LEACHING OF ARSENIC FROM A FLY ASH DUMP IN BEVERLY, MASSACHUSETTS

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Abstract

The Vitale Dump in Beverly, Massachusetts is a former sand and gravel pit where sea quenched coal fly ash, construction debris, and miscellaneous wastes were dumped for many years beginning in the 1950s. The site was a primary ash disposal area for New England Power Company who operated a power generation station in Salem, Massachusetts. Ash deposits buried at the site range in thickness from 14 to 36 feet. Ground water has been measured from 10 to 20 feet below grade leaving large portions of the dump below the water table. Arsenic concentrations in ground water at the up-gradient wells on the property were measured at 6 ug/L while down-gradient wells contained arsenic at 386 ug/L.

Airport Brook flows through the site discharges to Wenham Lake about 1,500 feet east. Wenham Lake is the public water supply for the 80,000 residents of Salem and Beverly, Massachusetts. Fly ash has been eroding from the site into Airport Brook. Testing in Wenham Lake has detected several feet of fly ash in a portion of the Lake. This has promoted a significant debate concerning actual and perceived public health risks. Current remediation plans include excavation of sediment along Airport Brook and Wenham Lake and placing the dredged materials on the Vitale Site. A solid waste cap will then be placed at the Vitale Dump site. Soccer fields have been proposed on the site after closure. At this time, the arsenic concentrations in ground water do not appear to require any active treatment to comply with the applicable State and Federal regulations.

Introduction and Site History

The Vitale Dump was owned by George H. Vitale and George W. Vitale and was initially developed during the 1940s for sand and gravel excavation which continued until the 1950s. The City of Beverly took ownership of the property in 1987.

The study area (Site) consists of the Vitale Dump, approximately 45 acres along Airport Brook and 25 acres within the northwest portion of Wenham Lake. Surface water drainage is northeasterly via Airport Brook into Wenham Lake which is the primary drinking water source for the 80,000 residents of Beverly and Salem Massachusetts. The Vitale site is divided into two distinct areas, the upland portion, which includes the fly ash dump (15 acres) and lowland portion which includes Wenham Lake and Airport Brook.

Based on a review of historical aerial photographs for the area from 1938, the Site was undeveloped and consisted of agricultural land. Following sand and gravel excavation, the Vitales used the fly ash, which was not considered a waste, to fill the sand and gravel pit. New England Power Company (NEP) had an agreement with the Vitales to dispose of saltwater-quenched fly ash from NEP's Salem Harbor Power Station beginning in the 1950s.

There have been a variety of consultants who have investigated the Site over the years, including Haley and Aldrich (1985), Gulf of Maine (1986), Normandeau (1988), Weston and Sampson (1989), Ransom (1995), Haley and Aldrich (2003) and Blaslund, Bouck & Lee (2003) and Hart Crowser (2003). Ransom reviewed aerial photographs dated 1938, 1957, 1969 and 1978 correlating with the known site history. The 1938 aerial photograph showed that the garage building had not yet been constructed, but a dirt road, coinciding approximately with the present entrance to the Site, extended north across the Site and divided into two paths extending across the northwest and northeast portions of the Site. In the 1969 aerial photograph, fly ash, lacking any vegetative cover, was apparent across most of the eastern half of the Site extending from the north of the garage to the northeast Site boundary and to the south abutting Airport Brook. Due to the lack of vegetative cover, erosion gullies are apparent along the edges (flank) of the fill in the area abutting the wetlands along the eastern border of the site and also along Airport Brook. The

conditions at this time as shown in the aerial photograph correlate with local complaints of erosion during the early 1970s. The garage had been constructed at the time of the 1969 photo (Ransom, 1995). The 1978 study shows the fly ash area to be partially vegetated.[1]

Today, most of the Site is filled with 15 to 30 feet of fly ash and municipal fill and is covered with scrub vegetation and invasive trees. Wetland areas adjacent to Airport Brook are impacted with fly ash sediment from erosion of the Site. Fly ash has been found throughout the Airport Brook and fly ash delta has formed over the last thirty years at the discharge point to Wenham Lake. In addition to fly ash, roofing material, asbestos siding, household appliances, car bodies and empty steel drums were also reported to have been disposed of at the Site during the Vitale's and City's ownership.

History of Non-Compliance

Until the property was taken by the City of Beverly in 1987, the Vitale Brothers had a history of non-compliance with State and local regulation. In 1969, the Massachusetts Department of Environmental Quality Engineering (DEQE), now the Massachusetts Department of Environmental Protection (MADEP), reported that fly ash was being disposed of at the Site without a permit from the local Board of Health. In 1971, a restraining order was issued to the Vitales by the Massachusetts Department of Wetlands to stop any further work that would impact the wetlands on the Site. In 1973, a neighbor on Trask Street, 500 feet east of the Site, complained of flooding of his yard due to damming caused by the erosion of the fly ash. Similar notices of violations were cited during that time period. In 1975, the Massachusetts Department of Public Health issued an order to the Vitales to prevent siltation and pollution of the stream, cut back the slope to the wetland and grade, cap and vegetate the filled areas of the Site. The Vitales ignored this and subsequent State orders, resulting in litigation. In 1987, the City assumed ownership of the property from the Vitales due to their failure to pay real estate taxes. Beverly Fire Department records indicate that the garage building located on site burned in October of 1992.[2]

There has been considerable debate about the presence of fly ash at the Site. In 310 CMR 40.0006, the "presence of contaminants which are attributable to coal ash or wood ash associated with fill material are considered to be background." Pursuant to its regulations, MADEP continues to consider that status of coal ash to be exempt from closure requirements under the Massachusetts Contingency Plan and does not treat ash as a solid waste requiring a hybrid closure. This paper discusses current activities at one high profile ash disposal site in northeastern Massachusetts. It details how New England Power in cooperation with local and State governments as well as local environmental activists worked to a common goal to stabilize and close out the Vitale Dump Site and eliminate any potential public health and ecological risks associated with it.

Surface Water Hydrology

The Airport Brook watershed starts in the wetlands located adjacent the Beverly Airport and the west slope of Lords Hill. Surface water flow is southeast to the Site where it follows past the southern toe of the fly ash embankment and on through a culvert near the entrance to the Site. As the stream flows to the east and northeast it passes through greater than 20 feet of exposed fly ash on both banks at its deepest point. From this deep channel, the brook turns northerly following a man made channel toward Route 97. The Airport Brook then goes northeasterly through a culvert under Route 97 at Elevation. 37 feet before continuing through the nearby Dearborn property riparian zone into the wetland zone at approximately Elevation 35 feet and on to the northwest cove of Wenham Lake. High water in Wenham Lake is typically maintained below Elevation 34.4 feet.

Based on stream discharge and piezometer monitoring results from Haley and Aldrich (H&A) (2004), Airport Brook is a losing stream, at least throughout most of the periods between May and September of 2001 and 2002. As a result, this allows the surface water to infiltrate downward into the groundwater flow system. Any metals or organic chemicals present in Airport Brook would be available to enter groundwater.

Stream discharge measurements by H&A also confirm that Airport Brook is a losing stream through much of the

[1] Ransom Environmental, Phase II Comprehensive Site Assessment, April 2001
[2] Ransom Environmental, Phase II Comprehensive Site Assessment, April 2001

year, as there is little to no measurable stream flow during extended periods without rainfall. Therefore, most of Airport Brook functions as a seasonal stream where, during some periods of the year, the groundwater elevation is above the surface water elevation (i.e. a gaining stream) and most of the year the groundwater level is below the surface water elevation (i.e. a losing stream).[3]

Hydrogeologic Setting

The Vitale Site study area is located within a depressed region of low hills and coastal drainage basins referred to as the Seaboard Lowland Section of New England Physiographic Province. The underlying bedrock is highly faulted igneous intrusions called the Cape Ann Plutonic Series. Surficial deposits (soil) consist primarily of glacial and alluvial sediments that overlie bedrock. The major landforms in the vicinity include drumlins to the northwest and extensive sand and gravel kame and esker deposits at Wenham Lake.

Bedrock Geology

The Cape Ann Plutonic Series is unmetamorphosed granitic and dioritic rocks dominated by several large scale fault zones, trending to the northeast. The closest fault zones are the Ipswich Bay Fault and the Mystic Fault. Within the study area, two primary rock types occur, the Wenham Monzonite a light colored, medium grained granitic rock consisting primarily of the mineral feldspar that outcrops in several locations west of Route 97 and the Salem Gabbro-Diorite a dark colored rock of heterogeneous composition and texture locally identified as a medium to fine grained hornblende diorite.

Surficial Geology

Overlying bedrock is glacial material comprised of till, outwash, and glaciolacustrine deposits. In portions of the Site, they are locally overlain by more recent lacustrine, alluvial, and organic deposits along Airport Brook and low wetland areas. Fly ash and a variety of miscellaneous debris are present throughout the area and particularly in the low lying areas.

Glacial till deposited in elongated hills known as drumlins were formed at Lords Hill, north of the Vitale Property, and west of Wenham Lake about 25,000 years ago. These thick till deposits consist of a very dense mixture of clays and silts to sand and gravel with variable boulder content.

Years ago, the area below the Vitale Dump was formed by glaciers. Glacial meltwater streams deposited thick layers of sand and gravel onto the edge of drumlins within the study area. At various times while the ice retreated, one meltwater course flowed along the valley into Wenham Lake. Wenham Lake is made up of a group of glacial kettle holes created by the channeling of outwash sediments through stagnant glacial ice and the incorporation of ice block into meltwater deposits during the retreat of the glaciers. Sands and gravels underlie the lake and form numerous ice contact features including eskers, kame mounds, and kame terraces within the lake and the surrounding area. In this area, these deposits generally occur below Elevation 80 feet and overlie denser and less permeable glacial till deposits. The northwest cove of Wenham Lake is a glacial kettle bounded on the northeast by the remains of an esker. [4]

On the Vitale Property, outwash deposits reached a thickness of approximately 15 feet to 25 feet and were extensively quarried before and during the 1950s before being replaced with fly ash. During the waning stages of glaciation, melting of glacial ice and the initially poorly developed drainage patterns led to extensive but temporary impoundments of meltwater and the creation of small glacial lakes.[5]

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[3] Haley & Aldrich, Draft Data Report Vitale Fly Ash Investigation, February 2004
[4] Haley & Aldrich, Draft Data Report Vitale Fly Ash Investigation, February 2004
[5] Haley & Aldrich, Draft Data Report Vitale Fly Ash Investigation, February 2004

Discussion of Sediment and Water Quality

The Vitale Site is the major source of fly ash to the surrounding environment. Fly ash has migrated with surface water along Airport Brook from the Vitale property source area. Some of the fly ash has been deposited in Airport Brook and the remaining fly ash has been deposited in the cove and adjacent area in Wenham Lake approximately 1500 feet east.

Arsenic is one of the more toxic and most studied metals found in fly ash. Other metals detected (primarily in ash sediments) include barium, beryllium, chromium, nickel, strontium, vanadium and zinc. Arsenic has unique environmental mobility characteristics. Arsenic's can occur in the environment in four oxidation states (-3, 0, +3 [As (III)], and +5 [As (V)]). The two most common forms are As (III) and As (V). Of these forms, As (III) is the more mobile and toxic. This section summarizes the results of numerous sampling efforts conducted in the surface water of Wenham lake, the groundwater in overburden, deep overburden and bedrock throughout the study area, in sediment in the Wenham Lake Cove, and in the porewater of the sediment.

Surface Water

Surface water testing by Ransom Environmental generally contained non-detectable concentrations of arsenic in the brook near the Vitale Dump, except at SW-5, where arsenic was found at 7 micrograms per liter (ug/L). Results for the 2003 surface water samples within Wenham Lake indicated that the total arsenic concentrations ranged from 0.19 ug/L to 0.67 ug/L. That range is near the low end of the reported naturally occurring range (generally less than 1 ug/L) for arsenic in freshwater. One important consideration at this Site is that both the Federal and State drinking water standards for arsenic are currently 50 ug/L and will be lowered to 10 ug/L within the next several years. None of the detected concentrations of arsenic or any other constituent associated with fly ash have been detected in surface waters at concentrations in excess of the applicable current or proposed drinking water standards. The intakes for the Salem Beverly Water Supply System are located approximately 4,000 feet from the fly ash deposits in Wenham Lake Cove.

Ground Water Sampling Analysis

Ground water testing has occurred at the Vitale Dump for over 15 years. Table 1 contains the results of wells within the footprint of the ash deposit that have been tested first in July 1988.

Table 1. List of Wells With Elevated Dissolved Arsenic (ug/L) Within the Vitale Dump

Date	MWV-1S	MWV-2S	MWV-2D
7/12/88	BDL (50)	58	62
7/18/96	73	74	386
4/16/99	124	143	358
8/19/99	132	82	331
7/24/02	150	NT	NT
1/29/03	90	NT	NT

Date	MW-4S	MWV-3S	MWV-3D
12/88	191	52	56
7/18/96	97	58	43
4/16/99	BDL	BDL (50)	BDL (50)
8/19/99	116	NT	82 (1)
7/24/02	NT	NT	45
1/29/03	NT	NT	34

Note: (1) Testing date was 10/22/99; (50) indicates method detection limit in ug/L

Table 2 contains dissolved arsenic samples from locations hydraulically down gradient of the fly ash deposit.

Table 2. Arsenic Dissolved in Wells Down gradient of the Vitale Dump(ug/L)

Well	July/August 2002	January/February 2003
HA – 100D-OW	2	NT
HA – 101S-OW	BRL(1)	NT
HA – 101I-OW	13	17
HA – 101D-OW	BRL (1)	BRL (1.4)U
HA – 102S-OW	5	4J
HA – 102I-OW	BRL (1)	9
HA – 102D-OW	2	BRL (.0014)U
HA – 103D-OW	3	NT
HA – 104I-OW	.003	BRL (1.4)U
HA – 104D-OW	BRL (1)	BRL (1.4)U
HA – 105-OW	BRL (1)	1J
HA – 105I-OW	BRL(1)	NT

Terms: **ug/l -** micrograms per liter; **BRL** – Below Reporting Limit noted in parenthesis; **J -** values indicated an estimated concentration as the compound was detected below the BRL; **NT** – not tested

The methodology for well testing has evolved over the past 15 years and the more recent samples were collected using low-flow purging techniques where practical. Where recharge to well was slow or wells went dry, peristaltic pumps and bailers were used. These differences in collection techniques over the years likely had some small but non-quantifiable impact on the measurement of dissolved arsenic in ground water. Studies have shown that low flow sampling cause very little turbulence within the borehole and as a result natural aquifer materials (including fly ash particles) are not transported into the sample matrix.

The highest concentrations of dissolved arsenic were found in MWV-2D (Table 1) at 386 ug/L in July 1996 and 331 ug/L in August 1999. At location MWV-1S concentrations appear to reach their maximum value of 150 ug/L in July 2002 while declining to 90 ug/L in the January 2003. At location MWV-3D concentrations were measured at 45 ug/L in July 2002 while decreasing to 34 ug/L in the January 2003. MWV-1S is screened in coarse sand, inorganic silt and some cobbles. Both MWV-2D and MWV-3D are partially screened within the fly ash.

As shown in Table 2, samples collected downgradient of the Vitale Dump have consistently shown very low to non-detectable concentrations of arsenic. Wells screened both in the deep and shallow aquifers generally show low to non-detectable concentrations of dissolved arsenic, which suggests the As(III) present at the fly ash deposits has speciated to As (V), the more immobile form.

The ground water data suggests that As (III) desorbs/dissociates from fly ash into the porewater of the fly ash deposits. Percolating rainfall delivers the porewater to groundwater. The As (III) can then speciate to As (V) in ground water depending on redox/pH and sorb to soil particles. Groundwater located downgradient of the fly ash deposit has higher dissolved oxygen and redox potentials and, as a result, has lower concentrations of arsenic.

As (V) is also scavenged by sediment particles (particularly Fe and Mn minerals) and deposited within the aquifer or on surface sediment in Airport Brook, which ultimately discharges to Wenham Lake. However, this second process, although it does occur, is not the dominant process by which ash was delivered to Wenham Lake Cove. Due to the lack of vegetative cover, fly ash dumped at Vitale found its way by overland flow into Airport Brook and Wenham Lake. As stated earlier, erosion gullies were apparent along the edges (flank) of the dump and abutting the wetlands along the eastern border of the Site.

Sediment Sampling Analysis

Sediment is a complex mixture of solids, gases, and liquids. Within Wenham Lake cove, sediment solids include natural mineralogical material, natural organic materials, and fly ash particles. Sediment gases are generally created from decomposing organic material and share the spaces between sediment solids (i.e., pore spaces) with sediment liquids. Sediment liquids are comprised of porewater, which is the water that is located in the pore spaces between the sediment solids. The cove sediment porewater is derived from groundwater discharging from the upland

subsurface. This groundwater seeps into and through alluvial deposits that underlie the cove shallow sediment. Eventually, the pore water will flow to surface water.

Fly ash has been deposited in Wenham Lake Cove when the fly ash was eroded from the Vitale Dump, suspended in the surface water column and subsequently transported via Airport Brook. As the flow velocity drops at the terminus of Airport Brook in the cove area, attributable to significant widening and deepening of the Lake, the flow velocity drops and the fly ash is deposited.[6]

Fly ash sediment cores were collected, in the winter of 2001, in Wenham Lake Cove by the Wenham Lake Watershed Association (WLWA). Results indicated that fly ash transport and deposition was a dominant mechanism for ash deposition in this area. This transport of fly ash is the result of the unstable condition of the Vitale Dump property for many years. Outside the channel alignment, a higher proportion of natural sediment, compared to fly ash, was observed in shallow sediment sampling.

The average arsenic concentrations for 41 shallow sediment samples collected by H&A within the fly ash deposit area was approximately 47 milligrams per kilogram (mg/kg), compared to a naturally occurring sediment arsenic concentration range of about 20 to 25 mg/kg for ponds and lakes in eastern Massachusetts (Menzie-Cura, 2003). The highest sediment arsenic concentrations were found near the eastern edge of the fly ash deposit. Arsenic concentrations in bulk sediment samples do not correlate well with the amount of fly ash in sediment sample.

The sedimentation environment and processes that occur within the Lake are a key to understanding the transport and fate of the fly ash deposit. The sedimentation in the cove area of Wenham Lake and the extent of the fly ash deposit are well characterized because the fly ash has been transported and deposited over a 50-year period. The fly ash can also be distinguished visually from the natural sediment material.[7] (BBL, 2003)

Sediment Pore water

Unlike the bulk sediment laboratory chemical analysis results, there was an apparent correlation between the occurrence of fly ash and increased arsenic concentrations in sediment porewater (as compared to background concentrations in arsenic). BBL and Hart Crowser collected a variety of porewater samples for metals analysis. Increased sediment porewater concentrations for the various forms of arsenic were detected in four of the five shallow fly ash/sediment samples collected from within the fly ash area. A sample collected outside the fly ash deposit also did not show increased porewater concentrations of arsenic

The porewater related As (III) is likely to originate predominantly in the Vitale Dump area, based on the relatively elevated arsenic concentrations measured in sediment porewater. During seasonal periods where the deeper water at the sediment surface water interface is anaerobic, the As (III) is likely dissolved in the water column. As the DO concentrations increase with seasonal changes, the As (III) likely speciates to As (V). The surface water sampling results indicate that Airport Brook and Wenham Lake appear to follow this typical behavior. As (V) is likely to bind strongly to sediment solids and does not dissolve as readily in the water column as As (III) particularly along the stream where oxygen is present. As (III) desorbs/dissociates from fly ash into sediment porewater. Advecting groundwater transports As (III) to surface water and depending on redox/pH, As (III) speciates to As (V). As (V) can be scavenged by suspended sediment particles (particularly Fe and Mn minerals) and deposited in surface sediment.

Microbial activity may also play an important and unpredictable role in arsenic mobility and fate. Microbial reductive dissolution of iron hydroxides and associated release of retained arsenic has been proposed as a probable mechanism for the release of arsenic within sediments. (National Research Council, 2001) Additionally, some aquatic organisms metabolize arsenic, forming organoarsenic compounds.[8]

Summary of Risk Characterization

[6] Hart Crowser/Blaslund, Bouck and Lee, Wenham Lake Draft Feasibility Study, Executive Summary, November 2003
[7] Hart Crowser/Blaslund, Bouck and Lee, Wenham Lake Draft Feasibility Study, Executive Summary, November 2003

[8] Hart Crowser/Blasland, Bouck and Lee, Wenham Lake Draft Feasibility Study, Executive Summary, November 2003

Outside of the source area of the original fly ash deposit on the Vitale Site, there are no exceedences of Federal or State drinking water standards (50 ug/L for As, will be 10 ug/L in 2006). The Site is currently being evaluated for trespassers/recreational users. The likely conclusion will be No Significant Risk (NSR). A geotextile and soil cap has been proposed for the Vitale Dump property. The City of Beverly is also interested in placing athletic fields on top of the graded cover. There does not appear to be any widespread opposition to the final end use although several individuals have voiced their personal concerns for public health if children are allowed on the closed site.

Current surface water data indicates that detected concentrations of arsenic are all below ecological benchmark values. Menzie-Cura previously completed an Ecological Risk Assessment (ERC) and Hart Crowser completed a supplemental review focusing on fly ash deposit. The weight of evidence presently indicates "no significant risk" for the ecological receptors and pathways.

Clean up of Wenham Lake-A Public Water Supply

Wenham Lake is used as a public drinking water supply that provides drinking water to the approximately 80,000 residents of the City of Beverly and Salem. Originally, the proposal to address the fly ash in Wenham Lake was to hydraulically dredge the fly ash that could not be excavated by conventional means. After numerous discussions with various stakeholders, including the City of Beverly, City of Salem, MADEP and the Salem and Beverly Water Supply Board (SBWSB), NEP decided to reevaluate whether dredging was feasible or necessary.

A Feasibility Study (FS) report was prepared by Blaslund, Bouck & Lee (BBL) & Hart Crowser (HC) on behalf of NEP. The FS looked at numerous technologies that were then grouped into viable alternatives for removing the fly ash that had eroded from the Vitale property and along Airport Brook and was deposited into Wenham Lake. Based on previous investigations conducted at the Site, there are approximately 7,800 cy of fly ash present in Wenham Lake that has eroded from the former Vitale property. This fly ash covers an area of approximately 11 acres and ranges in thickness from a few particles of fly ash intermixed with natural sediment to up to 3 feet of fly ash.

The first alternative proposed is Monitored and Natural Attenuation (M&NR) for Wenham Lake. This alternative would monitor water quality and establish "Action Levels" to respond to results and, if necessary, re-open FS. In addition, this alternative would monitor sedimentation to evaluate natural restoration processes and enhance understanding of the Wenham Lake system. The positive aspects of this alternative are that water quality remains within acceptable levels and natural sedimentation buries fly ash, reducing contact with surface water and decreasing migration of porewater to surface water. The negative aspects are the perception that nothing is being done, fly ash remains in the Lake, and long-term commitment to monitoring (50 years used for cost comparison). The Net Present Value of this alternative was estimated to be $4,200,000.

The second alternative proposed is Capping. This alternative would carefully place up to 40,000 cy of sand/apatite mineral capping material over the geotextile area of 12-1/2 acres. The positive aspects of Capping are isolating fly ash below the cap, reducing direct contact with surface water, and decreasing migration of porewater As to surface water. The negative aspects are not testing in water supplies, loss of storage capacity and aesthetics, implementation issues, and long term post-construction monitoring. The Net Present Value of this alternative was estimated to be $9,500,000.

The third alternative is Removal. This alternative would remove some or all of the fly ash/sediments from the Lake bed. The positive aspect of this alternative would be the removal of fly ash from the drinking water reservoir. The negative aspect is the significant potential for the "cure being worse than the ailment". Large volumes of water will require treatment or disposal (and replacement) and disturbing the Lake bottom could cause uncontrollable releases of arsenic to surface water. The Net Present Value of this alternative was estimated to be $3,500,000 to $5,700,000.

The fourth alternative would include a combination of Limited Mechanical Removal (in specific dry areas of the Lake basin during extreme annual low water (generally in October) and Monitoring and Natural Restoration (M&NR) within the areas where sediment removal was not possible.

The FS concluded that the recommended alternative for addressing the fly ash is a combination of Limited Mechanical Removal (in specific dry areas of the Lake basin) and Monitoring and Natural Restoration (M&NR). To date, none of the compounds that are associated with fly ash have been detected in surface water in the Lake at

concentrations greater than one tenth (1/10) of the current Federal drinking water standards. The FS concluded that the recommended alternative for addressing the fly ash is a combination of Limited Mechanical Removal (in specific dry areas of the Lake basin) and M&NR. The elevation of the Wenham Lake reservoir has large stage fluctuations. The fly ash in Wenham Lake that is exposed and dry during low water elevations (typically in the late fall) will be removed with conventional excavation means and placed on the Vitale site prior to final stabilization. Because this material will no longer be under water, impacts to the water supply are eliminated.

Clean up Plan for the Vitale Fly Ash Site

Prior to the removal of the exposed fly ash from Wenham lake, the following activities will be completed to address the remainder of the fly ash that has eroded form the Vitale property:

- The former Vitale property and the slopes of the fill area will be properly stabilized, which will eliminate future erosion of fly ash off of the property.
- Ash will be removed from the wetlands and Airport Brook, and these resource areas will be restored.
- The ash that is exposed during the lowest feasible water level in Wenham Lake will be removed to the extent possible with conventional excavation means (in the "dry").
- The entire surface of the consolidated ash pile at the Vitale property will be covered with geo-textile, 12-inches of sand, and six-inches of loam, and then graded and seeded to control erosion.
- A monitoring program will be implemented to ensure that the limited extent of impacted groundwater does not change as a result of the fly ash consolidation, slope stabilization, and wetland restoration.

The City of Beverly is interested in placing athletic fields on top of the graded cover and any future concern regarding exposure to the fly ash will be eliminated by the cover system.

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