REVISED PHASE III – REMEDIAL ACTION PLAN FOR AREAS NORTH OF THE RACEWAY

OXFORD PAPER MILL LAWRENCE, MASSACHUSETTS

RTN 3-2691

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ACM	Asbestos Containing Material
AUL	Activity and Use Limitation
AWQC	Ambient Water Quality Criteria

List of Acronyms (Continued)

bgs	below ground surface
CDM	Camp Dresser & McKee, Inc.
COL	City of Lawrence
COPCs	Contaminants of Potential Concern
CSA	Comprehensive Site Assessment
CY	Cubic Yards
EPC	Exposure Point Concentrations
EPH	extractable petroleum hydrocarbons
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
HSO_3	sulfurous acid
IWPA	Interim Wellhead Protection Area
MADEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
MEK	methyl ethyl ketone
MHD	Massachusetts Highway Department
MIBK	methyl isobutyl ketone
NaOH	sodium hydroxide
Na_2S	sodium sulfide
OPM	Oxford Paper Mill
PAH	Polycyclic Aromatic Hydrocarbons
PCB	polychlorinated biphenyls
RAO	Response Action Outcome
RTN	Release Tracking Number
S&W	Stone & Webster Massachusetts, Inc.
THF	tetrahydrofuran
UST	Underground Storage Tank
VOC	Volatile Organic Compounds

1.0 INTRODUCTION

The purpose of this Revised Phase III Remedial Action Plan is to perform an evaluation of remedial action alternatives to address contaminants of potential concern (COPCs) for a portion of the Oxford Paper Mill (OPM) (the Site) in Lawrence, Massachusetts. The revision addresses the options of either reusing on the Site or shipping off the Site for disposal approximately 1,855 Cubic Yards (CY) of asbestos contaminated soil. This reduced volume is a result of maximizing excavation requirements with the design of the Site as a public passive park and thereby reducing overall remedial costs. The general site location is depicted on Figure 1 and the entire site is depicted on Figure 2. This Phase III is for the area north of the raceway including both the wedge area and the North area (See Figure 3). This Phase III was conducted by Stone & Webster Massachusetts, Inc. (Stone & Webster or S&W), a Shaw Group Company, in accordance with the Massachusetts Contingency Plan (MCP), 310 CMR 40.0850, on behalf of the City of Lawrence (COL), the owner of the Oxford Paper Mill property. Oxford Paper Mill has been assigned release tracking number (RTN) 3-2691 by the Massachusetts Department of Environmental Protection (MADEP), to whom this report will be provided.

The objectives of the Phase III evaluation were to identify and evaluate remedial action alternatives and technologies that would be reasonably likely to achieve a level of no significant risk, and to select a remedial action alternative that will result in a Permanent or Temporary Solution for areas north of the raceway. The contents of this report provide detailed description of each of the selected remedial alternatives with a final recommendation for the most appropriate technology to achieve the remedial goals established for areas north of the raceway at the Oxford Paper Mill.

2.0 BACKGROUND

2.1 Site Description and General Information

The former Oxford Paper Mill (OPM) Site, Release Tracking Number 3-2691, is located on approximately three acres of land in Lawrence, Massachusetts, immediately northwest of the intersection of Canal Street and the Spicket River (refer to the Site Locus Map attached as Figure 1). A small portion of the OPM is also located north of Canal Street on the eastern bank of the Spicket River (an urban surface water body that abuts the OPM). The OPM is transected by a raceway, which discharges to the Spicket River. All nine buildings (Building Nos. 1, 2, 3, 4, 5, 6, 13, 1A, and 28) that once occupied the south side of the OPM have been demolished. Buildings north of the raceway were demolished in the 1970s. Oxford Paper ceased operations at the Site in the mid-1970s. The City of Lawrence took ownership of the property in 1983.

Site Subject Area – North of Raceway (Wedge Area and North Area)

Currently the areas north of the raceway at the Oxford Paper Mill are in an area of commercial development within downtown Lawrence, Massachusetts. The property does not contain any buildings or structures and is unpaved. The Site is relatively flat throughout and slopes down to the Spicket River on the north and east sides. The Site consists mainly of tall grass and shrubs with portions consisting of wooded areas. The Site is bounded to the north and east by the Spicket River, to the west by commercial property (the O'Gara Building), and to the south by the raceway. Access to the property is partially restricted by fencing along the western boundary. However, the Site can be accessed from the Spicket River or via an exit door from the O'Gara Building. A Site Plan for the area north of the raceway is presented in Figure 3. The property will be used in the future as a passive park.

Properties surrounding the OPM are used for commercial, institutional, and industrial purposes. GenCorp, Inc. (GenCorp), the Everett Mills property, and Union Street are west of the Site. Canal Street and the North Canal are south of the OPM beyond where there are other historic mill buildings. The Spicket River is north and east of the Site. The Lawrence General Hospital is beyond the Spicket River to the north. The Everett Mills property is currently used for commercial purposes. The GenCorp facility, which was formerly occupied by Bolta Products and used for manufacturing rubber and plastic products, is currently vacant. The GenCorp facility was used most recently for manufacturing plastics and vinyl coated fabrics; polyvinyl chloride, resins; methyl isobutyl ketone (MIBK), methyl ethyl ketone (MEK), and tetrahydrofuran (THF) were used as part of these manufacturing operations.

Based on a review of the Massachusetts Geographic Information System (GIS) map, (refer to Figure 4), the OPM is not within an Interim Wellhead Protection Area (IWPA) or Zone II. Mr. Madden at the Lawrence Water Department indicated that the City of Lawrence obtains its water from the Merrimack River. Water is drawn from one well in the Merrimack River; this well is located in the river at the foot of Ames Street (i.e., at the intersection of Ames Street, Water Street, and Riverside Drive), approximately one and one-half miles west and cross gradient of the OPM. The city's reservoir is approximately one and one-half miles northeast of the OPM on Ames Hill. According to Mr. Madden, several car washes and only one residence have private water supply wells in the city. The closest private well is at a car wash approximately one mile from the OPM. Based on a review of Massachusetts Surface Water Quality Standards (314 CMR 4.00), the Spicket and Merrimack Rivers are Class B surface water bodies (i.e., designated as habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation).

According to the Federal Emergency Management Agency, Flood Insurance Rate Map (FIRM) for the City of Lawrence, Massachusetts (Community Panel Number 250087 0002B), the northwestern portion of the OPM is within Zone A17 (i.e., an area of 100-year flood) and portions of the north and southeastern areas of the Site are within Zone B (i.e., an area between the limits of the 100-year and 500-year flood).

2.2 Ownership History and Historic Paper Mill Activities

HMM Associates conducted a preliminary site assessment in 1992, which summarized the history of the OPM. The following information is drawn from the HMM report (HMM, 1992). The HMM report states that paper making had been conducted on the Site for 135 years, first under the name Russell Paper Company, then Champion International, Oxford, Ethyl, and finally

Pleasant Valley Paper Mills. Operations ceased completely in 1974. The City of Lawrence took ownership of the OPM in 1983.
Pulping of the wood chips was done by the “soda and sulphite” chemical process, which produced a foul odor (HMM, 1992) and typically used a base (lime or sodium hydroxide) plus sulfurous acid (HSO_3). Another pulping process, called the kraft chemical pulping process, uses sodium hydroxide (NaOH) and sodium sulfide (Na_2S), and may have also been used at the Oxford Site. The process was most likely conducted in steel digesters under steam pressure. Some papers were coated with clay, which was stored in silos that were once present on the property. Buildings identified on the Sanborn maps include the “soda pulp mill”, the “chemical mill” (No. 15), a machine building, (No. 3), and a building containing “beating engines” and a “rotary bleacher” (No. 6). Bleaching of pulp may have been done using chlorine or hypochlorite. An open coal bin, boiler room, and “black ash room” are also identified on some Sanborn maps. Note that building numbers, arrangements, and uses changed over the years according to the Sanborn maps.

Contaminants that may be present on the Site, due to former paper mill operations, include polycyclic aromatic hydrocarbons (PAHs) from coal, coal ash, and other combustion operations, chlorinated organic compounds that may have been formed during pulp bleaching operations, and sulfides from chemical pulp residues. The chlorinated organic compounds and sulfides would most likely have been released to surface water and air, as opposed to soil, because they are associated with mill operations that involved water discharges (to the raceway most likely) and air emissions (sulfur compounds and other volatile organic compounds (VOCs) from stacks and process tanks). In addition, underground storage tanks containing fuel oils and therefore, petroleum hydrocarbons (PHCs) may be present in soil and groundwater. Transformers containing polychlorinated biphenyls (PCBs) have historically been present on-site.

2.3 Previous Response Actions and Assessment Activities

Information on the status of storage tanks, drums and containers is provided in various letters and reports regarding the area north of the raceway and is summarized below.

According to a review of City of Lawrence Fire Department records by Briggs Associates, Inc. in the 1984 study, no aboveground storage tanks were present at the OPM. However, the records indicated that one 20,000-gallon and three 30,000-gallon underground storage tanks (USTs) were present at the Site. The license for these tanks was issued on July 6, 1953. Fire Department records also indicated that gasoline was stored in two 300-gallon USTs. One tank was installed in 1921 and the other one was installed in 1928; both gasoline tanks were removed on July 23, 1968.

A March 19, 1992 letter from Mr. Robert J. Devaney, Jr., Director of Environmental Engineering at GenCorp to the City of Lawrence Community Development Department summarizes the results of Camp Dresser & McKee’s (CDM) December 1985 report titled "Final Technical Memo Report #3 - Oxford Paper Site." The letter indicates that the presence of three 30,000-gallon tanks at the Site was confirmed in April 1989.

The May 15, 1989 NOR letter from MADEP to the City of Lawrence indicates that based on MADEP's review of a July 25, 1967 plan of the Site, seven fuel oil storage tanks were located on the property (three 30,000-gallon, one 20,000-gallon, one 10,000-gallon, and two 1,000-gallon tanks). Figure 3 depicts the former tank locations on the north side of the property. The letter indicates that these tanks were abandoned in 1976. According to the letter, two of the tanks (one 20,000-gallon and one 1,000-gallon) were located on April 19, 1989 and were removed.

A Commonwealth of Massachusetts, Department of Public Safety, Division of Fire Prevention, Permit for Removal and Transportation to Approved Tank Yard was obtained for the 20,000-gallon tank on April 18, 1989. The tank was removed on April 19, 1989 and no leakage was observed. The tank was transported off-site to John C. Tombarello & Sons of Lawrence, Massachusetts. The permit indicates that the tank was accepted at this location on June 9, 1989.

The 1,000-gallon tank was excavated on April 20, 1989. This 1,000-gallon tank was removed from the location of a supposed 10,000-gallon fuel oil tank shown on a historical map of the Site. According to a Commonwealth of Massachusetts, Department of Public Safety, Division of Fire Prevention, Permit for Removal and Transportation to Approved Tank Yard, the tank was transported off-Site to John C. Tombarello & Sons of Lawrence, Massachusetts. The permit indicates that the tank was accepted at this location on June 9, 1989.

An April 23, 1991 letter from Eckenfelder, Inc. to Mr. Robert J. Devaney, Jr., Director of Environmental Engineering at GenCorp, indicates that GenCorp responded to the 1988 oil release to the Spicket River by assisting with UST location, identification, and removal on the former OPM property. The letter also indicates that subsequent excavations conducted by the City of Lawrence confirmed the presence of several large diameter USTs, which contained petroleum residuals of unknown composition.

According to information gathered, as part of HMM's Preliminary Site Assessment in 1992, five underground storage tanks were identified on the Site to the north of the raceway. Two of these tanks (one 500-gallon and one 1,000-gallon) were removed by Clean Harbors in 1988. Records maintained by the City of Lawrence Fire Department indicate that one 1,000-gallon tank was removed in 1989. The remaining USTs were each 30,000-gallons. The contents of the tanks were sampled by Clean Harbors in 1988; analytical results indicated that petroleum was stored in the tanks. Clean Harbors reportedly removed the contents of two of the USTs. According to records at the City of Lawrence Fire Department, the contents of the third tank had solidified.

ENPRO, Inc. removed the three 30,000-gallon fuel oil USTs in November 2000. Analytical data showed no exceedances of the MCP reportable concentrations. Based on the above information, it appears that there are no remaining underground storage tanks in the North area of the former OPM Site. Figure 3 shows areas north of the raceway where former USTs were once located.

A Phase II - Comprehensive Site Assessment (CSA) Report for areas north of the raceway was submitted to MADEP in August, 2006. The Phase II CSA included a Method 3 Human Health Risk Characterization and Stage I Environmental Screening. The Risk Characterization concluded that under current site activities and uses, potential exposures to COPCs in soil and surface water (as estimated based on groundwater discharge to the Spicket River, and a dilution factor of 10) pose no significant risk of harm to current adolescent trespassers.

Under future foreseeable site activities and uses, potential direct contact exposures of COPCs in soil pose a significant risk of harm to human health. Significant risk of harm is posed to: (1) the future hypothetical young child user; and (2) the future hypothetical adult user. The risks are primarily attributable to the presence of carcinogenic PAHs and arsenic in soil. Future exposures to construction/utility workers or adolescent trespassers pose no significant risk to harm to health. Note that the assessment of future risk includes data for all soils currently present at the Site north of the raceway, including those in the wedge area. Removal of wedge area soils was not assumed in estimating future risk.

The Method 3 Human Health Risk Characterization for the areas north of the raceway also concluded that risk of harm to safety and public welfare is not significant under both current and future foreseeable site conditions. Also since the water Exposure Point Concentrations (EPC), modeled from groundwater contaminant concentrations, do not exceed Ambient Water Quality Criteria (AWQC) for aquatic receptors, it is concluded that the area north of the raceway does not pose a significant risk to the environment.

Risk of harm to the aquatic organisms was evaluated by comparison of the modeled surface water EPCs to Massachusetts AWQC provided by MADEP (MADEP, 1994). COPC EPCs are below the corresponding AWQCs, and thus pose no significant risk of harm to aquatic receptors.

Based on the findings of the Stage I Environmental Screening, current and future foreseeable site conditions pose no significant risk of harm to the environment, as defined in 310 CMR 40.09. In addition, a Stage II Environmental Risk Characterization (as defined in 310 CMR 40.0995(4)) is not required.

2.4 Regional and Site Specific Geology

Based on the soil survey for the northern part of Essex County, Massachusetts, the overlying surficial deposits consist primarily of loamy soils formed over compact glacial till. Two drumlins are located near the Site, including Prospect Hill to the northeast and a smaller hill located to the northwest. The thickness of glacial till is often on the order of 15 to 20 feet, although thicknesses of up 175 feet have been observed in the drumlin area (Eckenfelder, Inc., 1998).

According to the GenCorp Phase II Groundwater Model Report conducted by Eckenfelder, Inc. in 1998, bedrock underlying the Oxford Paper Mill site lies within the Merrimack Belt lithotectonic zone. Major faults further subdivide the Merrimack belt into individual tectonic zones – each of which has a different and distinct lithology. Furthermore, the OPM site is located north of the Clinton-Newbury fault, which is accompanied by a series of many smaller faults and associated disrupted geologic strata. The bedrock lithology consists of a series of meta-sedimentary rock types of the Berwick formation. The encountered bedrock of the OPM site is composed of phyllite, argillite, and quartzite with minor amounts of calcareous metagraywacke and schist (Eckenfelder, Inc., 1998).

The area north of the raceway is relatively flat with the eastern portion of the Site sloping downward to the Spicket River. The average elevation of the Site is approximately 100 feet above mean sea level (msl).

The soils on site are part of Urban Land, which consists of nearly level to moderately steep areas where the soils have been altered or obscured by urban works and structures. The site soils are part of the Paxton-Woodbridge-Monatauk association where the area is nearly level to steep, well drained and moderately well drained, loamy soils formed over compact glacial till (Soil Survey of Essex County, Massachusetts Northern Part, 1981).

The geology on the north side of the OPM was assessed through a subsurface boring program and test pits excavations. Based on observations of the test pits and split spoon samples, the general geologic profile was found to consist primarily of an assemblage of loamy and sandy soils. The mixture of differing sediment sizes indicates that the materials are not well sorted, and are consistent with glacial deposits. The soil borings also revealed similar conditions of differing amounts of loam, sand and gravel with coal ash, bricks, and debris encountered throughout the area north of the raceway.

Bedrock was not encountered on the north side of the OPM. Bedrock coring was not conducted as part of the Phase II CSA. Soil borings were advanced from 0 to 24 feet below ground surface (bgs) and test pits were advanced from 0 to 15 bgs. A detailed description of Site geology is presented in Section 3.0 of the Phase II CSA dated August 2006, presented by Stone & Webster.

2.5 Nature and Extent

The following section of this report provides a summary of the nature and extent of the contamination that has been identified for areas north of the raceway at the OPM. A detailed description of the nature and extent of site contamination is presented in Section 6.0 of the Phase II CSA dated August 2006, prepared by Stone & Webster. In general, contamination in surface (0 to 3 feet below ground surface (bgs)) and subsurface (> 3 feet bgs) wedge area soils consist of extractable petroleum hydrocarbon (EPH) carbon fraction ranges, PAHs, metals (namely arsenic), PCBs, and asbestos. In general for the North area, contamination in surface (0 to 3 feet bgs) soils consists of EPH carbon fraction ranges, PAHs, metals (namely arsenic, beryllium, and lead), and asbestos. North area subsurface (> 3 feet bgs) soils consists of EPH carbon faction ranges, PAHs, and metals (namely arsenic, beryllium, and vanadium). PAH contamination in soils north of the raceway is not likely to be due solely to coal ash and wood ash. Since the contribution of background materials to the elevated concentrations of PAHs cannot readily be determined, the PAHs are not treated as meeting the MCP definition of "background". The risk characterization includes those PAHs that were detected above MADEP background levels for natural soils, and does not screen COPCs on the basis of MADEP background concentrations for soil associated with fill material, or any other source of background concentrations. A detailed description of the rationale is provided in Section 5.5 of the August 2006 Phase II CSA Report.

Soil

For screening purposes, the analytical results for soils were compared to applicable MCP Standards. Surface and subsurface soil samples were compared to RCS-1 Standards. Results of the Phase II CSA established that RCS-1 Standards were exceeded in both the wedge area and North area soils of the OPM. Tables 2-1 through 2-6A indicates which samples collected had concentrations above the applicable RCS-1 Standards for areas north of the raceway.

Specifically, in the wedge area, both surface and subsurface soils contained concentrations of EPH carbon fraction ranges, PAHs, metals (namely arsenic), PCBs, and asbestos above applicable MCP Standards. Wedge area soil data collected from the Phase II CSA are summarized in Tables 2-2 through 2-5, and Table 2-6A. The laboratory analytical reports for the wedge area soil data are presented in Appendices C, E, and L of the Phase II CSA. In the North area, surface soil contained concentrations of EPH carbon fraction ranges, PAHs, metals (namely arsenic, beryllium, and lead), and asbestos above applicable MCP Standards. Lead impacted surface soils are only found in select locations within the North area. North area subsurface soil contained concentrations of EPH carbon fraction ranges, PAHs, and metals (namely arsenic, beryllium, and vanadium) above applicable MCP Standards. Asbestos samples were not collected during subsurface investigations. North area soil data collected from the Phase II CSA is summarized in Tables 2-1 and 2-6. The laboratory analytical reports for the North area soil data is presented in Appendices D and E of the Phase II CSA. A summary of minimum and maximum statistics for surface and subsurface soil analytical data for both the wedge area and north area is presented in Tables 2-8 and 2-9.

The total volume of impacted wedge area soil removed from the Site is 3,377 CY. The total volume of impacted soil in the North area is approximately 16,900 CY.

Groundwater

For screening purposes, the groundwater analytical results were compared to applicable MCP reportable concentration GW-2 Standards. Results of the Phase II CSA groundwater analyses revealed that only metals (selenium and vanadium) were detected exceeding the GW-2 Standards. No other analytes were detected above applicable GW-2 Standards. North area groundwater data collected from the Phase II CSA are summarized in Table 2-7. The laboratory analytical reports for the North area groundwater data is presented in Appendix F of the Phase II CSA. There was no groundwater data collected during the May 2002 and July 2006 wedge area investigations.

2.6 Selection of Remediation Goals

Selection of an appropriate and cost-effective remedial action plan requires the development of remediation goals based upon site-specific data. The MCP calls for selection of remedial action alternatives that reduce, to the extent feasible, the overall mass of contaminants in the environment to background levels, and therefore favors active removal or recovery alternatives over containment only. The goal for the areas north of the raceway is to achieve a permanent solution through a Response Action Outcome (RAO).

Stone & Webster has identified the following remediation goals and some of the remedial action alternatives that may be capable of achieving each goal.

Remediation Goals	**Activities to Attain the Remediation Alternative**	**Potential as or Feasible as a Remediation Goal?**
Perform response actions on the entire site to achieve background or approaching background conditions for a Class A-1 RAO.	▪ Excavation and disposal of 16,900 CY contaminated soil at the Site	No
Perform response actions only on portions of the Site to attain of condition of no significant risk for a Class A-2 RAO, without land use restrictions.	▪ Excavation and disposal of select areas • Phytoremediation • Enhanced Bioremediation ▪ Soil Flushing	No No No No
Perform response actions to create a condition of no significant risk with the implementation of an Activity and Use Limitation and a Class A-3 RAO, which would limit land use to a public passive park.	▪ Excavation and disposal of 3,377 CY of contaminated wedge area soils ▪ Geotextile capping/containment of wedge area and North area soils after excavation and sisposal of 1,855 CY of contaminated soil at the Site. ▪ Geotextile capping/containment of wedge area and North area soils after relocating 700 CY of con-tamination to the North area and 1,155 CY to the South. ▪ On-site stabilization/solidification ▪ Enhanced Bioremediation ▪ Phytoremediation ▪ Soil Flushing	Completed Yes Yes No No No No
Perform response actions for a Temporary Solution or a Class C RAO.	▪ Institutional Controls	Yes

Based on the results of the site assessment activities and risk characterization, Stone & Webster has selected, as identified in the table, to achieve an RAO at the Site. The first goal is the performance of response actions to attain a condition of no significant risk without the need for an Activity and Use Limitation (AUL). The second goal is the reduction of exposure to contaminant concentrations in soil through soil removal or capping to attain a condition of no significant risk with the implementation of an AUL. The third remediation goal would be to perform response actions to attain a Temporary Solution. The results of the Phase II will determine the appropriate remediation goal for the site based on a review of the pros and cons of remediation alternatives.

3.0 IDENTIFICATION OF REMEDIAL ACTION ALTERNATIVES

Remediation technologies are available to address the presence of EPH carbon fraction ranges, PAHs, metals (namely arsenic), PCBs, and asbestos in wedge area soil matrixes at the OPM. Likewise, there are remediation technologies available to address the presence of EPH carbon fraction ranges, PAHs, metals (namely arsenic, beryllium, and vanadium), and asbestos in North area soil matrixes at the OPM. Each of these can be considered a stand-alone technology or as part of an integrated remedial approach. As part of the Phase III evaluation, several alternatives were identified and screened based on effectiveness, reliability, implementability and cost to implement. Based on these factors, appropriate alternatives will be selected for detailed evaluation.

3.1 Description of Remedial Action Alternatives

Remedial action alternatives for areas north of the raceway include in-situ and ex-situ treatment, containment and other miscellaneous options. In-situ treatment involves treatment of contaminated soil in place onsite. This does not involve removing soils. In-situ treatment includes the following technologies: enhanced bioremediation, phytoremediation and soil flushing. Ex-situ treatment involves treatment of contaminated soils after they have been removed from the ground. Ex-situ treatment includes; chemical extraction, solidification/stabilization, separation, soil washing, and chemical reduction/oxidation. Containment would not involve extensive excavation activities and/or off-site removal and would consist of in place capping of contaminated areas on site. Containment with on-site relocation of contaminated soil or off-site disposal would involve some excavation activities for on-site placement or off-site disposal and would consist of in place capping of contaminated areas on site. Other options include excavation and disposal of contaminated soils, institutional controls or no further action with institutional controls. Descriptions of these remedial alternatives are provided in Table 3-1.

3.2 Initial Screening of Remedial Action Alternatives

As presented in Table 3-1, Stone & Webster has performed an initial screening of the applicable remediation technologies to select remedial action alternatives for detailed evaluation. During the initial screening, a technology was considered feasible if the technology was reasonably likely to achieve a Permanent Solution pursuant to the MCP and achieve the remedial goals set for areas north of the raceway at a reasonable cost. The screening of alternatives indicated that:

- Enhanced bioremediation, solidification/stabilization, and separation do not adequately address all of the contaminants of concern at the site;
- Phytoremediation is not feasible due to the amount of time it would take to remediate the site; and
- Soil flushing, chemical extraction, soil washing, and chemical reduction/oxidation are not

feasible due to the extremely high costs and the availability of other options that are less expensive.

Therefore, the initial screening identified three remedial technologies that are feasible for areas north of the raceway at the OPM and need further evaluation to determine the most appropriate action. The three possible remedial actions are: (1) no further action with institutional controls; (2) soil excavation and off-site disposal; or (3) geotextile capping/containment combined with relocating excavated soils on-site or with excavation and disposal of contaminated soils off-site. An evaluation of these feasible remedial actions is presented in Section 4.0.

4.0 EVALUATION OF FEASIBLE REMEDIAL ACTION ALTERNATIVES

The following section discusses and compares the three remedial action alternatives chosen from the initial screening: no further action, soil excavation and off site disposal, or geotextile capping/containment with excavation of contaminated soil relocated on-site or disposed off-site. According to the Phase II Report, there are two areas that must be addressed in order to achieve one of the three remediation goals selected for areas north of the raceway at the OPM. These two areas consist of the wedge area and the North area.

Each technology is described in detail with site specific information explaining how it would be applied to achieve site cleanup goals. The general effectiveness, implementability, and estimated cost of each technology are then presented. Some of the technologies have several options, such as capping, while others have no alternatives within the overall action, such as the need for excavation and disposal. For the technologies with two or more alternatives, effectiveness, implementability, and costs are presented with some discussion that compares alternatives.

4.1 No Further Action - Institutional Controls

No further action is used on sites where remedial actions are either not necessary or not possible. This alternative often relies on the presence of permanent structures and or institutional controls (such as fencing). No further action often relies on natural degradation of contaminants of concern.

Selection of the no further action alternative for areas north of the raceway at the OPM was elected for further evaluation as a base alternative. With this selection, the contaminated media located throughout the site would remain in place, and fencing would be installed and maintained completely surrounding areas that may pose an imminent hazard and/or risk to the public. A Class C RAO, which is not a permanent solution, would be completed for the site and periodic maintenance reports would be required to indicate that the effectiveness of the fencing remained. Additional sampling would be required and eventually a Permanent Solution would have to be achieved through the performance of response actions because COPCs at the site do not undergo natural attenuation.

4.1.1 Effectiveness

A no further action alternative would not be effective as a Permanent Solution, but rather as a temporary solution because a condition of no significant risk would not be reached by this alternative. No further action would not eliminate any contamination, but would rather reduce potential exposure to the contaminants of concern. Also, the North area will be used as a passive park in the future and the area currently does not have the means to separate the contaminants of concern from the would be park users. Installing a fence around the area would not allow the space to be used as a park in the future.

4.1.2 Short Term and Long Term Reliability

No further action would be reliable as a short term solution as long as the fences remained in good repair and were periodically checked. For the long term this solution is not reliable because a permanent solution has not been achieved and the contaminants of concern do not undergo significant natural attenuation. No contamination would be removed in this process and a level of no significant risk would not be reached for areas north of the raceway at the OPM.

4.1.3 Difficulty in Implementing Alternative

Minimal work would be required to install additional fencing, and therefore would not be difficult to implement.

4.1.4 Cost of the Alternative

Minimal work would be required, and therefore this option would involve minor additional costs for the installation of fencing around sections of areas that are currently not fenced or for the installation of new permanent fencing. Periodic site visits would be required to assess the condition of the fences and to ensure that certain areas of the site remain inaccessible. A maintenance schedule would have to be developed and the execution of the schedule would have to be monitored. The cost of a new permanent fence around the entire area (wedge and North areas) would range from $35,000 to $45,000. The cost of maintenance (assuming 8 hours a day four times a year for 10 to 20 years at $60/hour) would be $20,000 to $40,000. The cost of the five year evaluation would be $20,000 and additional costs for one of the other alternatives. Therefore, the cost of this option would range from $75,000 to $105,000.

4.1.5 Risks of the Remedial Action Alternative

Due to the presence of PCBs and asbestos located in the surface soils as well as the area not being controlled by an engineered barrier, the no further action alternative would not permanently eliminate risk at for areas north of the raceway at the OPM and therefore only a Class C RAO, Temporary Solution could be obtained. This alternative will disrupt the intended use of the property for areas north of the raceway and additional remedial actions would be required within five years.

4.1.6 Benefits of the Alternative

No further action would be the least cost for the owner and would include minimal work.

4.1.7 Timelines of Alternative

No further action will not require additional time and is immediately implementable.

4.1.8 Relative Effectiveness of the Alternative upon Non-Pecuniary Interests

The no further action alternative would not impact current site activities and would allow for the site to remain as is with areas not accessible to the public. The no further action alternative would impact future site activities. This alternative does reduce the overall use and aesthetics of the site. The fences and the inaccessibility of the portions of the property decrease the value gained by not spending money on the remediation.

4.1.9 Summary of Detailed Evaluation

According to the MCP, the goal of the Phase III is the identification, evaluation, and selection of a comprehensive remedial action alternative that will address the identified risk, which is likely to achieve a permanent solution. A detailed evaluation has been conducted in accordance with the requirements specified in 310 CMR 40.0850, which presents the detailed evaluation criteria to be utilized in the comparison of potential alternatives. This remedial alternative does not present a permanent solution for the site, but does have short term merit as a temporary solution due to the minimal cost required.

4.2 Soil Excavation with Off-Site Disposal

Soil excavation with off-site disposal of contaminated media was elected for further evaluation as a remedial action alternative for areas north of the raceway at the OPM. This is a common method of directly removing contaminated material from a site. This remedial action alternative involves removal of media from within areas of contamination with ultimate disposal of contaminated materials to an appropriately permitted off-site disposal facility. This option has been evaluated for the removal of North area soils that presents significant risk for the City of Lawrence. The excavation and removal of 3,377 CY of contaminated wedge area soils was completed on May 12, 2006. The volume of contaminated soil to be removed from the North area is approximately 16,900 cubic yards. Since this process physically removes the COPCs from all areas of the Site, this alternative is usually the quickest method of site remediation. If the site is fully accessible and proper field screening and sampling is conducted, this method also provides the greatest assurance that cleanup levels will be achieved. Restoration of the excavation area(s) would be completed once confirmatory samples have been collected and confirmed to meet site cleanup standards.

The excavation and disposal of North area soils (approximately 16,900 CY) would allow for the submittal of a RAO without the implementation of an AUL. This would also allow for the Site to achieve background or approach background conditions and ultimately be a permanent solution for the Site. The excavation and disposal of only wedge area soils (3,377 CY) would allow for the submittal of a RAO with the implementation of an AUL if a geotextile cap were to be utilized. The removal of wedge area soils reduces the average concentrations of COPCs across this portion of the Site. The degree and the amount of contamination are greater in the wedge area than that of the North area.

According to Metcalf & Eddy's site investigation report (August 2003) for areas north of the raceway, soil contamination was determined to be approximately 15 feet bgs for the North area. Therefore, the volume of contaminated soil to be removed from the rest of the North area would be approximately 16,900 CY, which is greater than the wedge area volume.

The activities associated with this alternative are:

- Design of the final landscaping plan for the area after excavation
- Preparation of specifications and for performing the work
- Permitting (Conservation Commission, DEP, etc.)
- Attendance at Town Meetings
- Clearing and grubbing
- Excavation
- Confirmatory Sampling
- Transportation and disposal
- Backfill and grading
- Landscaping and planting grass, etc.
- Preparation of DEP Submittals (Release Abatement Measure (RAM) Plan, RAM Completion, RAO, etc.)
- Load and go and stockpile characterization of soil for off-site disposal
- Health and Safety Plan
- Watering of soil

4.2.1 Effectiveness

If proper field screening and sampling procedures were performed, soil excavation would be the most effective alternative. This is the only alternative that will achieve a permanent solution without the requirement for the implementation of an AUL.

4.2.2 Short Term and Long Term Reliability

Soil excavation is the most reliable of the alternatives both short term and long term, since the mass of contamination would be removed by a proven technology. A level of no significant risk could be reached and concentrations of contaminants would be significantly reduced for areas north of the raceway at the OPM. Excavation and off site disposal does not require future activities to manage remaining contamination.

4.2.3 Difficulty in Implementing Alternative

Excavation of soils for off site disposal is complex and requires use of large open areas for stockpiling soils and storing equipment. Off-site disposal of 3,377 CY of wedge area material was a significant undertaking. An even greater undertaking would be the off-site disposal of 16,900 CY of North area soils. Staging areas and disposal facilities that could accept such a large volume of soil would have to be identified. Numerous logistic issues relative to the future land use, as a passive park, would have to be resolved. Overall this would be a difficult undertaking, but no more difficult than any other type of contaminated soil removal project. Also since the possibility of asbestos fibers becoming airborne exists, extensive measures are needed to control asbestos fiber releases to the ambient air. Continuous wetting of soil to prevent asbestos fibers releases into ambient air is needed. Perimeter air monitoring for asbestos is also needed for this remedial alternative. However, extensive measures would be in place and, therefore, this remedial option could be implemented.

4.2.4 Cost of the Alternative

Capital costs for excavation are relatively moderate but could increase significantly with the presence of rocks and old building foundations once excavation activities are underway. There are no operating and maintenance costs associated with excavation.

A summary of the costs associated with the excavation/disposal alternative of contaminated soils from the North area is provided in the following table.

Excavation/Disposal Alternative	**Estimated Cost ($)**
North area	$4,160,000

Note: A 15% contingency is included in the above costs.

Also there would be additional costs for backfill material for the North area excavation in order to get the area to site grade. An estimated amount for this alternative is not included in the table above. This was not be the case for the wedge area excavation/disposal alternative.

4.2.5 Risks of the Remedial Action Alternative

The wedge area required remediation through soil excavation and off-site disposal (completed in May 2006) since the degree and the amount of contamination was greater than that of the North area. The North area, which is the area that would not require remediation through soil excavation and off-site disposal, is located in an area that the public has no access to on a daily basis. The OPM will be closed to the public during construction activities and therefore the risk of soil excavation/disposal impacting the public would be minimal. However, construction activities would involve exposing workers to contaminated soils through the use of heavy machinery and the presence of stockpiles and open excavations on-site. This alternative would require the development and implementation of a site specific health and safety plan to reduce risk (mainly asbestos fibers) during the performance of this alternative. The other risk would be of discovering, during construction, more contamination to be removed than currently identified, which could significantly increase the cost.

4.2.6 Benefits of the Alternative

Since contamination would be removed and a condition of no significant risk would be reached, excavation and off-site disposal would be the most beneficial for the soils at OPM. Soil excavation and disposal would result in a condition of no significant risk for the wedge area and an AUL would not be required if all the area were excavated.

4.2.7 Timelines of Alternative

If a large enough crew were obtained the implementation of this project could be completed in one construction season or approximately three months. The upfront work for the design would most likely take three months. The on-going construction work by the Massachusetts Highway Department (MHD) on the south side of the OPM would not affect the excavation and disposal work that will be implemented in the North area.

4.2.8 Relative Effectiveness of the Alternative upon Non-Pecuniary Interests

The overall value of the OPM would be increased by this alternative. No use limitations will be placed on the wedge area and the North area will require an engineered barrier to be utilized as a passive park by the public and use restricted due to contaminants on the site.

4.2.9 Summary of Detailed Evaluation

According to the MCP, the goal of the Phase III is the identification, evaluation, and selection of a comprehensive remedial action alternative that will address the identified risk and which is likely to achieve a permanent solution. A detailed evaluation has been conducted in accordance with the requirements specified in 310 CMR 40.0850, which presents the detailed evaluation criteria to be utilized in the comparison of potential alternatives. The excavation/disposal alternative of wedge area soils would be extremely effective at achieving a condition of No Significant Risk and will require the implementation of an AUL. Due to high costs associated with excavating and disposing of North area soils, an associated option would be to place a geotextile cap on this area. This would allow for the submittal of a RAO with the implementation of an AUL.

Due to the reduced interference of structural voids from old building foundations and the level of contamination found within the soil of the wedge area as compared to the North area, it would be beneficial to remove only the wedge area soil. The cost as well as the reduction of average concentrations of COPCs across the Site would be more beneficial to the project if wedge area soil was excavated and disposed of. The excavation and disposal of wedge area material would allow for the submittal of a RAO with the implementation of an AUL. Due to the presence of PAHs at locations throughout the wedge area at the OPM, an AUL would be placed on the property.

4.3 Containment/Capping ofWedge Area and North Area after Excavation and Disposal Off-Site of 1,855 CY of Asbestos Contaminated Soil

Containment is a remedial action alternative where physical barriers are installed in an effort to prevent further contaminant migration and/or to eliminate potential exposure to contamination. This alternative would combine containment/capping with the excavation and disposal of approximately 1,855 CY of asbestos contaminated soil. This volume of soil was identified in Shadley Associates' preliminary design to address asbestos contaminated soil in the North area and the final plan for the site's eventual use as a passive public park. The volume calculations and site plans are attached as Appendix A. For areas north of the raceway as part of this remedial action, the two existing areas, designated as the wedge area and the North area, would be contained under one continuous geotextile cap that would encompass the area from the toe of the wedge area excavation to the northern extent of the North area. Containment in this context means a secure geotextile cap meeting the capping requirements applicable to the solid waste regulations.

The activities associated with this alternative are:

- Preparation of specifications and for performing the work
- Installing erosion preventative measures
- Permitting (Conservation Commission, DEP, etc.)
- Town Meetings
- Clearing and grubbing
- Load and go and stockpile characterization of soil for off-site disposal
- Excavation
- Transportation and disposal
- Confirmatory Sampling
- Backfill and grading
- Installing a geotextile cap
- Landscaping and planting grass, etc.
- Preparation of DEP Submittals RAM Plan, RAM Completion, RAO, etc.)

4.3.1 Effectiveness

By installing a geotextile cap over the wedge area and the North area soils, after excavcation, COPCs are isolated from public contact as well as to prevent further contaminant migration.

4.3.2 Short Term and Long Term Reliability

The capping of the areas north of raceway is a reliable remedial solution on both a short and long term basis, as long as accidental disturbance does not breach the cap. Cap disturbance is highly unlikely in these areas. The most likely cause of accidental disturbance would be the installation of new utilities or the construction of a new park structure. As a long term measure, this alternative will not be as reliable if maintenance and inspection was not performed, if they are performed it will be very reliable.

4.3.3 Difficulty in Implementing Alternative

The geotextile capping alternative combined with the excavation and disposal of the 1,855 CY of asbestos contaminated soils would be more difficult than No Further Action/Institutional Controls and would be the less difficult than the excavation only alternative of the entire site.

The excavation and capping of areas north of the raceway will require significant ground surface disturbance. Since the possibility of asbestos fibers becoming airborne exists, extensive measures are needed to control asbestos fiber releases to the ambient air. However, extensive measures would be in place and therefore this remedial option could be implemented. Due to the absence of paved roads and parking areas on site, the capping of the entire area north of the raceway would not be as overly difficult than if these structures were in place.

Protection of the adjacent Spicket River during all phases of construction will be implemented.

4.3.4 Cost of the Alternative

Capital costs for the excavation, transportation and disposal and capping both the wedge and north areas are relatively moderate but could increase significantly with the presence of rocks and old building foundation once capping activities are underway. There are also operating and maintenance costs associated with capping.

A summary of the costs associated with the geotextile capping alternative for contaminated soils for the entire Site is provided in the following table.

Capping Alternative	Estimated Cost ($)
Capping Wedge and North areas after excavation, transportation and disposal of 1,855 CY of asbestos contaminated soil	$655,000

Note: A 15% contingency is included in the above costs.

The cost above does not include landscaping costs after the entire Site has been capped.

4.3.5 Risks of the Remedial Action Alternative

Three risks are associated with the capping of the entire area north of raceway. They are 1) the risk of finding, during construction, more contamination to be removed than currently identified; 2) the public exposure and environmental risk of release of contamination during construction, and 3) future disruption of the geotextile cap.

Increased Extent of Contamination

During construction, should the contamination area and depth increase beyond the current assessment; the project costs would also increase. This may lead to an incomplete remediation project. The corresponding unresolved human and environmental risk factors that currently exist would remain. This project risk can be minimized by the order of construction. The wedge area was initially excavated and completed first due to the level and characteristics of contamination in this area before the capping activities are to take place for the entire site. The implementation of the geotextile cap with additional excavation will be associated with a separate remedial contract.

<u>Public and Environmental Risks During Construction.</u>

Public health risk is best minimized by closing and/or marking off areas during remediation activities. Exposure risk to contamination and physical hazard risk to construction activities are of key concern, and can be eliminated from the public by closing and/or marking off construction areas. Workers should be properly trained and outfitted with the necessary personal protection equipment to minimize their risks.

Environmental risks are controlled by proper containment of the contaminated materials by dust control and runoff control measures.

<u>Geotextile Cap Disruption</u>

As identified above, contamination areas left in place and capped, will always be susceptible to future cap disruption. This is especially true for the North area, where this area will be the most publicly used area of the passive park. Future site facility construction, while not currently planned, may include additional structures or utility work. After 50 years, the capping here could be forgotten and then accidental disruption is possible.

The wedge area disruption is not as large of a concern as the North area due to its location as being an area that will support a bridge that will transect the site. Due to the bridge, there will be greater public restrictions for use of the wedge area than the North area (passive park).

The risks associated with the capping of both areas are similar. The cap will eliminate exposure and, therefore, eliminate risks associated with exposure to the soil. The only risks are associated with erosion and degradation of the cap, which would lead to exposure to impacted soils. If the caps are maintained, there is little risk associated with this option.

4.3.6 Benefits of the Alternative

Risk reduction at a lower cost is the primary benefit of the capping option combined with the excavation and disposal of asbestos contaminated soils. . This is a lower cost alternative other than the no further action alternative, which does not eliminate risk. Capping the contaminated areas in place will always require attention since the contamination remains on site and may present a future human and environmental risk.

4.3.7 Timelines of Alternative

The time to excavate and dispose of the asbestos contaminated soils and construct a geotextile cap (with all layers) should be possible in a three to six month time frame, excluding establishment of vegetative cover.

4.3.8 Relative Effectiveness of the Alternative upon Non-Pecuniary Interests

The overall value of the park would be increased by this alternative because complete use of the park would be gained for passive activities. An AUL would have to be placed on the site and future development of the passive park would be restricted in the capped areas. Due to the current and projected use of the site as a passive public park, the implementation of an AUL would not have a significant impact on the projected utilization of the park.

4.3.9 Summary of Detailed Evaluation

The option for capping combined with the excavation and disposal of asbestos contaminated soil was evaluated. The evaluation determined that this alternative is a less expensive remediation option and provides a reasonable cost effective solution to create a condition of no significant risk with the implementation of an AUL.

According to the MCP, the goal of the Phase III is the identification, evaluation, and selection of a comprehensive remedial action alternative that will address the identified risk and which is likely to achieve a permanent solution. A detailed evaluation has been conducted in accordance with the requirements specified in 310 CMR 40.0850, which presents the detailed evaluation criteria to be utilized in the comparison of potential alternatives. A selection of an alternative is presented in Section 5.0.

4.4 Containment/Capping of Wedge Area and North Area after Excavation and Relocation of 1,855 CY of Asbestos Contaminated Soil On-Site

As stated in section 4.3, containment is a remedial action alternative where physical barriers are installed in an effort to prevent further contaminant migration and/or to eliminate potential exposure to contamination. This alternative would combine containment/capping with the excavation and relocation on-site of approximately 1,855 CY of asbestos contaminated soil. Two areas have been identified to receive the soils. One area is at the wedge area adjacent to and north of the raceway and will be able to accept approximately 700 CY of soil. The other area is in the south area adjacent to the raceway and will accept approximately 1,160 CY of soil. These areas will eventually be capped. The south area will be discussed in the “Revised Phase III-Remedial Action Plan for Areas South of the Raceway” which will be submitted simultaneously with this report. The soil relocation areas, site plans and volume calculations are identified in Shadley Associates’ preliminary design to address asbestos contaminated soil in the North area and the final plan for the site’s eventual use as a passive public park and are attached as Appendix A. For areas north of the raceway as part of this remedial action, the two existing areas, designated as the wedge area and the North area, would be contained under one continuous geotextile cap that would encompass the area from the toe of the wedge area

excavation to the northern extent of the North area. Containment in this context means a secure geotextile cap meeting the capping requirements applicable to the solid waste regulations.
The activities associated with this alternative are:

- Preparation of specifications and for performing the work
- Installing erosion preventative measures
- Permitting (Conservation Commission, DEP, etc.)
- Town Meetings
- Clearing and grubbing
- Excavation and temporary stockpiling
- Relocation of soils on-site
- Confirmatory Sampling
- Backfill and grading
- Installing a geotextile cap
- Landscaping and planting grass, etc.
- Preparation of DEP Submittals RAM Plan, RAM Completion, RAO, etc.)

4.4.1 Effectiveness

By installing a geotextile cap over the wedge area and North area soils, after excavation and relocation of the soils on-site, COPCs are isolated from public contact as well as to prevent further contaminant migration.

4.4.2 Short Term and Long Term Reliability

The capping of the areas north of raceway is a reliable remedial solution on both a short and long term basis, as long as accidental disturbance does not breach the cap. Cap disturbance is highly unlikely in these areas. The most likely cause of accidental disturbance would be the installation of new utilities or the construction of a new park structure. As a long term measure, this alternative will not be as reliable if maintenance and inspection was not performed, if they are performed it will be very reliable.

4.4.3 Difficulty in Implementing Alternative

The geotextile capping alternative combined with the excavation and relocation of the 1,855 CY of asbestos contaminated soils would be more difficult than No Further Action/Institutional Controls and Containment/Capping of Wedge Area and North Area after Excavation and Disposal Off-Site. It would be the less difficult than the excavation only alternative of the entire site.

The excavation/relocation of contaminated soils and capping of areas north of the raceway will require significant ground surface disturbance. Since the possibility of asbestos fibers becoming airborne exists, extensive measures are needed to control asbestos fiber releases to the ambient air. However, extensive measures would be in place and therefore this remedial option could be implemented. Due to the absence of paved roads and parking areas on site, the capping of the entire area north of the raceway would not be as overly difficult than if these structures were in place.

Protection of the adjacent Spicket River during all phases of construction will be implemented.

4.4.4 Cost of the Alternative

Capital costs for capping both the wedge and north areas are relatively moderate but could increase significantly with the presence of rocks and old building foundation once capping activities are underway. There are also operating and maintenance costs associated with capping.

A summary of the costs associated with the geotextile capping alternative for contaminated soils for the entire Site is provided in the following table.

Capping Alternative	**Estimated Cost ($)**
Capping Wedge and North areas after excavation and relocation of 1,855 CY of asbestos contaminated soil on-site.	$450,000

Note: A 15% contingency is included in the above costs.

The cost above does not include landscaping costs after the entire Site has been capped.

4.4.5 Risks of the Remedial Action Alternative

Three risks are associated with the capping of the entire area north of raceway. They are 1) the risk of finding, during construction, more contamination to be removed than currently identified; 2) the public exposure and environmental risk of release of contamination during construction, and 3) future disruption of the geotextile cap.

Increased Extent of Contamination

During construction, should the contamination area and depth increase beyond the current assessment; the project costs would also increase. This may lead to an incomplete remediation project. The corresponding unresolved human and environmental risk factors that currently exist would remain. This project risk can be minimized by the order of construction. The wedge area was excavated and completed first due to the level and characteristics of contamination in this area before the capping activities are to take place for the entire site. The implementation of the geotextile cap with additional excavation will be associated with a separate remedial contract.

Public and Environmental Risks During Construction.

Public health risk is best minimized by closing and/or marking off areas during remediation activities. Exposure risk to contamination and physical hazard risk to construction activities are of key concern, and can be eliminated from the public by closing and/or marking off construction areas. Workers should be properly trained and outfitted with the necessary personal protection equipment to minimize their risks.

Environmental risks are controlled by proper containment of the contaminated materials by dust control and runoff control measures.

<u>Geotextile Cap Disruption</u>

As identified above, contamination areas left in place and capped, will always be susceptible to future cap disruption. This is especially true for the North area, where this area will be the most publicly used area of the passive park. Future site facility construction, while not currently planned, may include additional structures or utility work. After 50 years, the capping here could be forgotten and then accidental disruption is possible.

The wedge area disruption is not as large of a concern as the North area due to its location as being an area that will support a bridge that will transect the site. Due to the bridge, there will be greater public restrictions for use of the wedge area than the North area (passive park).

The risks associated with the capping of both areas are similar. The cap will eliminate exposure and, therefore, eliminate risks associated with exposure to the soil. The only risks are associated with erosion and degradation of the cap, which would lead to exposure to impacted soils. If the caps are maintained, there is little risk associated with this option.

4.4.6 Benefits of the Alternative

Risk reduction at a lower cost is the primary benefit of the capping option combined with excavation and relocation of soils on-site. This is the lowest cost alternative other than the no further action alternative, which does not eliminate risk. Capping the contaminated areas in place will always require attention since the contamination remains on site and may present a future human and environmental risk.

4.4.7 Timelines of Alternative

The time to excavate and relocate the soils on-site and construct a geotextile cap (with all layers) should be possible in a three to six month time frame, excluding establishment of vegetative cover.

4.4.8 Relative Effectiveness of the Alternative upon Non-Pecuniary Interests

The overall value of the park would be increased by this alternative because complete use of the park would be gained for passive activities. An AUL would have to be placed on the site and future development of the passive park would be restricted in the capped areas. Due to the current and projected use of the site as a passive park, the implementation of an AUL would not have a significant impact on the projected utilization of the park.

4.4.9 Summary of Detailed Evaluation

The option for capping combined with the excavation and relocation of asbestos contaminated soil on-site was evaluated. The evaluation determined that this alternative is the least expensive remediation option while providing the best fit to institute a Permanent Solution for the entire site.

According to the MCP, the goal of the Phase III is the identification, evaluation, and selection of a comprehensive remedial action alternative that will address the identified risk and which is likely to achieve a permanent solution. A detailed evaluation has been conducted in accordance with the requirements specified in 310 CMR 40.0850, which presents the detailed evaluation criteria to be utilized in the comparison of potential alternatives. A selection of an alternative is presented in Section 5.0.

5.0 SELECTION OF THE FINAL REMEDIAL ACTION ALTERNATIVE

Three remedial alternatives have been evaluated for areas north of raceway at the OPM; no further action, soil excavation and disposal, geotextile capping combined with excavation and transportation and disposal off-site and geotextile capping combined with excavation and relocation of soils on-site. No further action with institutional controls was evaluated as a baseline, however this would not be effective for areas north of the raceway at the OPM, due to the future use as being a passive park. If no further action was conducted for areas north of the raceway at the OPM, contamination would remain on site, exposure to the contamination would still be present and a permanent solution would not be reached.

Due to the level and characteristics of contamination of the wedge area soil, the best remedial alternative was excavation and disposal since it would achieve a permanent solution for this heavily contaminated area. This has been completed. The best remedial alternative for the excavated wedge area and North area for future use as a passive park, based on the screening provided in Section 4, is the geotextile capping alternative combined with excavation of approximately 1,855 CY of asbestos contaminated soil and relocation of excavated soils on site. The capping of the Wedge and North areas with the relocation of the excavated soils on site would save the project significant amount in costs. The significant cost savings are due largely to the elimination of the disposal costs and the reduction of backfill needed to bring the North area back up to site grade. Based on cost and risk reduction, this is the best remedial alternative for the entire site.

The table below summarizes the costs, cleanup time, and feasibility associated with all remediation goals for areas north of the raceway.

Remediation Goal	Cost	Cleanup Time	Feasibility
Class A-1 RAO	$4,160,000	6 months	Not Feasible
Class A-2 RAO	$700,000	3 months	Not Feasible
Class A-3 RAO, AUL			

(Wedge area Excavation Completed on May 12, 2006 – Costs Approximately $700,000)	$450,000	3 to 6 months	Feasible
Class C RAO	$105,000	Less than 3 months	Not Feasible

Based upon the table above, the Class A-3 RAO and AUL option for areas north of the raceway is the best remedial goal. The feasibility, cleanup time, and the cost for this remedial option work best for site closure and the City of Lawrence.

6.0 PROJECTED SCHEDULE FOR IMPLEMENTATION OF PHASE IV

The Phase IV and Phase V reports are anticipated to occur within the deadlines established within the MCP. The Phase IV will be submitted within the next year and the Phase V will be completed within the following year. Completion of the work and the submittal of a RAO is anticipated to occur within the next three years.

7.0 LIMITATIONS

This report was prepared for the use of the City of Lawrence. The observations made and results presented in this report are believed to be representative of current conditions at the time of Stone & Webster's assessment. Any additional information regarding Site conditions or past/current Site use should be brought to Stone & Webster's attention so it may be addressed and incorporated in the Site study. This information could potentially result in modification of Stone & Webster's conclusions and recommendations.

Stone & Webster is not responsible for the accuracy and veracity of information provided to us by outside parties with respect to areas north of the raceway at the Oxford Paper Mill and adjacent properties. This report presents the opinions of Shaw/Stone & Webster Massachusetts Inc. with the respect to the environmental conditions of areas north of raceway at the Oxford Paper Mill. The actual determination of compliance of present or former operators of areas north of the raceway at the Oxford Paper Mill with federal or state regulations can only be made by the appropriate regulatory agencies. The opinions rendered herein are not intended to imply a warranty or a guarantee and are based solely upon areas north of the raceway at the Oxford Paper Mill conditions at the time of our investigation.

Chemical analyses were performed for certain parameters during this assessment. The parameters selected were based upon site knowledge and potential sources. However, chemical constituents not searched for during the studies may be present in soil and/or groundwater at areas north of raceway at the Oxford Paper Mill. Chemical conditions reported reflect conditions only at the locations tested at the time of testing and within the limitations of the methods used. Such conditions can differ rapidly from area to area and from time to time. No warranty is expressed or implied that chemical conditions other than those reported do not exist within areas north of the raceway at the Oxford Paper Mill.

Negative findings at a test location do not guarantee that the soil or groundwater at a greater depth is free of contaminants because geologic and/or hydrologic conditions may be present that prevents upward diffusion of contaminants from deeper horizons. Additionally, positive findings at a sample location can arise from soil contamination only and do not confirm that the underlying groundwater has been impacted.

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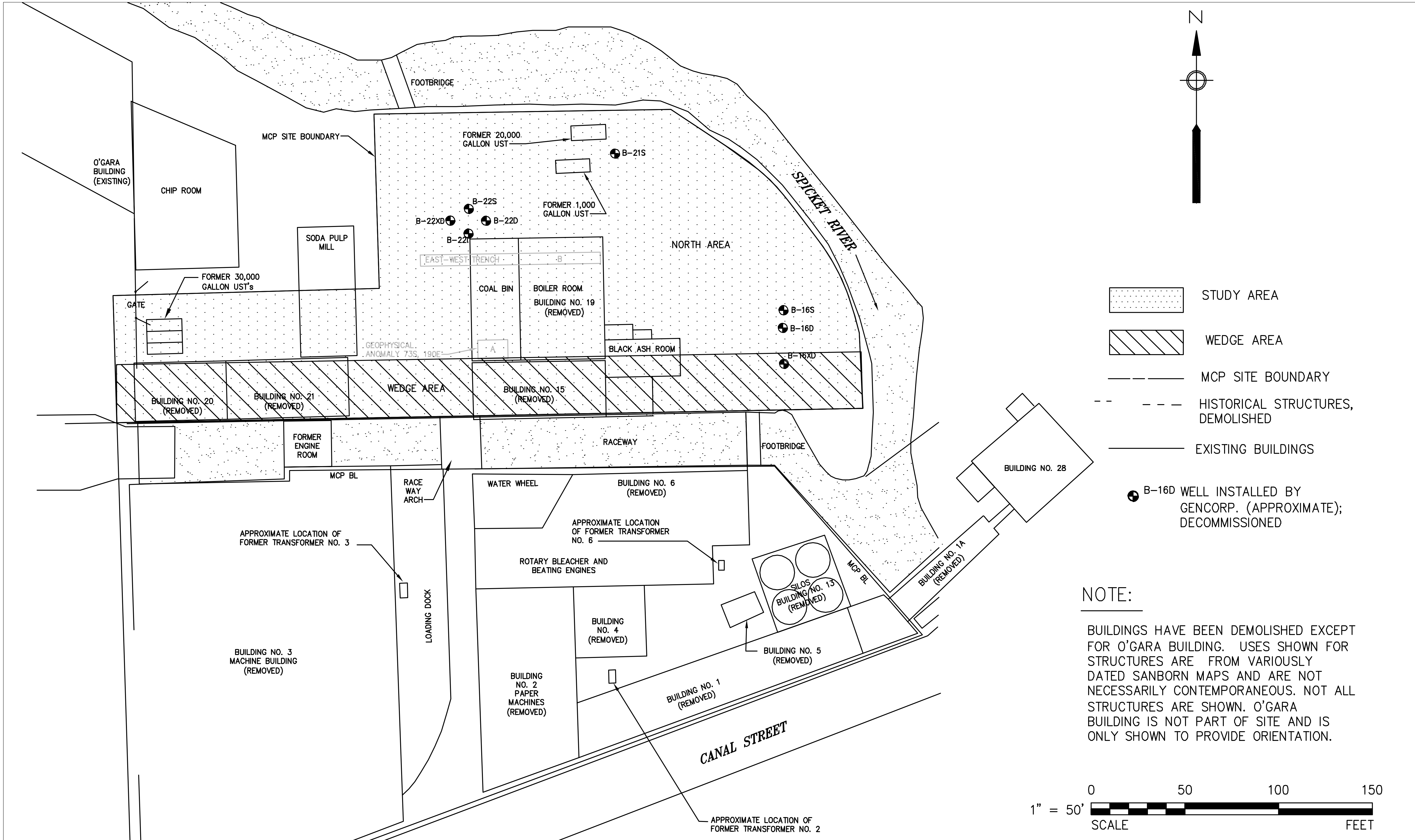
FIGURES

Figure 1: Site Locus Map
Former Oxford Paper Mill

Lawrence, MA



NOTE:

BUILDINGS HAVE BEEN DEMOLISHED EXCEPT FOR O'GARA BUILDING. USES SHOWN FOR STRUCTURES ARE FROM VARIOUSLY DATED SANBORN MAPS AND ARE NOT NECESSARILY CONTEMPORANEOUS. NOT ALL STRUCTURES ARE SHOWN. O'GARA BUILDING IS NOT PART OF SITE AND IS ONLY SHOWN TO PROVIDE ORIENTATION.

Shaw Environmental, Inc.

SHAW ENVIRONMENTAL OXFORD PAPER MILL SITE
SUBSURFACE INVESTIGATION – LAWRENCE, MASSACHUSETTS

FIGURE 2 – SITE PLAN AND SELECTED HISTORICAL FEATURES

SCALE: AS NOTED	3/16/04	DEH	

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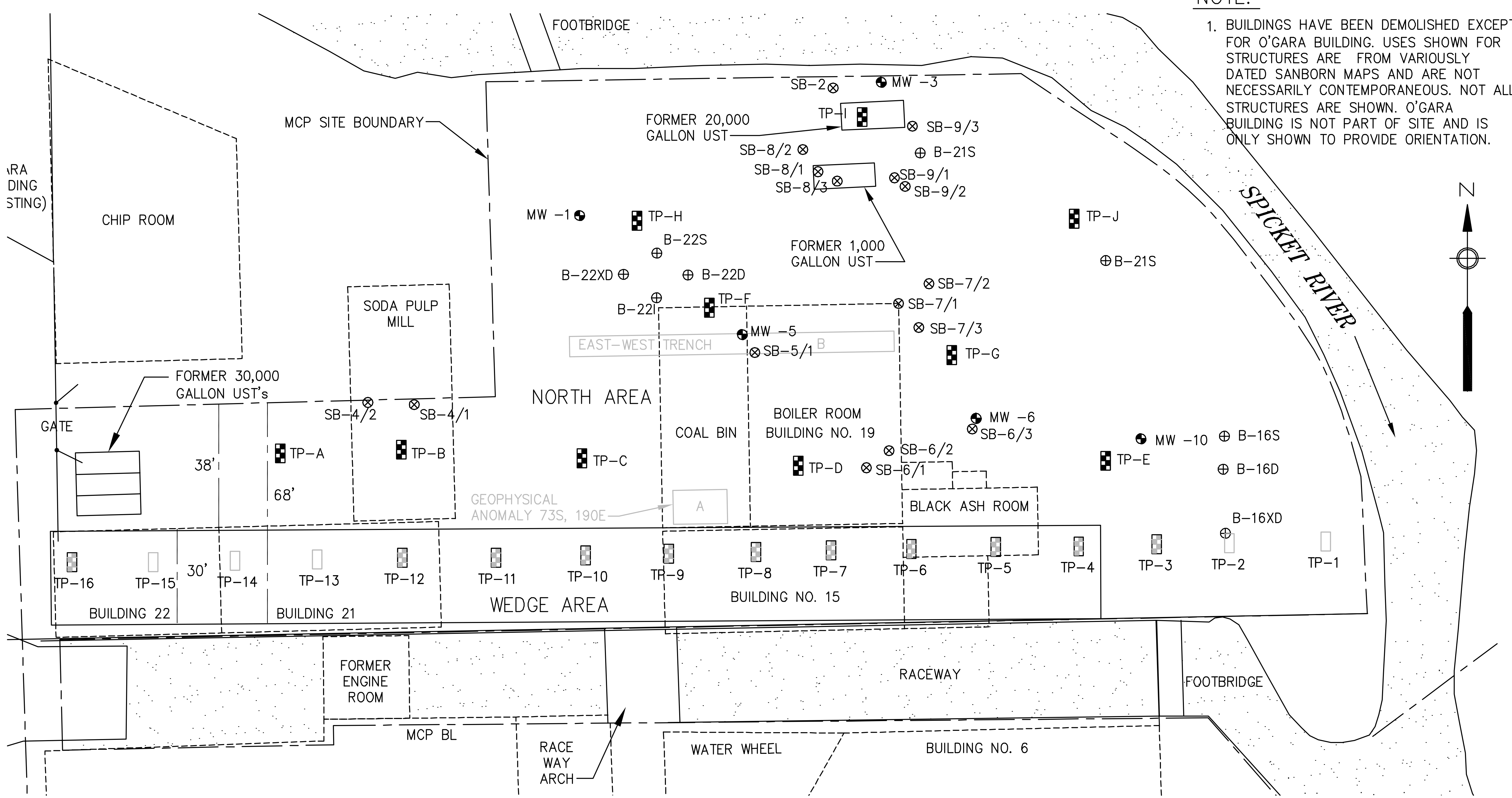


NOTE:

1. BUILDINGS HAVE BEEN DEMOLISHED EXCEPT FOR O'GARA BUILDING. USES SHOWN FOR STRUCTURES ARE FROM VARIOUSLY DATED SANBORN MAPS AND ARE NOT NECESSARILY CONTEMPORANEOUS. NOT ALL STRUCTURES ARE SHOWN. O'GARA BUILDING IS NOT PART OF SITE AND IS ONLY SHOWN TO PROVIDE ORIENTATION.

LEGEND

(dash-dot line)	MCP SITE BOUNDARY
(dashed line)	HISTORICAL STRUCTURES, DEMOLISHED
(solid line)	EXISTING BUILDING
MW–1	MONITORING WELL LOCATION
SB–7/1	SOIL BORING LOCATION (/1 FIRST ATTEMPT, /2 SECOND ATTEMPT, /3 THIRD ATTEMPT
B–16D	WELL INSTALLED BY GENCORP. (APPROXIMATE); DECOMMISSIONED
(open box)	WEDGE AREA TEST PITS NOT COMPLETED DUE TO ACM OR SLOPE
(grey box)	WEDGE AREA TEST PITS COMPLETED (2002)
(checkered box)	NORTH OF WEDGE AREA TEST PITS (2003)

0 30 60
1" = 30'
SCALE FEET

Shaw® Shaw Environmental, Inc.

SHAW ENVIRONMENTAL OXFORD PAPER MILL SITE
SUBSURFACE INVESTIGATION – LAWRENCE, MASSACHUSETTS

FIGURE 3 –
MAY 2002 & MARCH 2003 SITE INVESTIGATION TEST PIT AND BORING LOCATIONS

SCALE: AS NOTED	3/16/04	DEH	

3/17/04 L:\Hazwaste\Lawrence\figures_1_28_04\Figure3.dwg

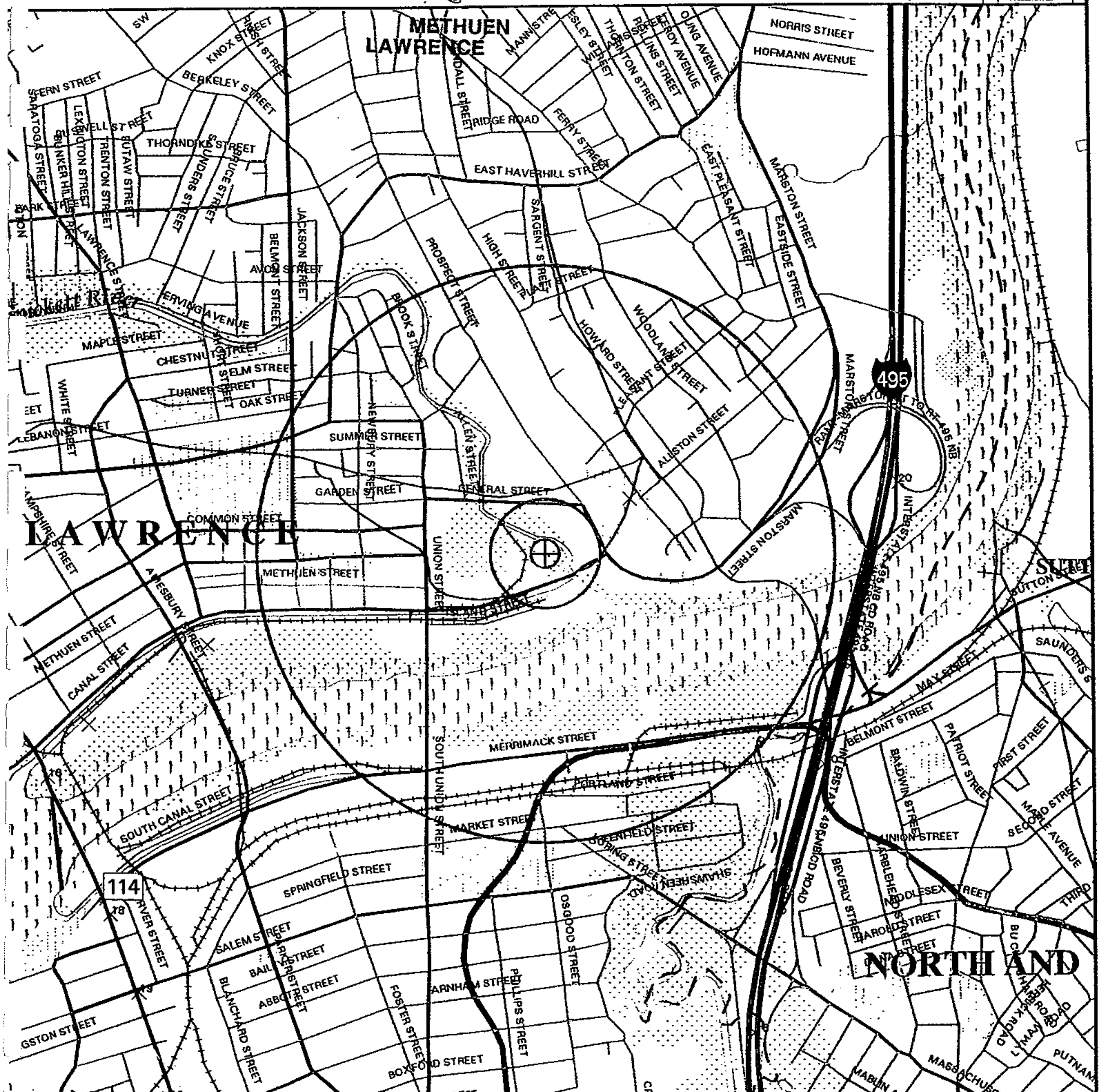
MA DEP - Bureau of Waste Site Cleanup

Site Scoring Map: 500 feet & 0.5 Mile Radii

SITE NAME:
Oxford Paper Mill
al Street
WRENCE, MA
939758n 228732ew

The information shown on this map is the best available at the date of printing. Please refer to the data source descriptions document.

MASS GIS
Massachusetts Geographic Information System
Massachusetts Executive Office of Environmental Affairs - 2003



Roads: Limited Access, Divided, Major Road, Connector, Street, Track, Trail
Boundaries: Town, County, DEP Region; Train; Powerline; Pipeline; Aqueduct
Basins: Major, Sub; Streams: Perennial, Intermittent, Man Made Shore, Dams
Potentially Productive Aquifers: Medium, High Yield
Non-Potential Drinking Water Source Area: Medium, High Yield
EPA Sole Source Aquifer; FEMA 100-year floodplain
Public Water Supplies: Ground, Surface, Non Community
Approved Zone2; IWPA; Surface Water Supply Zone A
Hydrography: Water Features, Public Surface Water Supply
Wetlands: Fresh, Salt, NHESP Wetlands Habitat
Protected Open Space; ACEC
DEP Permitted Solid Waste Facilities; Certified Vernal Pools

SCALE 1:15000

0 1/2 MILES
0 1/2 KILOMETERS 1

N E S W

May 30, 2003

NRS SCORING MAP DATA SOURCES

AQUIFERS: USGS-WRD/MassGIS, 1:48,000. Automated by MassGIS from the USGS Water Resources Div. Hydrologic Atlas series manuscripts. The definitions of high and medium yield vary among basins. Source dates 1977-1988.

SOLE SOURCE AQUIFERS: US EPA/MA DEP/MassGIS, various scales. They are defined by EPA as aquifers that are the 'sole or principal source' of drinking water for a given aquifer service area. Last updated May 1996.

NON POTENTIAL DRINKING WATER SOURCE AREAS: DEP-BWSC (Bureau of Waste Site Cleanup). Those portions of high and medium yield aquifers, which may not be considered as areas of groundwater conducive to the locations of public water supplies. Please refer to the MCP guidelines for the definitions of these areas.

DEP APPROVED ZONE II's: MA DEP, 1:25,000. As stated in 310 CMR 22.02 'that area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated.' Digitized from data provided to DEP in approved hydrologic engineering reports. Data is updated continuously.

INTERIM WELLHEAD PROTECTION AREAS: DEP-DWS (Division of Water Supply), 1:25,000. These polygons represent an interim Zone II for a groundwater source until an actual one is approved by the DEP Division of Water Supply. The radius of an IWPA varies according to the approved pumping rate. Updated in parallel with the Public Water Supplies data.

PUBLIC WATER SUPPLIES: DEP-DWS, 1:25,000. Community and non-community surface and withdrawal points were field collected using Global Positioning System receivers. The attributes were added from the DEP Division of Water Supply database. Continuously updated.

HYDROGRAPHY: USGS/MassGIS. 1:25,000 USGS Digital Line Graph (DLG) data modified by MassGIS. Approximately 40% of the data was provided by USGS and MassGIS created the remainder to USGS specifications. Source dates 1977-1997.

DRAINAGE BASINS: USGS-WRD/MassGIS, 1:24,000. Automated by MassGIS from USGS Water Resources Division manuscripts with approximately 2400 sub-basins as interpreted from 1:24,000 USGS quadrangle contour lines. 1987-1993.

WETLANDS: Umass Amherst RMP/MassGIS, 1:25,000. Includes nonforested wetlands extracted from the 1971-1991 Land Use datalayer, which was photointerpreted from summer CIR photography. Interpretation was not done in stereo. Also includes, in most areas, forested wetlands from USGS Digital Line Graph (DLG) data.

PROTECTED OPEN SPACE: EOEA (Executive Office of Environmental Affairs) MassGIS, 1:25,000. Includes federal, state, county, municipal, non-profit and protected private conservation and outdoor recreation lands. Ongoing updates.

ACECs: DEM, 1:25,000. Areas of Critical Environmental Concern are areas designated by the Secretary of EOEA as having a number of valuable environmental features coexisting. Projects in ACECs are subject to the highest standards of review and performance. Last updated October 1996.

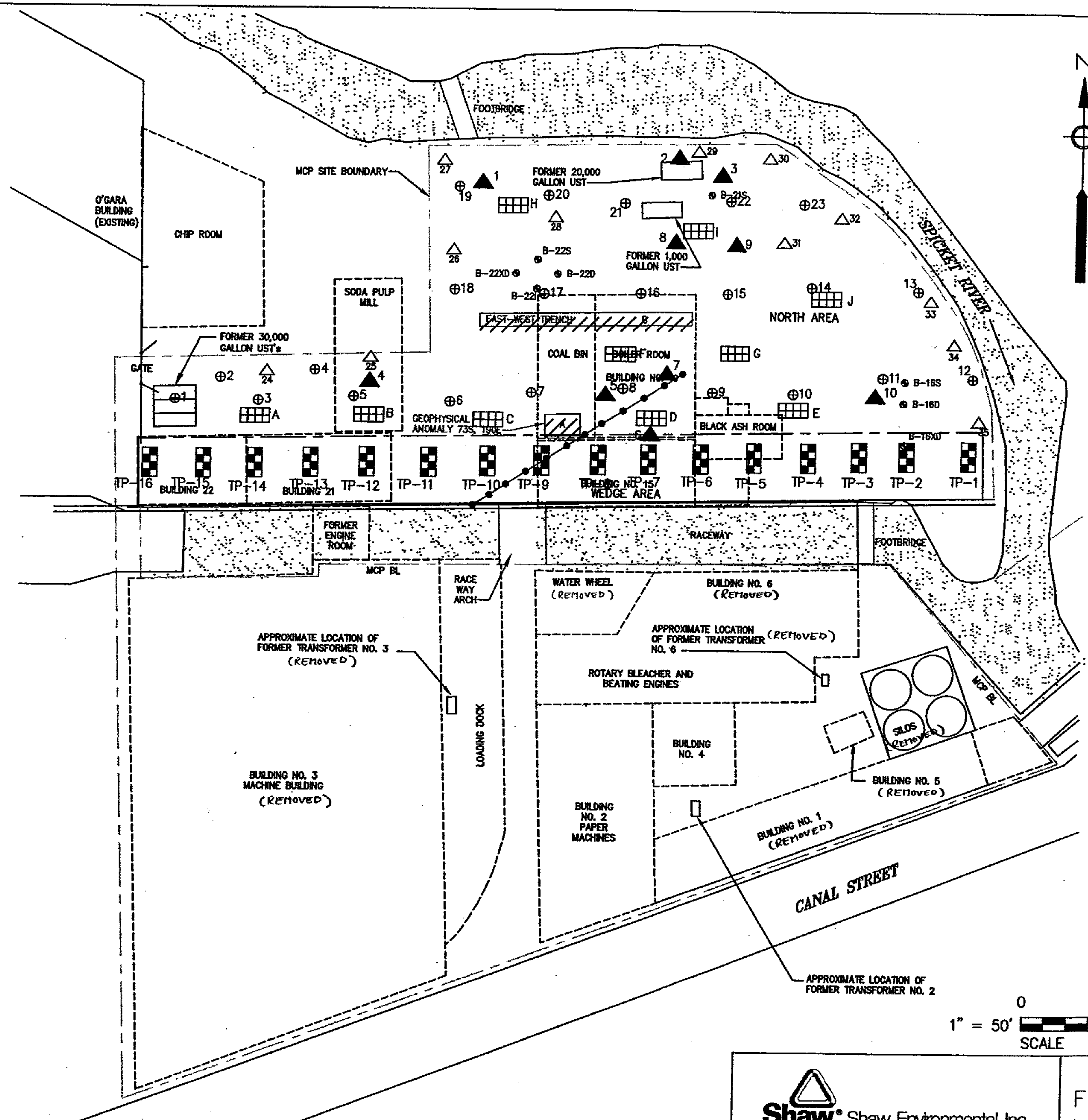
ROADS: USGS/MassGIS/MHD, 1:100,000. MassGIS extracted roads from the USGS Transportation DLG files. MA Highway Dept. updated roads through 1999. MassGIS and MA DEP GIS group further edited this layer. Numbered routes are part of the state, U.S. or Interstate highway systems.

POLITICAL BOUNDARIES: MassGIS/USGS, 1:25,000. This datalayer was digitized by MassGIS from mylar USGS quads. Source date is approximately 1985.

DEP PERMITTED SOLID WASTE FACILITIES: DEP-DSW (Division of Solid Waste), 1:25,000. Includes only facilities regulated since 1971. Data includes sanitary landfills, transfer stations and recycling or composting facilities. Facility boundaries were compiled or approximate facility point locations drafted onto USGS quadrangles and automated by the DEP Division of Solid Waste. Last updated 1997.

NHESP ESTIMATED HABITATS OF RARE WETLANDS WILDLIFE: Polygons show estimated habitats for all processed occurrences of rare wetlands wildlife. Data collected by Natural Heritage & Endangered Species Program and compiled at 1:24,000 or 1:25,000 scale. For use with Wetlands Protection Act Only. Effective 1999 - 2001.

NHESP CERTIFIED VERNAL POOLS: Points show all vernal pools certified by NHESP/MADFW (Fisheries and Wildlife) as of June 30, 1999. Data compiled at 1:24,000 or 1:25,000 scale. Effective 1999 - 2001.



LEGEND

- MCP SITE BOUNDARY
- HISTORICAL STRUCTURES, DEMOLISHED
- EXISTING BUILDING
- GEOPHYSICAL SURVEY GRID
- B-16 — WELL INSTALLED BY GENCORP. (APPROXIMATE); DECOMMISSIONED
- TP-3 — TEST PIT LOCATION
- TP-1 — PROPOSED TEST PIT; NOT PERFORMEED
- TEST TRENCH
- POSSIBLE BURIED UTILITY IDENTIFIED IN GEOPHYSICAL INVESTIGATION.
- 1 — PROPOSED SOIL BORING (10 TOTAL) COMPLETE UP TO 5 AS MONITORING WELLS.
- A — TEST PITS: CONDUCT UP TO 10 PITS TO INSPECT FOR FILL, POSSIBLE ACM, COAL, AND COAL ASH, PRIOR TO BORING INSTALLATION.
- 11 — ACM SAMPLING LOCATION (NOVEMBER 2002)
- 34 — ACM SAMPLING LOCATION (AUGUST 2003)

NOTE:

1. BUILDINGS HAVE BEEN DEMOLISHED EXCEPT FOR O'GARA BUILDING. USES SHOWN FOR STRUCTURES ARE FROM VARIOUSLY DATED SANBORN MAPS AND ARE NOT NECESSARILY CONTEMPORANEOUS. NOT ALL STRUCTURES ARE SHOWN. O'GARA BUILDING IS NOT PART OF SITE AND IS ONLY SHOWN TO PROVIDE ORIENTATION.

1" = 50' SCALE 0 50 100 150 FEET

Shaw® Shaw Environmental, Inc.

OXFORD PAPER MILLS, LAWRENCE, MA

FIGURE 5 – ASBESTOS SOIL SAMPLING LOCATIONS (NOV. 2002 / AUG. 2003)

SCALE:	1"=50'	3/16/04	DEH

3/17/04 L:\Hazwaste\Lawrence\figure_1_28_04\figure_6

TABLES

Table 2-1 - November 2002/August 2003 ACM Soil Sampling Events Results - North Area

Sample Number*	Reported Value (%)
1	Not Detected
2	Not Detected
3	Less than 1.0
4	1.3
5	Not Detected
6	1.2
7	1.8
8	Less than 1.0
9	Not Detected
10	1.3
11	Not Detected
12	Not Detected
13	Not Detected
14	Less than 1.0
15	Less than 1.0
16	1.3
17	Less than 1.0
18	1.4
19	Not Detected
20	1.3
21	Not Detected
22	1.3
23	Not Detected
24	Less than 1.0
25	Not Detected
26	Less than 1.0
27	Less than 1.0
28	2.9
29	Less than 1.0
30	Less than 1.0
31	1.5
32	Less than 1.0
33	Not Detected
34	Not Detected
35	Less than 1.0

* Refer to Figure 5 for the corresponding asbestos sampling locations (November 2002/August 2003)

Table 2-2. Oxford Paper Mill Site: Mobile Lab and Fixed Lab Analytical Results: PCBs

Pit	Horizon	Mobile Laboratory Results PCBs (mg/kg wet weight)				OEME Fixed Laboratory Results PCBs (mg/kg dry weight)					Mobile Laboratory Results PCBs (mg/kg dry weight)*				Relative Percent Difference for Detections** Mobile and OEME Fixed Labs			
		Aroclor 1254	Aroclor 1242	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1242	Aroclor 1260	Aroclor 1248	Percent Solids	Aroclor 1254	Aroclor 1242	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1242	Aroclor 1260	Aroclor 1248
3	A	1 U	2 U	0.5 U	5-6 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	KA	1 U	2 U	0.5 U	5-6 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	1 U	2 U	0.5 U	5-6 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	C	1 U	1 U	0.5 U	2 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	D	1 U	1 U	0.5 U	2 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	E	0.6	1 U	0.5 U	2-4 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	F	1 U	1 U	0.5 U	2 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	G	1 U	1 U	0.5 U	2 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	H	1 U	1 U	0.5 U	2 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
4	A	1 U	1 U	0.5 U	3-4 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	0.9	1 U	0.5 U	3-4 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	C	2.8	1 U	0.5 U	5-7 PD	**1.5**	0.4 U	0.4 U	0.4 U	78	**3.6**	0.5 U	0.5 U	6-9 PD	**82**	NC	NC	NC
	KC	–	–	–	–	**1.7**	0.4 U	0.4 U	0.4 U	82	–	–	–	–	**71**	NC	NC	NC
5	A	2 U	3 U	0.5 U	6-8 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	KA	2 U	3 U	0.5 U	8-10 PD	1.3	1.0 U	1.0 U	1.0 U	84	2 U	4 U	0.6 U	9-12 PD	NC	NC	NC	NC
6	A	1.5 U	2 U	0.5 U	7-8 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	1.5 U	8 U	0.5 U	10-15 PD	1.2	0.9 U	0.9 U	0.9 U	84	1.8 U	10 U	0.6 U	12-18 PD	NC	NC	NC	NC
	C	1.5 U	4 U	0.5 U	8-10 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	D	2 U	2 U	0.5 U	4-5 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	E	2 U	4 U	0.5 U	5-8 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
7	A	1 U	2 U	0.5 U	3-4 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	2 U	5 U	0.5 U	8-10 PD	1.1	1.1 U	1.1 U	1.1 U	75	3 U	7 U	0.7 U	11-13 PD	NC	NC	NC	NC
	C	2 U	2 U	0.5 U	8-10 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	D	2 U	3 U	0.5 U	10-15 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	E	2 U	3 U	0.5 U	10-15 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
8	A	1 U	2 U	0.5 U	2-3 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	C	2 U	2 U	0.5 U	4-5 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	D	2 U	4 U	0.5 U	8-10 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	E	3 U	5 U	0.5 U	8-10 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	F	3 U	5 U	0.5 U	8-10 PD	2.7	1.0 U	1.0 U	1.0 U	74	4 U	7 U	0.7 U	11-14 PD	NC	NC	NC	NC
	G	2 U	2 U	0.5 U	4-5 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
10	A	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	2 U	2 U	0.5 U	3-4 PD	0.40	0.4 U	0.4 U	0.4 U	86	2 U	2 U	0.6 U	3-5 PD	NC	NC	NC	NC
	C	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	KC	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	D	3 U	5 U	0.5 U	10-12 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	E	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	F	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	G	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	H	10 U	10 U	0.5 U	12 U	0.1 U	0.1 U	0.1 U	0.1 U	85	12 U	12 U	0.6 U	14 U	NC	NC	NC	NC
11	A	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	2.1	4 U	0.5 U	8-10 PD	**0.72**	0.9 U	0.9 U	0.9 U	85	**2.5**	5 U	0.6 U	9-12 PD	**110**	NC	NC	NC
	C	2 U	2 U	2.5	2-3 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	D	3 U	4 U	0.5 U	6-8 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	E	2 U	2 U	0.5 U	3-4 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	F	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
12	A	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	1 U	1 U	0.5 U	1 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	C	1 U	1 U	0.5 U	2 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC

Table 2-2. Oxford Paper Mill Site: Mobile Lab and Fixed Lab Analytical Results: PCBs

Pit	Horizon	Mobile Laboratory Results PCBs (mg/kg wet weight)				OEME Fixed Laboratory Results PCBs (mg/kg dry weight)					Mobile Laboratory Results PCBs (mg/kg dry weight)*				Relative Percent Difference for Detections** Mobile and OEME Fixed Labs			
		Aroclor 1254	Aroclor 1242	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1242	Aroclor 1260	Aroclor 1248	Percent Solids	Aroclor 1254	Aroclor 1242	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1242	Aroclor 1260	Aroclor 1248
	D	1 U	1 U	0.5 U	2 U	0.13	0.1 U	0.1 U	0.12	87	1 U	1 U	0.6 U	2 U	NC	NC	NC	NC
	E	1 U	1 U	0.5 U	2 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	F	1 U	1 U	0.5 U	2 U	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	G	1 U	1 U	0.5 U	4-5 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	H	3.1	5 U	0.5 U	10 U	**16**	2.3 U	2.3 U	2.3 U	81	**3.8**	6 U	0.6 U	12 U	**-123**	NC	NC	NC
14	A	1 U	1 U	0.5 U	4-5 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	1 U	2 U	0.5 U	2-3 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	C	2 U	6 J	0.5 U	4-5 PD	0.5 U	0.5 U	0.5 U	**6.0**	86	2 U	7 J	0.6 U	**5-6 PD**	NC	NC	NC	**0 to 18**
	D	1 U	1 U	0.5 U	1-2 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	E	1 U	1 U	0.5 U	1-2 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	F	1 U	1 U	0.5 U	2-3 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	G	1 U	2 U	0.5 U	2-3 PD	0.37	0.2 U	0.2 U	**0.44**	83	1 U	2 U	0.6 U	**2-4 PD**	NC	NC	NC	**130 to 160**
16	A	1 U	1 U	0.5 U	1-2 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	B	1 U	2 U	0.5 U	2-3 PD	0.58	0.2 U	0.2 U	**1.2**	86	1 U	2 U	0.6 U	**2-3 PD**	NC	NC	NC	**50 to 86**
	C	1 U	2 U	0.5 U	2-3 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC
	D	1 U	2 U	0.5 U	2-3 PD	–	–	–	–	–	–	–	–	–	NC	NC	NC	NC

NOTES:

*	Mobile laboratory results were converted to dry weight basis using the corresponding percent solids for that sample reported by the fixed laboratory. The calculated dry weight value was rounded to the same number of significant figures as the wet weight mobile laboratory result.
**	Relative percent difference between mobile laboratory result (after conversion to dry weight basis) and fixed laboratory result. RPD only calculated when both mobile laboratory and fixed laboratory reported a detection for a particular Aroclor. When the mobile laboratory reported a range, a range of RPDs was calculated.
NC	Relative percent difference not calculated, either due to non-detects, or no corresponding fixed laboratory sample analysis.
–	Sample not submitted for this analysis, or conversion to dry weight not possible due to no corresponding fixed laboratory analysis.
U	Not detected; value is the reporting limit
PD	Partially degraded
BOLD	Value is used to calculate RPD, or is an RPD value.

Table 2-3. Oxford Paper Mill Site: Asbestos Analytical Results

Pit	Horizon	Asbestos			
		Estimated Volume Percent			
		Chrysotile	Amosite	Crocidolite	Total Asbestos
3	A	--	--	--	--
	KA	--	--	--	--
	B	--	--	--	--
	C	--	--	--	--
	D	--	--	--	--
	E	--	--	--	--
	F	--	--	--	--
	G	--	--	--	--
	H	--	--	--	--
	AB Composite	1	<1	2	3
4	A	--	--	--	--
	B	--	--	--	--
	C	--	--	--	--
	AC Composite	4	<1	2	6
5	A	2	1	2	5
	KA	--	--	--	--
6	A	--	--	--	--
	B	--	--	--	--
	C	5	1	2	8
	D	4	1	3	8
	E	2	3	2	7
	AB Composite	3	1	3	7
7	A	--	--	--	--
	B	--	--	--	--
	B (Bulk)	3	30	ND	33
	C	--	--	--	--
	D	--	--	--	--
	E	--	--	--	--
8	A	--	--	--	--
	B	--	--	--	--
	C	--	--	--	--
	D	--	--	--	--
	E	--	--	--	--
	F	--	--	--	--
	G	--	--	--	--
10	A	--	--	--	--
	B	--	--	--	--
	C	--	--	--	--
	KC	--	--	--	--
	D	--	--	--	--
	E	--	--	--	--
	F	--	--	--	--
	G	--	--	--	--
	H	--	--	--	--
11	A	--	--	--	--
	B	--	--	--	--
	C	--	--	--	--
	D	--	--	--	--
	E	--	--	--	--
	F	--	--	--	--
	AC Composite	<1	<1	<1	<1
	DF Composite	3	ND	<1	3
12	A	--	--	--	--
	B	--	--	--	--
	C	<1	<1	<1	<1
	D	<1	<1	ND	<1
	E	<1	ND	<1	<1
	F	<1	<1	<1	<1
	G	<1	<1	<1	<1
	H	<1	<1	<1	<1
	AB Composite	ND	ND	ND	ND
14	A	--	--	--	--
	B	--	--	--	--
	C	<1	ND	ND	<1
	D	<1	<1	ND	<1
	E	<1	<1	ND	<1
	F	<1	<1	ND	<1
	G	<1	<1	<1	<1
	AB Composite	<1	1	<1	1
16	A	--	--	--	--
	B	--	--	--	--
	C	--	--	--	--
	D	--	--	--	--
	AD Composite	<1	<1	ND	<1
	E (Bulk)	ND	ND	ND	0

Notes:

KA = field duplicate

Bulk = sample of bulk suspect ACM, not soil

<1 = ACM present, but concentration is less than 1 percent

ND = not detected

-- = not sampled for ACM

Table 2-4. Summary Of Analytical Data For Composite Samples Analyzed By Woods Hole Group -- Soil
TBA Investigation -- Former Oxford Paper Mill -- May 2002

LOCATION NAME	4S	4D	6S	6D	8S	8D	10S	10D	K10D	12S	12D	14S	14D	MCP Reportable Concentrations **
APPROXIMATE SAMPLE DEPTH (ft bgs)	0 - 3	3 - 5	0 - 3	3 - 9	0 - 3	3 - 13	0 - 3	3 - 15		0 - 3	3 - 15	0 - 3	3 - 13	
M&E SAMPLE ID	4S	4D	4S	6D	8S	8D	10S	10D	K10D	12S	12D	14S	14D	
DATE SAMPLED	5/13/02	5/13/02	5/13/02	5/13/02	5/13/02	5/13/02	5/14/02	5/14/02	5/14/02	5/14/02	5/14/02	5/14/02	5/14/02	
COMMENTS									Duplicate					RCS-1
EXTRACTABLE PETROLEUM HYDROCARBONS - MADEP-EPH-98-1 (ug/kg)														
C_9-C_{18} Aliphatics (1)	3,700 U	3,800 U	3,700 U	4,000 U	4,200 U	15,000	3,500 U	3,600 U	3,600 U	3,300 U	3,400 U	3,600 U	3,500 U	1,000,000
C_{19}-C_{36} Aliphatics (1)	5,200	34,000	57,000	82,000	9,000	65,000	43,000	14,000 J	4,800 UJ	4,300 U	11,000	12,000	35,000	2,500,000
C_{11}-C_{22} Aromatics (1)	240,000	360,000	460,000	320,000	51,000	250,000	74,000	35,000 J	60,000 J	16,000	90,000	260,000	97,000	200,000
Acenaphthene	1,600	6,200	6400	5100	700 U	1000	700	590 U	780 J	540 U	1200	4200	1500	20,000
Acenaphthylene	620 U	1,300 U	1,200 U	660 U	700 U	660 U	580 U	590 U	600 U	540 U	560 U	590 U	580 U	100,000
Anthracene	4,100	11,000	14,000	9,200	1,000	4,300	1,300	930 J	1,900 J	540 U	2,400	7,800	2,900	1,000,000
Benzo(a)anthracene	16,000	29,000	35,000	21,000	2,900	17,000	2,700	1,900 J	4,300 J	540 U	5,400	16,000	5,700	700
Benzo(a)pyrene	14,000	21,000	24,000	16,000	2,400	13,000	2,600	1,800 J	3,500 J	540 U	4,700	13,000	4,700	700
Benzo(b)fluoranthene	17,000	27,000	35,000	23,000	2,300	22,000	2,700	2,000 J	4,500 J	540 U	5,700	17,000	5,300	700
Benzo(g,h,i)perylene	8,500	14,000	13,000	10,000	1,400	7,400	1,500	1,000 J	2,200	540 U	3,000	7,200	2,700	1,000,000
Benzo(k)fluoranthene	9,000	16,000	12,000	8,800	2,300	5,500	2,100	1,300 J	1,500	540 U	2,800	6,500	2,900	7,000
Chrysene	18,000	28,000	38,000	24,000	3,100	18,000	3,100	2,500 J	4,400 J	660	5,700	16,000	5,700	7,000
Dibenzo(a,h)anthracene	13,000	21,000	22,000	16,000	2,300	12,000	2,500	1,900 J	3,300 J	690	4,400	11,000	4,100	700
Fluoranthene	30,000	56,000	74,000	44,000	5,600	28,000	6,300	3,700 J	7,900 J	1,000	12,000	33,000	13,000	1,000,000
Fluorene	1,600	5,100	6,300	4,500	700 U	840	650	590 U	800 J	540 U	1,200	4,600	1,500	400,000
Indeno(1,2,3-cd)pyrene	13,000	21,000	22,000	16,000	2,300	12,000	2,500	1,900 J	3,300 J	690	4,400	11,000	4,100	700
Naphthalene	620 UJ	2,400 J	2,000 J	1,300 J	700 UJ	1,300 J	580 UJ	590 UJ	600 UJ	540 UJ	690 J	2,000 J	800 J	4,000
Phenanthrene	17,000	41,000	58,000	38,000	3,400	20,000	4,400	2,700 J	5,800 J	660	8,000	32,000	9,900	100,000
Pyrene	30,000	56,000	73,000	44,000	5,500	29,000	6,200	3,600 J	7,500 J	1,000	12,000	33,000	12,000	700,000
2-Methylnapthalene	620 U	1,500	1400	980	700 U	790	580 U	590 U	600 U	540 U	560 U	1100	580 U	4,000
Total Target PAHs (mg/kg)***	194	357	437	282	36	192	40	27	53	8	74	216	77	
INORGANICS - Priority Pollutant Metals Plus Barium and Vanadium (mg/Kg)														
Antimony	0.77 J	1.0 J	1.6 J	3.8 J	0.34 J	0.58 J	0.39 J	0.33 J	0.62 J	0.22 J	0.56 J	0.89 J	3.0 J	10
Arsenic	43 J	97 J	120 J	84 J	8.4 J	4.4 J	10 J	15 J	7.7 J	9.3 J	13 J	6.6 J	7.5 J	30
Barium	130	180	150	170	16	300	45	29	39	36	79	140	71	1,000
Beryllium	0.48	0.55	0.62	1.0	0.14	0.52	0.34	0.44	0.59	0.34	0.33	0.28	0.32	0.7
Chromium	32	43	46	50	6.8	13	15	18	19	26	21	27	20	1,000
Cadmium	2.5	2.3	1.9	1.6	0.16	0.79	0.24	0.13	0.14	0.24	0.52	0.81	0.82	30
Copper	54	85	91	72	12	140	36	32	.33	14	30	36	37	1,000
Lead	180	250	230	210	28	140	49	44	52	26	65	53	70	300
Mercury	2.0	3.2	5.3	17	0.85	1.6	0.14	0.11	0.11	0.073	0.25	0.23	0.59	20
Nickel	79	86	130	83	26	18	14	16	19	19	25	28	19	300
Selenium	0.41 U	0.82	0.76	0.54 U	0.47 U	0.11 UJ	0.22 UJ	0.40 U	0.37 U	0.22 U	0.20 UJ	0.26 U	0.23 U	400
Silver	0.25	0.18	0.33	0.89	0.11	0.13	0.090	0.071	0.095	0.040	0.079	0.065	0.11	100
Thallium	0.46	0.71	1.3	1.0	0.063	0.11	0.11	0.11	0.13	0.16	0.14	0.097	0.14	8
Vanadium	350	330	520	360	80	27	36	51	83	21	80	20	27	400
Zinc	390	560	300	450	35	300	75	65	75	38	100	130	91	2,500
TCLP METALS (ug/L)														**TCLP Regulatory Level (ug/L)**
Arsenic	94 J	130 J	220	250	29 J	27 U	27 U	27 U	27 U	27 U	28 J	29 J	27 U	5,000
Barium	440 U	120 UJ	70 UJ	120 UJ	180 UJ	450 U	430 U	360 U	270 U	480 U	460 U	890	630 U	100,000
Cadmium	13	2.0 U	2.0 U	4.2 J	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.4 J	7.5 J	16	15	1,000
Chromium	11 J	11 J	9.8 U	15 J	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	10 J	13 J	9.8 U	5,000
Lead	29 U	29 U	29 U	29 U	29 U	230	33 UJ	42 UJ	29 U	65 UJ	31 UJ	91 UJ	72 UJ	5,000
Mercury	0.27 U	0.12 U	0.12 U	0.50	0.27 U	0.27 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	200
Selenium	120 U	41 U	54 UJ	52 UJ	120 U	120 U	41 U	41 UJ	41 U	41 U	64 UJ	41 U	41 U	1,000
Silver	150 J	20 J	20 J	29	170 J	160 J	42	27	25	1.9 U	46	34	17 J	5,000
REACTIVE SULFIDE														
None Detected														
LAB SAMPLE ID														
All Parameters	4S	4D	6S	6D	8S	8D	10S	10D	K10D	12S	12D	14S	14D	

TABLE 2-4 NOTES:

1. Hydrocarbon ranges are adjusted to exclude the concentration of target and QC (surrogate) analytes.

** - Values shown for standards are in the same units as the analytical data.

*** - Total Target PAHs calculated by summing all detected concentrations, and including one-half the detection limit for target PAHs that were not detected. Note that units are mg/kg (not ug/kg, as for individual analytes).

MADEP Criteria

MCP Reportable Concentrations, 310 CMR 40.0000 Subpart P Massachusetts Oil and Hazardous Material List

"--" indicates no MCP Reportable Concentration available

The MCP reportable concentrations are shown for comparison purposes only.

ft bgs - feet below ground surface

FD - Indicates Field Duplicate

J - Quantitation is approximate due to limitations identified in the quality control review.

U - Analyte was not detected. Value reported is the sample-specific detection limit.

UJ - Sample-specific detection limit is approximate due to limitations identified in the quality control review.

Bold - indicates value greater than applicable MCP reportable concentration

Table 2-5. Oxford Paper Mill Site: Mobile Lab and Fixed Lab Analytical Results: Selected Metals

Pit	Horizon	Mobile Laboratory			OEME Fixed Laboratory				Relative Percent Difference for Detections*		
		Metals by XRF (mg/kg, wet weight)			Metals (mg/kg, dry weight)						
		Lead	Arsenic	Chromium	Lead	Arsenic	Chromium	Percent Solids	Lead	Arsenic	Chromium
3	A	108	<60	<140	--	--	--	--	--	--	--
4	A	241	136	653	260	86	44	NR	-8	45	175
4	LA	213	107	200	--	--	--	--	-20	22	128
5	A	253	124	525	300	94	50	NR	-17	28	165
6	A	318	146	361	330	140	66	NR	-4	4	138
6	KA	--	--	--	290	130	60	NR	--	--	--
7	A	126	75	508	170	93	63	NR	-30	-21	156
7	LA	136	58	516	--	--	--	--	-22	-46	156
8	A	60	<60	<120	--	--	--	--	--	--	--
10	A	<40	<60	<130	16	<41	15	NR	--	--	--
10	LA	<40	<60	<100	--	--	--	--	--	--	--
11	A	<40	<60	<110	--	--	--	--	--	--	--
11	LA	<40	<60	<120	--	--	--	--	--	--	--
12	A	40	<60	<120	--	--	--	--	--	--	--
14	A	67	<60	<150	79	<42	25	NR	-16	--	--
16	A	44	<60	<160	--	--	--	--	--	--	--

NOTES:

K = field duplicate

L = lab duplicate

NR = not reported by fixed laboratory

* = Relative percent difference between mobile lab value (wet weight) and fixed lab value (dry weight). Conversion of mobile lab results to dry weight not possible at this time, because the fixed lab did not formally report the percent solids for each sample. RPDs only calculated when the metal was detected by both the mobile lab and the fixed lab.

-- = Analysis was not performed.

Table 2-6. Summary Of Analytical Data For Surface And Subsurface Soil
Former Oxford Paper Mill – March 2003

LOCATION NAME	SB-1/0-1	SB-1/5-7	SB-1/17-19	SB-2/0-1	SB-2/7-9	SB-2/11-13	SB-3/0-1	SB-3/7-9	SB-3/13-15
APPROXIMATE SAMPLE DEPTH (ft bgs)	0-1	5-7	17-19	0-1	7-9	11-13	0-1	7-9	13-15
M&E SAMPLE ID	SB-1/0-1	SB-1/5-7	SB-1/17-19	SB-2/0-1	SB-2/7-9	SB-2/11-13	SB-3/0-1	SB-3/7-9	SB-3/13-15
DATE RECEIVED BY LAB:	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03
COMMENTS									
PARAMETER/ANALYTE									
PCBs - EPA SW-846 Method 8082 (ug/kg)									
Aroclor-1016	38 U	42 U	41 U	44 U	39 U	36 U	41 U	39 U	40 U
Aroclor-1221	38 U	42 U	41 U	44 U	39 U	36 U	41 U	39 U	40 U
Aroclor-1232	38 U	42 U	41 U	44 U	39 U	36 U	41 U	39 U	40 U
Aroclor-1242	38 U	42 U	41 U	44 U	39 U	36 U	41 U	39 U	40 U
Aroclor-1248	38 U	42 U	41 U	44 U	39 U	36 U	41 U	39 U	40 U
Aroclor-1254	1800 J	42 U	41 U	44 UJ	39 UJ	36 U	95	44	40 UJ
Aroclor-1260	38 UJ	42 UJ	41 UJ	44 UJ	39 UJ	36 UJ	41 UJ	39 UJ	40 UJ
EXTRACTABLE PETROLEUM HYDROCARBONS - MADEP-EPH-98-1 (ug/kg)									
C_9-C_{18} Aliphatics (1)	15,000	3,500 U	5,800	4,700	3,400 U	18,000	4,300	3,400 U	3,400 U
C_{19}-C_{36} Aliphatics (1)	150,000	5,500	9,400	38,000	13,000	23,000	270,000	4,500 U	14,000
C_{11}-C_{22} Aromatics (1)	120,000	51,000	25,000	49,000	34,000	52,000	110,000	15,000	9,800 U
Acenaphthene	1,400 U	590 U	600 U	650 U	570 U	520 U	580 U	560 U	580 U
Acenaphthylene	1,400 U	590 U	600 U	650 U	570 U	520 U	580 U	560 U	580 U
Anthracene	1,400 U	590 U	600 U	650 U	570 U	520 U	580	560 U	580 U
Benzo(a)anthracene	2,200	820	600 U	1,300	1,200	710	1,300	560 U	580 U
Benzo(a)pyrene	1,700	590	600 U	1,100	940	520 U	950	560 U	580 U
Benzo(b)fluoranthene	2,700	920	600 U	1,800	1,500	800	1,700	560 U	580 U
Benzo(g,h,i)perylene	1,400 U	590 U	600 U	650 U	570 U	520 U	580 U	560 U	580 U
Benzo(k)fluoranthene	1,400 U	590 U	600 U	820	610	520 U	640	560 U	580 U
Chrysene	2,300	880	600 U	1,400	1,300	760	1,400	560 U	580 U
Dibenzo(a,h)anthracene	1,400 U	590 U	600 U	650 U	570 U	520 U	580 U	560 U	580 U
Fluoranthene	4,900	1,800	600 U	2,700	2,700	1,800	2,800	740	580 U
Fluorene	1,400 U	590 U	600 U	650 U	570 U	520 U	580 U	560 U	580 U
Indeno(1,2,3-cd)pyrene	1,400 U	590 U	600 U	650 U	570 U	520 U	580 U	560 U	580 U
Naphthalene	1,400 U	590 U	600 U	650 U	570 U	520 U	740	560 U	580 U
Phenanthrene	3,700	1,400	600 U	1,500	1,600	1,000	1,800	560 U	580 U
Pyrene	4,500	1,700	600 U	2,600	2,500	1,500	2,600	630	580 U
2-Methylnaphthalene	1,400 U	590 U	600 U	650 U	570 U	520 U	580 U	560 U	580 U
Priority Pollutant Metals Plus Barium and Vanadium (mg/Kg)									
Antimony	8.8 J	2.1 UJ	0.25 UJ	0.81 UJ	0.72 UJ	0.41 UJ	1.4 UJ	0.36 UJ	0.17 UJ
Arsenic	9.3 J	9.5 J	2.3 J	19.6 J	18.9 J	7.0 J	14.8 J	13.2 J	2.5 J
Barium	68.4 J	47.8 J	9.8 J	67.2 J	42.8 J	25.8 J	52.1 J	42.7 J	12.9 J
Beryllium	0.98	0.83	0.44	0.73	0.75	0.44	0.75	0.58	0.54
Cadmium	1.2	0.46 U	0.080 UJ	0.40 U	0.31 U	0.16 UJ	0.39 U	0.23 UJ	0.085 UJ
Chromium	25.2	20.4	13.5	16.4	15.2	10.9	15.4	11.2	13.3
Copper	37.3 J	49.8 J	4.8 J	30.1 J	32.5 J	21.4 J	45.9 J	12.4 J	2.8 UJ
Lead	1970 J	208 J	3.5 J	87.2 J	163 J	30.0 J	142 J	28.5 J	2.4 J
Mercury	0.53	0.21	0.018 U	1.1	0.31	0.29	0.92	0.18	0.016 U
Nickel	22.7 J	11.8 J	9.4 J	41.1 J	23.9 J	15.2 J	36.2 J	27.3 J	10.3 J
Selenium	0.45 U	0.53 U	0.48 U	0.54 U	0.54 J	0.48 U	0.47 U	0.53 J	0.46 U
Silver	0.87 J	0.33 UJ	0.28 UJ	0.12 U	0.10 U	0.11 U	0.11 U	0.12 U	0.16 UJ
Thallium	1.0 UJ	1.2 UJ	1.1 UJ	1.2 U	1.0 UJ	1.1 U	1.08 UJ	1.2 U	1.0 UJ
Vanadium	30.7 J	14.4 J	7.7 J	148 J	95.2 J	45.0 J	128 J	90.1 J	26.1 J
Zinc	79.2 J	115 J	25.2 J	66.7 J	37.1 J	25.4 J	65.5 J	23.8 J	14.5 J
LAB SAMPLE ID									
PCBs	B0417-01A	B0417-02A	B0417-03A	B0417-07A	B0417-08A	B0417-09A	B0417-04A	B0417-05A	B0417-06A
EPH	B0417-01A	B0417-02A	B0417-03A	B0417-07A	B0417-08A	B0417-09A	B0417-04A	B0417-05A	B0417-06A
Priority Pollutant Metals plus Ba and V	B0417-01A	B0417-02A	B0417-03A	B0417-07A	B0417-08A	B0417-09A	B0417-04A	B0417-05A	B0417-06A

LOCATION NAME	SB-4/0-1	SB-4/5-7	SB-4/13-15	SB-5/0-1	SB-5/9-11	SB-5/14-16	SB-6/0-1	SB-6/5-7	MCP Reportable Concentrations **	MADEP Background Concentrations **	
APPROXIMATE SAMPLE DEPTH (ft bgs)	0-1	5-7	13-15	0-1	9-11	14-16	0-1	5-7			
M&E SAMPLE ID	SB-4/0-1	SB-4/5-7	SB-4/13-15	SB-5/0-1	SB-5/9-11	SB-5/14-16	SB-6/0-1	SB-6/5-7			
DATE RECEIVED BY LAB:	3/17/03	3/17/03	3/17/03	3/14/03	3/14/03	3/14/03	3/14/03	3/14/03	RCS-1	"Natural Soil"	"Soil Containing Fill Material"
COMMENTS											
PARAMETER/ANALYTE											
PCBs - EPA SW-846 Method 8082 (ug/kg)											
Aroclor-1016	44 U	36 U	44 U	42 U	39 U	42 U	42 U	40 U	2,000	--	--
Aroclor-1221	44 U	36 U	44 U	42 U	39 U	42 U	42 U	40 U	2,000	--	--
Aroclor-1232	44 U	36 U	44 U	42 U	39 U	42 U	42 U	40 U	2,000	--	--
Aroclor-1242	44 U	36 U	44 U	42 U	39 U	42 U	42 U	40 U	2,000	--	--
Aroclor-1248	44 U	36 U	44 U	42 U	39 U	42 U	42 U	40 U	2,000	--	--
Aroclor-1254	71	140	44 U	88	39 U	42 U	210	680	2,000	--	--
Aroclor-1260	44 U	36 U	44 U	42 U	39 U	42 U	42 U	40 U	2,000	--	--
EXTRACTABLE PETROLEUM HYDROCARBONS - MADEP-EPH-98-1 (ug/kg)											
C_9-C_{18} Aliphatics (1)	11,000	8,500	13,000 J	9,100	7,800	11,000	9,500 J	7,900 J	1,000,000	--	--
C_{19}-C_{36} Aliphatics (1)	66,000	49,000	14,000	10,000	4,700 U	5,000 U	180,000 J	46,000 J	2,500,000	--	--
C_{11}-C_{22} Aromatics (1)	110,000	160,000	11,000 U	65,000	32,000	19,000	400,000 J	220,000 J	200,000	--	--
Acenaphthene	670 U	1,400	650 U	640 U	590 U	630 U	2,900 J	4,100 J	20,000	500	2,000
Acenaphthylene	670 U	550 U	650 U	640 U	590 U	630 U	640 UJ	590 UJ	100,000	500	1,000
Anthracene	880	3,500	650 U	1,200	590 U	630 U	6,900 J	8,100 J	1,000,000	1,000	4,000
Benzo(a)anthracene	2,000	6,500	650 U	2,400	890	630 U	21,000 J	14,000 J	700	2,000	9,000
Benzo(a)pyrene	1,500	4,700	650 U	1,800	620	630 U	16,000 J	9,200 J	700	2,000	7,000
Benzo(b)fluoranthene	2,500	7,700	650 U	3,000	1,000	630 U	27,000 J	16,000 J	700	2,000	8,000
Benzo(g,h,i)perylene	670 U	2,200	650 U	640 U	590 U	630 U	8,000 J	4,400 J	1,000,000	1,000	3,000
Benzo(k)fluoranthene	960	2,700	650 U	1,200	590 U	630 U	8,900 J	5,400 J	7,000	1,000	4,000
Chrysene	1,900	6,300	650 U	2,400	900	630 U	20,000 J	15,000 J	7,000	2,000	7,000
Dibenzo(a,h)anthracene	670 U	900	650 U	640 U	590 U	630 U	3,300 J	1,800 J	700	500	1,000
Fluoranthene	4,500	14,000	650 U	6,000	2,000	630 U	44,000 J	39,000 J	1,000,000	4,000	10,000
Fluorene	670 U	1,600	650 U	640 U	590 U	630 U	2,400 J	3,900 J	400,000	1,000	2,000
Indeno(1,2,3-cd)pyrene	1,100	3,100	650 U	1,300	590 U	630 U	11,000 J	6,600 J	700	1,000	3,000
Naphthalene	670 U	620	650 U	640 U	590 U	630 U	800 J	920 J	4,000	500	1,000
Phenanthrene	2,800	12,000	650 U	4,800	1,700	630 U	23,000 J	38,000 J	100,000	3,000	20,000
Pyrene	4,300	13,000	650 U	5,400	1,900	630 U	42,000 J	35,000 J	700,000	4,000	20,000
2-Methylnaphthalene	670 U	550 U	650 U	640 U	590 U	630 U	640 UJ	720 J	4,000	500	1,000
Priority Pollutant Metals Plus Barium and Vanadium (mg/Kg)											
Antimony	1.1 UJ	2.3 J	0.21 UJ	R	1.7 J	R	7.0 J	1.1 UJ	10	1	7
Arsenic	11.1 J	31.8 J	4.4 J	7.0 J	47.4 J	5.7 J	49.1 J	30.9 J	30	20	20
Barium	53.3 J	101 J	20.0 J	20.8 J	55.8 J	24.1 J	143 J	113 J	1,000	50	50
Beryllium	1.0	0.84	1.1	0.33 J	0.57	0.66	0.91	0.77	0.7	0.4	0.9
Cadmium	1.0	1.7	0.22	0.15	0.75	0.038 U	2.0	2.4	30	2	3
Chromium	40.4 J	27.0 J	20.8 J	8.1 J	25.3 J	18.0 J	62.9 J	36.0 J	1,000	30	40
Copper	19.3	40.2	3.9 U	9.0 U	27.1	58.8	70.3	33.8	1,000	40	200
Lead	35.5 J	90.6 J	4.6 J	18.2 J	23.5 J	3.5 J	140 J	84.4 J	300	100	600
Mercury	R	R	R	0.46	1.1	0.039	1.3	0.51	20	0.3	1
Nickel	27.4 J	19.8 J	11.8 J	11.9 J	13.1 J	12.4 J	100 J	51.1 J	300	20	30
Selenium	0.53 UJ	0.42 UJ	0.48 UJ	1.3	0.50 J	0.49 U	0.55 U	0.49 U	400	0.5	1
Silver	0.12 UJ	0.10 UJ	0.14 UJ	0.12 U	0.10 U	0.11 U	0.12 U	0.11 U	200	0.6	5
Thallium	0.96	0.78	0.61	0.19 U	0.82	0.16 U	0.18 U	0.29 J	8	0.6	5
Vanadium	45.7 J	26.6 J	15.7 J	52.8 J	19.1 J	11.6 J	376 J	264 J	400	30	30
Zinc	57.9 J	125 J	23.2 J	29.4 J	33.5 J	22.5 J	274 J	134 J	2,500	100	300
LAB SAMPLE ID											
PCBs	B0428-11A	B0428-12A	B0428-13A	B0428-07A	B0428-08A	B0428-09A	B0428-01A	B0428-02A			
EPH	B0428-11A	B0428-12A	B0428-13A	B0428-07A	B0428-08A	B0428-09A	B0428-01A	B0428-02A			
Priority Pollutant Metals plus Ba and V	B0428-11A	B0428-12A	B0428-13A	B0428-07A	B0428-08A	B0428-09A	B0428-01A	B0428-02A			

Table 2-6. Summary Of Analytical Data For Surface And Subsurface Soil
Former Oxford Paper Mill – March 2003

LOCATION NAME	SB-6/14-16	KSB-6/14-16	SB-7/0-1	SB-7/7-9	SB-8/0-1	SB-8/7-9	SB-9/0-1	SB-9/5-7	SB-9-13-15	SB-10/0-1	SB-10/9-11	KSB-10/9-11	SB-10-13-15	MCP Reportable Concentrations **	MADEP Background Concentrations **	
APPROXIMATE SAMPLE DEPTH (ft bgs)	14-16	14-16	0-1	7-9	0-1	7-9	0-1	5-7	13-15	0-1	9-11	9-11	13-15			
M&E SAMPLE ID	SB-6/14-16	KSB-6/14-16	SB-7/0-1	SB-7/7-9	SB-8/0-1	SB-8/7-9	SB-9/0-1	SB-9/5-7	SB-9-13-15	SB-10/0-1	SB-10/9-11	KSB-10/9-11	SB-10-13-15			
DATE RECEIVED BY LAB:	3/14/03	3/14/03	3/14/03	3/14/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	3/12/03	RCS-1	"Natural Soil"	"Soil Containing Fill Material"
COMMENTS												FD				
PARAMETER/ANALYTE																
PCBs - EPA SW-846 Method 8082 (ug/kg)																
Aroclor-1016	43 U	44 U	47 U	39 U	40 U	39 U	47 U	38 U	38 U	38 U	36 U	36 U	39 U	2,000	–	–
Aroclor-1221	43 U	44 U	47 U	39 U	40 U	39 U	47 U	38 U	38 U	38 U	36 U	36 U	39 U	2,000	–	–
Aroclor-1232	43 U	44 U	47 U	39 U	40 U	39 U	47 U	38 U	38 U	38 U	36 U	36 U	39 U	2,000	–	–
Aroclor-1242	43 U	44 U	47 U	39 U	40 U	39 U	47 U	38 U	38 U	38 U	36 U	36 U	39 U	2,000	–	–
Aroclor-1248	43 U	44 U	47 U	39 U	40 U	39 U	47 U	38 U	38 U	38 U	36 U	36 U	39 U	2,000	–	–
Aroclor-1254	43 U	44 U	47 U	100	40 U	180	170	71	38 U	600	36 U	36 U	39 U	2,000	–	–
Aroclor-1260	43 U	44 U	47 U	39 U	40 UJ	39 UJ	47 UJ	38 UJ	38 UJ	38 UJ	36 UJ	36 UJ	39 UJ	2,000	–	–
EXTRACTABLE PETROLEUM HYDROCARBONS - MADEP-EPH-98-1 (ug/kg)																
C_9-C_{18} Aliphatics (1)	11,000 J	12,000 J	16,000	13,000	4,500	3,300 UJ	26,000	5,000	6,000	20,000	460,000	380,000	150,000	1,000,000	–	–
C_{19}-C_{36} Aliphatics (1)	7,500 J	6,400 J	12,000	32,000	13,000	9,700 J	30,000	17,000	4,500 U	54,000	76,000	60,000	32,000	2,500,000	–	–
C_{11}-C_{22} Aromatics (1)	14,000 J	11,000 UJ	35,000	120,000	45,000	96,000	66,000	58,000	9,600 U	190,000	280,000	280,000	140,000	200,000	–	–
Acenaphthene	660 UJ	640 UJ	710 U	1,000	580 U	1,900	660 U	640	570 U	1,400 U	530 UJ	1,200 J	560 U	20,000	500	2,000
Acenaphthylene	660 UJ	640 UJ	710 U	600 U	580 U	560 U	950	560 U	570 U	1,400 U	530 UJ	1,900 J	970	100,000	500	1,000
Anthracene	660 UJ	640 UJ	710 U	2,400	580 U	2,900	1,800	1,200	570 U	2,200	530 U	540 U	560 U	1,000,000	1,000	4,000
Benzo(a)anthracene	660 UJ	640 UJ	710 U	5,900	1,400	5,000	1,200	2,600	570 U	7,700	910	540 U	560 U	700	2,000	9,000
Benzo(a)pyrene	660 UJ	640 UJ	710 U	4,200	1,100	3,300	660 U	1,900	570 U	6,100	800	540 U	560 U	700	2,000	7,000
Benzo(b)fluoranthene	660 UJ	640 UJ	900	6,800	1,900	5,400	1,900	3,000	570 U	10,000	1,200 J	540 UJ	560 U	700	2,000	8,000
Benzo(g,h,i)perylene	660 UJ	640 UJ	710 U	2,200	580 U	1,600	660 U	560 U	570 U	1,400 U	530 U	540 U	560 U	1,000,000	1,000	3,000
Benzo(k)fluoranthene	660 UJ	640 UJ	710 U	2,500	690	2,000	790	1,200	570 U	3,700	530 U	540 U	560 U	7,000	1,000	4,000
Chrysene	660 UJ	640 UJ	720	5,700	1,600	4,900	1,800	2,600	570 U	7,800	1,000	540 U	560 U	7,000	2,000	7,000
Dibenzo(a,h)anthracene	660 UJ	640 UJ	710 U	880	580 U	610	660 U	560 U	570 U	1,400 U	530 U	540 U	560 U	700	500	1,000
Fluoranthene	660 UJ	640 UJ	1,500	13,000	3,100	13,000	4,200	6,000	570 U	15,000	2,200 J	540 UJ	560 U	1,000,000	4,000	10,000
Fluorene	660 UJ	640 UJ	710 U	990	580 U	1,700	660 U	570	570 U	1,400 U	2,100	2,100	1,000	400,000	1,000	2,000
Indeno(1,2,3-cd)pyrene	660 UJ	640 UJ	710 U	3,000	580 U	2,100	660 U	1,200	570 U	5,000	530 U	540 U	560 U	700	1,000	3,000
Naphthalene	660 UJ	640 UJ	710 U	600 U	580 U	1,100	660 U	560 U	570 U	1,400 U	620	850	560 U	4,000	500	1,000
Phenanthrene	660 UJ	640 UJ	960	8,300	2,000	12,000	3,800	4,400	570 U	8,100	2,500	1,500	750	100,000	3,000	20,000
Pyrene	660 UJ	640 UJ	1,300	12,000	2,900	12,000	3,900	5,600	570 U	15,000	1,900 J	540 UJ	560 U	700,000	4,000	20,000
2-Methylnaphthalene	660 UJ	640 UJ	710 U	600 U	580 U	560 U	660 U	560 U	570 U	1,400 U	960	1,100	2,000	4,000	500	1,000
Priority Pollutant Metals Plus Barium and Vanadium (mg/Kg)																
Antimony	0.39 UJ	R	R	1.0 UJ	0.73 UJ	R	0.64 UJ	0.59 UJ	0.31 UJ	1.7 UJ	R	R	0.73 UJ	10	1	7
Arsenic	4.1 J	3.7 J	21.0 J	24.1 J	16.6 J	12.1 J	9.4 J	21.0 J	8.2 J	19.4 J	3.8 J	4.4 J	4.1 J	30	20	20
Barium	14.4 J	12.8 J	57.5 J	103 J	63.4 J	64.5 J	26.8 J	93.6 J	24.2 J	111 J	34.4 J	44.0 J	34.8 J	1,000	50	50
Beryllium	0.55	0.55	0.93	0.72	0.74	1.0	0.41	0.61	0.71	1.0	0.77	1.0	0.64	0.7	0.4	0.9
Cadmium	0.060 J	0.051 J	0.31	0.96	0.51 U	0.62 U	0.21 UJ	0.56 U	0.15 UJ	4.2	0.20 UJ	0.25 U	0.12 UJ	30	2	3
Chromium	16.1 J	16.4 J	12.5 J	31.2 J	13.4	31.5	5.8	17.3	17.8	38.6	26.2	31.3	17.6	1,000	30	40
Copper	4.1 U	4.0 U	16.2 U	64.1	34.8 J	36.7 J	8.7 J	27.5 J	6.5 J	43.3 J	16.1 J	19.7 J	7.5 J	1,000	40	200
Lead	4.6 J	3.8 J	24.4 J	103 J	93.1 J	91.9 J	13.2 J	91.6 J	10.1 J	120 J	15.0 J	20.4 J	4.8 J	300	100	600
Mercury	0.019 U	0.018 U	0.23	0.70	0.83	0.95	0.28	1.4	0.10 U	3.3	0.048 U	0.048 U	0.030 UJ	20	0.3	1
Nickel	11.4 J	10.6 J	32.5 J	90.3 J	36.2 J	65.1 J	11.8 J	65.0 J	13.4 J	41.1 J	17.7 J	21.8 J	11.0 J	300	20	30
Selenium	0.51 U	0.55 U	1.8	0.47 U	0.96 J	0.50 U	1.6 J	0.44 U	0.43 U	0.44 U	0.41 U	0.42 U	0.46 U	400	0.5	1
Silver	0.11 U	0.12 U	0.13 U	0.10 U	0.10 U	0.11 U	0.13 U	0.098 U	0.096 U	0.097 U	0.092 U	0.094 U	0.10 U	200	0.6	5
Thallium	0.17 U	0.18 U	0.71	0.16 U	1.0 U	1.1 UJ	1.3 U	1.0 U	0.98 U	1.0 UJ	0.94 UJ	0.96 UJ	1.1 U	8	0.6	5
Vanadium	174 J	157 J	166 J	598 J	159 J	247 J	54.4 J	505 J	52.2 J	54.0 J	19.8 J	23.9 J	12.3 J	400	30	30
Zinc	21.1 J	17.9 J	32.6 J	252 J	72.3 J	429 J	24.1 J	59.9 J	17.8 J	161 J	24.2 J	30.5 J	15.6 J	2,500	100	300
LAB SAMPLE ID																
PCBs	B0428-03A	B0428-04A	B0428-05A	B0428-06A	B0417-10A	B0417-11A	B0417-12A	B0417-13A	B0417-18A	B0417-14A	B0417-15A	B0417-16A	B0417-17A			
EPH	B0428-03A	B0428-04A	B0428-05A	B0428-06A	B0417-10A	B0417-11A	B0417-12A	B0417-13A	B0417-18A	B0417-14A	B0417-15A	B0417-16A	B0417-17A			
Priority Pollutant Metals plus Ba and V	B0428-03A	B0428-04A	B0428-05A	B0428-06A	B0417-10A	B0417-11A	B0417-12A	B0417-13A	B0417-18A	B0417-14A	B0417-15A	B0417-16A	B0417-17A			

TABLE NOTES:

1. Hydrocarbon ranges are adjusted to exclude the concentration of target and QC (surrogate) analytes.

** - Values shown for standards are in the same units as the analytical data.

MADEP Criteria
MCP Reportable Concentrations, 310 CMR 40.0000 Subpart P Massachusetts Oil and Hazardous Material List
Background Values: MADEP, May 23, 2002. Technical Update: Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil.
"--" indicates no MCP Reportable Concentration or background value available
The MCP reportable concentrations and background values are shown for comparison purposes only.

ft bgs - feet below ground surface
FD - Indicates Field Duplicate
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Analyte was not detected. Value reported is the sample-specific detection limit.
UJ - Sample-specific detection limit is approximate due to limitations identified in the quality control review.

Bold / Box - indicates value greater than applicable MCP reportable concentration
Bold / Italics indicates that the detection limit exceeds the applicable MCP reportable concentration.

Table 2-6A - Summary of Analytical Results for Subsurface Samples Below the Wedge Area (Greater Than 15 Feet Below Original Ground Surface)
July 2006 Site Investigation
City of Lawrence - 21 Canal Street
RTN 3-2691

	Wedge Area - East of Building No. 22																				Below Building No. 22 Sub-Basement	
Sample ID	Wedge-SB 1		Wedge-SB 2		Wedge-SB 3		Wedge-SB 4		Wedge-SB 5		Wedge DUP1		Wedge-SB 6		Wedge-SB 7		Wedge-SB 8		Wedge-SB 9		Wedge-SB 10	
Sample Depth	(0-5')		(0-05')		(0-5')		(0-5')		(0-5')		(0-5')		(0-5')		(0-5')		(0-5')		(0-5')		(0-5')	
Date Sampled	7/12/06		7/12/06		7/12/06		7/12/06		7/12/06		7/12/06		7/12/06		7/12/06		7/12/06		7/12/06		7/13/06	
Analytes																						
	Result	QL	Result	QL	Result	QL	Result	QL	Result	QL	Result	QL	Result	QL	Result	QL	Result	QL	Result	QL	Result	QL
Metals																						
Arsenic	2.8J	1.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.8J	1.4	NT	NT	NT	NT	2.9J	1.5	NT	NT
Barium	21	0.12	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	42	0.13	NT	NT	NT	NT	15	0.14	NT	NT
Beryllium	U	0.069	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	U	0.074	NT	NT	NT	NT	U	0.079	NT	NT
Cadmium	0.14J	0.10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.25	0.11	NT	NT	NT	NT	0.18J	0.11	NT	NT
Chromium	30	0.26	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	13	0.28	NT	NT	NT	NT	19	0.29	NT	NT
Lead	2.8	0.61	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	110	0.64	NT	NT	NT	NT	2.4	0.69	NT	NT
Selenium	U	0.88	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	U	0.93	NT	NT	NT	NT	U	1.0	NT	NT
Silver	U	0.20	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.22J	0.21	NT	NT	NT	NT	U	0.23	NT	NT
Zinc	15	0.62	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	58	0.66	NT	NT	NT	NT	16	0.71	NT	NT
Mercury	U	0.031	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.055J	0.034	NT	NT	NT	NT	U	0.031	NT	NT
Polychlorinated Biphenyls - PCBs																						
Aroclor-1016	U	0.055	U	0.054	U	0.056	U	0.057	U	0.055	U	0.054	U	0.061	U	0.054	U	0.058	U	0.060	U	0.067
Aroclor-1221	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.120	U	0.110	U	0.120	U	0.120	U	0.130
Aroclor-1232	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.120	U	0.110	U	0.120	U	0.120	U	0.130
Aroclor-1242	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.120	U	0.110	U	0.120	U	0.120	U	0.130
Aroclor-1248	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.120	U	0.110	U	0.120	U	0.120	U	0.130
Aroclor-1254	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.120	U	0.110	U	0.120	U	0.120	U	0.130
Aroclor-1260	U	0.077	U	0.076	U	0.078	U	0.079	U	0.077	U	0.075	0.38	0.086	U	0.076	U	0.081	U	0.084	U	0.093
Aroclor-1262	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.120	U	0.110	U	0.120	U	0.120	U	0.130
Aroclor-1268	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.110	U	0.120	U	0.110	U	0.120	U	0.120	U	0.130
Volatile Organic Compounds - VOCs																						
1,1-Dichloroethene	U	0.00076	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	U	0.00088	NT	NT	NT	NT	0.0011J	0.0010	NT	NT
Semi-Volatile Organic Compounds - SVOCs																						
2-Methylnaphthalene	U	0.076	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.088	NT	NT	NT	NT	U	0.087	NT	NT
Acenaphthene	U	0.080	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.093	NT	NT	NT	NT	U	0.091	NT	NT
Acenaphthylene	U	0.081	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.094	NT	NT	NT	NT	U	0.093	NT	NT
Anthracene	U	0.078	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.091	NT	NT	NT	NT	U	0.090	NT	NT
Benzo(a)anthracene	U	0.075	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.088	NT	NT	NT	NT	U	0.087	NT	NT
Benzo(a)pyrene	U	0.078	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.091	NT	NT	NT	NT	U	0.090	NT	NT
Benzo(b)fluoranthene	U	0.110	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.130	NT	NT	NT	NT	U	0.120	NT	NT
Benzo(g,h,I)perylene	U	0.110	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.130	NT	NT	NT	NT	U	0.130	NT	NT
Benzo(k)fluoranthene	U	0.085	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.099	NT	NT	NT	NT	U	0.097	NT	NT
Chrysene	U	0.079	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.092	NT	NT	NT	NT	U	0.091	NT	NT
Dibenzo(a,h)anthracene	U	0.140	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.160	NT	NT	NT	NT	U	0.150	NT	NT
Fluoranthene	U	0.053	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.062	NT	NT	NT	NT	U	0.061	NT	NT
Fluorene	U	0.077	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.089	NT	NT	NT	NT	U	0.088	NT	NT
Indeno(1,2,3-cd)pyrene	U	0.130	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.150	NT	NT	NT	NT	U	0.140	NT	NT
Naphthalene	U	0.073	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.084	NT	NT	NT	NT	U	0.083	NT	NT
Phenanthrene	U	0.080	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.093	NT	NT	NT	NT	U	0.092	NT	NT
Pyrene	U	0.100	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	UJ	0.120	NT	NT	NT	NT	U	0.120	NT	NT
Extractable Petroleum Hydrocarbons (EPH)																						
C_9-C_{18} Aliphatics Hydrocarbons	U	3.70	U	3.70	U	3.70	U	3.6	U	3.9	U	3.9	U	4.30	U	3.6	U	3.9	U	4.2	U	4.4
C_{19}-C_{36} Aliphatics Hydrocarbons	U	3.70	U	3.70	U	3.70	U	3.6	U	3.9	U	3.9	U	4.30	U	3.6	U	3.9	U	4.2	U	4.4
C_{11}-C_{22} Aromatics Hydrocarbons(unadjusted)	U	3.70	U	3.70	U	3.70	U	3.6	U	3.9	U	3.9	U	4.30	U	3.6	U	3.9	U	4.2	U	4.4
C_{11}-C_{22} Aromatics Hydrocarbons(adjusted)	U	3.70	U	3.70	U	3.70	U	3.6	U	3.9	U	3.9	U	4.30	U	3.6	U	3.9	U	4.2	U	4.4
Acenaphthene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Acenaphthylene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Anthracene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Benzo(a)anthracene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Benzo(a)pyrene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Benzo(b)fluoranthene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Benzo(g,h,I)perylene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Benzo(k)fluoranthene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Chrysene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Dibenz(a,h)anthracene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Flouranthene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Flourene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Indeno[1,2,3-cd]pyrene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
2-Methylnaphthalene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Napthalene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Phenanthrene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44
Pyrene	U	0.37	U	0.37	U	0.37	U	0.36	U	0.39	U	0.39	U	0.43	U	0.36	U	0.39	U	0.42	U	0.44

All concentrations and quantitation limits expressed in mg/kg
U = Not Detected
UJ = Sample-specific detection limit is approximate
J = Quantitation is approximate due to limitations identified in the quality control review
NT = Not Tested

Table 2-7. Summary Of Analytical Data For Groundwater
Former Oxford Paper Mill – March 2003

LOCATION NAME M&E SAMPLE ID DATE RECEIVED BY LAB: DEPTH TO WATER FROM GROUND SURFACE: COMMENTS	MW-1 MW-1 3/27/03 16.5'	MW-3 MW-3 3/27/03 14.3'	MW-5 MW-5 3/27/03 14.8'	KMW-5 KMW-5 3/27/03 14.8' FD	MW-6 MW-6 3/27/03 15'	MW-10 MW-10 3/27/03 6.5'	MCP Reportable Concentrations ** GW-2
PARAMETER/ANALYTE							
PCBs - EPA SW-846 Method 8082 (ug/L)							
Aroclor-1016	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	0.3
Aroclor-1221	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	0.3
Aroclor-1232	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	0.3
Aroclor-1242	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	0.3
Aroclor-1248	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	0.3
Aroclor-1254	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	0.3
Aroclor-1260	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	0.3
VOLATILE PETROLEUM HYDROCARBONS - MADEP-VPH-98-1 (ug/L)							
C_5-C_8 Aliphatics (1)	100 U	100 U	100 U	100 U	100 U	100 U	1,000
C_9-C_{12} Aliphatics (1)	20 U	20 U	20 U	20 U	20 U	20 U	1,000
C_9-C_{10} Aromatics (1)	40 U	45 U	30 U	34 U	46 U	46 U	4,000
MTBE	15 U	15 U	15 U	15 U	15 U	15 U	50,000
Benzene	5 U	5 U	5 U	5 U	5 U	5 U	2,000
Toluene	15 U	15 U	15 U	15 U	15 U	15 U	6,000
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	5 U	
m- and p-Xylenes	20 U	20 U	20 U	20 U	20 U	20 U	6,000
o-Xylene	10 U	10 U	10 U	10 U	10 U	10 U	6,000
Naphthalene	10 U	10 U	10 U	10 U	10 U	10 U	6,000
EXTRACTABLE PETROLEUM HYDROCARBONS - MADEP-EPH-98-1 (ug/L)							
C_9-C_{18} Aliphatics (1)	30 UJ	35	30 U	30 U	40 J	44	1,000
C_{19}-C_{36} Aliphatics (1)	45	44	40 U	40 U	49 J	45	20,000
C_{11}-C_{22} Aromatics (1)	85 U	85 U	85 U	85 U	85 U	85 U	30,000
Acenaphthene	5 U	5 U	5 U	5 U	5 U	5 U	5,000
Acenaphthylene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Anthracene	5 U	5 U	5 U	5 U	5 U	5 U	600
Benzo(a)anthracene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Benzo(a)pyrene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Benzo(b)fluoranthene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Benzo(g,h,i)perylene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Benzo(k)fluoranthene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Chrysene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Dibenzo(a,h)anthracene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Fluoranthene	5 U	5 U	5 U	5 U	5 U	5 U	200
Fluorene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Indeno(1,2,3-cd)pyrene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Naphthalene	5 U	5 U	5 U	5 U	5 U	5 U	6,000
Phenanthrene	5 U	5 U	5 U	5 U	5 U	5 U	50
Pyrene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
2-Methylnaphthalene	5 U	5 U	5 U	5 U	5 U	5 U	3,000
Priority Pollutant Metals Plus Barium and Vanadium (ug/L)							
Antimony	3.4 UJ	6.7 UJ	6.8 UJ	4.3 UJ	7.1 UJ	4.7 UJ	300
Arsenic	3.0 U	4.2 J	7.9 J	4.8 J	11.0 J	4.4 J	400
Barium	76.8 J	83.4 J	34.2 J	81.6	44.0 J	14.7 UJ	30,000
Beryllium	0.50 U	0.50 U	0.50 U	0.71 J	0.50 U	0.50 U	50
Cadmium	0.70 U	0.70 U	0.70 U	0.70 U	0.70 U	0.70 U	10
Chromium	1.1 J	1.0 J	1.0 J	0.97 J	0.60 U	0.85 J	2,000
Copper	4.0 U	4.0 U	11.1 UJ	4.5 UJ	4.0 U	4.0 U	100,000
Lead	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	30
Mercury	0.12 U	0.14 U	0.13 U	0.13 U	0.12 U	0.14 U	1
Nickel	1.1 J	4.0 J	2.6 J	20.3 J	5.6 J	0.94 J	80
Selenium	9.0 U	188	9.0 U	16.0 J	12.1 J	9.0 U	80
Silver	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100,000
Thallium	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	7
Vanadium	1.2 J	158	0.70 U	11.1 J	3710	15.0 J	2,000
Zinc	7.0 U	7.0 U	18.9 J	15.9 J	7.0 U	7.0 U	900
LAB SAMPLE ID							
PCBs	B0502-01D	B0502-04D	B0502-02D	B0502-03D	B0502-05D	B0502-07D	
VPH	B0502-01A	B0502-04A	B0502-02A	B0502-03A	B0502-05A	B0502-07A	
EPH	B0502-01C	B0502-04C	B0502-02C	B0502-03C	B0502-05C	B0502-07C	
Priority Pollutant Metals plus Ba and V	B0502-01B	B0502-04B	B0502-02B	B0502-03B	B0502-05B	B0502-07B	

Table 2-8
Surface Soil Minimum and Maximum Results
Areas North of the Raceway - City of Lawrence RTN 3-2691

	Wedge Area			North Area	
	Minimum	Maximum		Minimum	Maximum
Analytes	mg/kg	mg/kg		mg/kg	mg/kg
Extractable Petroleum Hydrocarbons (EPH)					
C_9-C_{18} Aliphatics	U	U		4.3	26
C_{19}-C_{36} Aliphatics	U	57		10	270
C_{11}-C_{22} Aromatics	16	460		35	400
Polycyclic Aromatic Hydrocarbons (PAH)					
Acenaphthene	U	64		U	2.9
Acenaphthylene	U	U		U	0.95
Anthracene	U	14		U	6.9
Benzo(a)anthracene	U	35		U	21
Benzo(a)pyrene	U	24		U	16
Benzo(b)fluoranthene	U	35		0.9	27
Benzo(g,h,i)perylene	U	13		U	8.0
Benzo(k)fluoranthene	U	12		U	8.9
Chrysene	0.66	38		0.72	20
Dibenzo(a,h)anthracene	0.69	22		U	3.3
Fluoranthene	1.0	74		1.4	44
Fluorene	U	6.3		U	2.4
Indeno(1,2,3-cd)pyrene	0.69	22		U	11
Naphthalene	0.54	2.0		U	0.8
Phenanthrene	0.66	58		0.96	23
Pyrene	1.0	73		1.3	42
2-Methylnapthalene	U	1.4		U	0.64
Polychlorinated Biphenyls (PCB)					
Aroclor 1016	NT	NT		U	U
Aroclor 1221	NT	NT		U	U
Aroclor 1232	NT	NT		U	U
Aroclor 1242	U	U		U	U
Aroclor 1248	U	18		U	U
Aroclor 1254	U	2.5		U	1.8
Aroclor 1260	U	U		U	0.47
Metals					
Antimony	0.22	1.6		0.64	8.8
Arsenic	U	140		7.0	49.1
Barium	16	150		20.8	143
Beryllium	0.14	1.0		0.33	1.0

Chromium	6.8	66		5.8	62.9
Cadmium	0.16	2.5		U	4.2
Copper	12	91		U	70.3
Lead	16	330		13.2	1,970
Mercury	0.073	5.3		0.23	3.3
Nickel	14	130		11.8	100
Selenium	U	0.76		U	1.8
Silver	0.04	0.33		U	0.87
Thallium	0.063	1.3		U	1.08
Vanadium	20	520		30.7	376
Zinc	35	390		24.1	274
Asbestos					
Total Asbestos (%)	U	7.0		U	2.9

U - Not Detected

NT - Not tested

Table 2-9
Subsurface Soil Minimum and Maximum Results
Areas North of the Raceway - City of Lawrence RTN 3-2691

	Wedge Area			North Area	
	Minimum	Maximum		Minimum	Maximum
Analytes	mg/kg	mg/kg		mg/kg	mg/kg
Extractable Petroleum Hydrocarbons (EPH)					
C_9-C_{18} Aliphatics	U	15		U	460
C_{19}-C_{36} Aliphatics	U	82		U	76
C_{11}-C_{22} Aromatics	U	360		U	280
Polycyclic Aromatic Hydrocarbons (PAH)					
Acenaphthene	U	6.2		U	4.1
Acenaphthylene	U	U		U	1.9
Anthracene	U	11		U	8.1
Benzo(a)anthracene	U	29		U	14
Benzo(a)pyrene	U	21		U	9.2
Benzo(b)fluoranthene	U	27		U	16
Benzo(g,h,i)perylene	U	14		U	4.4
Benzo(k)fluoranthene	U	16		U	5.4
Chrysene	U	28		U	15
Dibenzo(a,h)anthracene	U	21		U	1.8
Fluoranthene	U	56		U	39
Fluorene	U	5.1		U	3.9
Indeno(1,2,3-cd)pyrene	U	21		U	6.6
Naphthalene	U	2.4		U	1.1
Phenanthrene	U	41		U	38
Pyrene	U	56		U	35
2-Methylnapthalene	U	1.5		U	2.0
Polychlorinated Biphenyls (PCB)					
Aroclor 1016	U	U		U	U
Aroclor 1221	U	U		U	U
Aroclor 1232	U	U		U	U
Aroclor 1242	U	7.0		U	U
Aroclor 1248	U	15		U	U
Aroclor 1254	U	16		U	0.68
Aroclor 1260	U	0.38		U	0.042
Metals					
Antimony	0.33	3.8		0.17	2.3
Arsenic	1.8J	97		2.3	47.4
Barium	15	300		9.8	113
Beryllium	U	1.0		0.44	1.1

Chromium	13	50		10.9	36
Cadmium	0.13	2.3		U	2.4
Copper	30	140		U	64.1
Lead	2.4	250		2.4	208
Mercury	U	17		U	1.4
Nickel	16	86		9.4	90.3
Selenium	U	0.82		U	0.54
Silver	U	0.89		U	0.33
Thallium	0.11	1.0		U	1.2
Vanadium	27	360		7.7	598
Zinc	15	560		14.5	429
Asbestos					
Total Asbestos (%)	U	8.0		NT	NT

U - Not Detected

J - Quantitation is approximate due to limitations identified in the quality control review

Table 3-1
Initial Screening Matrix of Remedial Action Alternatives
Areas North of the Raceway, Lawrence, MA
City of Lawrence

REMEDIAL ACTION ALTERNATIVE	DESCRIPTION	LIMITATIONS	FEASIBILITY	CLEANUP TIME	COST	SELECTED FOR DETAILED EVALUATION
IN-SITU TREATEMENT						
Enhanced Bioremediation	The activity of naturally occurring microbes is stimulated by circulating water-based solutions through contaminated soils to enhance in situ biological degradation of organic contaminants. Nutrients, oxygen, or other amendments may be used to enhance biodegradation and contaminant desorption from subsurface materials. Typically used for petroleum hydrocarbons.	• High concentrations of heavy metals are likely to be toxic to microorganisms. • Cleanup goals may not be attained if the soil matrix prohibits contaminant-microorganism contact. • Bioremediation slows at low temperatures. • The circulation of water-based solutions through the soil may increase contaminant mobility and necessitate treatment of underlying ground water.	Not feasible for remediation of heavy metals.	1-3 years	Average	No
Phytoremediation	Phytoremediation is a set of processes that use plants to clean contamination in soil, ground water, surface water, sediment, and air.	• Depth of treatment zone is determined by plants used in phytoremediation. In most cases, it is limited to shallow soils. • High concentrations of hazardous materials can be toxic to plants. • Seasonal treatment technology. • The technology is still in the demonstration stage. • Transfer of contaminants across media possible (i.e. soil to air) • Requires extensive maintenance (planting, fertilizing, and watering). • May expose ecological habitat.	Not feasible due to the duration needed to achieve site cleanup levels and maintenance required.	More than 3 years	Average	No
Soil Flushing	Water, or water containing an additive to enhance contaminant solubility, is applied to the soil or injected into the ground water to raise the water table into the contaminated soil zone. Contaminants are leached into the ground water, which is then extracted and treated.	• Low permeability or heterogeneous soils are difficult to treat. • Surfactants can adhere to soil and reduce effective soil porosity. • The potential of washing the contaminant beyond the capture zone and the introduction of surfactants to the subsurface concern regulators. The technology should be used only where flushed contaminants and soil-flushing fluid can be contained and recaptures. • Aboveground separation and treatment costs for recovered fluids can drive the economics of the process.	Not feasible due to high costs and difficulty in containing groundwater at areas north of the raceway at the OPM.	1-3 years	High	No

Table 3-1
Initial Screening Matrix of Remedial Action Alternatives
Areas North of the Raceway, Lawrence, MA
City of Lawrence

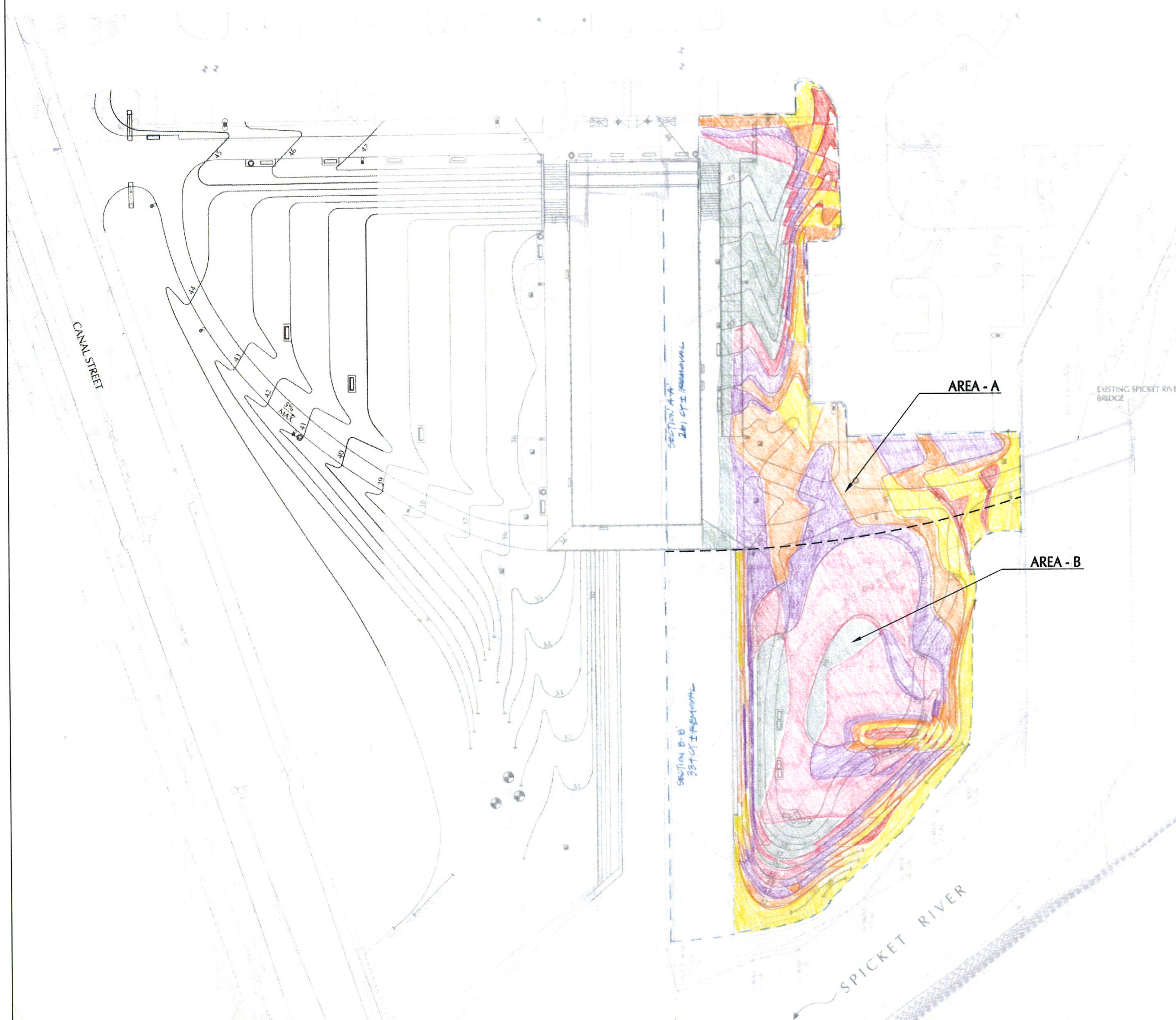
REMEDIAL ACTION ALTERNATIVE	DESCRIPTION	LIMITATIONS	FEASIBILITY	CLEANUP TIME	COST	SELECTED FOR DETAILED EVALUATION
EX-SITU TREATMENT						
Chemical Extraction	Waste contaminated soil and extractant are mixed in an extractor, dissolving the contaminants. The extracted solution is then placed in a separator, where the contaminants and extractant are separated for treatment and further use.	• Some soil types and moisture content levels will adversely impact process performance. • Organically bound metals can be extracted along with the target organic pollutants, which restricts handling of the residuals. • Traces of solvent may remain in the treated solids; toxicity of the solvent is an important consideration. • Capital costs can be relatively high and the technology may be more economical at larger sites. • Meeting highly stringent heavy metals criteria may prove uneconomical.	Not feasible due to high costs.	1-3 years	High	No
Solidification/Stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	• Depths of contaminants may limit some types of application processes. • Certain wastes are incompatible with variations of this process. • Treatability studies are generally required. • Reagent delivery and effective mixing are more difficult than for ex-situ applications. • The solidified material may hinder future site use. • Confirmatory sampling can be more difficult than for ex-situ treatment. • Eliminates exposure to leachable contaminants but not <u>total</u> concentrations.	Not feasible due to nature of the use of the site as a protected open space (passive park) and does not prevent exposure to total concentrations.	Less than 1 year	Average	No
Separation	Separation techniques concentrate contaminated solids through physical and chemical means. These processes seek to detach contaminants from their medium (i.e., the soil, sand, and/or binding material that contains them).	• High clay and moisture content will increase cost. • Gravity separation processed rely on a difference in the solids and liquid phase densities. Specific gravity of particles will affect settling rate and process efficiency. Additionally, settling velocity is dependent on the viscosity of the suspending fluid, which must be known to estimate process efficiency and to size equipment. • Special measures may be required to mitigate odor problems, resulting from organic sludge that undergoes septic conditions. • Successful in treating halogenated SVOCs, pesticides, PCBs, and selected halogenated VOCs.	Not feasible for remediation of PAHs and heavy metals.	Less than 1 year	Average	No
Soil Washing	Contaminants sorbed onto fine soil particles are separated from bulk soil in an aqueous-based system on the basis of particle size. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics and heavy metals.	• Complex waste mixtures (i.e. metals with orgaincs) make formulating washing fluid difficult. • The aqueous stream will require treatment at demobilization. • Additional treatment steps may be required to address hazardous levels of washing solvent remaining in the treated residuals.	Not feasible due to high costs and nature of the use of the site (passive park).	Less than 1 year	High	No
Chemical Reduction/Oxidation	Reduction/oxidation chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide.	• Incomplete oxidation or formation of intermediate contaminants may occur depending upon the contaminants and oxidizing agents used. • The process is not cost-effective for high contaminant concentration because of the large amounts of oxidizing agent required. • Oil and grease in the media should be minimized to optimize process efficiency.	Not feasible due to high costs.	Less than 1 year	High	No

Table 3-1
Initial Screening Matrix of Remedial Action Alternatives
Areas North of the Raceway, Lawrence, MA
City of Lawrence

REMEDIAL ACTION ALTERNATIVE	DESCRIPTION	LIMITATIONS	FEASIBILITY	CLEANUP TIME	COST	SELECTED FOR DETAILED EVALUATION
CONTAINMENT						
Capping	Geotextile caps are used for contaminant source control.	• Capping by itself cannot prevent the horizontal flow of ground water through the waste, only the vertical entry of water into the waste. • Vegetation (trees and shrubs), which has the tendency for deep root penetration, must be eliminated from the cap area. Grass will be the primary vegetation around the cap area. • Precautions must be taken to ensure that the integrity of the cap is not compromised by land use activities.	Feasible	Less than 1 year	Average	Yes
OTHER						
Excavation and Disposal Off-Site	Contaminated material is removed and transported to permitted off-site treatment and disposal facilities. Pretreatment may be required.	• Generation of fugitive emissions and/or asbestos fiber release to the ambient air may be a problem during operations. • The distance from the contaminated site to the nearest disposal facility with the required permit(s) will affect cost. • Depth and composition of the media requiring excavation must be considered. • Disposal options for certain waste may be limited.	Feasible	Less than 1 year	Average	Yes
Excavation and Relocation of Contaminated Soils On-Site	Contaminated material is removed and transported to on-site areas prepared for receiving the excavated materials. Pretreatment may be required.	• Generation of fugitive emissions and/or asbestos fiber release to the ambient air may be a problem during operations. • Depth and composition of the media requiring excavation must be considered.	Feasible	Less than 1 year	Average	Yes
No Further Action / Institutional Controls	Contaminated material is left in place. Fencing is installed around areas that showed risk.	• Existing conditions won't change. • Fences enclose large potions of the park. • Trespassers still exposed to risk.	Feasible	Less than 6 months	Low	Yes

APPENDIX A

Shadley Associates; Lawrence Gateway Park, Contaminated Soil Relocation Grading Plan and Volume Calculation



LEGEND

SYMBOL	DESCRIPTION
(yellow)	DIFFERENCE = 0' REMOVE 3'
(orange)	DIFFERENCE = 1' REMOVE 2'
(purple)	DIFFERENCE = 2' REMOVE 1'
(pink)	DIFFERENCE = 3' REMOVE 0'
(grey)	DIFFERENCE >3' REMOVE 0'
(red)	CUT = 1' REMOVE 4'
(red outline)	CUT >2' REMOVE 6'

NOTES:

1. ASSUME ALL EXISTING ON-SITE MATERIAL NORTH OF THE RACEWAY IS CONTAMINATED.
2. CALCULATIONS BASED ON GRADING PLAN DATED SEPTEMBER 25, 2009.
3. THE REMOVAL DEPTHS SHOWN IN THE LEGEND ARE WHAT WOULD BE REQUIRED TO ACHIEVE THE FINISHED GRADES ON THE GRADING PLAN UP TO THE BOTTOM OF THE CAP (CAP DEPTH IS 3' UNDER LANDSCAPED AREAS AND 1' UNDER PAVEMENT).

CONTAMINATED SOIL RELOCATION			
	APPROXIMATE TOTAL CONTAMINATED SOIL RELOCATION AREA "A" (NORTH OF RACEWAY)	944 CY	
	APPROXIMATE TOTAL CONTAMINATED SOIL RELOCATION AREA "B" ("PENINSULA")	911 CY	
	TOTAL	1855 CY	

GRAPHIC SCALE
(IN FEET)
1 inch = 20 ft.

Merrimack Valley Regional Transit Authority
85 Railroad Avenue
Haverhill, MA
01835

Shadley Associates
Landscape Architects / Site Planning Consultants
1730 Massachusetts Ave. • P 781.652.8809
Lexington, MA 02420 • F 781.862.2687
www.shadleyassociates.com

Lawrence Gateway Park

NOT FOR CONSTRUCTION

SA PROJECT NUMBER: 2007.31

SCALE: AS SHOWN

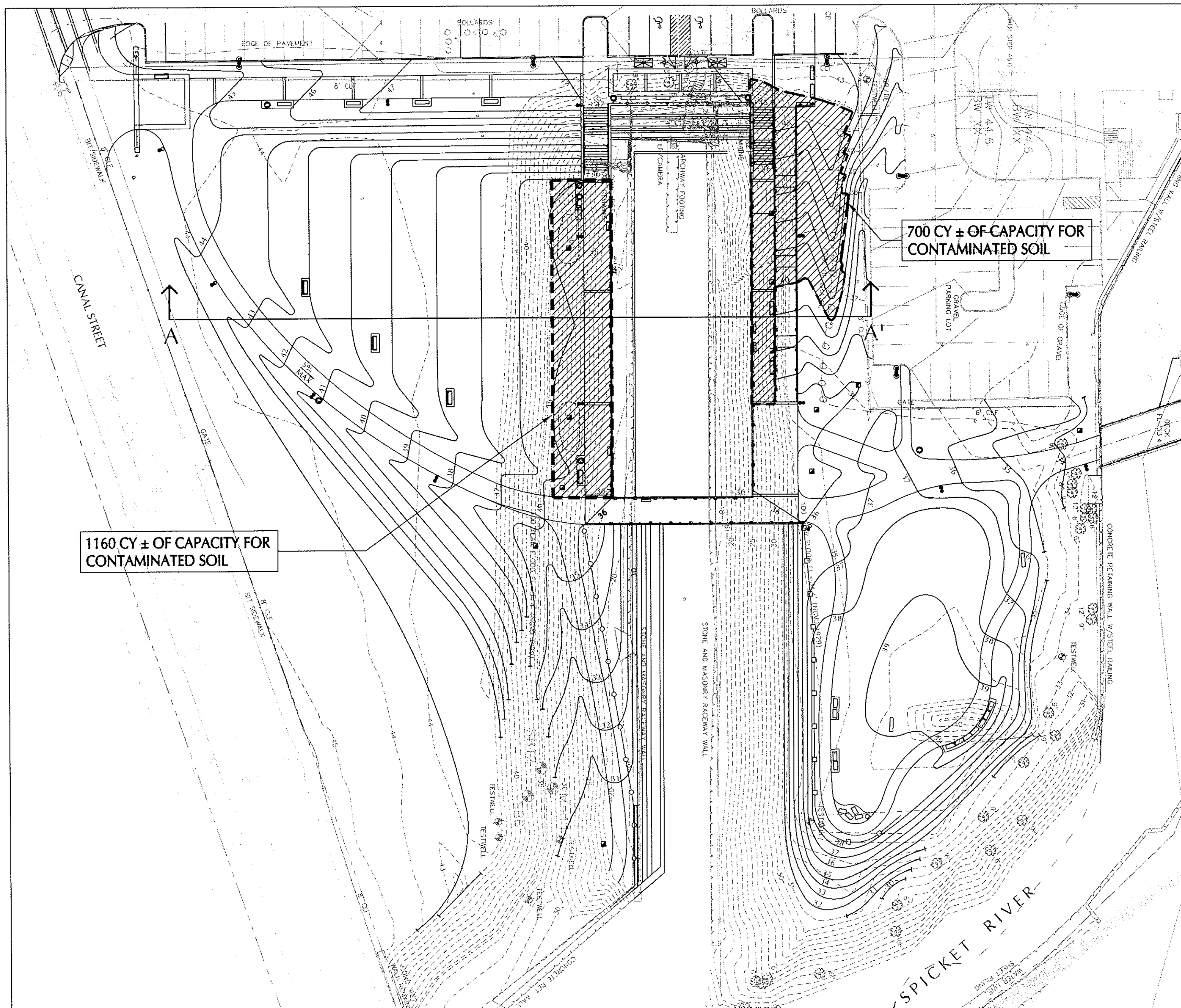
DRAWN BY: WC

REVIEWED BY: PS

DATE: JANUARY 6, 2009

SHEET TITLE:

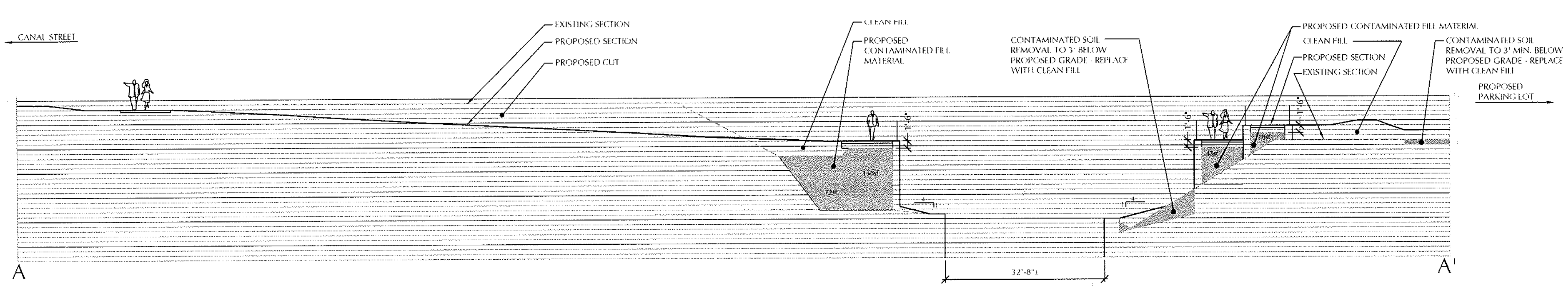
CONTAMINATED SOIL RELOCATION



NOTES:

1. ASSUME ALL EXISTING ON-SITE MATERIAL NORTH OF THE RACEWAY IS CONTAMINATED.
2. CALCULATIONS BASED ON GRADING PLAN DATED SEPTEMBER 25, 2009.
3. THE REMOVAL DEPTHS SHOWN IN THE LEGEND ARE WHAT WOULD BE REQUIRED TO ACHIEVE THE FINISHED GRADES ON THE GRADING PLAN UP TO THE BOTTOM OF THE CAP (CAP DEPTH IS 3' UNDER LANDSCAPED AREAS AND 1' UNDER PAVEMENT).

CAPACITY TO CONTAIN CONTAMINATED SOIL ON-SITE		
	APPROXIMATE STORAGE CAPACITY (NORTH OF RACEWAY)	700 CY
	APPROXIMATE STORAGE CAPACITY (SOUTH OF RACEWAY)	1160 CY
	TOTAL	1860 CY



Section A-A'

Scale: 1"=10'-0"

GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

MVRTA
Merrimack Valley Regional Transit Authority
85 Railroad Avenue
Haverhill, MA
01835

Shadley Associates

Lawrence
Gateway Park

NOT FOR CONSTRUCTION

SA PROJECT NUMBER: 2007.31

SCALE: AS SHOWN

DRAWN BY: WC

REVIEWED BY: PS

DATE: JANUARY 6, 2009

SHEET TITLE:

CONTAMINATED SOIL ONSITE CAPACITY

Shadley Associates, P.C.

1730 Massachusetts Avenue
Lexington, MA 02420
TEL: (781) 652-8809
FAX: (781) 862-2687

EARTHWORK CALCULATIONS

Project: Lawrence Gateway Park
Status: Design Development
Date: 1/6/2009

SUMMARY
Project Earthwork: 2,776 CY NET FILL (existing contours to proposed contours less surface treatments)

Estimated volume of contaminated soil to be relocated onsite: 1,854 CY
Capacity of site for contaminated soil: 1,860 CY
Contaminated soil calculations are included within the Project Earthwork figure above

Existing grade to finished grade, not including surface treatment sections (depths)		CY			
	Net Earthwork Elevation 35 and above (FILL)	947			
	Net Earthwork Below Elevation 35 (FILL)	4,707			
	Total Project Earthwork (NET FILL)	**5,654**			
Finished Surface Treatment Depths		SF	Depth In Feet	CF	CY
	Bituminous Concrete	7,348	1.25	9,185.00	340.19
	Cement Concrete	2,304	1.00	2,304.00	85.33
	Unit Pavers	9,451	2.00	18,902.00	700.07
	Seeded Areas	77,202	0.50	38,601.00	1,429.67
	Planted Areas	3,730	2.00	7,460.00	276.30
	Steps	628	2.00	1,256.00	46.52
	Total Surface Treatment Depths				2,878.07
	Total Project Earthwork Less Surface Treatments (NET FILL)	**2,776**			

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EARTHWORK CALCULATIONS FOR CONTAMINATED SOIL

Project: Lawrence Gateway Park
Status: Design Development
Date: 1/6/2009

SUMMARY

		QTY	UNIT
CONTAMINATED SOIL RELOCATION			
	Approximate Contaminated Soil Removal Area "A" (north of raceway)	944	CY
	Approximate Contaminated Soil Removal Area "B" ("peninsula")	911	CY
	Total Contaminated Removal	**1,855**	CY
CAPACITY TO CONTAIN CONTAMINATED SOIL			
	Approximate Storage Capacity North of Raceway	700	CY
	Approximate Storage Capacity South of Raceway	1,160	CY
	Total Contaminated Soil Capacity	**1,860**	CY
SUMMARY			
	Need to Find Additional Capacity for Contaminated Soil	**-5**	CY

EARTHWORK CALCULATIONS

Shadley Associates

Project: **Lawrence Gateway Park**

Status: Design Development

Date: 1/6/2009

Note: Calculations below are based on the difference between the existing contours and proposed contours per the Grading Plan dated 9/29/08.

	Cut (SF)	Fill (SF)	Net (SF)	Net CF	Net CY
Contour Number 47	0	1,852	1,852	1,852	69
Contour Number 46	0	4,639	4,639	4,639	172
Contour Number 45	170	8,058	7,888	7,888	292
Contour Number 44	24,549	3,958	20,591	20,591	763
Contour Number 43.5	*0*	*19,081*	*19,081*	*9,541*	*353*
Contour Number 43	18,036	3,938	14,098	14,098	522
Contour Number 42	15,534	3,943	11,591	11,591	429
Contour Number 41	12,849	4,594	8,255	8,255	306
Contour Number 40	10,165	4,761	5,404	5,404	200
Contour Number 39	6,984	6,835	149	149	6
Contour Number 38	3,994	13,065	9,071	9,071	336
Contour Number 37	1,410	15,327	13,917	13,917	515
Contour Number 36	102	23,903	23,801	23,801	882
Contour Number 35	154	15,109	14,955	14,955	554
Contour Number 34	199	11,254	11,055	11,055	409
Contour Number 33	213	10,244	10,031	10,031	372
Contour Number 32	184	10,045	9,861	9,861	365
Contour Number 31	106	9,659	9,553	9,553	354
Contour Number 30	100	10,843	10,743	10,743 0	398
Contour Number 29	47	9,968	9,921	9,921	367
Contour Number 28	265	9,220	8,955	8,955	332
Contour Number 27	339	8,618	8,279	8,279	307
Contour Number 26	437	8,496	8,059	8,059	298
Contour Number 25	395	7,904	7,509	7,509	278
Contour Number 24	374	7,112	6,738	6,738	250
Contour Number 23	327	6,739	6,412	6,412	237
Contour Number 22	292	6,527	6,235	6,235	231
Contour Number 21	0	5,797	5,797	5,797	215
Contour Number 20	0	4,739	4,739	4,739	176
Contour Number 19	0	3,099	3,099	3,099	115
Contour Number 18	0	90	90	90	3

Total Fill		7,876
Total Cut		2,225
Net Fill		5,650
Fill 35 and above		3,173
Cut 35 and above		2,225
Net Fill 35 and above		947
Fill 34 and below		4,707
Cut 34 and below		0
Net Fill 34 and below		4,707
Contaminated Cut	1,759	65
Non contaminated cut		2,160

OTHER APPENDICES

LABORATORY ANALYTICAL REPORTS FOR THE PHASE III – AREAS NORTH OF THE RACEWAY ARE PROVIDED IN THE PHASE II REPORT

LABORATORY ANALYTICAL REPORTS FOR THE PHASE III REPORT WERE PROVIDED FOR THE MADEP AND EPA SUBMITTALS