Lake Champlain Phosphorus Initiative

Seventh Meeting of the Agricultural Innovations Group 5/2/14

This summary reflects a range of views expressed during a meeting of the Agricultural Innovations Group. They do not reflect the formal or public position of any one group of people, organization or coalition. All errors and omissions are the sole responsibility of EMC/CBI.

Attendees: 10

Guests: 6

Experts were invited to assist the group in vetting the concept of a regional digester/closed nutrient loop pilot project, ideally to be situated in St. Alban's Bay. The goal of the project would be to improve water quality by developing a community digester with an integrated nutrient recovery for energy conversion. In order to spur innovation, the group determined that it is essential that nutrient runoff be addressed in a whole community setting. Fundamental to that aim is the recognition that society must find ways to treat what has been traditionally thought of as waste (e.g. manure and pre and post consumer waste) instead as a valuable resource that can be captured, put to productive use and re-purposed. Act 148's requirement to divert certain solid waste materials from landfills is a recent example of the growing recognition of the need to treat waste in a more progressive way.

The group sought feedback on the economic and technical viability of such a project and to learn from experts in sustainable energy and agricultural/ environmental technology as they explored options together.

A benefit of this roundtable discussion was that not only did the Group have the opportunity to vet their proposal with the panel, the meeting also brought together leaders in innovative water quality and sustainable, renewable energy technology with a cross section of local agricultural service providers, farmers, experts in soil management, environmental groups, state and federal agency personnel and private companies to have an open conversation about existing and upcoming projects and grant proposal opportunities that may provide avenues for possible public/private collaborations.

The Guests

Abe Collins from St. Albans, Vermont a grazing advocate for improving water quality by rebuilding topsoil and implementing agricultural management practices that reduce erosion preventing nutrient runoff.

Rob Crook from Floating Islands Solutions based in Minnesota and North Carolina installs Biohaven floating islands designed to remove excess nutrients and contaminants from lakes streams and wastewater lagoons. The process was recently featured in a showcase of innovative

American water technologies by the U.S. State Department at its U.S.Tech H2.0 Conference in March, 2014.

Rick Johnson from Clearas Water Recovery has been at other water quality meetings as noted in earlier meeting minutes. Clearas Water Recovery utilizes algae reactors to create energy and algae byproducts that can be used in a pellet form for bio-plastic or for soil applications. The technology can be used in conjunction with a digester.

Sean Breen from Native Energy. Sean has been at other meetings as noted in earlier meeting minutes. Native Energy is primarily focused on the utilization of carbon offsets and renewable energy credits and has experience in family farm bio-digester technology. In some cases the projects use a two-step process combining a digester with centrifuge technology to remove the phosphorus and produce a cake that can be applied to the soil.

David Dunn from Green Mountain Power's Energy Innovation Center. GMP is actively researching the technologies that have captured the interest of the Agricultural Innovations Group and has been looking to engage with cross sector groups to explore collaborative pilot projects that will produce sustainable energy and provide additional benefits.

Bob Fisher is the chief operator of the Montpelier Waste Water Treatment Plant and the President of the Green Mountain Water Environment Association. The GMWEA is a non-profit association that supports the work of water quality professionals and provides assistance to regulators and others on a variety of water quality issues.

These notes and the presentations that were given will be posted on the Environmental Mediation Center's website: http://www.emcenter.org/lake-champlain-phosphorous-pollution-initiative/

The purpose of this meeting was to bring together various leaders in alternative energy/water recovery and bio-tech to better vet the feasibility of the Agricultural Innovations Group recommendation for a pilot project to create a digester/closed loop nutrient management project in the St. Albans Bay area. The goal is to determine whether using a whole systems approach to waste treatment and management across various sectors (municipal, storm water, agricultural, wastewater) would produce more efficient water quality improvements than have been achievable thus far using a segmented sector by sector approach to addressing water quality issues.

Preliminary Discussions:

Before the discussions on the digester began, the group discussed questions about subjects discussed in past meetings and how to integrate them into a final report.

- Concerns were raised by the group regarding whether proposing just one major recommendation would effectively address the Phosphorous ("P") issue for water quality concerns.

- The Group vetted a much longer list of concepts and ideas and held meetings with other guests. These ideas included: a Water Quality Certification Program, Pasture Based Livestock, Farm Diversification, Water Quality Restrictions in Conservation Easements, Soil Health, Manure Management, Community Digesters, Land Swaps and Buyouts.

- An early idea that was not pursued for a more detailed review encompassed whether Vermont could create and sustain a nutrient trading system. Other states have tried to create such a system and it has not been successful, however, there is a grant-funded project that the Agency of Agriculture is spearheading to investigate the feasibility. The Group tabled this discussion on concerns that it would be premature without the feasibility study.

- Ultimately, a Nutrient Trading Program could complement the work being done by the AgInG by helping to create a market for P.

- The developing but uncertain market for P complicates conversations regarding how to improve water quality by reducing P. Even if P is reduced in one area, it logically follows that it has been increased in another area. Concerns were raised that none of the recommendations could address how to reduce the amount of P in a watershed that gets into waterways and then into the Lake. Without an export product or a technology tool that eliminates the P it's hard to find workable solutions.

- Questions were raised on whether the goal should even focus on reducing P. Perhaps that is the wrong approach. The goal is to keep the P in the soil where it is needed.

- P is a valuable nutrient. When ag advisors create nutrient management plans for farms, generally they are not finding excess P is an issue. In fact, many fields could use more P applied to the soil but farms either do not have it or their application method is inefficient and they cannot get P to where it is most needed.

- P should not be characterized as a waste. P is a nutrient and valuable to farmers. The goal cannot be removing P but, rather, creating a more calculated and targeted methodology to apply and use P.

- In St Albans Bay, have a geographical area that can be specifically targeted for a pilot project. P loading is as much a municipal as an agricultural issue in this area.

- AgInG recognized several independent projects were underway to address water quality initiatives but not enough of the companies and organizations involved in these projects were speaking with one another to see if it was possible to put together a more coherent, linked, highly targeted project to address water quality issues across sectors.

Promoting Soil Health

- Abe Collins- advocate to grow topsoil. Vermont has lost 1 foot of topsoil. The ability of agriculture to continue requires a more robust land base. Flooding, erosion, poor management practices have led to significant losses of the soil, the nutrients in the soil runoff into waterways and the soil remaining is not going to have optimal levels of nutrients for growing crops. Regrowing the topsoil to a uniform, deep base would result in being able to use the P we already have in the watershed.

- Soil loss carries the nutrients to areas of run off where it gets into the watershed. Keeping the soil in place is key as is ensuring an adequate topsoil base. Farmers must regrow the soil base and that takes a lot of P, a lot of microbes, so farmers need the nutrients on the farms.

- The ability of farms to increase topsoil and efficiently use nutrients is not a theory--- this is a fact and this is the basis for a farm economy – must regrow the base and build the soil aggregates.

- Farms need to be encouraged to grow soils, efficiently use nutrients and to understand how to manage and monitor the condition of the soil so they can react to any potential or actual soil loss and nutrient runoff event quickly.

- Best possible way to do this is to monitor every field and the technology exists to allow farmers to do that. Farmers can get early detection of soil loss/nutrient runoff and can react in real time to prevent the losses from happening.

The Group asked four questions about the community digester project and these were, in turn discussed by the expert roundtable:

I. <u>Would this proposal significantly reduce phosphorous?</u>

- A digester alone does not significantly treat the P in the waste. The use of the word waste is itself a misnomer, the "waste" is really a source of valuable nutrients and there needs to be nutrient recapture. If the project is

not thoughtfully designed, may only end up encouraging some farms to increase animal density to levels that in the end have a negative impact on water quality.

- A two-step digester using secondary technologies can isolate the P in a form that can be transported economically and applied in a more targeted manner.
- AgInG recognition that a digester for ag waste was not as efficient as one that could take pre consumer waste as well as ag waste, and that was not as efficient as one that could take pre consumer waste, post consumer waste and ag waste – would generate far more sustainable energy than a smaller digester alone.
- Conventional digesters create sustainable energy and repurpose the P by turning it into bedding and by producing an easier to apply liquid for field use.
- The liquid from the process can be utilized either by establishing a regional drag line or injector system or undergo further processing by secondary technologies.
- Secondary technologies such as utilizing a centrifuge, algae reactor, or floating islands can isolate and capture the P.
- Centrifuges are a proven technology that can easily be integrated into a digester and can significantly reduce P in the liquids.
- The liquid from a digester can be run through an algae reactor that captures P and other nutrients in wastewater by growing algae.
- P in wastewater and lake water can be captured using a floating island system to grow plants for food, restore wetlands and shorelines, create a sheltered habitat for fish species.

- There is no one process or product that, all by itself, is going to significantly solve the P issue. However, combining multiple technologies in a geographic area could lead to a more targeted use for the P in the area, it can be captured, repurposed and redeployed efficiently.

II. Is the proposal technically feasible? Do the technologies exist? Are they proven? Should there be modifications in scope?

Centrifuge Technology

- Sean Breen –mechanical separation is a proven way to remove P from the water. A centrifuge process has been shown to reduce the P 70% the key issue is whether it is economically feasible to do it.

- Some farms may be able to use it depending on the characteristics of their land base. Some farms are so spread out that there may be a justification for removing the P into a more easily transferable form (e.g. cake) to save on the lengthy transport and hauling costs the farms otherwise incur. However only a minority of farms have this issue and would find it justifiable. The majority of smaller farms may like the end result but would not be able to justify the cost of bringing such technology to their farm. If several combined together then it becomes more economically feasible.

- The centrifuge technology, along with other post-processing technology, could make the water clean enough to reuse it for animals – need the analysis to be done. Problem is if the end result is only the creation of less dirty water its not an advantage—may need to spray more water to get same application to the land of needed nutrients.

- There is a presumable sweet spot between density of land base and expense to haul manure to fields that need it that will determine whether the investment in the technology is worth it.

- Soil loss is a driving issue—gravity and erosion is creating issues for farms—they need nutrients and rebuilding of the soil but they do not have the money to invest in the process. Need to maximize the value of the manure.

Floating Islands to Address Legacy P

- Hardest issue to address from a water quality point of view is legacy P already existing in the lake.

- Floating Islands Solutions are one of the few strategies to address legacy P. The islands are porous plastic with foam injected into them for buoyancy. The islands are anchored in place, vegetation is planted on top, and microbes reduce phosphorus and other pollutants from the water.

- Can look at the nutrients, even excess ones, in the Lake as a valuable resource.

- Managing the nutrients in the Lake for growth of floating islands can help address the excess nutrients in a controlled way.
- Floating Islands built 1.5 acre island in New Zealand. Estimates .05 pounds per cubic foot per year in nutrient uptake. Looking to use the island as a source of periphyton, which serves as an important food source for aquatic ecosystems. Redirect the P away from algae that is not helping the ecosystem in the Lake into something within the Lake ecosystem that is higher on the scale and will be used by invertebrates and fish.
- Can also establish a floating island in an animal waste lagoon and harvest the organic matter for compost.
- The islands have been placed in the Gulf of Mexico and normal tide and wave action is not an issue—in some cases the islands are acting as a buffer moderating wave action. The islands have withstood a class 1 hurricane.
- The islands can be fitted with lights if there are concerns about navigation hazards for boaters and others.
- Can be used to promote fish habitats to grow larger fish—every 100 lbs of fish= 1 lb of P pulled out
- Could be used to grow forage for livestock—would need to create a system that will allow for light machinery for harvest.
- Biomass can be created that ties P up in organic matter that can be applied to a field; soil amendments can be added where needed.
- Cost is around $25-$30 per square foot but the larger the project the lower the price, would depend on the project. It's less expensive than dredging/alum treatment.

Algae Reactor

- Rick Johnson: Clearas biological water treatment system uses algae and other biological organisms to recover P or other nutrients in wastewater. Need to change approach from one of talking about reduction of P to recovery of P.
- Expose liquid manure/waste water and grow algae in a controlled environment harvest the biomass and create an end product sold for use in bioplastics and fertilizer as a soil enhancement.

- Systems are effective, used in municipal wastewater treatment plants, papermills, fish farms, aerobic and anaerobic digesters have many projects underway in New England.

- The technology works, the recovery of P is a national issue, not just a local issue more and more emphasis will be on pulling nutrients out of the waste streams to reuse it—not just about P, many more nutrients

- Benefit is also that the process creates oxygen that is released—the water is oxygenated.

- Can remove the solid part with P out of the water and pretreat it. Cost, economics of this is that $2.00 per pound for P removal.

- Have to pull a sample and determine the N. P. K. levels in the water than can see results when use a reactor, mass balance, treat a pilot level of water test at the site then use a modular unit to confirm findings.

- Point is to know before you commit to using the process what the end product will be and whether there is a productive, economic use for the end product, want the system vetted before buyer commits to it.

III. <u>Is the proposal economically feasible?</u>

- Currently the market for the P captured through a secondary treatment process is still developing. Clearas uses captured P in the bio-plastics and soil enhancement markets. The analysis of the secondary treatment technologies should further explore the marketability of P and other products that can be developed.

- Question is can these technologies work in tandem in a coordinated way to produce desired results?

- P is a very complex issue—soil loss, legacy P in Lake, multiple sources municipal, commercial, agricultural where P ends up in the Lake.

- Addressing P on a smaller scale is difficult to do—may not be economically feasible for even a large farm to install the kinds of technology needed to address the issue and may be better off encouraging a community based approach.

- Each technology standing alone may not create an economically viable way to address the P issue.

- Need combination cross sector programs that work together.
- Way forward may be a public/private partnership.
- Green Mountain Power looking to innovative sustainable energy solutions.
- Digesters reduce odor and create bedding that carries with it some of the P from the waste. Other farms buy, use and then compost the bedding.
- GMP looked at a community based digester project in 1990s at that time it was not economically viable. Looked again at the project in 2009 but trucking costs made it prohibitive—how to get the waste to the digester in an efficient way?
- Act 148 will prohibit organic waste from being sent to landfills. Act 148 creates a large opportunity by increasing the amount of waste that may be available for a community digester and makes it more economically feasible.
- Looked to Stone Environmental to do a study.
- Looked at how to use the end product—can use half of what is created for bedding but what can be done with the other half? Learned that Idaho has a project that adds the fibers in as a soil amendment and builds topsoil with it.
- Interested in using secondary technologies such as centrifuge or algae reactor to address water quality issues.
- Can use the heat recovery to support a large community greenhouse project in St Albans.
- Farms, if close enough could invest in a drag line infrastructure for the water and nutrients directly injected where most needed—admittedly there are issues with central pipelines for this type of project but properly engineered the issues can be addressed. The Wisconsin project is a cautionary tale their pipeline system broke and led to significant issues.
- Lots of different pieces could come together efficiently to create a larger scale pilot project to demonstrate how these technologies interact together to address the issue. Need to investigate economics with secondary treatment.

- With possible income streams from organic material tipping fees, bedding, water quality benefits, heat, energy, P or other by-products, it is possible for economics to work.

- Over time, more communities will want to address nutrient issues, solid waste, impacted waterways, sustainable, renewable energy sources, etc.

- Wastewater treatment plants have reduced P significantly over time, at this point, to achieve further reductions that would be very small would cost exponentially more.

- Have a small base of municipal rate payers and they must foot the costs of the small improvements that may be forced to make

IV. <u>If the above three issues are affirmed as possible, then what are the barriers and/or challenges to making this project happen?</u>

- The issue is what is the right combination of technology to produce the desired results? In order to combine the technologies, what regulatory issues need to be addressed?

- For example, post consumer waste raises issues regarding biotoxins. Pasteurizing or pre-treating the waste may solve that problem.

- If you wanted to be able to repurpose the water from a community digester system, could create a pipeline network but need to ensure the system was properly engineered with safeguards.

- Content of the nutrients to be reapplied to the land—how to generate and manage for the correct nutrient mix?

- Most farms need P but the P needs to be able to remain in place on the land. Need farms with management and monitoring practices in place to better rebuild the topsoil and attend to soil quality and soil loss issues.

- Using a technology to create a product to remove P from the area when most farms report they need more P to grow crops. Must figure out system that works for farmers so that they have access to the P they need and can use it so that it stays in the soil.

- Misperceptions need to be addressed—no one is saying to farms need to use less P or these technologies are being used to reduce available P to farmers.

- Idea is can such a project produce energy for the community; build back needed top soil for the community, clean water with overabundance of nutrients, address waste issues in landfills, agriculture and municipalities reuse and repurpose – nutrients won't get any cheaper- use them more efficiently

V. Next Steps and Conclusion

For a pilot project to be successful, it must be correctly scaled. It will take a combination of environmental, governmental (local, state, and federal), community, agriculture, and private sector participants working collaboratively. The technology is not theoretical—it's being used in various programs in this and other countries. The innovation will come in trying to use a combination of these technologies to address water quality concerns in a targeted geographic area.

The next steps are to review additional information from the secondary treatment technologies to determine the technologies that are most effective in capturing the P, what the cost is of removing P, and what products and other income streams do the respective technologies generate. Additional information will be circulated when we receive it.

There is also interest in forming a new cross-sector working group comprised of representatives from the St Albans farming community, the agricultural and environmental communities, St Albans municipality, and wastewater treatment plant to further investigate these issues and coordinate stakeholder outreach.