

TOWN OF ORLEANS

Request for Technical Assistance
related to
Hydrogeological Site Investigations
for
Permeable Reactive Barrier Projects

Submitted to:

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Request for Technical Assistance related to Hydrogeological Site Investigations for Permeable Reactive Barrier Projects

Orleans, Massachusetts

The Town of Orleans on Cape Cod is pleased to submit this request for technical assistance related to hydrogeologic site characterizations for Permeable Reactive Barrier (PRB) projects for nitrogen management for watersheds in Orleans, Massachusetts. It is understood that, although not identified as such on the PRB Project Site Viewer, the EPA will consider potential PRB locations within the Pleasant Bay watershed as eligible for technical assistance under this solicitation.

Orleans is a town of about 6,000 full time residents with a large seasonal population. As shown in the following link, the Town has numerous open waters and salt water terminal ponds within the Pleasant Bay system. On-site subsurface wastewater disposal system effluents discharge to the ground, enter the groundwater system and eventually enter the surface water bodies. In the sandy soils of Cape Cod, effluent that has entered the groundwater travel towards the coastal waters at an average rate of one foot per day. The nutrient load to the groundwater system is directly related to the number of subsurface wastewater disposal systems, which in turn are related to the population. The population of Brewster, Chatham, Harwich, and Orleans as with all of Cape Cod, has increased markedly since 1950. In the period from 1950 to 2000 the number of year round residents has almost quadrupled. In addition, summertime residents and visitors swell the population of the entire Cape by about 300% according to the Cape Cod Commission.

The MEP Report for Pleasant Bay:

<http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/pbtmdl.pdf>

identified a number of terminal ponds as “significantly impaired” or “substantially degraded” for parameters including DO, eelgrass, macro-algae and benthic fauna due to nitrogen enrichment primarily from on-site systems in the watersheds of the following terminal ponds or sub-estuaries:

- Pah Wah Pond
- Namequoit River
- Lonnie's Pond

The TMDL for Pleasant Bay lists requires remediation of these ponds.

While the 2010 CWMP recommended a six-phase collection and treatment plan for reduction of the nitrogen load to these ponds, additional evaluation of non-traditional technologies over the last year, as recommended by the Commission's 208 Plan, concluded that permeable reactive barriers could provide substantial cost savings and more expeditious improvements to water quality in the subject estuaries.

In addition to the relative percent contribution to the impaired water upstream of a potential PRB site, conceptual level studies of the water bodies in Orleans considered groundwater depths, directions of flow, land ownership, adjacent land uses, potential abutter concerns,

constructability, existing utilities and other factors in identifying the locations shown in the following three maps as potentially advantageous locations within the Pleasant Bay watershed for PRB technology.

It is noted that all of the three ponds were recommended for PRB demonstration or pilot projects because of the distance from areas to be sewered and difficulty in siting other types of non-traditional technologies. The sites are all on town owned property, are in residential areas, have no history of groundwater contamination, have easy access to the sites, have favorable groundwater conditions and have no known conflicts with utilities.

The following maps indicate the approximate location of the potential PRB sites based on the assessment of the above criteria.

Namequoit PRB

This potential location is a residential area with the PRB to be located along Namequoit Road in South Orleans. The PRB would be approximately 2,000 ft. long and control nitrogen from about 70 parcels. It would remove approximately 200 kg. of N per year.

Namequoit River



Pah Wah Pond PRB

This potential location is a residential area with the PRB to be located along Lockwood Lane in South Orleans. The PRB would be approximately 700 ft. long and control nitrogen from about 56 parcels. It would remove approximately 150 kg. of N per year.

Pah Wah Pond



Lonnie's Pond PRB

This potential location is a residential area with the PRB to be located along Herring Brook Way in Orleans. The PRB would be approximately 1,500 ft. long and control nitrogen from about 77 parcels. It would remove approximately 238 kg. of N per year.

Lonnie's Pond

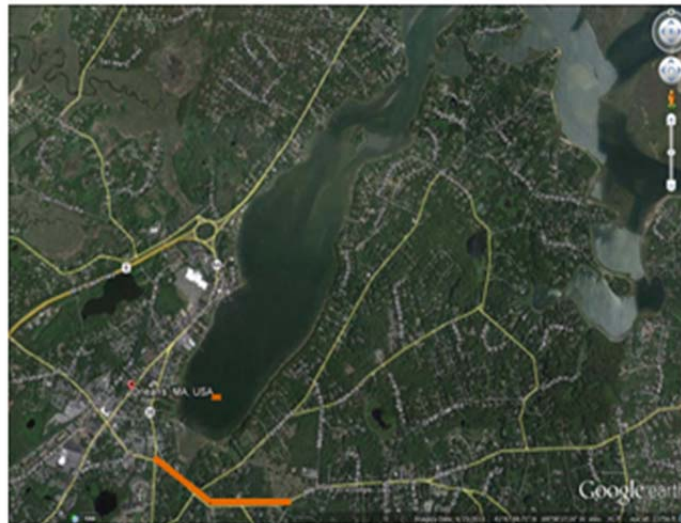


Town Cove PRB

A fourth location for a PRB was identified on Main Street near Town Cove. The PRB would be approximately 2,200 ft. long and control nitrogen from about 221 parcels. It would remove approximately 856 kg. of N per year.

This site would capture groundwater primarily tributary to Town Cove. However, because of the presence of an unlined landfill in the upper reaches of the aquifer recharge zone and the existence of a nitrate plume from this landfill and from adjacent abandoned septage disposal areas, more detailed studies of the groundwater flows paths and nitrate concentrations in this area were conducted using data from the monitoring wells at the landfill. It appears that the capping of the landfill in 2005 and re-contouring of the adjacent property, the groundwater infiltration patterns were altered, causing the significant increase in nitrate transport through the ground. The data indicates that, although the primary direction of flow of most of the aquifer is toward Town Cove, a significant percentage of the groundwater is probably toward Crystal Lake and the Pleasant Bay system due to the alteration in topography and hydrology due to the landfill construction.

Town Cove



Because of the concentrated nitrate plume from the landfill area, a PRB in this area could provide a substantially higher load reduction than anticipated in the estimate shown above. It is estimated that as much as 25% of the total N-load to Town Cove could be removed with this PRB, negating the high cost of sewerage in this area, as will be done in the other areas of downtown Orleans. Because of the potential for a PRB to provide substantial N-removal and the other favorable features of this site, it is proposed for consideration by EPA.

Geology, Soils, and Topography

Orleans lies at the confluence of two different glacial lobes: Harwich outwash plain on the west and the south, and Nauset Heights plain on the east. The town is generally lower in elevation than other Cape municipalities. The highest ground is along Route 6 (Mill Hill at the Route 6A interchange is 120 feet high). The Cape Cod Bay shoreline is very low and susceptible to coastal flooding and high storm winds. Orleans Center and East Orleans are generally flat at elevations below 50 feet high, though there are some steep bluffs to the salt water shoreline at Town Cove, Nauset Heights and Pochet and Barley Necks. South Orleans is more irregular, having the characteristic knob and kettle hole landscape found elsewhere on the Cape.

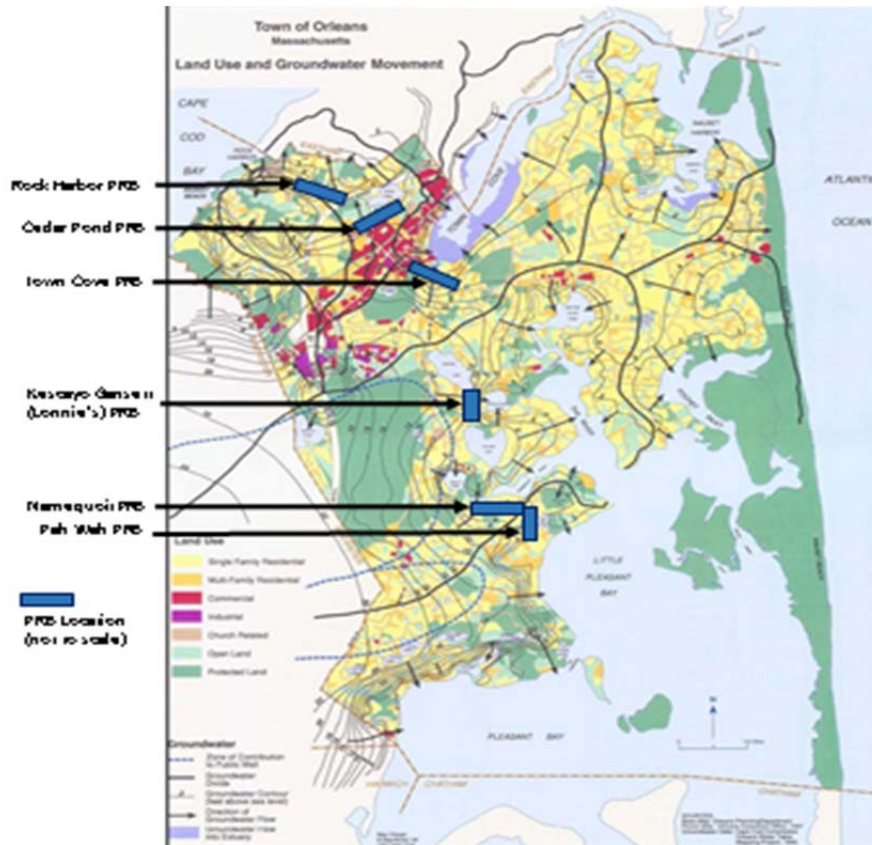
Most of the soil throughout town is derived from glacial deposits, consisting of coarse sands, sandy loams and gravel, with intermittent clay layers in some locations. Topsoil is generally thin and friable. The exception is East Orleans, particularly Barley Neck, Tonset and Nauset Heights where pockets of soil of prime, state or local importance for agriculture are found. Most of these sites have been consumed by residential development in the past thirty years. Peat from organic sources can be found in low areas around bogs, swamps and marshes. Barrier beaches composed of dune sand are extensive at Nauset Spit and Namskaket.

Surficial geology of Orleans determines natural communities and has an influence on human development in the town. The town's sandy soils drain rapidly, which generally reduces erosion, but allows contaminants to reach the water table readily. A common complaint of Cape Cod health officials is that sandy soils are unsuitable for development because they percolate too quickly rather than not quickly enough. Contaminants from wastewater, then, can easily reach the aquifer before biological and chemical cleansing in the soil can occur.

To date, neither soils nor topography, with the exception of wetlands, has proven to be an impediment to development. Therefore, relying on environmental constraints to development is not a viable method for retaining open space in Orleans.

As stated above, preliminary investigations using USGS groundwater mapping, information from local wells and other sources indicates that the shallow depth to groundwater and groundwater gradients and saturated zone, along with surface features such as lack of utilities, access to the sites for monitoring and maintenance, right-of-way ownership and other features make the selected sites appear to be feasible. (DEP TMDL, May 2007)

The figure below indicates the groundwater flow direction and land use in the areas of the Pleasant Bay PRBs and Town Cove.



Orleans Interest in Support of This Project

The Town of Orleans has been intensively engaged in wastewater and water quality management planning for over 15 years. Previous efforts to initiate a town-wide water quality management plan have failed because of the very high cost of traditional technologies. In May 2015, the Orleans Board of Selectmen approved town warrant articles to proceed in a new direction, combining non-traditional technologies agreed upon based on extensive public involvement and technical studies over the last year. The Consensus Plan includes PRBs as an integral part of the plan going forward, However, this is contingent on the results of PRB pilot demonstration projects that were approved in the warrant article for implementation in 2015 and 2016. The locations shown above are those targeted in the current plan.

As a result, with respect to the EPA’s criteria for selection of candidate projects:

1. The Town is very willing and enthusiastic about entering into an MOU with EPA and its consultants to undertake the more detailed hydrogeologic studies necessary to prove the feasibility of PRB technologies for nitrogen management
2. The Town is very interested in participating with EPA and its consultants to plan and facilitate PRB projects in the Orleans. The Town has voted funding for project management, public engagement and technical support that would complement the EPA efforts

3. The Town and its consultants can begin as soon as EPA is prepared to begin characterization work.
4. The Town through its departments and consultants can provide the following supporting in-kind services:
 - a. Mapping, existing groundwater monitoring data, underground utility information, parcel ownership and abutter information, boring logs and other information from wells and past projects, stormwater system information, conceptual layouts of possible PRB systems.
 - b. The Town's consultant who assisted with the landfill and PRB evaluation has been involved in numerous PRB projects nationwide and on Cape Cod. He has been engaged with the Ashumet Pond phosphorus PRB as well as the PRB studies on-going in Falmouth.
 - c. The Orleans Water Quality Advisory Panel has been convened, is very active and will provide an enthusiastic forum for public information and education related to the PRB projects.
5. The Town would be very willing to show the site and provide related monitoring plans and data, design plans, construction records and other information to other towns and parties interested in PRB projects both during and after project start-up.
6. The contacts for this project on behalf of the Town of Orleans will be:

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7. Other information requested in the solicitation is included above, including aerial photos of the proposed sites, preliminary horizontal alignments of the proposed PRBs and aquifer drainage areas tributary to the PRB locations. . The sites are all on town owned property, are in residential areas, have no history of groundwater contamination, have easy access to the sites, have favorable groundwater conditions and have no known conflicts with utilities.