Uplands Development Comments

Sewer Problem Mitigation

This comment expands on comments I made at the ZBA meeting June 28, 2006.

Sumner Brown, 617-484-1149

Summary

☒ Belmont's sanitary sewers are in terrible condition, but they can be fixed with money.
☒ Developers must negotiate a one-time payment for reducing inflow and infiltration to compensate for the additional sewage that will come from their development.
☒ This payment is determined by multiplying the anticipated amount of new sewage, expressed in units of gallons per day, times a ratio of the gallons of I/I to be removed per gallon of sewage, and then multiplying by the cost of improvements to remove a gallon of inflow per day.
☒ There is much variation in the numbers used in Massachusetts to reach a payment amount.
☒ The ratio, of removed I/I to new sewage, varies from a minimum demanded by the Massachusetts Department of Environmental Protection of 4. Cambridge uses about 11. An objective criterion, which would keep bacteria escaping from the Somerville Pumping Station constant, might be about 13.
☒ The cost to improve systems to reduce inflow by a gallon per day, used to negotiate mitigation payments, varies. I have been told by a member of the Massachusetts Department of Environmental Protection that two to four dollars is typical but some communities get ten dollars per gallon per day.
☒ Belmont's deal with McLean is very favorable for McLean. The mitigation payment is far lower than it should be. Please do not repeat this mistake.

Information Sources

Most of my information came from a meeting hosted by the Massachusetts Water Resource Authority on June 2, 2006. Both MWRA and DEP people attended this meeting. I believe that the two to four dollar cost to remover a gallon per day of inflow came from a DEP person, not from the MWRA as I said at the June 28 meeting. Other information came from attending the Arlington Belmont Cambridge Stormwater Flooding Board meetings. If any of the numbers I am providing need to be documented, I can pursue that.

Infiltration, Inflow, and Sewer Problems

There is an inconsistency in the use of "inflow" and "infiltration" that affects how sewer problem mitigation can be negotiated. This is a technical point that affects money. Let me explain.

Many, but not all, of Belmont's sewer problems arise because when rain begins, there is a very quick increase of flow in Belmont's sewers. This sewer flow increase starts almost immediately when rain begins and reaches full increase in perhaps an hour after the rain starts. It stops as quickly as it starts when the rain stops. This component of flow in sewers causes flooding in

basements, and sanitary sewer overflows. Roof downspouts attached to sanitary sewers, an illegal configuration in Belmont, cause this sort of flow, for example.

There is another component of flow from rain in sanitary sewers that starts slowly after a rain and lasts for weeks. The problems associated with this component are less acute. Rainwater soaks into the ground, raising the water table, thus increasing ground water leaking into sanitary sewers through sewer defects, to cause this sort of flow.

Without a doubt, the fast-response sewer flow from storms is what should be reduced with sewer problem mitigation money from developments. Carl Leone, the MWRA authority on I/I, calls this component "inflow." Alternately the DEP people define "inflow" to be water that improperly enters the sanitary sewer system at private properties. In the DEP usage, "infiltration" is water that improperly enters sanitary sewers in the publicly owned portions of the system. The DEP states emphatically that removing inflow is less expensive that removing infiltration. Everyone, as far as I know, agrees that inflow is what is to be removed with mitigation money

I recommend using the MWRA definition of "inflow" because Belmont has fast-response sewer flows that arise, in part, because of broken sanitary sewer pipes and broken storm drain pipes that are in close proximity and effectively interconnected. This is part of the picture that emerges from the work done for Belmont in the last five years by Fay, Spofford & Thorndike, to keep Belmont ahead of section 308 demands. Note that fixing this sort of problem is more expensive than removing illicit downspout connections. This is a reason that the cost to remove a gallon of inflow in Belmont should be higher than average.

Here are some numbers that describe the state of Belmont's sanitary sewers. We send about four million gallons per day of sewage toward Deer Island on average. About half of that is inflow and infiltration. Ralph Jones told the last Town Meeting that we have an urgent need to spend something like fourteen million dollars on our sewers.

Objective Criterion for the Ratio of Inflow Reduction to New Sewage

Belmont's sewage, along with sewage from other towns, goes through the MWRA's Somerville Pumping Station, located near where Alewife Brook goes into the Mystic River. This pumping station has been averaging about seven sanitary sewer overflows per year during heavy rain. The Arlington Belmont Cambridge Stormwater Flooding Board asked the MWRA to increase the capacity of the pumps in this station to stop the sanitary sewer overflows. The MWRA declined because the problem is caused by inflow and infiltration in town sewer systems, a town responsibility, and increasing pump capacity would move the problem downstream.

An objective criterion for I/I removal to compensate for sewage from new development is to keep the amount of bacteria that escapes from the Somerville pumping station constant as the development goes on line. Here is the basic concept. If I/I is removed from sewage entering the pump station, the overflows will be smaller, a larger percentage of the filth will be safely pumped toward Deer Island, and the amount of filth that spills into the Mystic River will be smaller. If more sewage from new development is added without I/I removal, the filth in what comes into the pump station will be more concentrated, the volume of flow will be larger, and the spills will be larger with a higher concentration of filth. So new sewage from development and I/I removal can counterbalance each other. For a given amount of new sewage from development, there is an

amount of I/I removal that will keep the amount of filth that gets into the river the same. This is the break-even criterion.

Using this criterion, modeling the pump station during a sanitary sewer overflow caused by rain is simple. Coming into the pump station is a mixture of undiluted sewage and water from inflow and infiltration. Going out of the station is as much as the pumps can handle going into the downstream lines toward Deer Island, and the remainder, the difference between input and safely pumped output, spilling onto the Mystic Valley Parkway and into the Mystic River. Now add more undiluted sewage from a development and simultaneously remove I/I water. Remove water so that the spill has less volume but has the same amount of filth. The equations that describe this are simple, but solving them for the unknown, the amount of I/I water to be removed to keep the spilled filth constant, is a challenge unless you are good at algebra. Calculus can be used to make the work easier. The concept is what is important. A simplified, approximate result is:

$$(\text{I/I removal})/(\text{new sewage}) = (\text{original I/I})^2 /((\text{original sewage})*(\text{pump capacity}))$$

This is not the answer. The model must be used with actual data and integrated over a benchmark storm to find what amount of I/I removal keeps the escaped filth constant. There is another complication. The model uses actual, real-time flows. Mitigation agreements are written in terms of average flow rates.

The MWRA presumably has data for the Somerville pumping station that could be used to get an answer. The MWRA has not been quick to share its data. The Arlington Belmont Cambridge Stormwater Flooding Board is asking for data. Dr. Steve Kaiser has done what he can with available information, and his present thinking is that an I/I to sewage ratio of about 13 might be about right for break-even.

There is no reason that Belmont can not ask for better than break-even.

A similar model for sewage flooding Belmont basements would be more satisfying but difficult. Belmont does have interest in not making sanitary sewer spills into the Mystic River worse. The Commonwealth of Massachusetts will not oppose our interest in the Mystic River.

Brief History of Inflow and Infiltration Mitigation

At first, no I/I removal was required for new development. When mitigation was first required, the I/I to new sewage ratio was one. The minimum ratio has gone up in steps and is now four. I expect it will continue to rise.

Whatever mitigation we get for the Uplands development, it will seem too small to the next generation.

Uplands Development Comments

Waste Water Pump

Sumner Brown, 617-484-1149

This comment expands on comments I made at the ZBA meeting June 28, 2006.

The only documentation of the proposed design of the uplands development sewer pumping station that I have found is in a response from Rizzo Associates dated May 4, 2006. This documentation is not adequate to be accepted as a design.

One difference between a gravity driven sewer system and a pumped sewer system is that gravity never breaks. Before approving a sewer pumping system design, I suggest you ask the following questions about system reliability.

When something in the pumping station breaks, where does the sewage go? Something will go wrong. Sewage will spill out somewhere. How many hours or minutes before sewage escapes?

What happens when there is a power failure? I suggest that an emergency back-up generator is needed.

What happens when a pump fails? The May 4 calculations mention two pumps for redundancy. At the June 28 meeting, an engineer described the two pumps as taking turns. This operation algorithm provides no improvement in system reliability. If either pump fails, sewage will spill. Without a description of sensors and controls to provide useful redundancy, there is no design. Look for a design where when one pump fails, the other pump will automatically take up the load without spilling sewage.

What happens at the start of Super Bowl half time? How many toilets can flush simultaneously before sewage spills?

Finally, the calculations in said May 4 response that are presented as a design are based on 25,000 gallons per day of waste water. At the June 28 meeting, the developer's representatives said they needed to dispose of twice that amount.

Uplands Development Comments

Storm Water Management

Sumner Brown, 617-484-1149

At the June 28, 2006, meeting, David Albrecht of Rizzo Associates described how water level measurements made with test pits in May had shown higher than expected wet season ground water levels. This led to adjustments in storm water management tank designs.

I can not find a reference to thc date on which the ground water measurements were made this spring. I suspect they were made shortly before the heavy May rains began. If so, and if no compensation was made for the abnormally dry conditions before May 9, the design could be flawed.

Based on the state of the vernal pools at Habitat, the ground water levels before the heavy rains in May were typical of normal ground water levels in late June or early July.