9	F	0.96	59	161	87.8	F	0.99	60	165	87.8	F	0.99	60	165	87.8	F	0.99	60	165	87.8	F	0.99	60	165
South Ave WB T	7.4	A	0.51	45	84	7.5	A	0.52	46	87	7.5	A	0.52	46	87	7.5	A	0.52	46	87	7.5	A	0.52	46	87

Intersection Operational Analysis Results: Evening Peak Hour																									
	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
River Rd SB L	131.2	F	1.16	105	202	141.0	F	1.18	109	207	141.0	F	1.18	109	207	234.4	F	1.41	122	220	148.0	F	1.20	110	209
River Rd SB T	98.1	F	1.09	143	253	106.9	F	1.12	150	260	106.9	F	1.12	150	260	106.9	F	1.12	150	260	106.9	F	1.12	150	260
River Rd SB R	6.3	A	0.40	0	33	6.3	A	0.41	0	34	6.3	A	0.41	0	34	6.3	A	0.41	0	34	6.3	A	0.41	0	34
Overall Intersection	**46.6**	**D**	**1.20**	**-**	**-**	**49.6**	**D**	**1.22**	**-**	**-**	**73.4**	**E**	**1.71**	**-**	**-**	**72.9**	**E**	**1.72**	**-**	**-**	**53.0**	**D**	**1.22**	**-**	**-**
I-95 N Off Ramp at South Avenue/Commonwealth Ave (Weston)																									
South Ave EB T	25.9	C	0.90	53	126	9.6	A	0.67	44	74	33.0	C	0.96	55	135	9.3	A	69.00	43	73	10.2	B	0.70	44	74
I-95 N Off Ramp L	12.3	B	0.57	34	68	12.5	B	0.55	35	70	16.0	B	0.67	47	98	12.5	B	0.55	35	71	12.0	B	0.54	38	75
I-95 N Off Ramp R	8.2	A	0.54	18	51	13.1	B	0.66	32	74	8.1	A	0.57	1	53	13.1	B	0.66	32	74	12.0	B	61.00	32	74
Commonwealth Ave WB T	20.1	C	0.89	67	159	22.8	C	0.92	71	165	24.8	C	0.93	165	165	22.8	C	0.92	71	165	27.0	C	0.95	71	165
Overall Intersection	**19.5**	**B**	**0.90**	**-**	**-**	**16.2**	**B**	**0.92**	**-**	**-**	**24.3**	**C**	**0.96**	**-**	**-**	**16.0**	**B**	**0.92**	**-**	**-**	**18.0**	**B**	**0.95**	**-**	**-**
Park Road at South Avenue (Weston)																									
South Ave EB T	26.4	C	0.58	273	427	27.1	C	0.59	285	445	27.1	C	0.59	285	445	27.1	C	0.59	285	445	27.1	C	0.59	285	445
South Ave EB R	1.8	A	0.23	29	43	1.8	A	0.24	30	44	1.8	A	0.24	30	44	1.8	A	0.24	30	44	1.8	A	0.24	30	44
Park Rd NB L	30.6	C	0.53	196	261	30.8	C	0.54	203	271	30.8	C	0.54	203	271	30.8	C	0.54	203	271	30.8	C	0.54	203	271
Park Rd NB LR	18.6	B	0.15	52	92	18.6	B	0.15	53	95	19.8	B	0.24	89	146	19.4	B	0.22	78	130	19.0	B	0.18	61	107
South Ave WB L	23.9	C	0.30	29	66	24.9	C	0.32	30	69	38.6	D	0.66	65	147	25.0	C	0.33	31	70	27.0	C	0.40	30	44
South Ave WB T	92.2	F	1.10	754	1140	104.7	F	1.13	798	1199	104.7	F	1.13	798	1199	104.7	F	1.13	798	1199	104.7	F	1.13	798	1199
Overall Intersection	**47.0**	**D**	**1.10**	**-**	**-**	**51.6**	**D**	**1.13**	**-**	**-**	**50.8**	**D**	**1.13**	**-**	**-**	**51.0**	**D**	**1.13**	**-**	**-**	**51.6**	**D**	**1.13**	**-**	**-**
Central Avenue at Cedar Street (Needham)																									
Central Ave EB L	8.9	A	0.04	-	-	8.9	A	0.04	-	0	9.0	A	0.10	-	0	9.0	A	0.04	-	0	9.0	A	0.04	-	0
Central Ave WB L	0.0	A	-	-	-	0.0	A	-	-	-	0.0	A	-	-	-	0.0	A	-	-	-	0.0	A	-	-	-
Cedar St SB LTR	59.9	F	0.84	-	-	69.8	F	0.88	-	8	74.8	F	0.91	-	8	75.7	F	0.91	-	8	74.8	F	0.91	-	8
Worcester Street at Cedar Street (Wellesley)																									
Worcester St EB L	29.5	C	0.51	69	129	30.3	C	0.51	72	134	32.4	C	0.54	75	142	32.6	C	0.54	76	143	32.4	C	0.54	75	142
Worcester St EB T	27.0	C	0.48	77	139	28.3	C	0.49	80	145	30.3	C	0.50	84	153	30.5	C	0.50	85	153	30.3	C	0.50	84	153
Cedar St NB L	13.9	B	0.04	2	10	13.9	B	0.04	2	10	13.9	B	0.04	2	10	13.9	B	0.04	2	10	13.9	B	0.04	2	10
Cedar St NB T	28.1	C	0.79	208	335	28.6	C	0.80	215	345	29.7	C	0.81	231	373	29.8	C	0.81	232	375	29.7	C	0.81	231	373
Worcester St WB LTR	22.7	C	0.02	3	6	23.3	C	0.02	3	6	25.0	C	0.02	3	6	23.0	C	0.02	3	6	25.0	C	0.02	3	6
Cedar St SB L	8.4	A	0.30	21	41	8.5	A	0.32	22	41	8.8	A	0.37	26	47	8.9	A	0.37	27	47	8.8	A	0.37	26	47

Intersection Operational Analysis Results: Evening Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Cedar St SB T	16.0	B	0.76	249	379	16.8	B	0.78	261	397	15.8	B	0.76	262	393	15.7	B	0.76	262	392	15.8	B	0.76	262	393
Overall Intersection	**21.7**	**C**	**0.79**	-	-	**22.3**	**C**	**0.80**	-	-	**22.6**	**C**	**0.81**	-	`	**22.3**	**C**	**0.81**	-	-	**22.6**	**C**	**0.81**	-	`
Route 9 at Woodward Street/Elliot Street (Newton)																									
Rt 9 EB L	154.8	F	0.98	80	194	184.6	F	1.07	94	216	184.6	F	1.07	94	216	184.6	F	1.07	94	216	184.6	F	1.07	94	216
Rt 9 EB T	68.1	E	1.04	940	1079	78.2	E	1.06	1057	1194	78.4	E	1.07	1058	1195	78.2	E	1.07	1058	1195	78.4	E	1.07	1058	1195
Elliot St NB L	38.3	D	0.18	39	76	40.2	D	0.18	43	80	40.2	D	0.18	43	80	40.2	D	0.18	43	80	40.2	D	0.18	43	80
Elliot St NB T	40.2	D	0.68	238	344	41.9	D	0.68	262	372	41.9	D	0.68	262	372	41.9	D	0.68	262	372	41.9	D	0.68	262	372
Rt 9 WB L	137.3	F	1.02	164	317	146.3	F	1.05	184	342	146.3	F	1.05	184	342	146.3	F	1.05	184	342	146.3	F	1.05	184	342
Rt 9 WB T	55.1	E	1.01	892	1078	61.1	E	1.02	1051	1187	64.1	E	1.03	1072	1208	64.5	E	1.03	1074	1211	64.1	E	1.03	1072	1208
Woodward St SB L	141.0	F	1.08	168	292	157.1	F	1.12	193	322	157.1	F	1.12	193	322	157.1	F	1.12	193	322	157.1	F	1.12	193	322
Overall Intersection	**65.8**	**E**	**1.08**	-	-	**73.7**	**E**	**1.13**	-	-	**75.0**	**E**	**1.13**	-	-	**75.1**	**E**	**1.13**	-	-	**75.0**	**E**	**1.13**	-	-
Grove Street at Newton Street (Brookline)																									
Newton St EB L	41.8	D	0.79	256	359	40.2	D	0.78	262	369	37.7	D	0.76	270	384	37.5	D	0.76	271	385	37.7	D	0.76	270	384
Newton St EB R	3.1	A	0.09	10	26	3.2	A	0.09	10	26	3.3	A	0.09	11	27	3.3	A	0.09	11	27	3.3	A	0.09	11	27
Grove St NB T	34.6	C	0.74	251	349	37.2	D	0.79	263	38	41.8	D	0.85	269	391	42.4	D	0.85	269	392	41.8	D	0.85	269	391
Newton St SB T	433.2	F	1.89	752	892	454.0	F	1.94	778	921	454.0	F	1.94	778	920	454.0	F	1.94	778	920	454.0	F	1.94	778	920
Newton St SB R	7.8	A	0.65	103	157	7.9	A	0.66	109	161	7.3	A	0.65	109	158	7.2	A	0.65	108	157	7.3	A	0.65	109	158
Overall Intersection	**187.5**	**F**	**1.89**	-	-	**196.2**	**F**	**1.94**	-	-	**195.9**	**F**	**1.94**	-	-	**196.2**	**F**	**1.94**	-	-	**195.9**	**F**	**1.94**	-	-
Newton Street at Clyde Street (Brookline)																									
Newton St EB L	502.2	F	2.03	396	574	523.7	F	2.08	410	565	566.9	F	2.18	437	575	571.8	F	2.19	440	576	566.9	F	2.18	437	575
Newton St EB T	526.7	F	2.10	439	572	549.5	F	2.15	455	587	551.4	F	2.16	457	577	551.3	F	2.16	457	574	551.4	F	2.16	457	577
Newton St WB T	40.6	D	0.88	315	400	41.7	D	0.89	327	417	41.7	D	0.89	327	417	41.7	D	0.89	327	417	41.7	D	0.89	327	417
Clyde St SB L	23.0	C	0.36	115	181	23.3	C	0.37	119	186	23.3	C	0.37	119	186	23.3	C	0.37	119	186	23.3	C	0.37	119	186
Clyde St SB R	17.4	B	0.64	242	318	18.0	B	0.66	252	331	18.1	B	0.66	253	332	18.1	B	0.66	253	332	18.1	B	0.66	253	332
Overall Intersection	**191.4**	**F**	**2.10**	-	-	**199.3**	**F**	**2.15**	-	-	**206.2**	**F**	**2.18**	-	-	**207.0**	**F**	**2.19**	-	-	**206.2**	**F**	**2.18**	-	-
Lee Street at Route 9 (Brookline)																									
Rt 9 EB T	16.7	B	0.67	287	374	18.1	B	0.70	313	397	19.0	B	0.71	334	400	19.1	B	0.71	336	400	19.0	B	0.71	334	400
Rt 9 EB R	2.6	A	0.53	34	35	2.7	A	0.54	35	36	2.7	A	0.56	35	36	2.7	A	0.54	35	36	2.7	A	0.54	35	36
Lee St NB L	43.1	B	0.75	211	247	42.5	D	0.75	216	249	42.7	D	0.75	225	260	42.8	D	0.76	226	262	42.7	D	0.75	225	260

Intersection Operational Analysis Results: Evening Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Rt 9 WB L	125.3	D	0.12	187	347	132.6	F	1.08	197	358	132.6	F	1.08	197	358	132.6	F	1.08	197	358	132.6	F	1.08	197	358
Rt 9 WB T	12.8	F	0.67	239	374	13.7	B	0.55	252	401	14.3	B	0.54	260	402	14.3	B	0.56	261	402	14.3	B	0.56	260	402
Overall Intersection	**23.5**	**C**	**1.05**	-	-	**24.6**	**C**	**1.08**	-	-	**25.1**	**C**	**1.08**	-	-	**24.6**	**C**	**1.08**	-	-	**25.1**	**C**	**1.08**	-	-
Chestnut Hill Avenue at Route 9 (Brookline)																									
Rt 9 EB L	135.6	F	1.14	339	532	144.7	F	1.16	354	549	144.7	F	1.16	354	549	144.7	F	1.16	354	549	144.7	F	1.16	354	549
Rt 9 EB T	22.2	C	0.66	348	423	22.9	C	0.67	363	441	23.0	C	0.67	363	442	22.1	C	0.67	363	442	23.0	C	0.67	363	442
Rt 9 WB L	81.7	F	0.77	87	184	82.2	F	0.78	89	189	82.1	F	0.78	89	188	82.2	F	0.78	89	188	82.1	F	0.78	89	188
Rt 9 WB T	35.6	D	0.78	443	528	37.0	D	0.80	458	546	38.7	D	0.81	470	557	33.4	D	0.81	472	560	38.7	D	0.81	470	557
Rt 9 WB R	9.0	A	0.40	85	180	9.1	A	0.41	91	191	8.9	A	0.41	93	188	8.1	A	0.41	93	188	8.9	A	0.41	93	188
Chestnut Hill Ave SB L	291.1	F	1.55	708	866	308.2	F	1.59	735	893	308.2	F	1.59	735	893	308.2	F	1.59	735	893	308.2	F	1.59	735	893
Chestnut Hill Ave SB R	10.9	B	0.42	22	75	11.1	B	0.43	23	78	11.1	B	0.43	23	78	11.1	B	0.43	23	78	11.1	B	0.43	23	78
Overall Intersection	**77.3**	**E**	**1.55**	-	-	**81.4**	**F**	**1.59**	-	-	**81.7**	**F**	**1.59**	-	-	**81.7**	**F**	**1.59**	-	-	**81.7**	**F**	**1.59**	-	-
Hammond Street at Route 9 (Brookline)																									
Rt 9 EB L	105.4	F	0.94	179	334	116.4	F	0.99	187	345	116.4	F	0.99	187	345	116.4	F	0.99	187	345	116.4	F	0.99	187	345
Rt 9 EB T	86.4	F	1.06	620	791	100.1	F	1.10	653	821	100.4	F	1.10	653	822	100.4	F	1.10	653	822	100.4	F	1.10	653	822
Hammond St NB T	191.3	F	2.55	271	361	203.6	F	2.57	282	372	203.6	F	2.57	282	372	203.6	F	2.57	282	372	203.6	F	2.57	282	372
Rt 9 WB L	74.3	E	0.76	146	225	75.0	E	0.77	149	299	75.0	E	0.77	149	229	75.0	E	0.77	149	229	75.0	E	0.77	149	229
Rt 9 WB T	76.0	E	1.03	583	721	83.4	E	1.06	612	751	88.4	E	1.07	629	768	89.2	E	1.07	632	771	88.4	E	1.07	629	768
Rt 9 WB R	0.3	A	0.08	0	0	0.3	A	0.08	0	0	0.3	A	0.08	0	0	0.3	A	0.08	0	0	0.3	A	0.08	0	0
Hammond St SB L	97.3	F	0.86	104	216	101.7	F	0.17	108	227	101.7	F	0.89	108	227	101.7	F	0.89	108	227	101.7	F	0.89	108	227
Hammond St SB T	56.1	E	0.82	187	253	57.0	E	0.83	194	260	57.0	E	0.83	194	260	57.0	E	0.83	194	260	57.0	E	0.83	194	260
Overall Intersection	**91.9**	**F**	**1.00**	-	-	**91.9**	**F**	**1.33**	-	-	**102.3**	**F**	**1.33**	-	-	**102.5**	**F**	**1.33**	-	-	**102.3**	**F**	**1.33**	-	-
Canterbury Lane at Morton Street (Boston)																									
Canterbury Ln EB LR	23.6	C	0.39	31	53	27.8	C	0.43	35	63	26.8	C	0.53	50	87	26.7	C	0.52	48	83	26.7	C	0.53	48	83
Morton St NB L	12.2	B	0.28	4	29	11.0	B	0.27	5	27	49.2	D	0.71	20	72	42.1	D	0.65	17	100	43.0	B	0.66	17	64
Morton St NB T	5.0	A	0.37	64	110	4.4	A	0.36	67	115	6.0	A	0.39	75	137	5.8	A	0.39	74	133	5.8	A	0.39	74	134
Morton St SB T	8.6	A	0.68	169	295	7.4	A	0.66	181	309	10.8	B	0.72	208	412	10.6	B	0.72	207	402	10.5	A	0.72	205	398
Overall Intersection	**8.0**	**A**	**0.68**	-	-	**7.2**	**A**	**0.66**	-	-	**11.3**	**B**	**0.72**	-	-	**10.7**	**B**	**0.72**	-	-	**10.8**	**B**	**0.66**	-	-
Morton Street at Harvard Street (Boston)																									

Intersection Operational Analysis Results: Evening Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Harvard St EB L	70.5	E	0.70	120	221	71.9	E	0.73	124	232	73.6	E	0.74	124	232	73.6	E	0.74	124	232	73.4	E	0.74	124	232
Harvard St EB T	30.4	C	0.44	188	283	30.7	C	0.45	194	291	31.4	C	0.46	194	291	31.4	C	0.46	194	291	31.3	C	0.45	194	291
Morton St NB L	61.6	E	0.27	26	60	61.9	E	0.28	26	62	62.4	E	0.29	26	62	62.4	E	0.29	26	62	62.3	E	0.29	26	62
Morton St NB T	34.5	C	0.70	298	368	35.2	D	0.72	308	380	35.8	D	0.73	334	409	35.6	D	0.73	331	405	35.8	D	0.73	331	405
Harvard St WB L	42.7	D	0.12	19	48	43.0	D	0.12	20	49	43.1	D	0.12	20	49	43.1	D	0.12	20	49	43.1	D	0.12	20	49
Harvard St WB T	63.2	E	0.83	261	438	64.8	E	0.84	269	454	67.0	E	0.86	269	454	67.0	E	0.86	269	454	66.6	E	0.85	269	454
Morton St SB L	68.2	E	0.67	108	192	69.6	E	0.68	112	202	71.0	E	0.69	112	202	71.0	E	0.69	112	202	70.7	E	0.69	112	202
Morton St SB T	34.4	C	0.83	484	607	35.8	D	0.85	504	633	37.9	D	0.88	552	731	37.9	D	0.88	552	731	37.8	D	0.88	547	726
Overall Intersection	**40.6**	**D**	**0.83**	**-**	**-**	**41.7**	**D**	**0.85**	**-**	**-**	**43.0**	**D**	**0.88**	**-**	**-**	**42.9**	**D**	**0.88**	**-**	**-**	**42.9**	**D**	**0.88**	**-**	**-**
Morton Street at Blue Hill Avenue (Boston)																									
Morton St EB T	30.4	C	0.70	224	306	30.0	C	0.71	234	315	32.1	C	0.75	267	350	32.1	C	0.75	267	350	32.0	C	0.75	264	347
Morton St EB R	6.3	A	0.51	12	80	7.0	A	0.52	19	91	6.8	A	0.51	19	91	6.8	A	0.51	19	91	6.8	A	0.51	19	91
Blue Hill Ave NB L	57.6	E	0.19	151	304	59.2	E	0.82	159	315	61.8	E	0.83	169	315	61.8	E	0.83	169	315	61.7	E	0.83	169	314
Blue Hill Ave NB T	36.7	D	0.27	197	281	37.2	D	0.77	206	290	38.2	D	0.77	218	290	38.2	D	0.77	218	290	38.1	D	0.77	217	290
Morton St WB T	28.6	C	0.33	202	281	29.2	C	0.71	211	290	30.3	C	0.73	238	318	30.0	C	0.72	235	314	30.0	C	0.73	234	314
Blue Hill Ave SB L	515.3	F	0.20	149	298	544.5	F	2.05	157	303	571.8	F	2.14	167	303	571.8	F	2.14	167	303	569.3	F	2.11	167	303
Overall Intersection	**51.2**	**D**	**2.00**	**-**	**-**	**53.3**	**D**	**2.05**	**-**	**-**	**54.6**	**D**	**2.14**	**-**	**-**	**54.6**	**D**	**2.14**	**-**	**-**	**54.5**	**D**	**2.11**	**-**	**-**
Morton Street at Norfolk Street (Boston)																									
Morton St EB L	74.5	E	0.72	97	162	75.3	E	0.73	99	166	75.3	E	0.73	99	166	75.3	E	0.73	99	166	75.3	E	0.73	99	166
Morton St EB T	73.4	E	0.99	366	505	80.9	F	1.02	395	526	105.2	F	1.11	456	588	105.2	F	1.11	456	588	103.3	F	1.10	451	583
Norfolk St NB T	23.5	C	0.39	150	220	23.7	C	0.41	154	226	23.7	C	0.41	154	226	23.7	C	0.41	154	226	23.7	C	0.41	154	226
Norfolk St NB R	8.8	A	0.16	45	73	8.8	A	0.17	46	74	8.8	A	0.17	46	74	8.8	A	0.17	46	74	8.8	A	0.17	46	74
Morton St WB L	50.6	D	0.93	81	303	53.6	D	0.94	91	91	54.8	D	0.94	98	313	54.6	D	0.94	98	313	54.6	D	0.94	97	313
Morton St WB T	32.1	C	0.74	308	379	32.7	C	0.77	317	388	35.5	C	0.82	344	434	34.9	C	0.81	340	425	35.0	C	0.81	341	426
Norfolk St SB LTR	27.5	C	0.54	183	250	27.9	C	0.59	189	258	27.9	C	0.56	189	258	27.9	C	0.56	189	258	27.9	C	0.56	189	258
Overall Intersection	**46.0**	**D**	**0.99**	**-**	**-**	**48.8**	**D**	**1.02**	**-**	**-**	**58.0**	**E**	**1.11**	**-**	**-**	**57.9**	**E**	**1.11**	**-**	**-**	**57.2**	**E**	**1.10**	**-**	**-**
Morton Street at Corbet Street (Boston)																									
Morton St EB L	62.2	E	0.68	43	55	62.5	E	0.69	44	55	58.8	E	0.69	45	52	58.8	E	0.69	45	52	59.2	E	0.69	45	52
Morton St EB T	30.6	C	0.74	432	445	30.6	C	0.75	442	445	31.4	C	0.78	477	451	31.4	C	0.78	477	451	31.3	C	0.78	474	451

Intersection Operational Analysis Results: Evening Peak Hour																									
	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
W Selden St NB LTR	28.0	C	0.35	126	168	28.6	C	0.36	132	172	29.3	C	0.37	134	172	29.3	C	0.37	134	172	29.2	C	0.37	134	172
Morton St WB L	79.5	E	0.66	49	114	80.2	F	0.67	49	116	80.6	F	0.67	49	114	80.5	F	0.67	49	117	80.5	F	0.67	49	117
Morton St WB T	35.4	D	0.70	333	391	35.6	D	0.71	341	404	36.0	D	0.73	364	432	35.9	D	0.73	361	428	35.9	D	0.73	362	428
Corbet St SB LTR	30.3	C	0.43	117	180	31.2	C	0.44	123	183	32.0	C	0.46	124	184	32.0	C	0.46	124	184	32.0	C	0.46	124	184
Overall Intersection	**34.2**	**C**	**0.74**	-	-	**34.4**	**C**	**0.75**	-	-	**34.9**	**C**	**0.78**	-	-	**34.8**	**C**	**0.78**	-	-	**35.0**	**C**	**0.77**	-	-
Morton Street at Woodmere Street/Gallivan Boulevard (Boston)																									
Morton St SEB L	33.2	C	0.40	173	234	33.5	C	0.41	179	241	35.2	D	0.45	207	271	35.2	D	0.45	207	271	35.0	C	0.45	204	268
Morton St SEB T	35.5	D	0.51	218	316	35.9	D	0.52	226	325	37.0	D	0.52	234	330	37.0	D	0.52	234	330	36.9	D	0.52	234	331
Woodmere St NEB LTR	12.0	B	0.46	0	24	12.3	B	0.47	26	98	12.6	B	0.47	0	26	12.6	B	0.47	0	26	12.6	B	0.47	0	26
Morton St NWB LT	28.7	C	0.33	101	142	28.8	C	0.33	104	145	28.8	C	0.33	104	145	28.8	C	0.33	104	145	28.8	C	0.33	104	145
Gallivan Blvd WB T	0.4	A	0.29	-	-	0.4	A	0.29	0	0	0.5	A	0.33	0	0	0.5	A	0.32	0	0	0.5	A	0.32	0	0
Overall Intersection	**23.4**	**C**	**0.51**	-	-	**23.4**	**C**	**0.51**	-	-	**24.0**	**C**	**0.52**	-	-	**24.1**	**C**	**0.52**	-	-	**24.0**	**C**	**0.52**	-	-
Gallivan Boulevard at Washington Street (Boston)																									
Gallivan Blvd EB LT	16.9	B	0.65	107	203	17.7	B	0.61	116	211	18.7	B	0.72	134	238	18.7	B	0.71	134	238	18.6	B	0.71	132	236
Gallivan Blvd EB R	4.5	A	0.06	0	16	4.7	A	0.07	0	17	4.6	A	0.06	0	17	4.6	A	0.06	0	17	4.6	A	0.06	0	17
Washington St NB LTR	18.6	B	0.58	94	473	19.0	B	0.36	102	165	19.6	B	0.60	111	165	19.6	B	0.60	111	172	19.6	B	0.60	111	165
Gallivan Blvd WB LTR	14.2	B	0.53	78	152	14.7	C	0.54	84	158	15.2	B	0.57	95	175	15.1	B	0.57	94	165	15.1	C	0.57	94	173
Washington St SB LTR	29.3	C	0.80	125	229	30.6	B	0.82	135	237	32.8	C	0.83	148	238	32.8	C	0.83	148	238	32.7	B	0.83	147	238
Overall Intersection	**18.5**	**B**	**0.80**	-	-	**19.2**	**B**	**0.82**	-	-	**20.0**	**C**	**0.83**	-	-	**19.7**	**B**	**0.83**	-	-	**20.0**	**B**	**0.83**	-	-
Gallivan Boulevard at Dorchester Avenue (Boston)																									
Gallivan Blvd EB T	13.4	B	0.69	80	138	14.3	B	0.71	85	146	16.5	B	0.77	96	195	16.5	B	0.77	96	195	16.3	B	0.77	95	193
Dorchester Ave NB LTR	17.7	B	0.64	62	120	18.0	B	0.65	64	124	18.0	B	0.65	64	124	18.0	B	0.65	64	124	18.0	B	0.65	64	124
Gallivan Blvd WB T	10.3	B	0.48	51	88	10.5	B	0.50	53	91	11.0	B	0.54	59	101	10.9	B	0.53	58	99	10.9	B	0.53	58	99
Dorchester Ave SB LTR	24.3	C	0.76	73	175	25.3	C	0.32	76	182	25.3	C	0.77	76	182	25.3	C	0.77	76	182	25.3	C	0.77	76	182
Overall Intersection	**15.0**	**B**	**0.76**	-	-	**15.7**	**B**	**0.77**	-	-	**16.6**	**B**	**0.77**	-	-	**16.6**	**B**	**0.77**	-	-	**16.5**	**B**	**0.77**	-	-
Gallivan Boulevard at Granite Avenue/Adams Street (Boston)																									
Gallivan Blvd EB L	12.1	B	0.32	31	59	12.3	B	0.34	32	60	12.6	B	0.35	32	60	12.5	B	0.35	32	60	12.5	B	0.35	32	60
Gallivan Blvd EB T	15.8	B	0.65	205	271	16.1	B	0.66	212	281	17.0	B	0.70	234	308	17.0	B	0.70	234	308	16.9	B	0.70	232	305
Granite Ave NB L	51.2	D	0.31	108	243	57.1	E	0.90	111	258	57.1	E	0.90	111	258	57.1	E	0.90	111	258	57.1	E	0.90	111	258

Intersection Operational Analysis Results: Evening Peak Hour																									
	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Granite Ave NB TR	46.6	D	0.22	162	315	48.5	D	0.92	168	325	48.5	D	0.82	168	325	48.5	D	0.82	168	325	48.5	D	0.82	168	325
Gallivan Blvd WB L	49.5	D	0.32	43	121	54.2	D	0.71	44	127	66.5	E	0.78	46	134	66.5	E	0.78	46	134	65.3	E	0.78	45	133
Gallivan Blvd WB T	23.7	C	0.32	132	184	24.0	C	0.57	136	189	25.0	C	0.62	150	207	24.8	C	0.61	148	205	24.9	C	0.61	148	206
Adams St SB L	23.1	C	0.30	37	71	23.7	C	0.42	38	72	23.7	C	0.42	38	72	23.7	C	0.42	38	72	23.7	C	0.42	38	72
Adams St SB T	37.5	D	0.20	106	177	38.1	D	0.64	109	181	38.1	D	0.64	109	181	38.1	D	0.64	109	181	38.1	D	0.64	109	181
Adams St SB R	5.5	A	0.40	8	42	6.2	A	0.22	12	46	7.6	A	0.22	17	52	7.4	A	0.22	17	52	7.4	A	0.22	17	52
Overall Intersection	**26.2**	**C**	**0.87**	-	-	**27.4**	**C**	**0.90**	-	-	**28.1**	**C**	**0.90**	-	-	**28.0**	**C**	**0.90**	-	-	**28.0**	**C**	**0.90**	-	-
Gallivan Boulevard at Hallet Street (Boston)																									
Gallivan Blvd EB T	21.7	C	0.77	186	286	22.6	C	0.80	193	299	25.9	C	0.85	213	333	25.9	C	0.85	213	333	25.6	C	0.85	212	331
Hallet St NB L	30.3	C	0.43	34	70	30.5	C	0.44	34	72	30.5	C	0.44	34	72	30.5	C	0.44	34	72	30.5	C	0.44	34	72
Hallet St NB R	33.2	C	0.74	101	204	34.1	C	0.75	105	212	34.1	C	0.75	105	212	34.1	C	0.75	105	212	34.1	C	0.75	105	212
Gallivan Blvd WB T	16.6	B	0.57	124	177	16.8	B	0.59	128	183	17.5	B	0.63	140	198	17.4	B	0.62	138	196	17.4	B	0.62	138	196
Hallet St SB L	27.8	C	0.23	16	43	27.9	C	0.23	16	43	27.9	C	0.23	16	43	27.9	C	0.23	16	43	27.9	C	0.23	16	43
Hallet St SB T	25.0	C	0.50	55	109	25.2	C	0.51	57	112	25.2	C	0.51	57	112	25.2	C	0.51	57	112	25.2	C	0.51	57	112
Overall Intersection	**22.1**	**C**	**0.77**	-	-	**22.8**	**C**	**0.80**	-	-	**24.3**	**C**	**0.85**	-	-	**24.3**	**C**	**0.85**	-	-	**24.1**	**C**	**0.85**	-	-
Gallivan Boulevard at Neponset Avenue (Boston)																									
Neponset Ave EB L	10.5	B	0.33	17	56	10.8	B	0.34	18	58	10.8	B	0.34	18	58	10.3	B	0.31	18	58	10.3	B	0.31	18	58
Neponset Ave EB T	40.4	D	0.95	157	242	45.5	D	0.97	163	252	45.5	D	0.97	163	252	45.5	D	0.97	163	252	45.5	D	0.97	163	252
Gallivan Blvd NB T	9.1	A	0.46	92	130	9.2	A	0.47	94	134	9.6	A	0.51	105	148	9.6	A	0.51	105	148	9.5	A	0.55	104	146
Gallivan Blvd NB R	23.1	C	0.91	231	412	25.9	C	0.94	244	430	25.9	C	0.94	244	430	25.9	C	0.94	244	430	25.9	C	0.94	244	430
Overall Intersection	**24.9**	**C**	**0.95**	-	-	**27.7**	**C**	**0.97**	-	-	**27.4**	**C**	**0.97**	-	-	**27.4**	**C**	**0.97**	-	-	**27.4**	**C**	**0.97**	-	-
Neponset Avenue at Morrissey Boulevard (Boston)																									
Neponset Ave EB T	16.3	B	0.66	47	83	16.6	B	0.67	48	86	16.6	B	0.67	48	86	16.6	B	0.67	48	86	16.6	B	0.67	48	86
Morrissey Blvd SB L	12.9	B	0.64	82	169	13.5	B	0.66	86	180	13.5	B	0.66	86	180	13.5	B	0.66	86	180	13.5	B	0.66	86	180
Morrissey Blvd SB T	8.6	A	0.56	70	102	8.7	A	0.57	72	105	9.0	A	0.60	77	111	8.9	A	0.59	76	110	8.9	A	0.59	77	110
Morrissey Blvd SB R	2.2	A	0.32	0	25	2.2	A	0.33	0	26	2.2	A	0.33	0	26	2.2	A	0.33	0	26	2.2	A	0.33	0	26
Overall Intersection	**10.2**	**B**	**0.66**	-	-	**10.5**	**B**	**0.67**	-	-	**10.6**	**B**	**0.67**	-	-	**10.5**	**B**	**0.67**	-	-	**10.6**	**B**	**0.67**	-	-
South Street at Washington Street (Boston)																									
South St EB L	74.8	E	0.95	365	493	80.2	F	0.97	378	513	96.0	F	0.99	403	550	103.0	F	1.01	414	562	96.0	F	0.99	403	550

Intersection Operational Analysis Results: Evening Peak Hour

	Existing					No-Build					Build Alternative 3					Build Alternative 4					Build Alternative 10				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Washington St NB T	13.0	B	0.61	111	143	13.3	B	0.37	114	147	13.6	B	0.37	114	147	14.0	B	0.37	114	147	13.6	B	0.37	114	147
South St SB T	12.5	B	0.50	120	140	12.6	B	0.59	123	142	12.6	B	0.60	123	143	13.0	B	0.60	123	143	12.6	B	0.60	123	143
Overall Intersection	**27.6**	**C**	**0.95**	**-**	**-**	**29.0**	**C**	**0.97**	**-**	**-**	**33.6**	**C**	**0.99**	**-**	**-**	**36.0**	**C**	**1.01**	**-**	**-**	**33.6**	**C**	**0.99**	**-**	**-**
South Street at Arborway/New Washington Street (Boston)																									
Arborway EB T	17.9	B	0.37	157	216	12.8	B	0.38	166	221	18.4	B	0.38	167	222	18.4	B	0.38	166	221	18.4	B	0.38	167	222
Arborway EB R	3.5	A	0.44	86	123	3.6	A	0.45	90	129	3.6	A	0.45	90	129	3.6	A	0.46	90	129	3.6	A	0.45	90	129
South St NB L	57.0	E	0.90	106	138	61.5	E	0.93	108	149	60.8	E	0.93	109	141	60.5	E	0.93	110	141	60.8	E	0.93	109	141
South St NB T	45.2	D	0.76	262	254	40.8	D	0.76	268	301	49.8	D	0.79	278	305	51.4	D	0.80	283	307	49.8	D	0.79	278	305
New Washington St WB T	11.6	B	0.51	87	296	11.9	B	0.53	89	264	11.9	B	0.53	89	264	11.9	B	0.53	89	264	11.9	B	0.53	89	264
South St SB L	32.2	C	0.52	59	92	32.6	C	0.54	30	94	33.6	C	0.56	60	94	34.0	C	0.57	60	94	33.6	C	0.56	60	94
South St SB T	56.5	E	0.82	270	357	56.5	E	0.82	275	368	56.5	E	0.82	275	368	56.5	E	0.82	275	368	56.5	E	0.82	275	368
Overall Intersection	**23.8**	**C**	**0.90**	**-**	**-**	**24.5**	**C**	**0.93**	**-**	**-**	**25.1**	**C**	**0.93**	**-**	**-**	**25.4**	**C**	**0.93**	**-**	**-**	**25.1**	**C**	**0.93**	**-**	**-**
Washington Street at Arborway (Boston)																									
New Washington St EB T	114.1	F	1.14	509	660	130.6	F	1.18	549	684	136.2	F	1.19	561	697	139.0	F	1.20	566	702	136.2	F	1.19	561	697
Washington St NB L	49.1	D	0.70	65	124	51.5	D	0.72	67	134	51.5	D	0.72	67	134	51.5	D	0.72	67	134	51.5	D	0.72	67	134
Washington St NB TR	31.9	C	0.51	175	230	31.8	C	0.52	181	236	31.8	C	0.52	181	236	31.8	C	0.52	181	236	31.8	C	0.52	181	236
Arborway WB L	770.7	F	2.57	178	297	802.9	F	2.64	184	304	802.9	F	2.64	184	304	802.9	F	2.64	184	304	802.9	F	2.64	184	304
Arborway WB T	13.3	B	0.42	112	134	13.5	B	0.43	117	139	13.5	B	0.43	117	139	13.5	B	0.43	117	139	13.5	B	0.43	117	139
Washington St SB L	40.2	D	0.26	42	85	40.6	D	0.34	44	89	40.6	D	0.34	44	89	40.6	D	0.34	44	89	40.6	D	0.34	44	89
Washington St SB TR	46.6	D	0.26	236	304	46.8	D	0.75	244	313	46.8	D	0.75	244	313	46.8	D	0.75	244	313	46.8	D	0.75	244	313
Overall Intersection	**83.8**	**F**	**2.57**	**-**	**-**	**91.1**	**F**	**2.64**	**-**	**-**	**93.4**	**F**	**2.64**	**-**	**-**	**94.0**	**F**	**2.64**	**-**	**-**	**93.4**	**F**	**2.64**	**-**	**-**
Arborway at Morton Street/Circuit Drive (Boston)																									
Arborway EB L	24.3	C	0.84	232	217	24.5	C	0.84	237	214	24.4	C	0.84	237	212	24.4	C	0.84	237	211	24.4	C	0.84	237	212
Arborway EB T	23.8	C	0.50	400	368	24.4	C	0.52	410	367	24.7	C	0.53	418	371	25.0	C	0.53	422	372	24.7	C	0.53	418	371
Morton St NB T	22.2	C	0.20	32	56	22.3	C	0.20	33	57	22.3	C	0.20.	33	57	22.3	C	0.20	33	57	22.3	C	0.20	33	57
Morton St WB L	60.8	E	0.80	10	32	60.8	E	0.18	10	32	60.8	E	0.18	10	32	60.8	E	0.18	10	32	60.8	E	0.18	10	32
Morton St WB T	31.5	C	0.56	242	341	32.5	C	0.59	253	352	32.5	C	0.59	253	353	32.5	C	0.59	253	352	32.5	C	0.59	253	353
Circuit Dr SB T	34.2	C	0.25	55	91	34.0	C	0.25	56	93	34.0	C	0.25	56	93	34.0	C	0.25	56	93	34.0	C	0.25	56	93
Overall Intersection	**25.5**	**C**	**0.84**	**-**	**-**	**26.0**	**C**	**0.84**	**-**	**-**	**26.1**	**C**	**0.84**	**-**	**-**	**26.0**	**C**	**0.84**	**-**	**-**	**26.1**	**C**	**0.84**	**-**	**-**

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Appendix F.4: Transportation Impact Assessment

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F.4 Transportation Impact Assessment

A Traffic Impact Assessment (TIA), consistent with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs (EEA) and Massachusetts Department of Transportation (MassDOT) *Transportation Impact Assessment (TIA) Guidelines*,[1] was prepared to assess the Proposed Program's traffic impacts on the three DEIR Alternatives (Alternatives 3, 4, and 10). The scope for transportation in the ENF Certificate was limited to requesting that the DEIR provide a comprehensive review of the Program's construction-period impacts and mitigation relative to transportation, including pedestrians, bicyclists, and transit users.

This chapter describes existing traffic conditions in terms of vehicular traffic, pedestrian and bicycle traffic, and public transportation. The assessment evaluates the traffic operations for roadways and key intersections on construction truck routes between the highway and shaft sites under existing and future construction conditions. Future traffic- and transportation-related impacts are discussed in **Section 4.10.3**.

This section presents the methodology and results of the study prepared to assess the traffic impacts of the proposed Metropolitan Water Tunnel Program.

F.4.1 Existing Conditions

For each DEIR Alternative, truck routes were established for each shaft site location by identifying the shortest path to and from the nearest highway. Critical intersections and roadways along these routes were examined; sensitive receptors, defined as properties/locations that may be impacted by construction of the Proposed Program, were identified and described. A high-level crash analysis was performed for each Study intersection identified by MassDOT as a high-crash location potentially eligible for Highway Safety Improvement Program funding.

F.4.1.1 Construction Period Impacts - Truck and Worker Trips

For the DEIR Alternatives, most traffic expected to be generated by construction activities at the proposed shaft sites would be due to construction workers driving to and from the sites at the beginning and ends of their workday shifts. The maximum amount of traffic would occur at sites where there is a shift change during the evening peak hour. These locations are adjacent to highway ramps and are therefore not expected to cause a significant traffic impact to nearby local roadways. Average daily truck trips and worker trips were calculated for each alternative and are summarized below:

Alternative 3

- The maximum expected overall number of daily truck trips would be 406 for a duration of one quarter of a year, taking all sites into consideration.

1 Massachusetts Department of Transportation, *Transportation Impact Assessment (TIA) Guidelines*, March 13, 2014, https://www.mass.gov/doc/transportation-impact-assessment-guidelines (accessed August 8, 2022).

- Construction activities at the Highland Avenue Northeast and Tandem Trailer sites would each be expected to generate a maximum of 156 truck trips per day for durations of seven quarters and five quarters, respectively. Actual durations are anticipated to be shorter.
- A maximum of 126 construction worker trips and 20 truck trips would be expected to arrive at and depart from each of the Tandem Trailer, Bifurcation, and Highland Avenue Northeast sites during the evening peak hour.
- The study intersections in Weston are expected to experience the highest additional traffic volumes during construction. The intersection of River Road and South Avenue is estimated to experience an additional 168 trips in the evening peak hour. The intersections of I-95 NB off-ramp at South Avenue and Park Road at South Avenue would each be expected to have 146 additional trips during the evening peak hour. Mitigation would be required to minimize the impacts to traffic operations at these intersections if these additional trips are realized.

Alternative 4

- The maximum expected overall number of daily truck trips would be 408 for a duration of one quarter of a year, taking all sites into consideration.
- Construction activities at the Highland Avenue Northwest site would be expected to generate a maximum of 158 trucks trips per day for a duration of three quarters. Actual durations are anticipated to be shorter.
- The Highland Avenue Northeast and Tandem Trailer sites would each be expected to generate a maximum of 156 truck trips per day for durations of seven quarters and five quarters, respectively.
- A maximum of 126 construction worker trips and 20 truck trips are expected to arrive at and depart from each of the Tandem Trailer, Highland Avenue Northeast, and Highland Avenue Northwest sites during the evening peak hour.
- The intersection of River Road and South Avenue in Weston is estimated to experience an additional 227 trips in the evening peak hour. Mitigation would be required to minimize the impacts to traffic operations at this intersection if these additional trips are realized.

Alternative 10

- The maximum expected overall number of daily truck trips would be 312 for a duration of one quarter of a year, taking all sites into consideration.
- Construction activities at the Highland Avenue Northeast and Highland Avenue Northwest sites would each be expected to generate a maximum of 156 truck trips per day for durations of seven quarters and nine quarters, respectively. Actual durations are anticipated to be shorter.
- A maximum of 126 construction worker trips and 20 truck trips would be expected to arrive at and depart from each of the Highland Avenue Northeast and Highland Avenue Northwest sites during the evening peak hour.
- The intersection of South Street at Weston Street in Waltham would be expected to experience the largest number of additional trips during construction: 66 trips during the evening peak hour.

Mitigation would be required to minimize the impacts to traffic operations at this intersection if these additional trips are realized.

Surface Piping Construction Impacts

Surface piping would be required at many of the shaft sites. Construction of these pipes at some shaft locations would require traffic management measures, including lane closures, sidewalk closures, and detours. Surface piping operations are expected to impact traffic at the School Street, American Legion, and Fernald Property sites in Waltham. Work at these locations would require detours along roadways functionally classified as arterials. All other surface piping locations are anticipated to result in low or moderate traffic impacts.

F.4.2 Mitigation Measures

At locations where surface piping construction would be expected to impact traffic, the activities would be limited to certain time periods depending on the characteristics of the roadways and surrounding land use.

The following intersections would require mitigation to minimize the impacts of additional traffic during construction:

F.4.2.1 Alternative 3

- Main Street at Ellison Park/Linden Street (Waltham)
- Main Street at Weston Street/South Street (Waltham)
- River Road at South Avenue (Weston)
- Park Road at South Avenue (Weston)
- I-95 Northbound Off-Ramp at South Avenue/Commonwealth Avenue (Weston)
- Central Avenue at Cedar Street (Needham)
- Newton Street at Clyde Street (Brookline)
- Morton Street at Blue Hill Avenue (Boston)
- Morton Street at Norfolk Street (Boston)
- South Street at Washington Street (Boston)

F.4.2.2 Alternative 4

- Main Street at Ellison Park/Linden Street (Waltham)
- Main Street at Weston Street/South Street (Waltham)
- River Road at South Avenue (Weston)

- Park Road at South Avenue (Weston)
- I-95 Northbound off-ramp at South Avenue/Commonwealth Avenue (Weston)
- Central Avenue at Cedar Street (Needham)

- Newton Street at Clyde Street (Brookline)
- Morton Street at Blue Hill Avenue (Boston)
- Morton Street at Norfolk Street (Boston)
- South Street at Washington Street (Boston)

F.4.2.3 Alternative 10

- Main Street at Weston Street/South Street (Waltham)
- River Road at South Avenue (Weston)
- Park Road at South Avenue (Weston)
- I-95 Northbound off-ramp at South Avenue/Commonwealth Avenue (Weston)
- Central Avenue at Cedar Street (Needham)
- Newton Street at Clyde Street (Brookline)
- Morton Street at Blue Hill Avenue (Boston)
- Morton Street at Norfolk Street (Boston)
- South Street at Washington Street (Boston)

Mitigation measures consist of adjusting traffic signal timings, potential roadway widening, and traffic signal warrant evaluation.

F.4.3 Regulatory Framework

The TIA conducted for the Metropolitan Water Tunnel Program follows the MassDOT TIA Guidelines for projects that trigger thresholds under the Massachusetts Environmental Policy Act (MEPA). The Program is subject to the preparation of a Mandatory EIR, pursuant to 301 CMR 11.03(4)(a)(3), because it requires State Agency Actions and involves the construction of one or more new water mains 10 or more miles in length. This assessment considers the potential effects that the Program may have on traffic operations.

F.4.4 Methodology

F.4.4.1 Study Area

The Study Area for the TIA constitutes the seven launching/receiving shaft, six connection shaft sites, and one isolation valve for Alternatives 3, 4 and 10. The Study Area encompasses the anticipated truck or haul routes between the access point(s) to each site and the nearest major highway. Haul routes are assumed to be used by contractors supplying equipment and materials and for hauling away excavated material from tunnel excavation. See **Chapter 3, Alternatives**, for a description of each alternative and the associated launching, receiving, connection, and isolation valve sites. All three DEIR Alternatives have common connection sites and a common isolation valve site. Details of the roads within the Study Area are provided in **Section 4.10.4.3**.

F.4.4.2 Existing Conditions Methodology

The TIA identified major roads near each proposed site and associated existing land uses. Depending on jurisdiction of the site, specific zoning regulations may apply, or a permit may be needed. Sensitive receptors, roadway functional classification, bicycle facilities, and pedestrian facilities were also identified. Traffic data collection included automatic traffic recorders (ATR) at 32 locations and peak hour turning movement counts (TMC) at 40 intersections on conceptual truck or haul routes between shaft sites and the nearest major highways. The ATR and TMC data collection was performed during April and May 2022 along truck routes associated with the 13 shaft sites. **Figure 4.10-1** through **Figure 4.10-6** shows the data collection locations.

F.4.4.3 Construction Conditions Impact Assessment Methodology

Construction period impacts were evaluated for each alternative by examining the characteristics of the truck routes and daily truck volume anticipated at each shaft site location. Impacts to the roadways along each truck route were designated as low, moderate, or high depending on the functional classification, land use, and major signalized intersections along the truck routes. **Table F.4-1** summarizes the criteria that were used to determine the level of impact.

Table F.4-1 Truck Route Impact Level Criteria

	Low Impact	Moderate Impact	High Impact
Functional Classification	All freeway or arterial	Some non-arterials	Predominantly non-arterials
Surrounding Land Use	Predominantly commercial and/or industrial	Some commercial, some residential	Predominantly residential
Major Signalized Intersections	None	Some	Many

To estimate the average daily number of truck trips for each shaft location, the quarterly number of expected truck trips was divided by 65, since there are 65 working days per quarter of a year on average. Once the average daily number of truck trips was estimated, the maximum number of daily trucks for each shaft site was examined to determine the most impactful scenarios. A “truck trip” refers to each time a truck enters or exits a proposed site. Each round-trip truck activity generates two trips.

Net new estimated vehicle trips at each shaft during construction were analyzed by combining truck trips and worker trips to and from the sites during both the morning and evening peak hours. It was assumed that, for sites requiring one shift per day, workers would arrive during the morning peak hour and depart during the evening peak hour. For sites requiring two shifts per day, it was assumed that workers for the first shift would arrive during the morning peak hours and depart during the evening peak hour. Second shift workers were assumed to arrive during the evening peak hour and would depart later in the night, outside of the peak hour.

The trips were then assigned to the study intersections along the corresponding truck routes. To be conservative, it was assumed that all workers would use the same routes as the trucks. This would represent the worst-case scenario for each study intersection. While analyzing the worst-case scenario follows all typical standard practices, it is noted that actual impacts are expected to fall well below the analysis presented herein, as discussed further in the sections below.

Using the traffic volume data collected for existing conditions, an operational analysis was performed to determine the existing level of service and the level of service that each intersection was expected to experience during construction. Intersections estimated to experience substantial increases in delay were identified.

Many of the shaft sites would also require surface piping installations (to connect to the local distribution network) that would impact existing roadways. The impacts to these roadways were designated as low, moderate, or high, depending on the recommended traffic management measure and the functional classification of the roadway.

A Policy on Geometric Design of Highways and Streets (2018), published by the American Association of State Highway and Transportation Officials (AASHTO), divides urban street systems into four functional classifications—freeways, arterials, collectors, and local streets. AASHTO functional classifications and the levels of impact (high, moderate, and low) on traffic for each functional classification are defined in **Table F.4-2**.

Table F.4-2 Functional Classification and Traffic Impact Level Criteria

Functional Classification	Characteristics	Impact Level: Low Impact	Moderate Impact	High Impact	Unacceptable
Arterials	• Carry high traffic volumes and a high proportion of urban trips, as well as trips between central business districts and outlying residential areas • May carry local bus routes • Provide intra-community continuity • Do not generally penetrate identifiable neighborhoods • Examples: South Street in Waltham, Route 9 in Wellesley	Does not require a lane closure	Requires lane closure on a multilane facility	Requires lane closure on a two-lane arterial; requires rerouting bus service	Complete closure of an arterial
Freeways	• Arterial highways with full control of access • Provide high levels of safety and efficiency in moving large volumes of high-speed traffic • Provide access to selected public roads only • Prohibit crossing at grade • Examples: I-95, I-90	Does not require a lane closure	Requires lane closure on a multilane facility	Requires lane closure on a two-lane arterial; requires rerouting bus service	Complete closure of an arterial
Collectors	• Provide local roadway access and traffic circulation within residential, commercial, or industrial areas • Distribute traffic from arterials to local streets • May carry bus traffic • Examples: School Street in Waltham, Park Road in Weston	Maintains two-lane, two-way operation	Requires lane closure	Complete closure; requires rerouting bus service	N/A
Local Streets	• Provide direct access to abutting land and connections to collectors and arterials • Do not usually support bus routes • Through traffic is generally discouraged • Examples: Chapel Road in Waltham, St. Mary Street in Needham	N/A	N/A	Requires rerouting bus service	Any construction operations, including closure with residential and emergency access

Arterials generally carry high traffic volumes and a high proportion of urban trips, as well as trips between central business districts and outlying residential areas. Arterials may also carry local bus routes. They provide intracommunity continuity but do not generally penetrate identifiable neighborhoods. For arterials, construction operations that do not require a lane closure would be considered to have low impact unless the arterial abuts a sensitive receptor(s) or serves as a bus route. A lane closure on a multilane facility would constitute a moderate level of impact. A lane closure on a two-lane arterial would be considered a high level of traffic impact. Complete closure of an arterial would constitute an unacceptable level of impact.

Freeways are arterial highways with full control of access. They are intended to provide for high levels of safety and efficiency in the movement of large volumes of traffic at high speeds. With full control of access, preference is given to through traffic by providing access connections only with selected public roads and by prohibiting crossings at grade and direct private driveway connections. Impact on traffic for freeways is the same as for arterials.

Collectors provide local roadway access and traffic circulation within residential, commercial, or industrial areas. Collector streets distribute traffic from arterials to local streets in residential neighborhoods. Conversely, collector streets also collect traffic from local streets and channel it into the arterials; they may also carry local bus traffic. Maintenance of two-lane, two-way operation on a collector street would constitute a low level of impact to traffic. A lane closure on a two-lane collector would be considered a moderate impact. Complete closure of a collector street would be considered a high impact to traffic.

Local streets provide direct access to abutting land as well as connections to collectors and arterials. Local streets usually do not support bus routes, and through-traffic movement is generally discouraged on local streets. Any construction operations on local streets, including closure of local streets with proper provisions for residents and emergency vehicles, would be considered to have low impact.

In the traffic impact rating system for this Program, the functional classification of a roadway is the primary basis for assessing traffic impacts to a roadway. MassDOT – Highway Division assigns one of the four functional classifications to every roadway in Massachusetts.

In addition to the levels of impact defined by the functional classification of a roadway segment, other factors, such as sensitive receptors, bus routes, pedestrian issues, and traffic volumes, have also been integrated into the evaluation of potential traffic impacts for each roadway segment and intersection. The MassDOT Top Crash Locations map was also reviewed to identify Study intersections that were designated as high-crash locations.

F.4.4.4 Mitigation Measures

Mitigation measures may be needed to safely accommodate and balance the needs of pedestrian, bicyclist, transit, and emergency vehicles. Typical mitigation measures for traffic impacts to sensitive receptors would include construction period on-street parking restrictions, time restrictions, and pedestrian and bicyclist detours. These measures would require approval and/or permits from agencies or applicable municipalities. Applicability of these mitigative measures would be discussed with the relevant municipalities or agencies that own the affected roadways.

F.4.5 Existing Conditions

Existing site and access conditions for the construction sites and connection sites are described below.

F.4.5.1 Launching and Receiving Sites

Fernald Property (Waltham)

The proposed construction shaft site is on a portion of the Fernald property on Chapel Road that is owned by the City of Waltham. This site is a proposed Tunnel Boring Machine (TBM) receiving location for all DEIR Alternatives. The shaft site is located between the southern turning segment of Chapel Road in the Fernald Property and Clematis Brook. Access and egress to the site is via Chapel Road from/to Waverley Oaks Road (Route 60). Residential and commercial properties are located along the northwest and southeast side of Waverley Oaks Road, respectively. There is no bus service along Waverley Oaks Road or near the site. No traffic is allowed on Chapel Road to the north of the site as Chapel Road is an unstriped local road without pedestrian and bicycle accommodation. A gate is present on Chapel Road to the west of the Chapel Road/Waverley Oaks Road intersection to control access.

Tandem Trailer and Park Road East Sites (Weston)

The Tandem Trailer site and associated Park Road East site in Weston are proposed TBM launching and a large connection shaft sites for Alternatives 3 and 4. The Tandem Trailer site would serve as the TBM launch site and the large connection at Park Road East would facilitate a near-surface connection to the Hultman Aqueduct. The Tandem Trailer site located between South Avenue (Route 30), and the I-95 to I-90 ramp currently serves as MassDOT's parking area for tandem trailers and as a staging area during snow emergencies. There is no public access to the Tandem Trailer site, and there are neither pedestrian nor bicycle accommodations.

The Park Road East site is located to the southwest of MassDOT Weston Maintenance Facility, along the south side of the I-90 to I-95 ramp. Park Road and the I-90 to I-95 ramp are located to the west and north of the site, respectively. This site can be accessed through the Weston Maintenance Facility parking lot.

Both sites are owned by the Commonwealth of Massachusetts under the care, custody, and control of MassDOT, and work would require a MassDOT access permit (the MWRA has an easement over a portion of the Park Road East site associated with the MWRA Hultman Aqueduct). Sidewalks are provided along the west side of Park Road, near the Park Road east site, but no crosswalk is present on Park Road. In general, no pedestrian or bicycle accommodations are provided near the sites, nor is there bus service in the area.

Bifurcation Site (Weston)

The Bifurcation site is a proposed TBM launching shaft site in Tunnel Alignment Alternative 3 and is located at the I-95/I-90 Interchange, at the terminus of Hultman Aqueduct and MetroWest Water Supply Tunnel in Weston. To its west is the I-95 to I-90 east ramp, to its east is the I-90 to I-95 south ramp, to its north is I-90 to I-95 ramp, and I-90 lies to its south. Riverside Office Park is to the south of the site across I-90. The site is owned by Weston and the Commonwealth of Massachusetts under the care, custody, and control of MassDOT; the MWRA has an easement over a portion of the site associated with the MWRA Hultman Aqueduct. Work on this site would require a MassDOT access permit. Light vehicles can enter or exit the site at the southeast corner via a paved road, which runs parallel to the I-90 to I-95 south ramp under I-90 and connects to the Liberty Mutual parking lot at the east of Riverside Office Park. Heavy vehicles can only enter the site from the I-90 westbound off-ramp to Route 30 and exit the site through the egress at north of the site to the I-90 to I-95 ramp. The site is not open to the general public, there are no pedestrian/bicycle accommodations on or near the site, and there is no bus service in the area.

Park Road West Site (Weston)

Park Road West site is a proposed TBM receiving shaft site in DEIR Alternative 4 and a large connection site in Alternative 10. The site is located within the I-95/I-90 Interchange in Weston. The grassed area is located with Park Road to its east, the I-90 west to I-95 ramp to its west and south, and a wetland to its north. The site can be accessed through existing gated access off the west side of Park Road, opposite the I-90 west Exit 123B to Route 30 off-ramp. The site is owned by the Commonwealth of Massachusetts under the care, custody, and control of MassDOT, and the MWRA has an existing easement over a portion of the site associated with the Hultman Aqueduct. A MassDOT access permit would be required for work at this site. A sidewalk is present along west side of Park Road near the site. No bicycle accommodation is provided on Park Road, and there is no bus service in the area.

Highland Avenue Northwest/Southwest Site (Needham)

The site, which is made up of the northwest and southwest cloverleafs of the interchange, serves as a proposed TBM receiving shaft site in Alternative 3 and a proposed TBM launching site in Alternatives 4 and 10. The northwest cloverleaf is inside the Highland Avenue west to I-95 south loop ramp of I-95/Highland Avenue full cloverleaf interchange in Needham. The site can be accessed through the Highland Avenue west to I-95 south loop ramp. When the site serves as a launching site, the southwest cloverleaf would also be used for additional parking or construction storage if needed. The southwest cloverleaf can be accessed through the I-95 south Exit 35B to Highland Avenue east loop ramp. The site is owned by the Commonwealth of Massachusetts under the care, custody, and control of MassDOT; the proposed dewatering piping would be in Town of Needham property. An access permit would be required. Sidewalks and buffered bike lanes are provided on the Highland Avenue overpass I-95 segment. There is no bus service in the area.

Highland Avenue Northeast/Southeast Site (Needham)

The site, which is located inside the northeast and southeast cloverleafs of the I-95/Highland Avenue interchange in Needham, serves as a proposed TBM launching shaft site in Alternatives 3, 4, and 10. Both cloverleafs are in mainly cleared and grassed areas. The proposed shaft is located inside the northeast cloverleaf site, which can be accessed through the I-95 north Exit 35C to Highland Avenue west loop ramp. The southeast cloverleaf site would be potentially used for parking or construction storage if needed. This site can be accessed through the Highland Avenue east to I-95 north loop ramp. The site is owned by the Commonwealth of Massachusetts under the care, custody, and control of MassDOT; the proposed dewatering piping would be in Town of Needham property. An access permit would be required. Sidewalks and buffered bike lanes are provided on the Highland Avenue overpass I-95 segment. There is no bus service in the area.

American Legion Site (Boston)

The site, which is a proposed TBM receiving shaft site in Alternatives 3, 4, and 10, is located to the south of Judge John J. Connelly Youth Center along Canterbury Street. The shaft site can be accessed through Canterbury Street, Canterbury Lane, and then Morton Street (Route 203). Because the site is owned by the Department of Conservation & Recreation (DCR), an access permit would be required. A sidewalk is present on the south side of Canterbury Street, and sidewalks are provided on both sides of Canterbury Lane. Buffered bike lanes are present on both sides of Morton Street to the north of the Morton Street/Canterbury Lane intersection, and Morton Street is on Massachusetts Bay Transportation Authority (MBTA) Bus Routes 21 and 31.

F.4.5.2 Connection and Isolation Valve Sites

School Street Site (Waltham)

A proposed connection shaft at the School Street site would be connected to the Lexington Street Pumping Station in Alternatives 3, 4, and 10. The proposed shaft site is located in an unpaved lot to the northeast of the Macks Court/School Street intersection in Waltham and surrounded by residential/commercial properties, with Macks Court to its west, School Street to its south, and Gormans Court to its east. The site is owned by the MWRA. Site access is via Macks Court and School Street. School Street in the vicinity consists of one lane in each direction, with sidewalks on both sides of the road, while Macks Court is an unstriped, short, and narrow local dead-end road without pedestrian accommodation. MBTA bus service is available along School Street. No bicycle accommodation is available along School Street.

Cedarwood Pumping Station Site (Waltham)

This site, on South Street, would serve as a proposed connection shaft site to the Cedarwood Pumping Station for Alternatives 3, 4, and 10. The shaft would be located to the southwest of Cedarwood Pumping Station (also called Waltham City Pumping Station), which is owned and operated by the City of Waltham. To the north of the site is William F. Stanley Elementary School. Most of the site is currently covered by trees. The site is under the jurisdiction of the City of Waltham. Site access would be via a pumping station driveway from South Street. No sidewalks are provided along the driveway. There are sidewalks on both sides of South Street, but no bicycle accommodation. MBTA Bus Route 553 runs along South Street, and there are bus stops at corners of the South Street/Shakespeare Road/Pumping Station Driveway intersection.

Hegarty Pumping Station Site (Wellesley)

This site would serve as a proposed connection site in Alternatives 3, 4, and 10. It is located to the southwest of Hegarty Pumping Station, which is owned and operated by the Town of Wellesley. To the southwest of the site is Ouellet Field, and to its south is Barton Road. Most of the site is currently covered by trees. Site access would be via Barton Road and then Cedar Street. A sidewalk is provided on the north side of Barton Road in the vicinity of the site. Sidewalks are present on both sides of Cedar Street. No bicycle accommodation is provided on either road. MetroWest Regional Transit Authority (MWRTA) Bus Route 1 runs along Cedar Street.

St. Mary Street Pumping Station Site (Needham)

This site would serve as a proposed connection site in Alternatives 3, 4 and 10 and would accommodate connections to the local water distribution system. Most of the site is located to the east of St. Mary Street in Needham. To its north are residential houses, and the MWRA's Sudbury Aqueduct is to its south. Another part of the site is situated to the west of the street and to the north of St. Mary Street Pumping Station. This rectangular shaped area would be used for potential additional construction site staging. The site is owned by the MWRA and is accessed through St. Mary Street, which is an unstriped local street. A sidewalk is provided along the west side of the street. No bicycle accommodation is available on the street near the site. MBTA bus service is provided on Central Avenue, to which St. Mary Street connects at its southern end.

Newton Street Pumping Station Site (Brookline)

This site on Newton Street would serve as a proposed connection site in Alternatives 3, 4, and 10 and is located on the site of the Newton Street Pumping Station in Brookline. Hollows Townhouse and Fairgreen Place condominiums are situated to the west and northeast of the site, respectively. The site is owned and operated by the MWRA. The site can be accessed through the pumping station driveway from Newton Street. Near the site, sidewalks are provided on both sides of Newton Street, but bicycle accommodation is unavailable. MBTA Bus Route 51 runs along Grove Street and Newton Street to the east of the site.

Southern Spine Mains Site (Boston)

The site would be a proposed connection site for a shaft to the Southern Spine water mains in Alternatives 3, 4, and 10. It is located to the north of the Massachusetts Department of Public Health parking lot. The parcel is owned by the Commonwealth of Massachusetts. The shaft site would be accessed through Arborway (Route 203), Washington Street and South Street. Sidewalks are provided on both sides of South Street. There is a designated bicycle lane along the site on Washington Street and on the Arborway. MBTA Orange Line service, commuter rail service, and bus service are available at the nearby Forest Hills Station. No trucks are allowed on South Street.

Hultman Aqueduct Isolation Valve Site (Weston)

The Hultman Aqueduct Isolation Valve is common to all three DEIR Alternatives. The isolation valve would be connected on the Hultman Aqueduct and would allow the proposed tunnels to be isolated into segments. The site is located on a semi-triangular parcel just west of the existing Shaft 5A. The site is owned by the Commonwealth of Massachusetts under care, custody, and control of MassDOT; the MWRA has an easement over a portion of the site. Access would be off the I-95 northbound off-ramp from Exit 39B.

F.4.6 Study Roadways

Table F.4-3 lists the roadways along the conceptual routes to and from each shaft site and truck routes are shown in **Figure 4.10-7** through **Figure 4.10-19**. Detailed descriptions of the study roadways can be found in **Appendix F.1**.

Table F.4-3 Study Roadways

Shaft Site	Roadway	From	To	Municipality
Fernald Property Receiving Shaft	Trapelo Road	I-95	Waverley Oaks Road	Waltham
	Waverley Oaks Road	Trapelo Road	Linden Street	Waltham
	Linden Street	Waverley Oaks Road	Main Street	Waltham
	Main Street	Linden Street	Weston Street (Route 20)	Waltham
	Weston Street (Route 20)	Main Street	I-95	Waltham
School Street Connection Shaft	Weston Street (Route 20)	I-95	Main Street	Waltham
	Main Street	Weston Street (Route 20)	Bacon Street	Waltham
	Bacon Street	Main Street	School Street	Waltham
	School Street	Bacon Street	Macks Court	Waltham
Cedarwood Pumping Station Connection Shaft	Weston Street (Route 20)	I-95	South Street	Waltham
	South Street	Weston Street (Route 20)	Shakespeare Road	Waltham
Bifurcation Launching Shaft	I-90 to I-95 Ramp	-	-	Weston
Park Road East Large Connection Shaft	South Avenue (Route 30)	I-95	Park Road	Weston
	Park Road	South Avenue (Route 30)	Site Entrance	Weston
Park Road West (Receiving Shaft/Large Connection Shaft)	South Avenue (Route 30)	I-95	Park Road	Weston
	Park Road	South Avenue (Route 30)	Site Entrance	Weston
Tandem Trailer Launching Site	South Avenue (Route 30)	Site Exit	I-95	Weston
	I-95 to I-90 West Ramp	I-95	Site Entrance	Weston
Hegarty Pumping Station Connection Shaft	Worcester Street (Route 9)	I-95	Cedar Street	Wellesley
	Cedar Street	Worcester Street (Route 9)	Barton Road	Wellesley
St. Mary Street Pumping Station Connection Shaft	Worcester Street (Route 9)	I-95	Cedar Street	Wellesley
	Cedar Street	Worcester Street (Route 9)	Central Avenue	Wellesley/ Needham
	Central Avenue	Cedar Street	St. Mary Street	Needham

Table F.4-3 Study Roadways

Shaft Site	Roadway	From	To	Municipality
	St. Mary Street	Central Avenue	Site Entrance	Needham
Highland Avenue Northeast Launching Shaft	I-95 Northbound On-Ramp	Highland Avenue	I-95	Needham
	I-95 Northbound Off-Ramp	I-95	Highland Avenue	Needham
Highland Avenue Northwest Receiving/Launching Shaft	I-95 Southbound On-Ramp	Highland Avenue	I-95	Needham
	I-95 Southbound Off-Ramp	I-95	Highland Avenue	Needham
Newton Street Pumping Station Connection Shaft	Boylston Street (Route 9)	I-95	Lee Street	Newton/ Brookline
	Lee Street	Boylston Street (Route 9)	Clyde Street	Brookline
	Clyde Street	Lee Street	Newton Street	Brookline
	Newton Street	Clyde Street	Site Entrance	Brookline
Southern Spine Mains Connection Shaft	Gallivan Boulevard (Route 203)	I-93	Morton Street (Route 203)	Boston
	Morton Street (Route 203)	Gallivan Boulevard (Route 203)	Arborway (Route 203)	Boston
	Arborway (Route 203)	Morton Street (Route 203)	Centre Street	Boston
	South Street	Arborway (Route 203)	Asticou Road	Boston
American Legion Receiving Shaft	Gallivan Boulevard (Route 203)	I-93	Morton Street (Route 203)	Boston
	Morton Street (Route 203)	Gallivan Boulevard (Route 203)	Arborway (Route 203)	Boston
	Arborway (Route 203)	Morton Street (Route 203)	Centre Street	Boston
	Canterbury Street	Morton Street (Route 203)	Site Entrance	Boston

F.4.7 Study Intersections

The TIA studies the following key intersections associated with different shaft sites. These intersections were selected based on estimates of vehicle traffic and pedestrian and bicyclist impacts that may result at these intersections from construction and operation of the Proposed Program. **Table F.4-4** lists the study intersections and their associated shaft sites by municipality. Study intersections are shown in **Figures 4.10-1** through **4.10-6**. Detailed descriptions of the study intersections can be found in **Appendix F2**.

Table F.4-4 Study Intersections and Associated Shafts

Municipality	Intersection	Associated Shaft Site(s)
Waltham	Trapelo Rd. at Lexington St.	Fernald Property
	Waverley Oaks Rd. at Trapelo Rd.	Fernald Property
	Beaver St. at Waverley Oaks Rd.	Fernald Property
	Main St. at Linden St./Ellison Park	Fernald Property
	Elm St. at Main St.	Fernald Property
	Moody St. at Main St.	Fernald Property
	Bacon St. at Main St.	Fernald Property, School Street
	Weston St. at Main St.	Fernald Property, School Street
	South St. at Weston St.	Fernald Property, School Street, Cedarwood Pumping Station
	Shakespeare Rd. at South St.	Cedarwood Pumping Station
	River Rd. at South Ave.	Tandem Trailer, Park Road East, Park Road West
Weston	I-95 N off-ramp at South Ave.	Tandem Trailer, Park Road East, Park Road West
	Park Rd. at South Ave.	Park Road West
Needham	Central Ave. at Cedar St.	Hegarty Pumping Station, St. Mary Street Pumping Station
Wellesley	Worcester St. at Cedar St.	Hegarty Pumping Station, St. Mary Street Pumping Station
Newton	Woodward St./Elliot St. at Rt 9	Newton Street Pumping Station
Brookline	Grove St. at Newton St.	Newton Street Pumping Station
	Newton St. at Clyde St.	Newton Street Pumping Station
	Dudley St. at Lee St.	Newton Street Pumping Station
	Lee St. at Rt 9	Newton Street Pumping Station
	Chestnut Hill Ave. at Rt 9	Newton Street Pumping Station
	Hammond St. at Rt 9	Newton Street Pumping Station
	Canterbury Ln. at Morton St.	American Legion, Southern Spine Mains

Table F.4-4 Study Intersections and Associated Shafts

Municipality	Intersection	Associated Shaft Site(s)
Boston	Morton St. at Harvard St.	American Legion, Southern Spine Mains
	Morton St. at Blue Hill Ave.	American Legion, Southern Spine Mains
	Morton St. at Norfolk St.	American Legion, Southern Spine Mains
	Morton St. at Corbet St.	American Legion, Southern Spine Mains
	Morton St. at Gallivan Blvd.	American Legion, Southern Spine Mains
	Gallivan Blvd. at Washington St.	American Legion, Southern Spine Mains
	Gallivan Blvd. at Dorchester Ave.	American Legion, Southern Spine Mains
	Gallivan Blvd. at Granite Ave./Adams St.	American Legion, Southern Spine Mains
	Gallivan Blvd. at Hallet St.	American Legion, Southern Spine Mains
	Gallivan Blvd. at Neponset Ave.	American Legion, Southern Spine Mains
	Neponset Ave. at Morrissey Blvd.	American Legion, Southern Spine Mains
	South St. at Washington St.	Southern Spine Mains
	South St. at Arborway	American Legion, Southern Spine Mains
	Centre St. at Arborway Rotary	American Legion, Southern Spine Mains
	Centre St. at Arborway	American Legion, Southern Spine Mains
	Washington St. at Arborway	American Legion, Southern Spine Mains

F.4.1.1 Sensitive Receptors

Sensitive receptors are properties/locations that may be impacted by construction and operation of the Program during construction. Different categories of sensitive receptors identified along or near proposed truck routes are listed below.

Single/Multifamily Houses & Apartment/Condominium Complexes

Single- or multifamily houses and apartment or condominium complexes associated with different shaft sites are summarized in **Table F.4-5** through **Table F.4-9** below.

Table F.4-5 Sensitive Receptors/High Density Residential Uses – Fernald Property Shaft Site

Location	Characteristics	Comments
Benchmark Senior Living at Waltham Crossings (Waltham)	Along truck route	

Table F.4-5 Sensitive Receptors/High Density Residential Uses – Fernald Property Shaft Site

Windsor Village (Waltham)	In the vicinity of truck route	
Waltham Overlook (Waltham)	Along truck route	
Wellington Crossing (Waltham)	Along truck route	
Meadow Green Rehabilitation and Nursing Center (Waltham)	In the vicinity of truck route	
Gardencrest Apartments (Waltham)	Along truck route	61 units in two 3-story buildings located on southeast side of Linden Street

Table F.4-6 Sensitive Receptors/High Density Residential Uses – Cedarwood Pumping Station Shaft Site

Location	Characteristics	Comments
Roberts Crossing townhouses (Waltham)	Along truck route	Located on 218 South Street, Waltham (right to the east of the driveway to the shaft site)

Table F.4-7 Sensitive Receptors/High-Density Residential Uses – St. Mary Street Pumping Station Shaft Site

Location	Characteristics	Comments
Townhouses in Capt. Robert Cook Drive (Needham)	In the vicinity of truck route	
Townhouses in Seabeds Way (Needham)	In the vicinity of truck route	
One Wingate Way (Needham)	In the vicinity of truck route	Retirement community, located to the west of I-95/Highland Avenue interchange
Wingate Residences (Needham)	Along truck route	Assisted living facility, located to the west of I-95/Highland Avenue interchange
Wingate at Needham (Needham)	In the vicinity of truck route	Nursing home, located to the west of I-95/Highland Avenue interchange

Table F.4-8 Sensitive Receptors/High-Density Residential Uses – Newton Street Pumping Station Shaft Site

Location	Characteristics	Comments
Longview Dell apartments (Brookline)	In the vicinity of truck route	Located at 321 Newton Street, Brookline (to the southwest of Newton Street/Grove Street intersection)
Hollows townhouse (Brookline)	In the vicinity of truck route	Located to the west of the shaft site
Fairgreen Place condominium (Brookline)	Along truck route	Located to the north of the shaft site
Towers of Chestnut Hill condominium (Newton)	Along truck route	Located to the north of Route 9 in Newton
Imperial Towers condominium (Newton)	Along truck route	Located to the south of Route 9 in Newton

Table F.4-8 Sensitive Receptors/High-Density Residential Uses – Newton Street Pumping Station Shaft Site

Location	Characteristics	Comments
Avalon at Chestnut Hill apartments (Newton)	Along truck route	Located to the southwest of Route 9/Hammond Pond Parkway intersection

Table F.4-9 Sensitive Receptors/High-Density Residential Uses – American Legion Shaft Site and Southern Spine Mains Shaft Site

Location	Characteristics	Comments
Hearth at Olmsted Green Senior Living apartment complex (Boston)	In the vicinity of truck route	Located at 2 Kingbird Road, Boston
Olmsted Green apartment complex (Boston)	Along truck route	Located to the northwest of Morton Street/Harvard Street intersection

Commercial Areas

Several major business districts are located along or near truck routes; they are as summarized in **Table F.4-10**.

Table F.4-10 Sensitive Receptors / Commercial Areas

Shaft Site	Commercial Property	Characteristics	Comments
Fernald Property	Commercial properties along southeast side of Waverley Oaks Road (Waltham)	Along truck route	
Fernald Property	Linden Plaza (Waltham)	Along truck route	Along southeast side of Linden Street
Hegarty Pumping Station, St. Mary Street Pumping Station	Park 9 (Wellesley)	Along truck route	Located on 112 Worcester Street, Wellesley
Hegarty Pumping Station, St. Mary Street Pumping Station	Wellesley Office Park (Wellesley)	Along truck route	Located on 65 William Street, Wellesley
Newton Street Pumping Station	Echo Bridge Office Park (Newton)	In the vicinity of truck route	Located on 353 Elliot Street, Newton
St. Mary Street Pumping Station	Riverbend Office Park (Needham)	In the vicinity of truck route	Located on 200 Reservoir Street, Needham
Highland Avenue Northwest, Highland Avenue Northeast	Muzi Motors, Inc. (Needham)	In the vicinity of truck route	

Table F.4-10 Sensitive Receptors / Commercial Areas

Shaft Site	Commercial Property	Characteristics	Comments
Highland Avenue Northwest, Highland Avenue Northeast	Commercial properties to the east of I-95/Highland Avenue interchange (Needham)	In the vicinity of truck route	
Newton Street Pumping Station	The Shops at Chestnut Hill (Newton)	Along truck route	
Newton Street Pumping Station	Chestnut Hill Square (Newton)	Along truck route	
Newton Street Pumping Station	Commercial properties along both sides of Boylston Street between Hammond Pond Parkway and Hammond Street (Newton/Brookline)	Along truck route	
Southern Spine Mains, American Legion	Commercial properties along Gallivan Boulevard (Boston)	Along truck route	In the vicinity of I-93/Gallivan Boulevard interchange

Hospitals, Family Care Facilities, and Medical Offices

Major hospitals, family care facilities, and medical offices located along or near truck routes are summarized in **Table F.4-11**.

Table F.4-11 Sensitive Receptors / Hospitals, Family Care Facilities and Medical Offices

Shaft Site	Property	Characteristics	Comments
Cedarwood Pumping Station	Boston Children's at Waltham (Waltham)	Along truck route	Located with South Street on its west, Highland Street on its north, and Hope Avenue on its east and south Vehicle access is mainly through intersections of South Street/Highland Street and South Street/Hope Avenue
Hegarty Pumping Station, St. Mary Street Pumping Station	Harvard Pilgrim Health Care (Wellesley)	Along truck route	Located to the northwest of I-95/Route 9 interchange The only vehicular access is through its driveway/Worcester Street intersection, which is approximately 700 feet to the west of the interchange.

Table F.4-11 Sensitive Receptors / Hospitals, Family Care Facilities and Medical Offices

Shaft Site	Property	Characteristics	Comments
Newton Street Pumping Station	Dana-Farber Cancer Institute – Chestnut Hill (Newton)	Along truck route	Located along south side of Route 9 in Newton Its main vehicular and pedestrian access via Route 9.
Newton Street Pumping Station	Medical Compound (Newton)	Along truck route	Located to the south of Route 9/Reservoir Road intersection
Southern Spine Mains, American Legion	Carney Hospital (Boston)	In the vicinity of truck route	
Southern Spine Mains, American Legion	Lemuel Shattuck Hospital (Boston)	Along truck route	

Religious Institutions

Major religious institutions located along or near truck routes are summarized in **Table F.4-12**.

Table F.4-12 Sensitive Receptors / Religious Institutions

Shaft Site	Property	Characteristics	Comments
Fernald Property	Waltham Haitian Church of the Nazarene (Waltham)	Along truck route	Located to the southeast corner of South Street/Trapelo Road in Waltham There are two vehicular accesses to the church: one through South Street and the other through Trapelo Road.
Fernald Property	Our Lady Comforter of the Afflicted Parish (Waltham)	Along truck route	Located along south side of Trapelo Road in Waltham Our Lady's Academy is located in the church. Access is provided on Trapelo Road.
Fernald Property	Ministerio Evangelico Rios De Agua Viva and New Covenant Church of Cambridge (Waltham)	Along truck route	Both are located along north side of Main Street in Waltham. Both have their main vehicular and pedestrian access through Main Street.
Fernald Property	New Light Korean Church (Waltham)	Along truck route	Situated along south side of Main Street in Waltham Vehicular and pedestrian access through Main Street.

Table F.4-12 Sensitive Receptors / Religious Institutions

Fernald Property, Cedarwood Pumping Station	Korean Hope Church in Boston and First Lutheran Church-Waltham (Waltham)	Along truck route	The two churches share the same place along north side of Weston Street in Waltham. Vehicular access is through Everett Street and main pedestrian access through Eddy Street.
School Street	St. Mary's Roman Catholic Church (Waltham)	Along truck route	Located on School Street west of Lexington Street. Access is provided on School Street.
Newton Street Pumping Station	Redemptoris Mater Seminary and St. Mary of the Assumption Parish (Brookline)	Along truck route	The two churches share the same place along south side of Route 9 in Brookline. The main pedestrian access through Boylston Street and vehicular access through Reservoir Road.

Schools

Schools located along or near truck routes are summarized in **Table F.4-13** below.

Table F.4-13 Sensitive Receptors / Schools

Shaft Site	School	Characteristics	Comments
Fernald Property	University of Massachusetts Medical School Eunice Kennedy Shriver Center (Waltham)	In the vicinity of truck route	Located on 200 Trapelo Road, Waltham The only access to Trapelo Road is through Cherry Lane.
Cedarwood Pumping Station	Stanley Elementary School (Waltham)	Along truck route	Located along South Street Access to the school is through signalized intersection of South Street at Wheelock Road and the driveway to Waltham City Pumping Station. Shaft site near the pumping station is right to the south of the school.
Newton Street Pumping Station	Apple Orchard School (Brookline)	Along truck route	Located on 282 D Newton Street, Brookline A school day typically runs from 8:15 AM to 12:00 PM with extended days until 2:30 PM. Access to the school is provided on Newton Street.

Table F.4-13 Sensitive Receptors / Schools

Shaft Site	School	Characteristics	Comments
Southern Spine Mains, American Legion	Brooke High School, Brooke 8th Grade Academy, Brooke Charter School Mattapan (Boston)	In the vicinity of truck route	Both schools are located along the east side of American Legion Highway in Boston. Vehicle and pedestrian access to the two schools is provided mainly on American Legion Highway.
Southern Spine Mains, American Legion	Berea SDA Academy, Shaw Pauline A Elementary School (Boston)	Along truck route	Located along the north side of Morton Street (Route 203) in Boston. Vehicle and pedestrian access to the two schools is provided only on Morton Street.

Parks

Parks located along or in the vicinity of truck routes are summarized in **Table F.4-14**.

Table F.4-14 Sensitive Receptors / Parks

Shaft Site	Park	Characteristics	Comments
Fernald Property	James Falzoe Memorial Park (Waltham)	Along truck route	Located along north side of Trapelo Road in Waltham Vehicle access to the park is provided only on Trapelo Road.
Fernald Property	Elsie Turner Field and Rock Meadow Playground (Waltham)	Along truck route	The baseball field and the playground are located along north side of Trapelo Road in Waltham. Vehicle and pedestrian access are provided only on Trapelo Road.
Fernald Property	Beaver Brook Reservation (Waltham)	Along truck route	The Reservation is to the southeast of signalized intersection of Trapelo Road/Waverley Oaks Road in Waltham.

Table F.4-14 Sensitive Receptors / Parks

Shaft Site	Park	Characteristics	Comments
			Its main access is provided on Waverley Oaks Road to picnic area parking. Another access is provided on Trapelo Road to spray deck and playground for pedestrians only, with roadside parking along Trapelo Road.
Fernald Property	Veteran Circle of Remembrance Park (Waltham)	Along truck route	
Cedarwood Pumping Station	Nipper Maher Park (Waltham)	Along truck route	Located to the west of South Street in Waltham Its main access is provided on South Street.
Cedarwood Pumping Station	Beth Israel Memorial Park (Waltham)	Along truck route	Located to the southeast of Roberts Crossing Townhouses complex, opposite Nipper Maher Park across the South Street in Waltham. Its only access is provided on South Street.

Fire Stations, Police Stations, and Public Libraries

Fire stations, police stations, and public libraries located along or near truck routes are summarized in **Table F.4-15** below.

Table F.4-15 Sensitive Receptors / Fire Stations, Police Stations, and Public Libraries

Shaft Site	Fire Stations, Police Stations, and Public Libraries	Characteristics	Comments
Fernald Property	Waltham Fire Engine 8 (Waltham)	Along truck route	Located on 699 Trapelo Road, Waltham
Fernald Property	Waltham Public Library (Waltham)	Along truck route	Located on 735 Main Street, Waltham
Southern Spine Mains, American Legion	Boston Police District B-3 Mattapan/North Dorchester (Boston)	Along truck route	Located on 1165 Blue Hill Avenue, Boston

Other Sensitive Receptors

Other sensitive receptors located along or near truck routes are summarized in **Table F.4-16** below.

Table F.4-16 Other Sensitive Receptors

Shaft Site	Sensitive Receptors	Characteristics	Comments
Fernald Property	National Archives at Boston (Boston)	Along truck route	Located on 380 Trapelo Road, Waltham
Fernald Property	Waltham District Court and Second District Court of Eastern Middlesex (Waltham)	Along truck route	Located on 38 Linden Street, Waltham Primary access to the building is via Linden Street
Fernald Property	Waltham City Hall (Waltham)	Along truck route	Located on 610 Main Street, Waltham
Southern Spine Mains, American Legion	Judge John J. Connelly Youth Center, Boston Pre-Release Center, City of Boston DPW Lot (Boston)	Along truck route	

F.4.7.2 Bus Routes

The MBTA operates several bus routes on roadway segments that include truck routes between proposed shaft locations and highways.

In Waltham, Route 61 runs along Trapelo Road; Route 70 runs along Weston Street (Route 20); Route 553 runs along South Street; and Routes 70, 553, and 556 run along Main Street (Route 20). Route 59 runs along Central Avenue in Needham and Elliot Street in Newton. In Boston, Routes 28 and 29 run along Blue Hill Avenue (Route 28); Route 14 runs along American Legion Highway; Routes 21, 26, and 31 run along Morton Street (Route 203); and Routes 21, 26, 201, and 215 run along Gallivan Boulevard (Route 203). In Brookline, Route 51 runs along Grove Street, Newton Street, Clyde Street, and Lee Street.

F.4.7.3 Safety

The MassDOT Top Crash Locations map was reviewed to determine which Study intersections were designated as Top-200 Crash Clusters or Highway Safety Improvement (HSIP) Clusters. HSIP clusters are defined as locations that rank within the top 5 percent of each Regional Planning Agency, based on frequency and severity of crashes. Locations identified as HSIP clusters require Road Safety Audits (RSAs) to identify existing safety deficiencies and potential mitigating actions. Top-200 Crash Clusters are locations that rank within the top 200 crash locations in the state.

Collision data are summarized in **Table F.4-17** for those Study intersections that were identified on the Top Crash Locations map.

Table F.4-17 Collision Data Summary and Proposed Safety Improvements of Study Intersections Identified on the Top Crash Location Map

Shaft Site	Intersection	Collision Data Summary
Fernald Property	Trapelo Rd. at Lexington St., Waltham	On the list of 2017-2019 HSIP Cluster Seven non-serious/possible injury crashes and 24 non-injury crashes during 2017-2019
Fernald Property	Main St. at Linden St./Ellison Pk., Waltham	On the list of 2017-2019 HSIP Cluster One fatal/serious injury crash, 5 non-serious/possible injury crashes, and 16 non-injury crashes during 2017-2019
Fernald Property	Main St. at Elm St./Church St.	On the list of 2017-2019 HSIP Cluster; located within a 2010-2019 HSIP Bicycle Cluster One fatal/serious intersection crash, 4 non-serious/possible injury crashes, and 13 non-injury crashes during 2017-2019
Fernald Property	Main St. at Common St./Moody St.	Located within a 2010-2019 HSIP Bicycle Cluster
Fernald Property, School Street	Main St. at Bacon St.	Located within a 2010-2019 HSIP Bicycle and Pedestrian Cluster
Fernald Property, School Street, Cedarwood Pumping Station	Main St. at Weston St., South St. at Weston St.	On the list of 2010-2019 HSIP Pedestrian Cluster Safety issues[1] on roadway/intersection geometry; lane markings and signage; traffic signal deficiencies; pedestrian, bicycle and transit operations; visibility/sight line obstruction
Tandem Trailer, Park Road East, Park Road West	South Ave. at River Rd., Weston	On the list of 2017-2019 HSIP Cluster Deficiency in signal indication and timing/phasing; intersection geometry deficiency; inadequate sight distance; substandard pedestrian and lack of bicycle accommodations[2]
Newton Street Pumping Station	Boylston St. (Rt 9) at Woodward St/Elliot St., Newton	On the list of 2017-2019 HSIP Cluster One fatal/serious intersection crash, 7 non-serious/possible injury crashes, and 12 non-injury crashes during 2017-2019 Inadequate pedestrian accommodation and pedestrian unfriendly; deficiency in signal and intersection operation; inadequate or outdated signage and pavement markings; access management issues; inadequate bus stop accommodation[3]
Southern Spine Mains, American Legion	Morton St. at Harvard St., Boston	On the list of Top 200 Crash Cluster 2017-2019 HSIP Cluster Ranks 3rd in 2015-2017 Statewide Top 200 Intersection Crash List 18 non-serious/possible injury crashes, and 12 non-injury crashes during 2017-2019 Inadequate intersection capacity; intersection geometry deficiency; inappropriate bus stop. location; malfunction of signal equipment[4]
Southern Spine Mains, American Legion	Morton St. at Norfolk St., Boston	On the list of 2017-2019 HSIP Cluster Seven non-serious/possible injury crashes and 6 non-injury crashes during 2017-2019
Southern Spine Mains, American Legion	Morton St. at Corbet St./Selden St., Boston	On the list of 2017-2019 HSIP Cluster Seven non-serious/possible injury crashes and 8 non-injury crashes during 2017-2019

Table F.4-17 Collision Data Summary and Proposed Safety Improvements of Study Intersections Identified on the Top Crash Location Map

Shaft Site	Intersection	Collision Data Summary
Southern Spine Mains, American Legion	Gallivan Blvd. at Washington St., Boston	On the list of 2017-2019 HSIP Cluster Eight non-serious/possible injury crashes and 11 non-injury crashes during 2017-2019
Southern Spine Mains, American Legion	Gallivan Blvd. at Dorchester Ave., Boston	On the list of 2017-2019 HSIP Cluster Eight non-serious/possible injury crashes and 12 non-injury crashes during 2017-2019
Southern Spine Mains, American Legion	Gallivan Blvd. at Granite Ave./Adams St., Boston	On the list of 2017-2019 HSIP Cluster Ranks #43 in 2015-2017 Statewide Top 200 Intersection Crash List Seventeen fatal/serious crashes, 6 non-serious/possible injury crashes and 8 non-injury crashes during 2017-2019
Southern Spine Mains, American Legion	Washington St. at Arborway, Boston	On the list of 2017-2019 HSIP Cluster One fatal/serious crash, 6 non-serious/possible injury crashes and 8 non-injury crashes during 2017-2019

1 Road Safety Audit: Weston Street (Route 20) at I-95 Ramps/Weston Street (Route 20) at Main Street (Route 117)/Totten Pond Road/Winter Street at 3rd Avenue Winter Street at 2nd Avenue. McMahon Associates, Inc., August 2017.
2 Road Safety Audit: Route 30 at River Road/I-95 Southbound Ramps. VHB, August 2019.
3 Road Safety Audit: Route 9 (Boylston Street) at Elliot Street, Woodward Street, Glenmore Terrace, and Ramsdell Street. Beta Group, Inc., May 7, 2021.
4 Road Safety Audit: Morton Street at Blue Hill Avenue, Morton Street at Courtland Road/Havelock Street, Morton Street at Harvard Street. Beta Group, Inc., January 20, 2012.

F.4.8 Construction Period Impacts

For the DEIR Alternatives, most traffic expected to be generated by construction activities at the proposed shaft sites would be due to construction workers driving to and from the sites at the beginning and ends of their workday shifts. The highest increase in traffic would occur at sites where there is a shift change during the evening peak hour. These locations are adjacent to highway ramps and are therefore not expected to cause a substantial traffic impact to nearby local roadways. Average daily truck trips and worker trips were calculated for each alternative and are summarized below. Full details are provided in the technical study.

To identify potential peak cumulative impacts, estimates of truck and worker trips were identified on a quarterly basis for the duration of the construction activities. These conservative assumptions include:

1. Construction of the launching and receiving shaft sites would occur at the same time and not sequentially.
2. All connection shaft sites would be constructed at the same time.
3. All surface piping connections would also be constructed at the time.

However, it is important to note the following:

1. This conservative approach was chosen to allow the contractor the most flexibility in determining the sequencing within a construction package without increasing impacts discussed herein.
2. It is highly unlikely that the assumed concurrent activities would happen at the same time. Rather the peak periods would likely be distributed with lesser degrees of impact over a longer duration.
3. It is also highly unlikely that the activities will occur during the exact year or quarter projected for the cumulative impact analysis. These will vary based on construction packaging and sequencing within a construction package

F.4.8.1 Alternative 3

Alternative 3 would require three tunnel boring machine (TBM) drives. The first TBM drive would be launched from the Tandem Trailer site and received at the Fernald Property. The second would be launched from the Bifurcation site and received at the Highland Avenue Northwest site. The third TBM drive would be launched from the Highland Avenue Northeast site and received at the American Legion site.

Trucks

Truck routes were developed for each shaft location based on the shortest path between the site and the nearest major highway for analysis purposes. MWRA would coordinate with the individual communities to determine the most appropriate truck routes. **Table F.4-18** shows the characteristics of the truck routes associated with the sites used in Alternative 3, including travel distance and time between the shaft and nearest highway, land use along the route, functional classification, major signalized intersections, and traffic impact level. Truck routes are shown in **Figures 4.10-7** through **4.10-19**.

Table F.4-18 Alternative 3 – Truck Route Characteristics

Shaft Location	Construction Vehicle Travel Distance (mi)	Construction Vehicle Travel Time (min) to nearest highway	Truck Route Land Use	Truck Route Functional Classification	Major Signalized Intersections	Traffic Impact Level
Fernald Receiving	7.7	24	Residential, Industrial	Arterial	Some	Moderate
School Street	3.2	12	Commercial, Residential	Arterial, Collector	Some	Moderate
Cedarwood Pumping Station	3	12	Commercial, Industrial	Arterial	None	Low
Tandem Trailer Launching	0.3	1	Highway Ramp	Freeway	None	Low
Park Road East Connection	0.2	1	Highway Ramp	Freeway	None	Low
Bifurcation Launching	0.2	1	Highway Ramp	Freeway	None	Low

Table F.4-18 Alternative 3 – Truck Route Characteristics

Shaft Location	Construction Vehicle Travel Distance (mi)	Construction Vehicle Travel Time (min) to nearest highway	Truck Route Land Use	Truck Route Functional Classification	Major Signalized Intersections	Traffic Impact Level
Hegarty Pumping Station	1.7	4	Commercial, Residential	Arterial	None	Low
St. Mary Street Pumping Station	2	6	Residential, Commercial	Arterial	None	Moderate
Highland Avenue NW Receiving	0.3	1	Highway Ramp	Freeway	None	Low
Highland Avenue NE Launching	0.3	1	Highway Ramp	Freeway	None	Low
Newton Street Pumping Station	6.4	17	Commercial, Residential	Arterial	None	Moderate
Southern Spine Mains	10.7	34	Commercial, Residential	Arterial	Many	Moderate
American Legion Receiving	7.7	25	Commercial, Residential	Arterial	Many	Moderate

As shown in **Table F.4-18**, all truck routes would have either moderate or low levels of traffic impact. Moderate impacts are associated with routes that would pass through residential areas or have numerous signalized intersections along the routes.

Table F.4-19 shows the average daily number of truck trips expected to be generated by each shaft site during each quarter throughout construction. The sequence of constructing each element within a construction package will be at the discretion of the selected contractor(s) and thus not known at this time. This impact assessment is based on conservative (i.e., worst case, most impactful) construction sequencing. Durations of construction activities and equipment were estimated to occur concurrently, resulting in conservative (higher) peak cumulative impacts that were assessed.

Table F.4-19 Alternative 3 – Average Daily Truck Trips by Quarter

	Year 1				**Year 2**				**Year 3**				**Year 4**				**Year 5**				**Year 6**				**Year 7**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Fernald Receiving	0	0	0	0	0	0	0	0	0	0	2	28	4	0	0	0	0	2	0	0	0	0	0	0	0	2	0	14
School Street	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	6	0	0	0	0	0
Cedarwood Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0
Tandem Trailer Launching	0	0	0	0	0	0	0	0	0	0	12	70	8	156	156	156	156	156	0	0	6	34	72	72	58	20	32	12
Park Road East Connecting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	12	4	0	0
Bifurcation Launching	0	0	0	0	0	8	6	74	10	152	152	152	102	0	20	58	58	20	0	12	34	0	0	0	0	0	0	0
Hegarty Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
St. Mary Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
Highland Avenue NW Receiving	0	0	0	0	0	0	6	34	16	4	0	0	2	0	14	14	0	2	0	18	6	0	0	0	0	0	0	0
Highland Avenue NE Launching	0	0	6	78	10	156	156	156	156	156	156	156	52	0	0	0	20	60	60	60	60	60	12	34	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
Southern Spine Mains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	4	0	0	0	0	0	0
American Legion Receiving	0	0	14	60	10	0	0	0	0	0	0	0	4	0	0	0	0	0	124	124	0	2	0	30	58	58	58	58
Total	**0**	**0**	**20**	**138**	**20**	**164**	**168**	**264**	**182**	**312**	**322**	**406**	**172**	**156**	**190**	**228**	**234**	**240**	**184**	**214**	**150**	**104**	**90**	**138**	**128**	**84**	**90**	**84**

The sequence of constructing each element within a construction package will be at the discretion of the selected contractor(s) and thus not known at this time. This impact assessment is based on conservative (i.e., worst case, most impactful) construction sequencing. Durations of construction activities and equipment were estimated to occur concurrently, resulting in conservative (higher) peak cumulative impacts that were assessed.

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As shown in **Table F.4-19**, the maximum expected overall number of daily truck trips by quarter is 406, which would be expected to occur during Quarter 4 of Year 3, when construction activities take place simultaneously at Highland Avenue Northeast, Bifurcation, and the Fernald Property.

Table F.4-20 shows the maximum number of truck trips expected to be generated by each site per day and the duration of the maximum impact.

Table F.4-20 Alternative 3 – Daily Trucks by Shaft Location

Shaft Location	Maximum Truck Trips per day	Duration of Maximum Truck Volume	Start of Maximum Truck Volume	End of Maximum Truck Volume
Fernald Receiving	28	1 Quarter	Year 3, Quarter 4	Year 3, Quarter 4
School Street	6	1 Quarter	Year 6, Quarter 3	Year 6, Quarter 3
Cedarwood Pumping Station	6	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Tandem Trailer Launching	156	5 Quarters	Year 4, Quarter 2	Year 5, Quarter 2
Park Road East Connecting	12	1 Quarter	Year 7, Quarter 1	Year 7, Quarter 1
Bifurcation Launching	152	3 Quarters	Year 3, Quarter 2	Year 3, Quarter 4
Hegarty Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
St. Mary Street Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Highland Avenue NW Receiving	34	1 Quarter	Year 2, Quarter 4	Year 2, Quarter 4
Highland Avenue NE Launching	156	7 Quarters	Year 2, Quarter 2	Year 3, Quarter 4
Newton Street Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Southern Spine Mains	10	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
American Legion Receiving	124	2 Quarter	Year 5, Quarter 3	Year 5, Quarter 4

As shown in **Table F.4-20**, the Highland Avenue Northeast and Tandem Trailer sites are expected to generate the highest number of truck trips per day. Highland Avenue Northeast is expected to generate 156 truck trips per day for a duration of seven quarters. Tandem Trailer is expected to generate 156 truck trips per day for a duration of five quarters. Both sites are located adjacent to highway ramps and therefore are not expected to have a significant impact on traffic operations on nearby roadways.

Net New Construction Vehicle Trips

To estimate the traffic impact during peak hours, the daily truck trips identified above were converted to hourly truck volumes. It was assumed that trucks would access the site over a period of eight hours, so the daily truck total was divided by eight.

It was assumed that all construction worker trips take place during the peak hours. For sites requiring one shift per day, all workers would arrive during the morning peak hour and depart during the evening peak hour. For sites requiring two shifts per day, workers for the first shift would arrive during the morning peak hours and depart during the evening peak hour. Second shift workers would arrive during the evening peak hour and depart later in the night outside of peak hours.

Table F.4-21 and **Table F.4-22** show the number of net new vehicle trips expected to access each shaft site during the morning and evening peak hours under Alternative 3.

Table F.4-21 Alternative 3 – Net New Construction Vehicle Trips by Shaft Location – AM Peak Hour

	Construction Workers			Trucks			All Vehicles		
Shaft Site	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**
Fernald Property	31	0	31	1	1	2	32	1	33
School Street	18	0	18	1	1	2	19	1	20
Cedarwood Pumping Station	18	0	18	1	1	2	19	1	20
Tandem Trailer	63	0	63	10	10	20	73	10	83
Park Road East	20	0	20	1	1	2	21	1	22
Bifurcation	63	0	63	10	10	20	73	10	83
Hegarty Pumping Station	18	0	18	1	1	2	19	1	20
St. Mary St Pumping Station	18	0	18	1	1	2	19	1	20
Highland Avenue NW	31	0	31	2	2	4	33	2	35
Highland Avenue NE	63	0	63	10	10	20	73	10	83
Newton Street Pumping Station	18	0	18	1	1	2	19	1	20
Southern Spine Mains	18	0	18	1	1	2	19	1	20
American Legion	36	0	36	8	8	16	44	8	52

As shown in **Table F.4-21**, Highland Avenue Northeast, Bifurcation, and Tandem Trailer construction activities are expected to generate the highest number of vehicle trips in the morning peak hour. Each of these sites would generate 63 construction worker trips and 20 truck trips during the morning peak hour.

Table F.4-22 Alternative 3 – Net New Construction Vehicle Trips by Shaft Location – PM Peak Hour

	Construction Workers			Trucks			All Vehicles		
Shaft Site	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**
Fernald Property	16	16	32	1	1	2	17	17	34
School Street	0	18	18	1	1	2	1	19	20
Cedarwood Pumping Station	0	18	18	1	1	2	1	19	20
Tandem Trailer	63	63	126	10	10	20	73	73	146
Park Road East	0	20	20	1	1	2	1	21	22
Bifurcation	63	63	126	10	10	20	73	73	146
Hegarty Pumping Station	0	18	18	1	1	2	1	19	20
St. Mary Street Pumping Station	0	18	18	1	1	2	1	19	20
Highland Avenue NW	26	26	52	1	1	2	27	27	54
Highland Avenue NE	63	63	126	10	10	20	73	73	146
Newton Street Pumping Station	0	18	18	1	1	2	1	19	20
Southern Spine Mains	0	18	18	1	1	2	1	19	20
American Legion	42	42	84	8	8	16	50	50	100

In the evening peak hour, Bifurcation, Tandem Trailer, and Highland Avenue Northeast construction activities are expected to generate the highest number of vehicle trips during the change from first to second shift. Each of these sites is expected to generate 126 construction worker trips and 20 truck trips.

Study Area Intersections Construction Period Traffic impacts

The vehicle trips expected at each shaft site were distributed onto the surrounding roadway network based on the previously described truck routes. This section describes the maximum net new vehicle trips expected to travel through each study intersection in each municipality during the morning and evening peak hours. The vehicle trips combine both construction worker trips and truck trips.

Waltham

Table F.4-23 shows the number of net new vehicle trips expected to travel through each study intersection in Waltham. These trips are also shown in **Figure 4.10-20**.

Table F.4-23 Alternative 3 – Net New Vehicle Trips – Waltham Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Trapelo Rd. at Lexington St.	Fernald Property	32	17
Waverley Oaks Rd. at Trapelo Rd.	Fernald Property	32	17
Beaver St. at Waverley Oaks Rd.	Fernald Property	1	17
Main St. at Linden St./Ellison Park	Fernald Property	1	17
Elm St. at Main St.	Fernald Property	1	17
Moody St. at Main St.	Fernald Property	1	17

Table F.4-23 Alternative 3 – Net New Vehicle Trips – Waltham Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Bacon St. at Main St.	Fernald Property, School Street	21	37
Weston St. at Main St.	Fernald Property, School Street	21	37
South St. at Weston St.	Fernald Property, School Street, Cedarwood Pumping Station	41	57
Shakespeare Rd. at South St.	Cedarwood Pumping Station	20	20

As shown in **Table F.4-23**, the intersection of South Street and Weston Street would be expected to experience the highest number of additional trips, with 41 trips in the morning peak hour and 57 trips in the evening peak hour. The intersections of Bacon Street at Main Street and Weston Street at Main Street would each be expected to experience an additional 21 trips during the morning peak hour and 37 trips during the evening peak hour.

Weston

Table F.4-24 shows the number of net new vehicle trips expected to travel through each study intersection in Weston during construction activities. These trips are also shown in **Figure 4.10-21**.

Table F.4-24 Alternative 3 – Net New Vehicle Trips – Weston Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
River Rd. at South Ave.	Tandem Trailer, Park Road East	105	168
I-95 N Off Ramp at South Ave.	Bifurcation	83	146
Park Rd. at South Ave.	Bifurcation	83	146

As shown in the **Table F.4-24**, the intersection of River Road and South Avenue would be expected to experience the highest number of additional construction period trips, with 105 trips in the morning peak hour and 168 trips in the evening peak hour. The intersections of the I-95 off-ramp at South Avenue and Park Road at South Avenue would each be expected to experience an additional 83 trips during the morning peak hour and 146 trips during the evening peak hour during shift changes.

Needham

Table F.4-25 shows the number of net new construction period vehicle trips expected to travel through the study intersection in Needham. These trips are also shown in **Figure 4.10-22**.

Table F.4-25 Alternative 3 – Net New Vehicle Trips – Needham Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Central Ave. at Cedar St.	Hegarty Pumping Station, St. Mary Street Pumping Station	20	20

The intersection of Central Avenue at Cedar Street would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Wellesley

Table F.4-26 shows the number of net new vehicle trips expected to travel through the study intersection in Wellesley. These trips are also shown in **Figure 4.10-22**.

Table F.4-26 Alternative 3 – Net New Vehicle Trips – Wellesley Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Worcester St. at Cedar St.	Hegarty Pumping Station, St. Mary Street Pumping Station	21	39

The intersection of Worcester Street at Cedar Street would be expected to experience 21 additional trips during the morning peak hour and 39 additional trips during the evening peak hour.

Newton

Table F.4-27 shows the number of net new vehicle trips expected to travel through the study intersection in Newton. These trips are also shown in **Figure 4.10-23**.

Table F.4-27 Alternative 3 – Net New Vehicle Trips – Newton Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Woodward St./Elliot St. at Rt 9	Newton Street Pumping Station	20	20

The intersection of Woodward Street and Elliot Street at Route 9 would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Brookline

Table F.4-28 shows the number of net new vehicle trips expected to travel through each study intersection in Brookline. These trips are also shown in **Figure 4.10-24**.

Table F.4-28 Alternative 3 – Net New Vehicle Trips – Brookline Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Grove St. at Newton St.	Newton Street Pumping Station	20	20
Newton St. at Clyde St.	Newton Street Pumping Station	20	20
Dudley St. at Lee St.	Newton Street Pumping Station	20	20
Lee St. at Rt 9	Newton Street Pumping Station	20	20
Chestnut Hill Ave. at Rt 9	Newton Street Pumping Station	20	20
Hammond St. at Rt 9	Newton Street Pumping Station	20	20

As shown in the table, all study intersections in Brookline would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Boston

Table F.4-29 shows the number of net new vehicle trips expected to travel through each study intersection in Boston. These trips are also shown in **Figure 4.10-25**.

Table F.4-29 Alternative 3 – Net New Vehicle Trips – Boston Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Canterbury Ln. at Morton St.	Southern Spine Mains, American Legion	72	120
Morton St. at Harvard St.	Southern Spine Mains, American Legion	72	120
Morton St. at Blue Hill Ave.	Southern Spine Mains, American Legion	72	120
Morton St. at Norfolk St.	Southern Spine Mains, American Legion	72	120
Morton St. at Corbet St.	Southern Spine Mains, American Legion	72	120
Morton St. at Gallivan Blvd.	Southern Spine Mains, American Legion	72	120
Gallivan Blvd. at Washington St.	Southern Spine Mains, American Legion	72	120
Gallivan Blvd. at Dorchester Ave.	Southern Spine Mains, American Legion	72	120
Gallivan Blvd. at Granite Ave./Adams St.	Southern Spine Mains, American Legion	72	120

Table F.4-29 Alternative 3 – Net New Vehicle Trips – Boston Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Gallivan Blvd. at Hallet St.	Southern Spine Mains, American Legion	72	120
Gallivan Blvd. at Neponset Ave.	Southern Spine Mains, American Legion	9	69
Neponset Ave. at Morrissey Blvd.	Southern Spine Mains, American Legion	63	51
South St. at Washington St.	Southern Spine Mains	20	20
South St. at Arborway.	Southern Spine Mains	39	21
Washington St. at Arborway	Southern Spine Mains	20	20
Arborway at Circuit Dr.	Southern Spine Mains	20	20

As shown in **Table F.4-29**, the intersections that are along the travel routes to and from both the American Legion and Southern Spine Mains sites would be expected to experience the highest number of additional vehicle trips, with 72 trips during the morning peak hour and 120 trips during the evening peak hour.

Surface Piping Construction Period Trucks

Surface piping would be required at many of the shaft sites. **Table F.4-30** shows the duration of work required for surface piping at each location, the associated number of truck trips per day, and the schedule of work to be performed.

Table F.4-30 Alternative 3 – Surface Piping Trips and Schedule

			Schedule																			
		Trucks trips per day	Year 1				Year 2				Year 6				Year 7				Year 8			
	Duration (weeks)		Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Highland Avenue NE Dewatering	64	6																				
Cedarwood Pumping Station	10	14																				
Hegarty Pumping Station	8	10																				
St. Mary Street Pumping Station	8	12																				
Newton Street Pumping Station	7	12																				
Southern Spine Mains	11	8																				
Bifurcation	54	14																				
School Street	12	14																				
Highland Avenue NE Piping	8	46																				
American Legion	63	24																				
Park Road East	21	20																				
Tandem Trailer	14	6																				
Fernald Property	45	22																			X	

Surface piping construction operations at each shaft site and associated traffic impacts are described below.

Highland Avenue Northeast (dewatering)

A dewatering pipe is proposed between the proposed shaft and the Charles River. The pipe would be installed along Brook Road, Wexford Street, and Fremont Street. Installation of this pipe would require detours along the three roadways, which are all functionally classified as local roads. Construction would be expected to generate an average of 6 truck trips per day and take place for 64 weeks, from Quarter 2 of Year 1 to Quarter 2 of Year 2. Traffic impacts on these roadways would be considered low.

Cedarwood Pumping Station

Surface piping construction would be expected to generate an average of 14 truck trips per day and take place for 10 weeks during Quarter 2 of Year 6. No traffic impacts to nearby roadways would be expected.

Hegarty Pumping Station

Surface piping construction would be expected to generate an average of 10 truck trips per day and take place for 8 weeks during Quarter 2 of Year 6. No traffic impacts to nearby roadways would be expected.

St. Mary Street Pumping Station

A surface pipe is proposed between the proposed tunnel and the existing MWRA transmission line along St. Mary Street. This connection would require a short-term detour on St. Mary Street, which is functionally classified as a local road. Construction would be expected to generate an average of 12 truck trips per day and take place for 8 weeks during Quarter 2 of Year 6. Traffic impacts on St. Mary Street would be considered low.

Newton Street Pumping Station

Surface piping construction would be expected to generate an average of 12 truck trips per day and take place for 7 weeks during Quarter 2 of Year 6. No traffic impacts to nearby roadways would be expected.

Southern Spine Mains

A surface pipe is proposed between the proposed shaft and the existing MWRA transmission lines along the Arborway. This connection would require temporary bicycle and pedestrian detours along the Arborway, which is functionally classified as an urban principal arterial. Construction would be expected to generate an average of 8 truck trips per day and take place for 11 weeks during Quarter 2 of Year 6. Traffic impacts on Arborway would be considered moderate.

Bifurcation

Surface piping construction would be expected to generate an average of 14 truck trips per day and take place for 54 weeks, from Quarter 2 to Quarter 4 of Year 6. No traffic impacts to nearby roadways would be expected.

School Street

A surface pipe is proposed between the proposed valve chamber and the existing MWRA transmission line along School Street. Installation of this pipe would require a short-term detour along School Street, which is functionally classified as an urban collector. Construction would be expected to generate an average of 14 truck trips per day and take place for 12 weeks, from Quarter 3 to Quarter 4 of Year 6. Traffic impacts on School Street would be considered high.

Highland Avenue Northeast (piping)

Surface piping construction would be expected to generate an average of 46 truck trips per day and take place for 8 weeks, from Quarter 1 to Quarter 2 of Year 7. No traffic impacts to nearby roadways would be expected.

American Legion

Two surface pipes are proposed at this location. One pipe would connect the proposed shaft and the existing MWRA transmission line along Morton Street. Installation of this pipe would require a short-term detour along Morton Street, which is functionally classified as an urban principal arterial. Traffic impacts on Morton Street would be considered high.

Another pipe would connect the proposed shaft and the Dorchester Tunnel. Installation of this pipe will require a short-term detour along American Legion Highway, which is functionally classified as an urban minor arterial. Traffic impacts on American Legion Highway would be considered high.

Construction would be expected to generate an average of 24 truck trips per day and take place for 63 weeks, during Quarter 2 of Year 6 and from Quarter 1 to Quarter 3 of Year 7.

Park Road East

Surface piping construction would be expected to generate an average of 20 truck trips per day and take place for 21 weeks, from Quarter 2 to Quarter 3 of Year 7. No traffic impacts to nearby roadways would be expected.

Tandem Trailer

Surface piping construction would be expected to generate an average of 12 truck trips per day and take place for 7 weeks during Quarter 1 of Year 8. No traffic impacts to nearby roadways would be expected.

Fernald Property

A surface pipe is proposed between the proposed valve chamber and the existing MWRA transmission line along Waverley Oaks Road. This connection would require a short-term detour along Waverley Oaks Road, which is functionally classified as an urban principal arterial. Construction would be expected to generate an average of 22 truck trips per day and take place for 45 weeks, from Quarter 1 to Quarter 3 of Year 8. Traffic impacts on Waverley Oaks Road would be considered high.

F.4.8.2 Alternative 4

Alternative 4 would require three TBM drives. The first drive would be launched from the Tandem Trailer site and received at the Fernald Property. The second would be launched from the Highland Avenue Northwest site and received at the Park Road West site. The third would be launched from the Highland Avenue Northeast site and received at the American Legion site.

Trucks

Truck routes were developed for each shaft location based on the shortest path between the site and the nearest major highway. **Table F.4-31** shows the characteristics of the truck routes associated with the sites used in Alternative 4, including travel distance and time between the shaft and nearest highway, land use along the route, functional classification, major signalized intersections, and traffic impact level. Truck routes are shown in **Figures 4.10-7** through **4.10-19**.

Table F.4-31 Alternative 4 – Truck Route Characteristics

Shaft Location	Construction Vehicle Travel Distance (mi)	Construction Vehicle Travel Time (min)	Truck Route Land Use	Truck Route Functional Classification	Major Signalized Intersections	Traffic Impact Level
Fernald Property Receiving	7.7	24	Residential, Industrial	Arterial	Some	Moderate
School Street	3.2	12	Commercial, Residential	Arterial, Collector	Some	Moderate
Cedarwood Pumping Station	3	12	Commercial, Industrial	Arterial	None	Low
Tandem Trailer Launching	0.3	1	Highway Ramp	Freeway	None	Low
Park Road West Receiving	0.2	1	Highway Ramp	Freeway	None	Low
Park Road East Connecting	0.2	1	Highway Ramp	Freeway	None	Low
Hegarty Pumping Station	1.7	4	Commercial, Residential	Arterial	None	Low
St. Mary Street Pumping Station	2	6	Residential, Commercial	Arterial	None	Moderate
Highland Avenue NW Launching	0.3	1	Highway Ramp	Freeway	None	Low

Table F.4-31 Alternative 4 – Truck Route Characteristics

Shaft Location	Construction Vehicle Travel Distance (mi)	Construction Vehicle Travel Time (min)	Truck Route Land Use	Truck Route Functional Classification	Major Signalized Intersections	Traffic Impact Level
Highland Avenue NE Launching	0.3	1	Highway Ramp	Freeway	None	Low
Newton Street Pumping Station	6.4	17	Commercial, Residential	Arterial	None	Moderate
Southern Spine Mains	10.7	34	Commercial, Residential	Arterial	Many	Moderate
American Legion Receiving	7.7	25	Commercial, Residential	Arterial	Many	Moderate

As shown in **Table F.4-31**, all truck routes would have either moderate or low levels of traffic impact. Moderate impacts are associated with routes that would pass through residential areas or have numerous signalized intersections along the routes.

Table F.4-32 shows the average daily number of truck trips expected to be generated by each shaft site during each quarter throughout construction. The sequence of constructing each element within a construction package will be at the discretion of the selected contractor(s) and thus not known at this time. This impact assessment is based on conservative (i.e., worst case, most impactful) construction sequencing. Durations of construction activities and equipment were estimated to occur concurrently, resulting in conservative (higher) peak cumulative impacts that were assessed.

Table F.4-32 Alternative 4 – Average Daily Truck Trips by Quarter

	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Fernald Property Receiving	0	0	0	0	0	0	0	0	0	0	2	28	4	0	0	0	0	2	0	0	0	0	0	0	0	2	0	14
School Street	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	6	0	0	0	0	0
Cedarwood Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0
Tandem Trailer Launching	0	0	0	0	0	0	0	0	0	0	12	70	8	156	156	156	156	156	0	0	6	34	72	72	72	50	12	12
Park Road West Receiving	0	0	0	0	0	0	2	32	14	4	0	0	2	0	0	0	0	2	0	16	6	0	0	0	0	0	0	0
Park Road East Connecting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	12	4	0	0
Hegarty Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
St. Mary Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
Highland Avenue NW Launching	0	0	0	0	0	0	0	78	10	156	156	156	106	0	20	60	60	20	0	12	34	0	0	0	0	0	0	0
Highland Avenue NE Launching	0	0	6	78	10	156	156	156	156	156	156	156	52	0	38	38	20	60	60	60	60	60	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
Southern Spine Mains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	4	0	0	0	0	0	0
American Legion Receiving	0	0	14	62	10	0	0	0	0	0	0	0	4	0	0	0	0	0	106	106	0	2	0	32	60	60	60	60
Total	**0**	**0**	**20**	**140**	**20**	**156**	**158**	**266**	**180**	**316**	**326**	**410**	**176**	**156**	**214**	**254**	**236**	**240**	**166**	**194**	**150**	**104**	**78**	**106**	**144**	**116**	**72**	**86**

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As shown in **Table F.4-32**, the maximum expected overall number of daily truck trips by quarter is 410, which would be expected to occur on days when construction activities take place simultaneously at Highland Avenue Northeast, Highland Avenue Northwest, and the Fernald Property.

Table F.4-33 shows the maximum number of truck trips expected to be generated by each site per day and the duration of the maximum impact.

Table F.4-33 Alternative 4 – Truck Trips by Shaft Location

Shaft Location	Maximum Truck Trips per day	Duration of Maximum Truck Volume	Start of Maximum Truck Volume	End of Maximum Truck Volume
Fernald Property Receiving	28	1 Quarter	Year 3, Quarter 4	Year 3, Quarter 4
School Street	6	1 Quarter	Year 6, Quarter 3	Year 6, Quarter 3
Cedarwood Pumping Station	6	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Tandem Trailer Launching	156	5 Quarters	Year 4, Quarter 2	Year 5, Quarter 2
Park Road West Receiving	32	1 Quarter	Year 2, Quarter 4	Year 2, Quarter 4
Park Road East Connecting	12	1 Quarter	Year 7, Quarter 1	Year 7, Quarter 1
Hegarty Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
St. Mary Street Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Highland Avenue NW Launching	156	3 Quarters	Year 3, Quarter 2	Year 3, Quarter 4
Highland Avenue NE Launching	156	7 Quarters	Year 2, Quarter 2	Year 3, Quarter 4
Newton Street Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Southern Spine Mains	10	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
American Legion Receiving	106	2 Quarters	Year 5, Quarter 3	Year 5, Quarter 4

As shown in **Table F.4-33**, the Highland Avenue Northwest, Highland Avenue Northeast, and Tandem Trailer sites are expected to generate the highest number of truck trips per day. Highland Avenue Northwest is expected to generate 156 truck trips per day for a duration of three quarters. Highland Avenue Northeast is expected to generate 156 truck trips per day for a duration of seven quarters. Tandem Trailer is expected to generate 156 truck trips per day for a duration of five quarters. These three sites are adjacent to highway ramps and therefore are not expected to have a significant impact on traffic operations on nearby roadways.

Net New Construction Vehicle Trips

To estimate the traffic impact during peak hours, the daily truck trips identified above were converted to hourly truck volumes. It was assumed that trucks would access the site over a period of eight hours, so the daily truck total was divided by eight.

As discussed previously, it was assumed that all construction worker trips take place during the peak hours. For sites requiring one shift per day, workers would arrive during the morning peak hour and depart during the evening peak hour. For sites requiring two shifts per day, workers for the first shift would arrive during the morning peak hours and depart during the evening peak hour. Second shift workers would arrive during the evening peak hour and depart later in the night outside of peak hours.

Table F.4-34 and **Table F.4-35** show the number of net new vehicle trips expected to access each shaft site during the morning and evening peak hours under Alternative 4.

Table F.4-34 Alternative 4 – Net New Construction Vehicle Trips by Shaft Location – AM Peak Hour

	Construction Workers			Trucks			All Vehicles		
Shaft Site	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**
Fernald Property	31	0	31	1	1	2	32	1	33
School Street	18	0	18	1	1	2	19	1	20
Cedarwood Pumping Station	18	0	18	1	1	2	19	1	20
Tandem Trailer	63	0	63	10	10	20	73	10	83
Park Road West	50	0	50	1	1	2	51	1	52
Park Road East	27	0	27	1	1	2	28	1	29
Hegarty Pumping Station	18	0	18	1	1	2	19	1	20
St. Mary Street Pumping Station	18	0	18	1	1	2	19	1	20
Highland Avenue NW	63	0	63	10	10	20	73	10	83
Highland Avenue NE	63	0	63	10	10	20	73	10	83
Newton Street Pumping Station	18	0	18	1	1	2	19	1	20
Southern Spine Mains	18	0	18	1	1	2	19	1	20
American Legion	36	0	36	7	7	14	43	7	50

As shown in **Table F.4-34**, the Highland Avenue Northeast, Highland Avenue Northwest, and Tandem Trailer sites would be expected to generate the highest number of vehicle trips in the morning peak hour. Each of these sites would generate 63 construction worker trips and 20 truck trips during the morning peak hour.

Table F.4-35 Alternative 4 – Net New Construction Vehicle Trips by Shaft Location – PM Peak Hour

	Construction Workers			Trucks			All Vehicles		
Shaft Site	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**
Fernald Property	0	31	31	1	1	2	1	32	33
School Street	0	18	18	1	1	2	1	19	20
Cedarwood Pumping Station	0	18	18	1	1	2	1	19	20
Tandem Trailer	63	63	126	10	10	20	73	73	146
Park Road West	0	50	50	1	1	2	1	51	52
Park Road East	0	27	27	1	1	2	1	28	29
Hegarty Pumping Station	0	18	18	1	1	2	1	19	20
St. Mary Street Pumping Station	0	18	18	1	1	2	1	19	20
Highland Avenue NW	63	63	126	10	10	20	73	73	146
Highland Avenue NE	63	63	126	10	10	20	73	73	146
Newton Street Pumping Station	0	18	18	1	1	2	1	19	20
Southern Spine Mains	0	18	18	1	1	2	1	19	20
American Legion	42	42	84	1	1	2	43	43	86

In the evening peak hour, the Highland Avenue Northeast, Highland Avenue Northwest, and Tandem Trailer es are expected to generate the highest number of vehicle trips during the change from first to second shift. Each of these sites is expected to generate 126 construction worker trips and 20 truck trips.

Study Areas Intersection Construction Period Traffic impacts

The vehicle trips expected at each shaft site were distributed onto the surrounding roadway network based on the previously described truck routes. This section describes the maximum net new vehicle trips expected to travel through each study intersection in each municipality during the morning and evening peak hours. The vehicle trips combine both construction worker trips and truck trips.

Waltham

Table F.4-36 shows the number of net new vehicle trips expected to travel through each study intersection in Waltham. These trips are also shown in **Figure 4.10-26**.

Table F.4-36 Alternative 4 – Net New Vehicle Trips – Waltham Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Trapelo Rd. at Lexington St.	Fernald Property	32	1
Waverley Oaks Rd. at Trapelo Rd.	Fernald Property	32	1
Beaver St. at Waverley Oaks Rd.	Fernald Property	1	32
Main St. at Linden St./Ellison Park	Fernald Property	1	32
Elm St. at Main St.	Fernald Property	1	32
Moody St. at Main St.	Fernald Property	1	32
Bacon St. at Main St.	Fernald Property, School Street	21	52
Weston St. at Main St.	Fernald Property, School Street	21	52
South St. at Weston St.	Fernald Property, School Street, Cedarwood Pumping Station	41	72
Shakespeare Rd. at South St.	Cedarwood Pumping Station	20	20

As shown in **Table F.4-36**, the intersection of South Street and Weston Street would be expected to experience the highest number of additional trips—41 trips in the morning peak hour and 72 trips in the evening peak hour. The intersections of Bacon Street at Main Street and Weston Street at Main Street would each be expected to experience an additional 21 trips during the morning peak hour and 52 trips during the evening peak hour.

Weston

Table F.4-37 shows the number of net new vehicle trips expected to travel through each study intersection in Weston. These trips are also shown in **Figure 4.10-27**.

Table F.4-37 Alternative 4 – Net New Vehicle Trips – Weston Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
River Rd at South Ave	Tandem Trailer, Park Road East, Park Road West	164	227
I-95 N Off Ramp at South Ave	Park Road West	52	52
Park Rd at South Ave	Park Road West	52	52

As shown in **Table F.4-37**, the intersection of River Road and South Avenue would be expected to experience the highest number of additional trips—164 trips in the morning peak hour and 227 trips in the evening peak hour. The intersections of the I-95 off-ramp at South Avenue and Park Road at South Avenue would each be expected to experience an additional 52 trips during the morning peak hour and 52 trips during the evening peak hour during shift changes.

Needham

Table F.4-38 shows the number of net new vehicle trips expected to travel through the study intersection in Needham. These trips are also shown in **Figure 4.10-28**.

Table F.4-38 Alternative 4 – Net New Vehicle Trips – Needham Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Central Ave. at Cedar St.	Hegarty Pumping Station, St. Mary Street Pumping Station	20	20

The intersection of Central Avenue at Cedar Street would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Wellesley

Table F.4-39 shows the number of net new vehicle trips expected to travel through the study intersection in Wellesley. These trips are also shown in **Figure 4.10-28**.

Table F.4-39 Alternative 4 – Net New Vehicle Trips – Wellesley Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Worcester St. at Cedar St.	Hegarty Pumping Station, St. Mary Street Pumping Station	21	39

The intersection of Worcester Street at Cedar Street would be expected to experience 21 additional trips during the morning peak hour and 39 additional trips during the evening peak hour.

Newton

Table F.4-40 shows the number of net new vehicle trips expected to travel through the study intersection in Newton. These trips are also shown in **Figure 4.10-29**.

Table F.4-40 Alternative 4 – Net New Vehicle Trips – Newton Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Woodward St./Elliot St. at Rt 9	Newton Street Pumping Station	20	20

The intersection of Woodward Street/Elliot Street at Route 9 would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Brookline

Table F.4-41 shows the number of net new vehicle trips expected to travel through each study intersection in Brookline. These trips are also shown in **Figure 4.10-30**.

Table F.4-41 Alternative 4 – Net New Vehicle Trips – Brookline Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Grove St. at Newton St.	Newton Street Pumping Station	20	20
Newton St. at Clyde St.	Newton Street Pumping Station	20	20
Dudley St. at Lee St.	Newton Street Pumping Station	20	20
Lee St. at Rt 9	Newton Street Pumping Station	20	20
Chestnut Hill Ave. at Rt 9	Newton Street Pumping Station	20	20
Hammond St. at Rt 9	Newton Street Pumping Station	20	20

As shown in **Table F.4-41**, all study intersections in Brookline would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Boston

Table F.4-42 shows the number of net new vehicle trips expected to travel through each study intersection in Boston. These trips are also shown in **Figure 4.10-31**.

Table F.4-42 Alternative 4 – Net New Vehicle Trips – Boston Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Canterbury Ln. at Morton St.	Southern Spine Mains, American Legion	70	106
Morton St. at Harvard St.	Southern Spine Mains, American Legion	70	106
Morton St. at Blue Hill Ave.	Southern Spine Mains, American Legion	70	106
Morton St. at Norfolk St.	Southern Spine Mains, American Legion	70	106
Morton St. at Corbet St.	Southern Spine Mains, American Legion	70	106
Morton St. at Gallivan Blvd.	Southern Spine Mains, American Legion	70	106
Gallivan Blvd. at Washington St.	Southern Spine Mains, American Legion	70	106

Table F.4-42 Alternative 4 – Net New Vehicle Trips – Boston Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Gallivan Blvd. at Dorchester Ave.	Southern Spine Mains, American Legion	70	106
Gallivan Blvd. at Granite Ave./Adams St.	Southern Spine Mains, American Legion	70	106
Gallivan Blvd. at Hallet St.	Southern Spine Mains, American Legion	70	106
Gallivan Blvd. at Neponset Ave.	Southern Spine Mains, American Legion	8	62
Neponset Ave. at Morrissey Blvd.	Southern Spine Mains, American Legion	62	44
South St. at Washington S.t	Southern Spine Mains	20	20
South St. at Arborway	Southern Spine Mains	39	21
Washington St. at Arborway	Southern Spine Mains	20	20
Arborway at Circuit Dr.	Southern Spine Mains	20	20

As shown in **Table F.4-42**, the intersections that are located along the travel routes to and from both the American Legion and Southern Spine Mains sites would be expected to experience the highest number of additional vehicle trips, 70 trips during the morning peak hour and 106 trips during the evening peak hour.

Surface Piping

Surface piping would be required at many of the shaft sites. **Table F.4-43** shows the duration of work required for surface piping at each location, the associated number of truck trips per day, and the schedule of work to be performed.

Table F.4-43 Alternative 4 – Surface Piping Trips and Schedule

			Schedule																			
	Duration (weeks)	Truck trips per day	Year 1				Year 2				Year 6				Year 7				Year 8			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue NE Dewatering	64	6																				
Cedarwood Pumping Station	10	14																				
Hegarty Pumping Station	8	10																				
St. Mary Street Pumping Station	8	12																				
Newton Street Pumping Station	7	12																				
Southern Spine Mains	11	8																				
Park Road West	29	20																				
School Street	12	14																				
Highland Avenue NE Piping	8	46																				
American Legion	63	24																				
Tandem Trailer	14	6																				
Fernald Property	45	22																				

Surface piping impacts under Alternative 4 would be the same as surface piping under Alternative 3.

F.4.8.3 Alternative 10

Alternative 10 would require two TBM drives. The first drive would be launched from the Highland Avenue Northwest site and received at the Fernald Property. The second drive would be launched from the Highland Avenue Northeast site and received at the American Legion site.

Trucks

Truck routes were developed for each shaft location based on the shortest path between the site and the nearest major highway. **Table F.4-44** shows the characteristics of the truck routes associated with the sites used in Alternative 10, including travel distance and time between the shaft and nearest highway, land use along the route, functional classification, major signalized intersections, and traffic impact level. Truck routes are shown in **Figures 4.10-7** through **4.10-19**.

Table F.4-44 Alternative 10 – Truck Route Characteristics

Shaft Location	Construction Vehicle Travel Distance (mi)	Construction Vehicle Travel Time (min)	Truck Route Land Use	Truck Route Functional Classification	Major Signalized Intersections	Traffic Impact Level
Fernald Property Receiving	7.7	24	Residential, Industrial	Arterial	Some	Moderate
School Street	3.2	12	Commercial, Residential	Arterial, Collector	Some	Moderate
Cedarwood Pumping Station	3	12	Commercial, Industrial	Arterial	None	Low
Park Road West Receiving	0.2	1	Highway Ramp	Freeway	None	Low
Hegarty Pumping Station	1.7	4	Commercial, Residential	Arterial	None	Low
St. Mary Street Pumping Station	2	6	Residential, Commercial	Arterial	None	Moderate
Highland Avenue NW Launching	0.3	1	Highway Ramp	Freeway	None	Low
Highland Avenue NE Launching	0.3	1	Highway Ramp	Freeway	None	Low
Newton Street Pumping Station	6.4	17	Commercial, Residential	Arterial	None	Moderate
Southern Spine Mains	10.7	34	Commercial, Residential	Arterial	Many	Moderate
American Legion Receiving	7.7	25	Commercial, Residential	Arterial	Many	Moderate

As shown in **Table F.4-44**, all truck routes would have either moderate or low levels of traffic impact. Moderate impacts are associated with routes that would pass through residential areas or have numerous signalized intersections along the routes.

Table F.4-45 shows the average daily number of truck trips expected to be generated by each shaft site during each quarter throughout construction. The sequence of constructing each element within a construction package will be at the discretion of the selected contractor(s) and thus not known at this time. This impact assessment is based on conservative (i.e., worst case, most impactful) construction sequencing. Durations of construction activities and equipment were estimated to occur concurrently, resulting in conservative (higher) peak cumulative impacts that were assessed.

Table F.4-45 Alternative 10 – Average Daily Truck Trips by Quarter

	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Fernald Property Receiving	0	0	2	28	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	14	0	0	0
School Street	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	6	0	0	0	0	0	0	0	0	0
Cedarwood Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Park Rd West	0	0	0	6	42	6	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	16	6	0	0
Hegarty Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue NW Launching	0	0	6	78	10	156	156	156	156	156	156	156	156	156	0	0	0	0	0	0	0	56	56	56	56	56	56	56	12	34	0	0
Highland Avenue NE Launching Site	0	0	0	0	0	0	6	78	0	156	156	156	156	156	156	156	52	0	14	14	20	60	60	60	60	60	12	34	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	4	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	0	0	0	0	14	64	10	0	0	0	0	0	0	0	0	0	0	4	0	0	0	126	126	2	32	60	60	60	60	0
Total	**0**	**0**	**8**	**112**	**56**	**162**	**176**	**298**	**170**	**312**	**312**	**312**	**312**	**312**	**156**	**156**	**52**	**0**	**14**	**20**	**64**	**124**	**122**	**244**	**242**	**118**	**100**	**152**	**102**	**100**	**60**	**0**

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The maximum expected overall number of daily truck trips by quarter is 312, which would be expected to occur from Quarter 2 of Year 3 to Quarter 2 of Year 4, when construction activities take place simultaneously at the Highland Avenue Northeast and Highland Avenue Northwest sites.

Table F.4-46 shows the maximum number of truck trips expected to be generated by each site per day and the duration of the maximum impact.

Table F.4-46 Alternative 10 – Truck Trips by Shaft Location

Shaft Location	Maximum Truck trips per day	Duration of Maximum Truck Volume	Start of Maximum Truck Volume	End of Maximum Truck Volume
Fernald Property Receiving	28	1 Quarter	Year 1, Quarter 4	Year 1, Quarter 4
School Street	6	1 Quarter	Year 6, Quarter 3	Year 6, Quarter 3
Cedarwood Pumping Station	6	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Park Road West Receiving	42	1 Quarter	Year 2, Quarter 1	Year 2, Quarter 1
Hegarty Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
St. Mary Street Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Highland Avenue NW Launching	156	9 Quarters	Year 2, Quarter 2	Year 4, Quarter 2
Highland Avenue NE Launching	156	7 Quarters	Year 3, Quarter 2	Year 4, Quarter 4
Newton Street Pumping Station	8	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
Southern Spine Mains	10	1 Quarter	Year 6, Quarter 1	Year 6, Quarter 1
American Legion Receiving	126	2 Quarters	Year 6, Quarter 4	Year 7, Quarter 1

As shown in **Table F.4-46**, the Highland Avenue northeast and Highland Avenue northwest sites are expected to generate the highest number of truck trips per day. Highland Avenue Northeast is expected to generate 156 truck trips per day for a duration of seven quarters. Highland Avenue Northwest is expected to generate 156 truck trips per day for a duration of nine quarters. Both sites are located adjacent to highway ramps and therefore are not expected to have a significant impact on traffic operations on nearby roadways.

Net New Construction Vehicle Trips

To estimate the traffic impact during peak hours, the daily truck trips identified above were converted to hourly truck volumes. It was assumed that trucks would access the sites over a period of eight hours, so the daily truck total was divided by eight.

It was assumed that all construction worker trips take place during the peak hours. For sites requiring one shift per day, all workers would arrive during the morning peak hour and depart during the evening peak hour. For sites requiring two shifts per day, workers for the first shift would arrive during the morning peak hours and depart during the evening peak hour. Second shift workers would arrive during the evening peak hour and depart later in the night outside of peak hours.

Table F.4-47 and **-48** show the number of net new vehicle trips expected to access each shaft site during the morning and evening peak hours under Alternative 10.

Table F.4-47 Alternative 10 – Net New Construction Vehicle Trips by Shaft Location – AM Peak Hour

	Construction Workers			Trucks			All Vehicles		
Shaft Site	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**
Fernald Property	31	0	31	1	1	2	32	1	33
School Street	18	0	18	1	1	2	19	1	20
Cedarwood Pumping Station	18	0	18	1	1	2	19	1	20
Park Road West	31	0	31	1	1	2	32	1	33
Hegarty Pumping Station	18	0	18	1	1	2	19	1	20
St. Mary Street Pumping Station	18	0	18	1	1	2	19	1	20
Highland Avenue NW	63	0	63	10	10	20	73	10	83
Highland Avenue NE	63	0	63	10	10	20	73	10	83
Newton Street Pumping Station	18	0	18	1	1	2	19	1	20
Southern Spine Mains	18	0	18	1	1	2	19	1	20
American Legion	36	0	36	8	8	16	44	8	52

As shown in **Table F.4-47**, Highland Avenue Northwest and Highland Avenue Northeast would be expected to generate the highest number of vehicle trips in the morning peak hour. Each of these sites would generate 63 construction worker trips and 20 truck trips during the morning peak hour.

Table F.4-48 Alternative 10 – Net New Construction Vehicle Trips by Shaft Location – PM Peak Hour

	Construction Workers			Trucks			All Vehicles		
Shaft Site	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**
Fernald Property	16	16	32	1	1	2	17	17	34
School Street	0	18	18	1	1	2	1	19	20
Cedarwood Pumping Station	0	18	18	1	1	2	1	19	20
Park Road West	16	16	32	1	1	2	17	17	34
Hegarty Pumping Station	0	18	18	1	1	2	1	19	20
St. Mary Street Pumping Station	0	18	18	1	1	2	1	19	20
Highland Avenue NW	63	63	126	10	10	20	73	73	146
Highland Avenue NE	63	63	126	10	10	20	73	73	146

Table F.4-48 Alternative 10 – Net New Construction Vehicle Trips by Shaft Location – PM Peak Hour

	Construction Workers			Trucks			All Vehicles		
Shaft Site	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**	**Entering**	**Exiting**	**Total**
Newton Street Pumping Station	0	18	18	1	1	2	1	19	20
Southern Spine Mains	0	18	18	1	1	2	1	19	20
American Legion	36	36	72	8	8	16	44	44	88

In the evening peak hour, Highland Avenue Northwest and Highland Avenue Northeast would be expected to generate the highest number of vehicle trips during the change from first to second shift. Each of these sites would be expected to generate 126 construction worker trips and 20 truck trips.

Study Areas Intersection Construction Period Traffic impacts

The vehicle trips expected at each shaft site were distributed onto the surrounding roadway network based on the previously described truck routes. This section describes the maximum net new vehicle trips expected to travel through each study intersection in each municipality during the morning and evening peak hours. The vehicle trips combine both construction worker trips and truck trips.

Waltham

Table F.4-49 shows the number of net new vehicle trips expected to travel through each study intersection in Waltham. These trips are also shown in **Figure 4.10-32**.

Table F.4-49 Alternative 10 – Net New Vehicle Trips – Waltham Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Trapelo Rd. at Lexington St.	Fernald Property	32	17
Waverley Oaks Rd. at Trapelo Rd.	Fernald Property	32	17
Beaver St. at Waverley Oaks Rd.	Fernald Property	1	17
Main St. at Linden St./Ellison Park	Fernald Property	1	17
Elm St. at Main St.	Fernald Property	1	17
Moody St. at Main St.	Fernald Property	1	17
Bacon St. at Main St.	Fernald Property, School Street	21	37
Weston St. at Main St.	Fernald Property, School Street	21	37
South St. at Weston St.	Fernald Property, School Street, Cedarwood Pumping Station	41	57
Shakespeare Rd. at South St.	Cedarwood Pumping Station	20	20

As shown in **Table F.4-49**, the intersection of South Street and Weston Street would be expected to experience the highest number of additional trips—41 trips in the morning peak hour and 57 trips in the evening peak hour. The intersections of Bacon Street at Main Street and Weston Street at Main Street would each be expected to experience an additional 21 trips during the morning peak hour and 37 trips during the evening peak hour.

Weston

Table F.4-50 shows the number of net new vehicle trips expected to travel through each study intersection in Weston. These trips are also shown in **Figure 4.10-33**.

Table F.4-50 Alternative 10 – Net New Vehicle Trips – Weston Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
River Rd. at South Ave.	Park Road West	32	34
I-95 N off-ramp at South Ave.	Park Road West	32	34
Park Rd. at South Ave.	Park Road West	32	34

As shown in **Table F.4-50**, all study intersections in Weston would be expected to experience 32 additional trips in the morning peak hour and 34 additional trips in the evening peak hour.

Needham

Table F.4-51 shows the number of net new vehicle trips expected to travel through the study intersection in Needham. These trips are also shown in **Figure 4.10-34**.

Table F.4-51 Alternative 10 – Net New Vehicle Trips – Needham Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Central Ave. at Cedar St.	Hegarty Pumping Station, St. Mary Street Pumping Station	20	20

The intersection of Central Avenue at Cedar Street would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Wellesley

Table F.4-52 shows the number of net new vehicle trips expected to travel through the study intersection in Wellesley. These trips are also shown in **Figure 4.10-34**.

Table F.4-52 Alternative 10 – Net New Vehicle Trips – Wellesley Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Worcester St. at Cedar St.	Hegarty Pumping Station, St. Mary Street Pumping Station	21	39

The intersection of Worcester Street at Cedar Street would be expected to experience 21 additional trips during the morning peak hour and 39 additional trips during the evening peak hour.

Newton

Table F.4-53 shows the number of net new vehicle trips expected to travel through the study intersection in Newton. These trips are also shown in **Figure 4.10-35**.

Table F.4-53 Alternative 10 – Net New Vehicle Trips – Newton Intersection

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Woodward St./Elliot St. at Rt 9	Newton Street Pumping Station	20	20

The intersection of Woodward Street/Elliot Street at Route 9 would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Brookline

Table F.4-54 shows the number of net new vehicle trips expected to travel through each study intersection in Brookline. These trips are also shown in **Figure 4.10-36**.

Table F.4-54 Alternative 10 – Net New Vehicle Trips – Brookline Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Grove St. at Newton St.	Newton Street Pumping Station	20	20
Newton St. at Clyde St.	Newton Street Pumping Station	20	20
Dudley St. at Lee St.	Newton Street Pumping Station	20	20
Lee St. at Rt 9	Newton Street Pumping Station	20	20
Chestnut Hill Ave. at Rt 9	Newton Street Pumping Station	20	20
Hammond St. at Rt 9	Newton Street Pumping Station	20	20

As shown in **Table F.4-54**, all study intersections in Brookline would be expected to experience 20 additional trips during the morning peak hour and 20 additional trips during the evening peak hour.

Boston

Table F.4-55 shows the number of net new vehicle trips expected to travel through each study intersection in Boston. These trips are also shown in **Figure 4.10-37**.

Table F.4-55 Alternative 10 – Net New Vehicle Trips – Boston Intersections

Intersection	Associated Shaft Site(s)	AM Peak Hour	PM Peak Hour
Canterbury Ln. at Morton St.	Southern Spine Mains, American Legion	72	108
Morton St. at Harvard St.	Southern Spine Mains, American Legion	72	108
Morton St. at Blue Hill Ave.	Southern Spine Mains, American Legion	72	108
Morton St. at Norfolk St.	Southern Spine Mains, American Legion	72	108
Morton St. at Corbet St.	Southern Spine Mains, American Legion	72	108
Morton St. at Gallivan Blvd.	Southern Spine Mains, American Legion	72	108
Gallivan Blvd. at Washington St.	Southern Spine Mains, American Legion	72	108
Gallivan Blvd. at Dorchester Ave.	Southern Spine Mains, American Legion	72	108
Gallivan Blvd. at Granite Ave./Adams St.	Southern Spine Mains, American Legion	72	108
Gallivan Blvd. at Hallet St.	Southern Spine Mains, American Legion	72	108
Gallivan Blvd. at Neponset Ave.	Southern Spine Mains, American Legion	9	63
Neponset Ave. at Morrissey Blvd.	Southern Spine Mains, American Legion	63	45
South St. at Washington St.	Southern Spine Mains	20	20
South St. at Arborway	Southern Spine Mains	39	21
Washington St. at Arborway	Southern Spine Mains	20	20
Arborway at Circuit Dr.	Southern Spine Mains	20	20

As shown in the table, the intersections along the travel routes to and from both the American Legion and Southern Spine Mains sites would experience the highest number of additional vehicle trips—72 trips during the morning peak hour and 108 trips during the evening peak hour.

Surface Piping

Surface piping would be required at many of the shaft sites. **Table F.4-56** shows the duration of work required for surface piping at each location, the associated number of truck trips per day, and the schedule of work to be performed.

Surface piping impacts under Alternative 10 would be the same as surface piping under Alternatives 3 and 4.

Table F.4-56 Alternative 10 – Surface Piping Trips and Schedule

			Schedule																					
	Duration (weeks)	Truck trips per day	Year 1				Year 2				Year 6				Year 7				Year 8				Year 9	
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Highland Avenue NE Dewatering	64	3																						
Cedarwood Pumping Station	10	7																						
Hegarty Pumping Station	8	5																						
St. Mary Street Pumping Station	8	6																						
Newton Street Pumping Station	7	6																						
Southern Spine Mains	11	4																						
School Street	12	7																						
American Legion	63	12																						
Highland Avenue NE Piping	8	23																						
Fernald Property	45	11																						
Park Road West Launching	50	9																						

F.4.9 Final Conditions

Due to the nature of this Program, regular trip generation associated with the various sites is not anticipated once construction is complete. While MWRA maintenance workers would access the properties for daily inspections, this would result in a maximum of two vehicle trips per day at any given location (one entering the site and one exiting). Therefore, operational analyses for the Build Condition were not evaluated as part of the transportation impact assessment and no permanent mitigation would be anticipated or recommended.

F.4.10 Intersection Operational Analysis

F.4.10.1 Methodology

For convenience of comparing alternatives, traffic analysis is included for each of the alternatives, including the Existing and No-Build conditions, in the following sections. The study intersections were examined with regard to flow rates, capacity and delay characteristics to determine the Level of Service (LOS), using the methodology defined in the Highway Capacity Manual (HCM)[2] for the existing and future (No-Build and Build) traffic conditions.

LOS is an indicator of operating conditions that occur on a given roadway feature while accommodating varying levels of traffic volumes. It is a qualitative measure that accounts for a number of operational factors, including roadway geometry, speed, traffic composition, peak hour factors, travel delay, freedom to maneuver, and driver expectation. When all of these measures are assessed, and an LOS is assigned to a roadway or intersection, it is equivalent to presenting an "index" to the operational qualities of the section under study. LOS is classified into six levels that are designated 'A' through 'F' based on the control delay ranges they fall under. Additionally, a movement with a volume-to-capacity (v/c) ratio of more than 1.00 also has a LOS of 'F', regardless of delay. These are presented in **Table F.4-57** for signalized and unsignalized intersections. In practice, any given roadway/intersection may operate at a wide LOS range depending upon time of day, day of week, or period of year. It should be noted that for unsignalized intersections, the LOS is not computed for the intersection as a whole. Instead, it is determined by the computed or measured control delay for each individual critical movement (typically the side-street movements).

2 Transportation Research Board, of the National Academies, Highway Capacity Manual 6th Edition, Washington, D.C., 2017.

Table F.4-57 Level of Service Criteria for Unsignalized and Signalized Intersections

LOS	Unsignalized Intersection (S)	Signalized Intersection (S)
A	≤10	≤10
B	>10 and ≤15	>10 and ≤20
C	>15 and ≤25	>20 and ≤35
D	>25 and ≤35	>35 and ≤55
E	>35 and ≤50	>55 and ≤80
F	>50 or v/c ≥1.00	>80 or v/c ≥1.00
Abbreviations: S = Seconds, v/c = Volume-to-Capacity Ratio, LOS = Level of Service		

The study intersections were evaluated using the Synchro 10 computer software for operational analysis. Detailed analysis results are presented below.

F.4.10.2 Summary of Results

Table F.4-58 and **Table F.4-59** show summaries of the operational analyses for Existing, No-Build, and Temporary Construction scenarios during the morning and evening peak hours, respectively. This methodology conforms with the previously referenced MassDOT TIA Guidelines. The No-Build condition projects traffic volumes into the future construction year using a background growth rate but assumes the project will not take place and no additional trips are added. Build conditions assume that construction will take place.

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Trapelo Road at Lexington Street (Waltham)					
Lexington St. SB L	D	D	D	D	D
Lexington St. SB T	C	C	C	C	C
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Trapelo Road at Waverley Oaks Road (Waltham)					
Trapelo Rd. EB T	C	D	D	D	D
Waverley Oaks Rd. NB L	B	B	B	B	B
Trapelo Rd. WB L	F	F	F	F	F
Trapelo Rd. WB T	A	A	A	A	A
Overall Intersection	**F**	**F**	**F**	**F**	**F**

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Beaver Street at Waverley Oaks Road (Waltham)					
Beaver St. EB L	D	D	D	D	D
Beaver St. EB T	C	C	C	C	C
Waverley Oaks Rd. NB L	D	D	D	D	D
Waverley Oaks Rd. NB T	D	D	D	D	D
Waverley Oaks Rd. NB R	A	A	A	A	A
Beaver St. WB L	D	D	D	D	D
Beaver St. WB T	B	B	B	B	B
Waverley Oaks Rd. SB L	D	D	D	D	D
Waverley Oaks Rd. SB T	C	C	C	C	C
Waverley Oaks Rd. SB R	A	A	A	A	A
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Main Street at Ellison Park/Linden Street (Waltham)					
Main St. EB L	F	F	F	F	F
Main St. EB T	E	E	E	E	E
Linden St. NB LTR	A	A	A	A	A
Main St. WB T	D	D	D	D	D
Linden St. SWB L	D	D	D	D	D
Linden St. SWB R	F	F	F	F	F
Ellison Park SB L	C	C	C	C	C
Ellison Park SB T	C	C	C	C	C
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Main Street at Elm Street (Waltham)					
Main St. EB L	A	A	A	A	A
Main St. EB T	B	B	B	B	B
Main St. EB R	D	E	E	E	E
Elm St. NB T	D	D	D	D	D
Main St. WB L	A	A	A	A	A

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Main St. WB T	B	B	B	B	B
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Main Street at Moody Street (Waltham)					
Main St EB T	B	B	B	B	B
Main St. EB R	B	B	B	B	B
Moody St. NB L	B	B	B	B	B
Moody St. NB T	B	B	B	B	B
Moody St. NB R	B	B	B	B	B
Main St. WB L	F	F	F	F	F
Main St. WB TR	B	B	B	B	B
Overall Intersection	**E**	**E**	**E**	**E**	**E**
Main Street at Bacon Street (Waltham)					
Main St. EB L	A	A	A	A	A
Main St. EB T	C	C	C	C	C
Main St. WB T	A	C	A	C	C
Bacon St. SB L	C	A	C	A	A
Bacon St. SB R	B	B	B	B	B
Overall Intersection	**B**	**B**	**B**	**B**	**B**
Main Street at Weston Street/ South Street (Waltham)					
Main St. EB T	C	C	C	C	C
Weston St. NEB L	C	D	D	D	D
Weston St. NEB R	B	D	D	D	D
Main St. WB L1	F	F	F	F	F
Main St. WB L2	C	C	C	C	C
Main St. WB T	D	D	D	D	D
South St. NB HL	D	C	C	C	C
South St. NB L	D	B	B	B	B
Overall Intersection	**E**	**E**	**E**	**E**	**E**

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Shakespeare Road at South Street (Waltham)					
South St. NEB LTR	A	A	A	A	A
Pump Station Drwy NB LTR	D	D	D	D	D
South St. SWB LTR	A	A	A	A	A
Shakespeare Rd. SB LTR	D	E	E	E	E
River Road at South Avenue (Weston)					
South Ave. NEB L	F	F	F	F	F
South Ave. NEB T	B	B	B	B	B
I-95 S Exit 39A off-ramp LT	D	D	F	F	D
I-95 S Exit 39A off-ramp R	B	B	B	B	B
South Ave. WB L	F	F	F	F	F
South Ave. WB T	B	B	F	B	B
River Rd. SB L	C	C	C	C	C
River Rd. SB T	C	C	C	C	C
River Rd. SB R	A	A	A	A	A
Overall Intersection	**D**	**D**	**E**	**D**	**D**
I-95 N Off Ramp at South Avenue/Commonwealth Ave (Weston)					
South Ave. EB T	B	A	B	B	B
I-95 N off-ramp L	C	B	E	E	D
I-95 N off-ramp R	B	B	B	B	B
Commonwealth Ave. WB T	B	C	B	B	C
Commonwealth Ave. WB TR	C	C	C	C	C
Overall Intersection	**A**	**B**	**C**	**B**	**B**
Park Road at South Avenue (Weston)					
South Ave. EB T	D	D	D	D	D
South Ave. EB R	A	A	A	A	A
Park Rd. NB L	D	D	D	D	D

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Park Rd. NB LR	D	D	D	D	D
South Ave. WB L	E	E	E	E	E
South Ave. WB T	C	C	C	C	C
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Central Avenue at Cedar Street (Needham)					
Central Ave. EB L	A	A	A	A	A
Central Ave. WB L	A	A	A	A	A
Cedar St. SB LTR	F	F	F	F	F
Worcester Street at Cedar Street (Wellesley)					
Worcester St. EB L	D	D	D	D	D
Worcester St. EB T	D	D	D	D	D
Cedar St. NB L	A	A	A	A	A
Cedar St. NB T	C	C	C	C	C
Worcester St. WB LTR	C	C	C	C	C
Cedar St. SB L	A	A	A	A	A
Cedar St. SB T	A	A	A	A	A
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Route 9 at Woodward Street/Elliot Street (Newton)					
Rt 9 EB L	F	F	F	F	F
Rt 9 EB T	F	F	F	F	F
Elliot St. NB L	C	C	C	C	C
Elliot St. NB T	D	D	D	D	D
Rt 9 WB L	F	F	F	F	F
Rt 9 WB T	F	F	F	F	F
Woodward St. SB L	F	F	F	F	F
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Grove Street at Newton Street (Brookline)					
Newton St. EB L	D	D	D	D	D

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Newton St. EB R	B	B	B	B	B
Grove St. NB T	B	C	C	C	C
Newton St. SB T	A	B	B	B	B
Newton St SB R	A	A	A	A	A
Overall Intersection	**B**	**B**	**B**	**B**	**B**
Newton Street at Clyde Street (Brookline)					
Newton St. EB L	F	F	F	F	F
Newton St. EB T	F	F	F	F	F
Newton St. WB T	E	E	E	E	E
Clyde St. SB L	D	D	D	D	D
Clyde St. SB R	A	A	A	A	A
Overall Intersection	**E**	**F**	**F**	**F**	**F**
Warren Street at Lee Street (Brookline)					
Lee St. NEB L	A	A	A	A	A
Lee St. NEB R	A	A	A	A	A
Warren St. WB LR	F	F	F	F	F
Lee St. SB L	A	A	A	A	A
Lee St. SB R	A	A	A	A	A
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Lee Street at Route 9 (Brookline)					
Rt 9 EB T	C	D	D	D	D
Rt 9 EB R	A	A	A	A	A
Lee St. NB L	D	D	D	D	D
Rt 9 WB L	F	F	F	F	F
Rt 9 WB T	D	E	E	E	E
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Chestnut Hill Avenue at Route 9 (Brookline)					
Rt 9 EB L	F	F	F	F	F

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Rt 9 EB T	C	C	C	C	C
Rt 9 WB L	D	D	D	D	D
Rt 9 WB T	E	E	E	E	E
Rt 9 WB R	A	A	A	A	A
Chestnut Hill Ave. SB L	F	F	F	F	F
Chestnut Hill Ave. SB R	A	A	A	A	A
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Hammond Street at Route 9 (Brookline)					
Rt 9 EB L	F	F	F	F	F
Rt 9 EB T	E	E	E	E	E
Hammond St. NB T	F	F	F	F	F
Rt 9 WB L	F	F	F	F	F
Rt 9 WB T	F	F	F	F	F
Rt 9 WB R	A	A	A	A	A
Hammond St. SB L	F	F	F	F	F
Hammond St. SB T	D	D	D	D	D
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Canterbury Lane at Morton Street (Boston)					
Canterbury Ln. EB LR	C	C	C	C	C
Morton St. NB L	A	A	A	A	A
Morton St. NB T	B	B	B	B	B
Morton St. SB T	A	A	A	A	A
Overall Intersection	**A**	**A**	**A**	**A**	**A**
Morton Street at Harvard Street (Boston)					
Harvard St. EB L	F	F	F	F	F
Harvard St. EB T	C	C	C	C	C
Morton St. NB L	E	E	E	E	E
Morton St. NB T	E	E	E	E	E

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
Harvard St. WB L	D	D	D	D	D
Harvard St. WB T	F	F	F	F	F
Morton St. SB L	F	F	F	F	F
Morton St. SB T	C	C	C	C	C
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Morton Street at Blue Hill Avenue (Boston)					
Morton St. EB T	C	C	C	C	C
Morton St. EB R	A	A	A	A	A
Blue Hill Ave. NB L	E	E	E	E	E
Blue Hill Ave. NB T	D	D	D	D	D
Morton St. WB T	D	D	D	D	D
Blue Hill Ave. SB L	F	F	F	F	F
Blue Hill Ave. SB T	D	D	D	D	D
Overall Intersection	**E**	**E**	**E**	**E**	**E**
Morton Street at Norfolk Street (Boston)					
Morton St. EB L	D	D	D	D	D
Morton St. EB T	D	E	E	E	E
Norfolk St. NB T	C	C	C	C	C
Norfolk St. NB R	A	A	A	A	A
Morton St. WB L	D	D	D	D	D
Morton St. WB T	D	F	F	F	F
Norfolk St. SB LTR	C	C	C	C	C
Overall Intersection	**D**	**D**	**E**	**E**	**E**
Morton Street at Corbet Street (Boston)					
Morton St. EB L	C	C	C	C	C
Morton St. EB T	C	C	C	C	C
W Selden St. NB LTR	C	C	C	C	C
Morton St. WB L	D	C	D	C	C

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Morton St. WB T	C	D	C	D	D
Corbet St. SB LTR	C	C	C	C	C
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Morton Street at Woodmere Street/Gallivan Boulevard (Boston)					
Morton St. SEB L	C	B	B	B	B
Morton St. SEB T	C	C	C	C	C
Woodmere St. NEB LTR	A	A	A	A	A
Morton St. NWB LT	B	B	B	B	B
Gallivan Blvd. WB T	A	A	A	A	A
Overall Intersection	**B**	**B**	**B**	**B**	**B**
Gallivan Boulevard at Washington Street (Boston)					
Gallivan Blvd. EB LT	B	B	B	B	B
Gallivan Blvd. EB R	A	A	A	A	A
Washington St. NB LTR	B	B	B	B	B
Gallivan Blvd. WB LTR	B	B	B	B	B
Washington St. SB LTR	C	C	C	C	C
Overall Intersection	**B**	**B**	**B**	**B**	**B**
Gallivan Boulevard at Dorchester Avenue (Boston)					
Gallivan Blvd. EB T	B	B	B	B	B
Dorchester Ave. NB LTR	C	C	C	C	C
Gallivan Blvd. WB T	B	B	B	B	B
Dorchester Ave. SB LTR	C	C	C	C	C
Overall Intersection	**B**	**B**	**B**	**B**	**B**
Gallivan Boulevard at Granite Avenue/Adams Street (Boston)					
Gallivan Blvd. EB L	C	C	C	C	C
Gallivan Blvd. EB T	D	D	D	D	D
Granite Ave. NB L	C	C	C	C	C
Granite Ave. NB TR	D	D	D	D	D

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
Gallivan Blvd. WB L	F	F	F	F	F
Gallivan Blvd. WB T	C	D	D	D	D
Adams St. SB L	C	B	C	C	X
Adams St. SB T	D	D	D	D	D
Adams St. SB R	A	A	A	A	A
Overall Intersection	**C**	**D**	**D**	**D**	**D**
Gallivan Boulevard at Hallet Street (Boston)					
Gallivan Blvd. EB T	C	C	C	C	C
Gallivan Blvd. EB TR	0	0	0	0	0
Hallet St. NB L	D	D	D	D	D
Hallet St. NB R	D	D	D	D	D
Gallivan Blvd. WB T	B	B	B	B	B
Hallet St. SB L	C	C	C	C	C
Hallet St. SB T	B	B	B	B	B
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Gallivan Boulevard at Neponset Avenue (Boston)					
Neponset Ave. EB L	B	B	B	B	B
Neponset Ave. EB T	B	B	B	B	B
Gallivan Blvd. NB T	A	A	A	A	A
Gallivan Blvd. NB R	A	A	A	A	A
Overall Intersection	**B**	**B**	**B**	**B**	**B**
Neponset Avenue at Morrissey Boulevard (Boston)					
Neponset Ave. EB T	A	A	A	A	A
Morrissey Blvd. SB L	A	A	B	B	B
Morrissey Blvd. SB T	A	A	A	A	A
Morrissey Blvd. SB R	A	A	A	A	A
Overall Intersection	**A**	**A**	**A**	**A**	**A**
South Street at Washington Street (Boston)					

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
South St. EB L	E	E	E	E	E
Washington St. NB LT	0	0	0	0	0
Washington St. NB T	B	B	B	B	B
South St. SB TR	0	0	0	0	0
South St. SB T	B	B	B	B	B
Overall Intersection	**C**	**C**	**C**	**C**	**C**
South Street at Arborway/New Washington Street (Boston)					
Arborway EB T	B	B	B	B	B
Arborway EB R	A	A	A	A	A
South St. NB L	D	E	E	E	E
South St. NB T	D	D	D	D	D
New Washington St. WB T	C	C	C	C	C
South St. SB L	F	F	F	F	F
South St. SB T	D	D	D	D	D
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Washington Street at Arborway (Boston)					
New Washington St. EB T	D	D	D	D	D
Washington St. NB L	D	D	D	D	D
Washington St. NB TR	D	D	D	D	D
Arborway WB L	F	F	F	F	F
Arborway WB T	B	B	B	B	B
Washington St. SB L	D	E	E	E	E
Washington St. SB TR	D	D	D	D	D
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Arborway at Morton Street/Circuit Drive (Boston)					
Arborway EB L	E	E	E	E	E
Arborway EB T	B	B	B	B	B
Morton St. NB T	D	D	D	D	D

Table F.4-58 Intersection Operational Analysis Results: Morning Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Morton St. WB L	E	E	E	E	E
Morton St. WB T	C	C	C	C	C
Circuit Dr. SB T	D	D	D	D	D
Overall Intersection	**D**	**D**	**D**	**D**	**D**

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Trapelo Road at Lexington Street (Waltham)					
Trapelo Rd. EB L	E	E	E	E	E
Trapelo Rd. EB T	C	C	C	C	C
Lexington St. NB L	E	E	E	E	E
Lexington St. NB T	D	D	D	D	D
Trapelo Rd. WB L	E	E	E	E	E
Trapelo Rd. WB T	D	D	D	D	D
Trapelo Rd. WB R	B	B	B	B	B
Lexington St. SB L	E	E	E	E	E
Lexington St. SB T	D	D	D	D	D
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Trapelo Road at Waverley Oaks Road (Waltham)					
Trapelo Rd. EB T	C	C	C	C	C
Waverley Oaks Rd. NB L	F	F	F	F	F
Waverley Oaks Rd. NB R	0	0	0	0	0
Trapelo Rd. WB L	F	F	F	F	F
Trapelo Rd. WB T	A	A	A	A	A
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Beaver Street at Waverley Oaks Road (Waltham)					

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
Beaver St. EB L	E	E	E	E	E
Beaver St. EB T	C	C	C	C	C
Waverley Oaks Rd. NB L	D	D	D	D	D
Waverley Oaks Rd. NB T	D	D	D	D	D
Waverley Oaks Rd. NB R	A	A	A	A	A
Beaver St. WB L	D	D	D	D	D
Beaver St. WB T	C	C	C	C	C
Waverley Oaks Rd. SB L	D	D	D	D	D
Waverley Oaks Rd. SB T	A	C	C	C	C
Waverley Oaks Rd. SB R	A	A	A	A	A
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Main Street at Ellison Park/Linden Street (Waltham)					
Main St. EB L	F	F	F	F	F
Main St. EB T	D	D	D	D	D
Main St. EB R	0	0	0	0	0
Linden St. NB LTR	C	A	A	A	A
Main St. WB LT	0	0	0	0	0
Main St. WB T	C	D	D	D	D
Linden St. SWB L	D	C	C	C	C
Linden St. SWB R	F	D	D	D	D
Ellison Park SB L	C	F	F	F	C
Ellison Park SB T	C	C	C	C	C
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Main Street at Elm Street (Waltham)					
Main St. EB L	A	A	A	A	A
Main St. EB T	B	B	B	B	B
Main St. EB R	C	C	C	C	C
Elm St. NB T	D	D	D	D	D

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Main St. WB L	A	A	A	A	A
Main St. WB T	B	B	B	B	B
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Main Street at Moody Street (Waltham)					
Main St. EB T	B	B	B	B	B
Main St. EB R	B	B	B	B	B
Moody St. NB L	B	B	B	B	B
Moody St. NB T	B	B	B	B	B
Moody St. NB R	B	B	B	B	B
Main St. WB L	F	F	F	F	F
Main St. WB TR	B	B	B	C	B
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Main Street at Bacon Street (Waltham)					
Main St. EB L	A	A	A	B	B
Main St. EB T	C	C	C	C	C
Main St. WB T	A	A	A	A	A
Main St. WB R	0	0	0	0	0
Bacon St. SB L	D	D	D	D	D
Bacon St. SB R	B	B	B	B	B
Overall Intersection	**B**	**B**	**B**	**B**	**B**
Main Street at Weston Street/ South Street (Waltham)					
Main St. EB T	D	D	D	D	D
Main St. EB TR	0	0	0	0	0
Weston St. NEB L	C	C	C	C	C
Weston St. NEB R	A	A	A	A	A
Main St. WB L1	F	F	F	F	F
Main St. WB L2	C	C	C	C	C
Main St. WB T	E	E	E	E	E

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Weston St. NEB T	0	0	0	0	0
Weston St. NEB TR	0	0	0	0	0
South St. NB HL	E	E	E	E	E
South St. NB L	E	E	E	E	E
Weston St. SWB L	0	0	0	0	0
Weston St. SWB T	0	0	0	0	0
Overall Intersection	**E**	**E**	**E**	**E**	**E**
Shakespeare Road at South Street (Waltham)					
South St. NEB LTR	A	A	A	A	A
Pump Station Drwy NB LTR	C	C	C	C	C
South St. SWB LTR	A	A	A	A	A
Shakespeare Rd. SB LTR	D	D	E	E	E
River Road at South Avenue (Weston)					
South Ave. NEB L	D	D	D	D	D
South Ave NEB T	B	B	B	B	B
South Ave. NEB R	0	0	0	0	0
I-95 S Exit 39A off-ramp LT	F	F	F	F	F
I-95 S Exit 39A off-ramp R	A	A	A	A	A
South Ave. WB L	F	F	F	F	F
South Ave. WB T	A	A	A	A	A
South Ave. WB R	0	0	0	0	0
River Rd. SB L	F	F	F	F	F
River Rd. SB T	F	F	F	F	F
River Rd. SB R	A	A	A	A	A
Overall Intersection	**D**	**D**	**E**	**E**	**D**
I-95 N Off Ramp at South Avenue/Commonwealth Ave (Weston)					
South Ave. EB T	C	A	C	A	B
South Ave. EB TR	0	0	0	0	0

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
I-95 N off-ramp L	B	B	B	B	B
I-95 N off-ramp R	A	B	A	B	B
Commonwealth Ave. WB T	C	C	C	C	C
Overall Intersection	**B**	**B**	**C**	**B**	**B**
Park Road at South Avenue (Weston)					
South Ave. EB T	C	C	C	C	C
South Ave. EB R	A	A	A	A	A
Park Rd. NB L	C	C	C	C	C
Park Rd. NB LR	B	B	B	B	B
South Ave. WB L	C	C	D	C	C
South Ave. WB T	F	F	F	F	F
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Central Avenue at Cedar Street (Needham)					
Central Ave. EB L	A	A	A	A	A
Central Ave. WB L	A	A	A	A	A
Cedar St. SB LTR	F	F	F	F	F
Worcester Street at Cedar Street (Wellesley)					
Worcester St. EB L	C	C	C	C	C
Worcester St. EB T	C	C	C	C	C
Cedar St. NB L	B	B	B	B	B
Cedar St. NB T	C	C	C	C	C
Worcester St. WB LTR	C	C	C	C	C
Cedar St. SB L	A	A	A	A	A
Cedar St. SB T	B	B	B	B	B
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Route 9 at Woodward Street/Elliot Street (Newton)					
Rt 9 EB L	F	F	F	F	F
Rt 9 EB T	E	E	E	E	E

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
Rt 9 EB TR	0	0	0	0	0
Elliot St. NB L	D	D	D	D	D
Elliot St. NB T	D	D	D	D	D
Elliot St. NB R	0	0	0	0	0
Rt 9 WB L	F	F	F	F	F
Rt 9 WB T	E	E	E	E	E
Rt 9 WB TR	0	0	0	0	0
Woodward St. SB L	F	F	F	F	F
Woodward St. SB TR	0	0	0	0	0
Overall Intersection	**E**	**E**	**E**	**E**	**E**
Grove Street at Newton Street (Brookline)					
Newton St. EB L	D	D	D	D	D
Newton St. EB R	A	A	A	A	A
Grove St. NB L	0	0	0	0	0
Grove St. NB T	C	D	D	D	D
Newton S.t SB T	F	F	F	F	F
Newton St. SB R	A	A	A	A	A
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Newton Street at Clyde Street (Brookline)					
Newton St. EB L	F	F	F	F	F
Newton St. EB T	F	F	F	F	F
Newton St. WB TR	0	0	0	0	0
Newton St. WB T	D	D	D	D	D
Clyde St. SB L	C	C	C	C	C
Clyde St. SB R	B	B	B	B	B
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Warren Street at Lee Street (Brookline)					
Lee St. NEB L	A	A	A	A	A

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
Lee St. NEB R	A	A	A	A	A
Warren St. WB LR	F	F	F	F	F
Lee St. SB L	A	A	A	A	A
Lee St. SB R	A	A	A	A	A
Overall Intersection	**C**		**D**	D	**D**
Lee Street at Route 9 (Brookline)					
Rt 9 EB T	B	B	B	B	B
Rt 9 EB R	A	A	A	A	A
Lee St. NB L	B	D	D	D	D
Rt 9 WB L	F	F	F	F	F
Rt 9 WB T	B	B	B	B	B
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Chestnut Hill Avenue at Route 9 (Brookline)					
Rt 9 EB L	F	F	F	F	F
Rt 9 EB T	C	C	C	C	C
Rt 9 WB L	F	F	F	F	F
Rt 9 WB T	D	D	D	D	D
Rt 9 WB R	A	A	A	A	A
Chestnut Hill Ave. SB L	F	F	F	F	F
Chestnut Hill Ave. SB R	B	B	B	B	B
Overall Intersection	**E**	**F**	**F**	**F**	**F**
Hammond Street at Route 9 (Brookline)					
Rt 9 EB L	F	F	F	F	F
Rt 9 EB T	F	F	F	F	F
Hammond St. NB T	F	F	F	F	F
Rt 9 WB L	E	E	E	E	E
Rt 9 WB T	E	E	E	E	E
Rt 9 WB R	A	A	A	A	A

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
Hammond St. SB L	F	F	F	F	F
Hammond St. SB T	E	E	E	E	E
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Canterbury Lane at Morton Street (Boston)					
Canterbury Ln. EB LR	C	C	C	C	C
Morton St. NB L	B	B	D	D	B
Morton St. NB T	A	A	A	A	A
Morton St. SB T	A	A	B	B	A
Morton St. SB TR	0	0	0	0	0
Overall Intersection	**A**	**A**	**B**	**B**	**B**
Morton Street at Harvard Street (Boston)					
Harvard St. EB L	E	E	E	E	E
Harvard St. EB T	C	C	C	C	C
Morton St. NB L	E	E	E	E	E
Morton St. NB T	C	D	D	D	D
Harvard St. WB L	E	D	D	D	D
Harvard St. WB T	E	E	E	E	E
Morton St. SB L	E	E	E	E	E
Morton St. SB T	C	D	D	D	D
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Morton Street at Blue Hill Avenue (Boston)					
Morton St. EB T	C	C	C	C	C
Morton St. EB R	A	A	A	A	A
Blue Hill Ave. NB L	E	E	E	E	E
Blue Hill Ave. NB T	D	D	D	D	D
Morton St WB T	C	C	C	C	C
Blue Hill Ave. SB L	F	F	F	F	F
Blue Hill Ave. SB T	D	D	D	D	D

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Overall Intersection	**D**	**D**	**D**	**D**	**D**
Morton Street at Norfolk Street (Boston)					
Morton St. EB L	E	E	E	E	E
Morton St. EB T	0	0	0	0	0
Morton St. EB T	E	F	F	F	F
Norfolk St. NB T	C	C	C	C	C
Norfolk St. NB R	A	A	A	A	A
Morton St. WB L	D	D	D	D	D
Morton St. WB T	0	0	0	0	0
Morton St. WB T	C	C	C	C	C
Norfolk St. SB LTR	C	C	C	C	C
Overall Intersection	**D**	**D**	**E**	**E**	**E**
Morton Street at Corbet Street (Boston)					
Morton St. EB L	E	E	E	E	E
Morton St. EB T	C	C	C	C	C
Morton St. EB TR	0	0	0	0	0
W Selden St. NB LTR	C	C	C	C	C
Morton St. WB L	E	F	F	F	F
Morton St. WB T	D	D	D	D	D
Morton St. WB TR	0	0	0	0	0
Corbet St. SB LTR	C	C	C	C	C
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Morton Street at Woodmere Street/Gallivan Boulevard (Boston)					
Morton St. SEB L	C	C	D	D	C
Morton St. SEB T	D	D	D	D	D
Woodmere St. NEB LTR	B	B	B	B	B
Morton St. NWB LT	C	C	C	C	C
Morton St. NWB TR	0	0	0	0	0

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Gallivan Blvd. WB T	A	A	A	A	A
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Gallivan Boulevard at Washington Street (Boston)					
Gallivan Blvd. EB LT	B	B	B	B	B
Gallivan Blvd. EB T	0	0	0	0	0
Gallivan Blvd. EB R	A	A	A	A	A
Washington St. NB LTR	B	B	B	B	B
Gallivan Blvd. WB LTR	B	C	B	B	C
Gallivan Blvd. WB TR	0	0	0	0	0
Washington St. SB LTR	C	B	C	C	B
Overall Intersection	**B**	**B**	**C**	**B**	**B**
Gallivan Boulevard at Dorchester Avenue (Boston)					
Gallivan Blvd. EB T	B	B	B	B	B
Gallivan Blvd. EB TR	0	0	0	0	0
Dorchester Ave. NB LTR	B	B	B	B	B
Gallivan Blvd. WB T	B	B	B	B	B
Gallivan Blvd. WB TR	0	0	0	0	0
Dorchester Ave. SB LTR	C	C	C	C	C
Overall Intersection	**B**	**B**	**B**	**B**	**B**
Gallivan Boulevard at Granite Avenue/Adams Street (Boston)					
Gallivan Blvd. EB L	B	B	B	B	B
Gallivan Blvd. EB T	B	B	B	B	B
Gallivan Blvd. EB TR	0	0	0	0	0
Granite Ave. NB L	D	E	E	E	E
Granite Ave. NB TR	D	D	D	D	D
Gallivan Blvd. WB L	D	D	E	E	E
Gallivan Blvd. WB T	C	C	C	C	C
Gallivan Blvd. WB TR	0	0	0	0	0

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Adams St. SB L	C	C	C	C	C
Adams St. SB T	D	D	D	D	D
Adams St. SB R	A	A	A	A	A
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Gallivan Boulevard at Hallet Street (Boston)					
Gallivan Blvd. EB T	C	C	C	C	C
Gallivan Blvd. EB TR	0	0	0	0	0
Hallet St. NB L	C	C	C	C	C
Hallet St. NB R	C	C	C	C	C
Gallivan Blvd. WB T	B	B	B	B	B
Hallet St. SB L	C	C	C	C	C
Hallet St. SB T	C	C	C	C	C
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Gallivan Boulevard at Neponset Avenue (Boston)					
Neponset Ave. EB L	B	B	B	B	B
Neponset Ave. EB T	D	D	D	D	D
Gallivan Blvd. NB T	A	A	A	A	A
Gallivan Blvd. NB R	C	C	C	C	C
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Neponset Avenue at Morrissey Boulevard (Boston)					
Neponset Ave. EB T	B	B	B	B	B
Morrissey Blvd. SB L	B	B	B	B	B
Morrissey Blvd. SB T	A	A	A	A	A
Morrissey Blvd. SB R	A	A	A	A	A
Overall Intersection	**B**	**B**	**B**	**B**	**B**
South Street at Washington Street (Boston)					
South St. EB L	E	F	F	F	F
Washington St. NB LT	0	0	0	0	0
Washington St. NB T	B	B	B	B	B

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	**LOS**	**LOS**	**LOS**	**LOS**
South St. SB TR	0	0	0	0	0
South St. SB T	B	B	B	B	B
Overall Intersection	**C**	**C**	**C**	**C**	**C**
South Street at Arborway/New Washington Street (Boston)					
Arborway EB L					
Arborway EB T	B	B	B	B	B
Arborway EB R	A	A	A	A	A
South St. NB L	E	E	E	E	E
South St. NB T	D	D	D	D	D
South St. NB TR	0	0	0	0	0
New Washington St. WB T	B	B	B	B	B
South St. SB L	C	C	C	C	C
South St. SB T	E	E	E	E	E
Overall Intersection	**C**	**C**	**C**	**C**	**C**
Washington Street at Arborway (Boston)					
New Washington St. EB T	F	F	F	F	F
New Washington St. EB TR	0	0	0	0	0
Washington St. NB L	D	D	D	D	D
Washington St. NB TR	C	C	C	C	C
Arborway WB L	F	F	F	F	F
Arborway WB T	B	B	B	B	B
Arborway WB TR	0	0	0	0	0
Washington St. SB L	D	D	D	D	D
Washington St. SB TR	D	D	D	D	D
Overall Intersection	**F**	**F**	**F**	**F**	**F**
Arborway at Morton Street/Circuit Drive (Boston)					
Arborway EB L	C	C	C	C	C
Arborway EB T	C	C	C	C	C

Table F.4-59 Intersection Operational Analysis Results: Evening Peak Hour

	Existing	Future No-Build	Build Alternative 3	Build Alternative 4	Build Alternative 10
	LOS	LOS	LOS	LOS	LOS
Arborway EB TR	0	0	0	0	0
Morton St. NB T	C	C	C	C	C
Morton St. WB L	E	E	E	E	E
Morton St. WB T	C	C	C	C	C
Morton St. WB TR	0	0	0	0	0
Circuit Dr. SB T	C	C	C	C	C
Circuit Dr. SB R	0	0	0	0	0
Overall Intersection	**C**	**C**	**C**	**C**	**C**

F.4.10.3 Alternative 3

The study intersections expected to be the most impacted by the additional traffic volumes during construction of Alternative 3 are described below. The impacts listed below represent the worst-case scenario and are not expected to be experienced over the full project duration.

Main Street at Ellison Park/Linden Street (Waltham)

During the evening peak hour at the intersection of Main Street and Ellison Park/Linden Street in Waltham, the Ellison Park southbound left turn movement would be expected to experience an increase in delay from 228.3 seconds under No-Build conditions to 256.0 seconds during construction of Alternative 3.

Main Street at Weston Street/ South Street (Waltham)

During the evening peak hour at the intersection of Main Street and Weston Street/ South Street in Waltham, the Ellison Park southbound left-turn movement would be expected to experience an increase in delay from 59.0 seconds under No-Build conditions to 69.2 seconds during construction of Alternative 3.

River Road at South Avenue (Weston)

During the morning peak hour, the intersection of River Road and South Avenue in Weston is expected to experience an overall delay of 50.7 seconds under No-Build conditions. During construction of Alternative 3, the intersection would be expected to experience an overall delay of 62.6 seconds. The left-turn movement from the I-95 southbound off-ramp would be expected to experience an increase in delay from 46.3 seconds under No-Build conditions to 167.0 seconds during construction.

During the evening peak hour, the intersection is expected to experience an overall delay of 49.6 seconds under No-Build conditions. During construction of Alternative 3, the intersection would be expected to experience an overall delay of 73.4 seconds. The left-turn movement from the I-95 southbound off-ramp would be expected to experience an increase in delay from 178.5 seconds under No-Build conditions to 372.7 seconds during construction.

Although queue lengths are expected to increase compared to No-Build conditions, the queues during construction are not expected to back up onto the highway mainline.

I-95 Northbound Off-Ramp at South Avenue/ Commonwealth Avenue (Weston)

During the morning peak hour, the intersection of the I-95 northbound off-ramp and South Avenue in Weston is expected to experience an overall delay of 16.2 seconds under No-Build conditions. During construction of Alternative 3, the intersection would be expected to experience an overall delay of 25.9 seconds. The left-turn movement from the I-95 northbound off-ramp would be expected to experience an increase in delay from 12.5 seconds under No-Build conditions to 68.3 seconds during construction.

During the evening peak hour, the intersection is expected to experience an overall delay of 16.2 seconds under No-Build conditions. During construction of Alternative 3, the intersection would be expected to experience an overall delay of 24.3 seconds. The South Avenue eastbound through movement would be expected to experience an increase in delay from 9.6 seconds under No-Build conditions to 33.0 seconds during construction.

Although queue lengths are expected to increase compared to No-Build conditions, the queues during construction are not expected to back up onto the highway mainline.

Park Road at South Avenue (Weston)

During the evening peak hour at the intersection of Park Road and South Avenue in Weston, the South Avenue westbound left turn movement would be expected to experience an increase in delay from 24.9 seconds under No-Build conditions to 38.6 seconds during construction of Alternative 3.

Central Avenue at Cedar Street (Needham)

During the morning peak hour at the intersection of Central Avenue at Cedar Street in Needham, the Cedar Street southbound approach would be expected to experience an increase in delay from 588.4 seconds under No-Build conditions to 661.2 seconds during construction of Alternative 3.

Newton Street at Clyde Street (Brookline)

During the evening peak hour at the intersection of Newton Street and Clyde Street in Brookline, the Newton Street eastbound left-turn movement would be expected to experience an increase in delay from 523.7 seconds under No-Build conditions to 566.9 seconds during construction of Alternative 3.

Morton Street at Blue Hill Avenue (Boston)

During the morning peak hour at the intersection of Morton Street and Blue Hill Avenue in Boston, the Blue Hill Avenue southbound left-turn movement would be expected to experience an increase in delay from 516.7 seconds under No-Build conditions to 536.0 seconds during construction of Alternative 3.

During the evening peak hour, the Blue Hill Avenue southbound left-turn movement would be expected to experience an increase in delay from 544.5 seconds under No-Build conditions to 571.8 seconds during construction of Alternative 3.

Morton Street at Norfolk Street (Boston)

During the morning peak hour at the intersection of Morton Street and Blue Hill Avenue in Boston, the Morton Street westbound through movement would be expected to experience an increase in delay from 80.1 seconds under No-Build conditions to 107.6 seconds during construction of Alternative 3.

During the evening peak hour, the Morton Street eastbound through movement would be expected to experience an increase in delay from 80.9 seconds under No-Build conditions to 105.2 seconds during construction of Alternative 3.

South Street at Washington Street (Boston)

During the evening peak hour at the intersection of South Street and Washington Street in Boston, the South Street eastbound left-turn movement would be expected to experience an increase in delay from 80.2 seconds under No-Build conditions to 96.0 seconds during construction of Alternative 3.

F.4.10.4 Alternative 4

The study intersections expected to be the most impacted by the additional traffic volumes during construction of Alternative 4 are described below. The impacts listed below represent the worst-case scenario and are not expected to be experienced over the full project duration.

Main Street at Ellison Park/Linden Street (Waltham)

During the evening peak hour at the intersection of Main Street and Ellison Park/Linden Street in Waltham, the Ellison Park southbound left-turn movement would be expected to experience an increase in delay from 228.3 seconds under No-Build conditions to 281.1 seconds during construction of Alternative 4.

Main Street at Weston Street/ South Street (Waltham)

During the evening peak hour at the intersection of Main Street and Weston Street/ South Street in Waltham, the Ellison Park southbound left-turn movement would be expected to experience an increase in delay from 59.0 seconds under No-Build conditions to 70.3 seconds during construction of Alternative 4.

River Road at South Avenue (Weston)

During the morning peak hour, the intersection of River Road and South Avenue in Weston is expected to experience an overall delay of 50.7 seconds under No-Build conditions. During construction of Alternative 4, the intersection would be expected to experience an overall delay of 76.0 seconds. The left-turn movement from the I-95 southbound off-ramp would be expected to experience an increase in delay from 46.3 seconds under No-Build conditions to 273.8 seconds during construction.

During the evening peak hour, the intersection is expected to experience an overall delay of 49.6 seconds under No-Build conditions. During construction of Alternative 4, the intersection would be expected to experience an overall delay of 72.9 seconds. The left-turn movement from the I-95 southbound off-ramp would be expected to experience an increase in delay from 178.5 seconds under No-Build conditions to 375.8 seconds during construction. The River Road southbound left-turn movement would be expected to experience an increase in delay from 141.0 seconds under No-Build conditions to 234.4 seconds during construction.

Although queue lengths are expected to increase compared to No-Build conditions, the queues during construction are not expected to back up onto the highway mainline.

I-95 Northbound Off-Ramp at South Avenue/ Commonwealth Avenue (Weston)

During the morning peak hour, the intersection of the I-95 northbound off-ramp and South Avenue in Weston is expected to experience an overall delay of 16.2 seconds under No-Build conditions. During construction of Alternative 4, the intersection would be expected to experience an overall delay of 23.6 seconds. The left-turn movement from the I-95 northbound off-ramp would be expected to experience an increase in delay from 12.5 seconds under No-Build conditions to 56.9 seconds during construction.

Although queue lengths are expected to increase compared to No-Build conditions, the queues during construction are not expected to back up onto the highway mainline.

Park Road at South Avenue (Weston)

During the morning peak hour, the intersection of Park Road and South Avenue in Weston is expected to experience an overall delay of 34.4 seconds under No-Build conditions. During construction of Alternative 4, the intersection would be expected to experience an overall delay of 40.5 seconds. The South Avenue westbound left-turn movement would be expected to experience an increase in delay from 61.0 seconds under No-Build conditions to 161.6 seconds during construction.

Central Avenue at Cedar Street (Needham)

During the morning peak hour at the intersection of Central Avenue at Cedar Street in in Needham, the Cedar Street southbound approach would be expected to experience an increase in delay from 588.4 seconds under No-Build conditions to 668.4 seconds during construction of Alternative 4.

Newton Street at Clyde Street (Brookline)

During the evening peak hour at the intersection of Newton Street and Clyde Street in Brookline, the Newton Street eastbound left-turn movement would be expected to experience an increase in delay from 523.7 seconds under No-Build conditions to 571.8 seconds during construction of Alternative 4.

Morton Street at Blue Hill Avenue (Boston)

During the morning peak hour at the intersection of Morton Street and Blue Hill Avenue in Boston, the Blue Hill Avenue southbound left-turn movement would be expected to experience an increase in delay from 516.7 seconds under No-Build conditions to 536.1 seconds under construction of Alternative 4.

During the evening peak hour, the Blue Hill Avenue southbound left-turn movement would be expected to experience an increase in delay from 544.5 seconds under No-Build conditions to 571.8 seconds during construction of Alternative 4.

Morton Street at Norfolk Street (Boston)

During the morning peak hour at the intersection of Morton Street and Blue Hill Avenue in Boston, the Morton Street westbound through movement would be expected to experience an increase in delay from 80.1 seconds under No-Build conditions to 110.3 seconds under construction of Alternative 4.

During the evening peak hour, the Morton Street eastbound through movement would be expected to experience an increase in delay from 80.9 seconds under No-Build conditions to 105.2 seconds during construction of Alternative 4.

South Street at Washington Street (Boston)

During the evening peak hour at the intersection of South Street and Washington Street in Boston, the South Street eastbound left-turn movement would be expected to experience an increase in delay from 80.2 seconds under No-Build conditions to 103.0 seconds during construction of Alternative 4.

South Street at Arborway/ New Washington Street (Boston)

During the evening peak hour at the intersection of South Street and Arborway/ New Washington Street in Boston, the South Street northbound through movement would be expected to experience an increase in delay from 40.8 seconds under No-Build conditions to 51.4 seconds during construction of Alternative 4.

F.4.10.5 Alternative 10

Intersection Operational Analysis

The study intersections expected to be the most impacted by the additional traffic volumes during construction of Alternative 10 are described below. The impacts listed below represent the worst-case scenario and are not expected to be experienced over the full project duration.

Main Street at Weston Street/ South Street (Waltham)

During the evening peak hour at the intersection of Main Street and Weston Street/ South Street in Waltham, the Ellison Park southbound left-turn movement would be expected to experience an increase in delay from 59.0 seconds under No-Build conditions to 69.2 seconds during construction of Alternative 10.

River Road at South Avenue (Weston)

During the morning peak hour, the intersection of River Road and South Avenue in Weston is expected to experience an overall delay of 50.7 seconds under No-Build conditions. During construction of Alternative 4, the intersection would be expected to experience an overall delay of 53.0 seconds. The left-turn movement from the I-95 southbound off-ramp would be expected to experience an increase in delay from 46.3 seconds under No-Build conditions to 72.0 seconds during construction of Alternative 10.

During the evening peak hour, the intersection is expected to experience an overall delay of 49.6 seconds under No-Build conditions. During construction of Alternative 10, the intersection would be expected to experience an overall delay of 53.0 seconds. The left-turn movement from the I-95 southbound off-ramp would be expected to experience an increase in delay from 178.5 seconds under No-Build conditions to 3218.0 seconds during construction.

Although queue lengths are expected to increase compared to No-Build conditions, the queues during construction are not expected to back up onto the highway mainline.

I-95 Northbound Off-Ramp at South Avenue/ Commonwealth Avenue (Weston)

During the morning peak hour at the intersection of the I-95 northbound off-ramp and South Avenue in Weston, the left-turn movement from the I-95 northbound off-ramp would be expected to experience an increase in delay from 12.5 seconds under No-Build conditions to 48.0 seconds during construction of Alternative 10.

Although queue lengths are expected to increase compared to No-Build conditions, the queues during construction are not expected to back up onto the highway mainline.

Park Road at South Avenue (Weston)

During the morning peak hour, the intersection of Park Road and South Avenue in Weston is expected to experience an overall delay of 34.4 seconds under No-Build conditions. During construction of Alternative 10, the intersection would be expected to experience an overall delay of 37.3 seconds. The South Avenue westbound left-turn movement would be expected to experience an increase in delay from 61.0 seconds under No-Build conditions to 115.0 seconds during construction.

Central Avenue at Cedar Street (Needham)

During the morning peak hour at the intersection of Central Avenue at Cedar Street in in Needham, the Cedar Street southbound approach would be expected to experience an increase in delay from 588.4 seconds under No-Build conditions to 661.2 seconds during construction of Alternative 10.

Newton Street at Clyde Street (Brookline)

During the evening peak hour at the intersection of Newton Street and Clyde Street in Brookline, the Newton Street eastbound left-turn movement would be expected to experience an increase in delay from 523.7 seconds under No-Build conditions to 566.9 seconds during construction of Alternative 10.

Morton Street at Blue Hill Avenue (Boston)

During the morning peak hour at the intersection of Morton Street and Blue Hill Avenue in Boston, the Blue Hill Avenue southbound left-turn movement would be expected to experience an increase in delay from 516.7 seconds under No-Build conditions to 536.0 seconds under construction of Alternative 10.

During the evening peak hour, the Blue Hill Avenue southbound left-turn movement would be expected to experience an increase in delay from 544.5 seconds under No-Build conditions to 569.3 seconds during construction of Alternative 10.

Morton Street at Norfolk Street (Boston)

During the morning peak hour at the intersection of Morton Street and Blue Hill Avenue in Boston, the Morton Street westbound through movement would be expected to experience an increase in delay from 80.1 seconds under No-Build conditions to 107.6 seconds under construction of Alternative 10.

During the evening peak hour, the Morton Street eastbound through movement would be expected to experience an increase in delay from 80.9 seconds under No-Build conditions to 103.3 seconds during construction of Alternative 10.

South Street at Washington Street (Boston)

During the evening peak hour at the intersection of South Street and Washington Street in Boston, the South Street eastbound left-turn movement would be expected to experience an increase in delay from 80.2 seconds under No-Build conditions to 96.0 seconds during construction of Alternative 10.

F.4.11 Avoidance, Minimization, and Mitigation Measures

Typical measures to mitigate the traffic impacts caused by construction-period activities are described in this section. Most of these mitigation measures would require approval and/or permits from MassDOT, DCR, or applicable municipalities. Applicability of these measures would be discussed with the municipalities or agencies prior to submitting permit applications.

When construction measures create the possibility of causing traffic congestion, such work could be restricted to certain hours when it is less likely to impact traffic. Construction work may need to be avoided during the weekends because roads, parks, and other recreational sites might be heavily used on weekends. Conversely, in some residential areas, work may need to be restricted to daytime hours so as not to disturb residents. Time restrictions also may be used for other periods, such as to avoid impacts to street sweeping or other activities.

F.4.11.1 Alternative 3

The primary source of traffic expected to be generated by this Program would be construction worker trips to and from the sites. Under Alternative 3, the Tandem Trailer, Bifurcation, and Highland Avenue Northeast sites would generate the highest volume of construction worker trips. Surface piping construction at some shaft locations would require traffic-management measures, including lane closures, sidewalk closures, and detours.

Intersection Operations

Based on the results of the capacity analysis, the following mitigation measures are proposed at the Study intersections expected to be most impacted by Alternative 3 construction traffic:

- Main Street at Ellison Park/ Linden Street (Waltham)
  - Adjust traffic signal timings
- Main Street at Weston Street/ South Street (Waltham)
  - Adjust traffic signal timings
- River Road at South Avenue (Weston)
  - Adjust traffic signal timings
- Park Road at South Avenue (Weston)
  - Adjust traffic signal timings
- I-95 Northbound off-ramp at South Avenue/ Commonwealth Avenue (Weston)
  - Adjust traffic signal timings
- Central Avenue at Cedar Street (Needham)
  - Evaluate traffic signal warrants
- Newton Street at Clyde Street (Brookline)
  - Adjust traffic signal timings
- Morton Street at Blue Hill Avenue (Boston)
  - Adjust traffic signal timings
- Morton Street at Norfolk Street (Boston)
  - Adjust traffic signal timings
- South Street at Washington Street (Boston)
  - Adjust traffic signal timings

Table F.4-60 and **Table F.4-61** show the operational analysis results with adjusted traffic signal timings during the morning and evening peak hours. As shown, after adjusting traffic signal timings, delays are generally reduced compared to the unadjusted Build conditions. In several cases, the adjusted traffic signal timings improve delays over the No-Build conditions.

Table F.4-60 Intersection Operational Analysis Results: Alternative 3 - Morning Peak Hour

	No-Build					Build Alternative 3					Build Alternative 3 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Main Street at Ellison Park/Linden Street (Waltham)															
Main St. EB L	398.2	F	1.77	223	398	352.9	F	1.67	200	96	73.1	E	0.93	150	327
Main St. EB T	72.1	E	0.97	269	463	58.9	E	0.91	246	461	42.3	D	0.74	284	431
Linden St. NB LTR	0.0	A	0.02	0	0	0.0	A	0.02	0	0	0.3	A	0.03	0	0
Main St. WB T	46.1	D	0.90	140	161	40.3	D	0.86	129	160	55.0	D	0.91	181	205
Linden St. SWB L	42.6	D	0.47	76	135	39.9	D	0.44	71	135	44.7	D	0.39	88	155
Linden St. SWB R	114.7	F	1.06	190	350	97.5	F	1.01	165	349	77.5	E	0.90	205	379
Ellison Park SB L	20.5	C	0.24	50	70	21.5	C	0.25	50	70	33.0	C	0.31	71	96
Ellison Park SB T	20.5	C	0.23	50	71	21.5	C	0.25	50	71	33.0	C	0.31	72	97
Overall Intersection	**104.5**	**F**	**1.77**	**-**	**-**	**104.5**	**F**	**1.67**	**-**	**-**	**54.1**	**D**	**0.93**	**-**	**-**
Main Street at Weston Street/ South Street (Waltham)															
Main St. EB T	29.2	C	0.50	108	151	29.2	C	0.50	108	151	23.9	C	0.50	81	127
Weston St. NEB L	43.2	D	0.62	99	153	43.3	D	0.62	99	153	32.9	C	0.60	64	157
Weston St. NEB R	48.5	D	0.68	101	156	48.5	D	0.69	101	156	12.0	B	0.42	25	87
Main St. WB L1	575.1	F	2.13	159	277	575.1	F	2.13	159	277	369.6	F	1.68	108	237
Main St. WB L2	30.4	C	0.59	159	289	30.5	C	0.59	160	291	34.4	C	0.73	130	278
Main St. WB T	40.2	D	0.75	175	285	40.2	D	0.75	175	285	35.1	D	0.74	131	278
South St. NB HL	27.4	C	0.38	67	141	28.2	C	0.42	77	158	32.7	C	0.59	73	112
South St. NB L	13.5	B	0.33	34	101	14.8	B	0.36	43	116	36.8	D	0.66	75	115
Overall Intersection	**79.6**	**E**	**2.13**	**-**	**-**	**78.7**	**E**	**2.13**	**-**	**-**	**58.2**	**E**	**1.68**	**-**	**-**
River Road at South Avenue (Weston)															
South Ave. NEB L	303.7	F	1.57	144	269	305.6	F	1.58	144	269	55.0	E	0.88	163	224
South Ave. NEB T	16.9	B	0.76	113	174	17.2	B	0.77	114	176	27.5	C	0.80	306	303
I-95 S Exit 39A off-ramp LT	46.3	D	0.84	71	175	167.0	F	1.26	135	263	53.0	D	0.89	167	318
I-95 S Exit 39A off-ramp R	11.5	B	0.67	15	91	11.4	B	0.67	15	91	5.5	A	0.53	0	61
South Ave. WB L	106.8	F	1.06	74	179	107.7	D	0.59	74	179	56.6	E	0.82	109	223
South Ave. WB T	17.3	B	1.02	105	210	17.3	F	1.06	105	210	26.3	C	1.00	176	302

Table F.4-60 Intersection Operational Analysis Results: Alternative 3 - Morning Peak Hour

	No-Build					Build Alternative 3					Build Alternative 3 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
River Rd. SB L	27.0	C	0.47	21	50	39.0	B	1.02	22	69	34.8	C	0.50	34	71
River Rd. SB T	20.4	C	0.20	36	69	20.3	C	0.38	36	69	23.0	C	0.27	55	90
River Rd. SB R	4.8	A	0.29	0	20	4.8	A	0.29	0	20	5.5	A	0.24	0	29
Overall Intersection	**50.7**	**D**	**1.57**	**-**	**-**	**62.6**	**E**	**1.58**	**-**	**-**	**30.8**	**C**	**0.89**	**-**	**-**
I-95 N Off Ramp at South Avenue/Commonwealth Ave (Weston)															
South Ave. EB T	9.6	A	0.67	44	74	17.9	B	0.89	57	145	17.8	B	0.82	129	245
I-95 N off-ramp L	12.5	B	0.55	35	70	68.3	E	1.05	100	222	29.7	C	0.87	153	319
I-95 N off-ramp R	13.1	B	0.66	32	74	10.9	B	0.57	29	65	11.0	B	0.49	47	102
Commonwealth Ave. WB T	22.8	C	0.92	71	165	16.2	B	0.88	142	142	17.9	B	0.85	128	253
Overall Intersection	**16.2**	**B**	**0.92**	**-**	**-**	**25.9**	**C**	**1.05**	**-**	**-**	**19.4**	**B**	**0.87**	**-**	**-**
Newton Street at Clyde Street (Brookline)															
Newton St. EB L	134.6	F	1.19	610	873	135.3	F	1.19	612	875	96.7	F	1.09	595	843
Newton St. EB T	122.1	F	1.18	632	792	122.1	F	1.18	632	792	82.2	F	1.08	615	758
Newton St. WB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0					
Newton St. WB T	62.0	E	0.94	271	335	62.7	E	0.94	271	335	70.0	E	0.98	274	347
Clyde St. SB L	41.4	D	0.61	186	242	41.4	D	0.61	186	242	45.3	D	0.67	187	247
Clyde St. SB R	7.3	A	0.27	72	85	7.4	A	0.29	76	90	7.0	A	0.28	73	86
Overall Intersection	**89.6**	**F**	**1.19**	**-**	**-**	**89.2**	**F**	**1.19**	**-**	**-**	**68.5**	**E**	**1.09**	**-**	**-**
Morton Street at Blue Hill Avenue (Boston)															
Morton St. EB T	32.2	C	0.53	182	238	32.1	C	0.53	185	242	26.8	C	0.54	145	198
Morton St. EB R	5.3	A	0.43	0	59	5.2	A	0.42	0	59	5.0	A	0.42	0	54
Blue Hill Ave. NB L	73.1	E	0.92	240	413	76.0	E	0.93	240	413	71.9	E	0.92	189	353
Blue Hill Ave. NB T	47.1	D	0.87	309	396	47.2	D	0.87	309	396	50.2	D	0.93	250	371
Morton St. WB T	43.5	D	0.87	332	417	47.2	D	0.90	367	491	42.9	D	0.92	287	413
Blue Hill Ave. SB L	516.7	F	1.98	149	237	536.0	F	2.02	149	273	359.7	F	1.63	107	218
Blue Hill Ave. SB T	0.0	0	0.00	0	0	36.4	D	0.60	194	255	33.1	C	0.66	157	215
Overall Intersection	**57.3**	**E**	**1.98**	**-**	**-**	**59.1**	**E**	**2.02**	**-**	**-**	**50.7**	**D**	**1.61**	**-**	**-**

Table F.4-60 Intersection Operational Analysis Results: Alternative 3 - Morning Peak Hour

	No-Build					Build Alternative 3					Build Alternative 3 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
South Street at Washington Street (Boston)															
South St. EB L	64.7	E	0.89	291	374	64.7	E	0.89	292	375	54.2	D	0.82	287	338
Washington St. NB T	14.0	B	0.90	192	271	14.1	B	0.53	194	272	21.7	C	0.54	201	324
South St. SB T	10.1	B	0.30	70	86	10.4	B	0.39	74	91	18.6	B	0.50	106	137
Overall Intersection	**23.0**	**C**	**0.89**	**-**	**-**	**23.1**	**C**	**0.89**	**-**	**-**	**27.1**	**C**	**0.82**	**-**	**-**

Table F.4-61 Intersection Operational Analysis Results: Alternative 3 - Evening Peak Hour

	No-Build					Build Alternative 3					Build Alternative 3 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Main Street at Ellison Park/Linden Street (Waltham)															
Main St. EB L	416.4	F	1.83	247	441	416.4	F	1.83	247	441	194.1	F	1.30	241	436
Main St. EB T	50.4	D	0.87	246	445	50.4	D	0.87	246	445	50.8	D	0.82	305	494
Linden St. NB LTR	0.2	A	0.04	0	0	0.2	A	0.04	0	0	0.2	A	0.05	0	0
Main St. WB T	35.1	D	0.81	134	192	35.1	D	0.81	134	192	54.6	D	0.91	189	271
Linden St. SWB L	21.3	C	0.21	38	73	21.3	C	0.21	38	73	38.7	D	0.34	88	154
Linden St. SWB R	38.7	D	0.45	75	139	38.7	D	0.45	75	139	125.3	F	1.12	356	573
Ellison Park SB L	228.3	F	1.39	312	507	256.0	F	1.46	335	535	32.2	C	0.24	55	98
Ellison Park SB T	21.2	C	0.20	37	72	21.1	C	0.20	37	72	32.1	C	0.23	98	97
Overall Intersection	**126.9**	**F**	**1.83**	**-**	**-**	**133.2**	**F**	**1.83**	**-**	**-**	**83.6**	**F**	**1.30**	**-**	**-**
Main Street at Weston Street/ South Street (Waltham)															
Main St. EB T	38.8	D	0.70	140	190	38.8	D	0.70	140	190	31.6	C	0.58	127	169
Weston St. NEB L	21.0	C	0.36	76	133	21.8	C	0.38	77	135	28.7	C	0.49	89	158
Weston St. NEB R	9.0	A	0.33	33	86	9.3	A	0.33	34	88	11.6	B	0.37	38	100
Main St. WB L1	407.0	F	1.75	124	200	407.0	F	1.75	124	200	404.4	F	1.75	126	205
Main St. WB L2	22.0	C	0.44	127	199	23.0	C	0.49	146	227	28.6	C	0.56	164	255
Main St. WB T	78.0	E	0.98	219	398	78.0	E	0.98	219	398	45.1	D	0.81	198	298

Table F.4-61 Intersection Operational Analysis Results: Alternative 3 - Evening Peak Hour

	No-Build					Build Alternative 3					Build Alternative 3 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
South St. NB HL	59.0	E	0.84	155	259	69.2	E	0.91	170	289	62.9	E	0.88	171	301
South St. NB L	74.5	E	0.93	156	275	74.5	E	0.93	156	275	67.4	E	0.89	157	285
Overall Intersection	**68.4**	**E**	**1.75**	-	-	**69.0**	**E**	**1.75**	-	-	**62.0**	**E**	**1.75**	-	-
River Road at South Avenue (Weston)															
South Ave. NEB L	42.1	D	0.70	42	110	42.1	D	0.70	42	110	39.0	D	0.66	42	110
South Ave. NEB T	10.5	B	0.39	43	71	11.7	B	0.48	57	90	12.6	B	0.53	53	94
I-95 S Exit 39A off-ramp LT	178.5	F	1.22	57	147	372.7	F	1.71	103	209	337.6	F	1.63	104	210
I-95 S Exit 39A off-ramp R	7.1	A	0.59	0	50	7.1	A	0.59	0	54	6.8	A	0.58	0	54
South Ave. WB L	87.8	F	0.99	60	165	87.8	F	0.99	60	165	23.1	C	0.56	52	101
South Ave. WB T	7.5	A	0.52	46	87	7.5	A	0.52	46	87	7.7	A	0.55	46	87
River Rd. SB L	141.0	F	1.18	109	207	141.0	F	1.18	109	207	180.3	F	1.28	119	217
River Rd. SB T	106.9	F	1.12	150	260	106.9	F	1.12	150	260	86.3	F	1.06	150	260
River Rd. SB R	6.3	A	0.41	0	34	6.3	A	0.41	0	34	3.3	A	0.36	0	16
Overall Intersection	**49.6**	**D**	**1.22**	-	-	**73.4**	**E**	**1.71**	-	-	**59.5**	**E**	**1.63**	-	-
I-95 N Off Ramp at South Avenue/Commonwealth Ave (Weston)															
South Ave. EB T	9.6	A	0.67	44	74	33.0	C	0.96	55	135	19.3	B	0.87	50	122
I-95 N off-ramp L	12.5	B	0.55	35	70	16.0	B	0.67	47	98	20.9	C	0.73	50	126
I-95 N off-ramp R	13.1	B	0.66	32	74	8.1	A	0.57	1	53	9.4	A	0.60	21	57
Commonwealth Ave. WB T	22.8	C	0.92	71	165	24.8	C	0.93	165	165	16.4	B	0.86	64	153
Overall Intersection	**16.2**	**B**	**0.92**	-	-	**24.3**	**C**	**0.96**	-	-	**17.1**	**B**	**0.87**	-	-
Newton Street at Clyde Street (Brookline)															
Newton St. EB L	523.7	F	2.08	410	565	566.9	F	2.18	437	575	56.7	E	0.89	242	379
Newton St. EB T	549.5	F	2.15	455	587	551.4	F	2.16	457	577	48.5	D	0.88	254	369
Newton St. WB T	41.7	D	0.89	327	417	41.7	D	0.89	327	417	50.4	D	0.95	343	478
Clyde St. SB L	23.3	C	0.37	119	186	23.3	C	0.37	119	186	37.7	D	0.57	147	230
Clyde St. SB R	18.0	B	0.66	252	331	18.1	B	0.66	253	332	16.2	B	0.64	233	306
Overall Intersection	**199.3**	**F**	**2.15**	-	-	**206.2**	**F**	**2.18**	-	-	**39.8**	**D**	**0.95**	-	-

Table F.4-61 Intersection Operational Analysis Results: Alternative 3 - Evening Peak Hour

	No-Build					Build Alternative 3					Build Alternative 3 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Morton Street at Blue Hill Avenue (Boston)															
Morton St. EB T	30.0	C	0.71	234	315	32.1	C	0.75	267	350	34.7	C	0.82	251	327
Morton St. EB R	7.0	A	0.52	19	91	6.8	A	0.51	19	91	5.3	A	0.51	0	61
Blue Hill Ave. NB L	59.2	E	0.82	159	315	61.8	E	0.83	169	315	54.7	D	0.81	145	262
Blue Hill Ave. NB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0					
Blue Hill Ave. NB T	37.2	D	0.77	206	290	38.2	D	0.77	218	290	39.8	D	0.83	196	264
Morton St. WB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0					
Morton St. WB T	29.2	C	0.71	211	290	30.3	C	0.73	238	318	32.1	C	0.79	222	296
Blue Hill Ave. SB L	544.5	F	2.05	157	303	571.8	F	2.14	167	303	485.4	F	1.93	141	263
Blue Hill Ave. SB T	0.0	0	0.00	0	0	38.3	D	0.76	224	295	33.8	C	0.73	194	261
Blue Hill Ave. SB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0					
Overall Intersection	**53.3**	**D**	**2.05**	**-**	**-**	**54.6**	**D**	**2.14**	**-**	**-**	**50.5**	**D**	**1.93**	**-**	**-**
South Street at Washington Street (Boston)															
South St. EB L	80.2	F	0.97	378	513	96.0	F	0.99	403	550	54.0	D	0.88	375	416
Washington St. NB T	13.3	B	0.37	114	147	13.6	B	0.37	114	147	17.9	B	0.40	129	193
South St. SB T	12.6	B	0.59	123	142	12.6	B	0.60	123	143	18.9	B	0.71	153	184
Overall Intersection	**29.0**	**C**	**0.97**	**-**	**-**	**33.6**	**C**	**0.99**	**-**	**-**	**27.3**	**C**	**0.88**	**-**	**-**
Washington Street at Arborway (Boston)															
New Washington St. EB T	130.6	F	1.18	549	684	136.2	F	1.19	561	697	44	D	0.89	376	509
New Washington St. EB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0					
Washington St. NB L	51.5	D	0.72	67	134	51.5	D	0.72	67	134	58	E	0.76	69	147
Washington St. NB TR	31.8	C	0.52	181	236	31.8	C	0.52	181	236	33	C	0.53	186	243
Arborway WB L	802.9	F	2.64	184	304	802.9	F	2.64	184	304	804	F	2.64	184	314
Arborway WB T	13.5	B	0.43	117	139	13.5	B	0.43	117	139	14	B	0.42	128	147
Arborway WB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0					
Washington St. SB L	40.6	D	0.34	44	89	40.6	D	0.34	44	89	43	D	0.35	45	91
Washington St. SB TR	46.8	D	0.75	244	313	46.8	D	0.75	244	313	49	D	0.78	250	320

Table F.4-61 Intersection Operational Analysis Results: Alternative 3 - Evening Peak Hour

	No-Build					Build Alternative 3					Build Alternative 3 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Overall Intersection	**91.1**	**F**	**2.64**	**-**	**-**	**93.4**	**F**	**2.64**	**-**	**-**	**60**	**E**	**2.64**	**-**	**-**

Air Quality

To discourage air pollution at the shaft sites, "No idling" signs would be installed in all parking lots.

Sensitive Receptors

Safe access to sensitive receptors would be maintained at all times.

Bicycles and Pedestrians

Bicycles and pedestrians will be accommodated through all on-street work zones. Police details will be employed as needed to manage traffic and ensure public safety. –Specific details, including traffic management plans for maintaining bicycle and pedestrian access, will be worked out through the final design process.

Fernald Property

To minimize disturbance to traffic, the surface pipe connections on Waverley Oaks Road would be installed during off-peak and overnight hours only. The existing pedestrian crossing across the access road to the proposed shaft location is faded and in poor condition. As a mitigation measure, the crosswalk would be restriped with high-visibility markings and ADA-compliant curb ramps with detectable warning panels would be constructed on each corner.

School Street

To minimize disturbance to traffic, the surface pipe along School Street would be installed largely during off-peak hours. Traffic would be maintained in at least one direction whenever possible.

St. Mary Street Pumping Station

Due to the residential nature of St. Mary Street, the surface pipe connection between the proposed shaft and the existing MWRA transmission line would be installed largely during daytime off-peak hours, between 9:00 AM and 3:00 PM.

Highland Avenue Northeast

The dewatering pipe along Brook Road, Wexford Street, and Fremont Street would be installed largely during off-peak and overnight hours , to minimize disturbance to traffic.

Southern Spine Mains

Installation of the surface pipe connection from the proposed shaft to the existing MWRA transmission line along Arborway would be performed largely during off-peak and overnight hours, to minimize the impacts to bicyclists and pedestrians.

American Legion

Surface pipe connections requiring work on Morton Street and American Legion Highway would be installed largely during off-peak and overnight hours, to minimize disturbance to traffic.

F.4.11.2 Alternative 4

The primary source of traffic expected to be generated by this Program would be construction worker trips to and from the sites. Under Alternative 4, the Tandem Trailer, Highland Avenue Northeast, and Highland Avenue Northwest sites would generate the highest volume of construction worker trips. Surface piping construction at some shaft locations would require traffic management measures, including lane closures, sidewalk closures, and detours.

Transportation Demand Management (TDM)

TDM measures under Alternative 4 would be the same as under Alternative 3.

Intersection Operations

Based on the results of the capacity analysis, the following mitigation measures are proposed at the study intersections expected to be most impacted by Alternative 4 construction traffic:

- Main Street at Ellison Park/ Linden Street (Waltham)
  - Adjust traffic signal timings
- Main Street at Weston Street/ South Street (Waltham)
  - Adjust traffic signal timings
- River Road at South Avenue (Weston)
  - Adjust traffic signal timings
- Park Road at South Avenue (Weston)
  - Adjust traffic signal timings

- I-95 Northbound Off-Ramp at South Avenue/ Commonwealth Avenue (Weston)
    - Adjust traffic signal timings
- Central Avenue at Cedar Street (Needham)
    - Evaluate traffic signal warrants
- Newton Street at Clyde Street (Brookline)
    - Adjust traffic signal timings
- Morton Street at Blue Hill Avenue (Boston)
    - Adjust traffic signal timings
- Morton Street at Norfolk Street (Boston)
    - Adjust traffic signal timings
- South Street at Washington Street (Boston)
    - Adjust traffic signal timings

Table F.4-62 and **Table F.4-63** show the operational analysis results with adjusted traffic signal timings during the morning and evening peak hours. As shown, after adjusting traffic signal timings, delays are generally reduced compared to the unadjusted Build conditions. In several cases, the adjusted traffic signal timings improve delays over the No-Build conditions.

Table F.4-62 Intersection Operational Analysis Results: Alternative 4 - Morning Peak Hour

	No-Build					Build Alternative 4					Build Alternative 4 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Main Street at Ellison Park/Linden Street (Waltham)															
Main St. EB L	398.2	F	1.77	223	398	352.9	F	1.67	200	396	73.1	E	0.93	150	327
Main St. EB T	72.1	E	0.97	269	463	58.9	E	0.91	246	461	42.3	D	0.74	284	431
Main St. EB R	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Linden St. NB LTR	0.0	A	0.02	0	0	0.0	A	0.02	0	0	0.3	A	0.03	0	0
Main St. WB LT	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Main St. WB T	46.1	D	0.90	140	161	40.3	D	0.86	129	160	55.0	D	0.91	181	205
Linden St. SWB L	42.6	D	0.47	76	135	39.9	D	0.44	71	135	44.7	D	0.39	88	155
Linden St. SWB R	114.7	F	1.06	190	350	97.5	F	1.01	165	349	77.5	E	0.90	205	379
Ellison Park SB L	20.5	C	0.24	50	70	21.5	C	0.25	50	70	33.0	C	0.31	71	96
Ellison Park SB T	20.5	C	0.23	50	71	21.4	C	0.25	50	71	33.0	C	0.31	72	97
Overall Intersection	**104.5**	**F**	**1.77**	**-**	**-**	**91.3**	**F**	**1.67**	**-**	**-**	**54.1**	**D**	**0.93**	**-**	**-**
Main Street at Weston Street/ South Street (Waltham)															
Main St. EB T	29.2	C	0.50	108	151	29.2	C	0.50	108	151	23.9	C	0.50	81	127
Main St. EB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0.0	0.00	0	0
Weston St. NEB L	43.2	D	0.62	99	153	43.3	D	0.62	99	153	32.9	C	0.60	64	157
Weston St. NEB R	48.5	D	0.68	101	156	48.5	D	0.69	101	156	12.0	B	0.42	25	87
Main St. WB L1	575.1	F	2.13	159	277	575.1	F	2.13	159	277	369.6	F	1.68	108	237
Main St. WB L2	30.4	C	0.59	159	289	30.5	C	0.59	160	291	34.4	C	0.73	130	278
Main St. WB T	40.2	D	0.75	175	285	40.2	D	0.75	175	285	35.1	D	0.74	131	278
South St. NB HL	27.4	C	0.38	67	141	28.3	C	0.35	78	160	32.7	C	0.59	73	112
South St. NB L	13.5	B	0.33	34	101	15.2	B	0.35	45	122	36.8	D	0.66	75	115
Weston St. SWB L	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0.0	0.00	0.0	0.0
Weston St. SWB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0.0	0.00	0.0	0.0
Overall Intersection	**79.6**	**E**	**2.13**	**-**	**-**	**78.4**	**E**	**2.13**	**-**	**-**	**58.2**	**E**	**1.68**	**-**	**-**

Table F.4-62 Intersection Operational Analysis Results: Alternative 4 - Morning Peak Hour

	No-Build					Build Alternative 4					Build Alternative 4 (Timing Adjusted)				
	Delay (SEC)	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**
River Road at South Avenue (Weston)															
South Ave. NEB L	303.7	F	1.57	144	269	305.6	F	1.58	144	269	67.3	E	0.92	189	348
South Ave. NEB T	16.9	B	0.76	113	174	17.3	B	0.77	115	176	32.2	C	0.82	262	344
I-95 S Exit 39A off-ramp LT	46.3	D	0.84	71	175	273.8	F	1.52	176	312	58.4	E	0.93	224	403
I-95 S Exit 39A off-ramp R	11.5	B	0.67	15	91	11.4	B	0.67	15	91	4.8	A	0.49	0	59
South Ave. WB L	106.8	F	1.06	74	179	107.7	F	1.06	74	179	73.8	E	0.89	127	260
South Ave. WB T	17.3	B	1.02	105	210	17.3	B	1.02	105	210	27.3	C	0.98	188	316
River Rd. SB L	27.0	C	0.47	21	50	39.0	C	0.59	22	65	34.7	C	0.49	37	76
River Rd. SB T	20.4	C	0.20	36	69	20.3	C	0.38	36	69	22.3	C	0.23	58	92
River Rd. SB R	4.8	A	0.29	0	20	4.8	A	0.29	0	20	3.9	A	0.21	0	23
Overall Intersection	**50.7**	**D**	**1.57**	**-**	**-**	**76.0**	**D**	**1.58**	**-**	**-**	**35.2**	**D**	**0.93**	**-**	**-**
I-95 N Off-Ramp at South Avenue/Commonwealth Ave (Weston)															
South Ave. EB T	9.6	A	0.67	44	74	18.0	B	0.89	58	146	16.0	B	0.83	90	197
I-95 N off-ramp L	12.5	B	0.55	35	70	56.9	E	1.01	90	212	34.9	C	0.91	119	274
I-95 N off-ramp R	13.1	B	0.66	32	74	10.9	B	0.88	52	142	11.2	B	0.52	40	91
Commonwealth Ave. WB T	22.8	C	0.92	71	165	16.2	B	0.57	29	65	15.6	B	0.85	84	201
Overall Intersection	**16.2**	**B**	**0.92**	**-**	**-**	**23.6**	**B**	**1.01**	**-**	**-**	**18.7**	**B**	**0.91**	**-**	**-**
Park Road at South Avenue (Weston)															
South Ave. EB T	39.5	D	0.84	677	869	39.5	D	0.84	677	869	50.1	D	0.98	400	651
South Ave. EB R	1.5	A	0.23	30	41	1.5	A	0.23	30	41	2.6	A	0.25	30	48
Park Rd. NB L	37.4	D	0.39	175	240	37.4	D	0.39	175	240	23.8	C	0.45	97	140
Park Rd. NB LR	41.7	D	0.72	433	622	41.8	D	0.72	435	626	23.2	C	0.69	214	330
South Ave. WB L	61.0	E	0.76	53	146	161.6	E	1.18	115	283	28.2	C	0.63	45	92
South Ave. WB T	30.5	C	0.44	241	356	30.5	C	0.44	241	356	18.2	B	0.45	128	200
Overall Intersection	**34.4**	**C**	**0.84**	**-**	**-**	**40.5**	**C**	**1.18**	**-**	**-**	**28.7**	**C**	**0.98**	**-**	**-**

Table F.4-62 Intersection Operational Analysis Results: Alternative 4 - Morning Peak Hour

	No-Build					Build Alternative 4					Build Alternative 4 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Newton Street at Clyde Street (Brookline)															
Newton St. EB L	134.6	F	1.19	610	873	135.3	F	1.19	612	875	96.7	F	1.09	595	843
Newton St. EB T	122.1	F	1.18	632	792	122.1	F	1.18	632	792	82.2	F	1.08	615	758
Newton St. WB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Newton St. WB T	62.0	E	0.94	271	335	62.7	E	0.94	271	335	70.0	E	0.98	274	347
Clyde St. SB L	41.4	D	0.61	186	242	41.4	D	0.61	186	242	45.3	D	0.67	187	247
Clyde St. SB R	7.3	A	0.27	72	85	7.4	A	0.29	76	90	7.0	A	0.28	73	86
Overall Intersection	**89.6**	**F**	**1.19**	**-**	**-**	**89.2**	**F**	**1.19**	**-**	**-**	**68.5**	**E**	**1.09**	**-**	**-**
Morton Street at Blue Hill Avenue (Boston)															
Morton St. EB T	32.2	C	0.53	182	238	32.0	C	0.52	185	242	26.8	C	0.54	145	198
Morton St. EB R	5.3	A	0.43	0	59	5.2	A	0.42	0	59	5.0	A	0.42	0	54
Blue Hill Ave. NB L	73.1	E	0.92	240	413	76.0	E	0.93	240	413	71.9	E	0.92	189	353
Blue Hill Ave. NB T	47.1	D	0.87	309	396	48.0	D	0.87	309	396	50.2	D	0.93	250	371
Morton St. WB T	43.5	D	0.87	332	417	47.7	D	0.91	371	497	42.9	D	0.92	287	413
Blue Hill Ave. SB L	516.7	F	1.98	149	237	536.1	F	2.02	149	273	359.7	F	1.63	107	218
Blue Hill Ave. SB T	0.0	0	0.00	0	0	36.4	D	0.60	194	255	33.1	C	0.66	157	215
Blue Hill Ave. SB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Overall Intersection	**57.3**	**E**	**1.98**	**-**	**-**	**59.2**	**E**	**2.02**	**-**	**-**	**50.7**	**D**	**1.61**	**-**	**-**
South Street at Washington Street (Boston)															
South St. EB L	64.7	E	0.89	291	374	64.7	E	0.89	292	375	54.2	D	0.82	287	338
Washington St. NB LT	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Washington St. NB T	14.0	B	0.90	192	271	14.0	B	0.53	192	273	21.7	C	0.54	201	324
South St. SB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
South St. SB T	10.1	B	0.30	70	86	11.0	B	0.39	76	93	18.6	B	0.50	106	137
Overall Intersection	**23.0**	**C**	**0.89**	**-**	**-**	**23.0**	**C**	**0.89**	**-**	**-**	**27.1**	**C**	**0.82**	**-**	**-**

Table F.4-63 Intersection Operational Analysis Results: Alternative 4 - Evening Peak Hour

	No-Build					Build Alternative 4					Build Alternative 4 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Main Street at Ellison Park/Linden Street (Waltham)															
Main St. EB L	416.4	F	1.83	247	441	416.4	F	1.83	247	441	225.6	F	1.38	250	444
Main St. EB T	50.4	D	0.87	246	445	50.4	D	0.87	246	445	51.5	D	0.83	304	496
Linden St. NB LTR	0.2	A	0.04	0	0	0.2	A	0.04	0	0	0.2	A	0.05	0	0
Main St. WB T	35.1	D	0.81	134	192	35.1	D	0.81	134	192	51.6	D	0.89	186	264
Linden St. SWB L	21.3	C	0.21	38	73	21.1	C	0.20	37	72	38.4	D	0.34	87	153
Linden St. SWB R	38.7	D	0.45	75	139	38.7	D	0.45	75	139	138.9	F	1.16	379	600
Ellison Park SB L	228.3	F	1.39	312	507	281.1	F	1.52	356	558	32.0	C	0.24	55	98
Ellison Park SB T	21.2	C	0.20	37	72	21.3	C	0.21	38	73	31.8	C	0.23	54	96
Overall Intersection	**126.9**	**F**	**1.83**	-	-	**126.9**	**F**	**1.83**	-	-	**90.2**	**F**	**1.38**	-	-
Main Street at Weston Street/ South Street (Waltham)															
Main St. EB T	38.8	D	0.70	140	190	38.8	D	0.70	140	190	34.7	C	0.63	134	181
Weston St. NEB L	21.0	C	0.36	76	133	22.1	C	0.39	76	135	28.0	C	0.47	87	156
Weston St. NEB R	9.0	A	0.33	33	86	9.4	A	0.33	35	90	11.6	B	0.37	40	103
Main St. WB L1	407.0	F	1.75	124	200	407.0	F	1.75	124	200	413.6	F	1.77	128	209
Main St. WB L2	22.0	C	0.44	127	199	23.7	C	0.52	158	244	28.6	C	0.58	178	275
Main St. WB T	78.0	E	0.98	219	398	78.0	E	0.98	219	398	56.1	E	0.88	209	361
Weston St. NEB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	28.0	C	0.47	87	156
Weston St. NEB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	11.6	B	0.37	40	103
South St NB HL	59.0	E	0.84	155	259	70.3	E	0.92	172	292	55.8	E	0.84	164	256
South St. NB L	74.5	E	0.93	156	275	74.5	E	0.93	156	275	58.9	E	0.85	149	242
Overall Intersection	**68.4**	**E**	**1.75**	-	-	**68.8**	**E**	**1.75**	-	-	**62.7**	**E**	**1.77**	-	-

Table F.4-63 Intersection Operational Analysis Results: Alternative 4 - Evening Peak Hour

	No-Build					Build Alternative 4					Build Alternative 4 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
River Road at South Avenue (Weston)															
South Ave. NEB L	42.1	D	0.70	42	110	42.1	D	0.70	42	110	83.0	F	0.90	60	153
South Ave. NEB T	10.5	B	0.39	43	71	12.5	B	0.54	66	103	19.8	B	0.72	82	134
I-95 S Exit 39A off-ramp LT	178.5	F	1.22	57	147	375.8	F	1.72	104	211	69.5	E	0.95	85	212
I-95 S Exit 39A off-ramp R	7.1	A	0.59	0	50	7.1	A	0.59	0	54	3.8	A	0.45	0	46
South Ave. WB L	87.8	F	0.99	60	165	87.8	F	0.99	60	165	43.4	D	0.74	78	169
South Ave. WB T	7.5	A	0.52	46	87	7.5	A	0.52	46	87	14.4	B	0.67	84	144
River Rd. SB L	141.0	F	1.18	109	207	234.4	F	1.41	122	220	30.2	C	0.74	98	170
River Rd. SB T	106.9	F	1.12	150	260	106.9	F	1.12	150	260	20.8	C	0.62	132	196
River Rd. SB R	6.3	A	0.41	0	34	6.3	A	0.41	0	34	3.5	A	0.28	0	29
Overall Intersection	**49.6**	**D**	**1.22**	**-**	**-**	**72.9**	**E**	**1.72**	**-**	**-**	**24.5**	**C**	**0.95**	**-**	**-**
I-95 N Off-Ramp at South Avenue/Commonwealth Ave (Weston)															
South Ave. EB T	9.6	A	0.67	44	74	9.3	A	69.00	43	73	7.9	A	0.64	39	67
I-95 N off-ramp L	12.5	B	0.55	35	70	12.5	B	0.55	35	71	14.4	B	0.59	38	76
I-95 N off-ramp R	13.1	B	0.66	32	74	13.1	B	0.66	32	74	14.7	B	0.68	31	85
Commonwealth Ave. WB T	22.8	C	0.92	71	165	22.8	C	0.92	71	165	15.6	B	0.85	64	153
Overall Intersection	**16.2**	**B**	**0.92**	**-**	**-**	**16.0**	**B**	**0.92**	**-**	**-**	**12.8**	**B**	**0.85**	**-**	**-**
Park Road at South Avenue (Weston)															
South Ave EB T	27.1	C	0.59	285	445	27.1	C	0.59	285	445	67.4	E	0.96	355	569
South Ave. EB R	1.8	A	0.24	30	44	1.8	A	0.24	30	44	11.9	B	0.34	107	163
Park Rd. NB L	30.8	C	0.54	203	271	30.8	C	0.54	203	271	40.0	D	0.73	214	280
Park Rd. NB LR	18.6	B	0.15	53	95	19.4	B	0.22	78	130	8.6	A	0.16	46	77
South Ave. WB L	24.9	C	0.32	30	69	25.0	C	0.33	31	70	12.7	B	0.11	23	46

Table F.4-63 Intersection Operational Analysis Results: Alternative 4 - Evening Peak Hour

	No-Build					Build Alternative 4					Build Alternative 4 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
South Ave. WB T	104.7	F	1.13	798	1199	104.7	F	1.13	798	1199	37.9	D	0.92	556	848
Overall Intersection	**51.6**	**D**	**1.13**	**-**	**-**	**51.0**	**D**	**1.13**	**-**	**-**	**38.4**	**D**	**0.96**	**-**	**-**
Newton Street at Clyde Street (Brookline)															
Newton St. EB L	523.7	F	2.08	410	565	571.8	F	2.19	440	576	56.7	E	0.89	242.0	379.0
Newton St. EB T	549.5	F	2.15	455	587	551.3	F	2.16	457	574	48.5	D	0.88	254.0	369.0
Newton St. WB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0.0	0.00	0.0	0.0
Newton St. WB T	41.7	D	0.89	327	417	41.7	D	0.89	327	417	50.4	D	0.95	343.0	478.0
Clyde St. SB L	23.3	C	0.37	119	186	23.3	C	0.37	119	186	37.7	D	0.57	147.0	230.0
Clyde St. SB R	18.0	B	0.66	252	331	18.1	B	0.66	253	332	16.2	B	0.64	233.0	306.0
Overall Intersection	**199.3**	**F**	**2.15**	**-**	**-**	**207.0**	**F**	**2.19**	**-**	**-**	**39.8**	**D**	**0.95**	**-**	**-**
Morton Street at Blue Hill Avenue (Boston)															
Morton St. EB T	30.0	C	0.71	234	315	32.1	C	0.75	267	350	34.7	C	0.82	251	327
Morton St. EB R	7.0	A	0.52	19	91	6.8	A	0.51	19	91	5.3	A	0.51	0	61
Blue Hill Ave. NB L	59.2	E	0.82	159	315	61.8	E	0.83	169	315	54.7	D	0.81	145	262
Blue Hill Ave. NB T	37.2	D	0.77	206	290	38.2	D	0.77	218	290	39.8	D	0.83	196	264
Morton St. WB T	29.2	C	0.71	211	290	30.0	C	0.72	235	314	32.1	C	0.79	222	296
Blue Hill Ave. SB L	544.5	F	2.05	157	303	571.8	F	2.14	167	303	485.4	F	1.93	141	263
Blue Hill Ave. SB T	0.0	0	0.00	0	0	38.3	D	0.76	224	295	33.8	C	0.73	194	261
Overall Intersection	**53.3**	**D**	**2.05**	**-**	**-**	**54.6**	**D**	**2.14**	**-**	**-**	**50.5**	**D**	**1.93**	**-**	**-**
South Street at Washington Street (Boston)															
South St. EB L	80.2	F	0.97	378	513	103.0	F	1.01	414	562	54.0	D	0.88	375	416
Washington St. NB T	13.3	B	0.37	114	147	14.0	B	0.37	114	147	17.9	B	0.40	129	193
South St. SB T	12.6	B	0.59	123	142	13.0	B	0.60	123	143	18.9	B	0.71	153	184
Overall Intersection	**29.0**	**C**	**0.97**	**-**	**-**	**36.0**	**C**	**1.01**	**-**	**-**	**27.3**	**C**	**0.88**	**-**	**-**

Air Quality

Air quality measures under Alternative 4 would be the same as under Alternative 3.

Sensitive Receptors

Safe access to sensitive receptors would be maintained at all times.

Bicycles and Pedestrians

Bicycles and pedestrians will be accommodated through on-street work zones. Specific details would be worked out through the final design process.

Fernald Property

Mitigation measures for Fernald Property under Alternative 4 would be the same as under Alternative 3.

Highland Avenue Northeast

Mitigation measures for Highland Avenue Northeast under Alternative 4 would be the same as under Alternative 3.

American Legion

Mitigation measures for American Legion under Alternative 4 would be the same as under Alternative 3.

Connection Sites

Mitigation measures for the Alternative 4 connection sites would be the same as under Alternative 3.

F.4.11.3 Alternative 10

The primary source of traffic expected to be generated by this Program would be construction worker trips to and from the sites. Under Alternative 10, the Highland Avenue Northeast and Highland Avenue Northwest sites would generate the highest volume of construction worker trips. Surface piping construction at some shaft locations would require traffic management measures, including lane closures, sidewalk closures, and detours.

Transportation Demand Management (TDM)

TDM measures under Alternative 10 would be the same as under Alternatives 3 and 4.

Intersection Operations

Based on the results of the capacity analysis, the following mitigation measures are proposed at the Study intersections expected to be most impacted by Alternative 10 construction traffic:

- Main Street at Weston Street/ South Street (Waltham)
  - Adjust traffic signal timings
- River Road at South Avenue (Weston)
  - Adjust traffic signal timings
  - Evaluate roadway widening to add turn lanes during construction. Depending on final design and coordination with MassDOT, modifications could be made permanent. Any alterations would be closely coordinated with the MassDOT interchange reconstruction project. Construction is expected to begin in 2023 and conclude in 2027.
- Park Road at South Avenue (Weston)
  - Adjust traffic signal timings
- I-95 Northbound off-ramp at South Avenue/Commonwealth Avenue (Weston)
  - Adjust traffic signal timings
- Central Avenue at Cedar Street (Needham)
  - Evaluate traffic signal warrants
- Newton Street at Clyde Street (Brookline)
  - Adjust traffic signal timings
- Morton Street at Blue Hill Avenue (Boston)
  - Adjust traffic signal timings
- Morton Street at Norfolk Street (Boston)
  - Adjust traffic signal timings
- South Street at Washington Street (Boston)
  - Adjust traffic signal timings

Table F4-64 and **Table F4-65** show the operational analysis results with adjusted traffic signal timings during the morning and evening peak hours. As shown, after adjusting traffic signal timings, delays are generally reduced compared to the unadjusted Build conditions. In several cases, the adjusted traffic signal timings improve delays over the No-Build conditions.

Table F.4-64 Intersection Operational Analysis Results: Alternative 10 - Morning Peak Hour

	No-Build					Build Alternative 10					Build Alternative 10 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
Main Street at Weston Street/ South Street (Waltham)															
Main St. EB T	29.2	C	0.50	108	151	29.2	C	0.50	108	151	23.9	C	0.50	81	127
Weston St. NEB L	43.2	D	0.62	99	153	43.3	D	0.62	99	153	32.9	C	0.60	64	157
Weston St. NEB R	48.5	D	0.68	101	156	48.5	D	0.69	101	156	12.0	B	0.42	25	87
Main St. WB L1	575.1	F	2.13	159	277	575.1	F	2.13	159	277	369.6	F	1.68	108	237
Main St. WB L2	30.4	C	0.59	159	289	30.5	C	0.59	160	291	34.4	C	0.73	130	278
Main St. WB T	40.2	D	0.75	175	285	40.2	D	0.75	175	285	35.1	D	0.74	131	278
South St. NB HL	27.4	C	0.38	67	141	28.2	C	0.42	77	158	32.7	C	0.59	73	112
South St. NB L	13.5	B	0.33	34	101	14.8	B	0.36	43	116	36.8	D	0.66	75	115
Overall Intersection	**79.6**	**E**	**2.13**	**-**	**-**	**78.7**	**E**	**2.13**	**-**	**-**	**58.2**	**E**	**1.68**	**-**	**-**
River Road at South Avenue (Weston)															
South Ave. NEB L	303.7	F	1.57	144	269	306.0	F	1.58	144	269	54.4	D	0.90	131	270
South Ave. NEB T	16.9	B	0.76	113	174	17.0	B	0.76	113	174	22.2	C	0.77	170	242
I-95 S Exit 39A off-ramp LT	46.3	D	0.84	71	175	72.0	D	0.97	83	206	54.3	D	0.88	111	239
I-95 S Exit 39A off-ramp R	11.5	B	0.67	15	91	11.0	B	0.67	15	91	7.0	A	0.59	0	61
South Ave. WB L	106.8	F	1.06	74	179	108.0	F	1.06	74	179	41.9	D	0.74	84	176
South Ave. WB T	17.3	B	1.02	105	210	17.0	B	1.02	105	210	24.3	C	1.05	152	271
River Rd. SB L	27.0	C	0.47	21	50	34.0	C	0.54	22	61	37.2	D	0.54	29	65
River Rd. SB T	20.4	C	0.20	36	69	20.0	C	0.38	36	69	23.7	C	0.35	48	84
River Rd. SB R	4.8	A	0.29	0	20	4.8	A	0.29	0	20	6.4	A	0.28	0	30
Overall Intersection	**50.7**	**D**	**1.57**	**-**	**-**	**53.0**	**D**	**1.58**	**-**	**-**	**27.8**	**C**	**0.90**	**-**	**-**
I-95 N Off-Ramp at South Avenue/Commonwealth Ave (Weston)															
South Ave. EB T	9.6	A	0.67	44	74	18.0	B	0.89	58	146	14.5	B	0.75	136	207
I-95 N off-ramp L	12.5	B	0.55	35	70	48.0	D	0.98	84	203	31.3	C	0.87	161	321
I-95 N off-ramp R	13.1	B	0.66	32	74	11.0	B	0.57	29	65	11.8	B	0.50	50	108
Commonwealth Ave. WB T	22.8	C	0.92	71	165	22.8	C	0.88	52	142	14.6	B	0.78	136	212
Overall Intersection	**16.2**	**B**	**0.92**	**-**	**-**	**16.2**	**B**	**0.98**	**-**	**-**	**17.2**	**B**	**0.87**	**-**	**-**

Table F.4-64 Intersection Operational Analysis Results: Alternative 10 - Morning Peak Hour

	No-Build					Build Alternative 10					Build Alternative 10 (Timing Adjusted)				
	Delay (SEC)	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**
Park Road at South Avenue (Weston)															
South Ave. EB T	39.5	D	0.84	677	869	39.5	D	0.84	677	869	37.9	D	0.83	621	921
South Ave. EB R	1.5	A	0.23	30	41	1.5	A	0.23	30	41	5.3	A	0.26	70	136
Park Rd. NB L	37.4	D	0.39	175	240	37.4	D	0.39	175	240	52.0	D	0.58	207	289
Park Rd. NB LR	41.7	D	0.72	433	622	41.7	D	0.72	435	626	41.0	D	0.73	450	596
South Ave. WB L	61.0	E	0.76	53	146	115.0	E	1.02	73	233	23.9	C	0.40	51	118
South Ave. WB T	30.5	C	0.44	241	356	30.5	C	0.44	241	356	13.8	B	0.32	158	214
Overall Intersection	**34.4**	**C**	**0.84**	**-**	**-**	**37.3**	**C**	**1.02**	**-**	**-**	**33.0.**	**C**	**0.83**	**-**	**-**
Newton Street at Clyde Street (Brookline)															
Newton St. EB L	134.6	F	1.19	610	873	135.3	F	1.19	612	875	96.7	F	1.09	595	843
Newton St. EB T	122.1	F	1.18	632	792	122.1	F	1.18	632	792	82.2	F	1.08	615	758
Newton St. WB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Newton St. WB T	62.0	E	0.94	271	335	62.7	E	0.94	271	335	70.0	E	0.98	274	347
Clyde St. SB L	41.4	D	0.61	186	242	41.4	D	0.61	186	242	45.3	D	0.67	187	247
Clyde St. SB R	7.3	A	0.27	72	85	7.4	A	0.29	76	90	7.0	A	0.28	73	86
Overall Intersection	**89.6**	**F**	**1.19**	**-**	**-**	**89.2**	**F**	**1.19**	**-**	**-**	**68.5**	**E**	**1.09**	**-**	**-**
Morton Street at Blue Hill Avenue (Boston)															
Morton St. EB T	32.2	C	0.53	182	238	32.1	C	0.53	185	242	26.8	C	0.54	145	198
Morton St. EB R	5.3	A	0.43	0	59	5.2	A	0.42	0	59	5.0	A	0.42	0	54
Blue Hill Ave. NB L	73.1	E	0.92	240	413	76.0	E	0.90	240	413	71.9	E	0.92	189	353
Blue Hill Ave. NB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Blue Hill Ave. NB T	47.1	D	0.87	309	396	48.0	D	0.87	309	396	50.2	D	0.93	250	371
Morton S.t WB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Morton St. WB T	43.5	D	0.87	332	417	47.2	D	0.93	367	491	42.9	D	0.92	287	413
Blue Hill Ave. SB L	516.7	F	1.98	149	237	536.0	F	2.02	149	273	359.7	F	1.63	107	218
Blue Hill Ave. SB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	33.1	C	0.66	157	215
Overall Intersection	**57.3**	**E**	**1.98**	**-**	**-**	**59.1**	**E**	**2.02**	**-**	**-**	**50.7**	**D**	**1.61**	**-**	**-**
South Street at Washington Street (Boston)															

Table F.4-64 Intersection Operational Analysis Results: Alternative 10 - Morning Peak Hour

	No-Build					Build Alternative 10					Build Alternative 10 (Timing Adjusted)				
	Delay (SEC)	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**
South St. EB L	64.7	E	0.89	291	374	64.7	E	0.89	292	375	54.2	D	0.82	287	338
Washington St. NB LT	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Washington St. NB T	14.0	B	0.90	192	271	14.1	B	0.53	194	272	21.7	C	0.54	201	324
South St. SB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
South St. SB T	10.1	B	0.30	70	86	10.4	B	0.39	74	91	18.6	B	0.50	106	137
Overall Intersection	**23.0**	**C**	**0.89**	**-**	**-**	**23.1**	**C**	**0.89**	**-**	**-**	**27.1**	**C**	**0.82**	**-**	**-**

Table F.4-65 Intersection Operational Analysis Results: Alternative 10 - Evening Peak Hour

	No-Build					Build Alternative 10					Build Alternative 10 (Timing Adjusted)				
	Delay (SEC)	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**
Main Street at Weston Street/ South Street (Waltham)															
Main St. EB T	38.8	D	0.70	140	190	38.8	D	0.70	140	190	31.6	C	0.58	127	169
Weston St. NEB L	21.0	C	0.36	76	133	21.8	C	0.38	77	135	28.7	C	0.49	89	158
Weston St. NEB R	9.0	A	0.33	33	86	9.3	A	0.33	34	88	11.6	B	0.37	38	100
Main St. WB L1	407.0	F	1.75	124	200	407.0	F	1.75	124	200	404.4	F	1.75	126	205
Main St. WB L2	22.0	C	0.44	127	199	23.0	C	0.49	146	227	28.6	C	0.56	164	255
Main St. WB T	78.0	E	0.98	219	398	78.0	E	0.98	219	398	45.1	D	0.81	198	298
Weston St. NEB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Weston St. NEB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
South St. NB HL	59.0	E	0.84	155	259	69.2	E	0.91	170	289	62.9	E	0.88	171	301
South St. NB L	74.5	E	0.93	156	275	74.5	E	0.93	156	275	67.4	E	0.89	157	285
Overall Intersection	**68.4**	**E**	**1.75**	**-**	**-**	**69.0**	**E**	**1.75**	**-**	**-**	**62.0**	**E**	**1.75**	**-**	**-**

Table F.4-65 Intersection Operational Analysis Results: Alternative 10 - Evening Peak Hour

	No-Build					Build Alternative 10					Build Alternative 10 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
River Road at South Avenue (Weston)															
South Ave. NEB L	42.1	D	0.70	42	110	42.1	D	0.70	42	110	63.8	E	0.82	54	140
South Ave. NEB T	10.5	B	0.39	43	71	11.0	B	0.40	46	75	17.8	B	0.56	67	107
I-95 S Exit 39A off-ramp LT	178.5	F	1.22	57	147	218.0	F	1.33	68	161	56.2	E	0.85	55	152
I-95 S Exit 39A off-ramp R	7.1	A	0.59	0	50	7.1	A	0.59	0	54	4.3	A	0.48	0	47
South Ave. WB L	87.8	F	0.99	60	165	87.8	F	0.99	60	165	41.1	D	0.73	72	162
South Ave. WB T	7.5	A	0.52	46	87	7.5	A	0.52	46	87	11.9	B	0.64	68	124
River Rd. SB L	141.0	F	1.18	109	207	148.0	F	1.20	110	209	32.7	C	0.77	92	161
River Rd. SB T	106.9	F	1.12	150	260	106.9	F	1.12	150	260	24.5	C	0.71	129	194
River Rd. SB R	6.3	A	0.41	0	34	6.3	A	0.41	0	34	4.0	A	0.31	0	29
Overall Intersection	**49.6**	**D**	**1.22**	**-**	**-**	**53.0**	**D**	**1.22**	**-**	**-**	**21.9**	**C**	**0.85**	**-**	**-**
I-95 N Off-Ramp at South Avenue/Commonwealth Ave (Weston)															
South Ave. EB T	9.6	A	0.67	44	74	10.2	B	0.70	44	74	8.2	A	0.63	40	68
I-95 N off-ramp L	12.5	B	0.55	35	70	12.0	B	0.54	38	75	15.3	B	0.62	40	82
I-95 N off-ramp R	13.1	B	0.66	32	74	12.0	B	61.00	32	74	14.6	B	0.68	31	85
Commonwealth Ave. WB T	22.8	C	0.92	71	165	27.0	C	0.95	71	165	15.7	B	0.85	64	153
Overall Intersection	**16.2**	**B**	**0.92**	**-**	**-**	**18.0**	**B**	**0.95**	**-**	**-**	**13.1**	**B**	**0.85**	**-**	**-**
Park Road at South Avenue (Weston)															
South Ave. EB T	27.1	C	0.59	285	445	27.1	C	0.59	285	445	17.5	B	0.47	252	338
South Ave. EB R	1.8	A	0.24	30	44	1.8	A	0.24	30	44	1.6	A	0.23	30	42
Park Rd. NB L	30.8	C	0.54	203	271	30.8	C	0.54	203	271	50.3	D	0.74	291	364
Park Rd. NB LR	18.6	B	0.15	53	95	19.0	B	0.18	61	107	32.5	C	0.23	93	150
South Ave. WB L	24.9	C	0.32	30	69	27.0	C	0.40	30	44	13.6	B	0.23	33	58

Table F.4-65 Intersection Operational Analysis Results: Alternative 10 - Evening Peak Hour

	No-Build					**Build Alternative 10**					**Build Alternative 10 (Timing Adjusted)**				
	Delay (SEC)	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**	**Delay (SEC)**	**LOS**	**v/c**	**50th Q (FT)**	**95th Q (FT)**
South Ave. WB T	104.7	F	1.13	798	1199	104.7	F	1.13	798	1199	31.6	C	0.85	634	845
Overall Intersection	**51.6**	**D**	**1.13**	**-**	**-**	**51.6**	**D**	**1.13**	**-**	**-**	**29.2**	**C**	**0.85**	**-**	**-**
Newton Street at Clyde Street (Brookline)															
Newton St. EB L	523.7	F	2.08	410	565	566.9	F	2.18	437	575	56.7	E	0.89	242	379
Newton St. EB T	549.5	F	2.15	455	587	551.4	F	2.16	457	577	48.5	D	0.88	254	369
Newton St. WB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Newton St. WB T	41.7	D	0.89	327	417	41.7	D	0.89	327	417	50.4	D	0.95	343	478
Clyde St. SB L	23.3	C	0.37	119	186	23.3	C	0.37	119	186	37.7	D	0.57	147	230
Clyde St SB R	18.0	B	0.66	252	331	18.1	B	0.66	253	332	16.2	B	0.64	233	306
Overall Intersection	**199.3**	**F**	**2.15**	**-**	**-**	**206.2**	**F**	**2.18**	**-**	**-**	**39.8**	**D**	**0.95**	**-**	**-**
Morton Street at Blue Hill Avenue (Boston)															
Morton St. EB T	30.0	C	0.71	234	315	32.0	C	0.75	264	347	34.7	C	0.82	251	327
Morton St. EB R	7.0	A	0.52	19	91	6.8	A	0.51	19	91	5.3	A	0.51	0	61
Blue Hill Ave. NB L	59.2	E	0.82	159	315	61.7	E	0.83	169	314	54.7	D	0.81	145	262
Blue Hill Ave. NB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Blue Hill Ave. NB T	37.2	D	0.77	206	290	38.1	D	0.77	217	290	39.8	D	0.83	196	264
Morton St. WB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Morton St. WB T	29.2	C	0.71	211	290	30.0	C	0.73	234	314	32.1	C	0.79	222	296
Blue Hill Ave. SB L	544.5	F	2.05	157	303	569.3	F	2.11	167	303	485.4	F	1.93	141	263
Blue Hill Ave. SB T	0.0	0	0.00	0	0	0.0	0	0.00	0	0	33.8	C	0.73	194	261
Blue Hill Ave. SB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Overall Intersection	**53.3**	**D**	**2.05**	**-**	**-**	**54.5**	**D**	**2.11**	**-**	**-**	**50.5**	**D**	**1.93**	**-**	**-**

Table F.4-65 Intersection Operational Analysis Results: Alternative 10 - Evening Peak Hour

	No-Build					Build Alternative 10					Build Alternative 10 (Timing Adjusted)				
	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)	Delay (SEC)	LOS	v/c	50th Q (FT)	95th Q (FT)
South Street at Washington Street (Boston)															
South St. EB L	80.2	F	0.97	378	513	96.0	F	0.99	403	550	54.0	D	0.88	375	416
Washington St. NB LT	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
Washington St. NB T	13.3	B	0.37	114	147	13.6	B	0.37	114	147	17.9	B	0.40	129	193
South St. SB TR	0.0	0	0.00	0	0	0.0	0	0.00	0	0	0.0	0	0.00	0	0
South St. SB T	12.6	B	0.59	123	142	12.6	B	0.60	123	143	18.9	B	0.71	153	184
Overall Intersection	**29.0**	**C**	**0.97**	-	-	**33.6**	**C**	**0.99**	-	-	**27.3**	**C**	**0.88**	-	-

Air Quality

Air quality measures under Alternative 10 would be the same as under Alternatives 3 and 4.

Sensitive Receptors

Safe access to sensitive receptors would be maintained at all times.

Bicycles and Pedestrians

Bicycles and pedestrians will be accommodated through all on-street work zones. Police details will be employed as needed to manage traffic and ensure public safety. Specific details, including traffic management plans for maintaining bicycle and pedestrian access, will be worked out through the final design process.

Fernald Property

Mitigation measures for Fernald Property under Alternative 10 would be the same as under Alternatives 3 and 4.

Highland Avenue Northeast

Mitigation measures for Highland Avenue Northeast under Alternative 10 would be the same as under Alternatives 3 and 4.

American Legion

Mitigation measures for American Legion under Alternative 10 would be the same as under Alternatives 3 and 4.

Connection Sites

Mitigation measures for the Alternative 10 connection sites would be the same as under Alternatives 3 and 4.

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Appendix G: Air Quality Supporting Documentation

- Appendix G.1 Emissions Summary
- Appendix G.2 Off-Road Emission Factors
- Appendix G.3 Off-Road Equipment Hours
- Appendix G.4 On-Road Emission Factors
- Appendix G.5 On-Road Vehicle Trips and Site Mileage

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Appendix G.1: Emissions Summary

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Alternative 3

Nox Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.2	0.0	0.0	0.0	1.3	3.8	3.8	3.8	3.8	3.8	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bifurcation Launching	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.3	0.3	3.7	3.7	3.7	2.5	0.0	1.3	3.8	3.8	1.3	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.1	0.0	0.0	0.1	0.0	1.2	1.2	0.0	1.3	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.3	3.7	3.7	3.7	3.7	3.7	0.0	0.0	0.4	2.5	5.0	5.0	3.8	1.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Road Total	0.0	0.0	0.7	0.5	0.4	4.1	4.3	4.3	4.2	7.5	8.3	7.7	4.3	3.7	6.2	8.7	8.7	10.1	3.8	4.0	6.4	7.9	5.4	5.4	3.9	2.6	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bifurcation Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-Road Total	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.2	0.0	0.0	0.0	1.3	3.8	3.8	3.8	3.8	3.8	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	1.3	0.0	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bifurcation Launching	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.3	0.3	3.7	3.7	3.7	2.5	0.0	1.3	3.8	3.8	1.3	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.1	0.0	0.0	0.1	0.0	1.2	1.2	0.0	1.3	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.3	3.7	3.7	3.7	3.7	3.7	0.0	0.0	0.4	2.5	5.0	5.0	3.8	1.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Total	0.0	0.0	0.8	0.6	0.4	4.1	4.3	4.3	4.2	7.5	8.3	7.8	4.3	3.7	6.2	8.7	8.8	10.1	3.9	4.1	6.4	7.9	5.5	5.5	4.0	2.6	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trailing 4 Quarter Off-Road Total	0.0	0.0	0.7	1.3	1.7	5.8	9.3	13.1	16.8	20.2	24.2	27.7	27.8	24.0	21.9	22.9	27.4	33.7	31.3	26.6	24.2	22.0	23.7	25.1	22.7	17.4	12.1	6.9	3.0	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trailing 4 Quarter On-Road Total	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.2	0.3	0.3	0.4	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Trailing 4 Quarter Total	0.0	0.0	0.8	1.4	1.8	5.9	9.4	13.1	16.9	20.3	24.3	27.8	27.9	24.1	22.0	22.9	27.4	33.8	31.5	26.9	24.5	22.4	23.9	25.3	22.9	17.6	12.4	7.2	3.2	0.6	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Highlight indicates peak year of emissions

Alternative 3

VOC Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bifurcation Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.2	0.0	0.1	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.2	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Road Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.3**	**0.3**	**0.3**	**0.6**	**0.6**	**0.6**	**0.3**	**0.3**	**0.5**	**0.6**	**0.7**	**0.8**	**0.3**	**0.3**	**0.5**	**0.6**	**0.4**	**0.4**	**0.3**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bifurcation Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-Road Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bifurcation Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.2	0.0	0.1	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.2	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Total	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.3**	**0.3**	**0.3**	**0.3**	**0.6**	**0.6**	**0.6**	**0.3**	**0.3**	**0.5**	**0.6**	**0.7**	**0.8**	**0.3**	**0.3**	**0.5**	**0.6**	**0.4**	**0.4**	**0.3**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter Off-Road Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.4**	**0.7**	**1.0**	**1.2**	**1.5**	**1.8**	**2.0**	**2.1**	**1.8**	**1.6**	**1.7**	**2.0**	**2.5**	**2.3**	**2.0**	**1.8**	**1.6**	**1.7**	**1.8**	**1.7**	**1.3**	**0.9**	**0.5**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter On-Road Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter Total	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.4**	**0.7**	**1.0**	**1.2**	**1.5**	**1.8**	**2.1**	**2.1**	**1.8**	**1.6**	**1.7**	**2.0**	**2.5**	**2.3**	**2.0**	**1.8**	**1.6**	**1.8**	**1.9**	**1.7**	**1.3**	**0.9**	**0.5**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Highlight indicates peak year of emissions

Alternative 3

CO2 Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northeast Launching	0	0	129	117	232	665	665	665	665	665	665	665	222	0	0	0	224	672	672	672	672	672	45	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	129	117	101	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	0	224	0	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bifurcation Launching	0	0	0	0	0	129	86	117	232	665	665	665	443	0	224	672	672	224	0	45	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Receiving	0	0	0	0	0	0	129	117	106	67	0	0	66	0	309	309	0	224	0	119	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	0	0	0	0	0	0	0	0	0	0	259	12	232	665	665	665	665	665	0	0	104	536	985	985	672	224	136	45	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	0	0	0	0	0	0	117	101	0	0	0	0	66	0	0	0	0	0	0	0	224	0	119	0	0	0	0	0	0	0	0	0	0	0	0
Park Road East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	95	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97	65	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Road Total	**0**	**0**	**259**	**235**	**333**	**794**	**880**	**899**	**1003**	**1396**	**1588**	**1458**	**1130**	**665**	**1198**	**1646**	**1561**	**1851**	**672**	**837**	**1766**	**1563**	**1174**	**1274**	**767**	**491**	**136**	**165**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northeast Launching	0	0	0	1	1	3	3	3	3	3	3	3	2	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	13	24	11	0	0	0	0	0	0	0	11	0	0	0	0	0	56	56	0	11	0	18	18	18	18	18	0	0	0	0	0	0	0	0	0	0	0	0
Bifurcation Launching	0	0	0	0	0	0	0	1	1	3	3	3	2	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Receiving	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	0	0	0	0	0	0	0	0	0	0	1	1	1	3	3	3	3	3	0	0	0	1	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	0	0	0	0	0	10	21	10	0	0	0	0	10	0	0	0	0	0	0	0	10	0	16	6	14	14	14	0	0	0	0	0	0	0	0
Park Road East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	3	10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-Road Total	**0**	**0**	**13**	**25**	**12**	**3**	**3**	**5**	**4**	**6**	**16**	**27**	**26**	**3**	**4**	**5**	**5**	**16**	**57**	**58**	**51**	**35**	**16**	**32**	**20**	**30**	**19**	**35**	**6**	**14**	**14**	**14**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Sites	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northeast Launching	0	0	130	118	233	667	667	667	667	667	667	667	223	0	0	0	225	674	674	674	674	673	46	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	142	141	112	0	0	0	0	0	0	0	77	0	0	0	0	0	56	56	0	235	0	137	18	18	18	18	0	0	0	0	0	0	0	0	0	0	0	0
Bifurcation Launching	0	0	0	0	0	130	86	118	233	667	667	667	445	0	225	674	674	225	0	46	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Receiving	0	0	0	0	0	0	130	118	107	67	0	0	66	0	310	310	0	224	0	120	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	0	0	0	0	0	0	0	0	0	0	259	13	233	667	667	667	667	667	0	0	105	538	986	986	674	225	136	46	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	0	0	0	0	0	10	138	111	0	0	0	0	77	0	0	0	0	0	0	0	234	0	135	6	14	14	14	0	0	0	0	0	0	0	0
Park Road East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	95	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	101	66	148	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	208	68	10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Total	**0**	**0**	**272**	**259**	**345**	**797**	**884**	**904**	**1007**	**1402**	**1604**	**1485**	**1156**	**667**	**1202**	**1651**	**1567**	**1867**	**729**	**895**	**1818**	**1597**	**1190**	**1307**	**787**	**520**	**155**	**199**	**6**	**14**	**14**	**14**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Trailing 4 Quarter Off-Road Total	**0**	**0**	**259**	**493**	**826**	**1,620**	**2,242**	**2,906**	**3,576**	**4,179**	**4,887**	**5,446**	**5,573**	**4,841**	**4,451**	**4,639**	**5,070**	**6,257**	**5,731**	**4,922**	**5,127**	**4,838**	**5,340**	**5,777**	**4,779**	**3,707**	**2,668**	**1,559**	**791**	**301**	**165**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Trailing 4 Quarter On-Road Total	**0**	**0**	**13**	**38**	**50**	**53**	**43**	**23**	**15**	**18**	**31**	**54**	**75**	**72**	**60**	**38**	**17**	**30**	**83**	**136**	**182**	**201**	**160**	**135**	**103**	**98**	**101**	**103**	**90**	**74**	**68**	**48**	**41**	**28**	**14**	**0**	**0**	**0**	**0**	**0**
Trailing 4 Quarter Total	**0**	**0**	**272**	**531**	**876**	**1,673**	**2,285**	**2,929**	**3,592**	**4,197**	**4,918**	**5,499**	**5,648**	**4,913**	**4,511**	**4,676**	**5,087**	**6,287**	**5,814**	**5,058**	**5,309**	**5,039**	**5,500**	**5,912**	**4,882**	**3,805**	**2,769**	**1,662**	**881**	**374**	**233**	**48**	**41**	**28**	**14**	**0**	**0**	**0**	**0**	**0**

Highlight indicates peak year of emissions

Alternative 4

Nox Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northeast Launching	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.2	0.0	1.2	1.2	1.3	3.8	3.8	3.8	3.8	3.8	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	2.5	0.0	1.3	3.8	3.8	1.3	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.3	3.7	3.7	3.7	3.7	3.7	0.0	0.0	0.4	2.5	5.0	5.0	3.8	1.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Road Total	**0.0**	**0.0**	**0.7**	**0.5**	**0.4**	**3.7**	**4.4**	**4.3**	**4.2**	**7.5**	**8.3**	**7.7**	**4.3**	**3.7**	**6.2**	**8.7**	**8.7**	**10.1**	**3.8**	**4.0**	**6.4**	**7.9**	**5.4**	**5.5**	**3.9**	**2.6**	**0.2**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-Road Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northeast Launching	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.2	0.0	1.2	1.2	1.3	3.8	3.8	3.8	3.8	3.8	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	1.3	0.0	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	2.5	0.0	1.3	3.8	3.8	1.3	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.3	3.7	3.7	3.7	3.7	3.7	0.0	0.0	0.4	2.5	5.0	5.0	3.8	1.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Total	**0.0**	**0.0**	**0.8**	**0.6**	**0.4**	**3.7**	**4.5**	**4.3**	**4.2**	**7.5**	**8.3**	**7.8**	**4.3**	**3.7**	**6.2**	**8.7**	**8.8**	**10.1**	**3.9**	**4.1**	**6.4**	**7.9**	**5.5**	**5.5**	**4.0**	**2.6**	**0.2**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Trailing 4 Quarter Off-Road Total	**0.0**	**0.0**	**0.7**	**1.3**	**1.7**	**5.4**	**9.1**	**12.8**	**16.6**	**20.4**	**24.2**	**27.7**	**27.8**	**24.0**	**21.9**	**22.9**	**27.4**	**33.7**	**31.3**	**26.6**	**24.2**	**22.0**	**23.7**	**25.1**	**22.7**	**17.4**	**12.1**	**6.9**	**3.0**	**0.4**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter On-Road Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.0**	**0.0**	**0.1**	**0.2**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter Total	**0.0**	**0.0**	**0.8**	**1.4**	**1.8**	**5.5**	**9.2**	**12.9**	**16.6**	**20.4**	**24.3**	**27.8**	**27.9**	**24.1**	**22.0**	**22.9**	**27.4**	**33.8**	**31.5**	**26.8**	**24.5**	**22.3**	**23.9**	**25.3**	**22.9**	**17.6**	**12.4**	**7.2**	**3.2**	**0.6**	**0.4**	**0.2**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Highlight indicates peak year of emissions

Alternative 4

VOC Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.0	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.2	0.0	0.1	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.2	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Road Total	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.3	0.3	0.5	0.6	0.7	0.8	0.3	0.3	0.5	0.6	0.4	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-Road Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.0	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.2	0.0	0.1	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tandem Trailer Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.2	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Total	0.0	0.0	0.1	0.0	0.0	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.3	0.3	0.5	0.6	0.7	0.8	0.3	0.3	0.5	0.6	0.4	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Trailing 4 Quarter Off-Road Total	0.0	0.0	0.0	0.1	0.1	0.4	0.7	0.9	1.2	1.5	1.8	2.0	2.1	1.8	1.6	1.7	2.0	2.5	2.3	2.0	1.8	1.6	1.7	1.8	1.7	1.3	0.9	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trailing 4 Quarter On-Road Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trailing 4 Quarter Total	0.0	0.0	0.1	0.1	0.1	0.4	0.7	0.9	1.2	1.5	1.8	2.1	2.1	1.8	1.6	1.7	2.0	2.5	2.3	2.0	1.8	1.6	1.8	1.9	1.7	1.3	0.9	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Highlight indicates peak year of emissions

Alternative 4

CO2 Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0	0	129	117	232	665	665	665	665	665	665	665	222	0	309	309	224	672	672	672	672	672	45	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	129	117	101	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	0	224	0	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Launching	0	0	0	0	0	0	129	117	232	665	665	665	443	0	224	672	672	224	0	45	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Park Road West Receiving	0	0	0	0	0	0	129	117	106	67	0	0	66	0	0	0	0	224	0	119	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	0	0	0	0	0	0	0	0	0	0	259	12	232	665	665	665	665	665	0	0	104	536	985	985	672	224	136	45	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	0	0	0	0	0	43	117	101	0	0	0	0	66	0	0	0	0	0	0	0	224	0	119	0	0	0	0	0	0	0	0	0	0	0	0
Park Road East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	95	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97	65	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Road Total	0	0	259	235	333	665	923	899	1003	1396	1631	1458	1130	665	1198	1646	1561	1851	672	837	1766	1563	1174	1279	767	491	136	165	0	0	0	0	0	0	0	0	0	0	0	0

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0	0	0	1	1	3	3	3	3	3	3	3	2	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	13	24	11	0	0	0	0	0	0	0	11	0	0	0	0	0	50	50	0	11	0	18	15	15	15	15	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Launching	0	0	0	0	0	0	0	1	1	3	3	3	2	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Park Road West Receiving	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	0	0	0	0	0	0	0	0	0	0	1	1	1	3	3	3	3	3	0	0	0	1	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	0	0	0	0	0	10	21	10	0	0	0	0	10	0	0	0	0	0	0	0	10	0	16	4	11	11	11	0	0	0	0	0	0	0	0
Park Road East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	3	10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-Road Total	0	0	13	25	12	3	3	5	4	6	16	27	26	3	4	5	5	15	52	53	51	35	16	32	17	27	16	32	4	11	11	11	0	0	0	0	0	0	0	0

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0	0	130	118	233	667	667	667	667	667	667	667	223	0	310	310	225	674	674	674	674	673	46	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	142	141	112	0	0	0	0	0	0	0	77	0	0	0	0	0	50	50	0	235	0	137	15	15	15	15	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Launching	0	0	0	0	0	0	130	118	233	668	668	668	445	1	225	674	674	224	0	46	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Park Road West Receiving	0	0	0	0	0	0	130	118	107	67	0	0	66	0	0	0	0	224	0	120	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	0	0	0	0	0	0	0	0	0	0	259	13	233	667	667	667	667	667	0	0	105	538	986	986	674	225	136	46	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	0	0	0	0	0	53	138	111	0	0	0	0	77	0	0	0	0	0	0	0	234	0	135	4	11	11	11	0	0	0	0	0	0	0	0
Park Road East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	95	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	101	66	148	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	208	68	10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Total	0	0	272	259	345	667	927	904	1007	1402	1647	1486	1156	668	1202	1651	1567	1867	724	890	1818	1598	1191	1311	784	517	152	196	4	11	11	11	0	0	0	0	0	0	0	0

Trailing 4 Quarter Off-Road Total	0	0	259	493	826	1,491	2,156	2,820	3,490	4,222	4,930	5,489	5,616	4,884	4,451	4,639	5,070	6,257	5,731	4,922	5,127	4,838	5,340	5,782	4,783	3,711	2,672	1,559	791	301	165	0	0	0	0	0	0	0	0	0
Trailing 4 Quarter On-Road Total	0	0	13	38	50	53	43	23	15	18	31	54	75	73	61	38	18	30	77	125	171	191	155	135	101	92	92	92	79	63	58	38	34	23	11	0	0	0	0	0
Trailing 4 Quarter Total	0	0	272	531	876	1,544	2,198	2,843	3,505	4,240	4,961	5,543	5,691	4,957	4,512	4,677	5,088	6,286	5,808	5,047	5,298	5,029	5,496	5,917	4,883	3,803	2,765	1,650	870	364	223	38	34	23	11	0	0	0	0	0

Highlight indicates peak year of emissions

Alternative 10

Nox Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Large Connection	0.0	0.0	0.0	0.2	0.2	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.2	0.0	1.2	1.2	1.3	3.8	3.8	3.8	3.8	3.8	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A10 Only - Park Road West	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Road Total	**0.0**	**0.0**	**0.5**	**0.8**	**0.6**	**3.8**	**4.4**	**4.3**	**4.2**	**7.4**	**7.4**	**7.4**	**7.4**	**7.4**	**3.7**	**3.7**	**1.2**	**0.0**	**1.2**	**1.4**	**4.1**	**8.0**	**7.9**	**8.8**	**7.5**	**8.8**	**4.0**	**5.2**	**0.4**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Large Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A10 Only - Park Road West	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-Road Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**0.1**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Large Connection	0.0	0.0	0.0	0.2	0.2	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.2	0.0	1.2	1.2	1.3	3.8	3.8	3.8	3.8	3.8	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	1.3	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A10 Only - Park Road West	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Total	**0.0**	**0.0**	**0.5**	**0.8**	**0.6**	**3.8**	**4.5**	**4.3**	**4.2**	**7.4**	**7.4**	**7.4**	**7.4**	**7.4**	**3.7**	**3.7**	**1.2**	**0.0**	**1.2**	**1.4**	**4.2**	**8.0**	**7.9**	**9.0**	**7.7**	**8.8**	**4.0**	**5.3**	**0.5**	**0.3**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Trailing 4 Quarter Off-Road Total	**0.0**	**0.0**	**0.5**	**1.3**	**1.9**	**5.7**	**9.7**	**13.1**	**16.7**	**20.3**	**23.3**	**26.5**	**29.7**	**29.7**	**26.0**	**22.3**	**16.1**	**8.7**	**6.2**	**3.9**	**6.7**	**14.7**	**21.4**	**28.8**	**32.2**	**33.0**	**29.1**	**25.5**	**18.4**	**9.8**	**5.8**	**0.6**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter On-Road Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.3**	**0.4**	**0.3**	**0.4**	**0.2**	**0.2**	**0.3**	**0.4**	**0.4**	**0.3**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter Total	**0.0**	**0.0**	**0.5**	**1.3**	**1.9**	**5.8**	**9.8**	**13.2**	**16.9**	**20.4**	**23.4**	**26.5**	**29.7**	**29.7**	**26.0**	**22.3**	**16.1**	**8.7**	**6.2**	**3.9**	**6.8**	**14.8**	**21.5**	**29.1**	**32.6**	**33.4**	**29.5**	**25.8**	**18.6**	**10.1**	**6.2**	**1.0**	**0.5**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Highlight indicates peak year of emissions

Alternative 10

VOC Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Large Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.0	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A10 Only - Park Road West	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Road Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.3**	**0.3**	**0.3**	**0.3**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.3**	**0.3**	**0.1**	**0.0**	**0.1**	**0.1**	**0.2**	**0.7**	**0.6**	**0.7**	**0.6**	**0.7**	**0.3**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Large Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A10 Only - Park Road West	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On-Road Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Highland Avenue Northwest Launching	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fernald Property Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Park Road West Large Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highland Avenue Northeast Launching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.0	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American Legion Receiving	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
School Street Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Mary Street Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hegarty Pumping Station Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Newton Street Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Spine Mains Connection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hultman Aqueduct Isolation Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A10 Only - Park Road West	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.3**	**0.3**	**0.3**	**0.3**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.3**	**0.3**	**0.1**	**0.0**	**0.1**	**0.1**	**0.2**	**0.7**	**0.6**	**0.7**	**0.6**	**0.7**	**0.3**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Trailing 4 Quarter Off-Road Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.4**	**0.7**	**1.0**	**1.2**	**1.5**	**1.7**	**2.0**	**2.2**	**2.2**	**1.9**	**1.7**	**1.2**	**0.6**	**0.5**	**0.3**	**0.3**	**1.0**	**1.5**	**2.1**	**2.5**	**2.5**	**2.2**	**1.9**	**1.4**	**0.7**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter On-Road Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Trailing 4 Quarter Total	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.4**	**0.7**	**1.0**	**1.2**	**1.5**	**1.7**	**2.0**	**2.2**	**2.2**	**1.9**	**1.7**	**1.2**	**0.6**	**0.5**	**0.3**	**0.4**	**1.1**	**1.6**	**2.2**	**2.6**	**2.5**	**2.2**	**1.9**	**1.4**	**0.7**	**0.4**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Highlight indicates peak year of emissions

Alternative 10

CO2 Emissions (tons)

Off-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0	0	129	117	232	665	665	665	665	665	665	665	665	665	0	0	0	0	0	0	0	672	672	672	672	672	672	672	45	136	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	43	117	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	224	119	0	0	0	0	0	0	0	0	0	0	0
Park Road West Large Connection	0	0	0	86	78	101	0	0	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	224	0	0	0	0	119	40	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northeast Launching	0	0	0	0	0	0	129	117	232	665	665	665	665	665	665	665	222	0	309	309	224	672	672	672	672	672	45	136	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	0	0	0	0	129	117	101	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	0	224	119	0	0	0	0	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97	65	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A10 Only - Park Road West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	240	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Road Total	**0**	**0**	**172**	**321**	**411**	**765**	**923**	**899**	**1064**	**1329**	**1329**	**1329**	**1329**	**1329**	**665**	**665**	**222**	**0**	**309**	**442**	**1279**	**1559**	**1489**	**1569**	**1345**	**1589**	**837**	**1032**	**284**	**176**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

On-Road Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0	0	0	1	1	3	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	1	21	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	10	20	11	11	11	0	0	0	0	0	0	0	0
Park Road West Large Connection	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northeast Launching	0	0	0	0	0	0	0	1	1	3	3	3	3	3	3	3	2	0	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	0	0	0	0	13	24	11	0	0	0	0	0	0	0	0	0	0	11	0	0	0	56	56	11	18	15	15	15	15	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	3	10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A10 Only - Park Road West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-Road Total	**0**	**0**	**1**	**22**	**11**	**3**	**16**	**28**	**15**	**6**	**6**	**6**	**6**	**6**	**3**	**3**	**2**	**0**	**1**	**22**	**50**	**24**	**16**	**70**	**58**	**13**	**20**	**27**	**36**	**28**	**27**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Total Emissions	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Launching/Receiving Site	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0	0	130	118	233	668	668	668	668	668	668	668	668	668	0	0	0	0	0	0	0	674	674	674	674	674	674	673	45	136	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	44	138	111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	0	0	0	0	0	0	0	234	139	11	11	11	0	0	0	0	0	0	0	0
Park Road West Large Connection	0	0	0	86	79	101	0	0	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	224	0	0	0	0	120	40	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northeast Launching	0	0	0	0	0	0	130	118	233	667	667	667	667	667	667	667	223	0	310	310	225	674	674	674	674	674	46	136	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	0	0	0	0	142	141	112	0	0	0	0	0	0	0	0	0	0	77	0	0	0	56	56	235	137	15	15	15	15	0	0	0	0	0	0	0	0	0
Connection Shafts Sites																																								
Cedarwood Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School Street Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	101	66	148	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	208	68	10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A10 Only - Park Road West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	240	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Total	**0**	**0**	**173**	**343**	**423**	**769**	**940**	**927**	**1079**	**1335**	**1335**	**1335**	**1335**	**1335**	**667**	**667**	**223**	**0**	**310**	**464**	**1328**	**1584**	**1505**	**1639**	**1403**	**1602**	**857**	**1059**	**320**	**203**	**27**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Trailing 4 Quarter Off-Road Total	**0**	**0**	**172**	**493**	**905**	**1,670**	**2,421**	**2,999**	**3,652**	**4,216**	**4,622**	**5,052**	**5,317**	**5,317**	**4,652**	**3,988**	**2,880**	**1,551**	**1,195**	**972**	**2,029**	**3,589**	**4,768**	**5,896**	**5,962**	**5,992**	**5,340**	**4,803**	**3,742**	**2,329**	**1,492**	**460**	**176**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Trailing 4 Quarter On-Road Total	**0**	**0**	**1**	**23**	**34**	**37**	**53**	**59**	**62**	**65**	**55**	**32**	**23**	**23**	**20**	**17**	**13**	**7**	**5**	**24**	**72**	**97**	**112**	**160**	**169**	**158**	**161**	**118**	**95**	**110**	**117**	**102**	**66**	**39**	**12**	**0**	**0**	**0**	**0**	**0**
Trailing 4 Quarter Total	**0**	**0**	**173**	**516**	**939**	**1,707**	**2,473**	**3,058**	**3,714**	**4,281**	**4,676**	**5,084**	**5,340**	**5,340**	**4,672**	**4,005**	**2,893**	**1,558**	**1,200**	**997**	**2,102**	**3,685**	**4,881**	**6,056**	**6,131**	**6,150**	**5,501**	**4,921**	**3,838**	**2,439**	**1,609**	**562**	**242**	**39**	**12**	**0**	**0**	**0**	**0**	**0**

Highlight indicates peak year of emissions

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Appendix G.2: Off-Road Emission Factors

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Off-Road Emission Factors

Nonroad Model Output and Manufacturer Spec Sheet

				Nonroad Emission Factors (g/hr)			Factored Emission Factors (g/hr)		
Equipment	**Fuel Type**	**Nonroad Equipment SCC**	**Load Factor**	**Nox**	**VOC**	**CO2**	**Nox**	**VOC**	**CO2**
220 ton Crawler Crane	diesel	2270002045	0.43	50.5	2.6	52,914.5	21.72	1.11	22,753.22
50 ton RT Crane	diesel	2270002045	0.43	50.5	2.6	52,914.5	21.72	1.11	22,753.22
Hyd Drill Soilmec 625/70ton	diesel	2270002033	0.43	257.5	16.7	40,790.6	110.73	7.17	17,539.97
Excavtr Cat320/50k-lb/1.6cy	diesel	2270002036	0.59	33.8	1.5	54,757.5	19.91	0.90	32,306.91
Excavtr Cat313/30k-lb/0.7cy	diesel	2270002036	0.59	33.8	1.5	54,757.5	19.91	0.90	32,306.91
Loader Cat966/51k-lb/4cy	diesel	2270002066	0.21	41.4	6.3	13,053.3	8.69	1.33	2,741.19
Dozer Cat D4/30k-lb	diesel	2270002069	0.59	83.3	3.1	82,755.7	49.13	1.83	48,825.88
End Dump Cat730/31tn -23cy	diesel	2270002078	0.21	30.6	5.9	4,724.1	6.43	1.24	992.07
ICE 815 Vibro	diesel	2270002033	0.43	257.5	16.7	40,790.6	110.73	7.17	17,539.97
ICE 160 Impact	diesel	2270002033	0.43	257.5	16.7	40,790.6	110.73	7.17	17,539.97
Welder 400amp	diesel	2270006025	0.21	30.5	3.7	6,425.2	6.40	0.77	1,349.29
Compressor 375cfm	diesel	2270006015	0.43	52.2	1.8	20,459.2	22.47	0.78	8,797.48
Compressor 1100cfm	diesel	2270006015	0.43	52.2	1.8	20,459.2	22.47	0.78	8,797.48
Concrete Pump Trk -125ft	diesel	2270002042	0.43	56.4	5.7	7,501.0	24.25	2.45	3,225.44
Boom Truck 18tn	diesel	2270002045	0.43	50.5	2.6	52,914.5	21.72	1.11	22,753.22
Robodrill Drill Jumbo 2-Boom	diesel	2270002033	0.43	257.5	16.7	40,790.6	110.73	7.17	17,539.97
Raisebore Equip	diesel	2270002033	0.43	257.5	16.7	40,790.6	110.7	7.2	17,540.0
HerrnkRBR800VF RaiseboreEq	diesel	2270002033	0.43	257.5	16.7	40,790.6	110.73	7.17	17,539.97
Train-25tnLoco-w/3FltCars	diesel	Brookville Spec Sheet	-	-	-	-	608.1	45.6	81,308.3
Train-25tnLoco-w/3AgCars10cy	diesel	Brookville Spec Sheet	-	-	-	-	608.1	45.6	81,308.3
Train-25tnLoco-w/2FltCars	diesel	Brookville Spec Sheet	-	-	-	-	608.1	45.6	81,308.3

Notes:

Emission Factors calcaulated using Nonroad emissions model and mutiplied by EPA load factor.

Train Emission Factors based on the manufacterer spec sheet for a Brookville 25 Ton Locomotive.

g/hr = grams per hour

SCC = Standard Classification Code

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Appendix G.3: Off-Road Equipment Hours

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Alternative 3a -CP1

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching			
LS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*	
	220 ton Crawler Crane	1	diesel			650
	50 ton RT Crane	1	diesel			650
	Hyd Drill Soilmec 625/70ton	2	diesel			1300
	Excavtr Cat320/50k-lb/1.6cy	1	diesel			650
	Excavtr Cat313/30k-lb/0.7cy		diesel			0
	Loader Cat966/51k-lb/4cy	1	diesel			650
	Dozer Cat D4/30k-lb		diesel			0
	End Dump Cat730/31tn -23cy	1	diesel			650
	ICE 815 Vibro	1	diesel			650
	ICE 160 Impact		diesel			0
	Welder 400amp	2	diesel			1300
	Compressor 375cfm	2	diesel			1300
	Compressor 1100cfm		diesel			0
	Concrete Pump Trk -125ft	1	diesel			650
	Boom Truck 18tn	1	diesel			650
LS -Shaft Excavation	*wrk days per quarter >*	*65*	
	220 ton Crawler Crane	1	diesel				650
	50 ton RT Crane		diesel				0
	Robodrill Drill Jumbo 2-Boom	2	diesel				1300
	Excavtr Cat320/50k-lb/1.6cy	1	diesel				650
	Excavtr Cat313/30k-lb/0.7cy	1	diesel				650
	Loader Cat966/51k-lb/4cy	1	diesel				650
	Dozer Cat D4/30k-lb		diesel				0
	End Dump Cat730/31tn -23cy	1	diesel				650
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric				1300
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric				1300
	Welder 400amp	2	diesel				1300
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric				2178
	Compressor 1100cfm	1	diesel				650
	Concrete Pump Trk -125ft	1	diesel				650
	Boom Truck 18tn	1	diesel				650
TBM Launch/LS Temp Works	*wrk days per quarter >*	*65*	
	220 ton Crawler Crane	2	diesel					2600
	50 ton RT Crane	2	diesel					2600
	Robodrill Drill Jumbo 2-Boom		diesel					0
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric					2600
	Excavtr Cat313/30k-lb/0.7cy	1	diesel					1300
	Loader Cat966/51k-lb/4cy	1	diesel					650
	Dozer Cat D4/30k-lb		diesel					0
	End Dump Cat730/31tn -23cy		diesel					0
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric					1300
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric					1300
	Welder 400amp	2	diesel					2600
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric					2178
	Compressor 1100cfm	1	diesel					1300
	Concrete Pump Trk -125ft	2	diesel					1300
	Boom Truck 18tn	1	diesel					1300
Ungrnd -utility power	TBM & Trailing Plant	1	electric					0
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric					0
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric					0
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric					0
Topside -utility power	Tun Ventilation Plnt -topside	1	electric					0
Ungrnd	Train-25tnLoco-w/3FltCars	2	diesel					0
TBM Tunnel Mining @ LS	*wrk days per quarter >*	*65*	
	220 ton Crawler Crane	1	diesel						1300	1300	1300	1300	1300	1300	1300	433
	50 ton RT Crane	2	diesel						2600	2600	2600	2600	2600	2600	2600	867
	Robodrill Drill Jumbo 2-Boom		diesel						0	0	0	0	0	0	0	0
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric						2600	2600	2600	2600	2600	2600	2600	867
	Excavtr Cat313/30k-lb/0.7cy	1	diesel						1300	1300	1300	1300	1300	1300	1300	433
	Loader Cat966/51k-lb/4cy	1	diesel						1300	1300	1300	1300	1300	1300	1300	433
	Dozer Cat D4/30k-lb		diesel						0	0	0	0	0	0	0	0
	End Dump Cat730/31tn -23cy	1	diesel						1300	1300	1300	1300	1300	1300	1300	433
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric						0	0	0	0	0	0	0	0
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric						0	0	0	0	0	0	0	0
	Welder 400amp	2	diesel						2600	2600	2600	2600	2600	2600	2600	867
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric						2178	2178	2178	2178	2178	2178	2178	726
	Compressor 1100cfm	1	diesel						1300	1300	1300	1300	1300	1300	1300	433
	Concrete Pump Trk -125ft	0	diesel						0	0	0	0	0	0	0	0
	Boom Truck 18tn	1	diesel						1300	1300	1300	1300	1300	1300	1300	433
Ungrnd -utility power	TBM & Trailing Plant	1	electric						1300	1300	1300	1300	1300	1300	1300	433
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric						1300	1300	1300	1300	1300	1300	1300	433
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric						1300	1300	1300	1300	1300	1300	1300	433
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric						1300	1300	1300	1300	1300	1300	1300	433
Topside -utility power	Tun Ventilation Plnt -topside	1	electric						1300	1300	1300	1300	1300	1300	1300	433
Ungrnd	Train-25tnLoco-w/3FltCars	4	diesel						5200	5200	5200	5200	5200	5200	5200	1733
Tunnel Conc Lining @ LS	*wrk days per quarter >*	*65*	
	220 ton Crawler Crane	1	diesel																	433	1300	1300	1300	1300	1300
	50 ton RT Crane	2	diesel																	867	2600	2600	2600	2600	2600
	Robodrill Drill Jumbo 2-Boom		diesel																	0	0	0	0	0	0

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																	867	2600	2600	2600	2600	2600																		
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																	433	1300	1300	1300	1300	1300																		
	Loader Cat966/51k-lb/4cy	1	diesel																	433	1300	1300	1300	1300	1300																		
	Dozer Cat D4/30k-lb		diesel																	0	0	0	0	0	0																		
	End Dump Cat730/31tn -23cy		diesel																	0	0	0	0	0	0																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																	0	0	0	0	0	0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																	0	0	0	0	0	0																		
	Welder 400amp	2	diesel																	867	2600	2600	2600	2600	2600																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																	726	2178	2178	2178	2178	2178																		
	Compressor 1100cfm	1	diesel																	433	1300	1300	1300	1300	1300																		
	Concrete Pump Trk -125ft	2	diesel																	867	2600	2600	2600	2600	2600																		
	Boom Truck 18tn	1	diesel																	433	1300	1300	1300	1300	1300																		
Ungrnd -utility power	TBM & Trailing Plant		electric																	0	0	0	0	0	0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																	0	0	0	0	0	0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																	0	0	0	0	0	0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																	433	1300	1300	1300	1300	1300																		
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																	433	1300	1300	1300	1300	1300																		
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																	1733	5200	5200	5200	5200	5200																		
LS-Adit -D&S Mine & Line	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	0	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								
Launch Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																							433	1300																
	50 ton RT Crane	3	diesel																							650	1950																
	Robodrill Drill Jumbo 2-Boom		diesel																							0	0																
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																							0	0																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																							217	650																
	Loader Cat966/51k-lb/4cy	1	diesel																							217	650																
	Dozer Cat D4/30k-lb		diesel																							0	0																
	End Dump Cat730/31tn -23cy		diesel																							0	0																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																							0	0																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																							0	0																
	Welder 400amp	2	diesel																							433	1300																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																							726	2178																
	Compressor 1100cfm	1	diesel																							217	650																
	Concrete Pump Trk -125ft	2	diesel																							433	1300																
	Boom Truck 18tn	1	diesel																							217	650																
Ungrnd -utility power	TBM & Trailing Plant		electric																							0	0																
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																							0	0																
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																							0	0																
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																							0	0																
Topside -utility power	Tun Ventilation Plnt -topside		electric																							0	0																
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																							0	0																
American Legion Receiving																																											
RS -Shaft Site Setup & SOE	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel			650																																					
	50 ton RT Crane	1	diesel			650																																					
	Hyd Drill Soilmec 625/70ton	2	diesel			1300																																					
	Excavtr Cat320/50k-lb/1.6cy	1	diesel			650																																					
	Excavtr Cat313/30k-lb/0.7cy		diesel			0																																					
	Loader Cat966/51k-lb/4cy	1	diesel			650																																					
	Dozer Cat D4/30k-lb		diesel			0																																					
	End Dump Cat730/31tn -23cy	1	diesel			650																																					
	ICE 815 Vibro	1	diesel			650																																					
	ICE 160 Impact		diesel			0																																					
	Welder 400amp	2	diesel			1300																																					
	Compressor 375cfm	2	diesel			1300																																					
	Compressor 1100cfm		diesel			0																																					
	Concrete Pump Trk -125ft	1	diesel			650																																					
	Boom Truck 18tn	1	diesel			650																																					
RS -Shaft Excavation	***wrk days per quarter >***	***65***																																									

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	220 ton Crawler Crane	1	diesel				650																																				
	50 ton RT Crane		diesel				0																																				
	Robodrill Drill Jumbo 2-Boom	2	diesel				1300																																				
	Excavtr Cat320/50k-lb/1.6cy	1	diesel				650																																				
	Excavtr Cat313/30k-lb/0.7cy	1	diesel				650																																				
	Loader Cat966/51k-lb/4cy	1	diesel				650																																				
	Dozer Cat D4/30k-lb		diesel				0																																				
	End Dump Cat730/31tn -23cy	1	diesel				650																																				
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric				1300																																				
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric				1300																																				
	Welder 400amp	2	diesel				1300																																				
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric				2178																																				
	Compressor 1100cfm	1	diesel				650																																				
	Concrete Pump Trk -125ft	1	diesel				650																																				
	Boom Truck 18tn	1	diesel				650																																				
Receive Shaft Temp Works	*wrk days per quarter >*	*65*																																							
	220 ton Crawler Crane	1	diesel					650																																	
	50 ton RT Crane	2	diesel					1300																																	
	Robodrill Drill Jumbo 2-Boom		diesel					0																																	
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric					1300																																	
	Excavtr Cat313/30k-lb/0.7cy	1	diesel					650																																	
	Loader Cat966/51k-lb/4cy	1	diesel					650																																	
	Dozer Cat D4/30k-lb		diesel					0																																	
	End Dump Cat730/31tn -23cy		diesel					0																																	
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric					650																																	
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric					650																																	
	Welder 400amp	2	diesel					1300																																	
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric					2178																																	
	Compressor 1100cfm	1	diesel					650																																	
	Concrete Pump Trk -125ft	1	diesel					650																																	
	Boom Truck 18tn	1	diesel					650																																	
Ungrnd -utility power	TBM & Trailing Plant		electric					0																																	
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric					0																																	
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric					0																																	
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric					0																																	
Topside -utility power	Tun Ventilation Plnt -topside		electric					0																																	
Ungrnd	Train-25tnLoco-w/3FltCars		diesel					0																																	
TBM Tunnel Mining @ RS	*wrk days per quarter >*	*65*																																							
	220 ton Crawler Crane	1	diesel													433																									
	50 ton RT Crane	2	diesel													867																									
	Robodrill Drill Jumbo 2-Boom		diesel													0																									
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric													867																									
	Excavtr Cat313/30k-lb/0.7cy	1	diesel													433																									
	Loader Cat966/51k-lb/4cy	1	diesel													433																									
	Dozer Cat D4/30k-lb		diesel													0																									
	End Dump Cat730/31tn -23cy	1	diesel													433																									
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric													0																									
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric													0																									
	Welder 400amp	2	diesel													867																									
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric													726																									
	Compressor 1100cfm	1	diesel													433																									
	Concrete Pump Trk -125ft	0	diesel													0																									
	Boom Truck 18tn	1	diesel													433																									
Ungrnd -utility power	TBM & Trailing Plant		electric													0																									
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric													0																									
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric													0																									
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric													0																									
Topside -utility power	Tun Ventilation Plnt -topside	1	electric													433																									
Ungrnd	Train-25tnLoco-w/3FltCars		diesel													0																									
Tunnel Conc Lining @ RS	*wrk days per quarter >*	*65*																																							
	220 ton Crawler Crane	1	diesel																						433																
	50 ton RT Crane	2	diesel																						867																
	Robodrill Drill Jumbo 2-Boom		diesel																						0																
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																						867																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																						433																
	Loader Cat966/51k-lb/4cy	1	diesel																						433																
	Dozer Cat D4/30k-lb		diesel																						0																
	End Dump Cat730/31tn -23cy		diesel																						0																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																						0																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																						0																
	Welder 400amp	2	diesel																						867																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																						726																
	Compressor 1100cfm	1	diesel																						433																
	Concrete Pump Trk -125ft	2	diesel																						867																
	Boom Truck 18tn	1	diesel																						433																
Ungrnd -utility power	TBM & Trailing Plant		electric																						0																
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																						0																
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																						0																
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																						433																
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																						433																
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																						1733																

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
RS-Adit -D&S Mine & Line	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								
Receive Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																										1300																
	50 ton RT Crane	2	diesel																										1300																
	Robodrill Drill Jumbo 2-Boom		diesel																										0																
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																										0																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																										650																
	Loader Cat966/51k-lb/4cy	1	diesel																										650																
	Dozer Cat D4/30k-lb		diesel																										0																
	End Dump Cat730/31tn -23cy		diesel																										0																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																										0																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																										0																
	Welder 400amp	2	diesel																										1300																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																										2178																
	Compressor 1100cfm	1	diesel																										650																
	Concrete Pump Trk -125ft	2	diesel																										1300																
	Boom Truck 18tn	1	diesel																										650																
Ungrnd -utility power	TBM & Trailing Plant		electric																										0																
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																										0																
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																										0																
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																										0																
Topside -utility power	Tun Ventilation Plnt -topside		electric																										0																
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																										0																

Alternative 3a -CP2

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Bifurcation Launching																																											
LS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel						650	433																																	
	50 ton RT Crane	1	diesel						650	433																																	
	Hyd Drill Soilmec 625/70ton	2	diesel						1300	867																																	
	Excavtr Cat320/50k-lb/1.6cy	1	diesel						650	433																																	
	Excavtr Cat313/30k-lb/0.7cy		diesel						0	0																																	
	Loader Cat966/51k-lb/4cy	1	diesel						650	433																																	
	Dozer Cat D4/30k-lb		diesel						0	0																																	
	End Dump Cat730/31tn -23cy	1	diesel						650	433																																	
	ICE 815 Vibro	1	diesel						650	433																																	
	ICE 160 Impact		diesel						0	0																																	
	Welder 400amp	2	diesel						1300	867																																	
	Compressor 375cfm	2	diesel						1300	867																																	
	Compressor 1100cfm		diesel						0	0																																	
	Concrete Pump Trk -125ft	1	diesel						650	433																																	
	Boom Truck 18tn	1	diesel						650	433																																	
LS -Shaft Excavation	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel								650																																
	50 ton RT Crane		diesel								0																																
	Robodrill Drill Jumbo 2-Boom	2	diesel								1300																																
	Excavtr Cat320/50k-lb/1.6cy	1	diesel								650																																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel								650																																
	Loader Cat966/51k-lb/4cy	1	diesel								650																																
	Dozer Cat D4/30k-lb		diesel								0																																
	End Dump Cat730/31tn -23cy	1	diesel								650																																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric								1300																																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric								1300																																
	Welder 400amp	2	diesel								1300																																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric								2178																																
	Compressor 1100cfm	1	diesel								650																																
	Concrete Pump Trk -125ft	1	diesel								650																																
	Boom Truck 18tn	1	diesel								650																																
TBM Launch/LS Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	2	diesel									2600																															
	50 ton RT Crane	2	diesel									2600																															
	Robodrill Drill Jumbo 2-Boom		diesel									0																															
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric									2600																															
	Excavtr Cat313/30k-lb/0.7cy	1	diesel									1300																															
	Loader Cat966/51k-lb/4cy	1	diesel									650																															
	Dozer Cat D4/30k-lb		diesel									0																															
	End Dump Cat730/31tn -23cy		diesel									0																															
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric									1300																															
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric									1300																															
	Welder 400amp	2	diesel									2600																															
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric									2178																															
	Compressor 1100cfm	1	diesel									1300																															
	Concrete Pump Trk -125ft	2	diesel									1300																															
	Boom Truck 18tn	1	diesel									1300																															
Ungrnd -utility power	TBM & Trailing Plant	1	electric									0																															
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric									0																															
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric									0																															
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric									0																															
Topside -utility power	Tun Ventilation Plnt -topside	1	electric									0																															
Ungrnd	Train-25tnLoco-w/3FltCars	2	diesel									0																															
TBM Tunnel Mining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel										1300	1300	1300	867																											
	50 ton RT Crane	2	diesel										2600	2600	2600	1733																											
	Robodrill Drill Jumbo 2-Boom		diesel										0	0	0	0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric										2600	2600	2600	1733																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel										1300	1300	1300	867																											
	Loader Cat966/51k-lb/4cy	1	diesel										1300	1300	1300	867																											
	Dozer Cat D4/30k-lb		diesel										0	0	0	0																											
	End Dump Cat730/31tn -23cy	1	diesel										1300	1300	1300	867																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric										0	0	0	0																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric										0	0	0	0																											
	Welder 400amp	2	diesel										2600	2600	2600	1733																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric										2178	2178	2178	1452																											
	Compressor 1100cfm	1	diesel										1300	1300	1300	867																											
	Concrete Pump Trk -125ft	0	diesel										0	0	0	0																											
	Boom Truck 18tn	1	diesel										1300	1300	1300	867																											
Ungrnd -utility power	TBM & Trailing Plant	1	electric										1300	1300	1300	867																											
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric										1300	1300	1300	867																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric										1300	1300	1300	867																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric										1300	1300	1300	867																											
Topside -utility power	Tun Ventilation Plnt -topside	1	electric										1300	1300	1300	867																											
Ungrnd	Train-25tnLoco-w/3FltCars	4	diesel										5200	5200	5200	3467																											
Tunnel Conc Lining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel															433	1300	1300	433																						
	50 ton RT Crane	2	diesel															867	2600	2600	867																						

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Robodrill Drill Jumbo 2-Boom		diesel															0	0	0	0																						
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric															867	2600	2600	867																						
	Excavtr Cat313/30k-lb/0.7cy	1	diesel															433	1300	1300	433																						
	Loader Cat966/51k-lb/4cy	1	diesel															433	1300	1300	433																						
	Dozer Cat D4/30k-lb		diesel															0	0	0	0																						
	End Dump Cat730/31tn -23cy		diesel															0	0	0	0																						
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric															0	0	0	0																						
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric															0	0	0	0																						
	Welder 400amp	2	diesel															867	2600	2600	867																						
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric															726	2178	2178	726																						
	Compressor 1100cfm	1	diesel															433	1300	1300	433																						
	Concrete Pump Trk -125ft	2	diesel															867	2600	2600	867																						
	Boom Truck 18tn	1	diesel															433	1300	1300	433																						
Ungrnd -utility power	TBM & Trailing Plant		electric															0	0	0	0																						
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric															0	0	0	0																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric															0	0	0	0																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric															433	1300	1300	433																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric															433	1300	1300	433																						
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel															1733	5200	5200	1733																						
LS-Adit -D&S Mine & Line	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								
Launch Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																				433	1300																			
	50 ton RT Crane	3	diesel																				650	1950																			
	Robodrill Drill Jumbo 2-Boom		diesel																				0	0																			
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																				0	0																			
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																				217	650																			
	Loader Cat966/51k-lb/4cy	1	diesel																				217	650																			
	Dozer Cat D4/30k-lb		diesel																				0	0																			
	End Dump Cat730/31tn -23cy		diesel																				0	0																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																				0	0																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																				0	0																			
	Welder 400amp	2	diesel																				433	1300																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																				726	2178																			
	Compressor 1100cfm	1	diesel																				217	650																			
	Concrete Pump Trk -125ft	2	diesel																				433	1300																			
	Boom Truck 18tn	1	diesel																				217	650																			
Ungrnd -utility power	TBM & Trailing Plant		electric																				0	0																			
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																				0	0																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																				0	0																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																				0	0																			
Topside -utility power	Tun Ventilation Plnt -topside		electric																				0	0																			
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																				0	0																			
Highland Avenue Northwest Receiving																																											
RS -Shaft Site Setup & SOE	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel							650																																	
	50 ton RT Crane	1	diesel							650																																	
	Hyd Drill Soilmec 625/70ton	2	diesel							1300																																	
	Excavtr Cat320/50k-lb/1.6cy	1	diesel							650																																	
	Excavtr Cat313/30k-lb/0.7cy		diesel							0																																	
	Loader Cat966/51k-lb/4cy	1	diesel							650																																	
	Dozer Cat D4/30k-lb		diesel							0																																	
	End Dump Cat730/31tn -23cy	1	diesel							650																																	
	ICE 815 Vibro	1	diesel							650																																	
	ICE 160 Impact		diesel							0																																	
	Welder 400amp	2	diesel							1300																																	
	Compressor 375cfm	2	diesel							1300																																	
	Compressor 1100cfm		diesel							0																																	
	Concrete Pump Trk -125ft	1	diesel							650																																	
	Boom Truck 18tn	1	diesel							650																																	

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
RS -Shaft Excavation	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel								650	217																													
	50 ton RT Crane		diesel								0	0																													
	Robodrill Drill Jumbo 2-Boom	2	diesel								1300	433																													
	Excavtr Cat320/50k-lb/1.6cy	1	diesel								650	217																													
	Excavtr Cat313/30k-lb/0.7cy	1	diesel								650	217																													
	Loader Cat966/51k-lb/4cy	1	diesel								650	217																													
	Dozer Cat D4/30k-lb		diesel								0	0																													
	End Dump Cat730/31tn -23cy	1	diesel								650	217																													
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric								1300	433																													
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric								1300	433																													
	Welder 400amp	2	diesel								1300	433																													
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric								2178	726																													
	Compressor 1100cfm	1	diesel								650	217																													
	Concrete Pump Trk -125ft	1	diesel								650	217																													
	Boom Truck 18tn	1	diesel								650	217																													
Receive Shaft Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel									433	433																												
	50 ton RT Crane	2	diesel									867	867																												
	Robodrill Drill Jumbo 2-Boom		diesel									0	0																												
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric									867	867																												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel									433	433																												
	Loader Cat966/51k-lb/4cy	1	diesel									433	433																												
	Dozer Cat D4/30k-lb		diesel									0	0																												
	End Dump Cat730/31tn -23cy		diesel									0	0																												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric									433	433																												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric									433	433																												
	Welder 400amp	2	diesel									867	867																												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric									1452	1452																												
	Compressor 1100cfm	1	diesel									433	433																												
	Concrete Pump Trk -125ft	1	diesel									433	433																												
	Boom Truck 18tn	1	diesel									433	433																												
Ungrnd -utility power	TBM & Trailing Plant		electric									0	0																												
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric									0	0																												
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric									0	0																												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric									0	0																												
Topside -utility power	Tun Ventilation Plnt -topside		electric									0	0																												
Ungrnd	Train-25tnLoco-w/3FltCars		diesel									0	0																												
TBM Tunnel Mining @ RS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel													433																											
	50 ton RT Crane	2	diesel													867																											
	Robodrill Drill Jumbo 2-Boom		diesel													0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric													867																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel													433																											
	Loader Cat966/51k-lb/4cy	1	diesel													433																											
	Dozer Cat D4/30k-lb		diesel													0																											
	End Dump Cat730/31tn -23cy	1	diesel													433																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric													0																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric													0																											
	Welder 400amp	2	diesel													867																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric													726																											
	Compressor 1100cfm	1	diesel													433																											
	Concrete Pump Trk -125ft	0	diesel													0																											
	Boom Truck 18tn	1	diesel													433																											
Ungrnd -utility power	TBM & Trailing Plant		electric													0																											
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric													0																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric													0																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric													0																											
Topside -utility power	Tun Ventilation Plnt -topside	1	electric													433																											
Ungrnd	Train-25tnLoco-w/3FltCars		diesel													0																											
Tunnel Conc Lining @ RS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																		433																						
	50 ton RT Crane	2	diesel																		867																						
	Robodrill Drill Jumbo 2-Boom		diesel																		0																						
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																		867																						
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																		433																						
	Loader Cat966/51k-lb/4cy	1	diesel																		433																						
	Dozer Cat D4/30k-lb		diesel																		0																						
	End Dump Cat730/31tn -23cy		diesel																		0																						
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																		0																						
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																		0																						
	Welder 400amp	2	diesel																		867																						
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																		726																						
	Compressor 1100cfm	1	diesel																		433																						
	Concrete Pump Trk -125ft	2	diesel																		867																						
	Boom Truck 18tn	1	diesel																		433																						
Ungrnd -utility power	TBM & Trailing Plant		electric																		0																						
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																		0																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																		0																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																		433																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																		433																						

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																		1733																						
RS- D&S Adit -Highland NW to NE -D&S Mine & Line	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel															1300	1300																								
	50 ton RT Crane	1	diesel															1300	1300																								
	Robodrill Drill Jumbo 2-Boom	1	diesel															1300	1300																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric															2600	2600																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel															1300	1300																								
	Loader Cat966/51k-lb/4cy	1	diesel															1300	1300																								
	Dozer Cat D4/30k-lb		diesel															0	0																								
	End Dump Cat730/31tn -23cy	1	diesel															650	650																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric															1300	1300																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric															1300	1300																								
	Welder 400amp	2	diesel															2600	2600																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric															2178	2178																								
	Compressor 1100cfm	1	diesel															1300	1300																								
	Concrete Pump Trk -125ft	1	diesel															650	650																								
	Boom Truck 18tn	1	diesel															1300	1300																								
Ungrnd -utility power	TBM & Trailing Plant		electric															0	0																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric															0	0																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric															0	0																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric															1300	1300																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric															1300	1300																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric															1300	1300																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel															1300	1300																								
Receive Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																				1300	433																			
	50 ton RT Crane	2	diesel																				1300	433																			
	Robodrill Drill Jumbo 2-Boom		diesel																				0	0																			
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																				0	0																			
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																				650	217																			
	Loader Cat966/51k-lb/4cy	1	diesel																				650	217																			
	Dozer Cat D4/30k-lb		diesel																				0	0																			
	End Dump Cat730/31tn -23cy		diesel																				0	0																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																				0	0																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																				0	0																			
	Welder 400amp	2	diesel																				1300	433																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																				2178	726																			
	Compressor 1100cfm	1	diesel																				650	217																			
	Concrete Pump Trk -125ft	2	diesel																				1300	433																			
	Boom Truck 18tn	1	diesel																				650	217																			
Ungrnd -utility power	TBM & Trailing Plant		electric																				0	0																			
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																				0	0																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																				0	0																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																				0	0																			
Topside -utility power	Tun Ventilation Plnt -topside		electric																				0	0																			
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																				0	0																			

Alternative 3a-CP3

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Tandem Trailer Launching																																											
LS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel											1300																													
	50 ton RT Crane	1	diesel											1300																													
	Hyd Drill Soilmec 625/70ton	2	diesel											2600																													
	Excavtr Cat320/50k-lb/1.6cy	1	diesel											1300																													
	Excavtr Cat313/30k-lb/0.7cy		diesel											0																													
	Loader Cat966/51k-lb/4cy	1	diesel											1300																													
	Dozer Cat D4/30k-lb		diesel											0																													
	End Dump Cat730/31tn -23cy	1	diesel											1300																													
	ICE 815 Vibro	1	diesel											1300																													
	ICE 160 Impact		diesel											0																													
	Welder 400amp	2	diesel											2600																													
	Compressor 375cfm	2	diesel											2600																													
	Compressor 1100cfm		diesel											0																													
	Concrete Pump Trk -125ft	1	diesel											1300																													
	Boom Truck 18tn	1	diesel											1300																													
LS -Shaft Excavation	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel												65																												
	50 ton RT Crane		diesel												0																												
	Robodrill Drill Jumbo 2-Boom	2	diesel												130																												
	Excavtr Cat320/50k-lb/1.6cy	1	diesel												65																												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel												65																												
	Loader Cat966/51k-lb/4cy	1	diesel												65																												
	Dozer Cat D4/30k-lb		diesel												0																												
	End Dump Cat730/31tn -23cy	1	diesel												65																												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric												130																												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric												130																												
	Welder 400amp	2	diesel												130																												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric												218																												
	Compressor 1100cfm	1	diesel												65																												
	Concrete Pump Trk -125ft	1	diesel												65																												
	Boom Truck 18tn	1	diesel												65																												
TBM Launch/LS Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	2	diesel													2600																											
	50 ton RT Crane	2	diesel													2600																											
	Robodrill Drill Jumbo 2-Boom		diesel													0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric													2600																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel													1300																											
	Loader Cat966/51k-lb/4cy	1	diesel													650																											
	Dozer Cat D4/30k-lb		diesel													0																											
	End Dump Cat730/31tn -23cy		diesel													0																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric													1300																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric													1300																											
	Welder 400amp	2	diesel													2600																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric													2178																											
	Compressor 1100cfm	1	diesel													1300																											
	Concrete Pump Trk -125ft	2	diesel													1300																											
	Boom Truck 18tn	1	diesel													1300																											
Ungrnd -utility power	TBM & Trailing Plant	1	electric													0																											
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric													0																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric													0																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric													0																											
Topside -utility power	Tun Ventilation Plnt -topside	1	electric													0																											
Ungrnd	Train-25tnLoco-w/3FltCars	2	diesel													0																											
TBM Tunnel Mining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel														1300	1300	1300	1300	1300																						
	50 ton RT Crane	2	diesel														2600	2600	2600	2600	2600																						
	Robodrill Drill Jumbo 2-Boom		diesel														0	0	0	0	0																						
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric														2600	2600	2600	2600	2600																						
	Excavtr Cat313/30k-lb/0.7cy	1	diesel														1300	1300	1300	1300	1300																						
	Loader Cat966/51k-lb/4cy	1	diesel														1300	1300	1300	1300	1300																						
	Dozer Cat D4/30k-lb		diesel														0	0	0	0	0																						
	End Dump Cat730/31tn -23cy	1	diesel														1300	1300	1300	1300	1300																						
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric														0	0	0	0	0																						
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric														0	0	0	0	0																						
	Welder 400amp	2	diesel														2600	2600	2600	2600	2600																						
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric														2178	2178	2178	2178	2178																						
	Compressor 1100cfm	1	diesel														1300	1300	1300	1300	1300																						
	Concrete Pump Trk -125ft	0	diesel														0	0	0	0	0																						
	Boom Truck 18tn	1	diesel														1300	1300	1300	1300	1300																						
Ungrnd -utility power	TBM & Trailing Plant	1	electric														1300	1300	1300	1300	1300																						
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric														1300	1300	1300	1300	1300																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric														1300	1300	1300	1300	1300																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric														1300	1300	1300	1300	1300																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric														1300	1300	1300	1300	1300																						
Ungrnd	Train-25tnLoco-w/3FltCars	4	diesel														5200	5200	5200	5200	5200																						
Tunnel Conc Lining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																						433	1300	1300	1300	433														
	50 ton RT Crane	2	diesel																						867	2600	2600	2600	867														

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Robodrill Drill Jumbo 2-Boom		diesel																						0	0	0	0	0														
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																						867	2600	2600	2600	867														
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																						433	1300	1300	1300	433														
	Loader Cat966/51k-lb/4cy	1	diesel																						433	1300	1300	1300	433														
	Dozer Cat D4/30k-lb		diesel																						0	0	0	0	0														
	End Dump Cat730/31tn -23cy		diesel																						0	0	0	0	0														
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																						0	0	0	0	0														
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																						0	0	0	0	0														
	Welder 400amp	2	diesel																						867	2600	2600	2600	867														
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																						726	2178	2178	2178	726														
	Compressor 1100cfm	1	diesel																						433	1300	1300	1300	433														
	Concrete Pump Trk -125ft	2	diesel																						867	2600	2600	2600	867														
	Boom Truck 18tn	1	diesel																						433	1300	1300	1300	433														
Ungrnd -utility power	TBM & Trailing Plant		electric																						0	0	0	0	0														
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																						0	0	0	0	0														
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																						0	0	0	0	0														
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																						433	1300	1300	1300	433														
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																						433	1300	1300	1300	433														
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																						1733	5200	5200	5200	1733														
LS- D&S Adit -Tandem Trailer to Park Rd East -D&S Mine & Line	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel																					433	1300	1300	1300																
	50 ton RT Crane	1	diesel																					433	1300	1300	1300																
	Robodrill Drill Jumbo 2-Boom	1	diesel																					433	1300	1300	1300																
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																					867	2600	2600	2600																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																					433	1300	1300	1300																
	Loader Cat966/51k-lb/4cy	1	diesel																					433	1300	1300	1300																
	Dozer Cat D4/30k-lb		diesel																					0	0	0	0																
	End Dump Cat730/31tn -23cy	1	diesel																					433	1300	1300	1300																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																					433	1300	1300	1300																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																					433	1300	1300	1300																
	Welder 400amp	2	diesel																					867	2600	2600	2600																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																					726	2178	2178	2178																
	Compressor 1100cfm	1	diesel																					433	1300	1300	1300																
	Concrete Pump Trk -125ft	1	diesel																					433	1300	1300	1300																
	Boom Truck 18tn	1	diesel																					433	1300	1300	1300																
Ungrnd -utility power	TBM & Trailing Plant		electric																					0	0	0	0																
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																					0	0	0	0																
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																					0	0	0	0																
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																					433	1300	1300	1300																
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																					433	1300	1300	1300																
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																					433	1300	1300	1300																
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																					433	1300	1300	1300																
Launch Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																											1300	433												
	50 ton RT Crane	3	diesel																											1950	650												
	Robodrill Drill Jumbo 2-Boom		diesel																											0	0												
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																											0	0												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																											650	217												
	Loader Cat966/51k-lb/4cy	1	diesel																											650	217												
	Dozer Cat D4/30k-lb		diesel																											0	0												
	End Dump Cat730/31tn -23cy		diesel																											0	0												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																											0	0												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																											0	0												
	Welder 400amp	2	diesel																											1300	433												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																											2178	726												
	Compressor 1100cfm	1	diesel																											650	217												
	Concrete Pump Trk -125ft	2	diesel																											1300	433												
	Boom Truck 18tn	1	diesel																											650	217												
Ungrnd -utility power	TBM & Trailing Plant		electric																											0	0												
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																											0	0												
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																											0	0												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																											0	0												
Topside -utility power	Tun Ventilation Plnt -topside		electric																											0	0												
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																											0	0												
Fernald Property Receiving																																											
RS -Shaft Site Setup & SOE	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel											217																													
	50 ton RT Crane	1	diesel											217																													
	Hyd Drill Soilmec 625/70ton	2	diesel											433																													
	Excavtr Cat320/50k-lb/1.6cy	1	diesel											217																													
	Excavtr Cat313/30k-lb/0.7cy		diesel											0																													
	Loader Cat966/51k-lb/4cy	1	diesel											217																													
	Dozer Cat D4/30k-lb		diesel											0																													
	End Dump Cat730/31tn -23cy	1	diesel											217																													
	ICE 815 Vibro	1	diesel											217																													
	ICE 160 Impact		diesel											0																													
	Welder 400amp	2	diesel											433																													
	Compressor 375cfm	2	diesel											433																													
	Compressor 1100cfm		diesel											0																													

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Concrete Pump Trk -125ft	1	diesel												217																													
	Boom Truck 18tn	1	diesel												217																													
RS -Shaft Excavation	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel													650																												
	50 ton RT Crane		diesel													0																												
	Robodrill Drill Jumbo 2-Boom	2	diesel													1300																												
	Excavtr Cat320/50k-lb/1.6cy	1	diesel													650																												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel													650																												
	Loader Cat966/51k-lb/4cy	1	diesel													650																												
	Dozer Cat D4/30k-lb		diesel													0																												
	End Dump Cat730/31tn -23cy	1	diesel													650																												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric													1300																												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric													1300																												
	Welder 400amp	2	diesel													1300																												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric													2178																												
	Compressor 1100cfm	1	diesel													650																												
	Concrete Pump Trk -125ft	1	diesel													650																												
	Boom Truck 18tn	1	diesel													650																												
Receive Shaft Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel														650																											
	50 ton RT Crane	2	diesel														1300																											
	Robodrill Drill Jumbo 2-Boom		diesel														0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric														1300																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel														650																											
	Loader Cat966/51k-lb/4cy	1	diesel														650																											
	Dozer Cat D4/30k-lb		diesel														0																											
	End Dump Cat730/31tn -23cy		diesel														0																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric														650																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric														650																											
	Welder 400amp	2	diesel														1300																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric														2178																											
	Compressor 1100cfm	1	diesel														650																											
	Concrete Pump Trk -125ft	1	diesel														650																											
	Boom Truck 18tn	1	diesel														650																											
Ungrnd -utility power	TBM & Trailing Plant		electric														0																											
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric														0																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric														0																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric														0																											
Topside -utility power	Tun Ventilation Plnt -topside		electric														0																											
Ungrnd	Train-25tnLoco-w/3FltCars		diesel														0																											
TBM Tunnel Mining @ RS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																			433																						
	50 ton RT Crane	2	diesel																			867																						
	Robodrill Drill Jumbo 2-Boom		diesel																			0																						
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																			867																						
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																			433																						
	Loader Cat966/51k-lb/4cy	1	diesel																			433																						
	Dozer Cat D4/30k-lb		diesel																			0																						
	End Dump Cat730/31tn -23cy	1	diesel																			433																						
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																			0																						
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																			0																						
	Welder 400amp	2	diesel																			867																						
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																			726																						
	Compressor 1100cfm	1	diesel																			433																						
	Concrete Pump Trk -125ft	0	diesel																			0																						
	Boom Truck 18tn	1	diesel																			433																						
Ungrnd -utility power	TBM & Trailing Plant		electric																			0																						
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																			0																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																			0																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																			0																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																			433																						
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																			0																						
Tunnel Conc Lining @ RS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																											433														
	50 ton RT Crane	2	diesel																											867														
	Robodrill Drill Jumbo 2-Boom		diesel																											0														
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																											867														
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																											433														
	Loader Cat966/51k-lb/4cy	1	diesel																											433														
	Dozer Cat D4/30k-lb		diesel																											0														
	End Dump Cat730/31tn -23cy		diesel																											0														
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																											0														
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																											0														
	Welder 400amp	2	diesel																											867														
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																											726														
	Compressor 1100cfm	1	diesel																											433														
	Concrete Pump Trk -125ft	2	diesel																											867														
	Boom Truck 18tn	1	diesel																											433														
Ungrnd -utility power	TBM & Trailing Plant		electric																											0														
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																											0														
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																											0														

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																										433														
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																										433														
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																										1733														
RS-Adit -D&S Mine & Line	wrk days per quarter >	65																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								
Receive Shaft Perm Lining	wrk days per quarter >	65																																									
	220 ton Crawler Crane	2	diesel																												1300												
	50 ton RT Crane	2	diesel																												1300												
	Robodrill Drill Jumbo 2-Boom		diesel																												0												
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																												0												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																												650												
	Loader Cat966/51k-lb/4cy	1	diesel																												650												
	Dozer Cat D4/30k-lb		diesel																												0												
	End Dump Cat730/31tn -23cy		diesel																												0												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																												0												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																												0												
	Welder 400amp	2	diesel																												1300												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																												2178												
	Compressor 1100cfm	1	diesel																												650												
	Concrete Pump Trk -125ft	2	diesel																												1300												
	Boom Truck 18tn	1	diesel																												650												
Ungrnd -utility power	TBM & Trailing Plant		electric																												0												
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																												0												
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																												0												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																												0												
Topside -utility power	Tun Ventilation Plnt -topside		electric																												0												
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																												0												

Park Road East Connecting

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CSS -Shaft Site Setup & SOE	wrk days per quarter >	65																																									
	220 ton Crawler Crane	1	diesel																								217																
	50 ton RT Crane	1	diesel																								217																
	Hyd Drill Soilmec 625/70ton		diesel																								0																
	Excavtr Cat320/50k-lb/1.6cy	1	diesel																								217																
	Excavtr Cat313/30k-lb/0.7cy		diesel																								0																
	Loader Cat966/51k-lb/4cy	1	diesel																								217																
	Dozer Cat D4/30k-lb		diesel																								0																
	End Dump Cat730/31tn -23cy		diesel																								0																
	ICE 815 Vibro	1	diesel																								217																
	ICE 160 Impact		diesel																								0																
	Welder 400amp	2	diesel																								433																
	Compressor 375cfm	2	diesel																								433																
	Compressor 1100cfm		diesel																								0																
	Concrete Pump Trk -125ft	1	diesel																								217																
	Boom Truck 18tn	1	diesel																								217																
CS -Shaft Ex/Raise Drilling	wrk days per quarter >	65																																									
	220 ton Crawler Crane	1	diesel																									650															
	50 ton RT Crane	1	diesel																									650															
	HerrnkRBR800VF RaiseboreEq	1	diesel																									650															
	Excavtr Cat320/50k-lb/1.6cy	1	diesel																									650															
	Excavtr Cat313/30k-lb/0.7cy		diesel																									0															
	Loader Cat966/51k-lb/4cy	1	diesel																									650															
	Dozer Cat D4/30k-lb		diesel																									0															
	End Dump Cat730/31tn -23cy		diesel																									0															
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																									0															
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																									0															
	Welder 400amp	2	diesel																									1300															
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																									2178															
	Compressor 1100cfm	1	diesel																									650															

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Concrete Pump Trk -125ft		diesel																									0															
	Boom Truck 18tn	1	diesel																									650															
Connect Shaft Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	2	diesel																																								
	Robodrill Drill Jumbo 2-Boom		diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy		diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																																								
Topside -utility power	Tun Ventilation Plnt -topside		electric																																								
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																																								
TBM Mining @Connect Shft	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	2	diesel																																								
	Robodrill Drill Jumbo 2-Boom		diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	0	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																																								
Tunnel Conc Lining @ CS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	2	diesel																																								
	Robodrill Drill Jumbo 2-Boom		diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy		diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	2	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																																								
CS-Adit -D&S Mine & Line	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								
Connect Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane		diesel																										0														
	50 ton RT Crane	1	diesel																										217														
	Robodrill Drill Jumbo 2-Boom		diesel																										0														
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																										0														
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																										217														
	Loader Cat966/51k-lb/4cy	1	diesel																										217														
	Dozer Cat D4/30k-lb		diesel																										0														
	End Dump Cat730/31tn -23cy		diesel																										0														
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																										0														
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																										0														
	Welder 400amp	2	diesel																										433														
24/7 Topside -utility power	Shaft/Tunnel Pump System		electric																										0														
	Compressor 1100cfm	1	diesel																										217														
	Concrete Pump Trk -125ft	1	diesel																										217														
	Boom Truck 18tn	1	diesel																										217														
Ungrnd -utility power	TBM & Trailing Plant		electric																										0														
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																										0														
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																										0														
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																										0														
Topside -utility power	Tun Ventilation Plnt -topside		electric																										0														
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																										0														

Alternative 4a -CP1

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching																																											
LS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel			650																																					
	50 ton RT Crane	1	diesel			650																																					
	Hyd Drill Soilmec 625/70ton	2	diesel			1300																																					
	Excavtr Cat320/50k-lb/1.6cy	1	diesel			650																																					
	Excavtr Cat313/30k-lb/0.7cy		diesel			0																																					
	Loader Cat966/51k-lb/4cy	1	diesel			650																																					
	Dozer Cat D4/30k-lb		diesel			0																																					
	End Dump Cat730/31tn -23cy	1	diesel			650																																					
	ICE 815 Vibro	1	diesel			650																																					
	ICE 160 Impact		diesel			0																																					
	Welder 400amp	2	diesel			1300																																					
	Compressor 375cfm	2	diesel			1300																																					
	Compressor 1100cfm		diesel			0																																					
	Concrete Pump Trk -125ft	1	diesel			650																																					
	Boom Truck 18tn	1	diesel			650																																					
LS -Shaft Excavation	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel				650																																				
	50 ton RT Crane		diesel				0																																				
	Robodrill Drill Jumbo 2-Boom	2	diesel				1300																																				
	Excavtr Cat320/50k-lb/1.6cy	1	diesel				650																																				
	Excavtr Cat313/30k-lb/0.7cy	1	diesel				650																																				
	Loader Cat966/51k-lb/4cy	1	diesel				650																																				
	Dozer Cat D4/30k-lb		diesel				0																																				
	End Dump Cat730/31tn -23cy	1	diesel				650																																				
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric				1300																																				
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric				1300																																				
	Welder 400amp	2	diesel				1300																																				
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric				2178																																				
	Compressor 1100cfm	1	diesel				650																																				
	Concrete Pump Trk -125ft	1	diesel				650																																				
	Boom Truck 18tn	1	diesel				650																																				
TBM Launch/LS Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	2	diesel					2600																																			
	50 ton RT Crane	2	diesel					2600																																			
	Robodrill Drill Jumbo 2-Boom		diesel					0																																			
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric					2600																																			
	Excavtr Cat313/30k-lb/0.7cy	1	diesel					1300																																			
	Loader Cat966/51k-lb/4cy	1	diesel					650																																			
	Dozer Cat D4/30k-lb		diesel					0																																			
	End Dump Cat730/31tn -23cy		diesel					0																																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric					1300																																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric					1300																																			
	Welder 400amp	2	diesel					2600																																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric					2178																																			
	Compressor 1100cfm	1	diesel					1300																																			
	Concrete Pump Trk -125ft	2	diesel					1300																																			
	Boom Truck 18tn	1	diesel					1300																																			
Ungrnd -utility power	TBM & Trailing Plant	1	electric					0																																			
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric					0																																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric					0																																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric					0																																			
Topside -utility power	Tun Ventilation Plnt -topside	1	electric					0																																			
Ungrnd	Train-25tnLoco-w/3FltCars	2	diesel					0																																			
TBM Tunnel Mining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel						1300	1300	1300	1300	1300	1300	1300	433																									
	50 ton RT Crane	2	diesel						2600	2600	2600	2600	2600	2600	2600	867																									
	Robodrill Drill Jumbo 2-Boom		diesel						0	0	0	0	0	0	0	0																									
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric						2600	2600	2600	2600	2600	2600	2600	867																									
	Excavtr Cat313/30k-lb/0.7cy	1	diesel						1300	1300	1300	1300	1300	1300	1300	433																									
	Loader Cat966/51k-lb/4cy	1	diesel						1300	1300	1300	1300	1300	1300	1300	433																									
	Dozer Cat D4/30k-lb		diesel						0	0	0	0	0	0	0	0																									
	End Dump Cat730/31tn -23cy	1	diesel						1300	1300	1300	1300	1300	1300	1300	433																									
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric						0	0	0	0	0	0	0	0																									
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric						0	0	0	0	0	0	0	0																									
	Welder 400amp	2	diesel						2600	2600	2600	2600	2600	2600	2600	867																									
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric						2178	2178	2178	2178	2178	2178	2178	726																									
	Compressor 1100cfm	1	diesel						1300	1300	1300	1300	1300	1300	1300	433																									
	Concrete Pump Trk -125ft	0	diesel						0	0	0	0	0	0	0	0																									
	Boom Truck 18tn	1	diesel						1300	1300	1300	1300	1300	1300	1300	433																									
Ungrnd -utility power	TBM & Trailing Plant	1	electric						1300	1300	1300	1300	1300	1300	1300	433																									
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric						1300	1300	1300	1300	1300	1300	1300	433																									
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric						1300	1300	1300	1300	1300	1300	1300	433																									
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric						1300	1300	1300	1300	1300	1300	1300	433																									
Topside -utility power	Tun Ventilation Plnt -topside	1	electric						1300	1300	1300	1300	1300	1300	1300	433																									
Ungrnd	Train-25tnLoco-w/3FltCars	4	diesel						5200	5200	5200	5200	5200	5200	5200	1733																									
Tunnel Conc Lining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																	433	1300	1300	1300	1300	1300																
	50 ton RT Crane	2	diesel																	867	2600	2600	2600	2600	2600																
	Robodrill Drill Jumbo 2-Boom		diesel																	0	0	0	0	0	0																
Topside -utility power	**Shotcrete&Grout Batch Plnts**	2	electric																	867	2600	2600	2600	2600	2600																
Large Plant	Excavtr Cat313/30k-lb/0.7cy	1	diesel																	433	1300	1300	1300	1300	1300																
	Loader Cat966/51k-lb/4cy	1	diesel																	433	1300	1300	1300	1300	1300																
	Dozer Cat D4/30k-lb		diesel																	0	0	0	0	0	0																
	End Dump Cat730/31tn -23cy		diesel																	0	0	0	0	0	0																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																	0	0	0	0	0	0																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																	0	0	0	0	0	0																

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Welder 400amp	2	diesel																	867	2600	2600	2600	2600	2600																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																	726	2178	2178	2178	2178	2178																		
	Compressor 1100cfm	1	diesel																	433	1300	1300	1300	1300	1300																		
	Concrete Pump Trk -125ft	2	diesel																	867	2600	2600	2600	2600	2600																		
	Boom Truck 18tn	1	diesel																	433	1300	1300	1300	1300	1300																		
Ungrnd -utility power	TBM & Trailing Plant		electric																	0	0	0	0	0	0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																	0	0	0	0	0	0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																	0	0	0	0	0	0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																	433	1300	1300	1300	1300	1300																		
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																	433	1300	1300	1300	1300	1300																		
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																	1733	5200	5200	5200	5200	5200																		
LS-Adit -D&S Mine & Line	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel															1300	1300																								
	50 ton RT Crane	1	diesel															1300	1300																								
	Robodrill Drill Jumbo 2-Boom	1	diesel															1300	1300																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric															2600	2600																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel															1300	1300																								
	Loader Cat966/51k-lb/4cy	1	diesel															1300	1300																								
	Dozer Cat D4/30k-lb		diesel															0	0																								
	End Dump Cat730/31tn -23cy	1	diesel															650	650																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric															1300	1300																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric															1300	1300																								
	Welder 400amp	2	diesel															2600	2600																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric															2178	2178																								
	Compressor 1100cfm	1	diesel															1300	1300																								
	Concrete Pump Trk -125ft	1	diesel															650	650																								
	Boom Truck 18tn	1	diesel															1300	1300																								
Ungrnd -utility power	TBM & Trailing Plant		electric															0	0																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric															0	0																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric															0	0																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric															1300	1300																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric															1300	1300																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric															1300	1300																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel															1300	1300																								
Launch Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																							433	1300																
	50 ton RT Crane	3	diesel																							650	1950																
	Robodrill Drill Jumbo 2-Boom		diesel																							0	0																
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																							0	0																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																							217	650																
	Loader Cat966/51k-lb/4cy	1	diesel																							217	650																
	Dozer Cat D4/30k-lb		diesel																							0	0																
	End Dump Cat730/31tn -23cy		diesel																							0	0																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																							0	0																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																							0	0																
	Welder 400amp	2	diesel																							433	1300																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																							726	2178																
	Compressor 1100cfm	1	diesel																							217	650																
	Concrete Pump Trk -125ft	2	diesel																							433	1300																
	Boom Truck 18tn	1	diesel																							217	650																
Ungrnd -utility power	TBM & Trailing Plant		electric																							0	0																
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																							0	0																
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																							0	0																
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																							0	0																
Topside -utility power	Tun Ventilation Plnt -topside		electric																							0	0																
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																							0	0																
American Legion Receiving																																											
RS -Shaft Site Setup & SOE	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel			650																																			
	50 ton RT Crane	1	diesel			650																																			
	Hyd Drill Soilmec 625/70ton	2	diesel			1300																																			
	Excavtr Cat320/50k-lb/1.6cy	1	diesel			650																																			
	Excavtr Cat313/30k-lb/0.7cy		diesel			0																																			
	Loader Cat966/51k-lb/4cy	1	diesel			650																																			
	Dozer Cat D4/30k-lb		diesel			0																																			
	End Dump Cat730/31tn -23cy	1	diesel			650																																			
	ICE 815 Vibro	1	diesel			650																																			
	ICE 160 Impact		diesel			0																																			
	Welder 400amp	2	diesel			1300																																			
	Compressor 375cfm	2	diesel			1300																																			
	Compressor 1100cfm		diesel			0																																			
	Concrete Pump Trk -125ft	1	diesel			650																																			
	Boom Truck 18tn	1	diesel			650																																			
RS -Shaft Excavation	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel				650																																		
	50 ton RT Crane		diesel				0																																		
	Robodrill Drill Jumbo 2-Boom	2	diesel				1300																																		
	Excavtr Cat320/50k-lb/1.6cy	1	diesel				650																																		
	Excavtr Cat313/30k-lb/0.7cy	1	diesel				650																																		
	Loader Cat966/51k-lb/4cy	1	diesel				650																																		
	Dozer Cat D4/30k-lb		diesel				0																																		
	End Dump Cat730/31tn -23cy	1	diesel				650																																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric				1300																																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric				1300																																		
	Welder 400amp	2	diesel				1300																																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric				2178																																		
	Compressor 1100cfm	1	diesel				650																																		
	Concrete Pump Trk -125ft	1	diesel				650																																		
	Boom Truck 18tn	1	diesel				650																																		

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Receive Shaft Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel					650																																			
	50 ton RT Crane	2	diesel					1300																																			
	Robodrill Drill Jumbo 2-Boom		diesel					0																																			
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric					1300																																			
	Excavtr Cat313/30k-lb/0.7cy	1	diesel					650																																			
	Loader Cat966/51k-lb/4cy	1	diesel					650																																			
	Dozer Cat D4/30k-lb		diesel					0																																			
	End Dump Cat730/31tn -23cy		diesel					0																																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric					650																																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric					650																																			
	Welder 400amp	2	diesel					1300																																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric					2178																																			
	Compressor 1100cfm	1	diesel					650																																			
	Concrete Pump Trk -125ft	1	diesel					650																																			
	Boom Truck 18tn	1	diesel					650																																			
Ungrnd -utility power	TBM & Trailing Plant		electric					0																																			
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric					0																																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric					0																																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric					0																																			
Topside -utility power	Tun Ventilation Plnt -topside		electric					0																																			
Ungrnd	Train-25tnLoco-w/3FltCars		diesel					0																																			
TBM Tunnel Mining @ RS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel													433																											
	50 ton RT Crane	2	diesel													867																											
	Robodrill Drill Jumbo 2-Boom		diesel													0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric													867																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel													433																											
	Loader Cat966/51k-lb/4cy	1	diesel													433																											
	Dozer Cat D4/30k-lb		diesel													0																											
	End Dump Cat730/31tn -23cy	1	diesel													433																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric													0																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric													0																											
	Welder 400amp	2	diesel													867																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric													726																											
	Compressor 1100cfm	1	diesel													433																											
	Concrete Pump Trk -125ft	0	diesel													0																											
	Boom Truck 18tn	1	diesel													433																											
Ungrnd -utility power	TBM & Trailing Plant		electric													0																											
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric													0																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric													0																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric													0																											
Topside -utility power	Tun Ventilation Plnt -topside	1	electric													433																											
Ungrnd	Train-25tnLoco-w/3FltCars		diesel													0																											
Tunnel Conc Lining @ RS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																						433																		
	50 ton RT Crane	2	diesel																						867																		
	Robodrill Drill Jumbo 2-Boom		diesel																						0																		
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																						867																		
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																						433																		
	Loader Cat966/51k-lb/4cy	1	diesel																						433																		
	Dozer Cat D4/30k-lb		diesel																						0																		
	End Dump Cat730/31tn -23cy		diesel																						0																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																						0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																						0																		
	Welder 400amp	2	diesel																						867																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																						726																		
	Compressor 1100cfm	1	diesel																						433																		
	Concrete Pump Trk -125ft	2	diesel																						867																		
	Boom Truck 18tn	1	diesel																						433																		
Ungrnd -utility power	TBM & Trailing Plant		electric																						0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																						0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																						0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																						433																		
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																						433																		
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																						1733																		
RS-Adit -D&S Mine & Line	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Receive Shaft Perm Lining	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	2	diesel																								1300																
	50 ton RT Crane	2	diesel																								1300																
	Robodrill Drill Jumbo 2-Boom		diesel																								0																
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																								0																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																								650																
	Loader Cat966/51k-lb/4cy	1	diesel																								650																
	Dozer Cat D4/30k-lb		diesel																								0																
	End Dump Cat730/31tn -23cy		diesel																								0																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																								0																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																								0																
	Welder 400amp	2	diesel																								1300																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																								2178																
	Compressor 1100cfm	1	diesel																								650																
	Concrete Pump Trk -125ft	2	diesel																								1300																
	Boom Truck 18tn	1	diesel																								650																
Ungrnd -utility power	TBM & Trailing Plant		electric																								0																
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																								0																
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																								0																
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																								0																
Topside -utility power	Tun Ventilation Plnt -topside		electric																								0																
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																								0																

Alternative 4a -CP2

Operation Description	Description	Qty Count	Fuel Source	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching																																											
LS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel							650																																	
	50 ton RT Crane	1	diesel							650																																	
	Hyd Drill Soilmec 625/70ton	2	diesel							1300																																	
	Excavtr Cat320/50k-lb/1.6cy	1	diesel							650																																	
	Excavtr Cat313/30k-lb/0.7cy		diesel							0																																	
	Loader Cat966/51k-lb/4cy	1	diesel							650																																	
	Dozer Cat D4/30k-lb		diesel							0																																	
	End Dump Cat730/31tn -23cy	1	diesel							650																																	
	ICE 815 Vibro	1	diesel							650																																	
	ICE 160 Impact		diesel							0																																	
	Welder 400amp	2	diesel							1300																																	
	Compressor 375cfm	2	diesel							1300																																	
	Compressor 1100cfm		diesel							0																																	
	Concrete Pump Trk -125ft	1	diesel							650																																	
	Boom Truck 18tn	1	diesel							650																																	
LS -Shaft Excavation	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel								650																																
	50 ton RT Crane		diesel								0																																
	Robodrill Drill Jumbo 2-Boom	2	diesel								1300																																
	Excavtr Cat320/50k-lb/1.6cy	1	diesel								650																																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel								650																																
	Loader Cat966/51k-lb/4cy	1	diesel								650																																
	Dozer Cat D4/30k-lb		diesel								0																																
	End Dump Cat730/31tn -23cy	1	diesel								650																																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric								1300																																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric								1300																																
	Welder 400amp	2	diesel								1300																																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric								2178																																
	Compressor 1100cfm	1	diesel								650																																
	Concrete Pump Trk -125ft	1	diesel								650																																
	Boom Truck 18tn	1	diesel								650																																
TBM Launch/LS Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	2	diesel									2600																															
	50 ton RT Crane	2	diesel									2600																															
	Robodrill Drill Jumbo 2-Boom		diesel									0																															
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric									2600																															
	Excavtr Cat313/30k-lb/0.7cy	1	diesel									1300																															
	Loader Cat966/51k-lb/4cy	1	diesel									650																															
	Dozer Cat D4/30k-lb		diesel									0																															
	End Dump Cat730/31tn -23cy		diesel									0																															
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric									1300																															
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric									1300																															
	Welder 400amp	2	diesel									2600																															
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric									2178																															
	Compressor 1100cfm	1	diesel									1300																															
	Concrete Pump Trk -125ft	2	diesel									1300																															
	Boom Truck 18tn	1	diesel									1300																															
Ungrnd -utility power	TBM & Trailing Plant	1	electric									0																															
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric									0																															
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric									0																															
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric									0																															
Topside -utility power	Tun Ventilation Plnt -topside	1	electric									0																															
Ungrnd	Train-25tnLoco-w/3FltCars	2	diesel									0																															
TBM Tunnel Mining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel										1300	1300	1300	867																											
	50 ton RT Crane	2	diesel										2600	2600	2600	1733																											
	Robodrill Drill Jumbo 2-Boom		diesel										0	0	0	0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric										2600	2600	2600	1733																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel										1300	1300	1300	867																											
	Loader Cat966/51k-lb/4cy	1	diesel										1300	1300	1300	867																											
	Dozer Cat D4/30k-lb		diesel										0	0	0	0																											
	End Dump Cat730/31tn -23cy	1	diesel										1300	1300	1300	867																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric										0	0	0	0																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric										0	0	0	0																											
	Welder 400amp	2	diesel										2600	2600	2600	1733																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric										2178	2178	2178	1452																											
	Compressor 1100cfm	1	diesel										1300	1300	1300	867																											
	Concrete Pump Trk -125ft	0	diesel										0	0	0	0																											
	Boom Truck 18tn	1	diesel										1300	1300	1300	867																											
Ungrnd -utility power	TBM & Trailing Plant	1	electric										1300	1300	1300	867																											
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric										1300	1300	1300	867																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric										1300	1300	1300	867																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric										1300	1300	1300	867																											
Topside -utility power	Tun Ventilation Plnt -topside	1	electric										1300	1300	1300	867																											
Ungrnd	Train-25tnLoco-w/3FltCars	4	diesel										5200	5200	5200	3467																											
Tunnel Conc Lining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel															433	1300	1300	433																						
	50 ton RT Crane	2	diesel															867	2600	2600	867																						
	Robodrill Drill Jumbo 2-Boom		diesel															0	0	0	0																						
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric															867	2600	2600	867																						
Large Plant	Excavtr Cat313/30k-lb/0.7cy	1	diesel															433	1300	1300	433																						
	Loader Cat966/51k-lb/4cy	1	diesel															433	1300	1300	433																						
	Dozer Cat D4/30k-lb		diesel															0	0	0	0																						
	End Dump Cat730/31tn -23cy		diesel															0	0	0	0																						

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric															0	0	0	0																						
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric															0	0	0	0																						
	Welder 400amp	2	diesel															867	2600	2600	867																						
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric															726	2178	2178	726																						
	Compressor 1100cfm	1	diesel															433	1300	1300	433																						
	Concrete Pump Trk -125ft	2	diesel															867	2600	2600	867																						
	Boom Truck 18tn	1	diesel															433	1300	1300	433																						
Ungrnd -utility power	TBM & Trailing Plant		electric															0	0	0	0																						
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric															0	0	0	0																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric															0	0	0	0																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric															433	1300	1300	433																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric															433	1300	1300	433																						
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel															1733	5200	5200	1733																						
LS-Adit -D&S Mine & Line	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								
Launch Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																						433	1300																	
	50 ton RT Crane	3	diesel																						650	1950																	
	Robodrill Drill Jumbo 2-Boom		diesel																						0	0																	
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																						0	0																	
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																						217	650																	
	Loader Cat966/51k-lb/4cy	1	diesel																						217	650																	
	Dozer Cat D4/30k-lb		diesel																						0	0																	
	End Dump Cat730/31tn -23cy		diesel																						0	0																	
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																						0	0																	
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																						0	0																	
	Welder 400amp	2	diesel																						433	1300																	
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																						726	2178																	
	Compressor 1100cfm	1	diesel																						217	650																	
	Concrete Pump Trk -125ft	2	diesel																						433	1300																	
	Boom Truck 18tn	1	diesel																						217	650																	
Ungrnd -utility power	TBM & Trailing Plant		electric																						0	0																	
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																						0	0																	
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																						0	0																	
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																						0	0																	
Topside -utility power	Tun Ventilation Plnt -topside		electric																						0	0																	
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																						0	0																	
Park Road West Receiving																																											
RS -Shaft Site Setup & SOE	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel							650																																	
	50 ton RT Crane	1	diesel							650																																	
	Hyd Drill Soilmec 625/70ton	2	diesel							1300																																	
	Excavtr Cat320/50k-lb/1.6cy	1	diesel							650																																	
	Excavtr Cat313/30k-lb/0.7cy		diesel							0																																	
	Loader Cat966/51k-lb/4cy	1	diesel							650																																	
	Dozer Cat D4/30k-lb		diesel							0																																	
	End Dump Cat730/31tn -23cy	1	diesel							650																																	
	ICE 815 Vibro	1	diesel							650																																	
	ICE 160 Impact		diesel							0																																	
	Welder 400amp	2	diesel							1300																																	
	Compressor 375cfm	2	diesel							1300																																	
	Compressor 1100cfm		diesel							0																																	
	Concrete Pump Trk -125ft	1	diesel							650																																	
	Boom Truck 18tn	1	diesel							650																																	
RS -Shaft Excavation	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel								650	217																													
	50 ton RT Crane		diesel								0	0																													
	Robodrill Drill Jumbo 2-Boom	2	diesel								1300	433																													
	Excavtr Cat320/50k-lb/1.6cy	1	diesel								650	217																													
	Excavtr Cat313/30k-lb/0.7cy	1	diesel								650	217																													
	Loader Cat966/51k-lb/4cy	1	diesel								650	217																													
	Dozer Cat D4/30k-lb		diesel								0	0																													
	End Dump Cat730/31tn -23cy	1	diesel								650	217																													
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric								1300	433																													
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric								1300	433																													
	Welder 400amp	2	diesel								1300	433																													

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric								2178	726																															
	Compressor 1100cfm	1	diesel								650	217																															
	Concrete Pump Trk -125ft	1	diesel								650	217																															
	Boom Truck 18tn	1	diesel								650	217																															
Receive Shaft Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel									433	433																														
	50 ton RT Crane	2	diesel									867	867																														
	Robodrill Drill Jumbo 2-Boom		diesel									0	0																														
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric									867	867																														
	Excavtr Cat313/30k-lb/0.7cy	1	diesel									433	433																														
	Loader Cat966/51k-lb/4cy	1	diesel									433	433																														
	Dozer Cat D4/30k-lb		diesel									0	0																														
	End Dump Cat730/31tn -23cy		diesel									0	0																														
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric									433	433																														
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric									433	433																														
	Welder 400amp	2	diesel									867	867																														
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric									1452	1452																														
	Compressor 1100cfm	1	diesel									433	433																														
	Concrete Pump Trk -125ft	1	diesel									433	433																														
	Boom Truck 18tn	1	diesel									433	433																														
Ungrnd -utility power	TBM & Trailing Plant		electric									0	0																														
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric									0	0																														
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric									0	0																														
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric									0	0																														
Topside -utility power	Tun Ventilation Plnt -topside		electric									0	0																														
Ungrnd	Train-25tnLoco-w/3FltCars		diesel									0	0																														
TBM Tunnel Mining @ RS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel													433																											
	50 ton RT Crane	2	diesel													867																											
	Robodrill Drill Jumbo 2-Boom		diesel													0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric													867																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel													433																											
	Loader Cat966/51k-lb/4cy	1	diesel													433																											
	Dozer Cat D4/30k-lb		diesel													0																											
	End Dump Cat730/31tn -23cy	1	diesel													433																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric													0																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric													0																											
	Welder 400amp	2	diesel													867																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric													726																											
	Compressor 1100cfm	1	diesel													433																											
	Concrete Pump Trk -125ft	0	diesel													0																											
	Boom Truck 18tn	1	diesel													433																											
Ungrnd -utility power	TBM & Trailing Plant		electric													0																											
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric													0																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric													0																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric													0																											
Topside -utility power	Tun Ventilation Plnt -topside	1	electric													433																											
Ungrnd	Train-25tnLoco-w/3FltCars		diesel													0																											
Tunnel Conc Lining @ RS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																		433																						
	50 ton RT Crane	2	diesel																		867																						
	Robodrill Drill Jumbo 2-Boom		diesel																		0																						
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																		867																						
large shaft	Excavtr Cat313/30k-lb/0.7cy	1	diesel																		433																						
	Loader Cat966/51k-lb/4cy	1	diesel																		433																						
	Dozer Cat D4/30k-lb		diesel																		0																						
	End Dump Cat730/31tn -23cy		diesel																		0																						
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																		0																						
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																		0																						
	Welder 400amp	2	diesel																		867																						
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																		726																						
	Compressor 1100cfm	1	diesel																		433																						
	Concrete Pump Trk -125ft	2	diesel																		867																						
	Boom Truck 18tn	1	diesel																		433																						
Ungrnd -utility power	TBM & Trailing Plant		electric																		0																						
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																		0																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																		0																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																		433																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																		433																						
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																		1733																						
RS-Adit -D&S Mine & Line	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								
Receive Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																				1300	433																			
	50 ton RT Crane	2	diesel																				1300	433																			
	Robodrill Drill Jumbo 2-Boom		diesel																				0	0																			
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																				0	0																			
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																				650	217																			
	Loader Cat966/51k-lb/4cy	1	diesel																				650	217																			
	Dozer Cat D4/30k-lb		diesel																				0	0																			
	End Dump Cat730/31tn -23cy		diesel																				0	0																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																				0	0																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																				0	0																			
	Welder 400amp	2	diesel																				1300	433																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																				2178	726																			
	Compressor 1100cfm	1	diesel																				650	217																			
	Concrete Pump Trk -125ft	2	diesel																				1300	433																			
	Boom Truck 18tn	1	diesel																				650	217																			
Ungrnd -utility power	TBM & Trailing Plant		electric																				0	0																			
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																				0	0																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																				0	0																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																				0	0																			
Topside -utility power	Tun Ventilation Plnt -topside		electric																				0	0																			
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																				0	0																			

Alternative 4a -CP3

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Tandem Trailer Launching																																											
LS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel											1300																													
	50 ton RT Crane	1	diesel											1300																													
	Hyd Drill Soilmec 625/70ton	2	diesel											2600																													
	Excavtr Cat320/50k-lb/1.6cy	1	diesel											1300																													
	Excavtr Cat313/30k-lb/0.7cy		diesel											0																													
	Loader Cat966/51k-lb/4cy	1	diesel											1300																													
	Dozer Cat D4/30k-lb		diesel											0																													
	End Dump Cat730/31tn -23cy	1	diesel											1300																													
	ICE 815 Vibro	1	diesel											1300																													
	ICE 160 Impact		diesel											0																													
	Welder 400amp	2	diesel											2600																													
	Compressor 375cfm	2	diesel											2600																													
	Compressor 1100cfm		diesel											0																													
	Concrete Pump Trk -125ft	1	diesel											1300																													
	Boom Truck 18tn	1	diesel											1300																													
LS -Shaft Excavation	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel												65																												
	50 ton RT Crane		diesel												0																												
	Robodrill Drill Jumbo 2-Boom	2	diesel												130																												
	Excavtr Cat320/50k-lb/1.6cy	1	diesel												65																												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel												65																												
	Loader Cat966/51k-lb/4cy	1	diesel												65																												
	Dozer Cat D4/30k-lb		diesel												0																												
	End Dump Cat730/31tn -23cy	1	diesel												65																												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric												130																												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric												130																												
	Welder 400amp	2	diesel												130																												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric												218																												
	Compressor 1100cfm	1	diesel												65																												
	Concrete Pump Trk -125ft	1	diesel												65																												
	Boom Truck 18tn	1	diesel												65																												
TBM Launch/LS Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	2	diesel													2600																											
	50 ton RT Crane	2	diesel													2600																											
	Robodrill Drill Jumbo 2-Boom		diesel													0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric													2600																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel													1300																											
	Loader Cat966/51k-lb/4cy	1	diesel													650																											
	Dozer Cat D4/30k-lb		diesel													0																											
	End Dump Cat730/31tn -23cy		diesel													0																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric													1300																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric													1300																											
	Welder 400amp	2	diesel													2600																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric													2178																											
	Compressor 1100cfm	1	diesel													1300																											
	Concrete Pump Trk -125ft	2	diesel													1300																											
	Boom Truck 18tn	1	diesel													1300																											
Ungrnd -utility power	TBM & Trailing Plant	1	electric													0																											
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric													0																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric													0																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric													0																											
Topside -utility power	Tun Ventilation Plnt -topside	1	electric													0																											
Ungrnd	Train-25tnLoco-w/3FltCars	2	diesel													0																											
TBM Tunnel Mining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel														1300	1300	1300	1300	1300																						
	50 ton RT Crane	2	diesel														2600	2600	2600	2600	2600																						
	Robodrill Drill Jumbo 2-Boom		diesel														0	0	0	0	0																						
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric														2600	2600	2600	2600	2600																						
	Excavtr Cat313/30k-lb/0.7cy	1	diesel														1300	1300	1300	1300	1300																						
	Loader Cat966/51k-lb/4cy	1	diesel														1300	1300	1300	1300	1300																						
	Dozer Cat D4/30k-lb		diesel														0	0	0	0	0																						
	End Dump Cat730/31tn -23cy	1	diesel														1300	1300	1300	1300	1300																						
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric														0	0	0	0	0																						
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric														0	0	0	0	0																						
	Welder 400amp	2	diesel														2600	2600	2600	2600	2600																						
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric														2178	2178	2178	2178	2178																						
	Compressor 1100cfm	1	diesel														1300	1300	1300	1300	1300																						
	Concrete Pump Trk -125ft	0	diesel														0	0	0	0	0																						
	Boom Truck 18tn	1	diesel														1300	1300	1300	1300	1300																						
Ungrnd -utility power	TBM & Trailing Plant	1	electric														1300	1300	1300	1300	1300																						
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric														1300	1300	1300	1300	1300																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric														1300	1300	1300	1300	1300																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric														1300	1300	1300	1300	1300																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric														1300	1300	1300	1300	1300																						
Ungrnd	Train-25tnLoco-w/3FltCars	4	diesel														5200	5200	5200	5200	5200																						
Tunnel Conc Lining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																						433	1300	1300	1300	433														
	50 ton RT Crane	2	diesel																						867	2600	2600	2600	867														

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Robodrill Drill Jumbo 2-Boom		diesel																						0	0	0	0	0														
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																						867	2600	2600	2600	867														
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																						433	1300	1300	1300	433														
	Loader Cat966/51k-lb/4cy	1	diesel																						433	1300	1300	1300	433														
	Dozer Cat D4/30k-lb		diesel																						0	0	0	0	0														
	End Dump Cat730/31tn -23cy		diesel																						0	0	0	0	0														
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																						0	0	0	0	0														
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																						0	0	0	0	0														
	Welder 400amp	2	diesel																						867	2600	2600	2600	867														
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																						726	2178	2178	2178	726														
Large plant	Compressor 1100cfm	1	diesel																						433	1300	1300	1300	433														
	Concrete Pump Trk -125ft	2	diesel																						867	2600	2600	2600	867														
	Boom Truck 18tn	1	diesel																						433	1300	1300	1300	433														
Ungrnd -utility power	TBM & Trailing Plant		electric																						0	0	0	0	0														
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																						0	0	0	0	0														
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																						0	0	0	0	0														
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																						433	1300	1300	1300	433														
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																						433	1300	1300	1300	433														
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																						1733	5200	5200	5200	1733														
LS-Adit -D&S Mine & Line	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																					433	1300	1300	1300																
	50 ton RT Crane	1	diesel																					433	1300	1300	1300																
	Robodrill Drill Jumbo 2-Boom	1	diesel																					433	1300	1300	1300																
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																					867	2600	2600	2600																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																					433	1300	1300	1300																
	Loader Cat966/51k-lb/4cy	1	diesel																					433	1300	1300	1300																
	Dozer Cat D4/30k-lb		diesel																					0	0	0	0																
	End Dump Cat730/31tn -23cy	1	diesel																					433	1300	1300	1300																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																					433	1300	1300	1300																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																					433	1300	1300	1300																
	Welder 400amp	2	diesel																					867	2600	2600	2600																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																					726	2178	2178	2178																
	Compressor 1100cfm	1	diesel																					433	1300	1300	1300																
	Concrete Pump Trk -125ft	1	diesel																					433	1300	1300	1300																
	Boom Truck 18tn	1	diesel																					433	1300	1300	1300																
Ungrnd -utility power	TBM & Trailing Plant		electric																					0	0	0	0																
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																					0	0	0	0																
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																					0	0	0	0																
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																					433	1300	1300	1300																
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																					433	1300	1300	1300																
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																					433	1300	1300	1300																
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																					433	1300	1300	1300																
Launch Shaft Perm Lining	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	2	diesel																											1300	433												
	50 ton RT Crane	3	diesel																											1950	650												
	Robodrill Drill Jumbo 2-Boom		diesel																											0	0												
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																											0	0												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																											650	217												
	Loader Cat966/51k-lb/4cy	1	diesel																											650	217												
	Dozer Cat D4/30k-lb		diesel																											0	0												
	End Dump Cat730/31tn -23cy		diesel																											0	0												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																											0	0												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																											0	0												
	Welder 400amp	2	diesel																											1300	433												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																											2178	726												
	Compressor 1100cfm	1	diesel																											650	217												
	Concrete Pump Trk -125ft	2	diesel																											1300	433												
	Boom Truck 18tn	1	diesel																											650	217												
Ungrnd -utility power	TBM & Trailing Plant		electric																											0	0												
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																											0	0												
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																											0	0												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																											0	0												
Topside -utility power	Tun Ventilation Plnt -topside		electric																											0	0												
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																											0	0												
Fernald Property Receiving																																											
RS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel											217																													
	50 ton RT Crane	1	diesel											217																													
	Hyd Drill Soilmec 625/70ton	2	diesel											433																													
	Excavtr Cat320/50k-lb/1.6cy	1	diesel											217																													
	Excavtr Cat313/30k-lb/0.7cy		diesel											0																													
	Loader Cat966/51k-lb/4cy	1	diesel											217																													
	Dozer Cat D4/30k-lb		diesel											0																													
	End Dump Cat730/31tn -23cy	1	diesel											217																													
	ICE 815 Vibro	1	diesel											217																													
	ICE 160 Impact		diesel											0																													
	Welder 400amp	2	diesel											433																													
	Compressor 375cfm	2	diesel											433																													
	Compressor 1100cfm		diesel											0																													
	Concrete Pump Trk -125ft	1	diesel											217																													
	Boom Truck 18tn	1	diesel											217																													

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
RS -Shaft Excavation	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel												650																												
	50 ton RT Crane		diesel												0																												
	Robodrill Drill Jumbo 2-Boom	2	diesel												1300																												
	Excavtr Cat320/50k-lb/1.6cy	1	diesel												650																												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel												650																												
	Loader Cat966/51k-lb/4cy	1	diesel												650																												
	Dozer Cat D4/30k-lb		diesel												0																												
	End Dump Cat730/31tn -23cy	1	diesel												650																												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric												1300																												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric												1300																												
	Welder 400amp	2	diesel												1300																												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric												2178																												
	Compressor 1100cfm	1	diesel												650																												
	Concrete Pump Trk -125ft	1	diesel												650																												
	Boom Truck 18tn	1	diesel												650																												
Receive Shaft Temp Works	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel													650																											
	50 ton RT Crane	2	diesel													1300																											
	Robodrill Drill Jumbo 2-Boom		diesel													0																											
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric													1300																											
	Excavtr Cat313/30k-lb/0.7cy	1	diesel													650																											
	Loader Cat966/51k-lb/4cy	1	diesel													650																											
	Dozer Cat D4/30k-lb		diesel													0																											
	End Dump Cat730/31tn -23cy		diesel													0																											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric													650																											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric													650																											
	Welder 400amp	2	diesel													1300																											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric													2178																											
	Compressor 1100cfm	1	diesel													650																											
	Concrete Pump Trk -125ft	1	diesel													650																											
	Boom Truck 18tn	1	diesel													650																											
Ungrnd -utility power	TBM & Trailing Plant		electric													0																											
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric													0																											
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric													0																											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric													0																											
Topside -utility power	Tun Ventilation Plnt -topside		electric													0																											
Ungrnd	Train-25tnLoco-w/3FltCars		diesel													0																											
TBM Tunnel Mining @ RS	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel																		433																						
	50 ton RT Crane	2	diesel																		867																						
	Robodrill Drill Jumbo 2-Boom		diesel																		0																						
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																		867																						
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																		433																						
	Loader Cat966/51k-lb/4cy	1	diesel																		433																						
	Dozer Cat D4/30k-lb		diesel																		0																						
	End Dump Cat730/31tn -23cy	1	diesel																		433																						
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																		0																						
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																		0																						
	Welder 400amp	2	diesel																		867																						
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																		726																						
	Compressor 1100cfm	1	diesel																		433																						
	Concrete Pump Trk -125ft	0	diesel																		0																						
	Boom Truck 18tn	1	diesel																		433																						
Ungrnd -utility power	TBM & Trailing Plant		electric																		0																						
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																		0																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																		0																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																		0																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																		433																						
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																		0																						
Tunnel Conc Lining @ RS	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel																											433													
	50 ton RT Crane	2	diesel																											867													
	Robodrill Drill Jumbo 2-Boom		diesel																											0													
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																											867													
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																											433													
	Loader Cat966/51k-lb/4cy	1	diesel																											433													
	Dozer Cat D4/30k-lb		diesel																											0													
	End Dump Cat730/31tn -23cy		diesel																											0													
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																											0													
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																											0													
	Welder 400amp	2	diesel																											867													
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																											726													
large plant	Compressor 1100cfm	1	diesel																											433													
	Concrete Pump Trk -125ft	2	diesel																											867													
	Boom Truck 18tn	1	diesel																											433													
Ungrnd -utility power	TBM & Trailing Plant		electric																											0													
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																											0													
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																											0													
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																											433													
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																											433													

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																										1733														
RS-Adit -D&S Mine & Line	wrk days per quarter >	65																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																								
Receive Shaft Perm Lining	wrk days per quarter >	65																																									
	220 ton Crawler Crane	2	diesel																												1300												
	50 ton RT Crane	2	diesel																												1300												
	Robodrill Drill Jumbo 2-Boom		diesel																												0												
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																												0												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																												650												
	Loader Cat966/51k-lb/4cy	1	diesel																												650												
	Dozer Cat D4/30k-lb		diesel																												0												
	End Dump Cat730/31tn -23cy		diesel																												0												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																												0												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																												0												
	Welder 400amp	2	diesel																												1300												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																												2178												
	Compressor 1100cfm	1	diesel																												650												
	Concrete Pump Trk -125ft	2	diesel																												1300												
	Boom Truck 18tn	1	diesel																												650												
Ungrnd -utility power	TBM & Trailing Plant		electric																												0												
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																												0												
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																												0												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																												0												
Topside -utility power	Tun Ventilation Plnt -topside		electric																												0												
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																												0												
Park Road East Connecting																																											
Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CSS -Shaft Site Setup & SOE	wrk days per quarter >	65																																									
	220 ton Crawler Crane	1	diesel																								217																
	50 ton RT Crane	1	diesel																								217																
	Raisebore Equip	1	diesel																								217																
	Excavtr Cat320/50k-lb/1.6cy	1	diesel																								217																
	Excavtr Cat313/30k-lb/0.7cy		diesel																								0																
	Loader Cat966/51k-lb/4cy	1	diesel																								217																
	Dozer Cat D4/30k-lb		diesel																								0																
	End Dump Cat730/31tn -23cy		diesel																								0																
	ICE 815 Vibro	1	diesel																								217																
	ICE 160 Impact		diesel																								0																
	Welder 400amp	2	diesel																								433																
	Compressor 375cfm	2	diesel																								433																
	Compressor 1100cfm		diesel																								0																
	Concrete Pump Trk -125ft	1	diesel																								217																
	Boom Truck 18tn	1	diesel																								217																
CS -Shaft Ex/Raise Drilling	wrk days per quarter >	65																																									
	220 ton Crawler Crane	1	diesel																									650															
	50 ton RT Crane	1	diesel																									650															
	Raisebore Equip	1	diesel																									650															
	Excavtr Cat320/50k-lb/1.6cy	1	diesel																									650															
	Excavtr Cat313/30k-lb/0.7cy		diesel																									0															
	Loader Cat966/51k-lb/4cy	1	diesel																									650															
	Dozer Cat D4/30k-lb		diesel																									0															
	End Dump Cat730/31tn -23cy		diesel																									0															
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																									0															
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																									0															
	Welder 400amp	2	diesel																									1300															
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																									2178															
	Compressor 1100cfm	1	diesel																									650															
	Concrete Pump Trk -125ft		diesel																									0															
	Boom Truck 18tn	1	diesel																									650															

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Connect Shaft Temp Works	*wrk days per quarter >*	65																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	2	diesel																																								
	Robodrill Drill Jumbo 2-Boom		diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy		diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																																								
Topside -utility power	Tun Ventilation Plnt -topside		electric																																								
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																																								
TBM Mining @Connect Shft	*wrk days per quarter >*	65																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	2	diesel																																								
	Robodrill Drill Jumbo 2-Boom		diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	0	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																																								
Tunnel Conc Lining @ CS	*wrk days per quarter >*	65																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	2	diesel																																								
	Robodrill Drill Jumbo 2-Boom		diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
Large plant	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy		diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	2	diesel																																								
	Boom Truck 18tn	1	diesel																																								
Ungrnd -utility power	TBM & Trailing Plant		electric																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																								
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																								
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																																								
CS-Adit -D&S Mine & Line	*wrk days per quarter >*	65																																									
	220 ton Crawler Crane	1	diesel																																								
	50 ton RT Crane	1	diesel																																								
	Robodrill Drill Jumbo 2-Boom	1	diesel																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																								
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																								
	Loader Cat966/51k-lb/4cy	1	diesel																																								
	Dozer Cat D4/30k-lb		diesel																																								
	End Dump Cat730/31tn -23cy	1	diesel																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																								
	Welder 400amp	2	diesel																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																								
	Compressor 1100cfm	1	diesel																																								
	Concrete Pump Trk -125ft	1	diesel																																								

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Boom Truck 18tn	1	diesel																																						
Ungrnd -utility power	TBM & Trailing Plant		electric																																						
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																						
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																						
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																						
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																						
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																						
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																						
Connect Shaft Perm Lining	***wrk days per quarter >***	***65***																																							
	220 ton Crawler Crane		diesel																									0													
	50 ton RT Crane	1	diesel																									217													
	Robodrill Drill Jumbo 2-Boom		diesel																									0													
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																									0													
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																									217													
	Loader Cat966/51k-lb/4cy	1	diesel																									217													
	Dozer Cat D4/30k-lb		diesel																									0													
	End Dump Cat730/31tn -23cy		diesel																									0													
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																									0													
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																									0													
	Welder 400amp	2	diesel																									433													
24/7 Topside -utility power	Shaft/Tunnel Pump System		electric																									0													
	Compressor 1100cfm	1	diesel																									217													
	Concrete Pump Trk -125ft	1	diesel																									217													
	Boom Truck 18tn	1	diesel																									217													
Ungrnd -utility power	TBM & Trailing Plant		electric																									0													
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																									0													
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																									0													
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																									0													
Topside -utility power	Tun Ventilation Plnt -topside		electric																									0													
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																									0													

Alternative 10 -CP1

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching																																																
LS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	650			650																																					
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	650			650																																					
	Hyd Drill Soilmec 625/70ton	2	1	diesel	408	2	eqp hrs	1300			1300																																					
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	650			650																																					
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0			0																																					
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	650			650																																					
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0			0																																					
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	650			650																																					
	ICE 815 Vibro	1	1	diesel	505	1	eqp hrs	650			650																																					
	ICE 160 Impact			diesel	220	0	eqp hrs	0			0																																					
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1300			1300																																					
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	1300			1300																																					
	Compressor 1100cfm			diesel	475	0	eqp hrs	0			0																																					
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	650			650																																					
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	650			650																																					
LS -Shaft Excavation	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	650				650																																				
	50 ton RT Crane			diesel	175	0	eqp hrs	0				0																																				
	Robodrill Drill Jumbo 2-Boom	2	1	diesel	65	2	eqp hrs	1300				1300																																				
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	650				650																																				
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	650				650																																				
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	650				650																																				
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0				0																																				
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	650				650																																				
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	1	electric	125	2	eqp hrs	1300				1300																																				
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	1	electric	100	2	eqp hrs	1300				1300																																				
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1300				1300																																				
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2178				2178																																				
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	650				650																																				
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	650				650																																				
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	650				650																																				
TBM Launch/LS Temp Works	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	2	2	diesel	340	4	eqp hrs	2600					2600																																			
	50 ton RT Crane	2	2	diesel	175	4	eqp hrs	2600					2600																																			
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0					0																																			
Topside -utility power	Shotcrete&Grout Batch Plnts	2	2	electric	300	4	eqp hrs	2600					2600																																			
	Excavtr Cat313/30k-lb/0.7cy	1	2	diesel	108	2	eqp hrs	1300					1300																																			
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	650					650																																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0					0																																			
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0					0																																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	2	electric	125	2	eqp hrs	1300					1300																																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	2	electric	100	2	eqp hrs	1300					1300																																			
	Welder 400amp	2	2	diesel	25	4	eqp hrs	2600					2600																																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2178					2178																																			
	Compressor 1100cfm	1	2	diesel	475	2	eqp hrs	1300					1300																																			
	Concrete Pump Trk -125ft	2	1	diesel	425	2	eqp hrs	1300					1300																																			
	Boom Truck 18tn	1	2	diesel	350	2	eqp hrs	1300					1300																																			
Ungrnd -utility power	TBM & Trailing Plant	1		electric	3455	0	eqp hrs	0					0																																			
Ungrnd -utility power	TBM Tun Horiz Conveyor	1		electric	2050	0	eqp hrs	0					0																																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1		electric	500	0	eqp hrs	0					0																																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	6000	0	eqp hrs	0					0																																			
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0					0																																			
Ungrnd	Train-25tnLoco-w/3FltCars	2		diesel	305	0	eqp hrs	0					0																																			
TBM Tunnel Mining @ LS	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	1	2	diesel	340	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
	50 ton RT Crane	2	2	diesel	175	4	eqp hrs	23400						2600	2600	2600	2600	2600	2600	2600	2600	2600																										
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0						0	0	0	0	0	0	0	0	0																										
Topside -utility power	Shotcrete&Grout Batch Plnts	2	2	electric	300	4	eqp hrs	23400						2600	2600	2600	2600	2600	2600	2600	2600	2600																										
self contained on-site - premix /small	Excavtr Cat313/30k-lb/0.7cy	1	2	diesel	108	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
	Loader Cat966/51k-lb/4cy	1	2	diesel	321	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0						0	0	0	0	0	0	0	0	0																										
	End Dump Cat730/31tn -23cy	1	2	diesel	370	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0						0	0	0	0	0	0	0	0	0																										
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0						0	0	0	0	0	0	0	0	0																										
	Welder 400amp	2	2	diesel	25	4	eqp hrs	23400						2600	2600	2600	2600	2600	2600	2600	2600	2600																										
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	19598						2178	2178	2178	2178	2178	2178	2178	2178	2178																										
	Compressor 1100cfm	1	2	diesel	475	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
	Concrete Pump Trk -125ft	0	0	diesel	425	0	eqp hrs	0						0	0	0	0	0	0	0	0	0																										
	Boom Truck 18tn	1	2	diesel	350	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
Ungrnd -utility power	TBM & Trailing Plant	1	2	electric	3455	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	2	electric	2050	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	2	electric	500	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	2	electric	6000	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
Topside -utility power	Tun Ventilation Plnt -topside	1	2	electric	200	2	eqp hrs	11700						1300	1300	1300	1300	1300	1300	1300	1300	1300																										
Ungrnd	Train-25tnLoco-w/3FltCars	4	2	diesel	305	8	eqp hrs	46800						5200	5200	5200	5200	5200	5200	5200	5200	5200																										
Tunnel Conc Lining @ LS min batch plant	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	1	2	diesel	340	2	eqp hrs	9100																						1300	1300	1300	1300	1300	1300	1300												
	50 ton RT Crane	2	2	diesel	175	4	eqp hrs	18200																						2600	2600	2600	2600	2600	2600	2600												
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0																						0	0	0	0	0	0	0												
Topside -utility power	Shotcrete&Grout Batch Plnts	2	2	electric	300	4	eqp hrs	18200																						2600	2600	2600	2600	2600	2600	2600												
Large batch plant	Excavtr Cat313/30k-lb/0.7cy	1	2	diesel	108	2	eqp hrs	9100																						1300	1300	1300	1300	1300	1300	1300												
	Loader Cat966/51k-lb/4cy	1	2	diesel	321	2	eqp hrs	9100																						1300	1300	1300	1300	1300	1300	1300												
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																						0	0	0	0	0	0	0												
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																						0	0	0	0	0	0	0												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																						0	0	0	0	0	0	0												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																						0	0	0	0	0	0	0												
	Welder 400amp	2	2	diesel	25	4	eqp hrs	18200																						2600	2600	2600	2600	2600	2600	2600												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	15243																						2178	2178	2178	2178	2178	2178	2178												
	Compressor 1100cfm	1	2	diesel	475	2	eqp hrs	9100																						1300	1300	1300	1300	1300	1300	1300												
	Concrete Pump Trk -125ft	2	2	diesel	425	4	eqp hrs	18200																						2600	2600	2600	2600	2600	2600	2600												
	Boom Truck 18tn	1	2	diesel	350	2	eqp hrs	9100																						1300	1300	1300	1300	1300	1300	1300												
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																						0	0	0	0	0	0	0												
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																						0	0	0	0	0	0	0												
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																						0	0	0	0	0	0	0												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	2	electric	6000	2	eqp hrs	9100																						1300	1300	1300	1300	1300	1300	1300												
Topside -utility power	Tun Ventilation Plnt -topside	1	2	electric	200	2	eqp hrs	9100																						1300	1300	1300	1300	1300	1300	1300												
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	2	diesel	305	8	eqp hrs	36400																						5200	5200	5200	5200	5200	5200	5200												
LS-Adit -D&S Mine & Line	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																								
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0																																								

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0																																							
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0																																							
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0																																							
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0																																							
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																																							
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0																																							
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0																																							
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0																																							
	Welder 400amp	2		diesel	25	0	eqp hrs	0																																							
24/7 Topside -utility power	Shaft/Tunnel Pump System		3.35	electric	250	0	eqp hrs	0																																							
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0																																							
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0																																							
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0																																							
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																																							
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0																																							
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0																																							
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0																																							
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0																																							
Launch Shaft Perm Lining	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
	220 ton Crawler Crane	2	1	diesel	340	2	eqp hrs	1733																													433	1300										
	50 ton RT Crane	3	1	diesel	175	3	eqp hrs	2600																													650	1950										
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0																													0	0										
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																													0	0										
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	867																													217	650										
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	867																													217	650										
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																													0	0										
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																													0	0										
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																													0	0										
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																													0	0										
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1733																													433	1300										
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2903																													726	2178										
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	867																													217	650										
	Concrete Pump Trk -125ft	2	1	diesel	425	2	eqp hrs	1733																													433	1300										
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	867																													217	650										
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																													0	0										
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																													0	0										
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																													0	0										
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																													0	0										
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																													0	0										
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																													0	0										
Fernald Property Receiving																																																
RS -Shaft Site Setup & SOE	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217			217																																				
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217			217																																				
	Hyd Drill Soilmec 625/70ton	2	1	diesel	408	2	eqp hrs	433			433																																				
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217			217																																				
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0			0																																				
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217			217																																				
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0			0																																				
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	217			217																																				
	ICE 815 Vibro	1	1	diesel	505	1	eqp hrs	217			217																																				
	ICE 160 Impact			diesel	220	0	eqp hrs	0			0																																				
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433			433																																				
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	433			433																																				
	Compressor 1100cfm			diesel	475	0	eqp hrs	0			0																																				
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217			217																																				
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217			217																																				
RS -Shaft Excavation	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	650				650																																			
	50 ton RT Crane			diesel	175	0	eqp hrs	0				0																																			
	Robodrill Drill Jumbo 2-Boom	2	1	diesel	65	2	eqp hrs	1300				1300																																			
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	650				650																																			
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	650				650																																			
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	650				650																																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0				0																																			
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	650				650																																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	1	electric	125	2	eqp hrs	1300				1300																																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	1	electric	100	2	eqp hrs	1300				1300																																			
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1300				1300																																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2178				2178																																			
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	650				650																																			
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	650				650																																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	650				650																																			
Receive Shaft Temp Works	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	650					650																																		
	50 ton RT Crane	2	1	diesel	175	2	eqp hrs	1300					1300																																		
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0					0																																		
Topside -utility power	Shotcrete&Grout Batch Plnts	2	1	electric	300	2	eqp hrs	1300					1300																																		
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	650					650																																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	650					650																																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0					0																																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0					0																																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	1	electric	125	1	eqp hrs	650					650																																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	1	electric	100	1	eqp hrs	650					650																																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1300					1300																																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2178					2178																																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	650					650																																		
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	650					650																																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	650					650																																		
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0					0																																		
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0					0																																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0					0																																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0					0																																		
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0					0																																		
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0					0																																		
TBM Tunnel Mining @ RS	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
	220 ton Crawler Crane	1	2	diesel	340	2	eqp hrs	433																				433																			
	50 ton RT Crane	2	2	diesel	175	4	eqp hrs	867																				867																			
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0																				0																			
Topside -utility power	Shotcrete&Grout Batch Plnts	2	2	electric	300	4	eqp hrs	867																				867																			
	Excavtr Cat313/30k-lb/0.7cy	1	2	diesel	108	2	eqp hrs	433																				433																			

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Loader Cat966/51k-lb/4cy	1	2	diesel	321	2	eqp hrs	433																				433																				
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																				0																				
	End Dump Cat730/31tn -23cy	1	2	diesel	370	2	eqp hrs	433																				433																				
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																				0																				
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																				0																				
	Welder 400amp	2	2	diesel	25	4	eqp hrs	867																				867																				
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																				726																				
	Compressor 1100cfm	1	2	diesel	475	2	eqp hrs	433																				433																				
	Concrete Pump Trk -125ft	0	0	diesel	425	0	eqp hrs	0																				0																				
	Boom Truck 18tn	1	2	diesel	350	2	eqp hrs	433																				433																				
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																				0																				
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																				0																				
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																				0																				
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																				0																				
Topside -utility power	Tun Ventilation Plnt -topside	1	2	electric	200	2	eqp hrs	433																				433																				
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																				0																				
Tunnel Conc Lining @ RS	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	1	2	diesel	340	2	eqp hrs	433																												433												
	50 ton RT Crane	2	2	diesel	175	4	eqp hrs	867																												867												
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0																												0												
Topside -utility power	Shotcrete&Grout Batch Plnts	2	2	electric	300	4	eqp hrs	867																												867												
	Excavtr Cat313/30k-lb/0.7cy	1	2	diesel	108	2	eqp hrs	433																												433												
	Loader Cat966/51k-lb/4cy	1	2	diesel	321	2	eqp hrs	433																												433												
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																												0												
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																												0												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																												0												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																												0												
	Welder 400amp	2	2	diesel	25	4	eqp hrs	867																												867												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																												726												
	Compressor 1100cfm	1	2	diesel	475	2	eqp hrs	433																												433												
	Concrete Pump Trk -125ft	2	2	diesel	425	4	eqp hrs	867																												867												
	Boom Truck 18tn	1	2	diesel	350	2	eqp hrs	433																												433												
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																												0												
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																												0												
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																												0												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	2	electric	6000	2	eqp hrs	433																												433												
Topside -utility power	Tun Ventilation Plnt -topside	1	2	electric	200	2	eqp hrs	433																												433												
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	2	diesel	305	8	eqp hrs	1733																												1733												
RS-Adit -D&S Mine & Line	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																								
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0																																								
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0																																								
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0																																								
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0																																								
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																																								
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0																																								
	Welder 400amp	2		diesel	25	0	eqp hrs	0																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1		electric	250	0	eqp hrs	0																																								
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0																																								
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0																																								
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0																																								
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0																																								
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0																																								
Receive Shaft Perm Lining	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	2	1	diesel	340	2	eqp hrs	1300																													1300											
	50 ton RT Crane	2	1	diesel	175	2	eqp hrs	1300																													1300											
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0																													0											
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																													0											
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	650																													650											
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	650																													650											
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																													0											
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																													0											
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																													0											
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																													0											
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1300																													1300											
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2178																													2178											
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	650																													650											
	Concrete Pump Trk -125ft	2	1	diesel	425	2	eqp hrs	1300																													1300											
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	650																													650											
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																													0											
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																													0											
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																													0											
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																													0											
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																													0											
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																													0											

Park Road West Large Connection

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CSS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																								
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	433				433																																				
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	433				433																																				
	Hyd Drill Soilmec 625/70ton	2	1	diesel	408	2	eqp hrs	867				867																																				
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	433				433																																				
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0				0																																				
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	433				433																																				
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0				0																																				
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	433				433																																				
	ICE 815 Vibro	1	1	diesel	505	1	eqp hrs	433				433																																				
	ICE 160 Impact			diesel	220	0	eqp hrs	0				0																																				
	Welder 400amp	2	1	diesel	25	2	eqp hrs	867				867																																				
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	867				867																																				
	Compressor 1100cfm			diesel	475	0	eqp hrs	0				0																																				
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	433				433																																				
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	433				433																																				

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CS -Shaft Excavation	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	433					433																																		
	50 ton RT Crane			diesel	175	0	eqp hrs	0					0																																		
	Robodrill Drill Jumbo 2-Boom	2	1	diesel	65	2	eqp hrs	867					867																																		
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	433					433																																		
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	433					433																																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	433					433																																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0					0																																		
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	433					433																																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	1	electric	125	2	eqp hrs	867					867																																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	1	electric	100	2	eqp hrs	867					867																																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	867					867																																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	1452					1452																																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	433					433																																		
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	433					433																																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	433					433																																		
Connect Shaft Temp Works	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	650						650																																	
	50 ton RT Crane	2	1	diesel	175	2	eqp hrs	1300						1300																																	
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0						0																																	
Topside -utility power	Shotcrete&Grout Batch Plnts	2	1	electric	300	2	eqp hrs	1300						1300																																	
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	650						650																																	
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	650						650																																	
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0						0																																	
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0						0																																	
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	1	electric	125	1	eqp hrs	650						650																																	
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	1	electric	100	1	eqp hrs	650						650																																	
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1300						1300																																	
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2178						2178																																	
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	650						650																																	
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	650						650																																	
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	650						650																																	
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0						0																																	
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0						0																																	
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0						0																																	
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0						0																																	
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0						0																																	
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0						0																																	
TBM Mining @Connect Shft	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	2	diesel	340	2	eqp hrs	433									433																														
	50 ton RT Crane	2	2	diesel	175	4	eqp hrs	867									867																														
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0									0																														
Topside -utility power	Shotcrete&Grout Batch Plnts	2	2	electric	300	4	eqp hrs	867									867																														
	Excavtr Cat313/30k-lb/0.7cy	1	2	diesel	108	2	eqp hrs	433									433																														
	Loader Cat966/51k-lb/4cy	1	2	diesel	321	2	eqp hrs	433									433																														
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0									0																														
	End Dump Cat730/31tn -23cy	1	2	diesel	370	2	eqp hrs	433									433																														
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0									0																														
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0									0																														
	Welder 400amp	2	2	diesel	25	4	eqp hrs	867									867																														
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726									726																														
	Compressor 1100cfm	1	2	diesel	475	2	eqp hrs	433									433																														
	Concrete Pump Trk -125ft	0	0	diesel	425	0	eqp hrs	0									0																														
	Boom Truck 18tn	1	2	diesel	350	2	eqp hrs	433									433																														
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0									0																														
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0									0																														
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0									0																														
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0									0																														
Topside -utility power	Tun Ventilation Plnt -topside	1	2	electric	200	2	eqp hrs	433									433																														
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0									0																														
Tunnel Conc Lining @ CS	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	2	diesel	340	2	eqp hrs	433																										433															
	50 ton RT Crane	2	2	diesel	175	4	eqp hrs	867																										867															
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0																										0															
Topside -utility power	Shotcrete&Grout Batch Plnts	2	2	electric	300	4	eqp hrs	867																										867															
	Excavtr Cat313/30k-lb/0.7cy	1	2	diesel	108	2	eqp hrs	433																										433															
	Loader Cat966/51k-lb/4cy	1	2	diesel	321	2	eqp hrs	433																										433															
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																										0															
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																										0															
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																										0															
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																										0															
	Welder 400amp	2	2	diesel	25	4	eqp hrs	867																										867															
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																										726															
	Compressor 1100cfm	1	2	diesel	475	2	eqp hrs	433																										433															
	Concrete Pump Trk -125ft	2	2	diesel	425	4	eqp hrs	867																										867															
	Boom Truck 18tn	1	2	diesel	350	2	eqp hrs	433																										433															
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																										0															
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																										0															
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																										0															
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	2	electric	6000	2	eqp hrs	433																										433															
Topside -utility power	Tun Ventilation Plnt -topside	1	2	electric	200	2	eqp hrs	433																										433															
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	2	diesel	305	8	eqp hrs	1733																										1733															
CS-Adit -D&S Mine & Line	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																							
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0																																							
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0																																							
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0																																							
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0																																							
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0																																							
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																																							
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0																																							
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0																																							
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0																																							
	Welder 400amp	2		diesel	25	0	eqp hrs	0																																							
24/7 Topside -utility power	Shaft/Tunnel Pump System	1		electric	250	0	eqp hrs	0																																							
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0																																							
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0																																							
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0																																							
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																																							
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0																																							
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0																																							

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0																																								
Connect Shaft Perm Lining	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																								
	220 ton Crawler Crane	2	1	diesel	340	2	eqp hrs	1733																													1300	433										
	50 ton RT Crane	2	1	diesel	175	2	eqp hrs	1733																													1300	433										
	Robodrill Drill Jumbo 2-Boom			diesel	65	0	eqp hrs	0																													0	0										
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																													0	0										
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	867																													650	217										
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	867																													650	217										
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																													0	0										
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																													0	0										
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																													0	0										
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																													0	0										
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1733																													1300	433										
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2903																													2178	726										
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	867																													650	217										
	Concrete Pump Trk -125ft	2	1	diesel	425	2	eqp hrs	1733																													1300	433										
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	867																													650	217										
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																													0	0										
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																													0	0										
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																													0	0										
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																													0	0										
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																													0	0										
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																													0	0										

Alternative 10 -CP2

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching																																											
LS -Shaft Site Setup & SOE	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel							650																																	
	50 ton RT Crane	1	diesel							650																																	
	Hyd Drill Soilmec 625/70ton	2	diesel							1300																																	
	Excavtr Cat320/50k-lb/1.6cy	1	diesel							650																																	
	Excavtr Cat313/30k-lb/0.7cy		diesel							0																																	
	Loader Cat966/51k-lb/4cy	1	diesel							650																																	
	Dozer Cat D4/30k-lb		diesel							0																																	
	End Dump Cat730/31tn -23cy	1	diesel							650																																	
	ICE 815 Vibro	1	diesel							650																																	
	ICE 160 Impact		diesel							0																																	
	Welder 400amp	2	diesel							1300																																	
	Compressor 375cfm	2	diesel							1300																																	
	Compressor 1100cfm		diesel							0																																	
	Concrete Pump Trk -125ft	1	diesel							650																																	
	Boom Truck 18tn	1	diesel							650																																	
LS -Shaft Excavation	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel								650																																
	50 ton RT Crane		diesel								0																																
	Robodrill Drill Jumbo 2-Boom	2	diesel								1300																																
	Excavtr Cat320/50k-lb/1.6cy	1	diesel								650																																
	Excavtr Cat313/30k-lb/0.7cy	1	diesel								650																																
	Loader Cat966/51k-lb/4cy	1	diesel								650																																
	Dozer Cat D4/30k-lb		diesel								0																																
	End Dump Cat730/31tn -23cy	1	diesel								650																																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric								1300																																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric								1300																																
	Welder 400amp	2	diesel								1300																																
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric								2178																																
	Compressor 1100cfm	1	diesel								650																																
	Concrete Pump Trk -125ft	1	diesel								650																																
	Boom Truck 18tn	1	diesel								650																																
TBM Launch/LS Temp Works	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	2	diesel									2600																													
	50 ton RT Crane	2	diesel									2600																													
	Robodrill Drill Jumbo 2-Boom		diesel									0																													
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric									2600																													
	Excavtr Cat313/30k-lb/0.7cy	1	diesel									1300																													
	Loader Cat966/51k-lb/4cy	1	diesel									650																													
	Dozer Cat D4/30k-lb		diesel									0																													
	End Dump Cat730/31tn -23cy		diesel									0																													
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric									1300																													
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric									1300																													
	Welder 400amp	2	diesel									2600																													
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric									2178																													
	Compressor 1100cfm	1	diesel									1300																													
	Concrete Pump Trk -125ft	2	diesel									1300																													
	Boom Truck 18tn	1	diesel									1300																													
Ungrnd -utility power	TBM & Trailing Plant	1	electric									0																													
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric									0																													
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric									0																													
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric									0																													
Topside -utility power	Tun Ventilation Plnt -topside	1	electric									0																													
Ungrnd	Train-25tnLoco-w/3FltCars	2	diesel									0																													
TBM Tunnel Mining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel										1300	1300	1300	1300	1300	1300	1300	433																							
	50 ton RT Crane	2	diesel										2600	2600	2600	2600	2600	2600	2600	867																							
	Robodrill Drill Jumbo 2-Boom		diesel										0	0	0	0	0	0	0	0																							
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric										2600	2600	2600	2600	2600	2600	2600	867																							
	Excavtr Cat313/30k-lb/0.7cy	1	diesel										1300	1300	1300	1300	1300	1300	1300	433																							
	Loader Cat966/51k-lb/4cy	1	diesel										1300	1300	1300	1300	1300	1300	1300	433																							
	Dozer Cat D4/30k-lb		diesel										0	0	0	0	0	0	0	0																							
	End Dump Cat730/31tn -23cy	1	diesel										1300	1300	1300	1300	1300	1300	1300	433																							
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric										0	0	0	0	0	0	0	0																							
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric										0	0	0	0	0	0	0	0																							
	Welder 400amp	2	diesel										2600	2600	2600	2600	2600	2600	2600	867																							
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric										2178	2178	2178	2178	2178	2178	2178	726																							
	Compressor 1100cfm	1	diesel										1300	1300	1300	1300	1300	1300	1300	433																							
	Concrete Pump Trk -125ft	0	diesel										0	0	0	0	0	0	0	0																							
	Boom Truck 18tn	1	diesel										1300	1300	1300	1300	1300	1300	1300	433																							
Ungrnd -utility power	TBM & Trailing Plant	1	electric										1300	1300	1300	1300	1300	1300	1300	433																							
Ungrnd -utility power	TBM Tun Horiz Conveyor	1	electric										1300	1300	1300	1300	1300	1300	1300	433																							
Ungrnd -utility power	TBM Shaft Vertical Conveyor	1	electric										1300	1300	1300	1300	1300	1300	1300	433																							
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric										1300	1300	1300	1300	1300	1300	1300	433																							
Topside -utility power	Tun Ventilation Plnt -topside	1	electric										1300	1300	1300	1300	1300	1300	1300	433																							
Ungrnd	Train-25tnLoco-w/3FltCars	4	diesel										5200	5200	5200	5200	5200	5200	5200	1733																							
Tunnel Conc Lining @ LS	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																					433	1300	1300	1300	1300	1300														
	50 ton RT Crane	2	diesel																					867	2600	2600	2600	2600	2600														
	Robodrill Drill Jumbo 2-Boom		diesel																					0	0	0	0	0	0														
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																					867	2600	2600	2600	2600	2600														
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																					433	1300	1300	1300	1300	1300														
	Loader Cat966/51k-lb/4cy	1	diesel																					433	1300	1300	1300	1300	1300														
	Dozer Cat D4/30k-lb		diesel																					0	0	0	0	0	0														
	End Dump Cat730/31tn -23cy		diesel																					0	0	0	0	0	0														
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																					0	0	0	0	0	0														
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																					0	0	0	0	0	0														
	Welder 400amp	2	diesel																					867	2600	2600	2600	2600	2600														
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																					726	2178	2178	2178	2178	2178														
	Compressor 1100cfm	1	diesel																					433	1300	1300	1300	1300	1300														
	Concrete Pump Trk -125ft	2	diesel																					867	2600	2600	2600	2600	2600														
	Boom Truck 18tn	1	diesel																					433	1300	1300	1300	1300	1300														
Ungrnd -utility power	TBM & Trailing Plant		electric																					0	0	0	0	0	0														
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																					0	0	0	0	0	0														
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																					0	0	0	0	0	0														
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																					433	1300	1300	1300	1300	1300														
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																					433	1300	1300	1300	1300	1300														
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																					1733	5200	5200	5200	5200	5200														
LS- D&S Adit -Highland NE to NW -D&S Min	*wrk days per quarter >*	*65*																																									
	220 ton Crawler Crane	1	diesel																			1300	1300																				
	50 ton RT Crane	1	diesel																			1300	1300																				
	Robodrill Drill Jumbo 2-Boom	1	diesel																			1300	1300																				
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																			2600	2600																				
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																			1300	1300																				

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Loader Cat966/51k-lb/4cy	1	diesel																			1300	1300																				
	Dozer Cat D4/30k-lb		diesel																			0	0																				
	End Dump Cat730/31tn -23cy	1	diesel																			650	650																				
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																			1300	1300																				
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																			1300	1300																				
	Welder 400amp	2	diesel																			2600	2600																				
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																			2178	2178																				
	Compressor 1100cfm	1	diesel																			1300	1300																				
	Concrete Pump Trk -125ft	1	diesel																			650	650																				
	Boom Truck 18tn	1	diesel																			1300	1300																				
Ungrnd -utility power	TBM & Trailing Plant		electric																			0	0																				
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																			0	0																				
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																			0	0																				
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																			1300	1300																				
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																			1300	1300																				
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																			1300	1300																				
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																			1300	1300																				
Launch Shaft Perm Lining	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	2	diesel																									433	1300												
	50 ton RT Crane	3	diesel																									650	1950												
	Robodrill Drill Jumbo 2-Boom		diesel																									0	0												
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																									0	0												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																									217	650												
	Loader Cat966/51k-lb/4cy	1	diesel																									217	650												
	Dozer Cat D4/30k-lb		diesel																									0	0												
	End Dump Cat730/31tn -23cy		diesel																									0	0												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																									0	0												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																									0	0												
	Welder 400amp	2	diesel																									433	1300												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																									726	2178												
	Compressor 1100cfm	1	diesel																									217	650												
	Concrete Pump Trk -125ft	2	diesel																									433	1300												
	Boom Truck 18tn	1	diesel																									217	650												
Ungrnd -utility power	TBM & Trailing Plant		electric																									0	0												
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																									0	0												
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																									0	0												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																									0	0												
Topside -utility power	Tun Ventilation Plnt -topside		electric																									0	0												
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																									0	0												
American Legion Receiving																																											
RS -Shaft Site Setup & SOE	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel							650																															
	50 ton RT Crane	1	diesel							650																															
	Hyd Drill Soilmec 625/70ton	2	diesel							1300																															
	Excavtr Cat320/50k-lb/1.6cy	1	diesel							650																															
	Excavtr Cat313/30k-lb/0.7cy		diesel							0																															
	Loader Cat966/51k-lb/4cy	1	diesel							650																															
	Dozer Cat D4/30k-lb		diesel							0																															
	End Dump Cat730/31tn -23cy	1	diesel							650																															
	ICE 815 Vibro	1	diesel							650																															
	ICE 160 Impact		diesel							0																															
	Welder 400amp	2	diesel							1300																															
	Compressor 375cfm	2	diesel							1300																															
	Compressor 1100cfm		diesel							0																															
	Concrete Pump Trk -125ft	1	diesel							650																															
	Boom Truck 18tn	1	diesel							650																															
RS -Shaft Excavation	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel								650																														
	50 ton RT Crane		diesel								0																														
	Robodrill Drill Jumbo 2-Boom	2	diesel								1300																														
	Excavtr Cat320/50k-lb/1.6cy	1	diesel								650																														
	Excavtr Cat313/30k-lb/0.7cy	1	diesel								650																														
	Loader Cat966/51k-lb/4cy	1	diesel								650																														
	Dozer Cat D4/30k-lb		diesel								0																														
	End Dump Cat730/31tn -23cy	1	diesel								650																														
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	2	electric								1300																														
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	2	electric								1300																														
	Welder 400amp	2	diesel								1300																														
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric								2178																														
	Compressor 1100cfm	1	diesel								650																														
	Concrete Pump Trk -125ft	1	diesel								650																														
	Boom Truck 18tn	1	diesel								650																														
Receive Shaft Temp Works	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel									650																													
	50 ton RT Crane	2	diesel									1300																													
	Robodrill Drill Jumbo 2-Boom		diesel									0																													
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric									1300																													
	Excavtr Cat313/30k-lb/0.7cy	1	diesel									650																													
	Loader Cat966/51k-lb/4cy	1	diesel									650																													
	Dozer Cat D4/30k-lb		diesel									0																													
	End Dump Cat730/31tn -23cy		diesel									0																													
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric									650																													
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric									650																													
	Welder 400amp	2	diesel									1300																													
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric									2178																													
	Compressor 1100cfm	1	diesel									650																													
	Concrete Pump Trk -125ft	1	diesel									650																													
	Boom Truck 18tn	1	diesel									650																													
Ungrnd -utility power	TBM & Trailing Plant		electric									0																													
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric									0																													
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric									0																													
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric									0																													
Topside -utility power	Tun Ventilation Plnt -topside		electric									0																													
Ungrnd	Train-25tnLoco-w/3FltCars		diesel									0																													
TBM Tunnel Mining @ RS	***wrk days per quarter >***	***65***																																									
	220 ton Crawler Crane	1	diesel																				433																				
	50 ton RT Crane	2	diesel																				867																				
	Robodrill Drill Jumbo 2-Boom		diesel																				0																				
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																				867																				
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																				433																				
	Loader Cat966/51k-lb/4cy	1	diesel																				433																				
	Dozer Cat D4/30k-lb		diesel																				0																				
	End Dump Cat730/31tn -23cy	1	diesel																				433																				
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																				0																				
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																				0																				
	Welder 400amp	2	diesel																				867																				
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																				726																				

Operation Description	Description	Qty	Fuel	year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Source	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Compressor 1100cfm	1	diesel																				433																			
	Concrete Pump Trk -125ft	0	diesel																				0																			
	Boom Truck 18tn	1	diesel																				433																			
Ungrnd -utility power	TBM & Trailing Plant		electric																				0																			
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																				0																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																				0																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																				0																			
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																				433																			
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																				0																			
Tunnel Conc Lining @ RS	***wrk days per quarter >***	***65***																																								
	220 ton Crawler Crane	1	diesel																											433													
	50 ton RT Crane	2	diesel																											867													
	Robodrill Drill Jumbo 2-Boom		diesel																											0													
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																											867													
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																											433													
	Loader Cat966/51k-lb/4cy	1	diesel																											433													
	Dozer Cat D4/30k-lb		diesel																											0													
	End Dump Cat730/31tn -23cy		diesel																											0													
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																											0													
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																											0													
	Welder 400amp	2	diesel																											867													
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																											726													
	Compressor 1100cfm	1	diesel																											433													
	Concrete Pump Trk -125ft	2	diesel																											867													
	Boom Truck 18tn	1	diesel																											433													
Ungrnd -utility power	TBM & Trailing Plant		electric																											0													
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																											0													
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																											0													
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																											433													
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																											433													
Ungrnd	Train-25tnLoco-w/3AgCars10cy	4	diesel																											1733													
RS-Adit -D&S Mine & Line	***wrk days per quarter >***	***65***																																								
	220 ton Crawler Crane	1	diesel																																							
	50 ton RT Crane	1	diesel																																							
	Robodrill Drill Jumbo 2-Boom	1	diesel																																							
Topside -utility power	Shotcrete&Grout Batch Plnts	2	electric																																							
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																																							
	Loader Cat966/51k-lb/4cy	1	diesel																																							
	Dozer Cat D4/30k-lb		diesel																																							
	End Dump Cat730/31tn -23cy	1	diesel																																							
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	electric																																							
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	electric																																							
	Welder 400amp	2	diesel																																							
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																																							
	Compressor 1100cfm	1	diesel																																							
	Concrete Pump Trk -125ft	1	diesel																																							
	Boom Truck 18tn	1	diesel																																							
Ungrnd -utility power	TBM & Trailing Plant		electric																																							
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																																							
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																																							
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	electric																																							
Topside -utility power	Tun Ventilation Plnt -topside	1	electric																																							
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	electric																																							
Ungrnd	Train-25tnLoco-w/2FltCars	1	diesel																																							
Receive Shaft Perm Lining	***wrk days per quarter >***	***65***																																								
	220 ton Crawler Crane	2	diesel																												1300												
	50 ton RT Crane	2	diesel																												1300												
	Robodrill Drill Jumbo 2-Boom		diesel																												0												
Topside -utility power	Shotcrete&Grout Batch Plnts		electric																												0												
	Excavtr Cat313/30k-lb/0.7cy	1	diesel																												650												
	Loader Cat966/51k-lb/4cy	1	diesel																												650												
	Dozer Cat D4/30k-lb		diesel																												0												
	End Dump Cat730/31tn -23cy		diesel																												0												
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M		electric																												0												
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp		electric																												0												
	Welder 400amp	2	diesel																												1300												
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	electric																												2178												
	Compressor 1100cfm	1	diesel																												650												
	Concrete Pump Trk -125ft	2	diesel																												1300												
	Boom Truck 18tn	1	diesel																												650												
Ungrnd -utility power	TBM & Trailing Plant		electric																												0												
Ungrnd -utility power	TBM Tun Horiz Conveyor		electric																												0												
Ungrnd -utility power	TBM Shaft Vertical Conveyor		electric																												0												
Ungrnd -utility power	Tun Ventilation Plnt -tunnel		electric																												0												
Topside -utility power	Tun Ventilation Plnt -topside		electric																												0												
Ungrnd	Train-25tnLoco-w/3FltCars		diesel																												0												

All Alternatives - Northern Alignment Connection Sites -Raisebore Method

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5				year 6				year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Cedarwood Pumping Station Connection -Raisebore Method																																																
PSS -Shaft Site Setup & SOE	wrk days per quarter >	65	wrk hours per quarter -1shift >					650																																								
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																			
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																			
	Hyd Drill Soilmec 625/70ton			diesel	408	0	eqp hrs	0																					0																			
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																					217																			
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																			
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																			
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																			
	ICE 815 Vibro	1	1	diesel	505	1	eqp hrs	217																					217																			
	ICE 160 Impact			diesel	220	0	eqp hrs	0																					0																			
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																			
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	433																					433																			
	Compressor 1100cfm			diesel	475	0	eqp hrs	0																					0																			
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																					217																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																			
Shaft Raisebore Topside																																																
	wrk days per quarter >	65	wrk hours per quarter -1shift >					650																																								
	220 ton Crawler Crane			diesel	340	0	eqp hrs	0																					0																			
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																			
	HerrnkRBR800VF RaiseboreEq	1	1	diesel	965	1	eqp hrs	217																					217																			
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																					217																			
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																			
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																			
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																			
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																			
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																					0																			
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																			
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																			
Shaft Raisebore Undergrnd																																																
	wrk days per quarter >	65	wrk hours per quarter -1shift >					650																																								
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																			
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																			
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																					0																			
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																					0																			
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																			
	Loader Cat966/51k-lb/4cy			diesel	321	0	eqp hrs	0																					0																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																			
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	217																					217																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																			
	Welder 400amp			diesel	25	0	eqp hrs	0																					0																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																					726																			
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																			
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																			
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																					0																			
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																					0																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																					0																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																					0																			
Topside -utility power	Tun Ventilation Plnt -topside	1	1	electric	200	1	eqp hrs	217																					217																			
Ungrnd	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																					217																			
Ungrnd	Train-25tnLoco-w/3FltCars	1	1	diesel	305	1	eqp hrs	217																					217																			
Adit -D&S Mine & Line	wrk days per quarter >	65	wrk hours per quarter -1shift >					650																																								
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																								
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0																																								
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0																																								
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0																																								
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0																																								
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																																								
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0																																								
	Welder 400amp	2		diesel	25	0	eqp hrs	0																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1		electric	250	0	eqp hrs	0																																								
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0																																								
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0																																								
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0																																								
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0																																								
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0																																								
Shaft Perm Lining	wrk days per quarter >	65	wrk hours per quarter -1shift >					650																																								
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																			
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																			
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																					0																			
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																					0																			
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																					217																			
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																			
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																			

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5						year 6		year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																			
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																			
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																					0																			
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																			
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																					217																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																			
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																					0																			
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																					0																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																					0																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																					0																			
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																					0																			
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																					0																			
School Street Connection -Raisebore Method																																																
Shaft Site Setup & SOE	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																								
Ground Freezing	220 ton Crawler Crane			diesel	340	0	eqp hrs	0																					0	0																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	1083																					650	433																		
	Hyd Drill Soilmec 625/70ton	2	1	diesel	408	2	eqp hrs	2167																					1300	867																		
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	1083																					650	433																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0	0																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	1083																					650	433																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0	0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0	0																		
	ICE 815 Vibro			diesel	505	0	eqp hrs	0																					0	0																		
	ICE 160 Impact			diesel	220	0	eqp hrs	0																					0	0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	2167																					1300	867																		
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	2167																					1300	867																		
24/7 Topside -utility power	Freeze Plant System	1	3.35	electric	300	3	eqp hrs	3629																					2178	1452																		
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0	0																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	1083																					650	433																		
Shaft Raisebore Topside	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																								
	220 ton Crawler Crane			diesel	340	0	eqp hrs	0																							0																	
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																							217																	
	HerrnkRBR800VF RaiseboreEq	1	1	diesel	965	1	eqp hrs	217																							217																	
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																							217																	
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																							0																	
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																							217																	
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																							0																	
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																							0																	
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																							0																	
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																							0																	
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																							433																	
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																							0																	
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																							217																	
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																							0																	
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																							217																	
Shaft Raisebore Undergrnd	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																								
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																							217																	
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																							217																	
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																							0																	
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																							0																	
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																							0																	
	Loader Cat966/51k-lb/4cy			diesel	321	0	eqp hrs	0																							0																	
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																							0																	
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	217																							217																	
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																							0																	
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																							0																	
	Welder 400amp			diesel	25	0	eqp hrs	0																							0																	
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																							726																	
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																							217																	
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																							0																	
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																							217																	
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																							0																	
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																							0																	
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																							0																	
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																							0																	
Topside -utility power	Tun Ventilation Plnt -topside	1	1	electric	200	1	eqp hrs	217																							217																	
Ungrnd	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																							217																	
Ungrnd	Train-25tnLoco-w/3FltCars	1	1	diesel	305	1	eqp hrs	217																							217																	
Adit -D&S Mine & Line	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																								
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																								
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0																																								
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0																																								
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0																																								
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0																																								
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0																																								
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																																								
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0																																								
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0																																								
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0																																								
	Welder 400amp	2		diesel	25	0	eqp hrs	0																																								
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	0																																								
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0																																								
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0																																								
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0																																								
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																																								
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																																								
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																																								
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0																																								
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0																																								
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0																																								
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0																																								

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5						year 6		year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Shaft Perm Lining	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																							217																
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																							217																
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																							0																
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																							0																
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																							217																
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																							217																
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																							0																
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																							0																
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																							0																
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																							0																
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																							433																
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																							0																
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																							217																
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																							217																
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																							217																
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																							0																
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																							0																
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																							0																
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																							0																
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																							0																
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																							0																
St Mary Street Pumping Station Connection -Raisebore Method																																																
Shaft Site Setup & SOE	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	Hyd Drill Soilmec 625/70ton			diesel	408	0	eqp hrs	0																					0																		
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																					217																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																		
	ICE 815 Vibro	1	1	diesel	505	1	eqp hrs	217																					217																		
	ICE 160 Impact			diesel	220	0	eqp hrs	0																					0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																		
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	433																					433																		
	Compressor 1100cfm			diesel	475	0	eqp hrs	0																					0																		
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																					217																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Shaft Raisebore Topside																																																
	wrk days per quarter >	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane			diesel	340	0	eqp hrs	0																					0																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	HerrnkRBR800VF RaiseboreEq	1	1	diesel	965	1	eqp hrs	217																					217																		
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																					217																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																		
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																					0																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																		
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Shaft Raisebore Undergrnd																																																
	wrk days per quarter >	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																					0																		
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																					0																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																		
	Loader Cat966/51k-lb/4cy			diesel	321	0	eqp hrs	0																					0																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	217																					217																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																		
	Welder 400amp			diesel	25	0	eqp hrs	0																					0																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																					726																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																		
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																					0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																					0																		
Topside -utility power	Tun Ventilation Plnt -topside	1	1	electric	200	1	eqp hrs	217																					217																		
Ungrnd	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																					217																		
Ungrnd	Train-25tnLoco-w/3FltCars	1	1	diesel	305	1	eqp hrs	217																					217																		
Adit -D&S Mine & Line	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																							
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0																																							
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0																																							
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0																																							
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0																																							
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0																																							
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																																							
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0																																							
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0																																							
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0																																							
	Welder 400amp	2		diesel	25	0	eqp hrs	0																																							
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	0																																							

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5						year 6		year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0																																							
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0																																							
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0																																							
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																																							
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0																																							
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0																																							
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0																																							
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0																																							
Shaft Perm Lining	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																					0																		
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																					0																		
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																					217																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																		
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																					0																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																		
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																					217																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																					0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																					0																		
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																					0																		
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																					0																		
Hegarty Pumping Station Connection -Raisebore Method																																																
Shaft Site Setup & SOE	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	Hyd Drill Soilmec 625/70ton			diesel	408	0	eqp hrs	0																					0																		
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																					217																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																		
	ICE 815 Vibro	1	1	diesel	505	1	eqp hrs	217																					217																		
	ICE 160 Impact			diesel	220	0	eqp hrs	0																					0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																		
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	433																					433																		
	Compressor 1100cfm			diesel	475	0	eqp hrs	0																					0																		
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																					217																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Shaft Raisebore Topside	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane			diesel	340	0	eqp hrs	0																					0																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	HerrnkRBR800VF RaiseboreEq	1	1	diesel	965	1	eqp hrs	217																					217																		
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																					217																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																		
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																					0																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																		
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Shaft Raisebore Undergrnd	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																					0																		
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																					0																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																		
	Loader Cat966/51k-lb/4cy			diesel	321	0	eqp hrs	0																					0																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	217																					217																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																		
	Welder 400amp			diesel	25	0	eqp hrs	0																					0																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																					726																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																		
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																					0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																					0																		
Topside -utility power	Tun Ventilation Plnt -topside	1	1	electric	200	1	eqp hrs	217																					217																		
Ungrnd	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																					217																		
Ungrnd	Train-25tnLoco-w/3FltCars	1	1	diesel	305	1	eqp hrs	217																					217																		
Adit -D&S Mine & Line	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																							

Operation Description	Description	Qty Count	Shift Cnt/Day	Fuel Source	Horse Power	total unit/day	Year Totals Units	Qty	year 6 Q1
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0	
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0	
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0	
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0	
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0	
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0	
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0	
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0	
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0	
	Welder 400amp	2		diesel	25	0	eqp hrs	0	
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	0	
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0	
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0	
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0	
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0	
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0	
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0	
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0	
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0	
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0	
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0	
Shaft Perm Lining	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*	
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217	217
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217	217
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0	0
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0	0
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217	217
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217	217
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0	0
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0	0
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0	0
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0	0
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433	433
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0	0
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217	217
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217	217
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217	217
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0	0
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0	0
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0	0
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0	0
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0	0
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0	0
Alt 10 ONLY -Park Rd West Connection -Raisebore Method									
Shaft Site Setup & SOE	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*	
Shaft Raisebore Undergrnd	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*	
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	650	650
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	650	650
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0	0
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0	0
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0	0
	Loader Cat966/51k-lb/4cy			diesel	321	0	eqp hrs	0	0
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0	0
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	650	650
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0	0
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0	0
	Welder 400amp			diesel	25	0	eqp hrs	0	0
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	2178	2178
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	650	650
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0	0
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	650	650
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0	0
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0	0
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0	0
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0	0
Topside -utility power	Tun Ventilation Plnt -topside	1	1	electric	200	1	eqp hrs	650	650
Ungrnd	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	650	650
Ungrnd	Train-25tnLoco-w/3FltCars	1	1	diesel	305	1	eqp hrs	650	650
D&S Adit -PSS to TBM Tunnel -D&S Mine & Line	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*	
	220 ton Crawler Crane	1	2	diesel	340	2	eqp hrs	433	433
	50 ton RT Crane	1	2	diesel	175	2	eqp hrs	433	433
	Robodrill Drill Jumbo 2-Boom	1	2	diesel	65	2	eqp hrs	433	433
Topside -utility power	Shotcrete&Grout Batch Plnts	2	2	electric	300	4	eqp hrs	867	867
	Excavtr Cat313/30k-lb/0.7cy	1	2	diesel	108	2	eqp hrs	433	433
	Loader Cat966/51k-lb/4cy	1	2	diesel	321	2	eqp hrs	433	433
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0	0
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	217	217
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1	2	electric	125	2	eqp hrs	433	433
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1	2	electric	100	2	eqp hrs	433	433
	Welder 400amp	2	2	diesel	25	4	eqp hrs	867	867
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726	726
	Compressor 1100cfm	1	2	diesel	475	2	eqp hrs	433	433
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217	217
	Boom Truck 18tn	1	2	diesel	350	2	eqp hrs	433	433
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0	0
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0	0
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0	0
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1	2	electric	120	2	eqp hrs	433	433
Topside -utility power	Tun Ventilation Plnt -topside	1	2	electric	200	2	eqp hrs	433	433
Ungrnd -utility power	GIA 9HR2-B Haggloader	1	2	electric	75	2	eqp hrs	433	433

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5						year 6		year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd	Train-25tnLoco-w/2FltCars	1	2	diesel	305	2	eqp hrs	433																						433																			
Shaft Perm Lining	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	650																							650																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	650																							650																		
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																							0																		
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																							0																		
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	650																							650																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	650																							650																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																							0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																							0																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																							0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																							0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	1300																							1300																		
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																							0																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	650																							650																		
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	650																							650																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	650																							650																		
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																							0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																							0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																							0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																							0																		
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																							0																		
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																							0																		
Newton Street Pumping Station Connection -Raisebore Method																																																
Shaft Site Setup & SOE	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																						217																			
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																						217																			
	Hyd Drill Soilmec 625/70ton			diesel	408	0	eqp hrs	0																						0																			
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																						217																			
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																						0																			
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																						217																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																						0																			
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																						0																			
	ICE 815 Vibro	1	1	diesel	505	1	eqp hrs	217																						217																			
	ICE 160 Impact			diesel	220	0	eqp hrs	0																						0																			
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																						433																			
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	433																						433																			
	Compressor 1100cfm			diesel	475	0	eqp hrs	0																						0																			
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																						217																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																						217																			
Shaft Raisebore Topside	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane			diesel	340	0	eqp hrs	0																						0																			
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																						217																			
	HerrnkRBR800VF RaiseboreEq	1	1	diesel	965	1	eqp hrs	217																						217																			
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																						217																			
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																						0																			
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																						217																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																						0																			
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																						0																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																						0																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																						0																			
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																						433																			
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																						0																			
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																						217																			
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																						0																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																						217																			
Shaft Raisebore Undergrnd	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																						217																			
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																						217																			
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																						0																			
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																						0																			
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																						0																			
	Loader Cat966/51k-lb/4cy			diesel	321	0	eqp hrs	0																						0																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																						0																			
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	217																						217																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																						0																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																						0																			
	Welder 400amp			diesel	25	0	eqp hrs	0																						0																			
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																						726																			
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																						217																			
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																						0																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																						217																			
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																						0																			
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																						0																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																						0																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																						0																			
Topside -utility power	Tun Ventilation Plnt -topside	1	1	electric	200	1	eqp hrs	217																						217																			
Ungrnd	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																						217																			
Ungrnd	Train-25tnLoco-w/3FltCars	1	1	diesel	305	1	eqp hrs	217																						217																			
Adit -D&S Mine & Line	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																							
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0																																							
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0																																							
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0																																							
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0																																							
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0																																							
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																																							
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0																																							
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0																																							
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0																																							

| Operation Description | Description | Qty | Shift | Fuel | Horse | total | Year Totals | | year 1 | | | | year 2 | | | | year 3 | | | | year 4 | | | | year 5 | | | | | | year 6 | | year 7 | | | | year 8 | | | | year 9 | | | | year 10 | | | |
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Welder 400amp	2		diesel	25	0	eqp hrs	0																																							
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	0																																							
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0																																							
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0																																							
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0																																							
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																																							
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0																																							
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0																																							
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0																																							
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0																																							
Shaft Perm Lining	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																					0																		
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																					0																		
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																					217																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																		
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																					0																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																		
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																					217																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																					0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																					0																		
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																					0																		
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																					0																		
Southern Spine Mains Connection -Raisebore Method																																																
Shaft Site Setup & SOE	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
Ground Freezing	220 ton Crawler Crane			diesel	340	0	eqp hrs	0																					0	0																	
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	1083																					650	433																	
	Hyd Drill Soilmec 625/70ton	2	1	diesel	408	2	eqp hrs	2167																					1300	867																	
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	1083																					650	433																	
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0	0																	
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	1083																					650	433																	
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0	0																	
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0	0																	
	ICE 815 Vibro			diesel	505	0	eqp hrs	0																					0	0																	
	ICE 160 Impact			diesel	220	0	eqp hrs	0																					0	0																	
	Welder 400amp	2	1	diesel	25	2	eqp hrs	2167																					1300	867																	
	Compressor 375cfm	2	1	diesel	125	2	eqp hrs	2167																					1300	867																	
24/7 Topside -utility power	Freeze Plant System	1	3.35	diesel	475	3	eqp hrs	3629																					2178	1452																	
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0	0																	
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	1083																					650	433																	
Shaft Raisebore Topside	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
	220 ton Crawler Crane			diesel	340	0	eqp hrs	0																					0																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	HerrnkRBR800VF RaiseboreEq	1	1	diesel	965	1	eqp hrs	217																					217																		
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	172	1	eqp hrs	217																					217																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																		
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																		
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																		
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																					0																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																		
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Shaft Raisebore Undergrnd	***wrk days per quarter >***	***65***	***wrk hours per quarter -1shift >***					***650***																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																		
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																		
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																					0																		
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																					0																		
	Excavtr Cat313/30k-lb/0.7cy			diesel	108	0	eqp hrs	0																					0																		
	Loader Cat966/51k-lb/4cy			diesel	321	0	eqp hrs	0																					0																		
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																		
	End Dump Cat730/31tn -23cy	1	1	diesel	370	1	eqp hrs	217																					217																		
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																		
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																		
	Welder 400amp			diesel	25	0	eqp hrs	0																					0																		
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	726																					726																		
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																		
	Concrete Pump Trk -125ft			diesel	425	0	eqp hrs	0																					0																		
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																		
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																					0																		
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																					0																		
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																					0																		
Topside -utility power	Tun Ventilation Plnt -topside	1	1	electric	200	1	eqp hrs	217																					217																		
Ungrnd	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																					217																		

Operation Description	Description	Qty	Shift	Fuel	Horse	total	Year Totals		year 1				year 2				year 3				year 4				year 5						year 6		year 7				year 8				year 9				year 10			
		Count	Cnt/Day	Source	Power	unit/day	Units	Qty	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Ungrnd	Train-25tnLoco-w/3FltCars	1	1	diesel	305	1	eqp hrs	217																					217																			
Adit -D&S Mine & Line	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1		diesel	340	0	eqp hrs	0																																							
	50 ton RT Crane	1		diesel	175	0	eqp hrs	0																																							
	Robodrill Drill Jumbo 2-Boom	1		diesel	65	0	eqp hrs	0																																							
Topside -utility power	Shotcrete&Grout Batch Plnts	2		electric	300	0	eqp hrs	0																																							
	Excavtr Cat313/30k-lb/0.7cy	1		diesel	108	0	eqp hrs	0																																							
	Loader Cat966/51k-lb/4cy	1		diesel	321	0	eqp hrs	0																																							
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																																							
	End Dump Cat730/31tn -23cy	1		diesel	370	0	eqp hrs	0																																							
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M	1		electric	125	0	eqp hrs	0																																							
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp	1		electric	100	0	eqp hrs	0																																							
	Welder 400amp	2		diesel	25	0	eqp hrs	0																																							
24/7 Topside -utility power	Shaft/Tunnel Pump System	1	3.35	electric	250	3	eqp hrs	0																																							
	Compressor 1100cfm	1		diesel	475	0	eqp hrs	0																																							
	Concrete Pump Trk -125ft	1		diesel	425	0	eqp hrs	0																																							
	Boom Truck 18tn	1		diesel	350	0	eqp hrs	0																																							
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																																							
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																																							
Ungrnd -utility power	Tun Ventilation Plnt -tunnel	1		electric	120	0	eqp hrs	0																																							
Topside -utility power	Tun Ventilation Plnt -topside	1		electric	200	0	eqp hrs	0																																							
Ungrnd -utility power	GIA 9HR2-B Haggloader	1		electric	75	0	eqp hrs	0																																							
Ungrnd	Train-25tnLoco-w/2FltCars	1		diesel	305	0	eqp hrs	0																																							
Shaft Perm Lining	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	220 ton Crawler Crane	1	1	diesel	340	1	eqp hrs	217																					217																			
	50 ton RT Crane	1	1	diesel	175	1	eqp hrs	217																					217																			
	HerrnkRBR800VF RaiseboreEq			diesel	965	0	eqp hrs	0																					0																			
Topside -utility power	Shotcrete&Grout Batch Plnts			electric	300	0	eqp hrs	0																					0																			
	Excavtr Cat313/30k-lb/0.7cy	1	1	diesel	108	1	eqp hrs	217																					217																			
	Loader Cat966/51k-lb/4cy	1	1	diesel	321	1	eqp hrs	217																					217																			
	Dozer Cat D4/30k-lb			diesel	130	0	eqp hrs	0																					0																			
	End Dump Cat730/31tn -23cy			diesel	370	0	eqp hrs	0																					0																			
Ungrnd -utility power	ACMeyco-ME3SprayBoom5M			electric	125	0	eqp hrs	0																					0																			
Ungrnd -utility power	ShtcrtePlnt-252Rotry w/Pmp			electric	100	0	eqp hrs	0																					0																			
	Welder 400amp	2	1	diesel	25	2	eqp hrs	433																					433																			
24/7 Topside -utility power	Shaft/Tunnel Pump System			electric	250	0	eqp hrs	0																					0																			
	Compressor 1100cfm	1	1	diesel	475	1	eqp hrs	217																					217																			
	Concrete Pump Trk -125ft	1	1	diesel	425	1	eqp hrs	217																					217																			
	Boom Truck 18tn	1	1	diesel	350	1	eqp hrs	217																					217																			
Ungrnd -utility power	TBM & Trailing Plant			electric	3455	0	eqp hrs	0																					0																			
Ungrnd -utility power	TBM Tun Horiz Conveyor			electric	2050	0	eqp hrs	0																					0																			
Ungrnd -utility power	TBM Shaft Vertical Conveyor			electric	500	0	eqp hrs	0																					0																			
Ungrnd -utility power	Tun Ventilation Plnt -tunnel			electric	6000	0	eqp hrs	0																					0																			
Topside -utility power	Tun Ventilation Plnt -topside			electric	200	0	eqp hrs	0																					0																			
Ungrnd	Train-25tnLoco-w/3FltCars			diesel	305	0	eqp hrs	0																					0																			
Hultman Aqueduct Isolation Valve																																																
Connection Work	*wrk days per quarter >*	*65*	*wrk hours per quarter -1shift >*					*650*																																							
	50 ton RT Crane	1		diesel	340	0	eqp hrs	0																										325														
	Excavtr Cat320/50k-lb/1.6cy	1	1	diesel	175	1	eqp hrs	1083																										325														

Appendix G.4: On-Road Emission Factors

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On-Road Emission Factors

MOVES3 Output

	Emission Factor (g/mi)		
Vehicle Type	**Nox**	**VOC**	**CO2**
Diesel Truck	7.27	0.26	1,827.74
Passenger Vehicle	0.03	0.05	281.30

Notes:

Emission Factors Calculated using MOVES 3

g/mi = grams per mile

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Appendix G.5: On Road Vehicle Trips and Site Mileage

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ALTERNATIVE 4 (Launching, Receiving and Connecting Sites)

Vehicle Trips per Quarter

Diesel Truck per Quarter	Miles	Nox EF (g/mi)	VOC EF (g/mi)	CO2 EF (g/mi)		Year 1				Year 2				Year 3				Year 4				Year 5			
						Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.2	7.27	0.26	1827.74		0	0	185	2529	273	5038	5038	5038	5038	5038	5038	5038	1680	0	399	399	1893	1893	1893	1893
American Legion Receiving	8.0	7.27	0.26	1827.74		0	0	217	986	155	0	0	0	0	0	0	0	52	0	0	0	0	0	1699	1699
Highland Avenue Northwest Launching	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	185	2529	273	5122	5122	5122	3415	0	642	1925	1925	642	0	367
Park Road West Receiving	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	142	1020	438	98	0	0	52	0	0	0	0	25	0	503
Tandem Trailer Launching	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	387	2229	260	5049	5049	5049	5049	5049	0	0
Fernald Property Receiving	7.5	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	53	873	125	0	0	0	0	52	0	0
Park Road East	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					Total	**0**	**0**	**402**	**3515**	**428**	**5038**	**5365**	**8587**	**5749**	**10257**	**10599**	**13261**	**5583**	**5049**	**6089**	**7372**	**8866**	**7660**	**3592**	**4461**

Diesel Truck per Quarter	Year 6				Year 7				Year 8				Year 9				Year 10			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	1893	631	1102	368	486	486	486	486	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	25	0	497	952	952	952	952	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Launching	1102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Park Road West Receiving	168	617	617	206	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	152	1084	2338	2338	1881	627	991	330	192	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	25	0	421	249	748	748	748	0	0	0	0	0	0	0	0
Park Road East	0	0	0	32	350	512	613	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**3314**	**2357**	**4057**	**3440**	**3669**	**2602**	**3041**	**2189**	**441**	**748**	**748**	**748**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Passenger Vehicle per Quarter	Miles	Nox EF (g/mi)	VOC EF (g/mi)	CO2 EF (g/mi)		Year 1				Year 2				Year 3				Year 4				Year 5			
						Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.2	0.029	0.051	281.295		0	0	3900	3120	10660	16380	16380	16380	16380	16380	16380	16380	16380	0	6760	6760	9360	9360	9360	9360
American Legion Receiving	8.0	0.029	0.051	281.295		0	0	3900	3120	3380	0	0	0	0	0	0	0	4160	0	0	0	0	0	9360	9360
Highland Avenue Northwest Launching	0.2	0.029	0.051	281.295		0	0	0	0	0	0	3900	3120	10660	16380	16380	16380	16380	9360	9360	9360	9360	0	0	4030
Park Road West Receiving	0.2	0.029	0.051	281.295		0	0	0	0	0	0	3900	3120	6500	3380	0	0	4160	0	0	0	0	4160	0	4030
Tandem Trailer Launching	0.2	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	7800	3120	10660	16380	16380	16380	16380	16380	0	0
Fernald Property Receiving	7.5	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	3900	3120	3380	0	0	0	0	4160	0	0
Park Road East	0.2	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					Total	**0**	**0**	**7800**	**6240**	**14040**	**16380**	**24180**	**22620**	**33540**	**36140**	**44460**	**39000**	**55120**	**25740**	**32500**	**32500**	**35100**	**34060**	**18720**	**26780**

Passenger Vehicle per Quarter	Year 6				Year 7				Year 8				Year 9				Year 10			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	9360	9360	4030	4030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	4160	0	4030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Launching	4030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Park Road West Receiving	4030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	6760	16120	16120	16120	9360	9360	4030	4030	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	4160	0	4030	0	0	0	0	0	0	0	0	0	0	0	0
Park Road East	0	0	0	1950	1950	2600	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**24180**	**29640**	**20150**	**26130**	**11310**	**16120**	**4030**	**8060**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ALTERNATIVE3 (Launching, Receiving and Connection Sites)

Vehicle Trips per Quarter

Diesel Truck per Quarter	Miles	Nox EF (g/mi)	VOC EF (g/mi)	CO2 EF (g/mi)		Year 1				Year 2				Year 3				Year 4				Year 5			
						Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.2	7.27	0.26	1827.74		0	0	185	2529	273	5037	5037	5037	5037	5037	5037	5037	1679	0	0	0	1893	1893	1893	1893
American Legion Receiving	8.0	7.27	0.26	1827.74		0	0	217	986	155	0	0	0	0	0	0	0	52	0	0	0	0	0	2019	2019
Bifurcation Launching	0.2	7.27	0.26	1827.74		0	0	0	0	0	198	132	2369	268	4906	4906	4906	3270	0	614	1843	1843	614	0	347
Highland Avenue Northwest Receiving	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	142	1068	459	103	0	0	52	0	399	399	0	25	0	530
Tandem Trailer Launching	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	387	2229	260	5049	5049	5049	5049	5049	0	0
Fernald Property Receiving	7.5	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	53	873	125	0	0	0	0	52	0	0
Park Road East	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					Total	**0**	**0**	**402**	**3515**	**428**	**5235**	**5311**	**8474**	**5764**	**10045**	**10383**	**13045**	**5438**	**5049**	**6061**	**7290**	**8784**	**7633**	**3912**	**4788**

Diesel Truck per Quarter	Year 6				Year 7				Year 8				Year 9				Year 10			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	1893	631	1102	367	486	486	486	486	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	25	0	497	952	952	952	952	0	0	0	0	0	0	0	0	0	0	0	0
Bifurcation Launching	1042	0	0	0	493	493	493	493	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Receiving	177	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	152	1084	2338	2338	1881	627	991	330	192	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	25	0	421	249	748	748	748	0	0	0	0	0	0	0	0
Park Road East	0	0	0	33	350	513	613	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**3263**	**1740**	**3440**	**3235**	**4162**	**3095**	**3534**	**2682**	**441**	**748**	**748**	**748**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Passenger Vehicle per Quarter	Miles	Nox EF (g/mi)	VOC EF (g/mi)	CO2 EF (g/mi)		Year 1				Year 2				Year 3				Year 4				Year 5			
						Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	0.2	0.029	0.051	281.295		0	0	3900	3120	10660	16380	16380	16380	16380	16380	16380	16380	16380	0	0	0	9360	9360	9360	9360
American Legion Receiving	8.0	0.029	0.051	281.295		0	0	3900	3120	3380	0	0	0	0	0	0	0	4160	0	0	0	0	0	9360	9360
Bifurcation Launching	0.2	0.029	0.051	281.295		0	0	0	0	0	3900	3900	3120	10660	16380	16380	16380	16380	0	9360	9360	9360	9360	0	4030
Highland Avenue Northwest Receiving	0.2	0.029	0.051	281.295		0	0	0	0	0	0	3900	3120	6500	3380	0	0	4160	0	6760	6760	0	4160	0	4030
Tandem Trailer Launching	0.2	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	7800	3120	10660	16380	16380	16380	16380	16380	0	0
Fernald Property Receiving	7.5	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	3900	3120	3380	0	0	0	0	4160	0	0
Park Road East	0.2	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					Total	**0**	**0**	**7800**	**6240**	**14040**	**20280**	**24180**	**22620**	**33540**	**36140**	**44460**	**39000**	**55120**	**16380**	**32500**	**32500**	**35100**	**43420**	**18720**	**26780**

Passenger Vehicle per Quarter	Year 6				Year 7				Year 8				Year 9				Year 10			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northeast Launching	9360	9360	4030	4030	1040	1040	1040	1040	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	4160	0	4030	1040	1040	1040	1040	0	0	0	0	0	0	0	0	0	0	0	0
Bifurcation Launching	4030	0	0	0	1040	1040	1040	1040	0	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northwest Receiving	4030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Trailer Launching	6760	16120	16120	16120	9360	9360	4030	4030	1040	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	4160	0	4030	1040	1040	1040	1040	0	0	0	0	0	0	0	0
Park Road East	0	0	0	1950	1950	3640	1040	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**24180**	**29640**	**20150**	**26130**	**14430**	**20280**	**8190**	**11180**	**2080**	**1040**	**1040**	**1040**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

ALTERNATIVE 10 (Launching, Receiving and Connecting Sites)

Vehicle Trips per Quarter

Diesel Truck per Quarter	Miles	Nox EF (g/mi)	VOC EF (g/mi)	CO2 EF (g/mi)		Year 1				Year 2				Year 3				Year 4				Year 5			
						Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0.2	7.27	0.26	1827.74		0	0	185	2529	273	5075	5075	5075	5075	5075	5075	5075	5075	5075	0	0	0	0	0	0
Fernald Property Receiving	7.5	7.27	0.26	1827.74		0	0	53	873	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52
Park Road West Large Connection	0.2	7.27	0.26	1827.74		0	0	0	138	1360	196	0	0	102	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northeast Launching	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	185	2529	273	5037	5037	5037	5037	5037	5037	5037	1679	0	399	399
American Legion Receiving	8.0	7.27	0.26	1827.74		0	0	0	0	0	0	217	1021	155	0	0	0	0	0	0	0	0	0	0	52
					Total	**0**	**0**	**238**	**3540**	**1758**	**5271**	**5477**	**8625**	**5605**	**10112**	**10112**	**10112**	**10112**	**10112**	**5037**	**5037**	**1679**	**0**	**399**	**503**

Diesel Truck per Quarter	Year 6				Year 7				Year 8				Year 9				Year 10			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0	1783	1783	1783	1783	1783	1783	1783	367	1102	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	0	0	25	671	748	748	748	0	0	0	0	0	0	0	0
Park Road West Large Connection	0	0	0	48	0	0	0	0	503	527	360	360	360	0	0	0	0	0	0	0
Highland Avenue Northeast Launching	631	1893	1893	1893	1893	1893	367	1102	486	486	486	486	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	0	2019	2019	25	497	952	952	952	952	0	0	0	0	0	0	0	0	0
Total	**631**	**3675**	**3675**	**5742**	**5694**	**3700**	**2647**	**3861**	**2978**	**3815**	**2546**	**1594**	**360**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

						Year 1				Year 2				Year 3				Year 4				Year 5			
Passenger Vehicle per Quarter	Miles	Nox EF (g/mi)	VOC EF (g/mi)	CO2 EF (g/mi)		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0.2	0.029	0.051	281.295		0	0	3900	3120	10660	16380	16380	16380	16380	16380	16380	16380	16380	16380	0	0	0	0	0	0
Fernald Property Receiving	7.5	0.029	0.051	281.295		0	0	0	3120	3380	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4160
Park Road West Large Connection	0.2	0.029	0.051	281.295		0	0	0	3900	3120	3380	0	0	4160	0	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northeast Launching	0.2	0.029	0.051	281.295		0	0	0	0	0	0	3900	3120	10660	16380	16380	16380	16380	16380	16380	16380	16380	0	6760	6760
American Legion Receiving	8.0	0.029	0.051	281.295		0	0	0	0	0	0	3900	3120	3380	0	0	0	0	0	0	0	0	0	0	4160
					Total	**0**	**0**	**3900**	**10140**	**17160**	**19760**	**24180**	**22620**	**34580**	**32760**	**32760**	**32760**	**32760**	**32760**	**16380**	**16380**	**16380**	**0**	**6760**	**15080**

	Year 6				Year 7				Year 8				Year 9				Year 10			
Passenger Vehicle per Quarter	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Highland Avenue Northwest Launching	0	9360	9360	9360	9360	9360	9360	0	0	0	0	0	0	0	0	0	0	0	0	0
Fernald Property Receiving	0	0	0	0	0	0	0	4160	4030	0	0	0	0	0	0	0	0	0	0	0
Park Road West Large Connection	0	0	0	4160	0	0	0	0	4030	4030	0	0	0	0	0	0	0	0	0	0
Highland Avenue Northeast Launching	9360	9360	9360	9360	9360	9360	4030	4030	0	0	0	0	0	0	0	0	0	0	0	0
American Legion Receiving	0	0	0	9360	9360	4160	4030	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**9360**	**18720**	**18720**	**32240**	**28080**	**22880**	**17420**	**8190**	**8060**	**4030**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Connection Sites (All Alterantives)

Vehicle Trips per Quarter

Diesel Truck per Quarter	Miles	Nox EF (g/mi)	VOC EF (g/mi)	CO2 EF (g/mi)		Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
						Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Cedarwood Pumping Station Connection	3.0	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	368	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School St Connection	3.2	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	191	5	59	449	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	4.0	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	248	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	1.8	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	107	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station Connection	12.8	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	217	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	9.7	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	170	5	60	242	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0.2	7.27	0.26	1827.74		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**736**	**1028**	**119**	**951**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

						Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10			
Passenger Vehicle per Quarter	**Miles**	**Nox EF (g/mi)**	**VOC EF (g/mi)**	**CO2 EF (g/mi)**		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Cedarwood Pumping Station Connection	3.0	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4485	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
School St Connection	3.2	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2535	1040	3023	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Mary Street Pumping Station Connection	4.0	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4485	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hegarty Pumping Station Connection	1.8	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4485	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton Street Pumping Station Connection	12.8	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4485	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Spine Mains Connection	9.7	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2503	1040	3023	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hultman Aqueduct Isolation Valve	0.2	0.029	0.051	281.295		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**22978**	**6240**	**6045**	**3120**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Appendix H: RMAT Output Report

- Fernald Property
- Tandem Trailer
- Park Road East
- Park Road West
- Bifurcation
- Highland Avenue Northeast
- Highland Avenue Northwest
- American Legion
- School Street
- Cedarwood Pumping Station
- Hegarty Pumping Station
- St. Mary Street Pumping Station
- Newton Street Pumping Station
- Southern Spine Mains
- Hultman Aqueduct Isolation Valve

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RMAT Climate Resilience Design Standards Tool Project Report

Fernald Property

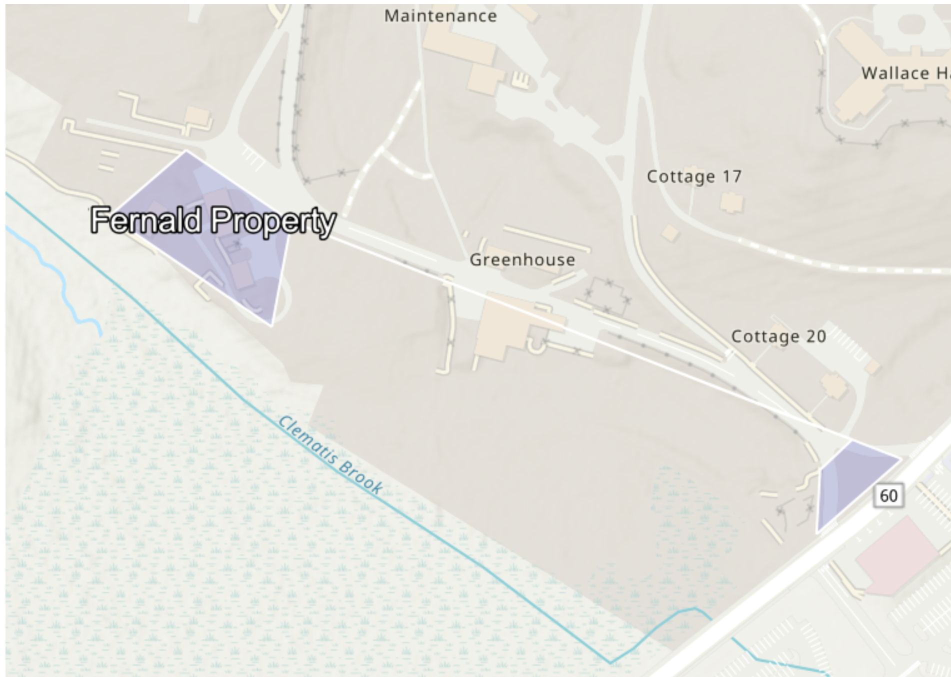
Date Created: 4/28/2022 4:27:27 PM   Created By: ofisher@vhb.com   Download

Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: No

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Moderate Exposure
Extreme Heat	High Exposure



Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Fernald Property Construction Site	Low Risk	High Risk	High Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Fernald Property Construction Site					
Extreme Precipitation					
Fernald Property Construction Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Fernald Property Construction Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- Existing impervious area of the project site is greater than 50%

- No historic flooding at project site

Extreme Precipitation - Riverine Flooding

This project received a "Moderate Exposure" because of the following:

- Part of the project is within 500ft of a waterbody and less than 20ft above the waterbody
- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is greater than 50%
- Located within 100 ft of existing water body

Scoring Rationale - Asset Risk Scoring

Asset - Fernald Property Construction Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Fernald Property Construction Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Fernald Property Construction Site	2070	100-Year (1%)	11	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: Yes

Extreme Heat	High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Fernald Property
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Waltham
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Fernald Property Construction Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.
Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)
Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people
Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
Will the infrastructure reduce the risk of flooding?
No
If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate
If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million
Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist
What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Climate Resilience Design Standards Tool Project Report

Tandem Trailer

Date Created: 4/28/2022 4:37:53 PM　　Created By: ofisher@vhb.com

Date Report Generated: 9/13/2022 4:46:32 PM　　Tool Version: Version 1.2

Project Contact Information: Colleen Rizzi (Colleen.Rizzi@mwra.com)

Project Summary

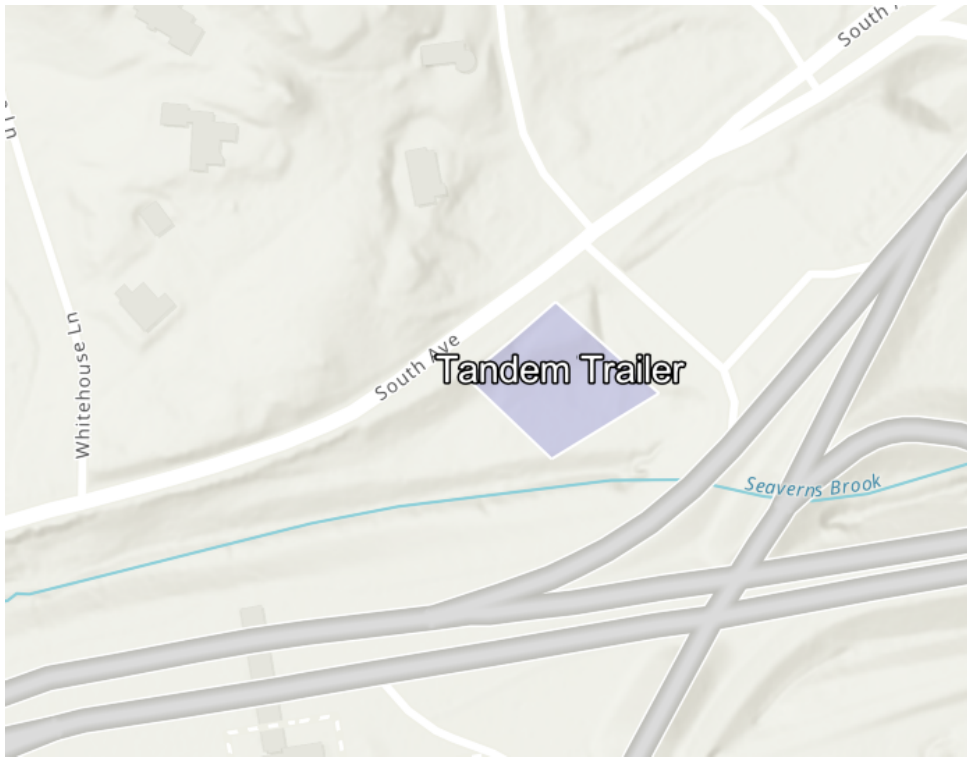
Link to Project

Estimated Capital Cost: $1500000000.00

End of Useful Life Year: 2127

Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Tandem Trailer Construction Shaft Site	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Tandem Trailer Construction Shaft Site					
Extreme Precipitation					
Tandem Trailer Construction Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Tandem Trailer Construction Shaft Site	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 200ft of a waterbody and less than 30ft above the waterbody
- No historic riverine flooding at project site
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is less than 10%

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Tandem Trailer Construction Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Tandem Trailer Construction Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Tandem Trailer Construction Shaft Site	2070	100-Year (1%)	11.0	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Tandem Trailer
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Weston
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes
Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No

Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Tandem Trailer Construction Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

Climate Resilience Design Standards Tool Project Report

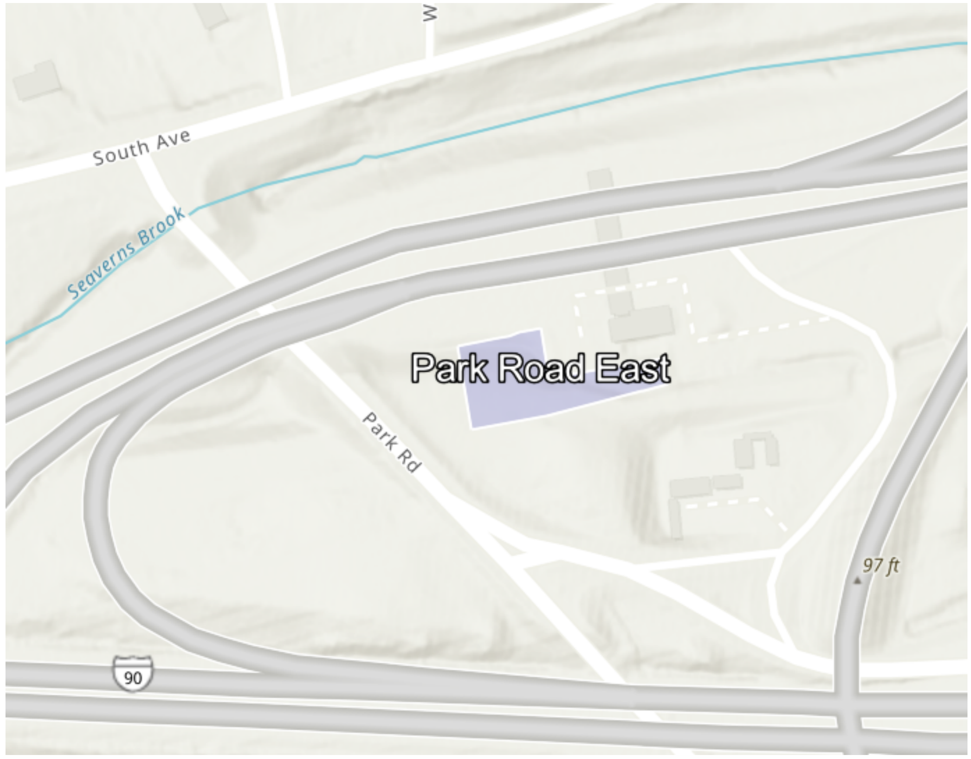
Park Road East
Date Created: 4/28/2022 4:40:30 PM
Created By: ofisher@vhb.com
Date Report Generated: 9/13/2022 4:18:09 PM
Tool Version: Version 1.2
Project Contact Information: Colleen Rizzi (Colleen.Rizzi@mwra.com)

Project Summary

Link to Project

Estimated Capital Cost: $1500000000.00
End of Useful Life Year: 2127
Project within mapped Environmental Justice neighborhood: No

Ecosystem Service Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure



Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Park Road East Construction Shaft Site	Low Risk	High Risk	High Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Park Road East Construction Shaft Site					
Extreme Precipitation					
Park Road East Construction Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Park Road East Construction Shaft Site	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Part of the project is within 100ft of a waterbody
- Project is potentially susceptible to riverine erosion
- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Park Road East Construction Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Park Road East Construction Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Park Road East Construction Shaft Site	2070	100-Year (1%)	11.0	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Park Road East
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Weston
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes
Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No

Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Park Road East Construction Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

Park Road West
Date Created: 4/28/2022 4:44:35 PM   Created By: ofisher@vhb.com   Download

Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: No

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure

Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Park Road West Construction Shaft Site	Low Risk	High Risk	High Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Park Road West Construction Shaft Site					
Extreme Precipitation					
Park Road West Construction Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Park Road West Construction Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site

- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Part of the project is within 100ft of a waterbody
- Project is potentially susceptible to riverine erosion
- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover

Scoring Rationale - Asset Risk Scoring

Asset - Park Road West Construction Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Park Road West Construction Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Park Road West Construction Shaft Site	2070	100-Year (1%)	11	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: Yes

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Park Road West
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Weston
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Park Road West Construction Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

Bifurcation

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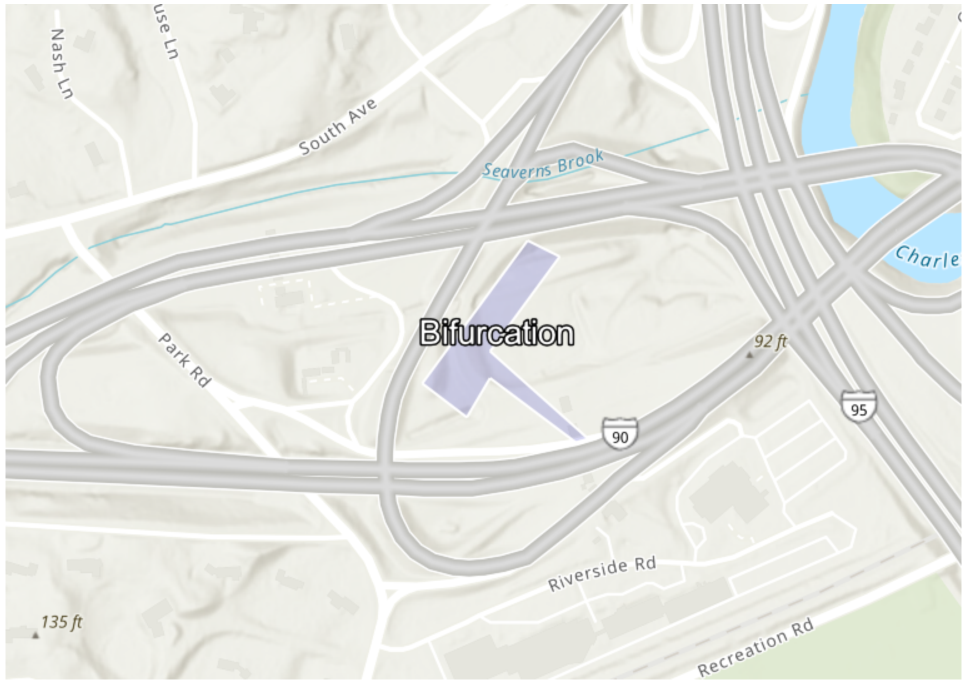
Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: No

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Moderate Exposure
Extreme Heat	High Exposure



Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Bifurcation Construction Shaft Site	Low Risk	High Risk	High Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Bifurcation Construction Shaft Site					
Extreme Precipitation					
Bifurcation Construction Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Bifurcation Construction Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site

- Existing impervious area of the project site is between 10% and 50%

Extreme Precipitation - Riverine Flooding

This project received a "Moderate Exposure" because of the following:

- Part of the project is within 100ft of a waterbody
- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover

Scoring Rationale - Asset Risk Scoring

Asset - Bifurcation Construction Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Bifurcation Construction Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Bifurcation Construction Shaft Site	2070	100-Year (1%)	11	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: Yes

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Bifurcation
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Weston
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Bifurcation Construction Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

Highland Ave Northeast

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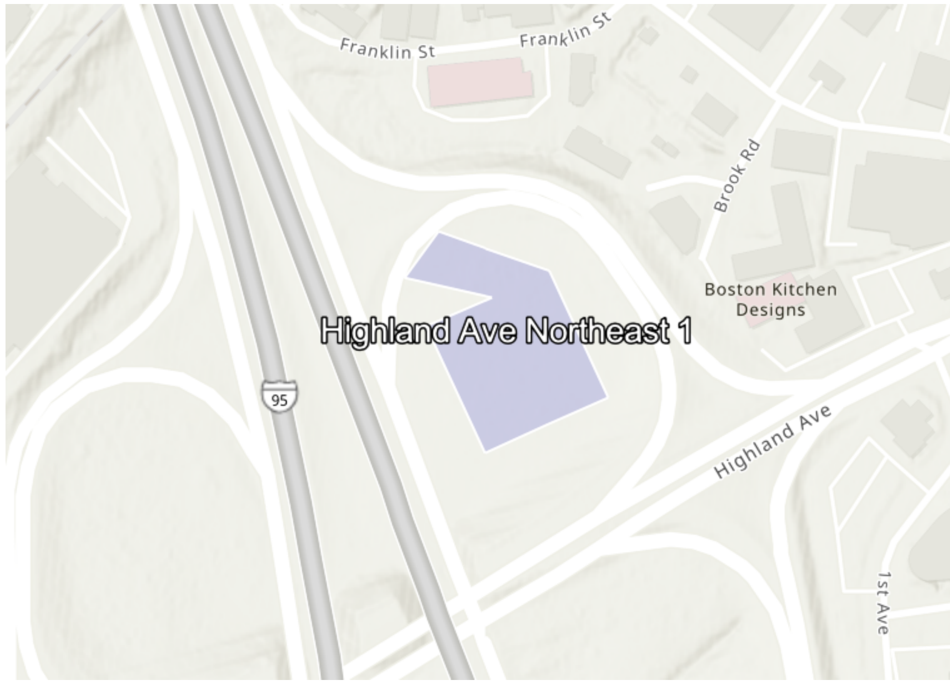
Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: No

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Not Exposed
Extreme Heat	High Exposure



Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Highland Ave Northeast Construction Shaft Site	Low Risk	High Risk	Low Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Highland Ave Northeast Construction Shaft Site					
Extreme Precipitation					
Highland Ave Northeast Construction Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Highland Ave Northeast Construction Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site

- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "Not Exposed" because of the following:

- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is more than 500ft from a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover

Scoring Rationale - Asset Risk Scoring

Asset - Highland Ave Northeast Construction Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Highland Ave Northeast Construction Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Highland Ave Northeast Construction Shaft Site	2070	100-Year (1%)	11.1	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: No

Extreme Heat	High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Highland Ave Northeast
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Needham
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority’s aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Highland Ave Northeast Construction Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrastructurte may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

Highland Ave Northwest 1

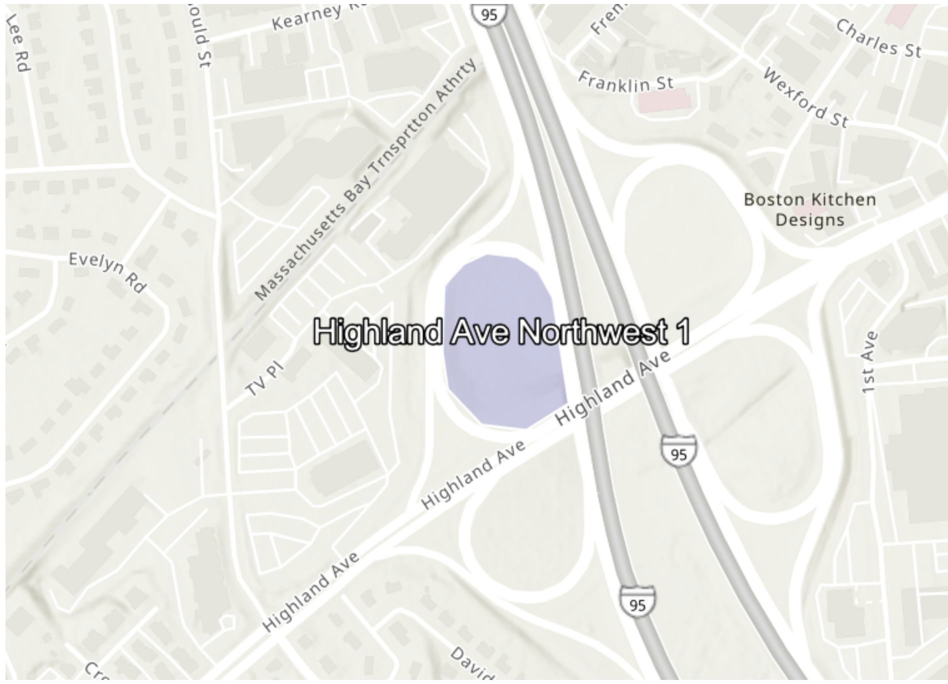
Date Created: 4/28/2022 4:53:35 PM   Created By: ofisher@vhb.com   Download

Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: No

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Not Exposed
Extreme Heat	High Exposure



Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Highland Ave Northwest Construction Shaft Site	Low Risk	High Risk	Low Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Highland Ave Northwest Construction Shaft Site					
Extreme Precipitation					
Highland Ave Northwest Construction Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Highland Ave Northwest Construction Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site

- Existing impervious area of the project site is between 10% and 50%

Extreme Precipitation - Riverine Flooding

This project received a "Not Exposed" because of the following:

- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is more than 500ft from a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is between 10% and 50%

Scoring Rationale - Asset Risk Scoring

Asset - Highland Ave Northwest Construction Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Highland Ave Northwest Construction Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Highland Ave Northwest Construction Shaft Site	2070	100-Year (1%)	11.1	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: No

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Highland Ave Northwest 1
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Needham
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority’s aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Highland Ave Northwest Construction Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

American Legion
Date Created: 4/28/2022 5:02:07 PM   Created By: ofisher@vhb.com   Download

Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Benefits	Scores
Project Score	Low

Exposure	Scores
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	High Exposure
Extreme Heat	High Exposure

Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
American Legion Construction Shaft Site	Low Risk	High Risk	High Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
American Legion Construction Shaft Site					
Extreme Precipitation					
American Legion Construction Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
American Legion Construction Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site

- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Part of the project is within 100ft of a waterbody
- Project is potentially susceptible to riverine erosion
- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover

Scoring Rationale - Asset Risk Scoring

Asset - American Legion Construction Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: American Legion Construction Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
American Legion Construction Shaft Site	2070	100-Year (1%)	11.2	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: Yes

Extreme Heat	High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	American Legion
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Boston
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: American Legion Construction Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.
Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)
Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people
Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
Will the infrastructure reduce the risk of flooding?
No
If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate
If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million
Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist
What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

School Street

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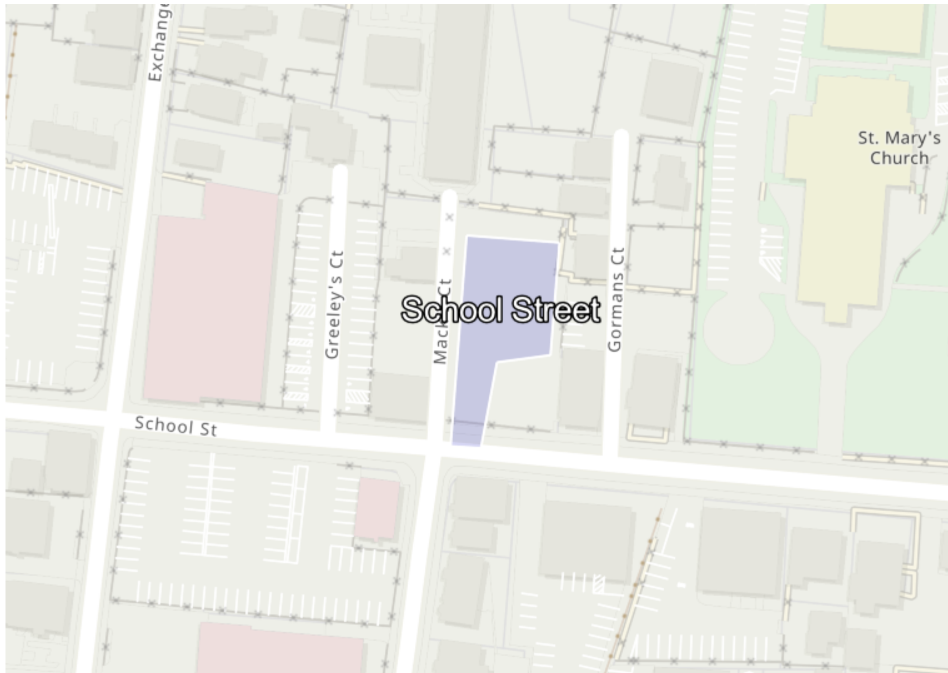
Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Not Exposed
Extreme Heat	High Exposure



Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
School Street Connection Shaft Site	Low Risk	High Risk	Low Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
School Street Connection Shaft Site					
Extreme Precipitation					
School Street Connection Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
School Street Connection Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- Existing impervious area of the project site is greater than 50%
- No historic flooding at project site

- No increase to impervious area

Extreme Precipitation - Riverine Flooding

This project received a "Not Exposed" because of the following:

- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is more than 500ft from a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Existing impervious area of the project site is greater than 50%
- No increase to the impervious area of the project site
- No tree removal

Scoring Rationale - Asset Risk Scoring

Asset - School Street Connection Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: School Street Connection Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
School Street Connection Shaft Site	2070	100-Year (1%)	10.9	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: No

Extreme Heat	High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	School Street
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Waltham
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	No
Are existing trees being removed as part of the proposed project?	No

Project Assets

Asset: School Street Connection Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.
Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)
Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people
Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
Will the infrastructure reduce the risk of flooding?
No
If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate
If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million
Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrastructure may reduce the ability to maintain most government services, while some sevices will still exist
What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

Cedarwood Pumping Station
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Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Benefits	Scores
Project Score	Low

Exposure	Scores
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Moderate Exposure
Extreme Heat	High Exposure

Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Cedarwood Pumping Station Connection Shaft Site	Low Risk	High Risk	High Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Cedarwood Pumping Station Connection Shaft Site					
Extreme Precipitation					
Cedarwood Pumping Station Connection Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Cedarwood Pumping Station Connection Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "Moderate Exposure" because of the following:

- Part of the project is within 500ft of a waterbody and less than 20ft above the waterbody
- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Between 10% and 40% of the existing project site has canopy cover
- Located within 100 ft of existing water body

Scoring Rationale - Asset Risk Scoring

Asset - Cedarwood Pumping Station Connection Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Cedarwood Pumping Station Connection Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Cedarwood Pumping Station Connection Shaft Site	2070	100-Year (1%)	10.9	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: Yes

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Cedarwood Pumping Station
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Waltham
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No

Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes
Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Cedarwood Pumping Station Connection Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

Hegarty Pumping Station
Date Created: 4/28/2022 4:47:29 PM   Created By: ofisher@vhb.com   Download

Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Moderate Exposure
Extreme Heat	High Exposure

Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Hegarty Pumping Station Connection Shaft Site	Low Risk	High Risk	High Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Hegarty Pumping Station Connection Shaft Site					
Extreme Precipitation					
Hegarty Pumping Station Connection Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Hegarty Pumping Station Connection Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site

- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "Moderate Exposure" because of the following:

- Part of the project is within 500ft of a waterbody and less than 20ft above the waterbody
- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is less than 10%

Scoring Rationale - Asset Risk Scoring

Asset - Hegarty Pumping Station Connection Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Hegarty Pumping Station Connection Shaft Site | Infrastructure

Sea Level Rise/Storm Surge | Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation | High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Hegarty Pumping Station Connection Shaft Site	2070	100-Year (1%)	11	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: Yes

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Hegarty Pumping Station
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Wellesley
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Hegarty Pumping Station Connection Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.
Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)
Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people
Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
Will the infrastructure reduce the risk of flooding?
No
If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate
If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million
Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected
If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrastructurcture may reduce the ability to maintain most government services, while some sevices will still exist
What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

St.Mary Street Pumping Station

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Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: No

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Not Exposed
Extreme Heat	High Exposure

Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
St.Mary Street Pumping Station Connection Shaft Site	Low Risk	High Risk	Low Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
St.Mary Street Pumping Station Connection Shaft Site					
Extreme Precipitation					
St.Mary Street Pumping Station Connection Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
St.Mary Street Pumping Station Connection Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "Not Exposed" because of the following:

- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is more than 500ft from a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover

Scoring Rationale - Asset Risk Scoring

Asset - St.Mary Street Pumping Station Connection Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: St.Mary Street Pumping Station Connection Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
St.Mary Street Pumping Station Connection Shaft Site	2070	100-Year (1%)	11	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: No

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	St.Mary Street Pumping Station
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Needham
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes
Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: St.Mary Street Pumping Station Connection Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.

Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.

Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.

Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?

No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?

Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?

There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?

Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?

Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.

No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?

No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?

Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?

Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

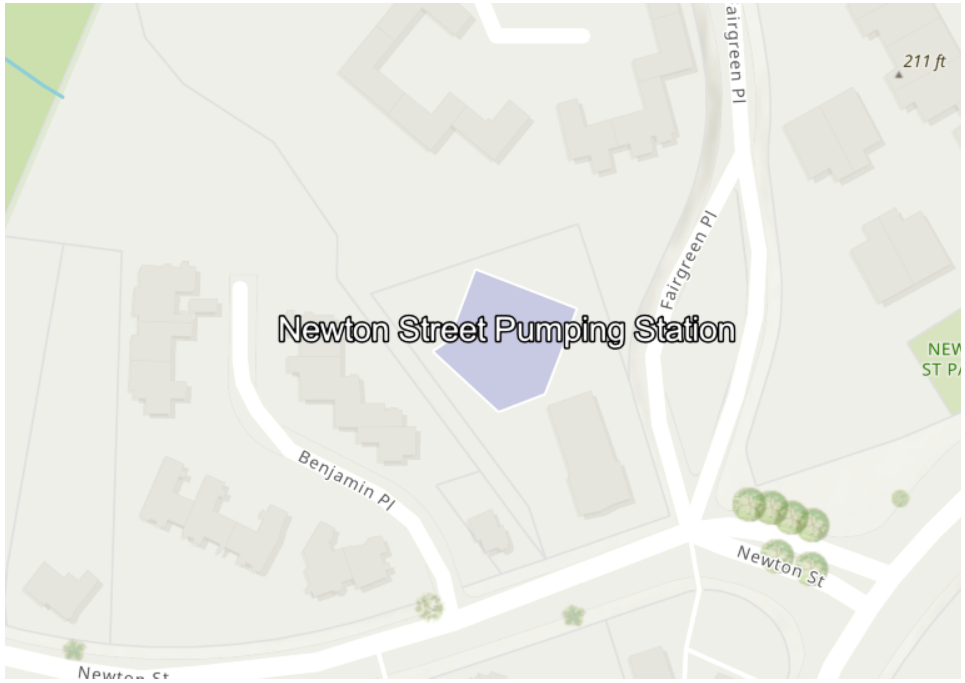
Newton Street Pumping Station
Date Created: 4/28/2022 4:59:52 PM Created By: ofisher@vhb.com Download

Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Not Exposed
Extreme Heat	High Exposure



Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Newton Street Pumping Station Connection Shaft Site	Low Risk	High Risk	Low Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Newton Street Pumping Station Connection Shaft Site					
Extreme Precipitation					
Newton Street Pumping Station Connection Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Newton Street Pumping Station Connection Shaft Site	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- Existing impervious area of the project site is between 10% and 50%

Extreme Precipitation - Riverine Flooding

This project received a "Not Exposed" because of the following:

- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is more than 500ft from a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is between 10% and 50%

Scoring Rationale - Asset Risk Scoring

Asset - Newton Street Pumping Station Connection Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Newton Street Pumping Station Connection Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Newton Street Pumping Station Connection Shaft Site	2070	100-Year (1%)	11.1	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: No

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Newton Street Pumping Station
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Brookline
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes
Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Newton Street Pumping Station Connection Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.

Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.

Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.

Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?

No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?

Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?

There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?

Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?

Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.

No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?

No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?

Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?

Loss of confidence in government agency

Report Comments

N/A

Climate Resilience Design Standards Tool Project Report

Southern Spine Mains

Date Created: 4/28/2022 5:01:00 PM
Created By: ofisher@vhb.com
Date Report Generated: 9/13/2022 4:26:07 PM
Tool Version: Version 1.2
Project Contact Information: Colleen Rizzi (Colleen.Rizzi@mwra.com)

Project Summary

Link to Project

Estimated Capital Cost: $1500000000.00
End of Useful Life Year: 2127
Project within mapped Environmental Justice neighborhood: Yes

Ecosystem Service Benefits	Scores
Project Score	Low

Exposure	Scores
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Not Exposed
Extreme Heat	High Exposure

Asset Preliminary Climate Risk Rating Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Southern Spine Mains Connection Shaft Site	Low Risk	High Risk	Low Risk	High Risk

Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Southern Spine Mains Connection Shaft Site					
Extreme Precipitation					
Southern Spine Mains Connection Shaft Site	2070			100-yr (1%)	Tier 3
Extreme Heat					
Southern Spine Mains Connection Shaft Site	2070		90th		Tier 3

Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- Existing impervious area of the project site is between 10% and 50%

Extreme Precipitation - Riverine Flooding

This project received a "Not Exposed" because of the following:

- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is more than 500ft from a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Not located within 100 ft of existing water body
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Existing impervious area of the project site is between 10% and 50%

Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

Asset - Southern Spine Mains Connection Shaft Site
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: Southern Spine Mains Connection Shaft Site — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: NOT APPLICABLE

Projected Water Surface Elevation: NOT APPLICABLE

Projected Wave Action Water Elevation: NOT APPLICABLE

Projected Wave Heights: NOT APPLICABLE

Projected Duration of Flooding: NOT APPLICABLE

Projected Design Flood Velocity: NOT APPLICABLE

Projected Scour & Erosion: NOT APPLICABLE

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

LIMITATIONS: The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

The projected values, standards, and guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Southern Spine Mains Connection Shaft Site	2070	100-Year (1%)	11.2	Downloadable Methodology PDF

Projected Riverine Peak Discharge & Peak Flood Elevation: NOT APPLICABLE

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Heat Index: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Growing Degree Days: NOT APPLICABLE

Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Number of Heat Waves Per Year & Average Heat Wave Duration: APPLICABLE
Methodology to Estimate Projected Values : Tier 3

Projected Cooling Degree Days & Heating Degree Days (base = 65°F): NOT APPLICABLE

Project Inputs

Core Project Information

Name:	Southern Spine Mains
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Boston
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Service Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes
Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No

Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Southern Spine Mains Connection Shaft Site
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.
Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.
Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.
Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?
No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?
Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?
There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?
Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?
Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.
No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?
No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?
Loss of infrasturcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?
Loss of confidence in government agency

Report Comments

N/A

RMAT Climate Resilience Design Standards Tool Project Report

Hultman Aqueduct Isolation Valve
Date Created: 5/5/2022 12:24:57 PM   Created By: ofisher@vhb.com   Download

Project Summary

Link to Project

Estimated Construction Cost: $1500000000.00
End of Life Year: 2127
Project within mapped Environmental Justice neighborhood: No

Ecosystem Benefits	Scores
Project Score	Low
Exposure	**Scores**
Sea Level Rise/Storm Surge	Not Exposed
Extreme Precipitation - Urban Flooding	High Exposure
Extreme Precipitation - Riverine Flooding	Not Exposed
Extreme Heat	High Exposure

Asset Summary

Number of Assets: 1

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
Hultman Aqueduct Isolation Valve	Low Risk	High Risk	Low Risk	High Risk

Project Outputs

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
Sea Level Rise/Storm Surge					
Hultman Aqueduct Isolation Valve					
Extreme Precipitation					
Hultman Aqueduct Isolation Valve	2070			100-yr (1%)	Tier 3
Extreme Heat					
Hultman Aqueduct Isolation Valve	2070		90th		Tier 3

Scoring Rationale - Exposure

Sea Level Rise/Storm Surge

This project received a "Not Exposed" because of the following:

- Not located within the predicted mean high water shoreline by 2030
- No historic coastal flooding at project site
- Not located within the Massachusetts Coast Flood Risk Model (MC-FRM)

Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Increased impervious area
- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site

- Existing impervious area of the project site is less than 10%

Extreme Precipitation - Riverine Flooding

This project received a "Not Exposed" because of the following:

- No historic riverine flooding at project site
- The project is not within a mapped FEMA floodplain [outside of the Massachusetts Coast Flood Risk Model (MC-FRM)]
- Project is more than 500ft from a waterbody
- Project is not likely susceptible to riverine erosion

Extreme Heat

This project received a "High Exposure" because of the following:

- 30+ days increase in days over 90 deg. F within project's useful life
- Increased impervious area
- Existing trees are being removed as part of the proposed project
- Less than 10% of the existing project site has canopy cover
- Located within 100 ft of existing water body

Scoring Rationale - Asset Risk Scoring

Asset - Hultman Aqueduct Isolation Valve
Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Greater than 100,000 people would be directly affected by the loss/inoperability of the asset
- The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.
- Inoperability of the asset would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses
- Cost to replace is greater than $100 million
- There are no hazardous materials in the asset

Project Design Standards Output

Asset: Hultman Aqueduct Isolation Valve — Infrastructure

Sea Level Rise/Storm Surge — Low Risk

Applicable Design Criteria

Projected Tidal Datums: No
Projected Water Surface Elevation: No
Projected Wave Action Water Elevation: No
Projected Wave Heights: No
Projected Duration of Flooding: No
Projected Design Flood Velocity: No
Projected Scour & Erosion: No

Extreme Precipitation — High Risk

Target Planning Horizon: 2070
Return Period: 100-yr (1%)

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms: Yes

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
Hultman Aqueduct Isolation Valve	2070	100-Year (1%)	11	Downloadable Methodology PDF

Limitations: While precipitation depth is useful for project planning and design, rainfall distribution and peak intensity of the design storm is recommended to also be considered. Lower-intensity, longer-duration storms allow time for infiltration and reduce the load on the infrastructure system over the duration of the storm. Higher-intensity, shorter-duration storms often have higher runoff volumes because the water does not have enough

time to infiltrate and infrastructure systems (e.g., catch basins) and may overflow or back up during such storms. In the Northeast, short -duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. These events can result in the rapid inundation of the asset project location. Design should consider both short- and long-duration precipitation events and how they may impact the asset.

The precipitation values provided by this Tool (version 1) are recommended to inform planning and design, but they do not guarantee that the asset will be protected from or be able to withstand an extreme precipitation event. The planning, design, and review guidance accompanying these values is general and projects are encouraged to do their own due diligence to understand the vulnerability of their asset.

Projected Riverine Peak Discharge & Peak Flood Elevation: No

Extreme Heat High Risk

Target Planning Horizon: 2070
Percentile: 90th Percentile

Applicable Design Criteria

Tiered Methodology: Tier 3

Projected Annual/Summer/Winter Average Temperatures: Yes
Projected Heat Index: Yes
Projected Growing Degree Days: No
Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F: Yes
Projected Number of Heat Waves Per Year & Average Heat Wave Duration: Yes
Projected Cooling Degree Days & Heating Degree Days (base = 65°F): No

Project Inputs

Core Project Information

Name:	Hultman Aqueduct Isolation Valve
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2127
Location of Project:	Weston
Estimated Capital Cost:	$1,500,000,000
Who is the Submitting Entity?	Private Other Massachusetts Water Resource Authority Colleen Rizzi (Colleen.Rizzi@mwra.com)
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	No
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Through the Metropolitan Water Tunnel Program (the Program), the Authority will construct approximately 14 miles of new water supply deep rock tunnels that will provide redundancy for MWRA's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), City Tunnel Extension (1963) and Dorchester Tunnel (1976) serving 2.5 million people. The Program will also allow the Authority's aging existing water tunnel system to be rehabilitated without interrupting service. It is anticipated that up to 12 shaft sites will be required as part of the deep rock tunnel construction and provide permanent connections to the existing surface water distribution system. Tunnel construction is planned to occur from approximately 2026-2027 through 2037. The project is subject to MEPA review.
Project Submission Comments:	

Project Ecosystem Benefits

Factors Influencing Output

✓ Project protects public water supply

Factors to Improve Output

✓ Incorporate green infrastructure to filter stormwater

Is the primary purpose of this project ecological restoration?

No

Project Benefits

Provides flood protection through nature-based solutions	No
Reduces storm damage	No
Recharges groundwater	No
Protects public water supply	Yes

Filters stormwater using green infrastructure	Maybe
Improves water quality	No
Promotes decarbonization	No
Enables carbon sequestration	No
Provides oxygen production	No
Improves air quality	No
Prevents pollution	No
Remediates existing sources of pollution	No
Protects fisheries, wildlife, and plant habitat	No
Protects land containing shellfish	No
Provides pollinator habitat	No
Provides recreation	No
Provides cultural resources/education	No

Project Climate Exposure

Is the primary purpose of this project ecological restoration?	No
Does the project site have a history of coastal flooding?	No
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	No
Does the project site have a history of riverine flooding?	No
Does the project result in a net increase in impervious area of the site?	Yes
Are existing trees being removed as part of the proposed project?	Yes

Project Assets

Asset: Hultman Aqueduct Isolation Valve
Asset Type: Utility Infrastructure
Asset Sub-Type: Water
Construction Type: New Construction
Construction Year: 2027
Useful Life: 100

Identify the length of time the asset can be inaccessible/inoperable without significant consequences.

Infrastructure must be accessible/operable at all times, even during natural hazard event.

Identify the geographic area directly affected by permanent loss or significant inoperability of the infrastructure.

Impacts would be regional (more than one municipality and/or surrounding region)

Identify the population directly served that would be affected by the permanent loss or significant inoperability of the infrastructure.

Greater than 100,000 people

Identify if the infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

The infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

Will the infrastructure reduce the risk of flooding?

No

If the infrastructure became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?

Inoperability of the infrastructure would result in moderate or severe injuries or moderate or severe impacts to chronic illnesses

If there are hazardous materials in your infrastructure, what are the extents of impacts related to spills/releases of these materials?

There are no hazardous materials in the infrastructure

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?

Significant – Inoperability is likely to impact other facilities, assets, or buildings and result in cascading impacts that will likely affect their ability to operate

If the infrastructure was damaged beyond repair, how much would it approximately cost to replace?

Greater than or equal to $100 million

Does the infrastructure function as an evacuation route during emergencies? This question only applies to roadway projects.

No

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?

No impact on surrounding natural resources is expected

If the infrastructure became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the infrastructure is not able to serve or operate its intended users or function)?

Loss of infrastructurcture may reduce the ability to maintain most government services, while some sevices will still exist

What are the impacts to loss of confidence in government resulting from loss of infrastructure functionality (i.e. the infrastructure asset is not able to serve or operate its intended users or function)?

Loss of confidence in government agency

Report Comments

N/A

Appendix I: Draft Section 61 Findings by Agency

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I Draft Section 61 Findings by Agency

The Massachusetts Environmental Policy Act (MEPA) regulations, at 301 Code of Massachusetts Regulations (CMR) 11.07(j), outline mitigation measures to be addressed in the Environmental Impact Report (EIR) process, including an "assessment of physical, biological and chemical measures and management techniques designed to limit negative environmental impacts or to cause positive environmental impacts during development and operation of a Project." The Secretary's Certificate on the Environmental Notification Form (ENF) for the Metropolitan Water Tunnel Program (the Program) included requirements for the scope of the Draft Environmental Impact Report (DEIR), including a mitigation chapter that:

- Demonstrates that the Massachusetts Water Resources Authority (MWRA, the Authority) consulted with the MEPA Office prior to filing the DEIR for guidance on the analyses of impacts and mitigation measures appropriate for the level of Program information to be provided (**Section 7.2**)
- Summarizes all proposed mitigation measures, including construction-period measures (**Section 7.2** and **Section 7.3**)
- Includes draft Section 61 Findings for each permit to be issued by state agencies (**Section I.4.1**); and
- Contains clear commitments to implement these mitigation measures, estimates the individual costs of each proposed measure, identifies the parties responsible for implementation, and provides a schedule for implementation (**Section 7.2**).

This Appendix provides a brief overview of the Program, explains the history of the MEPA review process for the Metropolitan Water Tunnel Program, outlines required state and federal permits and their authorities, and provides draft Section 61 determination language for state agencies issuing Section 61 Findings documenting mitigation commitments.

I.1 Program Description

The Authority plans to construct two new deep rock water supply tunnels (north and south tunnels). Known as the Metropolitan Water Tunnel Program, this important new infrastructure will provide redundancy for the Authority's existing Metropolitan Tunnel System, which includes the City Tunnel (1950), the City Tunnel Extension (1963), and the Dorchester Tunnel (1976). The Metropolitan Tunnel System delivers 60 percent of the water that travels eastward from the Quabbin Reservoir through a series of tunnels and aqueducts to the Authority's state-of-the-art John J. Carroll Water Treatment Plant in Marlborough to serve 53 communities. Treated water is conveyed from the plant through the MetroWest Water Supply Tunnel (MWWST) and the Hultman Aqueduct.

The new, redundant deep rock tunnels will originate at a site located at the westernmost portion of the Metropolitan Tunnel System roughly in the vicinity of the Interstate I-90/I-95 Interchange in Weston. The tunnels will be constructed such that water flows in two directions, with one tunnel extending north towards Waltham and the other south towards Boston/Dorchester. Each tunnel will connect to existing water supply infrastructure at key locations to achieve redundancy goals.

The Program was conceived to address outstanding challenges, primarily the inability to maintain or repair the existing Metropolitan Tunnel System or readily respond to emergencies because boil water orders are needed when implementing back-up measures. As a result of the construction of the two new deep rock tunnels, the Program would allow the Authority to take its aging existing water tunnel system offline to be rehabilitated without interrupting water service to more than 2.5 million[1] water customers.

Program construction is estimated to take approximately 8 to 12 years and is planned to occur over the 2027 to 2040 timeframe. The Authority expects that the proposed new deep-rock tunnel system will be placed into service by or around 2040 and that the system will have a useful life of more than 100 years. Therefore, for the sizing of the proposed facilities, the Authority considered projected future water demands due to population and employment increases within the service area and increased water use efficiency. The intent of the Program is not to increase total capacity of the system, but to ensure redundancy by providing a backup to the existing Metropolitan Tunnel System if it were ever out of service for planned or unplanned reasons.

I.2 Summary of Program Changes Since the ENF

The Secretary's Certificate on the ENF requested a description of Program changes since the filing of the ENF. While the Program's intent has not changed since the ENF, the alternatives analysis has advanced to ultimately identify a preferred alternative, as well as two back-up alternatives, in this DEIR. Prior to the ENF, the Authority completed preliminary steps to identify the type and size of the tunnels. The ENF built upon the previous studies and identified 13 North Tunnel Alternatives and 15 South Tunnel Alternatives, screening 28 preliminary alternatives using two tiers of screening criteria. The alternatives analysis in the ENF concluded that a deep rock tunnel to the north and south would be the preferred solution to advance for further evaluation. Each tunnel alternative would include a TBM launching shaft at the starting point for each tunnel segment and a TBM receiving shaft at each tunnel segment terminus. See **Appendix C, Alternatives Supporting Documentation**, for additional information on the 28 alternatives previously evaluated.

Since the ENF filing, the Authority identified and evaluated potential launching, receiving, and connection point locations to determine the candidate alternatives that would advance into the DEIR. Since the candidate DEIR Alternatives are made up of different combinations of launching, receiving, and connection sites and different tunnel segments, the Authority developed a multi-criteria decision tool to consistently apply the evaluation criteria and subcriteria to each site or tunnel segment, and to score the alternative components to develop a mechanism for comparing one against the other and in combination. The candidate DEIR Alternatives are composed of two or three deep rock tunnel segments, each with a launching shaft site at the start of the tunnel segment, a receiving shaft site at the terminus of the tunnel segment, connection shaft sites where the tunnels are connected to the existing water distribution system, and deep rock tunnel segments connecting the various shaft sites. Together these shaft sites and tunnel segments comprise a tunnel alignment.

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1 The Authority provides a total of 3.1 million people with water and sewer services, 2.5 million of whom are supplied with water only.

Ten candidate DEIR Alternatives were evaluated and ranked to ultimately determine the preferred alternative and two back-up alternatives (in the event the Authority determines the Preferred Alternative no longer effectively meets the Program's goals). The DEIR details this process in **Chapter 3, Alternatives Analysis.** The Authority also assessed impacts for the Preferred Alternative and two back-up alternatives, as described in **Chapter 4, Existing Conditions and Assessment of Impacts**.

I.3 Status of Review/Updates to MEPA Guidance

The Authority filed an ENF for the Program with the MEPA Office on March 31, 2021, to initiate MEPA review. The ENF was noticed in the Environmental Monitor on April 7, 2021, and the Secretary of the Executive Office of Energy and Environmental Affairs (EEA) issued an ENF Certificate on May 7, 2021, requiring that the Program prepare a mandatory DEIR.

This DEIR was prepared in accordance with the scope outlined in the ENF Certificate. Since the ENF filing, MEPA amended its regulations under 301 CMR 11.00, which were promulgated on December 24, 2021. Additionally, the *MEPA Interim Protocol on Climate Change Adaptation and Resiliency*[2] is effective for all new filings as of October 1, 2021, and the *MEPA Public Involvement Protocol for Environmental Justice Populations*[3] and the *MEPA Interim Protocol for Analysis of Project Impacts on Environmental Justice Populations*[4] were finalized and are effective as of January 1, 2022, for all new filings. Although the ENF was filed before these effective dates, the Authority continues to work with MEPA on assessing Program impacts to EJ populations and resiliency considerations in accordance with these updates and the DEIR scope outlined in the ENF Certificate.

The Authority has elected to voluntarily follow components of the *MEPA Interim Protocol on Climate Change Adaptation and Resiliency* as a part of this DEIR. This includes use of the Resilient Massachusetts Action Teams' Climate Resilience Design Standards Tool (RMAT Tool) for evaluating the Program's climate exposure to sea-level rise, flooding, and extreme heat as well as mitigating these impacts (see **Chapter 6, Climate Change**).

Similarly, the Authority has voluntarily followed components of the *MEPA Interim Protocol for Analysis of Project Impacts on Environmental Justice Populations* and the *MEPA Public Involvement Protocol for Environmental Justice Populations* as a part of this DEIR. This includes identifying EJ populations using the EJ Maps Viewer and Department of Public Health (DPH) criterion data by census tract within 1 mile of each site to assess Program impacts on EJ populations. Details on the Program's public outreach plan and

2 MEPA Office. (2021, Oct. 1). MEPA Interim Protocol on Climate Change Adaptation and Resiliency. [Online.] Available: https://www.mass.gov/doc/mepa-interim-protocol-on-climate-change-adaptation-and-resiliency-effective-oct-1-2021/download.

3 MEPA Office. (2022, Jan. 1). MEPA Public Involvement Protocol for Environmental Justice Populations. [Online.] Available: https://www.mass.gov/doc/final-mepa-public-involvement-protocol-for-environmental-justice-populations-effective-date-of-january-1-2022/download.

4 MEPA Office. (2022, Jan. 1). MEPA Interim Protocol for Analysis of Project Impacts on Environmental Justice Populations. [Online.] Available: https://www.mass.gov/doc/final-mepa-interim-protocol-for-analysis-of-project-impacts-on-environmental-justice-populations-effective-date-of-january-1-2022/download.

a summary of the outreach conducted to date, as well as EJ populations near the Program's sites, are documented in **Chapter 2, Public Outreach and Environmental Justice**.

I.4 Draft Section 61 Findings

Massachusetts General Law Chapter 30, Section 61 authorizes state agencies with permitting responsibilities to make an official determination regarding potential impacts from a proposed project and whether impacts have been avoided, minimized, and/or mitigated for appropriately. The law requires agencies/authorities to issue a determination that includes a finding describing the environmental impact, if any, of the Project and whether all feasible measures have been taken to avoid or minimize that impact.

I.4.1 State Agency Actions

In addition to compliance with MEPA, a number of state agency actions are needed for the Program, as listed in **Table I.4-1**.

Table I.4-1 Potential State Actions

Agency/Department	Permit/Approval/Action	Status
Commonwealth of Massachusetts		
Massachusetts Department of Environmental Protection	Water Management Act	To be obtained
	Section 401 Water Quality Certificate[1]	To be obtained
	Chapter 91 License[1]	To be obtained
Massachusetts Department of Transportation (MassDOT)	Land disposition/easements[1]	To be obtained
	Highway Access/Construction Access Permits[1]	To be obtained
Department of Conservation and Recreation (DCR)	Construction Access Permits	To be obtained
	Land disposition/easements	To be obtained
	Compliance with Article 97[1]	To be obtained
Massachusetts Bay Transportation Authority (MBTA)	MBTA Right of Way Access License Agreement	To be obtained, if needed
Massachusetts Historical Commission (MHC)	Review pursuant to MGL Ch. 9, Section 26-27C (Section 61 Findings not applicable)	Underway through MEPA review

1 Indicates that the permit or approval is site specific

Note: This is a preliminary list of state permits and approvals that may be sought for the Program. This list is based on current information about the Program and is subject to change as the design of the Program evolves.

I.4.1.1 Massachusetts Department of Environmental Protection

Project Name: *Metropolitan Water Tunnel Program*

Project Location: *Waltham, Weston, Newton, Wellesley, Needham, Brookline, Boston*

Project Proponent: *Massachusetts Water Resources Authority*

EEA Number: *16355*

Date Noticed in Monitor: *October 24, 2022*

Applicable State Action/Permit

- Water Management Act
- Section 401 Water Quality Certificate
- Chapter 91 License

This Section 61 Finding for the Metropolitan Water Tunnel Program (EEA 16355) has been prepared in accordance with the provisions of M.G.L. Chapter 30, Section 61 and 301 CMR 11.07(6)(k).

The potential environmental impacts of the Program are characterized and quantified in the Metropolitan Water Tunnel Program Draft Environmental Impact Report (DEIR), which is incorporated by reference into this Section 61 Finding. To the greatest extent practicable, the Authority has taken all feasible measures to avoid and/or minimize adverse environmental impacts of the Program. Where impacts are not avoidable, the Authority has worked throughout the planning and environmental review process to develop measures to mitigate impacts of the Program to the extent practicable. With the implementation of the proposed mitigation, and cooperation with state agencies, the Massachusetts Department of Environmental Protection (MassDEP) finds that there are no significant unmitigated impacts.

*The Authority recognizes that the identification of effective mitigation, and implementation of that mitigation throughout the life of the Metropolitan Water Tunnel Program, is central to its responsibilities under MEPA. Accordingly, the Authority has prepared a Table of Mitigation Commitments (*__Table I.4-2__ and __Table I.4-3__*) that specifies, for each potential state permit, the mitigation that the Authority would provide. In the Table of Mitigation Commitments, the Authority provides clear commitments to implement the mitigation measures; identifies the parties responsible for implementation of measures; and provides a schedule for their implementation based upon Program phasing.*

MassDEP has reviewed the MEPA filings for the Metropolitan Water Tunnel Program and finds that the environmental impacts resulting from construction of the Metropolitan Water Tunnel Program are those impacts as described in the DEIR, which would be updated as needed in permit applications submitted for compliance with federal and state environmental laws. Pursuant to M.G.L. Chapter 30, Section 61, MassDEP finds that with the implementation of mitigation measures as identified in the Table of Mitigation Commitments, all practicable and feasible means and measures would have been taken to avoid or minimize potential damage to the environment due to the construction and operation of the Metropolitan Water Tunnel Program. In making this finding, MassDEP has considered reasonably foreseeable climate change impacts and environmental justice impacts.

Water Supply Mitigation

As discussed in **Chapter 5**, **Water Supply and Water Management Act**, during construction, there would be the potential for groundwater drawdown due to tunnel inflows to temporarily impact water levels in surface waters and wells. No impacts to groundwater resources would be anticipated in the Final Condition. Loss of annual recharge resulting from new impervious area at launching and receiving shaft sites, and connection and isolation valve sites would be minimized in accordance with the Stormwater Management Standards.

In areas of concern, the tunnel boring machine (TBM) has the capability to simultaneously drill and pre-grout the tunnel route, which would reduce the volume of groundwater inflow into the tunnel and help mitigate potential impacts to water supply wells. The contract documents would specify that the Contractor conduct a preconstruction survey to verify the locations of wells and well characteristics. The Water Supply Contingency Plan (see **Appendix J**) includes a summary of mitigation measures the Contractor would implement if water supplies would be impacted during construction.

The mitigation to reduce the potential for groundwater inflow and resulting possible drawdown during construction would be probing from the tunnel heading in advance of the excavation to assess water inflows, followed by pre-excavation grouting (also from the tunnel heading) in the event the probing encounters water-bearing features. Probing and pre-excavation grouting would be implemented before the tunnel proceeds beneath select important areas of groundwater well production or beneath local water bodies; the determination for probing (both where this may be required and the number and relative position of probe holes) would be assessed during the final design phase of the Program. Construction contract specifications for hard-rock tunnels typically have limits for groundwater inflows into probe holes, which trigger the need for pre-excavation grouting. These limits would also be set during final design.

For cases where groundwater is affected by tunnel excavation after implementation of the grouting programs, a mitigation for disruption of water supply from groundwater wells is to provide users with an alternative water supply until groundwater levels can be restored. This mitigation is described in the Water Supply Contingency Plan in Appendix J.

Table I.4-2 Water Supply Impacts and Mitigation

<table>
<tr><th>Estimated Impact</th><th>Mitigation</th><th>Responsible Party/Schedule</th></tr>
<tr><td colspan="2">Potential Construction Period Impacts</td><td></td></tr>
<tr><td>Potential for groundwater drawdown<table><tr><th>Town</th><th>Location</th></tr><tr><td>All communities</td><td>Along Tunnel Alignments</td></tr></table></td><td>Probing and pre-excavation grouting before the tunnel proceeds beneath select important areas of groundwater well production or beneath local water bodies</td><td>Contractors/
During Construction</td></tr>
<tr><td>Loss of potable or irrigation well along the tunnel Alignment</td><td>Implement Water Supply Contingency Plan with alternate source of water</td><td>Authority prepares Contingency Plan / Prior to construction.</td></tr>
</table>

Table I.4-2 Water Supply Impacts and Mitigation

Estimated Impact	Mitigation	Responsible Party/Schedule
Potential Construction Period Impacts		
		Authority implements Contingency Plan / During Construction.

Wetlands and Waterways

As a result of implementation of the avoidance measures described in **Section 4.6.7** of **Chapter 4, Wetlands and Waterways**, none of the proposed DEIR Alternatives would involve permanent impacts to any federally jurisdictional Vegetated Wetlands (VW). Unavoidable permanent impacts to federally jurisdictional waterway (WW) would be required due discharge pipes and associated riprap splash pads necessary for dewatering and to enable future tunnel maintenance. The dewatering discharge pipes and rip rap splash pads also would require Chapter 91 Licenses for placement of the structures at Clematis Brook (Fernald Property), two locations along Seaverns Brook (Tandem Trailer and Bifurcation), the Charles River (Highland Avenue) and Canterbury Brook (American Legion). Unavoidable temporary impacts to federally jurisdictional VW would be required for connections to the existing water supply infrastructure. The issuance of a Section 401 Water Quality Certification by MassDEP would be required for the discharges of fill into waters of the U.S. for splash pad and pipeline construction. In accordance with Clean Water Act (CWA) requirements, mitigation would be provided for all proposed permanent wetland impacts. These impacts and associated mitigation measures are summarized in **Table I.4-3** and in the following sections.

Mitigation for VW impacts would include restoring the wetland in-place, in-kind upon completion of pipeline construction. Stormwater mitigation measures for the construction-period would be detailed in the Stormwater Pollution Prevention Plan (SWPPP) to be prepared by the contractor pursuant to the NPDES Construction General Permit (CGP), which would include:

- Minimization of exposed soils through sequencing work and temporary stabilization.
- Site controls and erosion and sedimentation Best Management Practices (BMPs) such as siltation barriers, temporary sediment basins and stabilized construction entrances to prevent siltation in waterways.
- Regular inspection and monitoring of discharges in accordance with NPDES CGP to avoid permanent and indirect effects due to construction site runoff.

Table I.4-3 State Wetland and Waterway Resources Impact and Mitigation

Estimated Impact				**Mitigation**	**Responsible Party/Schedule**
Construction Period Impacts					
A buried pipeline for surface connection would cause temporary impacts to federally jurisdictional VW, in sf:				Restoration and revegetation of areas disturbed by construction	Contractors/ Post construction
	Alt.3	**Alt.4**	**Alt.10**		
American Legion	1,558	1,558	1,558		
Total	**1,558**	**1,558**	**1,559**		
A dewatering discharge pipe and rip rap splash pad would cause temporary impacts to federally jurisdictional VW, in sf:				Restoration and revegetation of areas disturbed by construction	Contractors/ Post construction
	Alt.3	**Alt.4**	**Alt.10**		
Fernald Property	116	116	116		
Total	**116**	**116**	**116**		
Construction of dewatering discharge pipes and rip rap splash pads would cause temporary impacts to federally jurisdictional WW, in sf:				Restoration and revegetation of areas disturbed outside of the footprint of the splash pad	Contractors/ Post construction
	Alt.3	**Alt.4**	**Alt.10**		
Fernald Property	289	289	289		
Tandem Trailer	652	652	-		
Bifurcation	652	-	-		
Highland Avenue	6252	652	1,034		
American Legion	289	289	289		
Total	**2,534**	**1,882**	**1,612**		
Potential impacts on wetlands, surface waters on or adjacent to site to be impacted by erosion or sedimentation All sites				Restoration and revegetation of areas disturbed by construction, including riverfront area	Contractors/ Post construction
				Implementation of erosion and sedimentation Best Management Practices (BMPs)	Contractors/ During construction
Potential impact on surface water quality due to pollutants used in tunnel dewatering discharges, disinfection, and flushing All sites				Regular inspection and monitoring of discharges in accordance with NPDES Construction General Permit (CGP) to avoid permanent and indirect effects due to construction	Contractors/ During construction

Table I.4-3 State Wetland and Waterway Resources Impact and Mitigation

<table>
<tr><th>Estimated Impact</th><th>Mitigation</th><th>Responsible Party/Schedule</th></tr>
<tr><td rowspan="3">Potential for groundwater drawdown due to tunnel inflows temporarily impacting surface water levels and wells
All sites</td><td>Preconstruction survey to verify well locations and characteristics</td><td>Contractors/
Preconstruction</td></tr>
<tr><td>Limitations on volumes of groundwater inflows to require initiation of pre-excavation and/or post-excavation grouting</td><td>Contractors/
During construction</td></tr>
<tr><td>Provide alternative water supply in accordance with Water Supply Contingency Plan (Appendix J)</td><td>Contractors/
During construction</td></tr>
<tr><td colspan="3">Permanent Impacts</td></tr>
<tr><td>Permanent impacts to federally jurisdictional WW for rip rap splash pads at dewatering discharge locations, in sf:
<table>
<tr><th></th><th>Alt.3</th><th>Alt.4</th><th>Alt.10</th></tr>
<tr><td>Fernald Property</td><td>91</td><td>91</td><td>91</td></tr>
<tr><td>Tandem Trailer</td><td>368</td><td>368</td><td>-</td></tr>
<tr><td>Bifurcation</td><td>368</td><td>-</td><td>-</td></tr>
<tr><td>Highland Avenue Sites</td><td>368</td><td>368</td><td>726</td></tr>
<tr><td>American Legion</td><td>91</td><td>91</td><td>91</td></tr>
<tr><td>Total</td><td>1,286</td><td>918</td><td>908</td></tr>
</table></td><td>Restoration and revegetation of areas disturbed outside of the footprint of the splash pad</td><td>Contractors/
Post construction</td></tr>
</table>

I.4.1.2 Massachusetts Department of Transportation

Project Name: *Metropolitan Water Tunnel Program*

Project Location: *Waltham, Weston, Newton, Wellesley, Needham, Brookline, Boston*

Project Proponent: *Massachusetts Water Resources Authority*

EEA Number: *16355*

Date Noticed in Monitor: *October 24, 2022*

Applicable State Action/Permits

- Land disposition/easements[1]
- Highway Access/Construction Access Permits

This Section 61 Finding for the Metropolitan Water Supply Tunnel Program (EEA 16355) has been prepared in accordance with the provisions of M.G.L. Chapter 30, Section 61 and 301 CMR 11.07(6)(k).

The potential environmental impacts of the Program are characterized and quantified in the Metropolitan Water Tunnel Program Draft Environmental Impact Report (DEIR), which is incorporated by reference into this Section 61 Finding. To the greatest extent practicable, the Authority has taken all feasible measures to avoid and/or minimize adverse environmental impacts of the Program. Where impacts are not avoidable, the Authority has worked throughout the planning and environmental review process to develop measures to mitigate impacts of the Program to the extent practicable. With the implementation of the proposed mitigation, and cooperation with state agencies, the Massachusetts Department of Transportation (MassDOT) finds that there are no significant unmitigated impacts.

The Authority recognizes that the identification of effective mitigation, and implementation of that mitigation throughout the life of the Metropolitan Water Tunnel Program, is central to its responsibilities under MEPA. Accordingly, the Authority has prepared a Table of Mitigation Commitments (See **Table I.4-4***) that specifies, the mitigation that the Authority would provide. In the Table of Mitigation Commitments, the Authority provides clear commitments to implement the mitigation measures; identifies the parties responsible for implementation of measures; and provides a schedule for their implementation based upon Program phasing.*

MassDOT has reviewed the MEPA filings for the Metropolitan Water Tunnel Program, and finds that the environmental impacts resulting from construction of the Metropolitan Water Tunnel Program are those impacts as described in the DEIR, which would be updated as needed in permit applications submitted for compliance with federal and state environmental laws. Pursuant to M.G.L. Chapter 30, Section 61, MassDOT finds that with the implementation of mitigation measures as identified in the Table of Mitigation Commitments, all practicable and feasible means and measures would have been taken to avoid or minimize potential damage to the environment due to the construction and operation of the Metropolitan Water Tunnel Program. In making this finding, MassDOT has considered reasonably foreseeable climate change impacts and environmental justice impacts.

Transportation Mitigation

When construction measures could cause traffic congestion, work within the roadway may not be permitted during weekday peak hours, which normally occur from 7:00 AM to 9:00 AM and from 3:00 PM to 7:00 PM. On heavily traveled urban arterials, work within the roadway may primarily be permitted during off-peak hours. In some residential areas, work may be restricted to daytime hours only so as not to disturb residents. In some areas, time restrictions also may be used to avoid impacts to routine street sweeping or other activities.

Typical measures to mitigate the traffic impacts caused by construction-period activities are described in this section. Most of the mitigation measures described in this section would require approval and/or permits from MassDOT, Department of Conservation and Recreation (DCR), or applicable municipalities. Applicability of these measures would be discussed with the municipalities or agencies prior to submitting permit applications. These impacts and associated mitigation are summarized in **Table I.4-4** and described in detail in the following sections.

Any construction activities relating to MassDOT's planned Newton-Weston-Bridge Bundle Replacement and Rehabilitation Project at the I-90/I-95 Interchange in Newton and Weston (MassDOT Project No. 606783) would be coordinated with MassDOT.

Table I.4-4 Transportation Impacts and Mitigation

<table>
<tr><th>Estimated Impact</th><th>Mitigation</th><th>Responsible Party/Schedule</th></tr>
<tr><td colspan="3">Construction Period Impacts</td></tr>
<tr><td>Increased traffic at local intersections<table><tr><th>Town</th><th>Intersections</th></tr><tr><td>Weston (Tandem Trailer, Park Road East, Bifurcation, Park Road West, and Hultman Aqueduct Isolation Valve)</td><td>- River Rd. at South Ave.
- I-95 N Off Ramp at South Ave.
- Park Rd. at South Ave.</td></tr><tr><td>Needham (Highland Avenue Sites)</td><td>Cedar Avenue at Cedar Street</td></tr></table></td><td>- When possible, the Authority will conduct trucking during off-peak hours
- Where possible, the Authority will provide contractor parking on site
- Maintain safe access to sensitive receptors at all times</td><td>Contractors/
Construction Period</td></tr>
<tr><td>Increase in traffic impacting intersections along truck routes<table><tr><th>Town</th><th>Truck Route</th></tr><tr><td>Weston (Tandem Trailer, Park Road East, Bifurcation, Park Road West, and Hultman Aqueduct Isolation Valve)</td><td>- River Road at South Avenue
- Park Road at South Avenue (Alt.4 and 10)
- I-95 Northbound off-ramp at South Avenue/ Commonwealth</td></tr><tr><td>Needham (Highland Avenue Sites, St. Mary Street Pumping Station)</td><td>- Cedar Avenue at Cedar Street</td></tr></table></td><td>- The Authority will coordinate with the Massachusetts Department of Transportation (MassDOT) or local municipal officials to adjust traffic signal timings at impacted intersections, as appropriate
- Maintain safe access to sensitive receptors at all times</td><td>Authority /Contractors/
Construction period</td></tr>
<tr><td>Increase in traffic impacting local intersections along truck routes<table><tr><th>Town</th><th>Location</th></tr><tr><td>Weston</td><td>- Weston: River Road at South Avenue (Alt. 10)</td></tr></table></td><td>- Evaluate methods for roadway widening and modifications at select intersections
- Maintain safe access to sensitive receptors at all times</td><td>Authority /Contractors/
Construction period</td></tr>
</table>

Table I.4-4 Transportation Impacts and Mitigation

<table>
<tr><th>Estimated Impact</th><th>Mitigation</th><th>Responsible Party/Schedule</th></tr>
<tr><td colspan="3">Construction Period Impacts</td></tr>
<tr><td>Installation of surface piping causing local detours
<table>
<tr><th>Town</th><th>Duration and Location</th></tr>
<tr><td>Needham</td><td>Highland Avenue sites lasting 64 weeks on Brook Road, Wexford Road, and Freemont Street</td></tr>
<tr><td>Boston</td><td>American Legion lasting 63 weeks in two phases on American Legion Highway and Morton Street</td></tr>
</table></td>
<td>- Install during off-peak and/or overnight hours only, to minimize disturbance to traffic, bicyclists, and pedestrians
- Install pipelines utilizing trenchless construction techniques when feasible to minimize roadway crossing impacts.
- Install during daytime off-peak hours, between 9:00 AM and 3:00 PM
- Restriping crosswalks with high-visibility markings and construction of Americans with Disabilities Act (ADA)-compliant curb ramps with detectable warning panels on each corner
- Maintain traffic in at least one direction whenever possible
- Temporary local detours
- Maintain safe access to sensitive receptors at all times</td>
<td>Authority /Contractors/ Construction period</td></tr>
</table>

I.4.1.3 Massachusetts Department of Conservation and Recreation (DCR)

Project Name: *Metropolitan Water Tunnel Program*

Project Location: *Waltham, Weston, Newton, Wellesley, Needham, Brookline, Boston*

Project Proponent: *Massachusetts Water Resources Authority*

EEA Number: *16355*

Date Noticed in Monitor: *October 24, 2022*

Applicable State Action/Permits

- Construction access permit
- Permanent easements
- Land disposition
- Article 97 Compliance

This Section 61 Finding for the Metropolitan Water Tunnel Program (EEA 16355) has been prepared in accordance with the provisions of M.G.L. Chapter 30, Section 61 and 301 CMR 11.07(6)(k).

The potential environmental impacts of the Program are characterized and quantified in the Metropolitan Water Tunnel Program Draft Environmental Impact Report (DEIR), which is incorporated by reference into this Section 61 Finding. To the greatest extent practicable, the Authority has taken all feasible measures to avoid and/or minimize adverse environmental impacts of the Program. Where impacts are not avoidable, the Authority has worked throughout the planning and environmental review process to develop measures to mitigate impacts of the Program to the extent practicable. With the implementation of the proposed mitigation, and cooperation with state agencies, the Massachusetts Department of Conservation and Recreation (DCR) finds that there are no significant unmitigated impacts.

*The Authority recognizes that the identification of effective mitigation, and implementation of that mitigation throughout the life of the Metropolitan Water Tunnel Program, is central to its responsibilities under MEPA. Accordingly, the Authority has prepared a Table of Mitigation Commitments (***Table I.4-5***) that specifies, the mitigation that the Authority would provide. In the Table of Mitigation Commitments, the Authority provides clear commitments to implement the mitigation measures; identifies the parties responsible for implementation of measures; and provides a schedule for their implementation based upon Program phasing.*

DCR has reviewed the MEPA filings for Metropolitan Water Tunnel Program and finds that the environmental impacts resulting from construction of the Metropolitan Water Tunnel Program are those impacts as described in the DEIR, which would be updated as needed in permit applications submitted for compliance with federal and state environmental laws. Pursuant to M.G.L. Chapter 30, Section 61, DCR finds that with the implementation of mitigation measures as identified in the Table of Mitigation Commitments, all practicable and feasible means and measures would have been taken to avoid or *minimize potential damage to the environment due to the construction and operation of the Metropolitan Water Tunnel Program. In making this finding, DCR has considered reasonably foreseeable climate change impacts and environmental justice impacts.*

DCR Resources Mitigation

Arborway

Typical measures to mitigate the traffic impacts caused by construction-period activities would be applied to the Arborway. Most of the mitigation measures described in **Table I.4-5** would require approval and/or permits from the DCR or applicable municipalities. Applicability of these measures would be discussed with the municipalities or agencies prior to submitting permit applications.

Article 97 Properties

Permanent impacts on community resources and open space would result from the proposed acquisition of land and/or easements on community resources and open space. Existing open space areas held for natural resources purposes in accordance with Article 97 of the Article of Amendment to the Constitution of the Commonwealth of Massachusetts (Article 97) and the EEA Article 97 Land Disposition Policy[5] have been avoided to the greatest extent practicable.

Two proposed sites owned by the Commonwealth of Massachusetts under care, custody, and control of DCR may require the disposition of land protected under the EEA Article 97 Land Disposition Policy:

1) The Southern Spine Mains connection site is within Southwest Corridor Park/Arborway I owned by the Commonwealth of Massachusetts under care, custody, and control of the DCR.
2) The American Legion receiving site is within the Morton Street Property owned by the Commonwealth of Massachusetts under care, custody, and control of the DCR.

Portions of these two DCR sites would need to be disposed of to the Authority following Article 97 legislation, which includes a 2/3 vote of the Massachusetts State Legislature (note the proposed Hegarty Pumping Station connection site may also be subject to Article 97 but is owned by the Town of Wellesley). Any transfer of an interest in Article 97 land would comply with the EEA Article 97 Land Disposition Policy. The Authority will continue to work closely with DCR and other landowners.

The Arborway, located within the limits of disturbance for the Southern Spine Mains connection site, is protected by Article 97 and would not require a disposition. The Arborway would be temporarily impacted by construction but would not contain any permanent Program-related infrastructure. **Table I.4-5** describes impacts and associated mitigation for DCR properties.

5 Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Article 97 Land Disposition Policy, February 19, 1998.

Table I.4-5 DCR Resources Impacts and Mitigation

Estimated Impact		Mitigation	Responsible Party/ Schedule
Construction Period Impacts			
Construction easement for shaft construction and for near-surface pipe installation		- Identify and provide compensatory land for parcels currently protected by Article 97 used by the Project for permanent facilities	Authority / Prior to construction
Boston (American Legion)			
Construction period activities on the Arborway Effecting Local Intersections		- Obtain DCR construction access permit - Install during off-peak and/or overnight hours only, to minimize disturbance to traffic, bicyclists, and pedestrians. - Accommodate bikes and pedestrians through on-street work zones and nighttime installation - Temporary bicycle and pedestrian detours - Maintain safe access to sensitive receptors at all times	Authority / Contractors/ Construction period
Boston (Southern Spine Mains and American Legion)	- South St. at Arborway. - Washington St. at Arborway - Arborway at Circuit Dr.		
Installation of surface piping impacting bikes and pedestrians		- Install during off-peak and/or overnight hours only, to minimize disturbance to traffic, bicyclists, and pedestrians. - Accommodate bikes and pedestrians through on-street work zones and nighttime installation - Temporary bicycle and pedestrian detours - Maintain safe access to sensitive receptors at all times	Authority / Contractors/ Construction period
Boston (Southern Spine Mains)	Detour along the Arborway		

Table I.4-5 ***DCR Resources Impacts and Mitigation***

Estimated Impact		Mitigation	Responsible Party/ Schedule
Installation of surface piping causing local detours		- Install during off-peak and/or overnight hours only, to minimize disturbance to traffic, bicyclists, and pedestrians. - Install during daytime off-peak hours, between 9:00 AM and 3:00 PM. - Install pipelines utilizing trenchless construction techniques when feasible to minimize roadway crossing impacts. - Restriping crosswalks with high-visibility markings and construction of Americans with Disabilities Act (ADA)-compliant curb ramps with detectable warning panels on each corner. - Maintain traffic in at least one direction whenever possible. - Temporary local detours - Maintain safe access to sensitive receptors at all times	Authority / Contractors/ Construction period
Boston (American Legion)	Installed in two phases on American Legion Highway and Morton Street		
Permanent Impacts			
Boston		- Comply with Article 97 land disposition process	Authority / Prior to construction
· American Legion	Permanent Impact top of shaft structure, parking and access		
· Southern Spine Mains	Permanent Impact top of shaft structure		

I.4.1.4 Massachusetts Bay Transportation Authority (MBTA)

Project Name: *Metropolitan Water Tunnel Program*

Project Location: *Waltham, Weston, Newton, Wellesley, Needham, Brookline, Boston*

Project Proponent: *Massachusetts Water Resources Authority*

EEA Number: *16355*

Date Noticed in Monitor: *October 24, 2022*

Applicable State Action:

- MBTA Right of Way Access License Agreement

This Section 61 Finding for the Metropolitan Water Tunnel Program (EEA 16355) has been prepared in accordance with the provisions of M.G.L. Chapter 30, Section 61 and 301 CMR 11.07(6)(k).

The potential environmental impacts of the Program are characterized and quantified in the Metropolitan Water Tunnel Program Draft Environmental Impact Report (DEIR), which is incorporated by reference into this Section 61 Finding. To the greatest extent practicable, the Authority has taken all feasible measures to avoid and/or minimize adverse environmental impacts of the proposed Program. Where impacts are not avoidable, the Authority has worked throughout the planning and environmental review process to develop measures to mitigate impacts of the Program to the extent practicable. With the implementation of the proposed mitigation, and cooperation with state agencies, the Massachusetts Bay Transportation Authority (MBTA) finds that there are no significant unmitigated impacts.

*The Authority recognizes that the identification of effective mitigation, and implementation of that mitigation throughout the life of the Metropolitan Water Tunnel Program, is central to its responsibilities under MEPA. Accordingly, the Authority has prepared a Table of Mitigation Commitments (**Table 1.4-6**) that specifies, for each potential state permit, the mitigation that the Authority would provide. In the Table of Mitigation Commitments, the Authority provides clear commitments to implement the mitigation measures; identifies the parties responsible for implementation of measures; and provides a schedule for their implementation based upon Program phasing.*

The MBTA has reviewed the MEPA filings for Metropolitan Water Tunnel Program, and finds that the environmental impacts resulting from construction of the Metropolitan Water Tunnel Program are those impacts as described in the DEIR, which would be updated as needed in permit applications submitted for compliance with federal and state environmental laws. Pursuant to M.G.L. Chapter 30, Section 61, the MBTA finds that with the implementation of mitigation measures as identified in the Table of Mitigation Commitments, all practicable and feasible means and measures would have been taken to avoid or minimize potential damage to the environment due to the construction and operation of the Metropolitan Water Tunnel Program. In making this finding, the MBTA has considered reasonably foreseeable climate change impacts and environmental justice impacts.

MBTA Resources Mitigation

The Authority will work with the MBTA through design development and where possible avoid the MBTA zone of influence along the tunnel alignment as noted in **Table I.4-6.**

Table I.4-6 MBTA Property Impacts and Mitigation

Estimated Impact		Mitigation	Responsible Party/Schedule
Permanent Impacts			
Potential right of way access		Avoid MBTA zone of influence	MWRA/Final Design
Waltham	**All Alternatives**		
Potential tunnel alignment	Three north tunnel alignments pass under MBTA property		

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Appendix J: Draft Water Supply Contingency Plan

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J.1 Introduction

This Appendix presents a Draft Water Supply Contingency plan as part of the Massachusetts Water Resources Authority (Authority) Metropolitan Water Tunnel Program (Program), Draft Environmental Impact Analysis for the program. This section summarizes the project background and water supply contingency plan objectives. **Section J.2** describes the data collection for private wells. **Section J.3** lists water supply alternatives. **Section J.4** summarizes the determination of the order of implementation.

J.1.1 Project Background

MWRA's existing Metropolitan Tunnel System, comprised of the City Tunnel, Dorchester Tunnel and City Tunnel Extension needs to be taken out-of-service so that these existing facilities, including isolation valves, can be refurbished and maintained in the future. To make this possible, additional (redundant) transmission capacity is needed to provide continued service while the existing tunnels are offline. The purpose of the Project is to provide redundancy for the Metropolitan Tunnel System east of Shaft 5/5A.

Construction of the new deep rock tunnel system would include use of a tunnel boring machine (TBM) along the proposed alignment. Although this construction method minimizes disruption at the surface as compared to open trench construction, there is the potential to temporarily affect water supplies (wells and surface waters) along the tunnel route by lowering the groundwater level during construction. In areas of concern, the drilling and pre-grouting ahead of the TBM would be required. This approach would reduce the likelihood of groundwater inflow into the tunnel, which would help to mitigate potential impacts to water supply wells and waterbodies.

J.1.1.1 Drawdown of Groundwater or Levels of Local Water Bodies

Groundwater drawdown during tunnel construction, and to a lesser extent during shaft construction, may impact the production of groundwater wells. The project is unlikely to impact local surface water body levels with the planned requirements for probing and grouting. Groundwater drawdown is typically caused by interconnectivity of discontinuities within an otherwise impermeable rock mass, which in turn is hydraulically connected to the groundwater well or water body.

The primary mitigation to reduce the potential for groundwater drawdown during construction is probing from the tunnel heading in advance of the excavation, followed by pre-excavation grouting (also from the tunnel heading) in the event water-bearing features are encountered by the probing. The probing could be made mandatory before the tunnel proceeds beneath important areas of groundwater well production or beneath local water bodies; the determination for mandatory probing and grouting (both where this may be required as well as the number and relative position of probe holes or grouting criteria) would be a risk-based assessment during the Final Design phase of the Program. The specification of mandatory probing and the setting of limits that trigger grouting must be judiciously applied, as performing these activities would require TBM stoppages, which may reduce overall TBM production rate and lead to a longer construction schedule.

A secondary mitigation to reduce groundwater inflow into the tunnel is drilling and cut-off grouting of water bearing features in the rock through the walls of the unlined tunnel after the tunnel boring machine (TBM) has passed. This type of grouting is not as effective as (and not proposed as a replacement for) the pre-excavation probing and grouting described earlier in this section, mainly because post-excavation cut-off grouting must be performed at lower pressures than pre-excavation grouting (due to the lower confining pressures that exist after tunnel excavation), and therefore is not as effective at penetrating water-bearing features in the rock.

A tertiary mitigation for disruption of water supply from groundwater wells or surface waters is to provide users with an alternative water supply until groundwater levels can be restored. This mitigation is described in **Section J.3** of this Appendix.

J.1.1.2 Water Supply Contingency Plan Objectives

The Water Supply Contingency Plan provides alternatives to address water supply issues if wells and surface waters are impacted during construction. The following are the objectives for the water supply contingency plan:

1. Provide the location of water supplies (wells and surface waters) within half a mile (2,640 feet) of the proposed tunnel alignment.
2. Provide information pertaining to the well's geologic and hydrological data, when available.
3. Provide information pertaining to the use of the water supply well, including wells for non-potable uses.
4. Develop recommended mitigation strategies for the contractor to implement should the water supply well be impacted during construction.

J.2 Water Supply Well Data Collection

Data pertaining to the water supply wells was reviewed from several sources. These sources include:

- Massachusetts Executive Office of Energy and Environmental Affairs (EEA) (Mass Well Database);
- MassDEP's Public Water Supplies by MassGIS
- MassDEP Wellhead Protection Areas (Zone II, Zone I, Interim Wellhead Protection Areas (IWPAs)) by MassGIS
- City of Waltham Engineering Department; and
- Town of Wellesley Geographic Information System Department.

The communities of Needham, Newton, Brookline, Boston, and Weston were also contacted for any available information on wells, but no additional City or Town specific data was available.

The various data sources were compiled and included in a Geographic Information System (GIS) geodatabase. Using the location data, maps showing the locations and types of wells within a half mile (2,640 feet) of the proposed tunnel alignment were developed and are included in **Chapter 5, Water Supply, Figure 5.1-1** through **Figure 5.1-24**. It should be noted that the proposed tunnel alignments and the offset are all within the Charles River watershed. This is the only watershed expected to be impacted during construction. The following information pertaining to the wells are stored in the geodatabase:

- Well ID
- Location information including street address, longitude and latitude information, and northing and easting
- Date of construction
- Well type
- Well depth
- Depth to bedrock
- Water level
- Elevation

The contract documents will require a preconstruction survey to be conducted by the contractor to verify the locations and well characteristics prior to construction. Key information included in the geodatabase, such as well characteristics and address, are included in **Table J.2-1** through **Table J.2-3.**

J.3 Water Supply Alternatives and Determination of the Order of Implementation

It is recommended that the contractor follow the same protocols previously implemented on tunnel construction projects, such as the construction of the MetroWest Water Supply Tunnel for example, should a private well be impacted during construction. There are three levels to be considered: emergency (24 hours after the incident), interim (48 hours after the incident), and permanent (after construction). These levels are detailed in **Table J.3-1**. Alternatives for providing potable water supply are described in **Table J.3-2**, along with the corresponding order in which the supply alternative is recommended to be implemented. This order corresponds to the complexity of establishing a water supply during construction with 1 being the least complex and most desirable alternative and 7 being the most complex and least desirable. The first alternative, supplying bottled water, is to provide water immediately after the incident because the remaining alternatives require the completion of the 48-hour Dig Safe waiting period before implementation.

For impacted irrigation wells, the contractor could arrange for a landscaping service to provide watering of lawns and other outdoor uses. For impacted geothermal wells, other heating sources, such as use of space heaters or existing oil, electric, or natural gas services could be utilized until the well has returned to pre-construction conditions and the geothermal well can be operated again.

Table J.3-1 Water Supply Levels

Level	Implementation Timeline	Description
Emergency	24 hours after incident	Provide water for at least drinking and cooking purposes for the duration of construction, including: Contact pre-approved bottled water supplier to deliver and install a refrigeration unit and provide an adequate volume of bottled water for drinking and cooking. Contact the City or Town's Water Department and Dig Safe to mark out utilities in the vicinity of the well owner's address.
Interim	48 hours after incident	Provide water for domestic and/or irrigation purposes for the duration of construction or until the groundwater level returns to normal, including: Provide reliable water supply for domestic uses such as showering and dishwashing through a temporary or long-term system. Water supply process and materials should be submitted through the shop drawing review process prior to the start of construction. Stockpile the materials required for temporary water supply system prior to construction. Water supply systems will vary depending on the location of the property served by the impacted well in relation to properties served by public water supply. A description of different water supply alternatives is included in **Table J.3-2**.
Permanent	After construction	Evaluate the affected wells after construction is complete to determine whether water supply quality and quantity has returned to pre-construction conditions. If the well has been determined to be damaged beyond repair, the contractor will be directed to replace the well with one of an equivalent size and water quality or provide an alternative water supply.

List of Wells with Key Data within Half a Mile of the Proposed Alternative 3 Tunnel Route

WellID	Town	StreetNumber	StreetName	Latitude	Longitude	spcNorthing_usft_Y	spcEasting_usft_X	DateComplete	WellType	WorkPerformed	Total Depth	Depthto Bedrock	Water Level	Dates	GroundElev_BCB	Z	GroundElev_Ft	HitBedrock	BedrockElev_BCB
266340	BOSTON	125	Arborway	42.30746	-71.120906	2937294.292	758710.498	2/24/1993	Irrigation	New Well	1005	49	22	2/24/1993	65.6481926	59.1981926	59.1981926	Yes	16.6481926
266339	BOSTON	7	Louders Lane	42.306007	-71.125431	2936759.387	757488.832	2/17/1993	Irrigation	New Well	255	60	50	2/17/1993	148.9375183	142.4875183	142.4875183	Yes	88.93751831
123519	BOSTON		St. Joseph Cemetery	42.301312	-71.104536	2935073.967	763148.892	9/7/2004	Irrigation	New Well	500	10	27	8/16/2004	78.86679382	72.41679382	72.41679382	Yes	68.86679382
105422	BOSTON[1]	Lot 49	Country Club Road	42.307069	-71.193309	2937073.073	739126.303	11/28/2001	Domestic	New Well	510	8	50	12/5/2001	157.1465942	150.6965942	150.6965942	Yes	149.1465942
2318	BOSTON	5	Woodlawn Avenue	42.299243	-71.113476	2934308.904	760733.847	3/14/2000	Domestic	New Well	105	0	1	3/16/2000	48.02450867	41.57450867	41.57450867		
282434	BROOKLINE	191	Newton Street	42.310554	-71.142905	2938396.119	752755.148	5/11/1989	Irrigation	New Well	0	74	35	5/17/1989	211.3908264	204.9408264	204.9408264	Yes	137.3908264
282375	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	4/1/1998	Irrigation	New Well	1000	3	52	4/1/1998	234.3170044	227.8670044	227.8670044	Yes	231.3170044
257944	BROOKLINE	186	Newton Street	42.30945	-71.141633	2937995.245	753100.892	8/20/2008	GeoThermal Open Loop	New Well	1000	30	18	8/20/2008	219.9852478	213.5352478	213.5352478	Yes	189.9852478
100863	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	6/5/2001	Irrigation	New Well	1300	0	15	6/5/2001	234.3170044	227.8670044	227.8670044		
2900	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	7/13/1999	Irrigation	New Well	1000	0	30	7/27/1999	234.3170044	227.8670044	227.8670044		
663558	NEWTON	530	DUDLEY ROAD	42.30641	-71.17603	2936850.201	743801.147	7/9/2019	Irrigation	New Well	500	6	7	7/2/2019	195.2411987	188.7911987	188.7911987	Yes	189.2411987
659148	NEWTON	181	WINDSOR ROAD	42.3317	-71.25741	2945993.265	721761.565	10/17/2017	Irrigation	New Well	1000	85	54.7	10/17/2017	69.90000076	63.45000076	63.45000076	Yes	-15.09999924
656616	NEWTON	179	LAGRANGE STREET	42.30421	-71.1672	2936057.679	746192.794	2/24/2017	Irrigation	New Well	705	11	0		193.899173	187.449173	187.449173	Yes	182.899173
655572	NEWTON	380	DEDHAM STREET	42.30885	-71.1992	2937716.427	737530.51	7/12/2016	Irrigation	New Well	500	38	40	7/7/2016	183.0266144	176.5766144	176.5766144	Yes	145.0266144
304378	NEWTON		Grove Street and Route 16	42.32577	-71.25632	2943833.092	722062.467	12/1/1980	Domestic	New Well	405	44	0		73.30900879	66.85900879	66.85900879	Yes	29.30900879
304367	NEWTON	400	Dedham Street	42.308428	-71.19821	2937563.589	737798.84	10/12/1989	Irrigation	New Well	450	23	25	10/12/1989	185.9413025	179.4913025	179.4913025	Yes	162.9413025
304353	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/3/1991	Irrigation	New Well	330	30	7	4/3/1991	120.8999969	114.4499969	114.4499969	Yes	90.89999695
304350	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	3/22/1991	Irrigation	New Well	500	9	28	3/22/1991	120.8999969	114.4499969	114.4499969	Yes	111.8999969
304349	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	3/26/1991	Irrigation	New Well	350	10	34	3/26/1991	120.8999969	114.4499969	114.4499969	Yes	110.8999969
304348	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/5/1991	Irrigation	New Well	500	7	40	4/5/1991	120.8999969	114.4499969	114.4499969	Yes	113.8999969
304347	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/14/1991	Irrigation	New Well	405	8	30	4/14/1991	120.8999969	114.4499969	114.4499969	Yes	112.8999969
304346	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/30/1991	Irrigation	New Well	500	10	12	4/30/1991	120.8999969	114.4499969	114.4499969	Yes	110.8999969
304344	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	5/17/1991	Irrigation	New Well	480	10	30	5/17/1991	120.8999969	114.4499969	114.4499969	Yes	110.8999969
304335	NEWTON	29	Charles Street	42.344068	-71.256131	2950501.411	722094.511	6/3/1991	Domestic	New Well	260	55	20	6/3/1991	59.90000076	53.45000076	53.45000076	Yes	4.900000763
304321	NEWTON	21	Placid Road	42.311998	-71.198113	2938864.655	737820.473	10/25/1991	Irrigation	New Well	305	32	16	10/25/1991	125.340831	118.890831	118.890831	Yes	93.34083099
304288	NEWTON	275	Brookline Street	42.300822	-71.177481	2934812.35	743416.35	8/9/1993	Irrigation	New Well	625	13	35	8/9/1993	187.6864197	181.2364197	181.2364197	Yes	174.6864197
304287	NEWTON	85	Kingswood Road	42.354185	-71.253941	2954189.969	722675.921	8/1/1993	Irrigation	New Well	27	0	20	8/1/1993	71.89095612	65.44095612	65.44095612		
304278	NEWTON	185	Christina Street	42.304348	-71.209367	2936066.283	734786.024	4/15/1994	Irrigation	New Well	345	42	25	4/15/1994	114.8999969	108.4499969	108.4499969	Yes	72.89999695
304268	NEWTON	605	Grove Street	42.328369	-71.258656	2944778.424	721428.089	6/17/1994	Irrigation	New Well	500	90	80	6/17/1994	87.41557617	80.96557617	80.96557617	Yes	-2.584423828
304265	NEWTON	130	Wheeler Road	42.310092	-71.191544	2938176.43	739599.748	8/4/1994	Irrigation	New Well	1000	50	10	8/4/1994	135.8999969	129.4499969	129.4499969	Yes	85.89999695
304263	NEWTON	471	Nahanton Street	42.297404	-71.207079	2933537.884	735413.641	8/11/1994	Irrigation	New Well	820	18	40	8/11/1994	116.285495	109.835495	109.835495	Yes	98.285495
304243	NEWTON	7	Melina Road	42.31081	-71.196701	2938433.081	738203.926	12/27/1994	Irrigation	New Well	175	10	14	12/27/1994	146.0838806	139.6338806	139.6338806	Yes	136.0838806
304214	NEWTON	123	Baldpate Hill Road	42.30506	-71.180194	2936353.987	742676.627	7/9/1996	Irrigation	New Well	325	80	60	7/9/1996	261.6592133	255.2092133	255.2092133	Yes	181.6592133
304210	NEWTON		Cornell Street	42.329787	-71.259677	2945294.393	721150.547	8/24/1996	Irrigation	New Well	1000	90	15	8/24/1996	80.25924988	73.80924988	73.80924988	Yes	-9.740750122
304209	NEWTON		Wheeler Road	42.310384	-71.193965	2938280.482	738944.522	9/29/1996	Domestic	Hydrofracture	1000	25	7	9/29/1996	127.8999969	121.4499969	121.4499969	Yes	102.8999969
304177	NEWTON	74	Oak Hill Street	42.298672	-71.179113	2934027.188	742977.802	4/9/1998	Domestic	New Well	500	5	20	4/9/1998	135.8999969	129.4499969	129.4499969	Yes	130.8999969
304170	NEWTON[1]	24	Bryon Road	42.301863	-71.166924	2935202.683	746270.794	8/8/1998	Irrigation	New Well	500	45	20	8/8/1998	156.8999969	150.4499969	150.4499969	Yes	111.8999969
304165	NEWTON	142	Neshobe Road	42.326972	-71.244996	2944280.077	725123.378	9/1/1998	Irrigation	Hydrofracture	820	65	30	9/1/1998	168.8999969	162.4499969	162.4499969	Yes	103.8999969
304161	NEWTON[1]	24	Bryon Road	42.301863	-71.166924	2935202.683	746270.794	12/5/1998	Irrigation	New Well	505	4	20	12/5/1998	156.8999969	150.4499969	150.4499969	Yes	152.8999969
258804	NEWTON	17	Racheal Rd.	42.30915	-71.202	2937823.094	736772.755	3/10/2009	GeoThermal Closed Loop	New Well	360	22	41	3/10/2009	182.3013031	175.8513031	175.8513031	Yes	160.3013031
257132	NEWTON	354	dudley road	42.30935	-71.181567	2937915.949	742299.385	5/12/2008	Irrigation	New Well	500	15	22	5/12/2008	152.8999969	146.4499969	146.4499969	Yes	137.8999969
158209	NEWTON	2253	Commonwealth Avenue	42.347217	-71.254883	2951649.942	722428.599	6/12/2009	Irrigation	New Well	520	40	19.6	4/15/2009	67.90000076	61.45000076	61.45000076	Yes	27.90000076
155281	NEWTON	369	Dudley Road	42.308333	-71.182517	2937544.379	742043.801	11/13/2007	Irrigation	New Well	425	22	40	11/13/2007	161.0908844	154.6408844	154.6408844	Yes	139.0908844
150099	NEWTON	11	Placid Road	42.307033	-71.192617	2937060.628	739313.534	11/10/2006	Irrigation	New Well	160	25	10	11/11/2006	154.7581055	148.3081055	148.3081055	Yes	129.7581055
146978	NEWTON	21	Columbine Road	42.29903	-71.178494	2934158.28	743144.77	9/11/2006	Irrigation	New Well	220	26	20	8/3/2006	131.5530731	125.1030731	125.1030731	Yes	105.5530731
139646	NEWTON	303	Nahanten Street	42.297823	-71.200698	2933696.568	737139.416	4/12/2006	Irrigation	New Well	27	0	4	4/12/2006	112.7166473	106.2666473	106.2666473		
135288	NEWTON	554	Grove Street	42.330087	-71.257671	2945405.254	721692.662	4/25/2005	Irrigation	New Well	1005	30	20	4/26/2005	83.89999695	77.44999695	77.44999695	Yes	53.89999695
123535	NEWTON	41	Old Farm Road	42.299198	-71.185172	2934212.763	741337.931	5/8/2006	Irrigation	New Well	23	0	18.75	4/18/2006	168.0910675	161.6410675	161.6410675		
106072	NEWTON	12	Laurus Lane	42.300441	-71.182577	2934668.335	742038.274	3/11/2002	Irrigation	New Well	325	40	21.9	3/18/2002	155.8012573	149.3512573	149.3512573	Yes	115.8012573
106054	NEWTON	46	Varick Road	42.32792	-71.245823	2944624.879	724898.717	10/10/2002	Irrigation	New Well	116	115	95	10/9/2002	172.8999969	166.4499969	166.4499969	Yes	57.89999695
103608	NEWTON	27	Pudding Stone Lane	42.299993	-71.177456	2934510.274	743424.256	6/6/2001	Irrigation	New Well	600	10	20	6/6/2001	161.6835663	155.2335663	155.2335663	Yes	151.6835663
304789	WALTHAM	24	Sagamore Way	42.359708	-71.260258	2956197.813	720962.796	11/1/1981	Domestic	New Well	79	67	1	11/1/1981	94.92100067	88.47100067	88.47100067	Yes	27.92100067
304772	WALTHAM	215	Waverley Oaks Road	42.383245	-71.209767	2964817.637	734579.988	5/19/1989	Irrigation	New Well	300	65	10	5/19/1989	73.94291992	67.49291992	67.49291992	Yes	8.942919922
304759	WALTHAM	10	Prospect Hill Road	42.376608	-71.252061	2962362.903	723160.327	6/12/1990	Irrigation	New Well	1000	8	30	6/12/1990	83.11716766	76.66716766	76.66716766	Yes	75.11716766
304716	WALTHAM	601	Beaver Street	42.385188	-71.228649	2965508.92	729476.333	12/11/1992	Irrigation	New Well	225	6	25	12/11/1992	101.2899124	94.83991241	94.83991241	Yes	95.28991241
112825	WALTHAM	213	Beaver Street	42.38417	-71.210531	2965154.028	734372.432	8/27/2002	Irrigation	New Well	180	0	10	8/28/2002	73.59553833	67.14553833	67.14553833		
112667	WALTHAM		Beaver Street	42.385444	-71.223709	2965606.497	730810.644	1/2/2003	Irrigation	New Well	0	120	10	1/4/2003	87.1364624	80.6864624	80.6864624	Yes	-32.8635376
112664	WALTHAM	175	Forest Street	42.387918	-71.218891	2966512.336	732109.32	11/25/2002	Irrigation	New Well	600	120	10	11/26/2002	214.6716644	208.2216644	208.2216644	Yes	94.67166443
112654	WALTHAM	175	Forest Street	42.387918	-71.218891	2966512.336	732109.32	10/9/2002	Irrigation	New Well	900	95	7.8	10/30/2002	214.6716644	208.2216644	208.2216644	Yes	119.6716644
112651	WALTHAM		Beaver Street	42.385444	-71.223709	2965606.497	730810.644	9/20/2002	Irrigation	New Well	400	100	5	9/21/2002	87.1364624	80.6864624	80.6864624	Yes	-12.8635376

Table J.2-1

List of Wells with Key Data within Half a Mile of the Proposed Alternative 3 Tunnel Route

WellID	Town	StreetNumber	StreetName	Latitude	Longitude	spcNorthing_usft_Y	spcEasting_usft_X	DateComplete	WellType	WorkPerformed	Total Depth	Depthto Bedrock	Water Level	Dates	GroundElev_BCB	Z	GroundElev_Ft	HitBedrock	BedrockElev_BCB
668958	WELLESLEY	40	WILLIAM STREET	42.31805	-71.23175	2941039.712	728715.499	6/11/2021	Irrigation	New Well	1005	16	60	5/4/2021	91.6236908	85.1736908	85.1736908	Yes	75.6236908
309600	WELLESLEY	7	Ashmont Road	42.312337	-71.24152	2938949.626	726079.497	12/5/1997	Irrigation	New Well	220	70	20	12/5/1997	99.89999695	93.44999695	93.44999695	Yes	29.89999695
308617	WELLESLEY	83	Walnut Street	42.324077	-71.253577	2943218.26	722806.008	5/10/1989	Domestic	New Well	625	50	40	5/10/1989	129.8999969	123.4499969	123.4499969	Yes	79.89999695
135983	WELLESLEY[1]	65	Mill Hill Road	42.29889	-71.229703	2934059.201	729291.239	4/15/2005	Domestic	Replacement	50	0	33	4/15/2005	162.9268677	156.4768677	156.4768677		
669062	WESTON	18	GATE HOUSE LANE	42.3543	-71.26556	2954223.031	719535.222	7/14/2021	Domestic	New Well	1005	16	14	6/23/2021	84.21760864	77.76760864	77.76760864	Yes	68.21760864
660151	WESTON	7	CUTTERS BLUFF LANE	42.344	-71.26725	2950468.232	719088.663	3/28/2018	Irrigation	New Well	465	8	182	3/28/2018	161.3444702	154.8944702	154.8944702	Yes	153.3444702
650969	WESTON	24	MEADOWBROOK RD	42.34916	-71.27023	2952346.465	718277.981	10/31/2014	Irrigation	New Well	800	10	36	10/30/2014	179.8658783	173.4158783	173.4158783	Yes	169.8658783
617861	WESTON	44	MEADOWBROOK ROAD	42.3497	-71.26996	2952543.45	718350.437	11/21/2012	Irrigation	New Well	940	4	0		176.7796967	170.3296967	170.3296967	Yes	172.7796967
305070	WESTON	72	River Road	42.348696	-71.26396	2952182.001	719973.348	1/29/1993	Domestic	Deepen	785	0	100	1/29/1993	88.57319183	82.12319183	82.12319183		
305047	WESTON	9	Newton Street	42.341779	-71.275886	2949652.599	716756.125	9/10/1997	Domestic	Hydrofracture	525	20	32	9/10/1997	129.8999969	123.4499969	123.4499969	Yes	109.8999969
305032	WESTON	93	South Avenue	42.341906	-71.267946	2949704.621	718902.581	9/4/1998	Irrigation	New Well	600	70	12	9/4/1998	110.1142609	103.6642609	103.6642609	Yes	40.11426086
163620	WESTON	20	Tamarack Road	42.336517	-71.2701	2947739.177	718325.541	12/15/2010	GeoThermal Open Loop	New Well	1205	45	45	12/15/2010	132.6488525	126.1988525	126.1988525	Yes	87.64885254
122634	WESTON	71	Meadow Beach Road	42.351856	-71.272657	2953327.19	717619.299	5/2/2003	Domestic	New Well	725	3	18	5/2/2003	197.5386841	191.0886841	191.0886841	Yes	194.5386841
117062	WESTON	80	Orchard Avenue	42.33462	-71.272199	2947046.347	717759.875	9/12/2002	Irrigation	New Well	900	80	20	9/12/2002	169.7197754	163.2697754	163.2697754	Yes	89.71977539
114591	WESTON	70	Meadowbrook Road	42.350817	-71.273218	2952948.151	717468.663	6/13/2002	Irrigation	New Well	600	1	14	6/19/2002	239.2779572	232.8279572	232.8279572	Yes	238.2779572
114511	WESTON	45	Young Road	42.344178	-71.275781	2950526.921	716782.214	7/1/2002	Irrigation	New Well	700	29	10	7/12/2002	168.7977173	162.3477173	162.3477173	Yes	139.7977173
112922	WESTON	71	Meadowbrook Road	42.351856	-71.272657	2953327.19	717619.299	1/6/2003	Irrigation	New Well	705	8	16	1/6/2003	197.5386841	191.0886841	191.0886841	Yes	189.5386841
107473	WESTON[1]	167	South Street (rte 30)	42.370125	-71.250359	2960001.684	723627.125	11/12/2001	Irrigation	New Well	700	30	30	11/13/2001	87.51864929	81.06864929	81.06864929	Yes	57.51864929
106117	WESTON	46	River Road	42.34682	-71.264341	2951498.061	719872.245	12/8/2001	Irrigation	New Well	600	6	10	1/4/2001	98.20183868	91.75183868	91.75183868	Yes	92.20183868
105624	WESTON	31	Farm Raod	42.355538	-71.272193	2954669.328	717741.138	9/15/2001	GeoThermal Open Loop	New Well	1507	11	50	9/15/2001	155.0550568	148.6050568	148.6050568	Yes	144.0550568
310539	WESTWOOD[1]		Grove Street	42.331134	-71.257524	2945786.915	721731.326	5/21/1985	Domestic	New Well	600	3	0		71.89999695	65.44999695	65.44999695	Yes	68.89999695
310380	WESTWOOD[1]		Grove Street	42.331134	-71.257524	2945786.915	721731.326	2/19/1982	Domestic	New Well	250	6	12	2/19/1982	71.89999695	65.44999695	65.44999695	Yes	65.89999695
3333000-03G	WESTON		NICKERSON FIELD G.P. WELL	42.340324	-71.263817														MassGIS
3333000-04G	WESTON		RTE. 128 G.P. WELL	42.341896	-71.263733														MassGIS
3317000-05G	WELLESLEY			42.314106	-71.253868														MassGIS

Note: 1. Recorded latitude/longitude of well is causing the plotting of well in GIS to show as being in a different City/Town. Exact well location should be field verified.

Table J.2-2

List of Wells with Key Data within Half a Mile of the Proposed Alternative 4 Tunnel Route

WellID	Town	Street Number	StreetName	Latitude	Longitude	spcNorthing_usft_Y	spcEasting_usft_X	DateComplete	WellType	WorkPerformed	Total Depth	Depthto Bedrock	Water Level	Dates	Z	Elev_NAD83Ft	TopOfRockElev
266340	BOSTON	125	Arborway	42.30746	-71.120906	2937294.292	758710.498	2/24/1993	Irrigation	New Well	1005	49	22	2/24/1993			
266339	BOSTON	7	Louders Lane	42.306007	-71.125431	2936759.387	757488.832	2/17/1993	Irrigation	New Well	255	60	50	2/17/1993	53.91604614	53.916046	53.916046
123519	BOSTON		St. Joseph Cemetery	42.301312	-71.104536	2935073.967	763148.892	9/7/2004	Irrigation	New Well	500	10	27	8/16/2004			
105422	BOSTON[1]		Country Club Road	42.307069	-71.193309	2937073.073	739126.303	11/28/2001	Domestic	New Well	510	8	50	12/5/2001	143.6488953	143.6489	143.6489
2318	BOSTON	5	Woodlawn Avenue	42.299243	-71.113476	2934308.904	760733.847	3/14/2000	Domestic	New Well	105	0	1	3/16/2000	35.21578598	35.215786	
282434	BROOKLINE	191	Newton Street	42.310554	-71.142905	2938396.119	752755.148	5/11/1989	Irrigation	New Well	0	74	35	5/17/1989	264.8783569	264.87836	264.87836
282375	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	4/1/1998	Irrigation	New Well	1000	3	52	4/1/1998	190.9111176	190.91112	190.91112
257944	BROOKLINE	186	Newton Street	42.30945	-71.141633	2937995.245	753100.892	8/20/2008	GeoThermal Open Loop	New Well	1000	30	18	8/20/2008	265.6067505	265.60675	265.60675
100863	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	6/5/2001	Irrigation	New Well	1300	0	15	6/5/2001	190.9111176	190.91112	
2900	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	7/13/1999	Irrigation	New Well	1000	0	30	7/27/1999	190.9111176	190.91112	
663558	NEWTON	530	DUDLEY ROAD	42.30641	-71.17603	2936850.201	743801.147	7/9/2019	Irrigation	New Well	500	6	7	7/2/2019	182.3028412	182.30284	182.30284
659148	NEWTON	181	WINDSOR ROAD	42.3317	-71.25741	2945993.265	721761.565	10/17/2017	Irrigation	New Well	1000	85	-2E+09	10/17/2017	57.00632858	57.006329	57.006329
656616	NEWTON	179	LAGRANGE STREET	42.30421	-71.1672	2936057.679	746192.794	2/24/2017	Irrigation	New Well	705	11	0		130.837616	130.83762	130.83762
655572	NEWTON	380	DEDHAM STREET	42.30885	-71.1992	2937716.427	737530.51	7/12/2016	Irrigation	New Well	500	38	40	7/7/2016	188.9265289	188.92653	188.92653
653868	NEWTON	373	DEDHAM ST	42.308703	-71.199853	2937662.236	737354.069	4/30/2016	Irrigation	New Well	250	12	10	4/30/2016	189.9477997	189.9478	189.9478
304378	NEWTON		Grove Street and Route 16	42.32577	-71.25632	2943833.092	722062.467	12/1/1980	Domestic	New Well	405	44	0				
304367	NEWTON	400	Dedham Street	42.308428	-71.19821	2937563.589	737798.84	10/12/1989	Irrigation	New Well	450	23	25	10/12/1989	185.7204132	185.72041	185.72041
304353	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/3/1991	Irrigation	New Well	330	30	7	4/3/1991	98.40291595	98.402916	98.402916
304350	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	3/22/1991	Irrigation	New Well	500	9	28	3/22/1991	98.40291595	98.402916	98.402916
304349	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	3/26/1991	Irrigation	New Well	350	10	34	3/26/1991	98.40291595	98.402916	98.402916
304348	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/5/1991	Irrigation	New Well	500	7	40	4/5/1991	98.40291595	98.402916	98.402916
304347	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/14/1991	Irrigation	New Well	405	8	30	4/14/1991	98.40291595	98.402916	98.402916
304346	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/30/1991	Irrigation	New Well	500	10	12	4/30/1991	98.40291595	98.402916	98.402916
304344	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	5/17/1991	Irrigation	New Well	480	10	30	5/17/1991	98.40291595	98.402916	98.402916
304335	NEWTON	29	Charles Street	42.344068	-71.256131	2950501.411	722094.511	6/3/1991	Domestic	New Well	260	55	20	6/3/1991	53.14040756	53.140408	53.140408
304321	NEWTON	21	Placid Road	42.311998	-71.198113	2938864.655	737820.473	10/25/1991	Irrigation	New Well	305	32	16	10/25/1991	149.79776	149.79776	149.79776
304288	NEWTON	275	Brookline Street	42.300822	-71.177481	2934812.35	743416.35	8/9/1993	Irrigation	New Well	625	13	35	8/9/1993	155.1386414	155.13864	155.13864
304287	NEWTON	85	Kingswood Road	42.354185	-71.253941	2954189.969	722675.921	8/1/1993	Irrigation	New Well	27	0	20	8/1/1993	38.45722198	38.457222	
304278	NEWTON	185	Christina Street	42.304348	-71.209367	2936066.283	734786.024	4/15/1994	Irrigation	New Well	345	42	25	4/15/1994	102	102	102
304268	NEWTON	605	Grove Street	42.328369	-71.258656	2944778.424	721428.089	6/17/1994	Irrigation	New Well	500	90	80	6/17/1994			
304265	NEWTON	130	Wheeler Road	42.310092	-71.191544	2938176.43	739599.748	8/4/1994	Irrigation	New Well	1000	50	10	8/4/1994	140.0252991	140.0253	140.0253
304263	NEWTON	471	Nahanton Street	42.297404	-71.207079	2933537.884	735413.641	8/11/1994	Irrigation	New Well	820	18	40	8/11/1994			
304243	NEWTON	7	Melina Road	42.31081	-71.196701	2938433.081	738203.926	12/27/1994	Irrigation	New Well	175	10	14	12/27/1994	145.6761169	145.67612	145.67612
304214	NEWTON	123	Baldpate Hill Road	42.30506	-71.180194	2936353.987	742676.627	7/9/1996	Irrigation	New Well	325	80	60	7/9/1996	248.3180695	248.31807	248.31807
304210	NEWTON		Cornell Street	42.329787	-71.259677	2945294.393	721150.547	8/24/1996	Irrigation	New Well	1000	90	15	8/24/1996			
304209	NEWTON		Wheeler Road	42.310384	-71.193965	2938280.482	738944.522	9/29/1996	Domestic	Hydrofracture	1000	25	7	9/29/1996	125.9862518	125.98625	125.98625
304177	NEWTON	74	Oak Hill Street	42.298672	-71.179113	2934027.188	742977.802	4/9/1998	Domestic	New Well	500	5	20	4/9/1998	110.7127533	110.71275	110.71275
304170	NEWTON[1]	24	Bryon Road	42.301863	-71.166924	2935202.683	746270.794	8/8/1998	Irrigation	New Well	500	45	20	8/8/1998	140.2731323	140.27313	140.27313
304165	NEWTON	142	Neshobe Road	42.326972	-71.244996	2944280.077	725123.378	9/1/1998	Irrigation	Hydrofracture	820	65	30	9/1/1998	72.26209259	72.262093	72.262093
304161	NEWTON[1]	24	Bryon Road	42.301863	-71.166924	2935202.683	746270.794	12/5/1998	Irrigation	New Well	505	4	20	12/5/1998	140.2731323	140.27313	140.27313
258804	NEWTON	17	Racheal Rd.	42.30915	-71.202	2937823.094	736772.755	3/10/2009	GeoThermal Closed Loop	New Well	360	22	41	3/10/2009	182.9972076	182.99721	182.99721
257132	NEWTON	354	dudley road	42.30935	-71.181567	2937915.949	742299.385	5/12/2008	Irrigation	New Well	500	15	22	5/12/2008	170.7354126	170.73541	170.73541
158209	NEWTON	2253	Commonwealth Avenue	42.347217	-71.254883	2951649.942	722428.599	6/12/2009	Irrigation	New Well	520	40	-2E+09	4/15/2009	50.79621887	50.796219	50.796219
155281	NEWTON	369	Dudley Road	42.308333	-71.182517	2937544.379	742043.801	11/13/2007	Irrigation	New Well	425	22	40	11/13/2007	153.3340912	153.33409	153.33409
150099	NEWTON	11	Placid Road	42.307033	-71.192617	2937060.628	739313.534	11/10/2006	Irrigation	New Well	160	25	10	11/11/2006	140.8580322	140.85803	140.85803
146978	NEWTON	21	Columbine Road	42.29903	-71.178494	2934158.28	743144.77	9/11/2006	Irrigation	New Well	220	26	20	8/3/2006	116.1653366	116.16534	116.16534
139646	NEWTON	303	Nahanten Street	42.297823	-71.200698	2933696.568	737139.416	4/12/2006	Irrigation	New Well	27	0	4	4/12/2006			
135288	NEWTON	554	Grove Street	42.330087	-71.257671	2945405.254	721692.662	4/25/2005	Irrigation	New Well	1005	30	20	4/26/2005	71	71	71
123535	NEWTON	41	Old Farm Road	42.299198	-71.185172	2934212.763	741337.931	5/8/2006	Irrigation	New Well	23	0	0	4/18/2006	112.5763855	112.57639	

Table J.2-2

List of Wells with Key Data within Half a Mile of the Proposed Alternative 4 Tunnel Route

WellID	Town	Street Number	StreetName	Latitude	Longitude	spcNorthing_usft_Y	spcEasting_usft_X	DateComplete	WellType	WorkPerformed	Total Depth	Depthto Bedrock	Water Level	Dates	Z	Elev_ NAD83Ft	TopOf RockElev
106072	NEWTON	12	Laurus Lane	42.300441	-71.182577	2934668.335	742038.274	3/11/2002	Irrigation	New Well	325	40	2E+09	3/18/2002	133.5980988	133.5981	133.5981
106054	NEWTON	46	Varick Road	42.32792	-71.245823	2944624.879	724898.717	10/10/2002	Irrigation	New Well	116	115	95	10/9/2002	73.18985748	73.189857	73.189857
103608	NEWTON	27	Pudding Stone Lane	42.299993	-71.177456	2934510.274	743424.256	6/6/2001	Irrigation	New Well	600	10	20	6/6/2001	145.0875702	145.08757	145.08757
304789	WALTHAM	24	Sagamore Way	42.359708	-71.260258	2956197.813	720962.796	11/1/1981	Domestic	New Well	79	67	1	11/1/1981	25.00705454	82.044145	82.044145
304772	WALTHAM	215	Waverley Oaks Road	42.383245	-71.209767	2964817.637	734579.988	5/19/1989	Irrigation	New Well	300	65	10	5/19/1989			
304759	WALTHAM	10	Prospect Hill Road	42.376608	-71.252061	2962362.903	723160.327	6/12/1990	Irrigation	New Well	1000	8	30	6/12/1990			
304716	WALTHAM	601	Beaver Street	42.385188	-71.228649	2965508.92	729476.333	12/11/1992	Irrigation	New Well	225	6	25	12/11/1992	26.77721172	87.851747	87.851747
112825	WALTHAM	213	Beaver Street	42.38417	-71.210531	2965154.028	734372.432	8/27/2002	Irrigation	New Well	180	0	10	8/28/2002			
112667	WALTHAM		Beaver Street	42.385444	-71.223709	2965606.497	730810.644	1/2/2003	Irrigation	New Well	0	120	10	1/4/2003	22.63574352	74.264253	74.264253
112664	WALTHAM	175	Forest Street	42.387918	-71.218891	2966512.336	732109.32	11/25/2002	Irrigation	New Well	600	120	10	11/26/2002	61.48029454	201.70701	201.70701
112654	WALTHAM	175	Forest Street	42.387918	-71.218891	2966512.336	732109.32	10/9/2002	Irrigation	New Well	900	95	9E+08	10/30/2002	61.48029454	201.70701	201.70701
112651	WALTHAM		Beaver Street	42.385444	-71.223709	2965606.497	730810.644	9/20/2002	Irrigation	New Well	400	100	5	9/21/2002	22.63574352	74.264253	74.264253
668958	WELLESLEY	40	WILLIAM STREET	42.31805	-71.23175	2941039.712	728715.499	6/11/2021	Irrigation	New Well	1005	16	60	5/4/2021	80.72761536	80.727615	80.727615
309600	WELLESLEY	7	Ashmont Road	42.312337	-71.24152	2938949.626	726079.497	12/5/1997	Irrigation	New Well	220	70	20	12/5/1997			
308617	WELLESLEY	83	Walnut Street	42.324077	-71.253577	2943218.26	722806.008	5/10/1989	Domestic	New Well	625	50	40	5/10/1989			
135983	WELLESLEY[1]	65	Mill Hill Road	42.29889	-71.229703	2934059.201	729291.239	4/15/2005	Domestic	Replacement	50	0	33	4/15/2005			
669062	WESTON	18	GATE HOUSE LANE	42.3543	-71.26556	2954223.031	719535.222	7/14/2021	Domestic	New Well	1005	16	14	6/23/2021	21.7169054	71.249692	71.249692
660882	WESTON	100	RIDGEWAY RD	42.33487	-71.27732	2947133.796	716375.016	6/13/2018	Irrigation	New Well	700	9	21	6/13/2018			
660151	WESTON	7	CUTTERS BLUFF LANE	42.344	-71.26725	2950468.232	719088.663	3/28/2018	Irrigation	New Well	465	8	182	3/28/2018			
657690	WESTON	55	RIDGEWAY ROAD	42.33673	-71.27901	2947810.431	715916.317	6/6/2017	Irrigation	New Well	1400	32	-9E+08	6/6/2017			
650969	WESTON	24	MEADOWBROOK RD	42.34916	-71.27023	2952346.465	718277.981	10/31/2014	Irrigation	New Well	800	10	36	10/30/2014	50.91780932	167.05319	167.05319
617861	WESTON	44	MEADOWBROOK ROAD	42.3497	-71.26996	2952543.45	718350.437	11/21/2012	Irrigation	New Well	940	4	0		50.17807065	164.62622	164.62622
305153	WESTON	115	Orchard Avenue	42.33424	-71.275682	2946905.371	716818.502	2/15/1980	Domestic	New Well	320	25	20	2/15/1980			
305124	WESTON	48	Ridgeway Road	42.33667	-71.27793	2947789.324	716208.376	8/3/1989	Domestic	New Well	480	10	35	8/3/1989			
305070	WESTON	72	River Road	42.348696	-71.26396	2952182.001	719973.348	1/29/1993	Domestic	Deepen	785	0	100	1/29/1993	75.74117279	75.741173	
305047	WESTON	9	Newton Street	42.341779	-71.275886	2949652.599	716756.125	9/10/1997	Domestic	Hydrofracture	525	20	32	9/10/1997			
305032	WESTON	93	South Avenue	42.341906	-71.267946	2949704.621	718902.581	9/4/1998	Irrigation	New Well	600	70	12	9/4/1998			
163620	WESTON	20	Tamarack Road	42.336517	-71.2701	2947739.177	718325.541	12/15/2010	GeoThermal Open Loop	New Well	1205	45	45	12/15/2010			
122634	WESTON	71	Meadow Beach Road	42.351856	-71.272657	2953327.19	717619.299	5/2/2003	Domestic	New Well	725	3	18	5/2/2003	56.30302601	184.72122	184.72122
117062	WESTON	80	Orchard Avenue	42.33462	-71.272199	2947046.347	717759.875	9/12/2002	Irrigation	New Well	900	80	20	9/12/2002			
114591	WESTON	70	Meadowbrook Road	42.350817	-71.273218	2952948.151	717468.663	6/13/2002	Irrigation	New Well	600	1	14	6/19/2002	69.1055701	226.72432	226.72432
114511	WESTON	45	Young Road	42.344178	-71.275781	2950526.921	716782.214	7/1/2002	Irrigation	New Well	700	29	10	7/12/2002			
112922	WESTON	71	Meadowbrook Road	42.351856	-71.272657	2953327.19	717619.299	1/6/2003	Irrigation	New Well	705	8	16	1/6/2003	56.30302601	184.72122	184.72122
107473	WESTON[1]	167	South Street (rte 30)	42.370125	-71.250359	2960001.684	723627.125	11/12/2001	Irrigation	New Well	700	30	30	11/13/2001	22.82396148	74.881766	74.881766
106117	WESTON	46	River Road	42.34682	-71.264341	2951498.061	719872.245	12/8/2001	Irrigation	New Well	600	6	10	1/4/2001	26.15982801	85.82621	85.82621
105624	WESTON	31	Farm Raod	42.355538	-71.272193	2954669.328	717741.138	9/15/2001	GeoThermal Open Loop	New Well	1507	11	50	9/15/2001	43.19941404	141.73037	141.73037
310539	WESTWOOD[1]		Grove Street	42.331134	-71.257524	2945786.915	721731.326	5/21/1985	Domestic	New Well	600	3	0		59	59	59
310380	WESTWOOD[1]		Grove Street	42.331134	-71.257524	2945786.915	721731.326	2/19/1982	Domestic	New Well	250	6	12	2/19/1982	59	59	59
3333000-04G	WESTON		RTE. 128 G.P. WELL	42.341896	-71.263733												
3333000-03G	WESTON		NICKERSON FIELD G.P. WELL	42.340324	-71.263817												
3317000-05G	WELLESLEY			42.314106	-71.253868												

Note: 1. Recorded latitude/longitude of well is causing the plotting of well in GIS to show as being in a different City/Town. Exact well location should be field verified.

Table J.2-3

List of Wells with Key Data within half a Mile of the Proposed Alternative 10 Route

WellID	Town	Street Number	StreetName	Latitude	Longitude	spcNorthing_usft_Y	spcEasting_usft_X	DateComplete	WellType	WorkPerformed	Total Depth	Depthto Bedrock	Water Level	Dates	GroundElev_BCB	Z	GroundElev_Ft	Hit Bedrock	BedrockElev_BCB
266340	BOSTON	125	Arborway	42.30746	-71.120906	2937294.292	758710.498	2/24/1993	Irrigation	New Well	1005	49	22	2/24/1993	65.6481926	59.1981926	59.1981926	Yes	16.6481926
266339	BOSTON	7	Louders Lane	42.306007	-71.125431	2936759.387	757488.832	2/17/1993	Irrigation	New Well	255	60	50	2/17/1993	148.9375183	142.4875183	142.4875183	Yes	88.93751831
123519	BOSTON		St. Joseph Cemetery	42.301312	-71.104536	2935073.967	763148.892	9/7/2004	Irrigation	New Well	500	10	27	8/16/2004	78.86679382	72.41679382	72.41679382	Yes	68.86679382
105422	BOSTON[1]	Lot 49	Country Club Road	42.307069	-71.193309	2937073.073	739126.303	11/28/2001	Domestic	New Well	510	8	50	12/5/2001	157.1465942	150.6965942	150.6965942	Yes	149.1465942
2318	BOSTON	5	Woodlawn Avenue	42.299243	-71.113476	2934308.904	760733.847	3/14/2000	Domestic	New Well	105	0	1	3/16/2000	48.02450867	41.57450867	41.57450867		
282434	BROOKLINE	191	Newton Street	42.310554	-71.142905	2938396.119	752755.148	5/11/1989	Irrigation	New Well	0	74	35	5/17/1989	211.3908264	204.9408264	204.9408264	Yes	137.3908264
282375	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	4/1/1998	Irrigation	New Well	1000	3	52	4/1/1998	234.3170044	227.8670044	227.8670044	Yes	231.3170044
257944	BROOKLINE	186	Newton Street	42.30945	-71.141633	2937995.245	753100.892	8/20/2008	GeoThermal Open Loop	New Well	1000	30	18	8/20/2008	219.9852478	213.5352478	213.5352478	Yes	189.9852478
100863	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	6/5/2001	Irrigation	New Well	1300	0	15	6/5/2001	234.3170044	227.8670044	227.8670044		
2900	BROOKLINE	150	Woodland Road	42.314477	-71.15786	2939809.149	748704.347	7/13/1999	Irrigation	New Well	1000	0	30	7/27/1999	234.3170044	227.8670044	227.8670044		
663558	NEWTON	530	DUDLEY ROAD	42.30641	-71.17603	2936850.201	743801.147	7/9/2019	Irrigation	New Well	500	6	7	7/2/2019	195.2411987	188.7911987	188.7911987	Yes	189.2411987
659148	NEWTON	181	WINDSOR ROAD	42.3317	-71.25741	2945993.265	721761.565	10/17/2017	Irrigation	New Well	1000	85	54.7	10/17/2017	69.90000076	63.45000076	63.45000076	Yes	-15.09999924
656616	NEWTON	179	LAGRANGE STREET	42.30421	-71.1672	2936057.679	746192.794	2/24/2017	Irrigation	New Well	705	11	0		193.899173	187.449173	187.449173	Yes	182.899173
655572	NEWTON	380	DEDHAM STREET	42.30885	-71.1992	2937716.427	737530.51	7/12/2016	Irrigation	New Well	500	38	40	7/7/2016	183.0266144	176.5766144	176.5766144	Yes	145.0266144
304378	NEWTON		Grove Street and Route 16	42.32577	-71.25632	2943833.092	722062.467	12/1/1980	Domestic	New Well	405	44	0		73.30900879	66.85900879	66.85900879	Yes	29.30900879
304367	NEWTON	400	Dedham Street	42.308428	-71.19821	2937563.589	737798.84	10/12/1989	Irrigation	New Well	450	23	25	10/12/1989	185.9413025	179.4913025	179.4913025	Yes	162.9413025
304353	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/3/1991	Irrigation	New Well	330	30	7	4/3/1991	120.8999969	114.4499969	114.4499969	Yes	90.89999695
304350	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	3/22/1991	Irrigation	New Well	500	9	28	3/22/1991	120.8999969	114.4499969	114.4499969	Yes	111.8999969
304349	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	3/26/1991	Irrigation	New Well	350	10	34	3/26/1991	120.8999969	114.4499969	114.4499969	Yes	110.8999969
304348	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/5/1991	Irrigation	New Well	500	7	40	4/5/1991	120.8999969	114.4499969	114.4499969	Yes	113.8999969
304347	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/14/1991	Irrigation	New Well	405	8	30	4/14/1991	120.8999969	114.4499969	114.4499969	Yes	112.8999969
304346	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	4/30/1991	Irrigation	New Well	500	10	12	4/30/1991	120.8999969	114.4499969	114.4499969	Yes	110.8999969
304344	NEWTON		Nahanton Street	42.298969	-71.198264	2934116.51	737796.427	5/17/1991	Irrigation	New Well	480	10	30	5/17/1991	120.8999969	114.4499969	114.4499969	Yes	110.8999969
304321	NEWTON	21	Placid Road	42.311998	-71.198113	2938864.655	737820.473	10/25/1991	Irrigation	New Well	305	32	16	10/25/1991	125.340831	118.890831	118.890831	Yes	93.34083099
304288	NEWTON	275	Brookline Street	42.300822	-71.177481	2934812.35	743416.35	8/9/1993	Irrigation	New Well	625	13	35	8/9/1993	187.6864197	181.2364197	181.2364197	Yes	174.6864197
304287	NEWTON	85	Kingswood Road	42.354185	-71.253941	2954189.969	722675.921	8/1/1993	Irrigation	New Well	27	0	20	8/1/1993	71.89095612	65.44095612	65.44095612		
304278	NEWTON	185	Christina Street	42.304348	-71.209367	2936066.283	734786.024	4/15/1994	Irrigation	New Well	345	42	25	4/15/1994	114.8999969	108.4499969	108.4499969	Yes	72.89999695
304268	NEWTON	605	Grove Street	42.328369	-71.258656	2944778.424	721428.089	6/17/1994	Irrigation	New Well	500	90	80	6/17/1994	87.41557617	80.96557617	80.96557617	Yes	-2.584423828
304265	NEWTON	130	Wheeler Road	42.310092	-71.191544	2938176.43	739599.748	8/4/1994	Irrigation	New Well	1000	50	10	8/4/1994	135.8999969	129.4499969	129.4499969	Yes	85.89999695
304263	NEWTON	471	Nahanton Street	42.297404	-71.207079	2933537.884	735413.641	8/11/1994	Irrigation	New Well	820	18	40	8/11/1994	116.285495	109.835495	109.835495	Yes	98.285495
304243	NEWTON	7	Melina Road	42.31081	-71.196701	2938433.081	738203.926	12/27/1994	Irrigation	New Well	175	10	14	12/27/1994	146.0838806	139.6338806	139.6338806	Yes	136.0838806
304214	NEWTON	123	Baldpate Hill Road	42.30506	-71.180194	2936353.987	742676.627	7/9/1996	Irrigation	New Well	325	80	60	7/9/1996	261.6592133	255.2092133	255.2092133	Yes	181.6592133
304210	NEWTON		Cornell Street	42.329787	-71.259677	2945294.393	721150.547	8/24/1996	Irrigation	New Well	1000	90	15	8/24/1996	80.25924988	73.80924988	73.80924988	Yes	-9.740750122
304209	NEWTON		Wheeler Road	42.310384	-71.193965	2938280.482	738944.522	9/29/1996	Domestic	Hydrofracture	1000	25	7	9/29/1996	127.8999969	121.4499969	121.4499969	Yes	102.8999969
304177	NEWTON	74	Oak Hill Street	42.298672	-71.179113	2934027.188	742977.802	4/9/1998	Domestic	New Well	500	5	20	4/9/1998	135.8999969	129.4499969	129.4499969	Yes	130.8999969
304170	NEWTON1	24	Bryon Road	42.301863	-71.166924	2935202.683	746270.794	8/8/1998	Irrigation	New Well	500	45	20	8/8/1998	156.8999969	150.4499969	150.4499969	Yes	111.8999969
304165	NEWTON	142	Neshobe Road	42.326972	-71.244996	2944280.077	725123.378	9/1/1998	Irrigation	Hydrofracture	820	65	30	9/1/1998	168.8999969	162.4499969	162.4499969	Yes	103.8999969
304161	NEWTON[1]	24	Bryon Road	42.301863	-71.166924	2935202.683	746270.794	12/5/1998	Irrigation	New Well	505	4	20	12/5/1998	156.8999969	150.4499969	150.4499969	Yes	152.8999969
258804	NEWTON	17	Racheal Rd.	42.30915	-71.202	2937823.094	736772.755	3/10/2009	GeoThermal Closed Loop	New Well	360	22	41	3/10/2009	182.3013031	175.8513031	175.8513031	Yes	160.3013031
257132	NEWTON	354	dudley road	42.30935	-71.181567	2937915.949	742299.385	5/12/2008	Irrigation	New Well	500	15	22	5/12/2008	152.8999969	146.4499969	146.4499969	Yes	137.8999969
155281	NEWTON	369	Dudley Road	42.308333	-71.182517	2937544.379	742043.801	11/13/2007	Irrigation	New Well	425	22	40	11/13/2007	161.0908844	154.6408844	154.6408844	Yes	139.0908844
150099	NEWTON	11	Placid Road	42.307033	-71.192617	2937060.628	739313.534	11/10/2006	Irrigation	New Well	160	25	10	11/11/2006	154.7581055	148.3081055	148.3081055	Yes	129.7581055
146978	NEWTON	21	Columbine Road	42.29903	-71.178494	2934158.28	743144.77	9/11/2006	Irrigation	New Well	220	26	20	8/3/2006	131.5530731	125.1030731	125.1030731	Yes	105.5530731
139646	NEWTON	303	Nahanten Street	42.297823	-71.200698	2933696.568	737139.416	4/12/2006	Irrigation	New Well	27	0	4	4/12/2006	112.7166473	106.2666473	106.2666473		
135288	NEWTON	554	Grove Street	42.330087	-71.257671	2945405.254	721692.662	4/25/2005	Irrigation	New Well	1005	30	20	4/26/2005	83.89999695	77.44999695	77.44999695	Yes	53.89999695
123535	NEWTON	41	Old Farm Road	42.299198	-71.185172	2934212.763	741337.931	5/8/2006	Irrigation	New Well	23	0	18.75	4/18/2006	168.0910675	161.6410675	161.6410675		
106072	NEWTON	12	Laurus Lane	42.300441	-71.182577	2934668.335	742038.274	3/11/2002	Irrigation	New Well	325	40	21.9	3/18/2002	155.8012573	149.3512573	149.3512573	Yes	115.8012573
106054	NEWTON	46	Varick Road	42.32792	-71.245823	2944624.879	724898.717	10/10/2002	Irrigation	New Well	116	115	95	10/9/2002	172.8999969	166.4499969	166.4499969	Yes	57.89999695
103608	NEWTON	27	Pudding Stone Lane	42.299993	-71.177456	2934510.274	743424.256	6/6/2001	Irrigation	New Well	600	10	20	6/6/2001	161.6835663	155.2335663	155.2335663	Yes	151.6835663
304789	WALTHAM	24	Sagamore Way	42.359708	-71.260258	2956197.813	720962.796	11/1/1981	Domestic	New Well	79	67	1	11/1/1981	94.92100067	88.47100067	88.47100067	Yes	27.92100067
304772	WALTHAM	215	Waverley Oaks Road	42.383245	-71.209767	2964817.637	734579.988	5/19/1989	Irrigation	New Well	300	65	10	5/19/1989	73.94291992	67.49291992	67.49291992	Yes	8.942919922
304759	WALTHAM	10	Prospect Hill Road	42.376608	-71.252061	2962362.903	723160.327	6/12/1990	Irrigation	New Well	1000	8	30	6/12/1990	83.11716766	76.66716766	76.66716766	Yes	75.11716766
304716	WALTHAM	601	Beaver Street	42.385188	-71.228649	2965508.92	729476.333	12/11/1992	Irrigation	New Well	225	6	25	12/11/1992	101.2899124	94.83991241	94.83991241	Yes	95.28991241
112825	WALTHAM	213	Beaver Street	42.38417	-71.210531	2965154.028	734372.432	8/27/2002	Irrigation	New Well	180	0	10	8/28/2002	73.59553833	67.14553833	67.14553833		
112667	WALTHAM		Beaver Street	42.385444	-71.223709	2965606.497	730810.644	1/2/2003	Irrigation	New Well	0	120	10	1/4/2003	87.1364624	80.6864624	80.6864624	Yes	-32.8635376
112664	WALTHAM	175	Forest Street	42.387918	-71.218891	2966512.336	732109.32	11/25/2002	Irrigation	New Well	600	120	10	11/26/2002	214.6716644	208.2216644	208.2216644	Yes	94.67166443
112654	WALTHAM	175	Forest Street	42.387918	-71.218891	2966512.336	732109.32	10/9/2002	Irrigation	New Well	900	95	7.8	10/30/2002	214.6716644	208.2216644	208.2216644	Yes	119.6716644
112651	WALTHAM		Beaver Street	42.385444	-71.223709	2965606.497	730810.644	9/20/2002	Irrigation	New Well	400	100	5	9/21/2002	87.1364624	80.6864624	80.6864624	Yes	-12.8635376

Table J.2-3

List of Wells with Key Data within half a Mile of the Proposed Alternative 10 Route

WellID	Town	Street Number	StreetName	Latitude	Longitude	spcNorthing_usft_Y	spcEasting_usft_X	DateComplete	WellType	WorkPerformed	Total Depth	Depthto Bedrock	Water Level	Dates	GroundElev_BCB	Z	GroundElev_Ft	Hit Bedrock	BedrockElev_BCB
668958	WELLESLEY	40	WILLIAM STREET	42.31805	-71.23175	2941039.712	728715.499	6/11/2021	Irrigation	New Well	1005	16	60	5/4/2021	91.6236908	85.1736908	85.1736908	Yes	75.6236908
309600	WELLESLEY	7	Ashmont Road	42.312337	-71.24152	2938949.626	726079.497	12/5/1997	Irrigation	New Well	220	70	20	12/5/1997	99.89999695	93.44999695	93.44999695	Yes	29.89999695
308617	WELLESLEY	83	Walnut Street	42.324077	-71.253577	2943218.26	722806.008	5/10/1989	Domestic	New Well	625	50	40	5/10/1989	129.8999969	123.4499969	123.4499969	Yes	79.89999695
135983	WELLESLEY[1]	65	Mill Hill Road	42.29889	-71.229703	2934059.201	729291.239	4/15/2005	Domestic	Replacement	50	0	33	4/15/2005	162.9268677	156.4768677	156.4768677		
669062	WESTON	18	GATE HOUSE LANE	42.3543	-71.26556	2954223.031	719535.222	7/14/2021	Domestic	New Well	1005	16	14	6/23/2021	84.21760864	77.76760864	77.76760864	Yes	68.21760864
660882	WESTON	100	RIDGEWAY RD	42.33487	-71.27732	2947133.796	716375.016	6/13/2018	Irrigation	New Well	700	9	21	6/13/2018	179.4576752	173.0076752	173.0076752	Yes	170.4576752
660151	WESTON	7	CUTTERS BLUFF LANE	42.344	-71.26725	2950468.232	719088.663	3/28/2018	Irrigation	New Well	465	8	182	3/28/2018	161.3444702	154.8944702	154.8944702	Yes	153.3444702
657690	WESTON	55	RIDGEWAY ROAD	42.33673	-71.27901	2947810.431	715916.317	6/6/2017	Irrigation	New Well	1400	32	18.3	6/6/2017	180.5790894	174.1290894	174.1290894	Yes	148.5790894
650969	WESTON	24	MEADOWBROOK RD	42.34916	-71.27023	2952346.465	718277.981	10/31/2014	Irrigation	New Well	800	10	36	10/30/2014	179.8658783	173.4158783	173.4158783	Yes	169.8658783
617861	WESTON	44	MEADOWBROOK ROAD	42.3497	-71.26996	2952543.45	718350.437	11/21/2012	Irrigation	New Well	940	4	0		176.7796967	170.3296967	170.3296967	Yes	172.7796967
305153	WESTON	115	Orchard Avenue	42.33424	-71.275682	2946905.371	716818.502	2/15/1980	Domestic	New Well	320	25	20	2/15/1980	174.8999969	168.4499969	168.4499969	Yes	149.8999969
305124	WESTON	48	Ridgeway Road	42.33667	-71.27793	2947789.324	716208.376	8/3/1989	Domestic	New Well	480	10	35	8/3/1989	174.090625	167.640625	167.640625	Yes	164.090625
305070	WESTON	72	River Road	42.348696	-71.26396	2952182.001	719973.348	1/29/1993	Domestic	Deepen	785	0	100	1/29/1993	88.57319183	82.12319183	82.12319183		
305047	WESTON	9	Newton Street	42.341779	-71.275886	2949652.599	716756.125	9/10/1997	Domestic	Hydrofracture	525	20	32	9/10/1997	129.8999969	123.4499969	123.4499969	Yes	109.8999969
305044	WESTON	75	Doublet Hill Road	42.348869	-71.275925	2952236.323	716738.794	2/14/1998	Irrigation	New Well	1660	4	1000	2/14/1998	364.4698975	358.0198975	358.0198975	Yes	360.4698975
305043	WESTON	75	Doublet Hill Road	42.348869	-71.275925	2952236.323	716738.794	2/21/1998	Irrigation	New Well	1140	10	1000	2/21/1998	364.4698975	358.0198975	358.0198975	Yes	354.4698975
305032	WESTON	93	South Avenue	42.341906	-71.267946	2949704.621	718902.581	9/4/1998	Irrigation	New Well	600	70	12	9/4/1998	110.1142609	103.6642609	103.6642609	Yes	40.11426086
163620	WESTON	20	Tamarack Road	42.336517	-71.2701	2947739.177	718325.541	12/15/2010	GeoThermal Open Loop	New Well	1205	45	45	12/15/2010	132.6488525	126.1988525	126.1988525	Yes	87.64885254
122634	WESTON	71	Meadow Beach Road	42.351856	-71.272657	2953327.19	717619.299	5/2/2003	Domestic	New Well	725	3	18	5/2/2003	197.5386841	191.0886841	191.0886841	Yes	194.5386841
117062	WESTON	80	Orchard Avenue	42.33462	-71.272199	2947046.347	717759.875	9/12/2002	Irrigation	New Well	900	80	20	9/12/2002	169.7197754	163.2697754	163.2697754	Yes	89.71977539
114591	WESTON	70	Meadowbrook Road	42.350817	-71.273218	2952948.151	717468.663	6/13/2002	Irrigation	New Well	600	1	14	6/19/2002	239.2779572	232.8279572	232.8279572	Yes	238.2779572
114511	WESTON	45	Young Road	42.344178	-71.275781	2950526.921	716782.214	7/1/2002	Irrigation	New Well	700	29	10	7/12/2002	168.7977173	162.3477173	162.3477173	Yes	139.7977173
112922	WESTON	71	Meadowbrook Road	42.351856	-71.272657	2953327.19	717619.299	1/6/2003	Irrigation	New Well	705	8	16	1/6/2003	197.5386841	191.0886841	191.0886841	Yes	189.5386841
107473	WESTON[1]	167	South Street (rte 30)	42.370125	-71.250359	2960001.684	723627.125	11/12/2001	Irrigation	New Well	700	30	30	11/13/2001	87.51864929	81.06864929	81.06864929	Yes	57.51864929
106117	WESTON	46	River Road	42.34682	-71.264341	2951498.061	719872.245	12/8/2001	Irrigation	New Well	600	6	10	1/4/2001	98.20183868	91.75183868	91.75183868	Yes	92.20183868
105624	WESTON	31	Farm Raod	42.355538	-71.272193	2954669.328	717741.138	9/15/2001	GeoThermal Open Loop	New Well	1507	11	50	9/15/2001	155.0550568	148.6050568	148.6050568	Yes	144.0550568
310539	WESTWOOD[1]		Grove Street	42.331134	-71.257524	2945786.915	721731.326	5/21/1985	Domestic	New Well	600	3	0		71.89999695	65.44999695	65.44999695	Yes	68.89999695
310380	WESTWOOD[1]		Grove Street	42.331134	-71.257524	2945786.915	721731.326	2/19/1982	Domestic	New Well	250	6	12	2/19/1982	71.89999695	65.44999695	65.44999695	Yes	65.89999695
3333000-03G	WESTON		NICKERSON FIELD G.P. WELL	42.340324	-71.263817														
3333000-04G	WESTON		RTE. 128 G.P. WELL	42.341896	-71.263733														
3317000-05G	WELLESLEY			42.314106	-71.253868														

Note: 1. Recorded latitude/longitude of well is causing the plotting of well in GIS to show as being in a different City/Town. Exact well location should be field verified.

Table J.3-2 Alternative Potable Water Supply Levels

Order of Implementation	Alternative Name	Description
1	Bottled Water	Provide bottled water for drinking and cooking purposes within 24 hours of water supply emergency until the well owner puts in writing that they no longer require the bottled water.
2	Use of an existing water service	If the property has an existing connection to a municipal water system, the contractor can hire a licensed plumber to re-plumb the interior piping of the property to utilize the water service. This work may include upsizing the existing service or installation of an in-line booster pump if required to provide a minimum service pressure of 35 pounds per square inch.
3	Use of an outdoor spigot	If the property is within 200 feet of a property that receives municipal water service, the contractor could utilize the outdoor spigots of the two properties with proper backflow prevention. In this case, the property with the municipal service would supply water to the property with the well via a hose with a meter. Note that this alternative may not be feasible during cold weather months. During the design phase, the cost of water for one homeowner to supply another should be considered.
4	Construction of a new water service	If the property has a municipal water main in front of the residence, the contractor could tap the existing main and install a service connecting to the existing plumbing.
5	Use of a Hydrant	If the property is within 500 feet of a hydrant, a connection to the municipal water system could be made via the 2.5-inch port with proper backflow prevention and installation of appropriately sized temporary water main to extend to the property and then connect the new temporary water main to the existing plumbing with a new water service or via an outdoor spigot. Note that this alternative could only be utilized seasonally if the temporary piping is above ground, as it could freeze in the winter.
6	Construction of New Water Main and Service	If the property is within 1,000 feet of an existing municipal water main, the contractor could extend the water main to the property. In this alternative, a gate valve at the connection point and a hydrant at the end of the new main are recommended and an in-line booster pump may be required to provide a minimum service pressure of 35 pounds per square inch. A water service would be installed from the new main to the existing plumbing.
7	Use of an Above-Ground Tank System	If there are no ways to provide municipal water service to the property, installation of an above-ground tank system would be required to supply water. This system can be installed in a garage or basement and includes a plastic tank, disinfection system, and pump. The tank would need to be filled on an as-needed basis until a permanent water supply solution is constructed.

Note: The term "water main" refers to a larger diameter pipe that provides service to multiple buildings and fire protection. The term "water service" refers to a smaller diameter pipe that provides service to a single building.

J.4 Surface Water Impacts

In addition to groundwater impacts, there may be potential impacts to surface waters during construction. **Table J.4-1** summarizes the surface waters within a half mile of the proposed tunnel alignment and potential mitigation strategies should the surface water be disrupted during construction. It should be noted that the use of four of the waterbodies are unknown and thus, coordination with the landowner is recommended to understand the use and corresponding mitigation strategy, if required. Water Management Act (WMA) registrations and permits were checked, but these waterbodies with unknown use were not listed. If less than 100,000 gpd is used, a WMA permit or registration would not likely be required, so there is still a possibility that some of waterbodies with unknown uses could be used for irrigation water.

Table J.4-1 Water Supply Resources

Name	Attachment Map Location [1]	Communities	Use	Mitigation Strategy Needed
Charles River	All	Waltham, Weston, Newton, Wellesley, Needham, Brookline, Boston	Recreation	No
Clematis Brook	2 of 8	Waltham	Recreation	No
Lyman Pond	2 of 8	Waltham	Recreation	No
Stony Brook Reservoir	3 of 8	Waltham, Weston, Cambridge	Public Water Supply	Yes, this is a water source for City of Cambridge but the City has an emergency connection with MWRA that could be utilized.
Rosemary Brook	5 of 8	Wellesley	Public Water Supply	Yes, this is a water source for the Town of Wellesley but the Town is partially supplied by MWRA and could receive additional water from MWRA as mitigation.
Charles River Country Club Ponds	6 of 8	Newton	Unknown	While it is expected that this might be an irrigation pond, coordination with the golf course is recommended to confirm use of waterbodies and whether mitigation is required. A WMA registration # 32020701 exists for this golf course for 0.29 MGD for 136 days/year from the Charles River.
Robert T. Lynch Municipal Golf Course Ponds	6 of 8	Brookline	Unknown	While it is expected that this might be an irrigation pond, coordination with the golf course is recommended to confirm use of waterbodies and whether mitigation is required.
Pond at Larz Anderson Park	7 of 8	Brookline	Unknown	Coordination with Town of Brookline is recommended to confirm whether mitigation would be required.
Pond at Apple Orchard School	7 of 8	Brookline	Unknown	Coordination with the school is recommended to determine the use of the waterbody and whether mitigation Is required.
Scarboro Pond	7 of 8	Boston	Recreation	No
Lake Hibiscus	8 of 8	Boston	Recreation	No

*1 Attachment Map Reference Figures are included in **Chapter 5, Water Supply, Figures 5.1-1** through **5.1-8***

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