Wastewater Advisory Committee
Minutes
March 6, 2020
MAPC, 60 Temple Pl., Boston

MWRA: Wendy Leo

WAC: George Atallah, Belinda Stansbury, Kannan Vembu, James Guiod (AB), Adrianna Cillo (BWSC), Craig Allen&, Steven Greene*, Mary Adelstein, Philip Ashcroft (NEWEA), Wayne Chinouard (Vice-Chair, Arlington), Martin Pillsbury (MAPC), Karen Lachmayr (Chair)

*Phone in

Guests: Jim Dunbar, Ajay Singh, Lystek International

Staff: Andreae Downs

VOTE: February Minutes

REPORTS:

MWRA:

- Dusting off our pandemic plans, so prepared in case people have to be out. At lower levels so far.
- DI again no permit violations in 2019—Platinum 13 award.
- CSO program—lots going on. Tracking down where meters and models don't match, or where solutions might be where CSO data isn't where we would want it to be. Memo includes diagrams of actual regulators, etc.
- Nut Island odor control rebuilding--contract issues—getting started after the fire.
- Inspecting shaft to DI. Involves shutting down system and inspecting.
- Remote or with people??
- Making sure gas turbines on DI are up to snuff.

AB: Budget review—both submitted for AB. At March meeting having their public hearing on the budgets. April 12 is MWRA public hearing on budget. June 18th forum on PFAS from a number of different perspectives.

Chair: Thanked presenters for the February presentations on education & outreach. The topic of Education and outreach comes up so often in WAC, great to have last months' presentations. Don't recall having such a comprehensive presentation on the subject to WAC before. Everyone asking her as a microbiologist about Coronavirus.

Director: see attached report

PRESENTATION

Lystek: Low Temperature thermal-alkaline Hydrolysis for biosolids and organics management

Lystek: 20 year old company. Started in the Toronto area. WWTP was looking for something economical, recycling rather than "waste."

Low temperature hydrolysis (under 100 degrees Celsius).

End product something that can be sold—

1. biofertilizer—high solid content (13-16%) liquid product
2. Digester enhancement—fed back to digester to get more gas and solids destruction (not really activated sludge, but similar—instead of 50-60%, get almost another 30% of gas from the digestate)
3. If you have a carbon source for filtering—also can produce a carbon substitute

Hydrolysis comes in after the dewatering of the solids, after digestion.

Compared to other hydrolysis processes:

- Lower temperature, lower pressure.
- 30-45 minutes, one reactor, not done in batches.
- Uses a low pressure steam boiler. Post digestion. Other processes are pre-digestion.
- Smaller footprint. No side streams—don't return anything back to WWTP.
- Has high (30-50%) biogas yield improvement.

Lystek THP VS Conventional THP

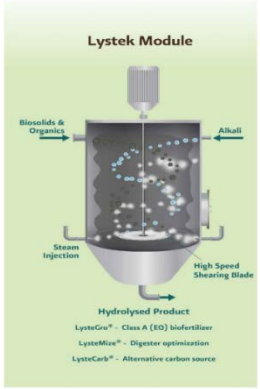
Items	Conventional THP Pre-digestion	Lystek THP Post Digestion
Technology	High temperature, high pressure hydrolysis	Low temperature, high shear, physical-chemical hydrolysis
Process conditions	160-170°C for 20 - 60 min @ 100 -130 psi	70 – 75°C, pH 9.5 – 10.0, high shear mixing, 30 - 45 min, at atm. pressure
Processing steps	Multiple step treatment process: Sludge thickening → Pre-dewatering → Thermal hydrolysis → Anaerobic digestion → Post-dewatering → Class A biosolids	One step treatment process: Anaerobic or Aerobic digestion → Dewatering → Lystek (Reactor) → Class A EQ biofertilizer product
Heat source	High pressure steam boiler, requires stationary engineer	Low pressure (15 psi) steam boiler
Installation	Prior to anaerobic digestion (AD)	After digestion and dewatering
Major equipment involved	High pressure vessel, high pressure steam boiler, pulper, flash tank, heat exchanger, sludge thickener, pumps	Low pressure vessel with mixer, low pressure steam boiler, pumps, chemical tank
Footprint	Large	Small, <2,000 sq ft
Capital/O&M cost	High	Low
Treatment options	Pre-treatment processes require anaerobic digesters to work with	Treats digested or undigested sludge and WAS as pre-digestion
Side stream	High nitrogen centrate requires extensive treatment	No side stream or residue generated
Product application	High solids Cake for land application	High solids liquid biofertilizer, AD enhancement, C source for BNR
Fertilizer value	High NP, low K value	High NPK value
Biogas yield improvement	30 – 50%	30 - 50%

Lystek manages all the end products. They design and install. In some cases, own their own plants.

Mostly designed for municipal wastewater, not industrial waste.

How Does it Work?

- Processing time = minimum 30-45 minutes – total 1 hr
- Processes 1%-35% biosolids and/or non-hazardous organics w/combination of:
  - Heat - low pressure steam injection (15 psi max), low temperature – 75°C (167°F) (Reactor Vessel Non-pressurized)
  - High speed shearing/mixing (Max 1000 RPM)
  - Alkali for pH adjustment (between 9.5 - 10) depending on biosolids source
- No additional waste (i.e. side streams/centrate) to further treat/manage



Can be on-site or off-site. In CA take biosolids from 10 different agencies. Use different polymers, some not digested yet. All through same process. Inside is a high-speed shearing device. 8-10 tons/hour. Can store the end product long-term--don't get separation or settlement.

Blade in the reactor is the most-often replaced. Costs about $1K, needs

replacement every 6 mo. (takes about 2 hours)

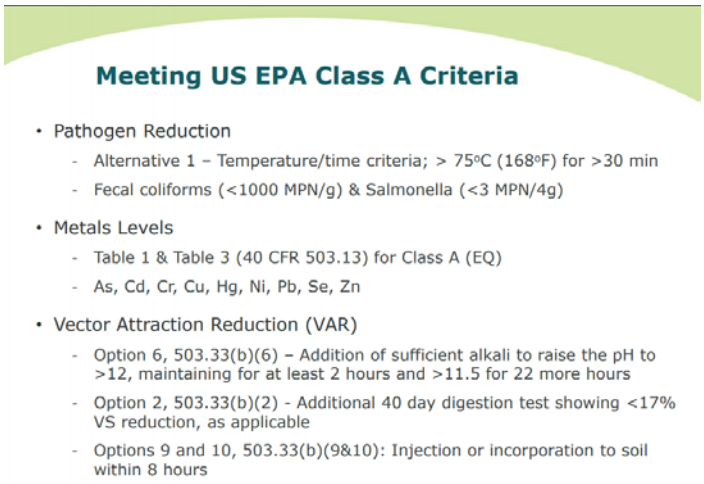
End product 5-4-2 NPK (or 4:3:2). Gets a class A quality biosolids. Disintegrates biological cells, releases water and micro-nutrients.

Not a biological process, a physical chemical one.

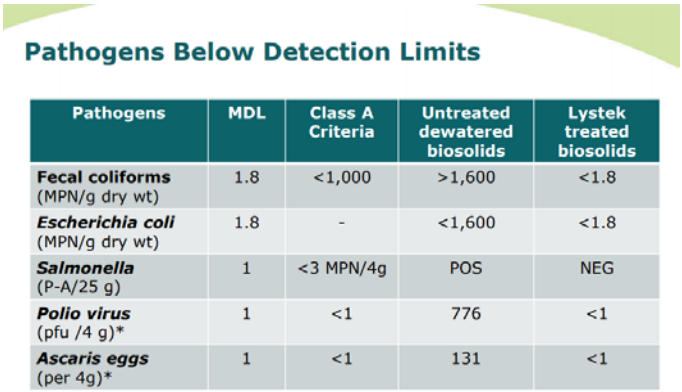
Sell the fertilizer and share revenue with the utilities.

Have 8 Canadian and 3 US facilities. Can co-locate with a WWTP. Can do between 1m to 50m gallons/day.

This fertilizer is injected—it has higher nutrient values. Uses less energy than the pelletizing process—more cost in transporting liquid vs. solids. Nitrogen in pellets is going to be low because often burnt off.



Needs minimal attention—can be continuous or just a few hours a week. Tied in to SCADA. Meets pathogen reduction requirements of EPA, because of heat for more than 30 minutes. Usually non-detect. Screen metals in the incoming biosolids because the process does not address them.



Pathogens	MDL	Class A Criteria	Untreated dewatered biosolids	Lystek treated biosolids
Fecal coliforms (MPN/g dry wt)	1.8	<1,000	>1,600	<1.8
Escherichia coli (MPN/g dry wt)	1.8	-	<1,600	<1.8
Salmonella (P-A/25 g)	1	<3 MPN/4g	POS	NEG
Polio virus (pfu /4 g)*	1	<1	776	<1
Ascaris eggs (per 4g)*	1	<1	131	<1

Uses 1/10th the energy of the drying process.

Don't test for PFAS. No testing standard yet for solids approved by USEPA. Not yet a validated test in any of the states so far. U of Perdue has done some testing of their process & PFAS. Vast majority are not affected by this process.

Don't dilute it before injection. It can't be used on rocks (Las Vegas), but even in clay soils, it can be used. Phosphorus—how demonstrate to MassDAR that this won't run off into the fresh water? The injection process doesn't turn over the soil, so the fertilizer does not run off.

Apply themselves. Do not apply in rainstorms, etc. to avoid runoff. For the farmer, makes sense because don't have to apply or use their equipment or staff. Passes CA rules for fertilizer (there are local/County ordinances which can restrict some biosolids land applications).

Apply with a 500 foot buffer from homes and water sources. Slight ammonia odor that can put off neighbors. Or by the local ordinances. Nuisance flies, odor, runoff is less of an issue with the liquid injection program. Unrestricted use in CA for food, but don't do it mostly. Use for establishing orchards, vineyards. In MA can't use for silage because of Molybdenum levels. Cannot use for certified organics.

Farmer's see good yields after injection. Does not require tilling, as it's injected. Better for soils.

Can scale up quickly up to 150,000 wet tons; How much does MWRA Deer Island produce?

Economic benefits—If you have your own landfill, this won't make sense. If your landfill is about to close, then there's a benefit. You will need soils for application.

Basic footprint without storage is 10-15,000 sf (400 wet tons/day). Biggest cost is alkaloid. Next biggest cost is land application process. Revenues from farmers offset this, and is shared with the utility. Trucking costs, labor, electricity are the net biggest. 60KWh per dry ton.

Next meeting Tuesday, April 21, 10:30 am, joint with WSCAC—MWRA Budgets, Waterworks Museum.

March Director's Report

Water Resources Commission 2/13

Vandana Rao:

- WRC is working on making its water conservation website more user-friendly.
- May move the meeting location to include people who won't come into Boston meetings. May include field trips.

Hydrologic report: January was warmer and drier than normal.

Mass DER overview.

- Formed in 2009. Merger of the riverways program and wetland restoration program. Mission to restore and protect rivers, wetlands and watersheds. Dam removal, culvert replacement, all have climate adaptation benefits. Growing & ramping up work. Have 50-60 projects going on at any one time; all driven by partnerships with nonprofits, state and federal agencies, and municipalities.

- Working to help towns & agencies to include dam removal, culvert upgrades and other adaptation actions part of standard operating procedures. Sharing best practices; training watershed organization members and town employees in watershed restoration and management. MA is a leader in adaptation and restoration.

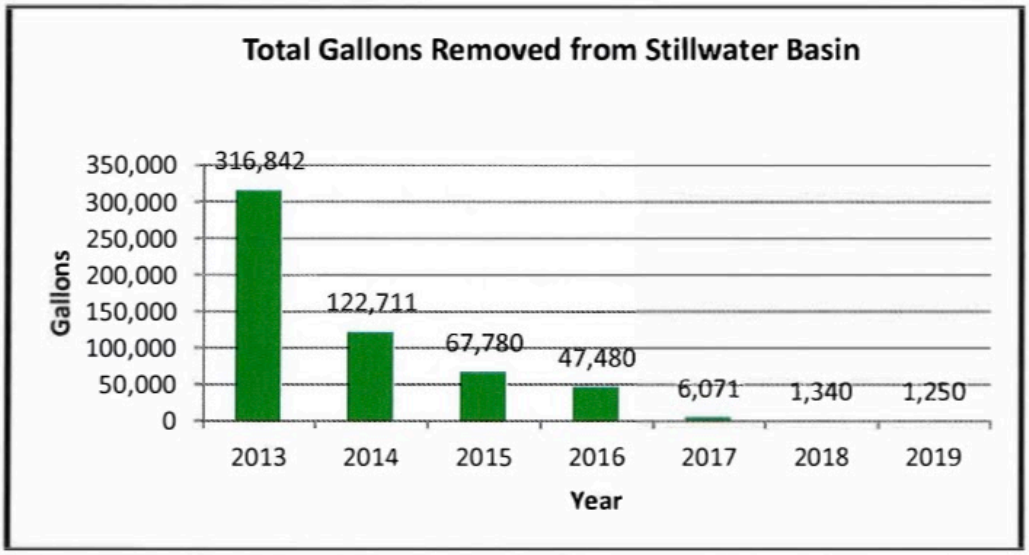
PFAS—David Gutterman, DEP drinking water

- Currently in the public comment period for limiting PFAS in drinking water.
- Comments due Feb. 28
- Establishing levels—20ppt for 6 PFAS. These are the six for which they have toxicology information. Limited methods for testing for PFAS, and can only now detect about 25 of them.
- The MCL applies to community water systems, schools, larger businesses. Does not apply to recreational areas, campgrounds, hotels, small businesses and towns that purchase all their water (like Boston—fully supplied). Are targeting those communities where firefighting foam has been used near wells (20-40 communities). Offering testing, but not requiring it.
- Will roll out slowly because of lack of capacity. Targeting largest systems first.
- Will have monitoring waivers available. Tri-annual (every 3 years) monitoring for those systems with low levels.
- Looking to require testing methods 537 or 537.1 and 533 and looking for comments on whether to approve these for use.
- Minimum reporting level of 2ppt for the 6 PFAS
- Consumer notification triggered by a confirmed result >MCL
- Results available on EEA data portal.
- Also required to be published in the consumer confidence report.
- Proposing using a three month average as a violation, with one month at 60ppt enough to trigger violation.
- The carbon filter systems are expensive and will cause rates to rise (Jenn Pederson)

MWRA Board 2/19

Water Supply

Invasive controls
Mark Johnson, director of waterworks. John Gregoire, reservoir operations. Aquatic Invasives—mostly dealing with 4 plants, 2 milfoils, fanwort and water chestnut. Heaviest level of effort in Wachusett Reservoir. Shallow areas in particular. One of the most effective measures is Diver Assisted Suction Harvesting (DASH).

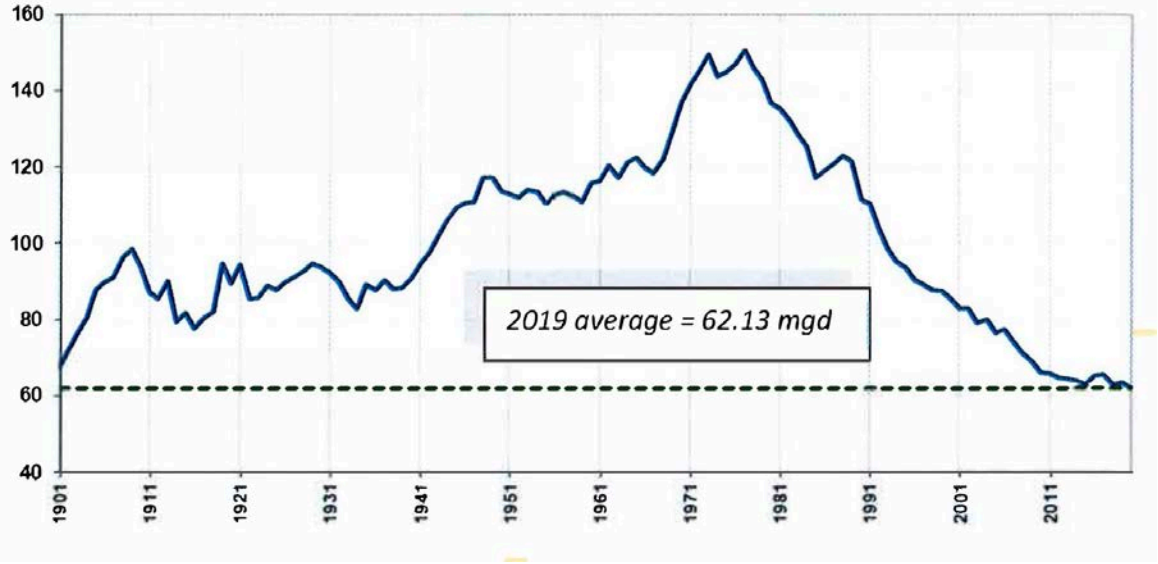


Stillwater Basin Aquatic Invasive Plants removal 2013 -2019

Seeing remarkable return of native plants.

Reservoir water levels
Steve Estes-Smargiassi. Despite expanding economy, more people, more jobs, less water use:

Figure 3: Boston Water Use (1900-2019)



Also less outdoor water use (usually 6-12%). Base demand is also declining. Reservoirs are well under safe withdrawal levels, even with additional water going to the fish hatchery. Does not expect to be reporting drought this year.

Personnel

Affirmative Action: MWRA is continuing to exceed its goals for hiring and promoting women and minorities.

Eight position description changes

Administration & Finance

Orange Notebook
Highlights—disinfection byproducts in drinking water. Metro Boston is doing well. CVA communities had a spike in byproducts as part of the reservoirs refilling after the dry period. Clinton WWTP flow compliance. Had a wet year last year, so rolling average went above NPDES limits, now trending down again.
Tracking workplace safety and training to avoid workman's compensation claims.

Capital Improvement Report
Spending is above budget by more than $3m. The root causes are when projects get awarded. Some already-evident slippage on the progress of projects may bring spending back down below budget.

FY2020 Financial Update
Positive budget variance of $11.4 m. Low interest rates are increasing savings.

Preliminary water & sewer rates

	FY21 Preliminary	FY20 Approved	$ Change from FY20	% Change from FY20
Water	$268,865,000	$258,751,692	$10,113,308	3.9%
Sewer	$520,521,000	$503,015,308	$17,505,692	3.5%
Total	$789,386,000	$761,767,000	$27,619,000	3.6%

2021 Proposed Current Expense budget
Budget is still mostly debt-service driven. Direct expenses 2.2%, Indirect expenses more volatile, but a tiny portion of the budget.
Drivers for multi-year planning:

- Capital expenses
- Existing expenses and revenue—inflation, changes like HEEC
- Long-term liabilities like pension, OPEB

Address debt service with

- defeasance,
- refunding,
- use of reserves
- Tactical issuance of debt
- Control capital spending
- Strategic use of current revenue for capital

Components of the budget:

- Direct costs
    - Wages, salaries, fringe benefits predicted to increase (largest part)
    - Chemical costs mostly up
    - Energy (electricity and fuel oil), usage down, but prices higher
    - Sludge palletization costs increasing
    - Health budget is also up. Expect 6% increase, but may be lower.
- Indirect expenses
    - PILOT in the watershed is the largest component
    - Pensions, increasing by $7 million
    - HEEC $7.2m—not using the $6.5m reserve as insurance and still don't know the full cost of the cable. Awaiting DPU decisions.
    - OPEB increasing by $100K, driven by premium costs

Concerns related to China—includes suppliers, market effects on investment funds and interest rates, and manufactured products on order from shut-down factories in Wuhan.

GASB orders 74 and 75 on OPEB require MWRA to hire a consultant to ensure it can comply.

Replacing underground fuel oil tanks at three pump stations—all over 25 years old.

<u>Wastewater</u>
CSO Control Plan report
Every six month report—December had some discrepancies in the model data and performance. The attached summary has MWRA's response to the court based on that discrepancy. Now have higher confidence in the model and a better understanding of where they can reduce CSOs.
Changes in rainfall, duration and volume are making the project more difficult.

Oxygen generation at DI—needed for secondary treatment via activated sludge. Complex system, and needs engineer to service.

Siphon and Junction rehab—Kleinfelder. Focused on those that may get inflow during high water — either tidal or recurrent flooding. 41 different sites. One bidder out of 20. Many firms were just too busy to even put together a proposal.

Executive Director's report—commendations.
New directive on hands-free driving.
Sludge to pellets—uncertainty on whether PFAS guidance will affect sales. Contract is coming to an end this year. Think prudent to extend the contract given the uncertainty.

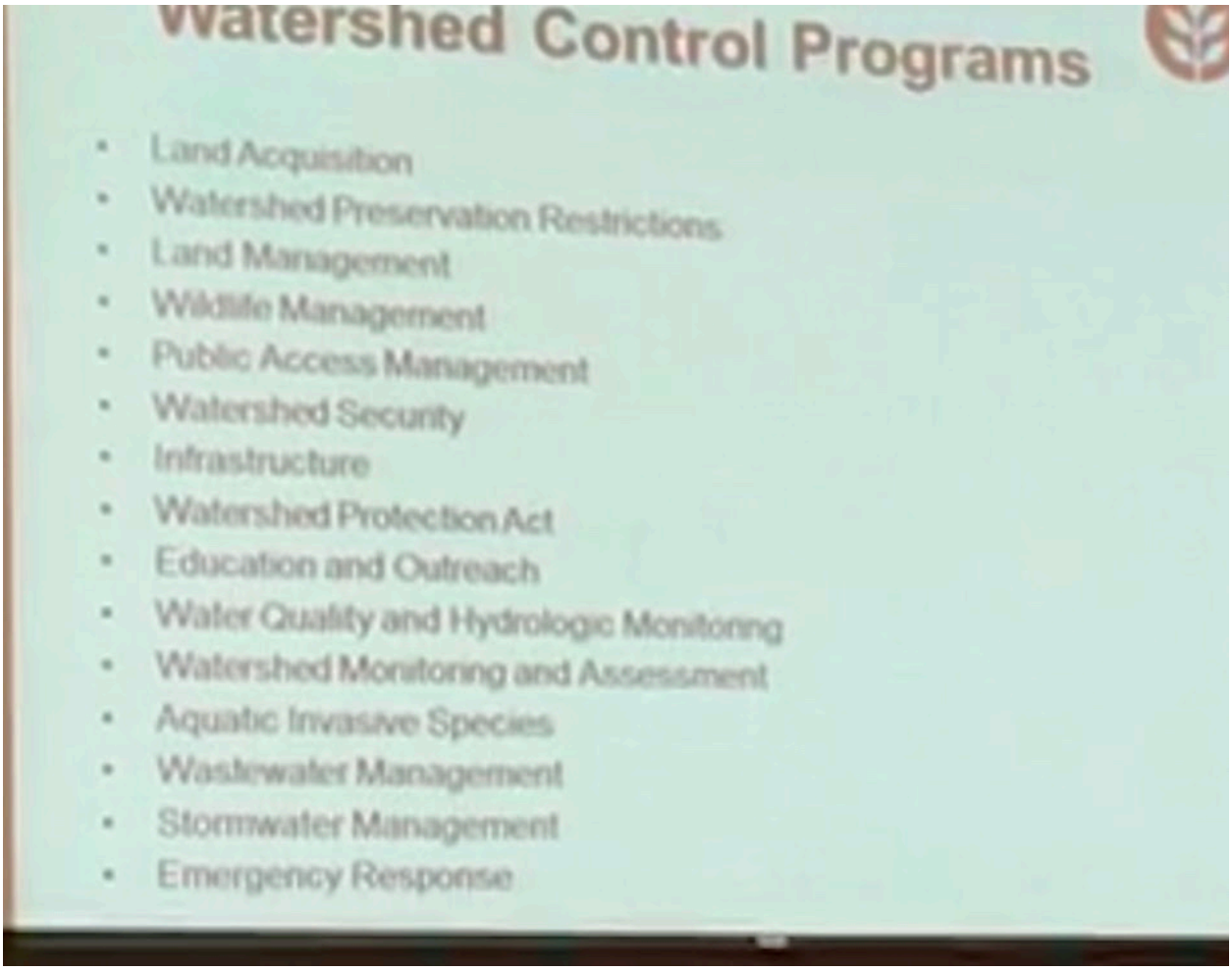
Election of officers: John Carroll, vice chair. Secretary: Andrew Pappastergoin; same chairs of subcommittees.

Presentation on water quality
Betsy Reilley, Mandu Inyang—Chloride in MWRA Reservoirs and how they are mitigating the impacts
Road salt application relatively new. Seeing chloride levels rise as a result in the water—particularly in northern water bodies. Is not seasonal anymore—it is coming in from groundwater.
Quabbin has less chloride because fewer roads. Wachusett has a higher level. 5 mg/lt in 1980s now 10. Cambridge approaching 50. Test the specific conductance, which correlates with salinity.
Approached surrounding towns about their application of salt—estimate more than 18,000 tons on roads. Parking lots are a significant additional source of salt.
One strategy is training of DPW staff—held a free training for town staff. Very well attended.
Carroll: may be a connection to increase in heart attacks. Everyone wants black streets in winter. Nobody puts down sand anymore—too hard to clean.
Pappastergoin: now using brine pre-treatment, which is staying on the asphalt, measured, and more effective.
Reilley: found can use 50-75% less salt with a better result. When chloride in water is high, get more corrosion.

Advisory Board 2/20

John Scannell, Director Division of Water Supply Protection, DCR
DCR Watershed Protection Program Updates

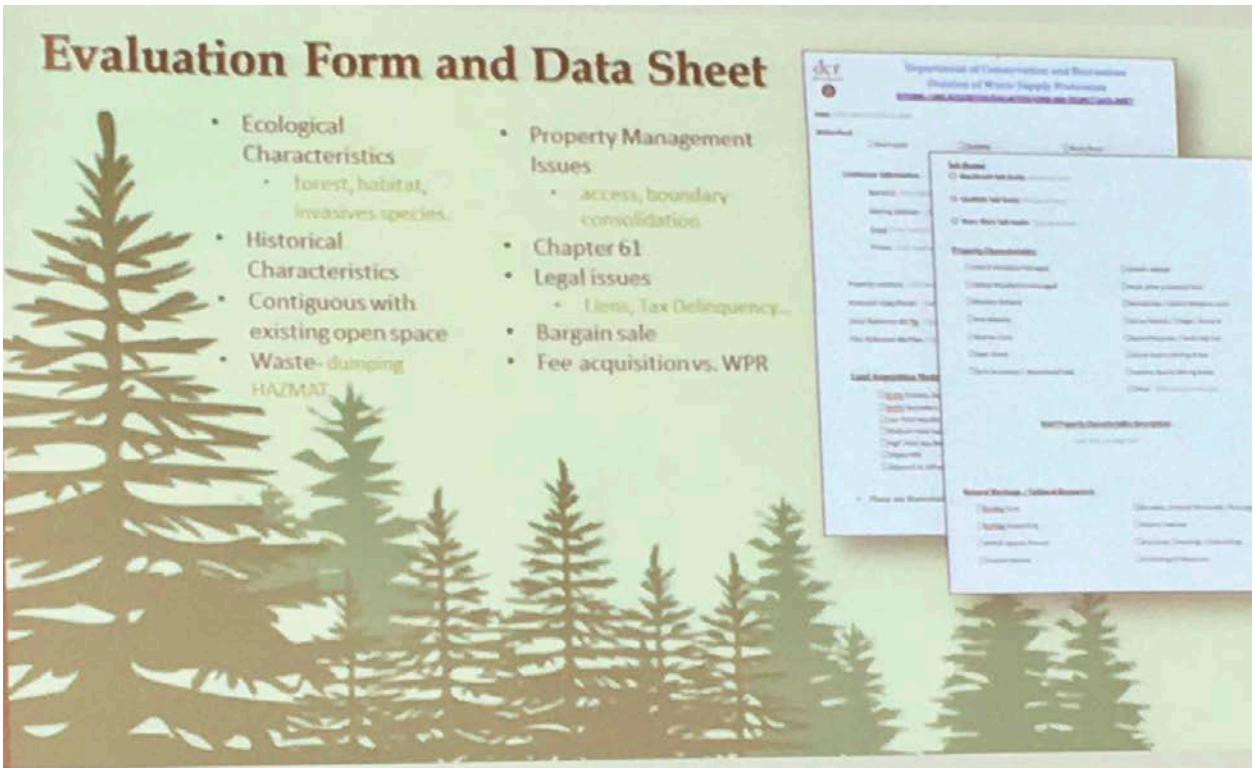
Watershed protection plan—5 year, guides all watershed activities.



Continue to acquire land—$1m budget, focus on Wachusett watershed.

- FY19: 12 acquisitions, 409 acres—also do conservation restrictions
- Criteria—distance to intake, aquifers, municipal zoning, slope
- Last few years—apply to Ware and Quabbin, create a “heat map” that overlays all the criteria to find those with the most impact.

Plus:



Land management—gypsy moth impacts—104,653 acres damaged in 2019. Worse in 2018.

Wildlife management—focus on impacts of wildlife & diversity. Bird harassment to keep guano out of the water. Manage beaver & control deer (hunting). Now also hunting in Wachusett and Sudbury as well as Quabbin.

Public Access: allow select activities and have rangers. Updating the Ware access plan. Working with stakeholders. Then move to the Sudbury.

New HQ at Clinton, New Salem
Also doing roads and culverts around Quabbin.

Water monitoring—reservoir, streams, flow of streams, improved data storage. Noticing the impact of chloride, particularly in Wachusett. Road salt—>chloride in water. Sales of salt started to spike in the 1970s in US, higher in 1990s and 2000s.

No longer just a winter/spring issue. Think it must be in the groundwater, since seeing higher summer chloride numbers. Using education & training for local DPWs, but also involves legislation to control liability (parking lots, walkways). Critical to change public expectations of black pavement.

Joseph Favaloro—reveals hiring cap at DCR set by Administration & Finance and how WSCAC and AB are writing letters protesting it. Water degradation happens slowly, when people don't have the staff or the time to do their jobs. Asks what the AB can do to get the cap lifted. Wants to know what will be the sign that the work isn't happening.

Scanlon—nothing critical is being left undone. Danger is in long term maintenance. Road management at the Quabbin that isn't moving forward.

Director's report—John Carroll (92) is running again for MWRA Board. Pleased not losing that experience, but anyone interested can run for the seat.

June PFAS Workshop in Needham Town Hall. 9 am. DEP Secretary Martin Suuberg and Rep. Hogan will be there. Also NEBRA, CLF, water suppliers.

Is hoping to have the HEEC issues resolved by July.

MWRA budget has 3.63% increase—"good start."

March meeting in Lexington is the budget public hearing

EBC PFAS Seminar—Framingham 2/25

Perflorinated substances—carbon bound to fluorine. Polyflouroalkyl substances carbon bound to other atoms, but can transform to Perflouroalkyl substances. All called PFAS, but once you get a per- substance, very stable.

Big sources are the AFFF (firefighting foams)—fire training facilities and stations, military bases. Landfills—leaching from consumer products. Biosolids, textile manufacturers, chemical facilities, plating…

ITRC PFAS —7 fact sheets.

PFAS in MA, Paul Locke, Mass DEP, Bureau of Waste Site Cleanup

Seeing PFAS in Public Drinking water supplies near current/former military bases. Other @ locations with firefighting activities—training, overturned trucks.

Looking at private wells where nearby public water supplies have tested positive. Many of the tested wells and surface waters were NOT contaminated.

DEP actions:

- Expanded list of PFAS—now testing for 5 or 6.
- Implementing AFFF take back
- Establish drinking water guideline
- Review and update toxicity info
- Develop cleanup standards & notification
- Drinking water MCL—comments until 2/28
- Well sampling
- Expand focus (biosolids, landfills, surface water)

Identifying and addressing Industrial Sources & Occurrence of PFAS in NH, Brandon Keenan, NH Department of Environmental Services

Started with PFAS 4 years ago, with contamination (air source) in Merrimack & Litchfield

2/20/20 notice EPA—preliminary regulatory determination for PFOS and PFOA. —60 day public comment. Eventual regulation in DW will take years. Last MCL was in 1995 for PAHs.

MCL mandates testing & notification across the US.
NH—set MCLs for 5 PFAS, not combined. Currently being challenged in court.
Other states landing with the same general levels. CA has come up with less than 1ppt for drinking water "cause of concern for cancer."

Sampling water supplies, groundwater, surface water, bottled water, wastewater, biosolids, leachate, soil, sediment, fish loon eggs, deer meat, air, stack residue.

About to sample all WWTP with NPDES permits.

Loon eggs—some of the highest levels on the globe, on a lake with 8 ppt.
Public water supplies exceeding NH MCL mostly in the south eastern part of the state, but 26% of NH population affected.

Half of NH population on private wells. 3,000 sampled. 1,000 exceeded MCL—but they concentrated tests near known issues. Some elevated levels unexplained.

Air source were textile manufacturers—air blowing to dry fabrics, PFAS airborne out the stack—falls to ground miles away.

297 waste sites (landfills, manufacturing, etc.) test high for PFAS. Highest levels where have AFFF. Next textiles, then paper, then metal plating.

In WWTP—identifying sources of PFAS, industry, septage, and biosolids.

Fate & Transport & Recycling of PFAS in the Environment Steven LaRosa, Weston & Sampson

Spread: air, waste, groundwater, surface water, stormwater, soils, animals that eat contaminated plants

Source types: AFFF and any fire site; Manufacturing; Landfill; WWTP

PFAS: hydrophilic head with hydrophobic tail—keep to surface of water. Sorption generally increases with longer tails—more carbon. Short chains migrate faster. Precursors can be transformed (oxygenation) esp. in soils, and result in more PFAS.

Air: can be volatile by drying—carried in water vapor, on air as a particulate. North Bennington—used PFAS to coat fabrics & then dried them—carried out via air 5 miles—25 sq. miles. Some wells have 4,000 ppt, and next door non-detects. Why? Difference is the age of the water.

Recycling—they don't degrade, they keep moving.

PFAS Cycling Between Landfills and WWTPs Steve Zema, Sanborn, Head

Surface water standards are coming & will affect WWTP. Based on human health risk of eating fish. So far are lower than DW standards—about 6ppt.

Landfill leachate. Lowell was taking 38K gal/day 1550 ppt PFOS. Dilution factor of Merrimack was .012 ppt. Can have up to 1,000 ppt in leachate if dilution factor is high enough.

WWTP produce about as much PFAS as there is leachate in the country (about 700 kg/yr.) US produces about a million lbs. of PFAS/year.

Sludge has longer-chain compounds that stick to solids. Leachate has shorter-chain compounds (alcohols). Almost all waste has some PFAS. Some that are higher concentrates are: carpeting, bulky items/coated fabrics. Some sludge (but not a major source compared to fabrics, carpets and couches!) More PFAS going in to landfills than coming out in leachate. Q: are landfills holding on to these compounds?

In some cases, the leachate contains more PFAS (shorter chain compounds) than in the source materials.

Expects more PFAS in sludge than in effluent.

PFOS seems to be everywhere in soils (tested contaminated soils)—background levels are in every soil tested in VT even in rural areas, parks and forests. Textiles, jackets, mattress covers—when they have PFAS they have lots of them. Also carpeting. Commercial wastes—chrome platers, waterproof coatings, food packaging, textiles and plastic manufacturing.

MI noticed that leachate was only a small source of the PFAS in effluent.

Biosolids and Agricultural Land Eamon Twohig, VT. Department of Environmental Conservation

VT has advisories for 5 PFAS, 20ppt groundwater, 1.22ppm soil. Tested all biosolids produced in VT, tested for 24 PFAS. Looked at influent and effluent. The ones which take landfill leachate have higher levels. Some areas (Montpelier and Newport) have more industry & more PFAS.

55% of state on septage. 84% is sent to WWTP. The rest is land-applied as if it were a class B biosolid.

Average PFAS in residuals were highest % for Class A, lowest for paper waste, but all were above 20 ppb for the 24 PFAS. Why class A? Higher temperatures? Paper recyclers have high PFAS in effluent. But not high solids PFAS out the other end.

Seeing high PFAS values in fields where sludge/biosolids land applied. Now looking at plant uptake, to see if this is a concern.

Current Tools for Treating proprietary Chemistry Annie Lu Dewitt, Clean Harbors

Discovered in 1938 from a failed refrigerant experiment. Chemistry is complicated, and not well understood. Companies protect the chemistry of the products—always innovating with new ones. Still new ones coming out.

Analytical tools for ID of PFAS — can see concentrations below 1 ppt. But very selective. A small change in the chemical structure makes a compound invisible to detection. Over 6,000 compounds. 35 have standards.

Treatment—adsorption (carbon filters, organic clay) and ion exchange, will remove a wide range PFAS effectively. But the chemistry of the water affects the removal—total organic carbon and volatile organic compounds will foul the membranes if in high concentrations.

Options include carbon, resins, other media, oxidation (may just break down to harder-to-treat compounds), incineration, reverse osmosis.

PFAS Remediation—current options Paul Dombrowski, ISOTEC

PFAS may be co-mingled with other VOCs.

DoD spending $100m on PFAS and is probably going to hit $500m.

Activated Carbon: works to remove benzene as well as PFAS. Can be used in-situ. But—then what? Can be removed as other compounds are absorbed. Less effective for short-chain PFAS. Not all activated carbons are alike.

Powdered adsorbent—blend of aluminum hydroxide, carbon and clays. Used to treat PFAS soils. Sent to landfill.

Permeable reactive barrier.

List of things that aren't yet proven: chemical oxidants, bubbles (air bubbles capture PFAS, which rise to the surface—remove concentrate with a vacuum); thermal treatment—destroyed between 900-1,000 C—>can go into the gas stream. Potential emissions; another test—300 C, with minimum of 2 weeks of heating, removed 99% of PFAS.

PFAS Sampling—Cross-contamination study Jim Occhialini, Alpha Analytical

False positives from the lab, sampling and site contamination? DEP has guidance, but the materials that contain PFAS may change. NY has guidelines—esp. for fish sampling.

Looked at sampling products that might have PFAS. Products a random sample. Not in depth, worst case scenario.

PFAS Forensics and Source ID, Elizabeth Denly, TRC
Important to determine who will pay for cleanup.

Chemical signatures—breakdown products, commingling.

Groups:

- paper & food packaging PFAS, less soluble
- Textile & leather—polymers
- AFFF—PFOA was the initial PFAS, then 8:2FTS
- WWTP/Landfills—carpeting residues & breakdown compounds
- Metal plating—PFOS in chromium plating.

WWTP Effluent signatures—highly variable, and depends on influent (e.g. chrome plating)

Ground/surface water contamination—consider

- Degradation
- Retention of PFAS in source area soil
- Sorption
- Mixing/dilution
- Commingling

Half-life of PFAS in fish is just a couple of days—sits in equilibrium with water. In humans, half-life is longer.