REPORT

EPA Contract No. 68-W9-0036
EPA Work Assignment No. 34-1R16

EPA Project Officer: Diana King
EPA Remedial Project Manager: Elaine Stanley

FINAL REPORT
FIVE YEAR REVIEW

Charles George Reclamation Landfill
Tyngsborough, Massachusetts

August 1995

Prepared by:

Metcalf & Eddy
An Air & Water Technologies Company

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FINAL FIVE YEAR REVIEW FOR THE CHARLES GEORGE RECLAMATION LANDFILL

CHARLES GEORGE RECLAMATION LANDFILL TYNGSBOROUGH, MASSACHUSETTS

August 1995

Prepared by:

M&E

Wakefield, Massachusetts

SITE ACTIVITIES SUMMARY
FIVE-YEAR REVIEW
for the Charles George Reclamation Landfill

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SECTION 1.0
BACKGROUND

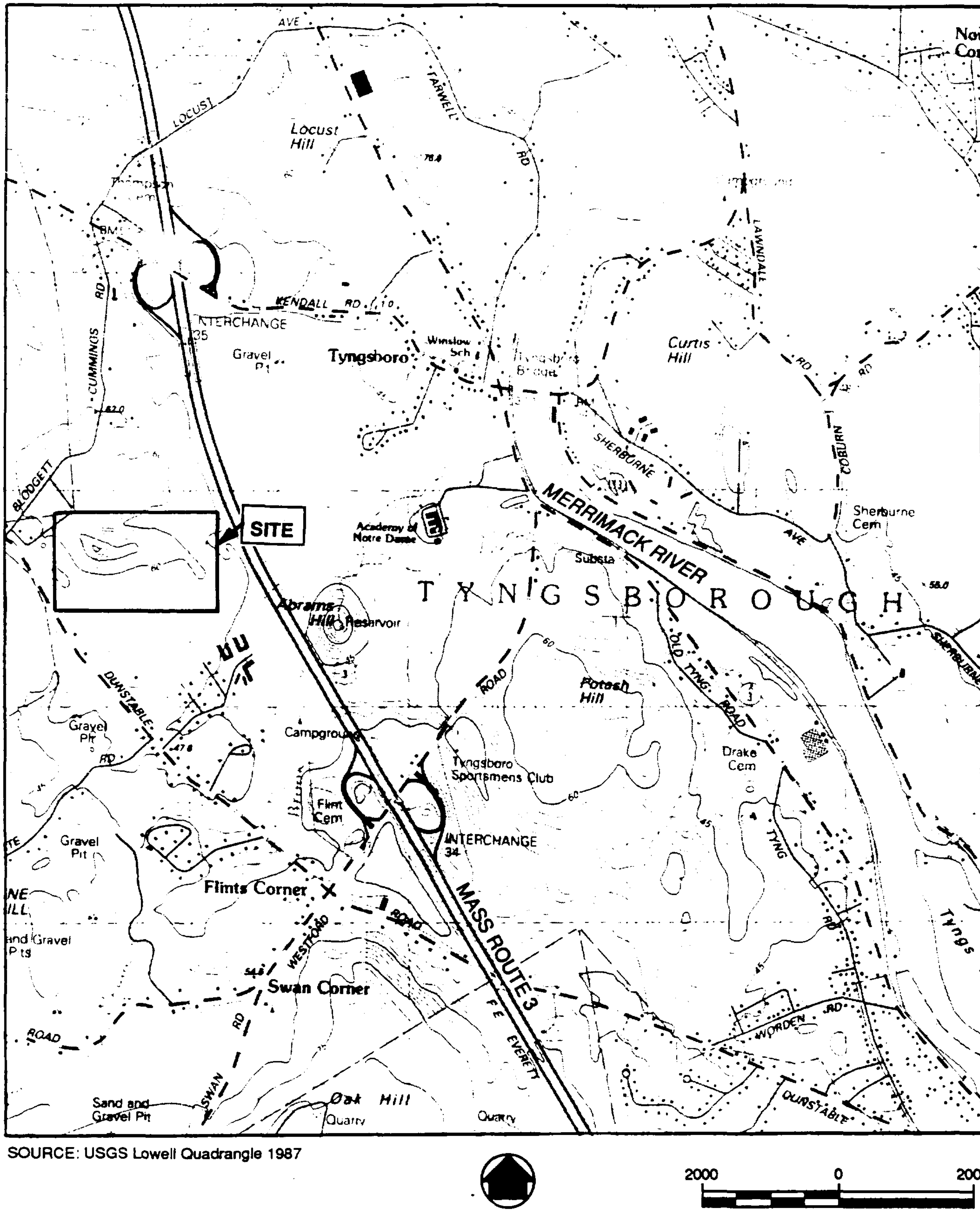
This document is a comprehensive and interpretive report on the five-year review conducted at the Charles George Land Reclamation Trust Landfill Superfund site (the site) in Tyngsboro, Massachusetts, (see Figure 1-1) for U.S. Environmental Protection Agency (EPA) Region I. This work was conducted by Metcalf & Eddy (M&E) under the Alternative Remedial Contract Services (ARCS) contract. The U.S. EPA is the lead agency and decision-maker for the Charles George Land Reclamation Trust Landfill site.

1.1 INTRODUCTION

The five-year review was undertaken to review remedial actions completed at the site to date, to ensure that the remedial actions remain protective of human health and the environment. This review is required by federal statute for any site remedy which results in hazardous substances remaining on-site (CERCLA §121(c) and 40 CFR §300.430(f)(4)(ii)).

1.1.1 Purpose of Report

The purpose of the five-year review is to: (1) confirm that the remedy as spelled out in the ROD and/or remedial design remains effective at protecting human health and the environment; and (2) to evaluate whether original cleanup levels remain protective of human health and the environment. This report presents the results of a "Level II" five-year review, as determined by U.S. EPA Region I and in accordance with OSWER Directive 9355.7-02 "Structure and Components of Five Year Reviews." This review includes elements of a Level II review (document reviews, regulatory review, site inspection, site sampling, statement of protectiveness and recommendations) except the recalculation of risk. EPA instructions for this work assignment specified a qualitative reevaluation of risk without a recalculation.



SOURCE: USGS Lowell Quadrangle 1987

FIGURE 1-1. CHARLES GEORGE RECLAMATION LANDFILL SITE LOCATION

1.1.2 Summary of Remedy Stipulated by Records Of Decision

The Charles George Reclamation Landfill is a sixty-acre mixed industrial, municipal, and hazardous waste landfill located approximately one mile southwest of the town center of Tyngsboro, Massachusetts (see Figure 1-2). Land use in the vicinity of the site is predominantly rural residential but also includes some light industry and seasonal livestock grazing. Drinking water in the area is supplied by local groundwater wells and by a new water main installed as a result of the EPA's first Record of Decision (ROD I) (Phase I) for the site. The water main is connected to the City of Lowell's system. The site is bordered to the east by U.S. Route 3, Flint Pond Marsh, and Flint Pond. Dunstable Road and Dunstable Brook border to the west, and the Cannongate Condominium complex is about 800 feet to the southeast. Blodgett Street forms the northwest border, eventually becoming Cummings Road further north of the landfill.

The landfill itself contains municipal and industrial waste disposed on site from the mid-1950s until the landfill's closing in 1983. The landfill was permitted to accept hazardous industrial waste from 1973 until 1976.

The investigation and remediation of contamination at the site is divided into four distinct operable units as follows:

- ROD I. Provide an alternative water supply.
- ROD II. Control the contamination source to reduce off-site migration of contaminants (i.e., cap the landfill gas and collect the leachate).
- ROD III. Provide treatment of groundwater, leachate and landfill gas and provide removal of Dunstable Brook sediments as the selected source removal remedy. ROD III covered both Operable Unit #3 (management of migration) and Operable Unit #1 (leachate treatment).

Selected remedial actions for the site were developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Contingency Plan (NCP) at 40 CFR Part 300. Remedial alternative selection was documented in the Records of Decision (RODs).

ROD I provided a permanent drinking water supply to local groundwater users by extending an existing water supply system. Local groundwater wells were found to contain volatile organic compounds associated with the site. The remedy minimized exposure and, therefore, provided a measure of protectiveness to human health.

ROD II provided a cap for the site including a synthetic membrane and soil cover, a surface water management system, a passive landfill gas venting system, and a leachate collection system. These measures minimized the migration of contaminants through the air and groundwater and, therefore, provided a measure of protectiveness to human health. The landfill cover minimized storm water infiltration which reduces leachate generation. The leachate collection system minimized impacts to off-site surface water and groundwater. The landfill gas collection system delivers landfill gas to an interim flare. The flare, provided under ROD III, thermally destroys contaminants carried in the gas and minimized impacts to the air.

Construction of a synthetic landfill cap and appurtenant systems was begun in early 1989 and completed in October 1990. Included in the construction of the cap were a new shallow perimeter leachate toe-drain, two leachate pump stations with force mains flowing to a temporary leachate holding pond, a passive gas collection and venting system, and a surface water diversion and sedimentation system. The old leachate collection systems on the east and west sides of the landfill, which were installed by the former landfill operator, have been connected into pump stations.

The landfill gas collection and venting system includes a passive, crushed stone gas collection trench system under the cap liner which will direct the landfill gas through 28 vents along the top of the landfill. Twelve pre-existing vents are tied into the new gas collection system below the liner. Landfill gas is being routed to an open flare, part of ROD III, on an interim basis.

ROD III completes the remedial actions via treatment of the media controlled during implementation of ROD II. The southwest groundwater collection trench has been constructed and operating since October 1993. In addition, the residential well monitoring program started in 1989 and continues to date.

The leachate and groundwater will be collected and treated on site. The treatment plant effluent is regulated by cleanup standards established in ROD III and, therefore, minimizes off-site impacts. Currently, leachate is collected in the leachate toe-drain installed with the cap during implementation of ROD II. The leachate is pumped to a lined holding pond. Periodically, the holding pond is pumped, treated onsite and discharged to nearby surface waters. The eastern groundwater remediation is currently in the design phase.

Landfill gas is currently being treated on an interim basis. The final remedy for landfill gas includes short term monitoring of landfill gas quality and quantity under capped conditions, followed by an upgrade, if necessary, to the existing treatment system.

The need for excavation of sediments from Dunstable Brook has been reevaluated as part of this five-year review. Sediments that were to be dredged and placed under the landfill cap during cover construction remain in the brook. The decision to dredge the brook was based on a risk assessment of contaminant levels and risk factors at the time ROD III was issued 1988. In 1989, EPA revised the relative absorption factors for PAHs. These changes were expected to result in decreased human health risk associated with exposure to sediments. Although new risk calculations were not performed, EPA decided not to dredge the brook.

Additional sediment data and a reevaluation of risk factors are presented in Section 2.2 and 3.1.

1.1.3 Report Organization

This document is organized for a Level II review. It presents the results of the five-year review within the following discussions:

Section 1.2, Remedial Objectives presents ROD-specified remedial objectives.

Section 1.3, Standards Review describes the results of a review of existing site documents which pertain to the remedial actions implemented at the site.

Section 1.4, Risk Assessment Review describes the risk factors and equations used during the RI/FS and proposes update alternatives.

Section 2.0, Site Conditions describes the present status of the remedial actions, results of data collected during the five year review, the information obtained during site inspections and the wetlands assessment conducted at the site.

Section 3.0, Recalculation of Risk presents updated sediment risk calculations based on updated quantitative risk factors and site data.

Section 4.0, Recommendations

Section 5.0, References contains references cited in the report.

1.2 REMEDIAL OBJECTIVES

<u>ROD I.</u> The first ROD, issued in December 1983, selected an extension of a water supply line to the residents of the Cannongate/Red Gate Road area. The objective of the new water main, an extension of Lowell's system, was to provide an uncontaminated alternative water service to the residents of the Cannongate Condominium complex and surrounding area.

ROD II. The objective of the second ROD, signed in July 1985, was the implementation of source control measures to contain contamination and thereby minimize any further off-site impacts. T' ·ed remedy described in ROD II includes: a synthetic membrane cap, establishment of a : 1 grade on the side slopes where required; a surface water diversion and collection system; a vent network with a passive gas collection system and a peripheral leachate collection system.

ROD III. The objective of this ROD, completed September 29, 1988, is on the control and cleanup of contaminants that have spread or are spreading from the site, including the treatment of leachate collected as part of the cap system. EPA selected the three-part remedy outlined below for the cleanup of contaminated groundwater and leachate, landfill gas emissions, and stream sediment. The selected remedies included in the ROD are:

1. Leachate collected from the landfill cap system will be combined with overburden and shallow bedrock groundwater from a groundwater recovery system and treated on-site with biological treatment, hydroxide precipitation, carbon adsorption, and, if necessary, ion exchange units. The treated leachate and groundwater will be monitored and discharged into groundwater on-site, if feasible. If discharge to groundwater is not feasible, the treated leachate and groundwater will be discharged into a nearby approved surface water. An upgradient groundwater diversion trench will also be also be installed to assist in lowering the water table beneath the landfill, thereby minimizing direct contact between groundwater and landfill wastes. In addition, groundwater monitoring will be performed to provide early warning of possible increases in contaminant concentrations that may impact residential drinking wells in deep bedrock.

2. Landfill vent gas emissions will be collected and thermally destroyed on-site.

3. Contaminated sediments in Dunstable Brook immediately west of the landfill will be dredged, solidified on-site, and placed beneath the synthetic cap constructed over the landfill, per EPA's second ROD.

1.3 STANDARDS REVIEW

This report is based on review of the documents listed in the references section of this report.

1.3.1 Historical Analytical Data Review

Analytical data has been collected at the site since the initial groundwater monitoring in 1979 and 1980. The data reviewed during this five year review, however, do not include results prior to those in the documents used to formulate ROD III.

The selection of residents to receive new water supply service hook-ups was based on groundwater data. The delivery system and pump station designs, however, were not necessarily designed based on site-specific concentrations. Likewise, the landfill cap design was sized, including the leachate toe drain, based on the volume or extent of the leachate and waste, not on the contaminant levels in the leachate or waste (except for HDPE compatibility studies). Based on this reasoning, analytical data reviewed and used in this five year review is all post ROD II data.

Groundwater

Historically several volatile organic compounds, semivolatile organic compounds and inorganic elements have been detected in site groundwater. Some of these analytes are chemicals of concern and are identified as such in RODs II and III. Others are not chemicals of concern but have recently been detected at concentrations that exceed MCLs. Three acid extractable compounds; phenol, 2-methylphenol and 4-methylphenol were identified as chemicals of concern in RODs II and III. Semivolatiles, which include the phenols, have been included in the recent (1990 to date) groundwater monitoring program for both residential and on- and off-site wells. Analytical results are summarized in Table 1-4 which presents the minimum and maximum concentrations detected and the frequency of detection for samples collected and analyzed between August 1990 and April 1993.

Leachate

The completion of the leachate collection system as part of ROD II remedial measures conducted at the site included a leachate collection pond which has a capacity of approximately 3.5 million gallons. On an interim basis (1991, 1992 and 1994), the USACE has contracted out to treat and discharge contents of the holding pond.

During treatment, leachate from the collection pond was sampled and analyzed for volatile organics, semivolatile organics, metals and several water quality parameters including biochemical oxygen demand, and total suspended solids. Samples of the effluent were also tested for acute and chronic toxicity. The maximum and minimum concentrations of leachate chemicals of concern and other chemicals reported at concentrations greater than their MCLs in the leachate are summarized in Table 1-4. The effluent met all discharge standards set by the Massachusetts DEP for chemical and water quality parameters. The leachate has historically had trouble meeting the whole-effluent toxicity standards (NOEL=100%), although improvements have been made with time. Through several Toxic Identification Evaluation studies conducted by CDM, it appears that ammonia is the major cause of toxicity.

The percentage of treated leachate effluent in water required to produce 50 percent mortality (LC_{50}) was determined in the acute toxicity testing for 24 and 48 hour durations. The percentage of effluent required in a mixture (e.g., 30% effluent, 70% diluent) to produce a limited observed effect concentration (LOEC) and no observed effect concentration (NOEC) was determined in the chronic toxicity testing. The results for four acute and three chronic facility tests are summarized in the following table. Data from toxicity tests conducted by USEPA on sediments collected in the fall of 1993 are provided in Section 2 and evaluated in Section 3.

Acute Toxicity	Concentration of Effluent in Water
LC_{50} 24 hour	12 - 94 percent
LC_{50} 48 hour	8.5 - 70 percent
Chronic Toxicity	
LOEC	25 - 50 percent
NOEC	12.5 - 25 percent

Sediment

Chemicals of concern for sediments identified in the ROD III (EPA, 1988) for the site included two inorganic elements, arsenic and cadmium, and six carcinogenic polycyclic aromatic hydrocarbons (PAH). The PAHs are benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene and indeno(1,2,3-cd)pyrene. The maximum and minimum concentrations detected and the frequency of detection for samples collected and analyzed between 1988 and 1992 are summarized in Table 1-6. Installation of the landfill cap, stormwater runoff, and leachate collection systems, were designed in part to prevent continued contamination of sediments adjacent to the site. These remedial measures should control the source of contaminants and minimize the migration of contaminants through the surface water and sediments in the vicinity of the site.

1.3.2 Historical Sediment Toxicity Testing Data Review

Based on a review of the 1987 Endangerment Assessment report (ATC, 1987) and the Draft Final Remedial Investigation report (Ebasco, 1988), no sediment toxicity tests were conducted during these studies. During treatment and discharge of the leachate holding pond (OHM, 1992) effluent samples were analyzed for toxicity.

1.3.3 ARARs Review

An analysis of newly promulgated or modified requirements of federal and state environmental laws was conducted to determine if they are applicable or relevant and appropriate requirements (ARARs) and to determine if they call into question the protectiveness of the remedy. The following terms, used within this report, require definition: "applicable", "relevant and appropriate", "to be considered (TBC)", "substantive", and "administrative".

"Applicable" requirements are those requirements that are legally applicable to the response action, if that action is not undertaken pursuant to Section 104 or 106 of CERCLA. Due to the variability of characteristics from site to site, it is impossible to determine, by regulation, which requirements are applicable. Those determinations are made on a case-by-case basis and "applicability" is determined objectively.

"Relevant and appropriate" requirements are defined as those requirements that, while not "applicable," are intended to apply to problems sufficiently similar to those encountered at hazardous waste sites that their application is appropriate." (EPA, 1988b) These non-applicable requirements are used only when they are appropriate or relevant to the site and are applied as applicable requirements.

In addition, other environmental and public health guidelines, although not ARARs, may be considered (and are termed "to be considered" or "TBC") to help determine what is protective or are useful in determining CERCLA remedies.

"Substantive" requirements are those requirements that pertain directly to actions or conditions in the environment. Examples include quantitative health or risk-based standards for certain hazardous substances (e.g., MCLs for drinking water), and technology-based standards (e.g., RCRA minimum technology requirements for double liners and leachate collection systems). CERCLA Section 121(e), codified at 40 CFR Part 300.400(e), exempts any response action conducted entirely at the site from having to obtain a federal, state, or local permit, where the action is carried out in compliance with Section 121. Remedial actions conducted on Superfund sites need comply only with the substantive aspects of applicable or relevant and appropriate requirements and not with corresponding administrative requirements.

"Administrative" requirements are those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation (e.g., requirements related to the approval of or consultation with administrative bodies, documentation, permit issuances, reporting, record keeping, and enforcement).

Under Section III.A of Attachment I "Explanation of Five-Year Review Policy" to OSWER Directive 9355.7-02, the Commonwealth of Massachusetts should be requested to identify state ARARs promulgated or modified since ROD signature which may have a bearing on the protectiveness of the remedy. M&E has not formally contacted the Department of Environmental Protection (DEP) regarding this issue.

The basis for the site ROD was developed prior to promulgation of the revised National Contingency Plan (40 CFR Part 300, March 1990) and prior to publication of the *CERCLA Compliance With Other Laws Manual: Parts I and II,* (OSWER Directives 9234.1-01 and 9234.1-02, respectively), although existing Draft ARAR procedures were followed in the ROD. Many changes to the ARARs have occurred over the past five years. These changes are presented in this section via several tables:

> **Table 1-1:** Potential chemical-specific ARARs and guidance identified in the ROD are re-evaluated in this table. The re-evaluation includes a determination of whether the rule is currently ARAR or TBC and whether the remediation is in compliance with the ARAR.
>
> **Table 1-2:** This chemical-specific ARARs table presents a comparison of the ROD-specified standards (1988) to current (1993) standards for groundwater and leachate chemicals of concern.

TABLE 1-1
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Groundwater				
Federal Regulatory Requirements	SDWA - Maximum Contaminant Levels (MCLs) (40 CFR 141.11 - 141.16)	Relevant and Appropriate	MCLs have been promulgated for a number of common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but may also be considered relevant and appropriate for groundwater aquifers used for drinking water. When risks to public health due to consumption of groundwater were assessed, concentrations of contaminants of concern, including benzene and TCE, were compared to their MCLs. Projected concentrations of benzene exceeded the MCL in several locations. SDWA MCLs also were used in setting discharge requirements.	MCLs and non-zero MCLGs have the status of ARARs for areas not directly overlain by waste. Many of the MCLs and MCLGs have changed since ROD completion. A comparison of changes to MCL/MCLG to those used for the ROD is provided in Table 1-2. An updated table is provided in Appendix B. An identification of the most stringent numerical standards and criteria is provided in Table 1-4. Also provided in Table 1-4 is a listing of groundwater COC levels as well as the maximum and minimum detections for the COC. Concentrations of benzene, ethylbenzene, trichloroethene, arsenic, 1,2-dichloroethane, methylene chloride, antimony, cadmium, and nickel all exceeded the MCL in at least one location. Groundwater still requires remediation under this rule.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Groundwater (contd.)	RCRA - Subpart F, Groundwater Protection Standards, Concentration Limits (40 CFR 264.94(a))	Relevant and Appropriate	Standards for 14 toxic compounds have been adopted as part of RCRA groundwater protection standards. These limits were originally set at MCLs. Groundwater contaminant levels were compared to these limits. Although eastern shallow groundwater is not a potential drinking water source, it does exceed these limits. Therefore it requires remediation.	Site COCs arsenic, chromium, mercur y and cadmium are included in the 14 toxic compounds for which standards have been adopted. Currently, only cadmium has a RCRA MCL (0.01 mg/L) that differs from the SDWA MCL (0.005 mg/L). RCRA sets the limit for organic constituents at background levels. Constituents in site groundwater exceed RCRA MCLs for arsenic and chromium, and exceed background concentrations for all organic COCs. Groundwater still requires remediation under this rule.
	RCRA - Subpart F Groundwater Protection Standards, Alternate Concentration Levels (ACLs) (40 CFR 264.94(b))	Relevant and Appropriate	ACLs are one of three possible standards (aside from MCLs and background concentrations) available under Subpart F for setting a clean-up level for remediation of groundwater contamination from a RCRA facility. ACLs may be relevant and appropriate if certain conditions relating to transport and exposure are met. ACLs may need to be determined by EPA. Procedures for developing ACLs are outlined in RCRA Subpart F, Section 264.94(b).	There is no change from the ROD presentation for this ARAR. At this time, ACLs are not being sought.
Massachusetts Regulatory Requirements	Massachusetts Groundwater Quality Standards (314 CMR 6.00)	Applicable	Massachusetts Groundwater Quality Standards have been promulgated for a number of contaminants. When state levels are more stringent than federal levels, the state levels will be used. DEP Groundwater Standards were considered when determining discharge levels.	Current Massachusetts groundwater standards are updated and compared to site groundwater in Tables 1-2 and 1-4. Groundwater underlying the site is designated Class I. Concentrations of arsenic and chromium exceeded these standards in at least one location. Site groundwater requires remediation under this rule.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Groundwater (contd.)	Massachusetts Drinking Water Requirements (310 CMR 22.05 to 22.09)	Relevant and Appropriate	Requirements were considered; however, standards do not apply to contaminants found in site groundwater.	Because the site is within 500 feet of a private water supply well that was in use at the time of site discovery, drinking water requirements are releva nt and appropriate. Many of the Massachusetts MCLs have changed since ROD completion; changes are shown on Table 1-2. An updated list is provided in Appendix B. Groundwater requires remediation under this rule.
	Massachusetts Contingency Plan - Groundwater Standards for GW-1 (310 CMR 40-0932, 40.0974(2))	Not identified (add as applicable)	None.	The revised MCP (July 1993) identifies groundwater standards potentially applicable at hazardous waste sites. Groundwater category GW-1 is considered applicable to the site because the groundwater is within 500 feet of a private water supply well that was in use at the time of site discovery (310 CMR 40.0932 (4)(f)). These standards are listed in Table 1-2 and Appendix B.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Federal Criteria, Advisories, and Guidance	SDWA - Maximum Contaminant Level Goals (MCLGs)	Relevant and Appropriate/ To Be Considered	MCLGs are health-based criteria that are to be considered for drinking water sources as a result of SARA. These goals are available for a number of organic and inorganic contaminants. Projected groundwater concentrations of copper, trans-1,2-dichloroethene, toluene, benzene, and TCE were compared to their MCLGs. For benzene and TCE, MCLGs are set at zero.	Non-zero MCLGs have the status of ARAR for areas not directly overlain by waste. Zero MCLGs cannot have the status of ARARs but are, however, to be considered in developing site remedies. Many of the MCLGs have changed since ROD completion. A comparison of MCLG changes to those used for the ROD is provided in Table 1-2. An updated table, without strikeouts and redlines, is provided in Appendix B. An identification of the most stringent criteria to be considered is provided in Table 1-2. Concentrations of benzene, ethylbenzene, trichloroethene, arsenic, cadmium, 1,2-dichloroethane, methylene chloride, antimony, lead, and nickel all exceeded MCLGs in at least one location. Groundwater requires remediation under this rule.
	Health Advisories (EPA Office of Drinking Water)	To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. Health Advisories were considered for contaminants in groundwater that may be used for drinking water.	Table 1-3 provides the latest US EPA health advisories of all COCs for which advisories are available. An updated table is also provided in Appendix B.
	EPA Risk Reference Doses (RfDs)	To Be Considered	RfDs are dose levels developed by EPA for non-carcinogenic effects. EPA RfDs were used to characterize risk due to exposure to contaminants in groundwater, as well as other media. They were considered for non-carcinogens including toluene, 2-butanone, n-dibutylphthalate, acetone, mercury, and thallium.	This factor is one of several factors used to calculate risk at a site, as discussed in Section 1.4. Reference doses and slope factors have changed from 1988, as shown in Table 1-10 for analytes assessed in 1988.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Groundwater (contd.)	EPA Carcinogen Assessment Group Potency Factors (CAGs)	To Be Considered	Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group. EPA Carcinogenic Potency Factors were used to compute the individual incremental cancer risk resulting from exposure to benzene, arsenic, PAHs, trichloroethene, and 1,1-dichloroethene.	This factor is one of several factors used to calculate risk at a site, as discussed in Section 1.4. Reference doses and slope factors have changed from 1988, as shown in Table 1-10 for analytes assessed in 1988.
	Acceptable Intake - Chronic (AIC) and Subchronic (AIS) - EPA Health Effects Assessment (HEA) Documents	To Be Considered	AIC and AIS values are developed from RfDs and HEAs for noncarcinogenic compounds. AIC and AIS values were used to characterize the risks due to several noncarcinogens in various media. These noncarcinogens include cadmium, chromium, copper, and lead.	AICs and AISs have essentially been replaced by RfDs, and are not used in the 1993 updates.
	EPA Office of Water Guidance - Water-related Fate of 129 Priority Pollutants (1979)	To Be Considered	This guidance manual gives transport and fate information for 129 priority pollutants. The manual was used to assess the transport and fate of a variety of contaminants.	There is no change from the ROD presentation for this ARAR.
Massachusetts Criteria, Advisories, and Guidance	Massachusetts Office of Research and Standards Guidelines (ORSGs)	To Be Considered	DEP Health Advisories are guidance criteria for drinking water. DEP Health Advisories were used to develop discharge levels for surface water and groundwater.	The Massachusetts DEP Office of Research and Standards issues guidelines for chemicals for which state MCLs have not yet been promulgated. These guidelines apply to non-chlorinated water supplies and represent a level at or below which adverse, non-cancer health effects are not expected to occur, and which generally has associated with it an excess lifetime cancer risk of less than or equal to one in one million. These criteria are included in Table 1-2.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Discharge to Publicly Owned Treatment Works				
Federal Regulatory Requirements	RCRA - Pretreatment Standards (40 CFR 403) - GLSD POTW Approved Pretreatment Program Requirements	Applicable	Discharges to a POTW must comply with the POTW's EPA-approved pretreatment requirements. POTWs in the area with approved pretreatment programs are being identified and the discharge must be treated to those levels required by the program.	There are no discharges currently occurring to the POTW. These standards would be applicable should any discharges be planned in the future.
Discharge to Surface Water				
Massachusetts Regulatory Requirements	Massachusetts Surface Water Quality Standards (314 CMR 4.05)	Applicable	DEP Surface Water Quality Standards are given for dissolved oxygen, temperature increase, pH, and total coliform and there is a narrative requirement for toxicants in toxic amounts. In the absence of a state standard for a compound, federal AWQC would be appropriate. Requirements were considered; however, no numerical standards exist for contaminants found in site groundwater which would be discharged to surface water. Federal AWQC will be used in the absence of narrative standards.	These regulations classify the surface waters of the Commonwealth according to the uses of those waters. The Merrimack River has a Class B waterway classification. Class B waters are designated as habitat for fish, other aquatic and wildlife , and for primary and secondary contact recreation. The state surface water minimum criteria for Class B waters are consistent with federal AWQC. These rules are applicable to the Merrimack River, Bridge Meadow Brook, Dunstable Brook, Flint Marsh, and Flint Pond.
	Massachusetts Surface Water Discharge Permit Program (314 CMR 3.00)	Not identified (Add as applicable)	None.	These regulations identify the list of toxic pollutants to be controlled with effluent limitations and are applicable to any current or planned discharge to Bridge Meadow Brook, Dunstable Brook, or Flint Marsh.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Surface Water</u>				
Federal Criteria, Advisories, and Guidance	Federal Ambient Water Quality Criteria (AWQC)	Applicable (Revise to Relevant and Appropriate)	Federal AWQC are health-based and ecologically based criteria which have been developed for 95 carcinogenic and non-carcinogenic compounds. AWQC were considered in characterizing public health risks to aquatic organisms due to contaminant concentrations in surface water at Flint Pond. Because this water is not used as a drinking water source, the criteria developed for aquatic organism protection and ingestion of contaminant aquatic organisms were considered. AWQC were also used as limits for discharge to the Merrimack River.	CERCLA Sec. 121 (d)(2)(A) specifically states that remedial actions shall at least attain federal AWQC established under the Clean Water Act if they are relevant and appropriate. Many of the AWQC have changed since ROD completion, illustrated by Table 1-3. Current AWQC are listed in Table 1-3 These criteria are ARAR for establishing discharge limits to the Merrimack River, Bridge Meadow Brook, Flint Marsh, and Flint Pond.
<u>Air</u>				
Federal Regulatory Requirements	CAA - National Ambient Air Quality Standards (NAAQS) - 40 CFR 40	Relevant and Appropriate	These standards were primarily developed to regulate stack and automobile emissions. Standards for sulfur dioxide, carbon monoxide and nitrogen dioxide apply.	NAAQS need to be used in establishing discharges to the atmosphere. This includes the landfill gas treatment system.
Massachusetts Regulatory Requirements	Massachusetts - Air Quality, Air Pollution (310 CMR 6.00 - 8.00)	Relevant and Appropriate	These standards were primarily developed to regulate stack and automobile emissions.	310 CMR 6.00 provide ambient air quality standards for the Commonwealth, standards for dust are contained in 310 CMR 7.09, and 310 CMR 7.08 provides incinerator standards. These standards need to be used in establishing discharge limits from the landfill gas treatment system.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Air (contd.)				
Federal Criteria, Advisories, and Guidance	Threshold Limit Values (TLVs)	To Be Considered	These standards were issued as consensus standards for controlling air quality in workplace environments. TLVs could be used to assess site inhalation risks for soil removal operations.	There is no change from the ROD presentation for this criteria.
Massachusetts Criteria, Advisories, and Guidance	Massachusetts Guidance on Acceptable Ambient Air Levels (AALs)	To Be Considered	These are guidelines in emission permit writing. AALs were considered when assessing the significance of monitored and modeled residential contamination from air emissions.	There is no change from the ROD presentation for this guidance.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Soil and Sediment				
Federal Regulatory Requirements				
There are no set maximum allowable residual levels for chemicals in soil or sediments under federal law.				
Massachusetts Regulatory Requirements	Massachusetts Contingency Plan - Soil Limits (310 CMR 40.0900)	Not identified (Add as applicable)	None.	The revised MCP (July 1993) identifies reportable concentrations and applicable standards in soil. Site soil at the site is categorized as S-3 due to its low accessibility. The MCP Method 1 soil standards consider both the potential risk of harm resulting from direct exposure to the contaminated soil and potential impacts on groundwater at the site. Method 2 soil standards consider both the potential risk of harm resulting from direct contact with the contaminated soil and the potential for contamination to leach to groundwater. Method 3 sets upper concentration limits in soil which, if exceeded, indicate future potential harm to public welfare and the environment. Soil standards for site COCs, for groundwater classification GW-1 and soil category S-3, Method 1, are presented in Table 1-5. There are no set reportable concentrations for soil categorized as S-3.

TABLE 1-2. COMPARISON OF ROD-SPECIFIED NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA[A] FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN WITH CURRENT STANDARDS AND CRITERIA, CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in mg/L)

CHEMICAL	SDWA[C] MCL		SDWA[C] MCLG		314 CMR 5.10 and 314 CMR 6.06[E]		Mass[tts] ORSGs[F]		Mass[tts] MCL (310 CMR 22.00)[G]	
	1988	1995	1988	1995	1988	1995	1988	1994	1988	1995
COC[B]										
acetone	--	--	--	--	--	--	0.25	3.0	--	--
benzene	0.005	0.005	0	0	0.005	--	--	--	--	0.005
benzoic acid	--	--	--	--	--	--	--	--	--	--
2-butanone (MEK)	--	--	--	--	--	--	0.060	0.35	--	--
1,1-dichloroethene	--	0.007	--	0.007	--	--	--	--	--	0.007
ethylbenzene	--	0.7	0.68	0.7	--	--	--	--	0.7	0.7
4-methyl,2-pentanone	--	--	--	--	--	--	--	--	--	--
4-methylphenol	--	--	--	--	--	--	--	--	--	--
2-methylphenol	--	--	--	--	--	--	--	--	--	--
phenol	--	--	--	--	--	--	--	--	--	--
toluene	--	1	2	1	--	--	0.34	--	--	1
trichloroethene	0.005	0.005	0	0	--	--	--	--	--	0.005
arsenic	0.05	0.05	0.05	**	0.05	0.05	0.05	--	--	0.05
cadmium	0.010	0.005	0.005	0.005	0.01	0.01	0.01	--	--	0.005
chromium (total)	--	0.1	--	0.1	--	0.05	--	--	--	0.1
copper	--	*	--	1.3	--	1.0	--	--	--	1.3
mercury	--	0.002	--	0.002	--	--	--	--	--	0.002
Other Chemicals[I]										
1,2-dichloroethane	#	0.005	#	0	#	--	#	--	#	0.005
methylene chloride	#	0.005	#	0	#	--	#	--	#	0.005
tetrahydrofuran	#	--	#	--	#	--	#	1.3	#	--
1,4-dioxane	#	--	#	--	#	--	#	0.05	#	--
antimony	#	0.006	#	0.006	#	--	#	--	#	0.006
lead	#	*	#	0	#	0.05	#	--	#	0.015
nickel	#	0.1	#	0.1	#	--	#	--	#	0.01
thallium	#	0.002	#	0.0005	#	--	#	--	#	0.002

TABLE 1-2 (Continued). COMPARISON OF ROD-SPECIFIED NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA[A] FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN[B] WITH CURRENT STANDARDS AND CRITERIA, CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in mg/L)

CHEMICAL	U.S. EPA Health Advisories[D] One-Day 1993	10-Day 1988	10-Day 1993	Longer-Term 1988	Longer-Term 1993	Lifetime 1988	Lifetime 1993	MCP 310 CMR 40[H] 1993
COC[B]								
acetone	--	--	--	--	--	--	--	3
benzene	0.2	0.233	0.2	--	--	--	--	0.005
benzoic acid	--	--	--	--	--	--	--	--
2-butanone (MEK)	**	7.5	**	2.5	**	0.17	**	0.35
1,1-dichloroethene	2	--	1	--	1	--	0.007	0.007
ethylbenzene	30	--	3	--	1	--	0.7	0.7
4-methyl,2-pentanone	--	--	--	--	--	--	--	--
4-methylphenol	--	--	--	--	--	--	--	--
2-methylphenol	--	--	--	--	--	--	--	--
phenol	6	--	6	--	6	--	4	4
toluene	20	6	2	--	2	2.42	1	1
trichloroethene	--	--	--	--	--	0.005	--	0.005
arsenic	--	0.05	--	0.05	--	0.05	--	0.05
cadmium	0.4	0.043	0.04	0.018	0.005	0.005	0.005	0.005
chromium (total)	1	--	1	--	0.2	--	0.1	0.1
copper	--	--	--	--	--	--	--	--
mercury	--	--	--	--	--	--	0.002	0.002
Other Chemicals[I]								
1,2-dichloroethane	0.7	#	0.7	#	0.7	#	--	0.005
methylene chloride	10	#	2	#	--	#	--	0.005
tetrahydrofuran	--	#	--	#	--	#	--	--
1,4-dioxane	--	#	--	#	--	#	--	--
antimony	0.015	#	0.015	#	0.015	#	0.003	0.006
lead	--	#	--	#	--	#	--	0.015
nickel	1	#	1	#	0.5	#	0.1	0.1
thallium	0.007	#	0.007	#	0.007	#	0.0004	0.002

TABLE 1-2 (Continued). COMPARISON OF ROD-SPECIFIED NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA[A] FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN[B] WITH CURRENT STANDARDS AND CRITERIA, CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in mg/L)

[A] This table provides an update of the regulations and criteria identified in Table 2-1 of the feasibility study (EBASCO, 1988) regulations and criteria.

[B] Chemicals of Concern (COCs) drawn from 1988 Record of Decision, Table 6, entitled *CGL Contaminants of Concern - Phase III.* ROD-specified criteria are from Table 2-1 of the Draft Final Feasibility Study Report, Charles George Landfill (EBASCO, 1988).

[C] Federal Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs). 40 CFR 141, National Primary Drinking Water Standards.

[D] U.S. Environmental Protection Agency, Drinking Water Regulations and Health Advisories, May 1993. One-day, ten-day, longer-term advisories are for 10 kg child; lifetime advisory is for 70 kg adult.

[E] The standards listed are under both sets of Massachusetts Department of Environmental Protection Division of Water Pollution Control regulations and are based on Class I and II groundwaters. 314 CMR 5.10, Groundwater Discharge Program, water quality based effluent limitations (primary and secondary). Toxic pollutants without listed limits are subject to Health Advisory criteria. 314 CMR 6.06, Groundwater Quality Standards, provides minimum groundwater quality criteria for Class I and II.

[F] Massachusetts Department of Environmental Protection, Office of Research and Standards Guidelines, drinking water guidelines. Autumn 1994.

[G] Massachusetts Department of Environmental Protection, 310 CMR 22.00, Drinking Water Regulations, Massachusetts maximum contaminant levels.

[H] Massachusetts Contingency Plan, 310 CMR 40.0974(2) Table 1, Class GW-1 Groundwater Standards for a Method 1 risk assessment, per 310 CMR 40.0932.

[I] Other chemicals listed, although not identified in the 1988 ROD as chemicals of concern, were analyzed as being present at levels greater than MCLs during sampling between 8/90 and 11/92.

* An action level of 1.3 mg/L for copper and 0.0015 mg/L for lead is provided for in the SDWA regulations. These levels are not MCLs.

** Under review

Not identified in the 1988 ROD.

Shading indicates the value has been updated since 1988.

Table 1-3: This chemical-specific ARARs table presents a comparison of the ROD-specified standards (1988) to current (1993) standards for surface water chemicals of concern.

Table 1-4: This table compares groundwater, leachate, and residential well monitoring results with current (1993) standards. The standards and criteria are derived from Table 1-2.

Table 1-5: In this table, Massachusetts Method 1 soil standards (MCP, July 1993) are presented. These soil standards have been selected as being applicable to the site. The standards apply to areas underlain by usable groundwater where the soil exposure route is low, i.e., subsurface soils, low intensity land use, or mixed frequency and intensity land use by adults only.

Table 1-6: This table compares sediment sampling results with available sediment guidelines or criteria.

Table 1-7: Potential location-specific ARARs and guidance identified in the ROD are presented.

Table 1-8: Potential action-specific ARARs and guidance identified in the ROD are re-evaluated. The re-evaluation includes a determination of whether the rule is currently ARAR or TBC.

For future use, a summary of 1993 ARARs as determined by this review is provided as Appendix B.

Overall, many of the ARARs have changed since ROD completion in 1988. What follows is a summary of newly promulgated or modified state and federal requirements.

1.3.3.1 Chemical-Specific ARARs. Standards specified by the various chemical-specific ARARs have undergone significant revision since ROD completion in 1988. These revisions are reflected in the tables accompanying this text. For future use, a summary of 1993 ARARs as determined by this review is provided as Appendix B.

Newly promulgated chemical-specific requirements include the Massachusetts Contingency Plan (MCP). The MCP, as revised (July, 1993), lists numerical standards for both soil and

TABLE 1-3. COMPARISON OF ROD-SPECIFIED NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA[A] FOR SURFACE WATER AND SEDIMENT CHEMICALS OF CONCERN[B], CHARLES GEORGE LANDFILL, MASSACHUSETTS
(All criteria in mg/L)

COC[B]	AMBIENT WATER QUALITY CRITERIA[C]			
	Aquatic Life[D]			
	Acute		Chronic	
	1988	1993	1988	1993
2-butanone (MEK)	--	--	--	--
toluene	17.5[F]	17.5[F]	--	--
acetone	--	--	--	--
benzene	5.3[F]	5.3[F]	--	--
4-methyl,2-pentanone	--	--	--	--
ethylbenzene	32[F]	32[F]	--	--
1,1-dichloroethene	--	--	--	--
trichloroethene	--	45[F]	--	21.9[F]
benzoic acid	--	--	--	--
4-methylphenol	--	--	--	--
2-methylphenol	--	--	--	--
phenol	--	10.2[F]	--	2.56[F]
PAHs	--	--	--	--
bis(2-ethylhexyl) phthalate	0.94[F]	0.94[F]	0.003[F]	0.003[F]
arsenic (trivalent)	0.36	0.36	0.19	0.19
arsenic (pentavalent)	0.85	0.85	0.048	--
chromium (III)	--	1.7[H]	--	0.21[H]
chromium (VI)	--	0.016	--	0.011
copper	--	0.018[H]	--	0.012[H]
mercury	--	2.4E-3	--	1.2E-5
cadmium	3.9E-3[H]	3.9E-3[H]	1.1E-3[H]	1.1E-3[H]

TABLE 1-3 (Continued). COMPARISON OF ROD-SPECIFIED NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA[A] FOR SURFACE WATER AND SEDIMENT CHEMICALS OF CONCERN[B], CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in mg/L)

COC[B]	AMBIENT WATER QUALITY CRITERIA[C]			
	Public Health[E]			
	Water Only 1988	Fish Consumption 1988	Fish Consumption 1993	Water & Fish Ing. 1993
2-butanone (MEK)	--	--	--	--
toluene	15	424	300	10
acetone	--	--	--	--
benzene	6.7E-4	0.040	7.1E-2	1.2E-3
4-methyl,2-pentanone	--	--	--	--
ethylbenzene	2.4	3.28	29	3.1
1,1-dichloroethene	--	--	3.2E-3	5.7E-5
trichloroethene	--	--	8.1E-2	2.7E-3
benzoic acid	--	--	--	--
4-methylphenol	--	--	--	--
2-methylphenol	--	--	--	--
phenol	--	--	4600	21
PAHs	--	--	3.11E-5	2.8E-6
bis(2-ethylhexyl) phthalate	15	50	5.9E-3	1.8E-3
arsenic (trivalent)	2.5E-6	--	0 ($1.8x10^{-5}$)	0 ($1.4x10^{-4}$)
arsenic (pentavalent)	2.5E-6	--	--	--
chromium (III)	--	--	670	33
chromium (VI)	--	--	0.17	3.4
copper	--	--	--	1.3
mercury	--	--	1.5E-4	1.4E-4
cadmium	1.1E-2	--	0.17	1.0E-2

[A] This table provides an update of the surface water regulatory criteria identified in Table 2-1 of the feasibility study (EBASCO, 1988) regulations and criteria.

[B] Chemicals of Concern (COCs) drawn from 1988 Record of Decision, Table 6, entitled *CGL Contaminants of Concern - Phase III*. ROD-specified criteria are from Table 2-1 of the Draft Final Feasibility Study Report, Charles George Landfill (EBASCO, 1988).

[C] Ambient Water Quality Criteria (AWQC). From Code of Massachusetts Regulation, Title 314, Section 4.05(5)(e) and/or U.S. Environmental Protection Agency, 57 FR 60848, December 22, 1992.

[D] Acute criteria are one-hour average concentrations not to be exceeded more than once every three years. Chronic criteria are four-day average concentrations not to be exceeded more than once every three years. Freshwater criteria are shown.

[E] The criterion value of zero for potential carcinogens is listed in the table. Concentrations in the parenthesis for potential carcinogens correspond to a risk of 10^{-6}. The U.S. EPA no longer calculates for a water only criterion - the Safe Drinking Water Act MCL would be the ARAR for drinking water.

[F] Value represented is the Lowest Observed Effect Level.

[H] Hardness-dependent criteria (100 mg/L as $CaCO_3$ used).

Shading indicates the value has been updated since 1988.

TABLE 1-4. 1993 COMPARISON OF NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN WITH ANALYTICAL RESULTS[1], CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in μg/L)

CHEMICAL	Most Stringent GW		Groundwater Results			Leachate Results			Residential Wells		
	ARAR	TBC	Max.	Min.	# Hits	Max.	Min.	# Hits	Max.	Min.	# Hits > ARAR
COC[B]											
acetone	300[H]	300[F]	140	2	27/48	96	ND	1/6	4	3	0
benzene	5[C, G, H]	0[I]	1,300	1	24/48	3	ND	1/9			
benzoic acid	--	--	See note 2.								
2-butanone (MEK)	350[H]	350[F]	300	2	8/43						
1,1-dichloroethene	7[C, G, H]	7[D(Lifetime), I]	ND	ND	0/48						
ethylbenzene	700[C, G, H]	700[I, D(Lifetime)]	1,800	1	16/48	1.4	ND	1/9			
4-methyl,2-pentanone	--	--	31	ND	2/48						
4-methylphenol	--	--	See note 2.								
2-methylphenol	--	--	See note 2.								
phenol	400[H]	400[D(Lifetime)]	See note 2.								
toluene	1,000[C, G, H]	340[D(Lifetime)]	21	2	11/48	2	ND	1/9			
trichloroethene	5[C, G, H]	0[I]	8	1	6/48						
arsenic	50[C, E, G, H, J]	50[I]	348	3.2	35/43	14	ND	8/11	13	1.9	0
cadmium	5[C, G, H]	5[I, D(Lifetime)]	5.6	1	7/43	ND	ND	0/11			
chromium (total)	50[E, J]	100[I]	54	7.4	18/43	28	ND	3/11			
copper	1,000[E]	1,300[I]	78.8	3.8	18/39	31	ND	2/11	910	4	0
mercury	2[C, G, H, J]	2[D(Lifetime), I]	0.36	0.12	6/43	ND	ND	0/10			
Other Chemicals[K]											
1,2-dichloroethane	5[C, G, H]	0[C]	13	1	10/48						
methylene chloride	5[C, H]	0[C]	93	1	13/48[See note 3.]	526	ND	1/9	2	2	0
antimony	6[C, H]	3[D(Lifetime)]	94.1	60	1/43[See note 3.]	380	ND	2/11	42	27	3
lead	15[G, H]	0[C]	49.3	1	24/43	18	ND	6/11	1600	1	14
nickel	100[H]	100[F, D(Lifetime)]	128	12.5	25/43	53	ND	9/11	85	7	0
thallium[See note 4]	2[C, G]	0.4[D (Lifetime)]	NA	NA	NA	ND	ND	0/2			
1,4-dioxane[See note 4]	--	50[F]	11,000	ND	4/70	ND	ND	0/2			
tetrahydrofuran[See note 4]	--	1,300[F]	94	ND	49/85	ND	ND	0/2			

Notes:

1. This table compares the most stringent ARARs and TBC, from Table 1-2, to analytical results from sampling conducted between August 1990 and November 1992, except where noted.
2. Although this constituent was identified in the ROD as a chemical of concern, the monitoring program did not include analysis for this compound.
3. Detection limits in most cases were equal to or higher than the SDWA MCL. Specifically: for antimony, 32/33 samples had detection limits greater than the MCL; for methylene chloride, only 5/40 samples had detection limits lower than the MCL.
4. Not all of the historical data was available at the time of printing. Thallium, 1,4-dioxane and tetrahydrofuran results shown are from November 1989 - August 1990 analytical data. NA = not analyzed.

TABLE 1-4 (Continued). 1993 COMPARISON OF NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN WITH ANALYTICAL RESULTS[I], CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in μg/L)

Sources:

[B] Chemicals of Concern (COCs) are drawn from 1988 Record of Decision, Table 6, entitled *CGL Contaminants of Concern - Phase III.* 1988).

[C] Federal Safe Drinking Water Act, Maximum Contaminant Levels (MCLs). 40 CFR 141, National Primary Drinking Water Standards.

[D] U.S. Environmental Protection Agency, Drinking Water Regulations and Health Advisories, December 1992. One-day, ten-day, longer-term advisories are 0 kg child; lifetime advisory is for 70 kg adult.

[E] The standards listed are under both sets of Massachusetts Department of Environmental Protection Division of Water Pollution Control regulations and are t on Class I and II groundwaters. 314 CMR 5.10, Groundwater Discharge Program, water quality based effluent limitations (primary and secondary). Toxic pollutants without listed limits are ject to Health Advisory criteria. 314 CMR 6.06, Groundwater Quality Standards, minimum groundwater quality criteria for Class I and II.

[F] Massachusetts Department of Environmental Protection, Office of Research and Standards Guidelines, drinking water guidelines. Autumn 1994.

[G] Massachusetts Department of Environmental Protection, 310 CMR 22.00, Drinking Water Regulations, maximum contaminant levels.

[H] Massachusetts Contingency Plan, 310 CMR 40.0974(2) Table 1, Method 1 Groundwater Standards per 310 CMR 40.0932.

[I] Federal Safe Drinking Water Act, Maximum Contaminant Goals (MCLGs). 40 CFR 141, National Primary Drinking Water Standards.

[J] Federal Resource Conservation and Recovery Act (RCRA) groundwater protection standards specified at 40 CFR 264.94.

[K] Other chemicals listed, although not identified in the 1988 ROD as chemicals of concern, were analyzed as being present at levels greater than MCLs during sampling between 8/90 and 11/92.

* An action level of 1.3 mg/L for copper and 0.0015 mg/L for lead is provided for in the SDWA regulations. These levels are not MCLs.

TABLE 1-5. NUMERICAL, CHEMICAL-SPECIFIC ARARS FOR SOIL, CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in μg/kg)

CHEMICAL	MCP METHOD 1 SOIL STANDARDS[A]
acetone	3,000
benzene	10,000
benzoic acid	--
bis(2-ethylhexyl)phthalate	100,000
2-butanone (MEK)	300
di-n-butylphthalate	--
1,1-dichloroethene	700
ethylbenzene	80,000
fluoranthene	600,000
4-methyl,2-pentanone	--
4-methylphenol	--
2-methylphenol	--
phenanthrene	700,000
phenol	60,000
pyrene	500,000
toluene	90,000
trichloroethene	400
arsenic	30,000
cadmium	80,000
chromium (total)	5,000,000
copper	--
mercury	60,000

Notes:

[A] Massachusetts Contingency Plan, 310 CMR 40.0975(6)(c), Table 4, applicable to soil where the combination of soil and groundwater categories are S-3 soil and GW-1 groundwater.

TABLE 1-6. 1993 COMPARISON OF NUMERICAL, CHEMICAL-SPECIFIC CRITERIA FOR SEDIMENT CHEMICALS OF CONCERN WITH ANALYTICAL RESULTS[1], CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in μg/Kg)

CHEMICAL	Ecological Sediment Criteria[2]	Sediment Results Max.	Min.	#Hits/#Samples
acetone	--	7.78	7.78	1/7
benzene	--	0.32	0.28	2/7
benzoic acid	--	ND	ND	0/7
bis(2-ethylhexyl) phthalate	3,600[4]	1.2	0.61	4/7
2-butanone (MEK)	--	ND	ND	0/7
1,1-dichloroethene	--	see note 3		
di-n-butylphthalate	--	0.43	0.43	1/7
ethylbenzene	--	ND	ND	0/7
fluoranthene	600	0.68	0.43	3/7
4-methyl,2-pentanone	--	ND	ND	0/7
4-methylphenol	--	ND	ND	0/7
2-methylphenol	--	ND	ND	0/7
phenanthrene	225	0.58	0.40	3/7
phenol (total)	18[4]	ND	ND	0/7
pyrene	350	0.60	0.40	4/7
toluene	--	0.28	0.18	2/7
trichloroethene	--	see note 3		
arsenic	3,000	7,500	3.1	4/7
cadmium	800	5,400	1.4	7/7
chromium (total)	25,000	22,000	8.9	7/7
copper	19,000	14,000	1.9	7/7
mercury	110	180	0.13	4/7
lead	27,000	34,000	5.4	5/7
nickel	20,000	22,000	6.6	7/7

Notes:

1. This table compares the most stringent ARARs, (see Section 1.4.2) to analytical results from sampling conducted between 1988 and 1992. Chemicals of Concern (COCs) are drawn from 1988 Record of Decision, Table 6, entitled *CGL Contaminants of Concern - Phase III*, 1988).
2. See Section 1.4.2 for references and criteria description. None of these criteria are considered ARARs.
3. Although this constituent was identified in the ROD as a chemical of concern, the monitoring program did not include analysis for this compound.
4. Based on total organic carbon content of 3%.

TABLE 1-7
POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

SITE FEATURE and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Wetlands</u>				
Federal Regulatory Requirements	Clean Water Act (CWA) - (40 CFR Part 230)	Applicable	Under this requirements, no activity that adversely affects a wetland shall be permitted if a practicable alternative that has less effect is available. During identification, screening, and evaluation of alternatives, the effects on wetlands are evaluated.	This ARAR has not been met. Adversely impacted wetlands have not been restored or mitigated.
	Fish and Wildlife Coordination Act (16 U.S.C. 661)	Applicable	This regulation requires that any federal agency proposing to modify a body of water must consult with the U.S. Fish and Wildlife Service. This requirement is addressed under CWA Section 404 requirements.	This ARAR was met; consultation occurred as part of the RI/FS process.
State Regulatory Requirements	Massachusetts - Wetlands Protection (310 CMR 10.00)	Applicable	These requirements are promulgated under Wetlands Protection Laws, which regulate dredging, filling, altering, or polluting inland wetlands. Work within 100 feet of a wetland is regulated under this requirement. The requirement also defines wetlands based on vegetation type and requires that effects on wetlands be mitigated. If alternatives require that work be completed within 100 feet of a defined wetland, these regulations will be considered. Mitigation of impacts on wetlands will be addressed under CWA 404.	This ARAR has not been met. Adversely impacted wetlands have not been restored/mitigated.
	Hazardous Waste Facility Siting Regulations (990 CMR 1.00)	Relevant and Appropriate	These regulations outline the criteria for the construction, operation, and maintenance of a new facility or increase in an existing facility for the storage, treatment, or disposal of hazardous waste. Specifically, no portion of the site may be located within a wetland or bordering a vegetated wetland. These regulations will be addressed during the design phase of the treatment facility construction.	This ARAR was not met. Facility impacted approximately 1.5 acres of wetlands without apparent mitigation.

TABLE 1-7 (continued)
POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

SITE FEATURE and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Federal Requirements to be Considered	Wetlands Executive Order (EO 11990)	To Be Considered	Under this regulation, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. Many of the requirements of this EO will be addressed under CWA Section 404. Any remaining requirements will also be considered during the identification, screening, and evaluation of alternatives.	This ARAR has not been met. Adversely impacted wetlands have not been restored/mitigated.
Floodplains				
Federal Regulatory Requirements	RCRA Location Standards 40 CFR 264.18(b)	Relevant and Appropriate	None	RCRA-defined listed or characteristic hazardous waste (40 CFR 261) facility must be designed, constructed, operated, and maintained to prevent washout by 100-year flood.
	Executive Order 11988; Clean Water Act (40 CFR 6.302(b), Appendix A)	Applicable	None	Federal agencies shall take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values of floodplains. Federal agencies shall also evaluate potential effects of actions in floodplains and ensure consideration of flood hazards and floodplain management. If action is taken in floodplains, alternatives to avoid adverse effects, incompatible development, and minimize potential harm must be taken.

TABLE 1-7 (continued)
POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

SITE FEATURE and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
State Regulatory Requirements	Massachusetts Wetlands Protection (310 CMR 10.57 (2), 10.04)	Applicable	None	Actions in "bordering land subject to flooding" shall provide compensatory storage for flood storage volume lost as a result of the project, shall not restrict flows so as to cause an increase in flood stage or velocity, and shall not impair its capacity to provide important wildlife habitat functions or alter vernal pool habitat. Actions in "isolated land subject to flooding" shall not result in flood damage because of lateral displacement of water that would otherwise be confined within the area, adverse effects on water supply, adverse effects on the capacity of the area to prevent groundwater pollution, or adverse effects on vernal pool habitat.
	Massachusetts Hazardous Waste Facility Location Standards (310 CMR 30.701)	Relevant and Appropriate	None	Active portions of new treatment or storage facilities are prohibited within the boundary of land subject to flooding from the statistical 100-year frequency storm. Active portion of surface impoundments are prohibited within the boundary of land subject to flooding from the statistical 500-year frequency storm.

TABLE 1-7 (continued)
POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

SITE FEATURE and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Landfill and Leachate Ponds</u>				
Federal Regulatory Requirements	RCRA - Standards for Owners and Operators of Permitted Hazardous Waste Facilities (40 CFR 264.10-264.18)	Relevant and Appropriate	General facility requirements outline waste analysis, security measures, and training requirements. Treatment residuals from the wastewater treatment facility will be disposed according to RCRA Subtitle C.	This action-specific ARAR is discussed in Table 1-8.
	RCRA - Preparedness and Prevention (40 CFR 264.30-264.37)	Relevant and Appropriate	This regulation outlines safety equipment and spill control requirements for hazardous waste facilities. Part of the regulation includes a requirement that facilities be designed, maintained, constructed, and operated so that the possibility of an unplanned release which could threaten public health or the environment is minimized. RCRA requirements must be considered when evaluating extensions to the present landfill.	This action-specific ARAR is discussed in Table 1-8.
	RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50-264.56)	Relevant and Appropriate	This regulation outlines requirements for emergency procedures to be used following explosions and fires. This regulation also requires that threats to public health and the environment be minimized. RCRA requirements must be considered when evaluating extensions to the present landfill.	This action-specific ARAR is discussed in Table 1-8.

TABLE 1-7 (continued)
POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

SITE FEATURE and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Landfill and Leachate Ponds (contd.)	RCRA - Groundwater Protection (40 CFR 264.90-264.109)	Relevant and Appropriate	Under this regulation, groundwater monitoring program requirements are outlined. A groundwater monitoring system must be installed as part of any alternative. During site characterization, the location and depth of monitoring wells will be evaluated for use in this monitoring program.	This action-specific ARAR is discussed in Table 1-8.
	RCRA - Closure and Post-Closure (40 CFR 264.110-264.120)	Relevant and Appropriate	This requirement details the specific requirements for closure and post-closure of hazardous waste facilities. A post-closure plan is currently being developed for the site by EPA.	This action-specific ARAR is discussed in Table 1-8.
State Regulatory Requirements	DEQE - Hazardous Waste Regulations, Phase I and II	Relevant and Appropriate	These regulations provide a comprehensive program for the handling, storage, and recordkeeping at hazardous waste facilities. They supplement RCRA regulations. Because these requirements supplement RCRA hazardous waste regulations, they must also be considered at the site.	This action-specific ARAR is discussed in Table 1-8.

TABLE 1-8
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
Federal Regulatory Requirements			
RCRA - Standards for Owners and Operators of Permitted Hazardous Waste Facilities (40 CFR 264.10 - 264.18)	General facility requirements outline general waste analysis, security measures, inspections, and training requirements - **Relevant and Appropriate**	All facilities on-site will be constructed, fenced, posted, and operated in accordance with this requirement. All workers will be properly trained. Process wastes will be evaluated for the characteristics of hazardous wastes to assess further requirements. Treatment residuals from wastewater treatment will be disposed of according to RCRA Subtitle C.	These requirements remain relevant and appropriate, and are being complied with.
RCRA - Preparedness and Prevention (40 CFR 264.30-264.37)	This regulation outlines safety equipment and spill control requirements for hazardous waste facilities. Part of the regulation includes a requirement that facilities be designed, maintained, constructed, and operated so that the possibility of an unplanned release which could threaten public health or the environment is minimized - **Relevant and Appropriate**.	Safety and communication equipment will be installed at the site; local authorities will be familiarized with site operations. RCRA requirements must be considered when evaluating extensions to the present landfill.	These requirements remain relevant and appropriate, and are being complied with.
RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50-264.56)	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc. This regulation also requires that threats to public health and the environment be minimized - **Relevant and Appropriate**.	Plans will be developed and implemented during site work including installation of monitoring wells, and implementation of site remedies. Copies of the plans will be kept on-site. RCRA requirements must be considered when evaluating extensions to the present landfill.	These requirements remain relevant and appropriate, and are being complied with.
RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70-264.77)	This regulation specifies the recordkeeping and reporting requirements for RCRA facilities - **Relevant and Appropriate**.	Records of facility activities will be developed and maintained during remedial actions.	These requirements remain relevant and appropriate, and are being complied with.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
RCRA - Groundwater Protection (40 CFR 264.90-264.109)	This regulation details requirements for a groundwater monitoring program to be installed at the site - **Relevant and Appropriate**.	A groundwater monitoring system must be installed as part of any alternative. During site characterization, the location and depth of monitoring wells will be evaluated for use in this monitoring program.	A groundwater monitoring program has been implemented at the site.
RCRA - Closure and Post-Closure (40 CFR 264.110-264.120)	This regulation details specific requirements for closure and post-closure of hazardous waste facilities - **Relevant and Appropriate**.	Those parts of the regulations concerned with long-term monitoring and maintenance of the site will be considered during remedial design. A post-closure plan will be developed.	A post closure plan is currently being managed by the EPA and USACE.
OSHA - General Industry Standards (29 CFR Part 1910)	This regulation specifies the 8-hour time-weighted average concentration for various organic compounds - **Not ARAR.**	Proper respiratory equipment will be worn if it is impossible to maintain the work atmosphere below the concentrations.	OSHA has promulgated standards for protection of workers at hazardous waste operations at RCRA or CERCLA sites. These regulations are designed to protect workers who would not be exposed to hazardous waste.
OSHA - Safety and Health Standards (29 CFR Part 1926)	This regulation specifies the type of safety equipment and procedures to be followed during site remediation - **Not ARAR.**	All appropriate safety equipment will be on-site. In addition, safety procedures will be followed during on-site activities.	
OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR 1904)	This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA - **Not ARAR.**	These requirements apply to all site contractors and subcontractors and must be followed during all site work.	OSHA requirements are no longer considered ARAR by the EPA as OSHA is viewed as an employee protection law rather than an "environmental" law, and as OSHA standards apply directly to all CERCLA response actions. (see Federal Register volume 55, page 8679, March 8, 1990). EPA requires compliance with the OSHA standards in the NCP (40 CFR 300.150), not through the ARAR process. OSHA standards are discussed in the Site Health and Safety Plan.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
RCRA - EPA Regulations on Land Disposal Restrictions (40 CFR 268)	This regulation outlines land disposal requirements and restrictions for hazardous wastes - **Relevant and Appropriate**.	Regulations to be phased in over the next few years require contaminated soils to be treated to the Best Demonstrated Available Technology levels before being placed or replaced on the land. Hazardous waste cannot be stored except when accumulated for recovery, treatment, or disposal. Land disposal restrictions for PAH's have not yet been developed.	Land disposal restrictions (LDR) apply (or are relevant and appropriate) only to wastes being placed on the land and not to wastes already in place. These rules may be applied only to new wastes generated on-site as a result of treatment or to wastes excavated or dredged that meet RCRA characteristics for hazardous wastes. LDR criteria have been developed for most site contaminants.
Clean Water Act - 40 CFR Parts 122, 125	Any point source discharges must meet NPDES permitting requirements, which include compliance with applicable water quality standards; establishment of a discharge monitoring system; and routine completion of discharge monitoring records. **Applicable.**	If groundwater that has been treated by on-site treatment processes is discharged to surface waters on-site, treated groundwater must be in compliance with applicable water quality standards. In addition, a discharge monitoring program must be implemented. Routine discharge monitoring records must be completed.	Leachate collection was implemented in 1991. Collected leachate is periodically treated and discharged to Bridge Meadow Brook. Discharges are monitored, although no specific monitoring program is documented. A groundwater collection and treatment program is under construction. Upon its completion, leachate treatment will be combined with groundwater treatment. A discharge monitoring program for the combined flows must them be implemented. Toxicity on surface water runoff is being conducted biannually. Any leachate breakouts that impact surface water bodies are thus being monitored. Discharges from the sedimentation basins are being monitored. Documentation of these activities is desirable.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
CWA - 40 CFR Part 403	This regulation specifies pretreatment standards for discharges to a POTW - **Not ARAR.**	If a leachate collection system is installed and the discharge is sent to a POTW, the POTW must have an approved pretreatment program. The collected leachate runoff must be in compliance with the approved program. Prior to discharging, a report must be submitted containing identifying information, list of approved permits, description of operations, flow measurements, measurement of pollutants, certification by a qualified professional, and a compliance schedule.	No on-site wastes are currently discharging, or planned for discharge, to the POTW.
CWA - 40 CFR Part 230	This regulation outlines requirements for discharges of dredged or fill material. Under this requirement, no activity that impacts a wetland will be permitted if a practicable alternative that has less impact on the wetland is available. If there is no other practicable alternative, impacts must be mitigated - **Applicable**	During the identification, screening, and evaluation of alternatives, the effects on wetlands must be evaluated.	An evaluation of the effects of remedial actions on wetlands is on-going. Wetlands mitigation efforts will continue throughout remediation.
CAA - NAAQS for Total Suspended Particulates (40 CFR 129.105,750)	This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter - **Applicable.**	Fugitive dust emissions from site excavation activities will be maintained below 260 $\mu g/m^3$ (primary standard) by dust suppressants, if necessary.	These requirements remain applicable.
Protection of Archeological Resources (32 CFR Part 229, 229.4; 43 CFR Parts 107, 171.1-171.5)	This regulation develops procedures for the protection of archeological resources - **Not ARAR**	If archeological resources are encountered during soil excavation, work will stop until the area has been reviewed by federal and state archaeologists.	No archeological resources have been, or are expected to be encountered at the site.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
DOT Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171.1-171.5)	This regulation outlines procedures for the packaging, labeling, manifesting, and transportation of hazardous materials - **Applicable**	Contaminated materials shipped off-site will be packaged, manifested, and transported to a licensed off-site disposal facility in compliance with these regulations.	Shipping of hazardous materials has been in compliance. A higher frequency of shipment is expected upon startup of the groundwater treatment plant.
State Regulatory Requirements			
Massachusetts Hazardous Waste Regulations, Phase I and II (310 CMR 30.000, MGL Ch. 21C)	These regulations provide a comprehensive program for the handling, storage, and recordkeeping at hazardous waste facilities. They supplement RCRA regulations - **Relevant and Appropriate**	Because these requirements supplement RCRA hazardous waste regulations, they must also be considered at the site.	These requirements remain relevant and appropriate, and are being complied with.
Massachusetts General Laws, Ch. III, Sec. 150B	Under this regulation, the local board of health may require a local site assignment for hazardous waste treatment, storage, and/or disposal facilities - **Relevant and Appropriate**	The local board of health should be made aware of any hazardous waste activities.	The local board of health is aware of all site activities and has been a participant in remediation efforts.
Acts of 1982, Ch. 232, Sec. 150A and 150B. (Now Codified in Massachusetts Solid Waste Management regulations at 310 CMR 19.141)	This regulation requires that notice be recorded in the Registry of Deeds whenever certain types of solid or hazardous waste activity occur on property - **Applicable.**	Notification of remedial actions will be given to the County Registry of Deeds.	
Massachusetts - Air Quality, Air Pollution (310 CMR 6.00 - 8.00)	This regulation outlines the standards and requirements for air pollution control in Massachusetts; all provisions, procedures, and definitions are described - **Applicable.**	Particulate matter emissions from site excavation activities must be maintained at an annual geometric mean of 75 $\mu g/m_3$, and a maximum 24-hour concentration of 40 mg/m^3 (primary standards).	Application of water, seed, cover, or other treatment is required over the landfill to prevent excessive emissions of particulate matter (310 CMR 7.09). Final seeding activities are ongoing and anticipated to be completed during 1994.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
Massachusetts Air Pollution Control (Continued)			All air emissions facilities as defined in 310 CMR 7.02 must meet Best Available Control Technology (BACT) requirements (310 CMR 7.02(2)(a)(2)(g) and (b)(2)(g)). The Charles George site remediation does not include any facilities as defined by 310 CMR 7.02 that emit greater than 1 ton/year VOCs. The definition of a "Contaminated Groundwater Treatment System (CGTS)" is restricted to the "stripping of VOC from the water. . ." The groundwater treatment system includes biological treatment, metal precipitation, carbon adsorption, and, if necessary, ion exchange. Air stripping of VOCs is not known to be included in the design, however, if the design does include a VOC stripper, this rule would become applicable and BACT would be required. The definition of a "Contaminated Soil Venting System" specifically excludes the venting of landfills and is, therefore, not applicable. However, MA DAQC has stated that the preferred treatment option for best available control technology for treatment of landfill gas is construction of an enclosed gas flare.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
			Preliminary calculations show that, without any treatment, total VOCs emitted would be less than .368 tons per year, far less than the one ton per year level that triggers additional MA DAQC facility requirements.
Off-Gas Treatment of Point-Source Remedial Air Emissions (Policy #WSC-94-150)	This policy concerns air emissions from remedial activities - **To be considered**	None.	This policy articulates when off-gas treatment of point-source remedial air emissions may be necessary to eliminate risks.
Massachusetts Wetlands Protection (310 CMR 10.00)	This regulation outlines the requirements necessary to work within 100 feet of a coastal or inland wetland. The act sets forth a public review and decision-making process by which activities affecting waters of the state are to be regulated to contribute to their protection - **Applicable.**	Wetland remediation will comply with the substantive but not the administrative requirements for wetland protection.	Based on field inspection, wetland remediation has not been conducted.
Massachusetts Surface Water Discharge Permit Program (314 CMR 2.00 - 4.00)	This section outlines the requirements for obtaining an NPDES permit in Massachusetts - **Applicable.**	Pollutant discharges to surface water must comply with NPDES permit requirements. Permit conditions and standards for different classes of water are specified.	314 CMR 3.00 establishes the program whereby discharges of pollutants to surface waters are regulated. Outlets for such discharges and any associated treatment works are also regulated. Surface water at the site is classified "B - warm water, treated water supply" under 314 CMR 4.06. Since the planned wastewater treatment facility will address, and possibly discharge, toxic pollutants listed under 314 CMR 3.16, these rules apply. Although a permit is not required, its substantive equivalent is.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
Massachusetts Groundwater Permit Program and Groundwater Quality Standards (314 CMR 2.00, 5.00, 6.00)	These rules specify the requirements for obtaining a groundwater discharge permit in Massachusetts - **Not ARAR**	Pollutant discharges to groundwater must comply with permit requirements. Permit conditions and standards for different classes of water are specified.	314 CMR 5.00 establishes the program whereby discharges of pollutants to groundwater are regulated, as are outlets for such discharges and any associated treatment works. 314 CMR 6.00 establishes groundwater quality standards and the designation and assignment of groundwater classifications. Groundwater underlying the site is designated Class I. Reinjection of treated groundwater is not planned at this time, so discharge permit-equivalent documentation is not required. (Groundwater does require remediation under chemical-specific requirements).
Supplemental Requirements for Hazardous Waste Management Facilities (314 CMR 8.00)	This regulation outlines the additional requirements that must be satisfied in order for a RCRA facility to comply with the NPDES regulations. These regulations apply to a water treatment unit; a surface impoundment that treats influent wastewater; and a POTW that generates, accumulates, and treats hazardous waste - **Not ARAR.**	All owners and operators of RCRA facilities shall comply with the management standard of 310 CMR 30.500, the technical standards of 310 CMR 30.600, the location standards of 310 CMR 30.700, the financial responsibility requirements of 310 CMR 30.900 and, in the case of POTWs, the standards for generators in 310 CMR 30.300.	314 CMR 8.00 establishes the program whereby wastewater treatment works exempted from RCRA rules would be regulated here. Since the wastewater treatment facility is being managed as a RCRA/MGL 21C facility, these rules are redundant. In the event that the facility is reclassified, these rules may become applicable.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
Certification for Dredging, Dredged Material Disposal, and Filling in Waters (314 CMR 9.00, MGL Ch. 21, ss. 26-53)	This regulation is promulgated to establish procedures, criteria, and standards for the water quality certification of dredging and dredged material disposal - **Not ARAR**.	Applications for proposed dredging/fill work need to be submitted and approved before work commences. Three categories have been established for dredge or fill material based on the chemical constituents. Approved methods for dredging, handling, and disposal options for the three categories must be met.	No dredging, discharge of dredge material, or filling in of navigable waters is occurring or planned to occur. However, during remedial actions the discharge of pollutants into surface water bodies will occur; this situation triggers Wetlands Protection Act (MGL Ch. 131) and waterways (MGL ch. 91) requirements.
Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works, and Indirect Discharges (314 CMR 12.00)	The regulations establish requirements that ensure the proper operation and maintenance of wastewater facilities within the Commonwealth - **Applicable**.	A wastewater treatment facility would be operated and maintained in compliance with this regulation.	No indirect discharges to a POTW have occurred or are planned. A wastewater treatment facility is currently under construction for the treatment of collected groundwater and leachate. The wastewater treatment facility would discharge directly on-site. These rules require any wastewater treatment facility to adopt and keep current an operation and maintenance manual in accordance with 314 CMR 12.04(1). An O&M manual is planned for the future facility.
Implementation of M.G.L. C.111F, Employee and Community "Right to Know" (310 CMR 33.00)	The regulations establish rules and requirements for the dissemination of information related to toxic and hazardous substances to the public - **Applicable**	Information applicable to site activities and characteristics will be made available to the public.	The EPA has implemented an active community relations program to disseminate information about the site to the local community.
Worker "Right to Know" (441 CMR 21.00)	These regulations establish requirements for worker "Right to Know."	These requirements apply to all site workers and must be followed during all site work.	Each contractor performing site work is responsible for compliance with this requirement.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
Massachusetts Solid Waste Management Regulations under MGL Ch. 21D (310 CMR 19.130)	Not identified in ROD - **Applicable**.	None.	Maintenance requirements of a solid waste landfill identified here include: prevention of unauthorized access by fences and other barriers; locked gates at all points of entry; and posting of warning signs. Maintenance requirements are being met.
Massachusetts Solid Waste Management Regulations under MGL Ch. 21D (310 CMR 19.110)	Not identified in ROD - **Applicable**.	None.	Groundwater protection systems are specified to control migration of leachate out of the landfill and into the groundwater. A leachate collection system has been installed at the site.
Massachusetts Solid Waste Management Regulations under MGL Ch. 21D (310 CMR 19.117, 19.118, 19.132, 19.133)	Not identified in ROD - **Applicable**.	None.	All solid waste landfills must include groundwater, surface water and gas monitoring systems designed, operated, and maintained in accordance with applicable rules. Explosive gases must be controlled to no greater than 25% LEL within on-site structures or at the property boundary. Long-term groundwater and surface water monitoring requirements are being met. Gas monitoring needs to be conducted at the property boundary.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
			Limitations on post-closure construction and use are outlined in the regulations. Alternative end uses need to be proposed. Use restrictions, such as deed restrictions, must be provided for after completion of remedial activities.
Massachusetts Solid Waste Management Regulations under MGL Ch. 21D (310 CMR 19.112, 19.140, 19.142)	Not included in ROD - **Applicable.**	None.	Final cover system standards and landfill closure/post-closure care requirements are applicable to the site. Applicable post-closure care requirements include: monitor the site during the post-closure period in order to ensure the integrity of the closure measures and to detect and prevent any adverse impacts of the site on public health, safety or the environment; take corrective actions in response to any conditions which would compromise the integrity and purpose of the final cover; maintain the integrity of the liner system and final cover system; collect leachate from and monitor and maintain leachate collection systems; monitor and maintain the surface water, groundwater, and air quality monitoring systems; maintain landfill gas control systems; maintain access roads; protect and maintain surveyed benchmarks.

TABLE 1-8 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	ROD REQUIREMENT SYNOPSIS AND REQUIREMENT STATUS	ROD-SPECIFIED ACTION TO BE TAKEN TO ATTAIN ARARS	FIVE-YEAR REVIEW
			The site cap is designed to meet the more stringent requirements for a hazardous waste landfill and, thus, achieves compliance with solid waste rules. Not all components of these requirements have been installed as yet.

groundwater, providing several methods for determining which standards would apply. For the site, it has been determined that category GW-1 groundwater applies since site groundwater is within 500 feet of a private water supply well that was in use at the time of site discovery (310 CMR 40.0932(4)(f)). Also, category S-3 soil applies due to the low accessibility of site soils. In addition, it has been determined that Method 1 Risk Assessment Soil Standards apply, as this method considers both the potential risk of harm resulting from direct exposure to the contaminated soil and potential impacts on groundwater.

Another requirement to be added to the chemical-specific ARAR list for the site is the Massachusetts Surface Water Discharge Permit Program. Even though this program existed in 1988, the ROD did not identify its requirements as ARAR. These regulations apply to any current or planned discharges to surface water bodies, such as Dunstable Brook, Bridge Meadow Brook, Flint Marsh, or Flint Pond. Although a Massachusetts surface water discharge permit is not required, equivalent documentation must be attained, and identified toxic pollutants are to be controlled to within equivalent effluent limitations. Discharge standards have been established for the leachate and groundwater treated effluent. These standards were developed by the MA DEP and have given EPA a window of 5 years to discharge, starting in 1992 and ending in 1996. Determination as to the feasibility of groundwater reinjection (ROD III remedy) must be made, with state approval, prior to extending this discharge allowance. The state conducts periodic sampling of surface water runoff from the site and sediments in the sedimentation ponds as part of its O&M responsibilities under OU #2 (ROD II).

Although federal ambient water quality criteria are non-enforceable guidance developed under the Clean Water Act, and therefore cannot be applicable by definition, Section 121(d) of CERCLA specifies that these criteria be attained when relevant and appropriate. Environmental factors being considered at the site render these requirements relevant and appropriate.

Criteria to-be-considered are also modified from the 1988 presentation. Massachusetts Drinking Water Health Advisories have been replaced by Massachusetts Office of Research and Standards Guidelines (ORSGs). Federal acceptable intake chronic and subchronic values are no longer used. having been replaced by Risk Reference Doses (RfDs). In addition, RfDs and Carcinogen Assessment Group (CAG) slope factors are two of several factors that may be used to calculate risk at a site. These criteria do not need to be identified in the ARAR section as they are usually covered under the risk assessment discussion. For the purposes of this re-evaluation, however, RfDs and CAG slope factors are updated on the numerical tables.

Revisions to the chemical-specific requirements affect treatment plant design, construction, operation, and maintenance as well as waste disposal practices. Environmental monitoring programs may also need to be modified to address the chemical-specific ARARs, particularly the groundwater protection programs under RCRA and the Commonwealth of Massachusetts.

1.3.3.2 Location-Specific ARARs. The wetlands ARARs identified in the 1988 ROD still apply today. The Resource Conservation and Recovery Act (RCRA) contains a number of explicit limitations on where on-site storage, treatment, or disposal of hazardous waste may occur. RCRA location requirements and land disposal restrictions are considered to be location-specific ARARs. Other siting requirements are also considered ARAR.

Because there are no wilderness areas in the vicinity of the site, the site is not located near any wild or scenic rivers, and the site is not located near a coastal area, the requirements associated with the Wilderness Act, the Coastal Zone Management Act, and the Marine Protection, Research, and Sanctuaries Act are not considered. Also, because there are no identified historic, scientific, or archaeologic sites in the vicinity of the site, the requirements associated with the Archaeological and Historic Preservation Act of 1974, Historic Sites Building and Antiquities Act, and the National Historic Preservation Act of 1966 are not considered. As no endangered or threatened species or critical habitat have been identified, the requirements of the federal Endangered Species Act are also not considered ARARs. Should any federal endangered or threatened species, or critical habitat, be identified in the vicinity of the site, this act would become applicable.

Based upon the 1993 wetlands assessment, areas impacted by remedial actions were assessed. The *Wetland Damage Assessment Report* (HMM, 1990) stated that approximately 1.5 acres of wetlands were filled during capping activities and an additional 5 acres of wetlands were altered or otherwise damaged. This report also outlined general mitigation requirements and procedures. Based on the 1993 wetlands inspection, it appears that the wetland mitigation proposed in the Wetland Damage Assessment Report has not been addressed since no replicated wetlands were observed and damage to other wetland areas persists. In ROD II, the Consistency With Other Environmental Laws and Regulations Section includes a provision for wetlands restoration and replication.

Several requirements listed as location-specific in the 1988 ROD have been deleted as being redundant with identified action-specific requirements.

1.3.3.3 Action-Specific ARARs. Action-specific requirements identified in the 1988 ROD were presented for all alternatives evaluated; action-specific requirements for the selected remedy were not clearly distinguished. An attempt has been made to clarify the requirements. The requirement status identified in Table 1-8 is accurate for on-going remedial actions.

1.4 RISK ASSESSMENT REVIEW

1.4.1 Human Health Risk Assessment

Site-related human health and environmental risks were estimated in the Remedial Investigation Report prepared by E.C. Jordan and Ebasco (Ebasco, 1988). Human health risks were estimated to exceed the EPA target cancer risk range of 10^{-7} to 10^{-4} and/or a hazard index of 1.0 from the following exposures:

1. Dermal exposure to sediment in one location in Dunstable Brook (carcinogenic risk at E.C. Jordan sample location No. 8 estimated as 2.2 x 10^{-4} from a worst-case scenario, mostly from PAHs).

2. Exposure to groundwater from a hypothetical future deep bedrock water supply well to the east (estimated carcinogenic risks from groundwater 500 feet from the landfill sum to 7.2 x 10^{-4}, mostly from arsenic present below the MCL).

3. Exposure to groundwater from existing domestic shallow groundwater wells to the southwest (carcinogenic risk for most-probable and realistic worst-case exposures estimated as 1.8 x 10^{-2}, and 2.2x10^{-2} respectively; and estimated hazard indices 0.90 and 1.09 from the same scenarios).

4. Exposure to groundwater from hypothetical bedrock groundwater wells, southwest of the landfill (hazard indices estimated as maximum of 1.2).

5. Inhalation of venting system emissions on-site (risks estimated as maximum of 1.2 x 10^{-3}, for a realistic worst case scenario, with a hazard index up to 8.0).

6. Inhalation of venting system emissions in off-site area (risk from inhalation of air, based on monitoring results at the Cannongate residential complex was estimated as at least 1.5 x 10^{-4}).

7. Inhalation of venting system emissions in off-site area (risk from inhalation of air, based on monitoring results at Flint Pond was estimated as at least 4.2 x 10^{-4}).

In this five-year review, risks from contaminants in groundwater and landfill gas are not reassessed, because remediation of these media is planned and/or under way, under ROD III. Human health risks from exposure to sediment are qualitatively re-assessed, using data from samples collected in 1993. Several factors differ in the risk from sediment, compared to the 1988 assessment.

The 1988 assessment evaluated human health risk separately for each sampling point. Metcalf & Eddy evaluated all Dunstable Brook sediment samples together as one exposure route. Measured sediment concentrations are expected to be different after five years. Table 1-9 presents sediment data from 1987 and 1988. The list of chemicals detected also differs; however, for comparability, only those compounds listed in ROD III as sediment contaminants of concern are compared to 1993 sediment data. Reference doses and slope factors have changed from 1988, as shown in Table 1-10, for analytes assessed in 1988. One assumption which does not need to be changed is that inhalation and ingestion of sediment would be negligible, so only dermal

TABLE 1-9. SEDIMENT CONCENTRATIONS, 1987-1988

CHEMICAL	1987 Concentrations from Alliance (mg/kg)		1988 Concentrations from ECJordan, by area (mg/kg)	
	Most-probable	Worst-case	Most-probable	Worst-case
Bis(2-ethylhexyl)phthalate	0.16	0.91		
Di-n-butyl phthalate	0.0334	0.2		
PAHs	0.393	6.32	-- (1)	11,000 (1)
			-- (2)	-- (2)
			-- (3)	5.3 (3)
2-Butanone	0.0036	0.073		
Toluene	0.0011	0.011		
Arsenic	20	86	29.4 (1)	110 (1)
			30.4 (2)	300 (2)
			-- (3)	17.0 (3)
Cadmium	0.4	6.5	0.14 (1)	0.2 (1)
			2.1 (2)	6.5 (2)
			-- (3)	4.8 (3)
Copper	13	75		

(a) RME, reasonable maximum exposure, is defined by U.S. EPA Region I as representing maximum contaminant concentrations.
(1) Concentration in Flint Pond
(2) Concentration in Flint Pond Marsh
(3) Concentration in Dunstable Brook
-- No value provided

TABLE 1-10. CHANGES IN REFERENCE DOSES AND SLOPE FACTORS 1988-1994

CHEMICAL NAME	Reference Doses (mg/kg/day)			Slope Factors (/(mg/kg/day))			
	1988 Value	April 1994		1988 Value	April 1994		
		Value	Source		Group	Value	Source
Bis(2-ethylhexyl)phthalate	0.02	0.02	IRIS 2/93	6.8×10^{-4}	B2	1.4×10^{-2}	IRIS 2/93
Di-n-butyl phthalate	0.1	0.1	IRIS 2/93	--	D	--	IRIS 2/93
PAHs: fluoranthene	--	0.04	IRIS 7/93	--	D	--	IRIS 7/93
phenanthrene	--	--	IRIS 7/93	--	D	--	IRIS 7/93
pyrene	--	0.03	IRIS 7/93	--	D	--	IRIS 7/93
carcinogenic PAHs	--	--		11.5	B2	7.3	IRIS 3/94 Slope factor for B(a)P applies to all cPAHs, per EPA Region I
2-Butanone	0.05	0.6	IRIS 6/93	--	D	--	IRIS 6/93
Toluene	0.29	0.2	IRIS 2/94	--	D	--	IRIS 2/94
Arsenic	--	0.0003	IRIS 3/94	1.5	A	1.75	IRIS 3/94 Slope factor extrapolated from unit risk
Cadmium	0.00029 [a]	0.001 [b]	IRIS 2/94	--	[c]	--	IRIS 2/94
Copper	0.037 [a]	0.037 [a]	HEAST 93	--	D	--	IRIS 1/92

NOTES
Shaded values are changed since 1988
-- No value provided
a. Value shown is based on the drinking water action level and is not a reference dose
b. Cadmium RfD is 0.001 mg/kg/day in food, 0.0005 mg/kg/day in water
c. Cadmium is a Group B1 carcinogen by inhalation, but is not considered carcinogenic by ingestion

contact requires evaluation. Current/recent EPA Region I risk assessment policy would be to evaluate dermal exposures to sediments only "qualitatively." This review evaluates dermal exposures qualitatively by comparing to the past quantitative assessment. Possible updates to dermal exposure assumptions are presented in Table 1-11. This includes reduction to one set of exposure parameters (except that exposures will be evaluated at two different concentrations - average and RME), in accordance with EPA Region I protocols. Also, M&E has recalculated the average weight of people in the age group which was selected for assessment in the 1988 assessment.

A limited percentage of contaminants present in sediments absorbed to skin will diffuse through the skin so as to be absorbed by the body. This amount is generally less than the absorption of chemicals following ingestion. The amount of chemical absorbed through the skin can be described as a roughly equivalent oral dose if the ratio between skin and gastrointestinal absorption can be estimated. This would be useful because most oral reference doses and slope factors are based on absorption following ingestion; in these cases the absorption ratio is the relative absorption factor (RAF). Relative absorption factors have been estimated for various chemicals from a soil matrix.

Metcalf & Eddy recommends using RAFs tabulated by the Massachusetts Department of Environmental Protection (MADEP, 1992). Chemical-specific RAFs are available from MADEP for most of the 1988 chemicals of concern in sediment, MADEP presents documentation of each selected RAF, and the values are in general use within the Commonwealth of Massachusetts. Alternatives would be to use discontinued EPA Region I absorption factors (EPA, 1989) or the values used by E.C. Jordan (1988).

1.4.2 Ecological Risk Assessment

Alliance Technologies Corporation (ATC) reviewed environmental risks in the vicinity of the Charles George Landfill in the 1987 Endangerment Assessment report (ATC, 1987). The report was largely qualitative and did not contain a quantitative characterization of risks to flora and

TABLE 1-11. POSSIBLE CHANGES IN EXPOSURE PARAMETERS, 1988-1994

Parameter	Alliance Selections, 1987	ECJordan Selections, 1988	Proposed, 1994	Source of 1994 parameter
Ages exposed	6-15 years	8-17 years	8-17 years	ECJordan
Average weight over period of exposure	35 kg	35 kg	47 kg	Calculated from EPA 1991 (EFH)
Frequency of contact: Most-probable Reasonable worst-case	 16 times/year 32 times/year	 16 times/year 32 times/year	 32 times/yr 32 times/yr	ECJordan (reasonable worst-case)
Years of exposure: Most-probable Reasonable worst-case	 1 year 5 years	 5 years 10 years	 10 years 10 years	ECJordan (reasonable worst-case)
Quantity of sediment contacted: Most-probable Reasonable worst-case	0.01 kg 0.02 kg	0.005 kg 0.01 kg	0.01 kg/day 0.01 kg/day	ECJordan (reasonable worst-case)
Relative absorption factor	-- [100%]	PAHs: 10% Others: 1% (most-probable); 10% (reasonable worst-case)	Alternative 1: phthalates: 2% (DEHP) PAHs: 2% to 29% MEK: 10% toluene: 12% As: 3% Cd: 14% Cu: 35% (from Ni) (MADEP, 1992)	Alternative 2: PAHs and, by extension, phthalates, 5%, MEK & toluene, 50%; metals, negligible (EPA, 1989)
Fraction of arsenic available for absorption	-- [100%]	5% 10%	-- [100%]	term assumed to be included in RAF term

Note: Shaded values would be changed from the parameters used in 1988.

fauna. The report defined the contaminants of most concern (with respect to human health) and discussed routes of exposure, mechanisms of contamination, and the potential direct and ecosystem-level indirect effects of contamination.

The ATC (1987) report stated that the greatest concern for the biota in the vicinity of the landfill were the chronic effects associated with bioaccumulation and biomagnification of inorganic and organic compounds within the food chain. Another subject of concern was the high potential for the loss of species diversity through competitive dominance of less sensitive plants and animals. ATC (1987) cited data from the NUS (1986) Remedial Investigation which suggested that sediment toxicity had caused a decrease in macroinvertebrate species diversity from the location of landfill leachate discharge downstream to Dunstable Brook.

Because previous studies only identified a risk to ecological receptors based on sediment exposures, only this medium will be directly re-evaluated in this five-year review for ecological risks. This reassessment will utilize data from sediment toxicity tests conducted on sediments collected in 1993. If these tests show that the sediments are toxic, results of sediment chemical analyses for volatile organic compounds, semivolatile organic compounds, and metals will be compared with available sediment standards, guidelines, or criteria, or to effect levels obtained from the literature. These include low effect range level (ER-L) and medium effect range level (ER-M) guideline values developed as part of the National Oceanic and Atmospheric Administration (NOAA) National Status and Trends Program (Long and Morgan, 1990), U.S. Environmental Protection Agency (USEPA) Region 5 unpublished guidelines (presented in Fitchko [1989] and Beyer [1990]) for the pollution classification of Great Lakes harbor sediments, New York State Department of Environmental Conservation (NYSDEC, 1989) sediment criteria, and USEPA interim sediment quality criteria (USEPA, 1988). Although none of these values are considered enforceable criteria and thus would not be considered ARARs, they provide a reasonable estimate of the potential ecological risk posed by contaminants in sediments.

Data from fish tissue sampling, conducted in the fall of 1993, will also be evaluated to estimate the risk to aquatic receptors. These 1993 fish tissue data, for metals only, will be compared to similar data collected previously at the site to determine temporal trends in contaminant concentrations.

SECTION 2.0
PRESENT SITE CONDITIONS

This section summarizes the activities performed at the site. Site activities performed as part of the five-year review include:

- A site visit
- Off-site sediment sampling
- Off-site fish tissue sampling
- Wetlands delineation
- Ecological profile

Section 2.1 gives a summary of each activity including the full wetlands and habitat characterization, Section 2.2 provides the analytical results for sediment and fish tissue analyses and a brief discussion of the results.

2.1 SUMMARY OF SITE ACTIVITIES

Five activities were performed at or adjacent to the site. These activities documented the site conditions, downstream effects, and completeness of remedial actions implemented to date. This effort included the following activities; a visual inspection of the landfill cap, a wetlands area delineation, an ecological profile, and environmental data collection. Analytical data gathering activities were performed at locations directly adjacent to the landfill (e.g. sediment sampling in Dunstable Brook and Flint Pond Marsh) and downstream of the landfill (e.g. sediment and fish tissue sampling in Flint Pond).

2.1.1 Cap Inspection

On December 9, 1993, M&E performed a site visit to inspect the landfill surface for cracks, erosion, settlement, vegetative growth, drainage structures and other general features of the landfill cap. The inspection (site walkover) included walking the toe of slope, the bench, the access road and the crest of the landfill. Representatives of the EPA, DEP and the U.S. Army Corps of Engineers were present throughout the site visit. DEP was present to inspect the landfill in preparation for subsidence testing. The USACE was present as the site construction managers.

Weather conditions during the inspection were cold but sunny. The inspection followed a recent period of rainfall. The ground was not frozen or snow covered, but there were areas of visible frost. Overall, the landfill cap is in good condition. Some areas require maintenance, but they are known and maintenance managed by the USACE is planned. These areas are identified below.

Subsidence

One purpose of the inspection was to determine the extent to which localized subsidence is visibly occurring. Because subsidence is often difficult to notice during field investigations, documentation from a site walkover can only be approximate in extent and location; the evaluation is subjective. While aerial photography and surveyed settlement markers provide a quantitative determination of actual settlement, such activities were not included in the scope or therefore not undertaken as part of this inspection. The DEP, will be conducting a more detailed investigation of settlement through the installation and surveying of settlement markers. The anticipated installation of the markers is the spring of 1994.

In several areas of the landfill, there were indications of potential subsidence such as subtle irregularities in the side slopes and slight dips or inconsistencies in the grade. One clear depression was evident on the southern portion of the landfill, between the bench (see Figure 1-2) and the access road along the top of the landfill. At a second area of possible subsidence along the northwestern side slope, it was not possible to distinguish whether the depressed area was indicative of grading or was actually subsiding. The survey work performed by the DEP should confirm the areas of actual subsidence.

Vegetative Growth

Since the side slopes are covered with crushed stone, the inspection of vegetative growth was limited to the top of the landfill. The condition of the vegetation varied substantially across the landfill surface. In some areas the vegetation was growing quite dense and high. Based on information exchanged during the site walkover, the USACE plans to reseed several areas during the spring of 1994. Along the top of the landfill, several areas were reseeded this past summer and fall (e.g., an area where preventive maintenance occurred to repair substantial, but not critical, subsidence.) Vegetative growth in these areas is virtually nonexistent, but reseeding is planned for spring 1994. Significant gully erosion is present in several locations across the top of the landfill. This erosion is addressed below.

Erosion

The cap includes crushed stone on most of the side slopes to minimize erosion and reduce maintenance associated with vegetative cover. Overall, the crushed stone has held up well as a cover material, but in various locations subtle ridges are evident in the stone. These ridges, which are somewhat random and are primarily perpendicular to the side slopes, may be indicative of minor erosion from stones washing down the side slopes due to erosion beneath the stones. However, these ridges could also be inherent from the initial placement of the stone and are not necessarily associated with erosion. In no area was significant stone washout observed, as would be evidenced by either exposed underlayers (geofabric) on the side slopes or buildup of stone at either the toe of slope or encroaching onto the perimeter road.

Some erosion was evident in several locations along the haybales that delineate the transition between the vegetated top of the landfill and the crushed stone side slope bench. In at least three areas, one or more haybale barriers have dislodged creating isolated eroded areas. Under the worst observed case, the soil under the dislodged haybales (east of the west sedimentation and along Dunstable Road) has washed away. An extra piece of fabric, not connected to the geofabric layer and therefore not a problem, was uncovered.

Along several lengths of the haybales, erosion was evident in the form of sediment buildup along the haybales. Along the north side of the landfill where the haybales run down the slope, gully erosion has formed along the haybales with sediment washed along the access road at the end of the haybale barrier. These areas require maintenance, such as replacing the haybales, improving the vegetative cover, and improving the tie-in from the vegetated areas to the stoned areas.

The greatest erosion onsite was present in the areas that were recently reseeded. Because vegetation has not yet been established in those areas, there is widespread erosion in the form of clearly visible rills and gullies. These eroded areas are scheduled to be repaired in the spring 1994 when reseeding will take place. The most significant erosion was observed on the west face of the landfill above the transition area from stone to earth cover. No vegetation is established in this area. There is a riprap lined swale immediately adjacent to the eroded area. Although the swale was visibly in good condition, surface water appears to be bypassing the swale (at least in part) and eroding the unvegetated side slopes forming deep gullies, estimated to be approximately twelve inches or deeper. This area requires maintenance, and should be addressed in the spring.

Drainage

The drainage channels onsite appeared to be in good condition. Overall, there appeared to be no scouring beneath the riprap. In a few locations some stone appeared to have dislodged from the side slopes of the channels. These areas were in the drainage channel along the western side of the landfill (near Dunstable Road) in the area of the west pump station, and in the drainage channel on the south-southeastern toe of the landfill. In addition, isolated areas of the drainage channels had vegetation growing up between the stones.

There are three detention/sedimentation basins onsite. All basins were in working condition, although some maintenance is required. The west basin exhibited erosion on the side slopes as well as some undermining of riprap. However, there are plans by the MA DEP to repair this basin during the spring of 1994. The southwest basin also exhibited signs of erosion, but to a much lesser extent. At this basin, the erosion was primarily limited to rills near the top of the side slopes at the edge of the dirt road. This erosion is a function of recent groundwater recovery trench construction in the immediate area. However, it should be repaired before it becomes more significant.

Miscellaneous

Although the major components of the inspection were subsidence, vegetative growth, erosion, and drainage structures, several miscellaneous issues were also observed.

- The perimeter road was in good condition, with the exception of the area of recent groundwater recovery trench construction (near the southwest basin.) The access road along the top of the landfill was recently regraded. There were several low spots along that road, and in some areas the regrading has exposed the underlying geotextile.

- Site security (fencing/signs) was in good condition.

- One area of the site exhibited potential leachate breakout, but such breakout is not confirmed. This area was at the toe of slope along Dunstable Road, and is being further investigated.

- One area of the site exhibited a strong landfill gas odor. This area was at the toe of slope along the southern side of the landfill, approximately in the area of the off-site swamp.

- Around the side slope bench, several small holes were observed in the earth cover at the haybale barrier. These holes are possibly due to rodents. Future inspections should continue to investigate the potential for rodent problems.

2.1.2 Sediment Sampling

On September 28, September 29 and October 1, 1993 sediment samples were collected from Dunstable Brook, an unnamed stream feeding Dunstable Brook, Flint Pond Marsh, Flint Pond and the areas downstream of the Flint Pond dam feeding the Merrimack River. Eighteen locations were sampled and analyzed for a variety of parameters. One additional sample, collected by the Environmental Services Division of EPA, was collected from Saw Mill Pond in Concord, MA, as a control sample. Table 2-1 lists the parameters, and analytical methods sample locations, and number of samples. Samples including quality assurance and quality control (QA/QC) samples were collected and analyzed in accordance with the protocols outlined in the Final Field Operations Plan for Five Year Review (M&E, September 1993).

A decision based on visual sample characteristics was performed in the field. The accuracy of the TOC analysis is questionable in high organic content samples. Therefore, as each sample was collected, its organic content was qualitatively assessed and the organic content analysis to be performed (TOC vs. TCO) was determined in the field. Sandy, low organic content samples were analyzed for organic content using the TOC method. High organic (black muddy) content samples were analyzed using the TCO method. The description of each sample follows. The sample locations are shown on Figure 2-1.

CGSED-1. Located in Dunstable Brook, this was the background sample. This location includes a toxicity sample. The sediment was a black muck, analyzed for TCO.

CGSED-2. Located in the unnamed stream feeding Dunstable Brook, this was a sandy, stony sample which includes a toxicity sample. The sample was analyzed for TOC. The sediment showed evidence of iron staining and the stream bank contained fresh deer tracks.

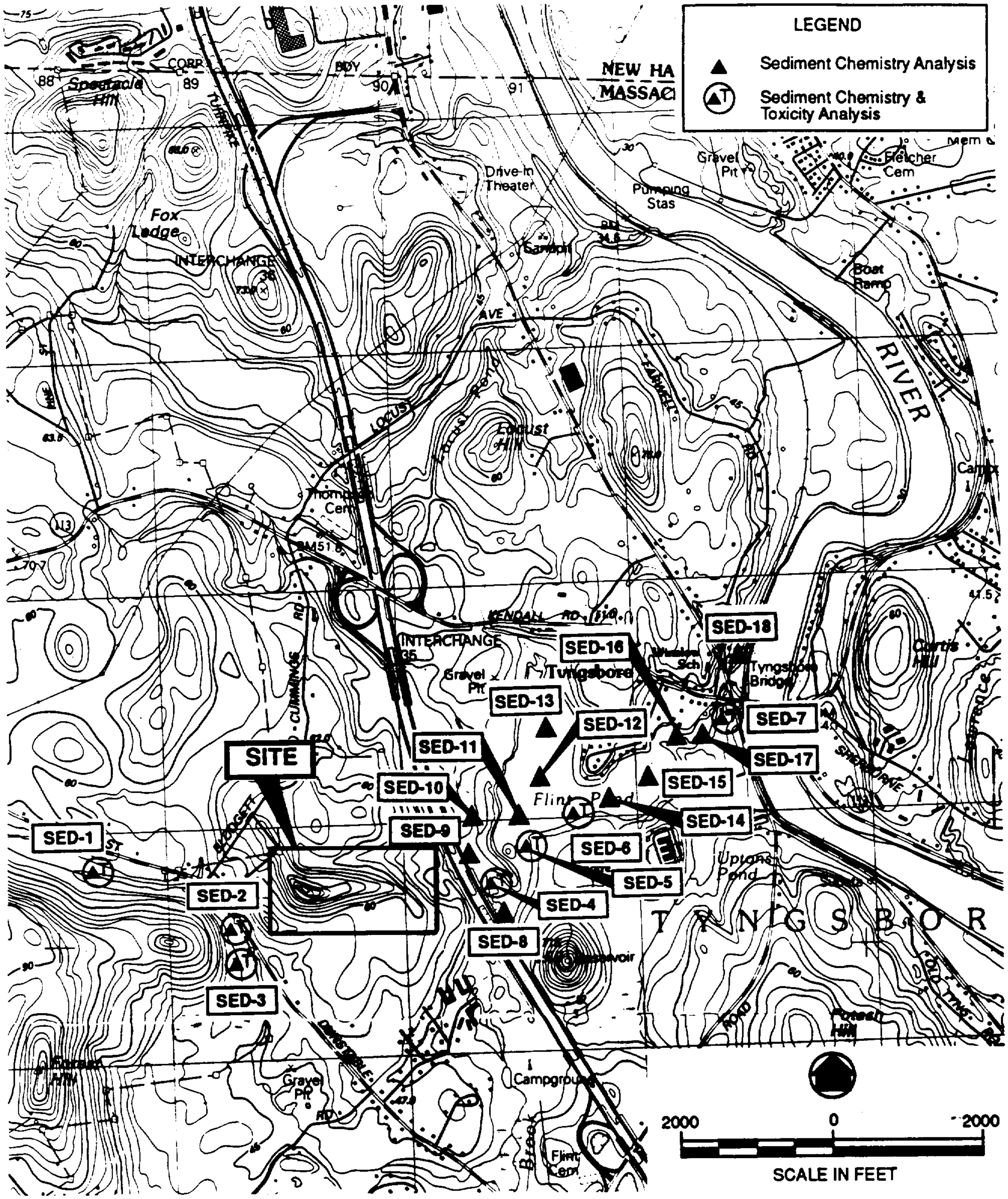


FIGURE 2-1.
SEDIMENT SAMPLE LOCATIONS

METCALF & EDDY

TABLE 2-1. SEDIMENT SAMPLING AND ANALYTICAL SUMMARY

		Number of Samples						
Parameter	Method	Unnamed Stream	Dunstable Brook	Flint Pond Marsh	Flint Pond	Downstream of Dam	Off-Site[5] Sample	Total
Volatile Organics	[1]	1	2	5	7	3	1	19
Semi-Volatile Organics	[1]	1	2	5	7	3	1	19
Metals	[1]	1	2	5	7	3	1	19
PAH's	[2]	1	2	5	7	3	1	19
Antimony & Cadmium	[3]	1	2	5	7	3	1	19
TOC	Lloyd Kahn Method	1	1	1	0	2	0	5
TCO	ASTM D2974-87	0	1	4	7	1	1	14
Grain Size	ASTM D422-63	1	2	5	7	3	1	19
Toxicity Test	[4]	1	2	2	1	1	1	8

Notes:

1. EPA-CLP Methods
   Organics: USEPA Contract Laboratory Program, Statement of Work for Organic Analysis, Multi-Media/Multi-Concentration, OLM01.0 with revisions to OLM01.8.
   Inorganics: USEPA Contract Laboratory Program, Statement of Work for Inorganic Analysis, Multi-Media/Multi-Concentration, ILM01.0 with revisions to ILM02.1.
2. Polynuclear aromatic hydrocarbons were analyzed utilizing GC/MS SIM techniques (modified SOW OLM01.8) under Special Analytical Services (SAS) request number 8118A-01 to achieve low level quantitation limits.
3. Antimony and cadmium were analyzed utilizing AA furnace techniques under SAS request number 8118A-02 to achieve low level quantitation limits.
4. Toxicity testing performed by the EPA Environmental Services Division (ESD) in Lexington, MA.
5. Saw Mill Pond in Concord, MA, is the location of the off-site control sample.

CGSED-3. Located in Dunstable Brook downstream of the confluence of the brook and unnamed stream. This was a sandy stony sample which included a toxicity sample and TOC analysis. This location showed slight iron staining, less than at CGSED-2.

CGSED-4. Located in the center of Flint Pond Marsh, this sample was a brown to black mud. It included a toxicity sample and TCO analysis.

CGSED-5. Located in the channel which connects the marsh to Flint Pond. This sample was also more brown than black mud, much lighter color than the pond samples. It includes a toxicity sample and TCO analysis. This sample was collected on the pond side of an abandoned demolished beaver dam.

CGSED-6. Located at the southern most end of the east branch of Flint Pond. This sample was black pond mud, it included a toxicity sample and was analyzed for TCO.

CGSED-7. Located farthest downstream of the Flint Pond Dam of the two downstream locations. This sample was brown mud, a little more sand than the pond but less sand than at CGSED-18 (located just prior to the Merrimack River.) This sample included a toxicity sample and TCO.

CGSED-8. Located along the bank of the channel which delivers Dunstable Brook under Route 3 into Flint Pond Marsh at the southern end. Sample collected in an area where the channel widens, and sediment settling appeared to be occurring. Brownish sediment with lower organic content than the other marsh locations. This sample did not include a toxicity sample. This sample was analyzed for TCO.

CGSED-9. Located at the culvert exit across Route 3 from the east leachate pump station. The sediment was clay and fine sand, therefore it was analyzed for TOC. This location shows evidence of iron staining. It did not include a toxicity sample.

CGSED-10. Located at the northern end of the marsh where the tree line begins. Very high organic content sample analyzed for TCO. It included grass, leaves and twigs with the sediment. This location did not include a toxicity sample.

CGSED-11. Located at the southern end of the west branch of Flint Pond. This sample was a black pond mud. Sample analyzed for TCO; not analyzed for toxicity.

CGSED-12. Central location of the west branch of Flint Pond. This location had roots mixed in with black sediment. The sample was analyzed for TCO but not analyzed for toxicity.

CGSED-13. This location is the northern most of the west branch of the pond. Sample was collected in a shallow area. This sample was analyzed for TCO (high organic content); not analyzed for toxicity.

CGSED-14. Located at the central portion of the east branch of the pond, this sample contained brown/black pond mud. The sample included TCO but not toxicity.

CGSED-15. Located at the northern most section of the east branch of the pond. This sample contains more clay, silt and sand than the other pond locations but was brown in color and analyzed for TCO. This sample was not analyzed for toxicity.

CGSED-16. Located in the cove upstream of the dam at the public ramp. The sample was silty and brown. It included TCO but not toxicity.

CGSED-17. Located just downstream of the dam. Sample collected towards the southern side of this cove where sediment settling appears to be occurring. The sample was sandy and stony, therefore it was analyzed for TOC. No toxicity testing on this sample.

CGSED-18. Located well downstream of the dam just prior to the Merrimack River. This sediment was also sandy and stony. It was analyzed for TOC but not toxicity.

CGSED-19 and CGSED-20. These were duplicate samples of CGSED-18 and CGSED-8 respectively.

CGSED-21. This sample was collected at Saw Mill Pond in Concord by EPA Lexington. It was submitted by M&E under CLP packaging and chain of custody protocols. It was a black pond mud analyzed for TCO and toxicity.

2.1.3 Off-site Wetlands Investigation

2.1.3.1 Methods of the Off-site Wetlands Investigation. The following is an account of the information obtained and the methods used to determine the location, extent, and character of wetlands and other natural resources in the vicinity of the Charles George Reclamation Landfill (the Site). The off-site wetlands determination was conducted in accordance with the *Preliminary Data Gathering and Synthesis* section of the *Corps of Engineers Wetlands Delineation Manual* (USACOE, 1987). The sources consulted and reviewed for the off-site investigation included the U.S. Geological Survey (USGS) Topographic Map (USGS, 1987), the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory Map (USFWS, 1990), the U.S. Department of Agriculture/Soil Conservation Service (USDA/SCS) Middlesex County Soil Survey (USDA/SCS, 1989), the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program Flood Insurance Rate Map (FEMA, 1982). The state and federal agencies contacted to obtain further information included the Natural Heritage and Endangered Species Program, Massachusetts Division of Fish and Wildlife (MANHESP), and the U.S. Fish and Wildlife Service. The final component of the off-site investigation entailed a review of documents relating to wetlands and other natural resources previously submitted to the U.S. Environmental Protection Agency (USEPA) for the Charles George Reclamation Landfill.

Review of Resource Mapping. Information obtained from the USGS Topographic Map to identify wetlands and other natural resources included the location of hydrographic features such as marshes, swamps, streams, rivers, lakes and ponds, and hypsographic features such as elevation and contour interval.

The USFWS National Wetlands Inventory Map was reviewed to locate, classify and characterize potential wetland and deepwater habitats. The identification of wetlands by the National Wetland Inventory (NWI) is based on stereoscopic analysis of high altitude aerial photographs and a wetland classification scheme following the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979). The classification scheme describes and arranges the ecological constituents of wetland habitats into a hierarchical taxonomic system. The National Wetland Inventory Map does not delineate wetland boundaries, but does provide information relative to wetland types and an approximation of areal extent.

The USDA/SCS Soil Survey provided specific information regarding the areal extent of soil types. The Soil Survey also contained information on hydrographic features, geological features, human activities, and governmental boundaries. Individual soil series identified in the vicinity of the landfill were cross-referenced with the *Hydric Soils of the United States List* (NTCHS, 1990). The presence of hydric soils is one of the three criteria used for determining whether an area is a wetland under federal jurisdiction.

Flood Insurance Rate Maps (FIRMs) from FEMA's National Flood Insurance Program were reviewed to determine the predicted floodplain zones and boundaries associated with a 100-year flooding event. The extent of the floodplain is determined by direct observations along with computer modeling of a 100-year flooding event.

Correspondence with State and Federal Agencies. State and federal agencies were contacted to request specific information regarding the site and surrounding lands. The U.S. Fish and Wildlife Service and the Natural Heritage and Endangered Species Program, Massachusetts

Division of Fish and Wildlife were contacted for information on the presence of state- or federally- listed rare, threatened and endangered species in the vicinity of the site. Both agencies maintain a data base of observations on the location-specific presence of rare, threatened and endangered species.

Review of Previous Documents. The off-site wetlands investigation included a review of the two most current wetlands documents submitted to the Commonwealth of Massachusetts or the USEPA for the site. As tasked in 1990 by the Commonwealth of Massachusetts, HMM Associates, Inc. prepared a damages assessment report for the site entitled *Wetland Damages Assessment-Charles George Landfill* (HMM, 1990). The report documented the negative effects associated with: (1) the release of toxic and hazardous materials deposited in the site, (2) the development and operation of the landfill, and (3) the implementation of corrective measures dictated by USEPA Record of Decision II (USEPA, 1985). The report included location and character of wetlands, area habitat characteristics, the geographic extent and level of contamination, and the extent of wetland destruction. Because HMM (1990) provided the most recent account of the wetlands in the vicinity of the site, it was used as the baseline reference for Metcalf & Eddy's on-site investigation.

A study similar to HMM (1990), entitled *Wetlands Assessment - Charles George Landfill Site, Massachusetts - Final Report*, was conducted in 1986 by the GCA Corporation for the USEPA (GCA, 1986). GCA (1986) characterized the wetlands in the vicinity of the landfill and evaluated the potential environmental impacts of each of the eight source-control alternatives proposed and discussed in the NUS *Source-Oriented Feasibility Study* (NUS, 1985) prior to the USEPA Record of Decision II (USEPA, 1985). The GCA report emphasized potential impacts from the remedial alternative selected by the USEPA which consisted of a synthetic membrane cap with surface water diversion and collection, a leachate collection system, and gas venting.

2.1.3.2 Findings of the Off-site Wetlands Investigation. The following is a summary of the location, extent and character of the wetland resources in the vicinity of the site as determined by the off-site wetlands investigation. To simplify this account and establish coherence between this study and the most recent previous work, Metcalf & Eddy (M&E) has adopted, with one exception, the wetland partitioning scheme used by HMM Associates, Inc. in the 1990 report, *Wetland Damages Assessment-Charles George Landfill* (HMM, 1990). The five wetland systems which will be described are Landfill-Adjacent Wetlands, Dunstable Brook, Bridge Meadow Brook, Flint Pond Marsh, and Flint Pond. The one exception to the HMM (1990) partitioning scheme is the use of the term "Landfill-Adjacent Wetlands" rather than "Other Wetlands". The description of each wetland system is supplemented by the account documented in the HMM damages assessment report (HMM, 1990). In addition, the GCA wetlands assessment (GCA, 1986) is utilized in the discussion of the Landfill-Adjacent Wetlands. The wetland resource maps which appeared in the HMM and GCA reports are duplicated as Appendix C of this report.

Review of Resource Mapping.

Landfill-Adjacent Wetlands - This section describes the wetlands in close proximity to the site which are not described in association with any of the other four wetland systems in the project area. Wetland areas in close proximity to the site do not appear on the USGS map of the Lowell 7.5 x 15 Minute Quadrangle (USGS, 1987, see Figure 2-2).

The USFWS National Wetlands Inventory Map of the Nashua South Quadrangle (USFWS, 1990) illustrates seven wetland resource areas in close proximity to the site (Figure 2-3). Areas of approximately 1 and 2 acres are shown on the western edge and northeastern corner of the landfill, respectively. Both are classified as excavated palustrine wetland with unconsolidated bottom (PUBFx). Another palustrine wetland with an unconsolidated shoreline (PUSCh) covers less than 0.15 acres and is identified 800 feet north of the wetland on the western edge of the landfill.

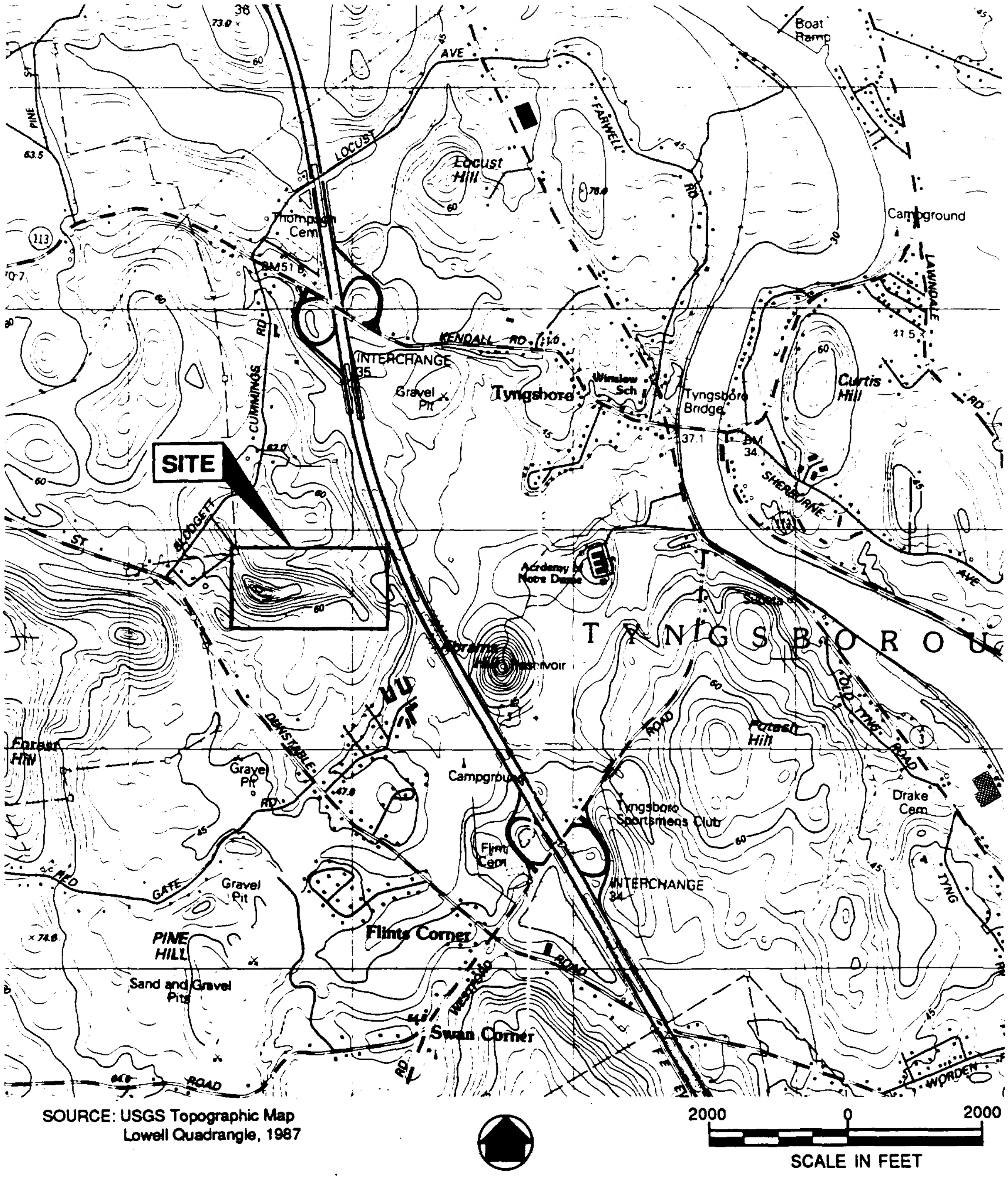
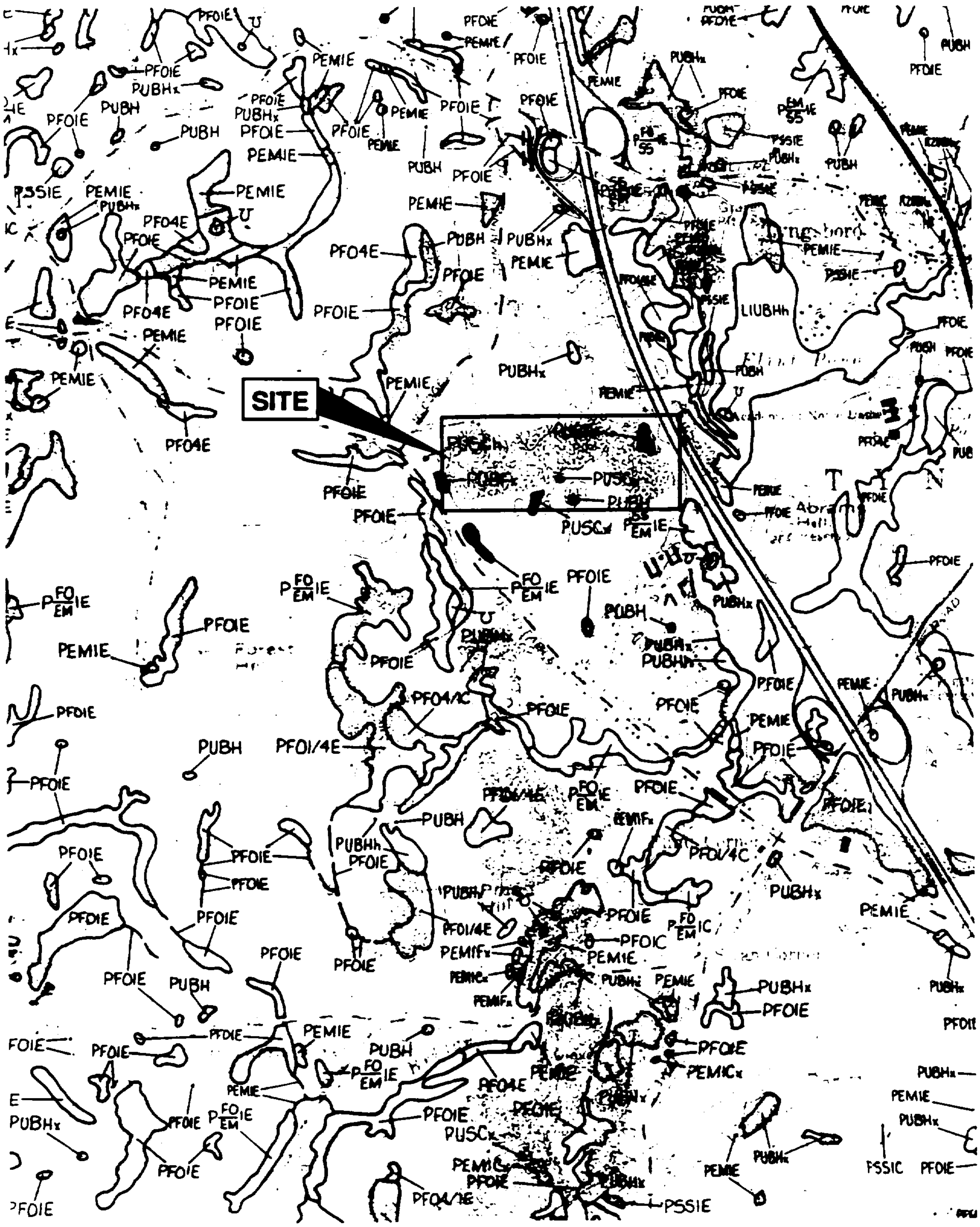


FIGURE 2-2. TOPOGRAPHIC MAP OF CHARLES GEORGE LANDFILL, TYNGSBOROUGH, MA



SOURCE: USFNS National Wetlands Inventory,
Nashua South Quadrangle, 1990.

2000 0 2000

SCALE IN FEET

FIGURE 2-3. NATIONAL WETLANDS INVENTORY MAP OF CHARLES GEORGE LANDFILL, TYNGSBOROUGH, MA

The NWI map depicts four wetland areas on the southern edge of the landfill (Figure 2-3). An area of palustrine forested broad-leaved deciduous/emergent persistent wetland (PFO/EM1E) covering 2 to 3 acres begins near the southwest corner of the landfill and extends approximately 500 feet south, parallel to Dunstable Road. Approximately 1000 feet to the east of this area, NWI shows two excavated palustrine wetland areas with unconsolidated shoreline (PUSCx) approximately 1 acre and 0.25 acres in size, respectively.

Southeast of the 0.25 acre wetland, NWI identifies another palustrine wetland (PUBH) 0.25 to 0.5 acre in size.

The Middlesex County Soil Survey (USDA/SCS, 1989) defines the two acre wetland on the northeast edge of the landfill as open water (Figure 2-4). The soil in the same location as the two wetlands on the western edge of the landfill is classified as Swansea muck. Swansea muck is considered hydric (NTCHS, 1990).

The NWI map shows four wetland areas on the southern side of the landfill (Figure 2-3). The soils map shows the area associated with the palustrine forested/emergent wetland consisting of three different soil series, Paxton fine sandy loam, Whitman loam, and Canton fine sandy loam (Figure 2-4). Of these soils, only Whitman loam is considered hydric (NTCHS, 1990). The smallest of the other three wetlands located on the south side of the landfill is located in an area of non-hydric Canton fine sandy loam. The remaining two wetlands are located on the Whitman loam soil series.

The wetlands adjacent to the site are not identified on the FEMA Flood Insurance Rate Map (FEMA, 1982) as part of the 100-year floodplain (Figure 2-5). Likewise, the landfill is depicted out of the 100-year floodplain zone.

The *Wetland Damages Assessment* (HMM, 1990) discussed three of the seven landfill adjacent wetland areas depicted on the NWI map. Based on the HMM site investigation, the wetland located on the southern side of the landfill and adjacent to Dunstable Road showed

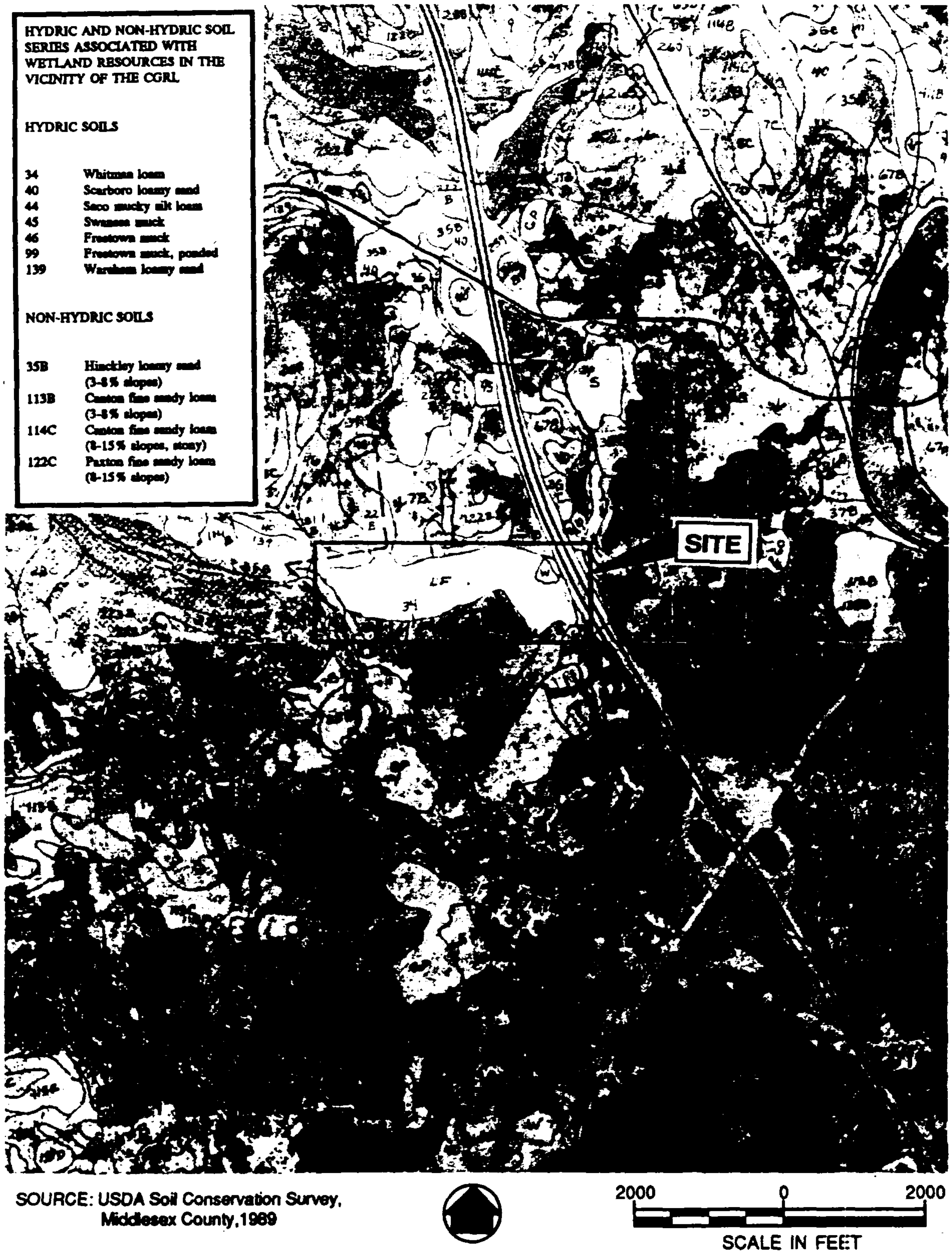
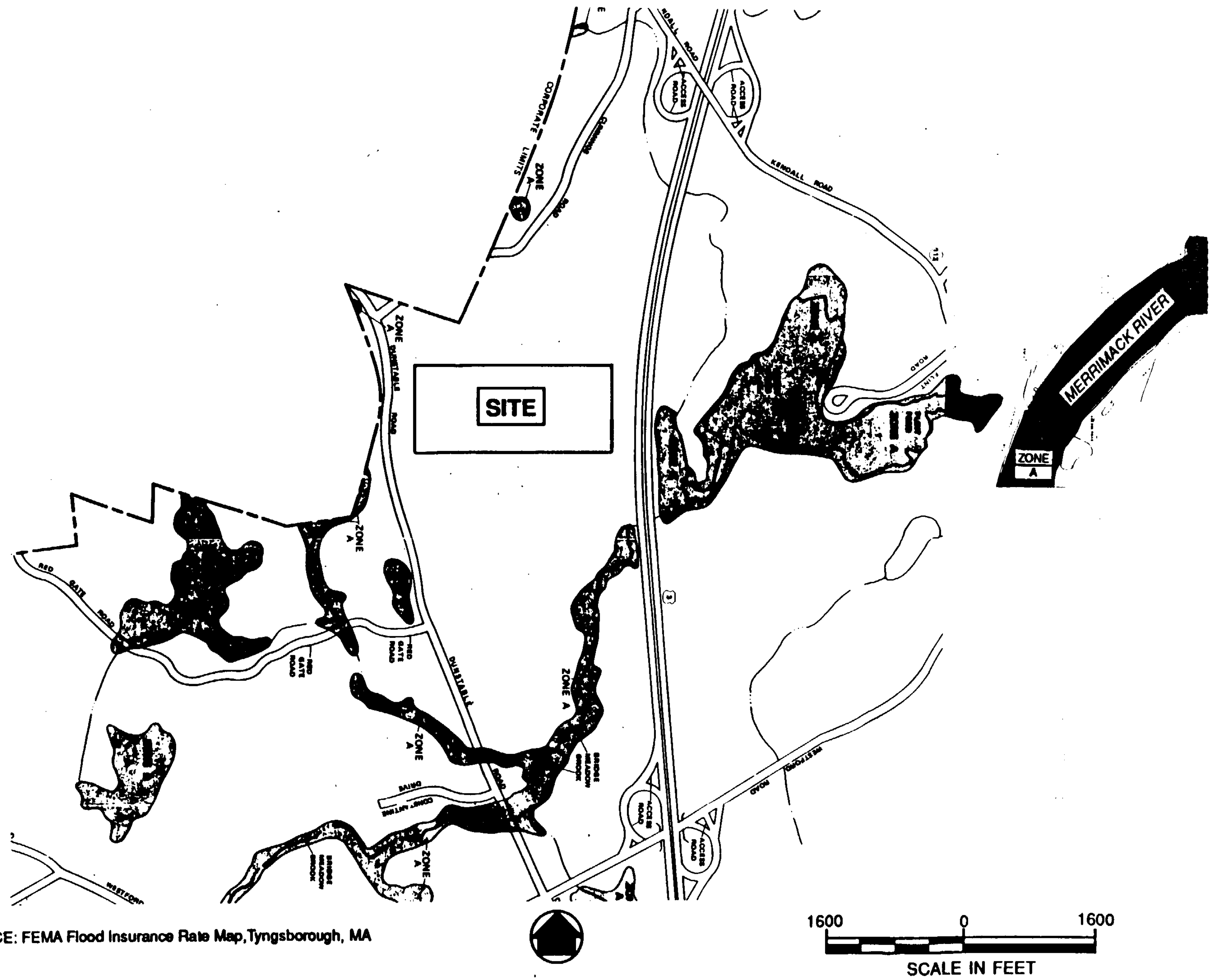


FIGURE 2-4. SCS SOIL SURVEY MAP OF CHARLES GEORGE LANDFILL, TYNGSBOROUGH, MA



SOURCE: FEMA Flood Insurance Rate Map, Tyngsborough, MA

FIGURE 2-5. 100-YEAR FLOODPLAIN MAP OF CHARLES GEORGE LANDFILL, TYNGSBOROUGH, MA.

signs that physical alteration had occurred during the landfill capping process. HMM observed that the landfill roadway had eroded into the wetland and riprap had been utilized to stabilize soils. Up to 12 inches of sediment was present in a wide band running parallel to the landfill roadway for over 150 feet. According to HMM, the wetland receives input from two landfill discharge outlets, an 18-inch pipe that drains the southwest detention basin at the toe of the landfill and an 8-inch pipe that drains the landfill roadway. Orange water, staining, and sedimentation were observed at these outlet areas. During the HMM site visit in November, 1990, the soils in the area were saturated, vegetation was sparse, and the wetland was dominated by purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites* spp). The red maples (*Acer rubrum*) near the 18-inch outlet pipe showed signs of stress. An outlet from the wetland to Dunstable Brook was also observed by HMM. This is the second of the two landfill tributaries to Dunstable Brook (see Review of Resource Mapping, Dunstable Brook).

HMM (1990) indicated that the next wetland to the east had been disturbed by landfill activities, such as the construction of roadways, to the point where the drainage pattern was altered. Portions of the outer edge of the wetland were filled, banks were altered and sedimentation was prevalent. The next wetland due east was also affected by landfill activities. HMM (1990) observed it had been reduced to a remnant of what it was when the GCA (1986) wetlands assessment was written in 1986.

The three wetland areas already discussed in this section are present on the NWI map. HMM (1990) also describes a wetland area between Dunstable Road and Dunstable Brook upstream of the unnamed stream that empties into Dunstable Brook near the west pump station. According to HMM, the wetland receives input from Dunstable Brook only during storm events. The area had sediment on the vegetation and natural soils, ruts from heavy equipment, and excavated channels that ran toward the channelized stream. Purple loosestrife, an indicator of disturbance, was a component of the plant community.

The *Wetlands Assessment - Charles George Landfill Site, Tyngsborough, Massachusetts* (GCA, 1986) provided additional information regarding the wetland areas in close proximity to the site. The NWI map depicts two palustrine, unconsolidated bottom wetlands which were excavated. According to the GCA report, these areas represent the east and southwest detention basins for the landfill. GCA (1986) described two small wetland areas that are not illustrated on the NWI map or discussed as extant in the HMM (1990) report. One of the wetlands is located on the southern edge of the landfill approximately 1000 feet west of Route 3. The second wetland is located on the northern side of the landfill and is likely the same wetland that was destroyed during the installation of the landfill leachate collection system (HMM, 1990).

Dunstable Brook - While not officially named on the topographic map (USGS, 1987), Dunstable Brook is depicted as a perennial stream that originates west of the site (Figure 2-2). It flows east toward the site and is fed by a short tributary before reaching the intersection of Blodgett/Cummings Road and Dunstable Road. In the vicinity of the site, Dunstable Brook flows south, parallel to Dunstable Road. The brook flows on the western side of Dunstable Road and, at its closest point, is located within 650 feet of the southwest corner of the landfill. Dunstable Brook then flows south toward Red Gate Road, passes under it, and then turns east toward its confluence with Bridge Meadow Brook. According to the topographic map, Dunstable Brook is bordered on its western bank by "swamp" before flowing through two small perennial open water bodies associated with the gravel pit north of Red Gate Road. From Red Gate Road, Dunstable Brook continues eastward through a residential area and into Bridge Meadow Brook.

With the exception of two stretches of approximately 200 feet each, the NWI map shows Dunstable Brook continually bordered by palustrine forested broad-leaved deciduous wetland (PFO1E) and/or palustrine emergent persistent wetland (PEM1E) from 2000 feet west of the site to its confluence with Bridge Meadow Brook (Figure 2-3). The stretches not bordered by wetland are identified due west of the site and 200 feet north of the larger of the two open water bodies illustrated by USGS north of Red Gate Road. In approximately the same location as the water resources associated with the gravel pit on the USGS map, NWI identifies two areas of excavated palustrine wetland with unconsolidated bottoms (PUBHx).

NWI depicts an area of upland north of the intersection of Red Gate Road and immediately west of the wetland areas adjacent to Dunstable Brook (Figure 2-3). The upland area is approximately 40 acres in size and is encircled by a "C" shaped chain of wetlands. The wetlands surrounding the upland area are defined as palustrine emergent and/or palustrine forested (PFO/EM1E, PFO1/4E, PFO4/1C, PFO1E). The northern section of the wetland chain is located in approximately the same place as the marsh/swamp depicted west of Dunstable Brook on the USGS map.

According to the Middlesex County Soil Survey (USDA/SCS, 1989), the land over which Dunstable Brook flows is classified into three different soil series, Swansea muck, Scarboro loamy sand, and Saco mucky silt loam (Figure 2-4). All three soil series are considered hydric (NTCHS, 1990). The land areas associated with the "C" shaped wetlands chain west of Dunstable Brook are classified as Swansea muck, Wareham loamy sand, Whitman loam, and Scarboro loamy sand. Wareham and Whitman are both considered hydric soil phases (NTCHS, 1990). The soils map also indicated a wet spot on a non-hydric soil series, Hinckley loamy sand, west of Dunstable Brook and within the "C" shaped wetlands chain (Figure 2-4).

The soils map (USDA/SCS, 1989) also illustrates three intermittent streams entering Dunstable Brook that are unmapped on the USGS and NWI maps (Figure 2-4). One stream flows through the northern section of the "C" shaped chain of wetlands and enters Dunstable Brook near the gravel pit shown on the topographic map. A second intermittent stream flows through the southern section of the "C" shaped chain of wetlands and enters Dunstable Brook in the general area where Dunstable Brook and Red Gate Road intersect. A third intermittent stream is shown entering Dunstable Brook approximately 1800 feet west of the confluence of Dunstable Brook and Bridge Meadow Brook.

The FEMA Flood Insurance Rate Map (FEMA, 1982) depicts the 100-year Dunstable Brook floodplain as a band, approximately 200 feet wide, tracking the stream's course (Figure 2-5). The only section of Dunstable Brook excluded from the 100-year floodplain begins approximately 330 feet downstream of Red Gate Road and extends roughly 200 feet south.

Two of the three intermittent streams shown on the soils map (the two that flow through the "C" shaped wetlands chain) are also depicted on the floodplain map. Sections of both are delineated as part of the 100-year floodplain as well as a large percentage of the "C" shaped wetland chain.

The *Wetlands Damages Assessment* (HMM, 1990) indicated that the Dunstable Brook wetlands system received leachate, and eroded soil, silt and gravel from the site. These materials reached the brook from overland runoff and also through an unnamed stream that connects the site to Dunstable Brook at the west leachate pump station. In November of 1990, when HMM investigated the site wetlands, the unnamed stream had been disturbed by erosion and sedimentation. It contained dark orange, turbid water. HMM reported the characteristics of Dunstable Brook changed markedly after the unnamed stream discharged into the brook. Erosion and siltation were evident in the Dunstable Brook and its floodplain (up to 50 feet from the brook). Dunstable Brook also contained highly colored, turbid water. HMM (1990) found no pronounced changes in plant species composition or density in the wetland areas that were examined along Dunstable Brook. However, there was evidence of vegetative stress in the forms of lost canopy, dead branches, and dead trees. While thriving in the upland areas, a significant number of mature white pine (*Pinus strobus*) and red maple were observed to be damaged in the Dunstable Brook wetlands. Roots were covered by sediment.

According to HMM (1990), a second landfill outlet discharges into Dunstable Brook south of the unnamed stream. Siltation and highly colored water were observed in the brook and bordering wetlands from the discharge point of the unnamed stream south to the gravel pit area. During the HMM site visit in November, 1990, songbirds were prevalent, but no waterfowl were observed. HMM listed purple loosestrife as part of the vegetative community in the Dunstable Brook wetland system.

Bridge Meadow Brook - Bridge Meadow Brook is a perennial stream that begins near Scribner Hill and flows northeast, passing under State Route 3 (F.E. Everett Turnpike), through the Cannongate Condominium Complex, and into Flint Pond (Figure 2-2). In the vicinity of Dunstable Road, the topographic map depicts Bridge Meadow Brook bordered on both banks by "swamp" and then further downstream by "marsh". Before passing under Route 3, Bridge Meadow Brook flows through three separate perennial open water bodies, one of which contains an island.

According to NWI, Bridge Meadow Brook is bordered on both banks near Dunstable Road by palustrine forested broad-leaved deciduous wetland (PFO1E) (Figure 2-3). Approximately 400 feet upstream of the confluence of Dunstable Brook and Bridge Meadow Brook, the wetland type bordering Bridge Meadow Brook changes to palustrine emergent persistent (PEM1E). From the confluence of the two brooks to and including the approximate location of the first of three open water bodies depicted on the topographic map, Bridge Meadow Brook is bordered by diked or impounded palustrine wetland with an unconsolidated bottom (PUBHh). The second open water body contains an island and is also defined as palustrine with unconsolidated bottom (PUBHx). The first and third open water bodies Bridge Meadow Brook passes through before flowing under Route 3 are not illustrated on the NWI map. From the second water body to Route 3, the NWI map identifies palustrine scrub/shrub broad-leaved deciduous -emergent persistent wetlands (PSS/EM1E). After crossing under Route 3, Bridge Meadow Brook flows through Flint Pond Marsh and into Flint Pond. The USGS topographic map shows Bridge Meadow Brook flowing into Flint Pond only.

According to the Middlesex County Soil Survey, Bridge Meadow Brook flows through and is bordered by Freetown muck, Saco mucky silt loam, Scarboro loamy sand, and the Swansea muck soil series before crossing under Route 3 (Figure 2-4). All four soil series are considered hydric (NTCHS, 1990). The soil series associated with the first of three open water bodies that USGS illustrates Bridge Meadow Brook flowing through is define as ponded Freetown muck (NTCHS, 1990). The second open water body is defined as "water" and the third is undefined specifically but is located in an area consisting of Freetown muck.

Within the project area, FEMA identifies the entire length of Bridge Meadow Brook as a part of the 100-year floodplain (Figure 2-5). The floodplain area associated with Bridge Meadow Brook is depicted as a band, approximately 280 feet wide, which tracks the course of the brook.

According to the *Wetlands Damage Assessment* by HMM (1990), the Bridge Meadow Brook wetlands system is densely vegetated with speckled alder (*Alnus rugosa*), black willow (*Salix nigra*), viburnum (*Viburnum* spp.) and red maple. The report also listed purple loosestrife as a member of the Bridge Meadow Brook plant community.

Flint Pond Marsh - Flint Pond Marsh is situated in a "V" between Route 3 and the western edge of Flint Pond (Figure 2-2). According to the USGS topographical map, it consists of two unnamed perennial water bodies and an area denoted as "swamp" that borders the western edge of the northernmost pond. An unnamed stream is depicted entering Flint Pond Marsh from the north.

At the southern end of the "V", the NWI map illustrates Bridge Meadow Brook crossing through a palustrine emergent persistent wetland (PEM1E) that parallels Route 3 and extends approximately 1500 feet north (Figure 2-3). Contrary to the USGS topographic map, the NWI map documents Bridge Meadow Brook as a tributary of Flint Pond Marsh. Another discrepancy between the USGS and NWI maps is evident in this area. According to NWI, the southern one-half of the southern perennial water body depicted by USGS is not independent of Flint Pond, but rather an oblong extension of Flint Pond defined as lacustrine, limnetic with an unconsolidated bottom (L1UBHh). The northern half of the USGS-defined southern open water body is divided by NWI into three areas, two of which are physically separate from Flint Pond. From south to north, these wetland areas are classified as palustrine emergent persistent (PEM1E), palustrine with an unconsolidated bottom (PUBH), and palustrine scrub/shrub broad-leaved deciduous (PSS1E). The northern open water body depicted by USGS is also divided into two classes by NWI. Again, from south to north, these wetland areas are defined as palustrine with an unconsolidated bottom (PUBHx) and palustrine forested broad-leaved deciduous (PFO1E). The area identified as swamp on the topographic map is depicted on the NWI map as palustrine forested broad-leaved deciduous - needle-leaved evergreen wetland (PFO1/4E) in approximately the same location. To the north of these wetlands, NWI illustrates areas of palustrine emergent (PEM1E) and palustrine forested broad-leaved deciduous wetland (PFO1E). The unnamed stream that flows into Flint Pond Marsh from the north flows through both of these wetland areas.

The Middlesex County Soil Survey defines the soil series associated with the Flint Pond Marsh wetlands as Freetown muck, ponded Freetown muck, and Scarboro loamy sand (Figure 2-4). All are considered hydric (NTCHS, 1990). The two areas of ponded Freetown muck are in approximately the same locations as the northern perennial open water body depicted by USGS and the palustrine emergent wetland illustrated on the NWI map at the southern end of Flint Pond Marsh.

Flint Pond Marsh is within the 100-year floodplain area illustrated by the FEMA flood rate insurance maps (Figure 2-5). The floodplain extends from where the unnamed stream enters Flint Pond Marsh from the north, south to Bridge Meadow Brook. The floodplain is bounded by Route 3 to the west. Flint Pond Marsh contacts the 100-year floodplain of Flint Pond only where Bridge Meadow Brook empties into Flint Pond.

In addition to the sources already discussed, the *Wetland Damages Assessment* (HMM, 1990) indicated that Flint Pond Marsh is fed by a channel at its northwestern corner, Route 3 drainage, and groundwater flow from the landfill. Via some of these sources, leachate contaminated with hazardous substances discharged into Flint Pond Marsh. During the November, 1990 site visit, HMM (1990) observed a groundwater outbreak in Flint Pond Marsh. The contaminated outbreak was a high orange color and extended approximately 100 feet along the Route 3 right-of-way. HMM also reported dark orange water and staining on the headwall and vegetation at the Route 3 culvert. Cattail (*Typha* spp.) was reported by HMM (1990) as the dominant species in the marsh. Purple loosestrife was also observed.

Flint Pond - Flint Pond is located east of the site between Route 3 and the Merrimack River (Figure 2-2). According to the USGS topographic map, it is fed by Bridge Meadow Brook and an unnamed stream which flows into Flint Pond at its most northern point. Although the USGS map indicates a small land gap between Flint Pond and Kendall Road, Flint Pond discharges into the Merrimack River. From the eastern edge of Flint Pond, water flows to the northeast through an unnamed perennial water body, into a channel that passes under Kendall Road and Middlesex Road, through another unnamed perennial open water body, and into the final discharge channel. No other wetland resources associated with Flint Pond are depicted on the USGS topographic map.

In the same location as Flint Pond on the topographic map, the NWI map identifies an area of lacustrine, limnetic wetland with an unconsolidated bottom (L1UBHh) covering approximately 61 acres (Figure 2-3). A small upland island is depicted in the southwestern section of Flint Pond. In addition, approximately one acre of palustrine forested broad-leaved deciduous wetland (PFO1E) is depicted on the eastern edge of Flint Pond 800 feet due west of Middlesex Road. In addition, the NWI map illustrates an area of palustrine scrub/shrub wetland approximately one acre in size on the northern side of Flint Pond. At the location where the unnamed stream enters Flint Pond from the north, the NWI map indicates an area of palustrine emergent persistent wetland (PEM1E). Contrary to the USGS topographic map, NWI depicts Flint Pond extending all the way to Kendall Road; no land gap is denoted between Flint Pond and Kendall Road. The NWI map defines the channel through which the waters of Flint Pond flow toward the Merrimack River as excavated lower perennial riverine with an unconsolidated bottom (R2UBHx). This habitat type widens along its course for approximately 400 feet, in the same location as the unnamed water body nearest the Merrimack River on the USGS map, and then narrows again near the river.

The Middlesex County Soil Survey illustrates areas of ponded Freetown muck in the same location NWI depicts palustrine emergent wetland on the northern and southwestern shores of Flint Pond (Figure 2-4). The acre of palustrine forested wetland adjacent to the eastern side of Flint Pond is classified as Wareham loamy sand. The Wareham and Freetown soil phases are both considered hydric (NTCHS, 1990). Finally, a wet area is shown on the soils map in the same location as the palustrine scrub/shrub wetland on the NWI map. The wet area is located on the non-hydric soil series, Hinckley loamy sand (NTCHS, 1990). The soils map also indicates a perennial discharge into Flint Pond from both Bridge Meadow Brook and the stream that enters Flint Pond Marsh from the north and flows south to Flint Pond.

The FEMA flood insurance rate map depicts Flint Pond within the 100-year floodplain (Figure 2-5). The floodplain extends onshore along the entire perimeter of the pond. The distance the floodplain extends onshore varies from 30 to 500 feet.

In addition to the sources already discussed, the *Wetland Damages Assessment* (HMM, 1990) listed Route 3 and other local roadway drainage areas as inputs to Flint Pond.

Correspondence with State and Federal Agencies. M&E contacted both federal and state agencies to obtain information on the presence of state- or federally-listed, rare, threatened, and endangered floral and faunal species in the vicinity of the site. On 12 October, 1993, M&E received correspondence from the Massachusetts Natural Heritage and Endangered Species Program (MANHESP), Massachusetts Division of Fish and Wildlife (MANHESP, 1993; see Appendix D). MANHESP was "not aware of any rare or endangered plants or animals or exemplary natural communities in the vicinity of (the site)." M&E received a similar response dated 20 November, 1993 from the U.S. Fish and Wildlife Service (USFWS, 1993; see Appendix D). The conclusions of the U.S. Fish and Wildlife were that, "no federally listed or proposed threatened and endangered species under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area, with the exception of occasional transient endangered bald eagles (*Haliaeetus leucocephalas*) or peregrine falcons (*Falco peregrinus anatum*)."

HMM (1990) and GCA (1986) also requested information from MANHESP and the USFWS on the presence of rare, threatened and endangered species on the CGRL and surrounding lands. The response from those inquiries was identical to the responses M&E received.

Review of Previous Documents. The *Wetland Damages Assessment-Charles George Landfill* report (HMM, 1990) documented extensive damage to the wetlands adjacent to and downgradient from the site. Damages were attributed to the release of toxic and hazardous waste and also to landfill operations and remediation activities. In the Review of Resource Mapping section of this document, results of the HMM report are summarized for each wetland area and compared to the descriptions generated from the current available mapping resources.

HMM (1990) indicated that wetland areas adjacent to the landfill have been lost to remediation support activities. In addition, the wetland to the southwest of the landfill has been "substantially altered" by sedimentation from landfill operations and remedial activities to the point where a "dramatic" reduction in plant species diversity has occurred and alien species have outcompeted the natural flora. In addition, vegetative stress and poor water quality was evident along stretches of Dunstable Brook. The report goes on to state that, " Runoff, leachate, and contaminated groundwater discharges to the surface waters and wetland systems have distributed sediment, contaminated sediments and/or dissolved and suspended toxic or hazardous materials over a substantial area, approximately 190 acres" (HMM, 1990).

HMM (1990) documented contamination of all five wetland systems with a wide range of chemicals and compounds including organic polynuclear aromatic hydrocarbons (PAHS) and polychlorinated biphenyls (PCBs), and inorganics such as arsenic, cadmium, lead, vanadium, silver, mercury, iron, and zinc. The report also indicated that areas receiving more direct exposure to landfill water flow, including Dunstable Brook, Flint Pond Marsh and the Landfill-Adjacent Wetlands, exhibit higher concentrations of contaminants. The conclusions of the *Wetlands Assessment - Charles George Landfill Site - Tyngsborough, Massachusetts*

(GCA, 1986) were similar. As of 1986, GCA documented that the surface water, ground water, and sediments of Flint Pond Marsh, the landfill-adjacent wetlands, and Dunstable Brook all had accumulated detectable levels of contaminants associated with the waste disposed at the CGRL (GCA, 1986).

2.1.4 On-Site Wetlands Characterization

The on-site wetland characterization was conducted on 20-22 October 1993 and included an investigation of the Landfill-Adjacent Wetlands, wetlands adjacent to Dunstable Brook and Bridge Meadow Brook, the Flint Pond Marsh, and Flint Pond. The field survey confirmed the approximate boundaries of the wetland areas described on published resource mapping and in the previous site documents, and a field map of their approximate locations was produced. The boundaries of the wetland areas were determined according to the three parameter method of the *Corps of Engineers Wetland Delineation Manual* (USACOE, 1987). The three wetland parameters described in the 1987 USACOE Manual (dominant vegetation, soil characteristics and hydrology) were examined and documented in representative plots within each wetland habitat and in an adjacent upland area. Each wetland habitat was described and classified according to the USFWS classification system described in *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979). The concurrent documentation of adjacent upland habitats was utilized for the field habitat characterization of the natural resources survey (Section 2.1.5).

In addition to the determination of wetland boundaries and documentation of soil characteristics, hydrology and dominant vegetation, any observed indicators of adverse impacts to the habitats downgradient of the landfill were recorded. Indicators such as damaged/stressed plant communities, disturbed soils, sedimentation or altered hydrology were investigated and documented.

The on-site wetland investigation confirmed the approximate locations of the wetlands documented in the off-site review of resource mapping (Section 2.1.3). The vegetation, soils and hydrology were examined in 19 representative plots within the wetlands, and in corresponding plots in adjacent upland areas. The observations were recorded on the Three Parameter Wetland Delineation Summary Sheets included in Appendix E.

Landfill-Adjacent Wetlands - The on-site wetlands investigation revealed the presence of six discrete wetland habitats within close proximity to the site (between Dunstable Road and Route 3). Three of the wetlands identified south of the landfill correspond with wetlands depicted on the NWI map (Figure 2-3). The wetlands classified during the on-site investigation do not include the two detention basins identified as excavated palustrine wetlands with unconsolidated bottom on the NWI map (Figure 2-3).

The on-site investigation confirmed the presence and location of five of the six wetlands identified on Figure 2-3 of the GCA (1986) study (see Figure C-1; Appendix C of this report), and identified one additional wetland north of the site. Because of the correspondence between the results of the on-site investigation and the previous study, the numbering/identification scheme from the earlier study was retained (see Figure 2-6). The presence of Wetland 1, depicted in the earlier study adjacent to the landfill to the north, could not be confirmed from outside the landfill perimeter fence (approximately 200 feet north); however, it appeared that this wetland, if still present, had been significantly altered and disrupted by landfill capping and remediation activities.

A small wetland area was identified north of the landfill, approximately 15 feet north of the perimeter fence and approximately 500 feet east of Blodgett Road (Wetland 1A on Figure 2-6). The palustrine emergent wetland (PEM1) is dominated by tussock sedge (*Carex stricta*) and marsh fern (*Thelypteris thelypteroides*). Wetland 1A is oblong and encompasses approximately 30 feet x 85 feet, filling a topographic depression surrounded by deciduous forested upland.

The remaining five wetlands identified adjacent to the site were located south of the landfill and the perimeter fence, approximately in the locations depicted on Figure 2-3 of the GCA

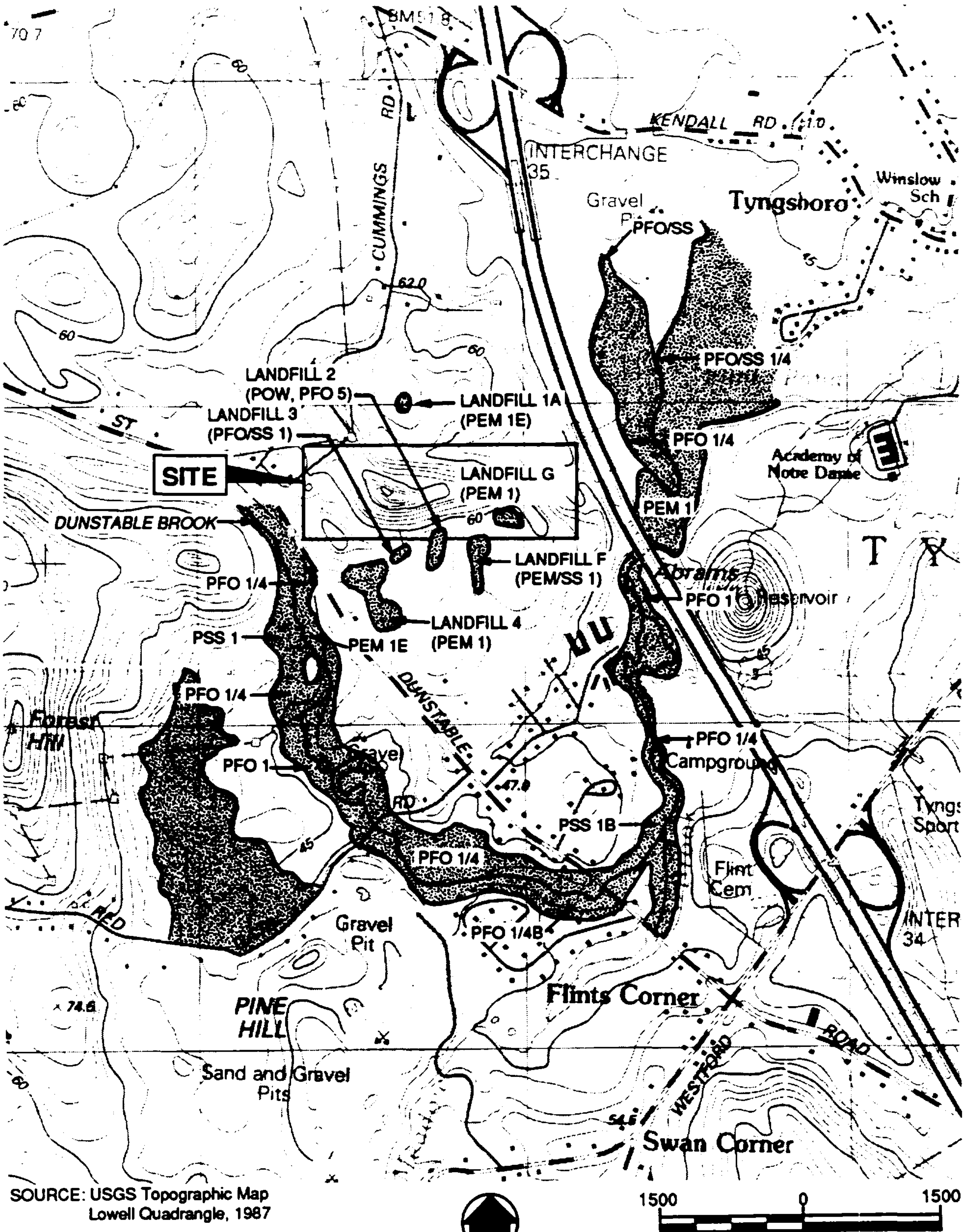


FIGURE 2-6. FIELD MAP OF WETLAND HABITATS

(1986) study (see Appendix C, Figure C-1). Wetland G was a palustrine emergent wetland (PEM1) located in a roughly triangular depression (approximately 40 feet x 75 feet) adjacent to the landfill perimeter fence, where the edge of the landfill makes a right angle turn (Figure 2-6). The vegetation community was dominated by the invasive purple loosestrife and the canopy of mature white pine consists exclusively of standing dead individuals. The physical evidence suggests that either the wetland plant community at this location has been directly and indirectly impacted by landfill activities, or that the wetland was itself formed by the artificial contours and surface water runoff generated by the landfill.
Southwest of Wetland G was the larger Wetland F, consisting of an oblong area of palustrine emergent and scrub/shrub vegetation (PEM/SS1) with a narrow band of palustrine forested wetland (PFO1) extending to the south (Figure 2-6). The vegetative community was dominated by tussock sedge, surrounded by a dense border of highbush blueberry (*Vaccinium corymbosum*), with red maple dominant to the south. Signs indicated the presence of a seasonal channel that drains the emergent/scrub-shrub wetland and flows south through the narrow forested wetland. The location of this wetland corresponded with the area identified as PUBH on the NWI map. No overt signs of adverse impacts to this wetland habitat were observed.

Wetland 2 was located approximately 500 feet west of Wetland F, with the landfill perimeter fence and its rip-rap slope forming the northern border. The center of the wetland consists of open water, corresponding to the larger area of excavated palustrine wetland with unconsolidated shoreline (PUSCx) on the NWI map (Figure 2-3). Wetland 2 was also dominated by standing dead white pine trees (PFO5), with standing water covering their roots and lower trunks. Viable saplings of white pine and grey birch (*Betula populifolia*) are present along the edges of the wetland, outside the open water area; the open water is also bordered by emergent vegetation dominated by broad-leaved cattail (*Typha latifolia*). HMM (1990) reported that the wetland had been significantly reduced in areal extent between 1986 and 1990. Because Wetland 2 ends abruptly at the perimeter fence approximately 30 to 50 feet south of the landfill across the access road, it is possible that this wetland previously extended farther north. The standing dead trees provide evidence that the wetland plant community has undergone significant change, possibly due to alterations in hydrology, but the origin of the changes could not be determined by the on-site investigation.

Wetland 3 is also located adjacent to the landfill perimeter fence, south of the southwest detention basin and west of Wetland 2 (Figure 2-6). Wetland 3 is a palustrine forested wetland (PFO1) dominated by white pine and deciduous saplings, with the emergent story dominated by purple loosestrife. An orange (rust-colored) residue was visible on the surface and in the top 4 inches of the saturated soils throughout Wetland 3. Figure 2-3 of the GCA (1986) wetlands assessment (see Appendix C, Figure C-1) depicted Wetland 3 extending northeast to southwest. The on-site investigation revealed the presence of only the southwestern portion of the wetland, covering only a fraction of the areal extent indicated by the previous study (GCA, 1986). Whether the rest of Wetland 3 was directly filled in order to construct or widen the landfill access road, or it no longer functions as a wetland due to indirect alterations to site hydrology, could not be determined during the on-site investigation.

Wetland 4 is located south of the perimeter fence, east of Dunstable Road, and west of Wetland 3 (Figure 2-6). The location and extent of Wetland 4 roughly corresponds with the palustrine forested/emergent persistent wetland depicted on the NWI map (Figure 2-3). Wetland 4 is a palustrine emergent wetland (PEM1), and the vegetative community is dominated by the invasive species purple loosestrife. A significant number of standing dead red maple trees are present throughout the wetland. At the time of the on-site investigation, the 18-inch outlet pipe was discharging water to the northern edge of the wetland. Neither soil discoloration nor recent sedimentation were detected. The on-site investigation revealed that the vegetative community of Wetland 4 has undergone recent and/or ongoing degradation.

Dunstable Brook - The on-site wetlands investigation included a site walkover, examination and documentation of the Dunstable Brook wetlands system from the area west of the site and west of Dunstable Road, to the point at which Dunstable Brook flows into Bridge Meadow Brook.

Due west of site, Dunstable Brook is bordered by palustrine forested wetlands on both sides in a band approximately 150 feet wide. These floodplain wetlands constitute a palustrine deciduous/coniferous forested community (PFO1/4), dominated by red maple, white pine, and white oak (*Quercus alba*). Dunstable Brook flows south and is fed by two small channels that flow from the site, under Dunstable Road and into the brook. The first appears to drain stormwater runoff from the landfill into this forested wetland community. The bottom sediments in the small channel and in the brook just downstream of the channel showed an orange discoloration, and an oil sheen was visible on the water surface. No evidence of sediment deposition was observed in the forested wetland, but the recently deposited leaf cover from the deciduous trees might have masked deposited sediments. No change in species composition or vegetation density was observed downstream of the landfill runoff channels.

South of the forested wetland and southwest of the site, Dunstable Brook flows through a wet meadow (Figure 2-6). This palustrine emergent wetland (PEM1) is dominated by lowbush blueberry (*Vaccinium augustifolium*), purple loosestrife, Virginia rye grass (*Elymus virginicus*) and other grass species. The emergent wetland and brook are bordered on the east by an actively grazed cow pasture, and it appeared that the emergent vegetation in the wet meadow is subject to grazing. The second channel flows from Wetland 4 under Dunstable Road, through a grassed swale across the pasture, and into the emergent wetland area. At the time of the on-site investigation, stormwater runoff was flowing swiftly through the grassed swale 10 feet wide and approximately 8 inches deep. With the exception of the significant stormwater runoff through the second channel, no discoloration, sedimentation, or other evidence of adverse impacts from the site were detected in the emergent wetland area.

Within the emergent wetland area, approximately 350 feet south of the forested wetland, Dunstable Brook flows into a small (35 feet x 30 feet) open water area. This small pond appears to have been created in conjunction with agricultural activities. A narrow band of emergent vegetation borders the pond, and Dunstable Brook flows out of the pond and continues south.

The pond is bordered to the west by a mixed deciduous/coniferous upland forest approximately 250 feet wide (east-west). Additional pastures are located west of the forested area. Northeast of the pond, north of the upland forest, is a palustrine scrub/shrub wetland dominated by speckled alder (*Alnus rugosa*) and switchgrass (*Panicum virgatum*), which drains into the pond. A small, possibly intermittent stream flows into the scrub/shrub wetland at its southwestern corner. The stream flows north through a narrow (30 to 40 feet wide) palustrine forested wetland (PFO1) dominated by red maple with white pine and American elm (*Ulmus americana*). The forested wetland and the stream are sandwiched between two actively grazed pastures, and the stream's headwaters are located in close proximity to Dunstable Brook approximately 400 feet south of the pond and scrub/shrub wetland.

South of the pond, Dunstable Brook continues to flow south through a narrow band (30 feet) of emergent vegetation, which is bordered on both sides by actively grazed pastures. Approximately 400 feet south of the pond, the emergent wetland vegetation is dominated by purple loosestrife and widens to approximately 50 feet as the brook bends to the west. Dunstable Brook flows west-southwest for approximately 150 feet and then flows south again through a forested wetland, along the western edge of the large gravel pit identified on the topographic map.

West of the gravel pit, Dunstable Brook flows south through a deciduous forested wetland (PFO1) significantly wider than the streambank wetlands encountered upstream (greater than 500 feet wide). The wetland plant community is dominated by red maple with an emergent understory dominated by tussock sedge. The wetland is laced with numerous interconnecting streams and tributaries, created by the accumulation of water behind a beaver dam farther south (near Red Gate Road). Dunstable Brook flows into an open water body that ranges from 15 to 35 feet wide and several hundred feet long. The location and configuration of this water body matches the open water areas depicted on the topographic map (Figure 2-2) and the excavated palustrine wetlands with unconsolidated bottoms (PUBHx) on the NWI map (Figure 2-3). The eastern bank of the open water, abutting the cleared gravel pit area, is formed by an artificial berm; the forested wetland continues along the western bank. Approximately 100 feet north of Red Gate Road, the open water narrows to approximately 12 feet wide where it is obstructed by a beaver dam. South of the beaver dam, Dunstable Brook flows south through palustrine forested wetlands (PFO1) and through a culvert under Red Gate Road.

West of Dunstable Brook and the palustrine emergent and open water areas, the NWI map and HMM report (HMM, 1990) identified a "C" shaped chain of wetlands extending north from the intersection of Red Gate Road and Dunstable Brook. The findings of the on-site investigation indicate that a stream flows north under Red Gate Road and through these mixed deciduous/coniferous forested wetlands (PFO1/4), but the location at which the stream flows into Dunstable Brook could not be ascertained.

South of Red Gate Road, Dunstable Brook flows southeast through a wide, flat, forested floodplain wetland, that is bordered on the east by residences along Dunstable Road and on the west by a gravel pit and another residential development (Figure 2-6). The mixed deciduous/coniferous forested wetland (PFO1/4b) is dominated by red maple and hemlock (*Tsuga canadensis*). Starting several hundred feet downstream of Red Gate Road, Dunstable Brook had widened and inundated a portion of its floodplain. This widening of the brook was attributable to beaver activity; the remnants of a beaver dam were obstructing the brook approximately 250 feet upstream of the culvert under Dunstable Road.

Dunstable Brook flows east through a culvert under Dunstable Road; immediately east of the road the brook opens into a small (35 feet x 30 feet) excavated open water area. The brook then flows northeast to its confluence with Bridge Meadow Brook, through a mixed deciduous/coniferous forested floodplain wetland, dominated by white pine with an understory of red maple.

With the exception of the orange staining and high flows from the two channels immediately west of the site, no evidence was observed of adverse impacts from the landfill to Dunstable Brook or its associated wetlands. No discoloration of the soils, oil sheen on the water surface, or sediment deposition was visible south of the locations identified above.

Bridge Meadow Brook - Southwest of Dunstable Road, palustrine forested and emergent wetlands border Bridge Meadow Brook. The brook flows through an emergent marsh dominated by purple loosestrife, and then flows through a culvert under Dunstable Road approximately 700 feet south of the Dunstable Brook culvert. North of Dunstable Road, the brook is bordered by palustrine forested wetlands, similar to the floodplain wetlands associated with Dunstable Brook to the north.

A beaver dam obstructing flow several hundred feet downstream has inundated the wetlands surrounding the confluence of Bridge Meadow Brook and Dunstable Brook. The wetlands at the confluence are dominated by red maple and a thick shrub understory, primarily red osier dogwood (*Cornus stolonifera*) and speckled alder (PSS1b), with standing water to an unknown depth throughout much of the area. The NWI map identifies this wetland as a diked or impounded palustrine wetland with unconsolidated bottom (PUBHh). Coniferous forested uplands of white pine border this wetland to the north and south.

Bridge Meadow Brook then flows north into the first of two open water areas, a previously excavated gravel pit (PUBHh) (with a campground to the east of the pond as labeled on the topographic map). Based on the observed inundation of emergent plant communities, the water level in the pond appeared to have risen recently due to accumulation of dead branches and other debris at the pond outlet (possible beaver activity). The pond is bordered by a fringe of palustrine emergent vegetation, and surrounded by mixed deciduous/coniferous forest.

Bridge Meadow Brook flows north from the pond through another mixed palustrine forested wetland (PFO1/4). The narrow (approximately 150 feet wide) band of wetland vegetation along the brook is dominated by white pine and red maple. Approximately 750 feet north of the first pond, the brook widens into a larger open water body at the eastern edge of the Cannongate condominium complex (Figure 2-6). The large pond is bordered to the west by landscaped lawns, to the east by a forested area with Route 3 farther east, and to the north and south by forested wetlands associated with Bridge Meadow Brook.

The outlet of the large pond is located at its northern end, and from there Bridge Meadow Brook flows north for approximately 800 feet before it flows through a culvert under Route 3. Upstream of the culvert, the brook widens to approximately 25 feet; this may represent the small open water area depicted on the topographic map (Figure 2-2). In this area, the brook is bordered by a broad-leaved deciduous wetland (PFO1) dominated by red maple and white oak, with a thick emergent understory including tussock sedge and purple loosestrife. The site is located approximately 1000 feet northwest of this wetland and the point at which Bridge Meadow Brook flows through a culvert under Route 3.

During the on-site investigation, a small open water area (less than 20 feet in diameter) was observed approximately 25 feet north of the culvert and adjacent to the Route 3 embankment. The water in this small pond was discolored an opaque blue, the color of copper rust. Water did not appear to flow into the pond from Bridge Meadow Brook. It could not be determined whether the discoloration of the water was caused by leachate/runoff from the landfill, or by runoff from Route 3. This opaque blue discoloration was not observed in any other wetland or waterway downgradient of the landfill.

With the exception of the discoloration of the small pond described above, Bridge Meadow Brook did not appear to have undergone any recent adverse impacts from the site. No other instances of stained soils, oil sheen, sediment migration or vegetation stress/damage attributable to the site were observed in Bridge Meadow Brook during the on-site investigation. The dominant vegetative species observed in the on-site investigation correspond with those documented in the 1990 investigation (HMM, 1990).

Flint Pond Marsh - The on-site wetlands investigation included the emergent, forested and open water areas east of Route 3 and west of Flint Pond. Bridge Meadow Brook flows through a culvert under Route 3 and empties into a palustrine emergent wetland (PEM1) at the southwestern corner of Flint Pond. This emergent marsh extends approximately 1000 feet north-northwest from the culvert outlet, and is bordered on the west by the Route 3 embankment, on the south, north and southeast by upland forests, on the northeast by Flint Pond (Figure 2-6). The emergent marsh is characterized by a homogenous cover of broad-leaved cattail and purple loosestrife, with high vegetation/standing water interspersion. No orange soil staining or other discoloration was observed; the groundwater outbreak of orange leachate observed in 1990 (HMM, 1990) was not present. No damage or disturbance of the plant community was observed.

To the northeast of the emergent marsh and west of Flint Pond is a series of palustrine forested, emergent and open water areas associated with an unnamed stream flowing north toward Flint Pond. The southernmost of the open water areas is depicted on the topographic map as a long narrow band that follows the bank of Flint Pond. The southern end of this small pond is formed by a beaver dam that obstructs flow into Flint Pond. The open water is interspersed with stands of purple loosestrife, and the water surface is covered with duckweed (*Lemna* sp.). The pond is bordered on both sides by a mixed deciduous/coniferous palustrine forest.

A second and slightly larger open water area is located upstream and north of the first small pond. Several large embayments on the western and northern edges of the second pond are covered with emergent vegetation (purple loosestrife) and standing dead white pine. The unnamed stream flows into the second pond at its southern end. The water level in both ponds may have fluctuated with periods of beaver activity, causing changes in the species and survivability of the plant communities along the banks. The second pond is isolated from

Flint Pond by a narrow upland strip; several small outlet channels draining into Flint Pond have been obstructed by beaver activity. The mixed palustrine forest surrounding the second pond is dominated by red oak (*Quercus rubra*), white oak and white pine. No soil or water discoloration or other evidence of adverse impacts from the site were visible in the open water areas west of Flint Pond.

The on-site investigation concluded downgradient at the western edge of Flint Pond. Flint Pond is bordered by a mixed forest of white pine and red oak, with a narrow wetland bank dominated by highbush blueberry. Deciduous leaf litter and submerged aquatic vegetation were visible on the pond bottom. No evidence of sedimentation, leachate migration, vegetation damage or other adverse impacts from the site were visible in Flint Pond or any of the wetland areas east of Route 3.

2.1.5 Field Habitat Characterization and Wildlife Observations

An on-site natural resource survey was conducted at the site and downgradient to Flint Pond on 20-22 October 1993. The field survey consisted of a site walkover during which direct observations of faunal species and their sign were observed and recorded. At the same time, and in conjunction with the wetland characterization (described in Section 2.1.4), habitats were described, dominant flora recorded, and the habitats classified according to the USFWS habitat classification system (USFWS, 1981). Any observations of disturbance, damage or alteration to the ecological community were recorded.

Wildlife observations were collected coincident to recording habitat characteristics and wetland properties on 20-22 October 1993. All species directly observed and whose sign was observed were noted (Table 2-2). Species were recorded for eight general areas. Four of the areas respectively represented the areas immediately north, east, south and west of the landfill (Landfill-Adjacent Wetlands). The remaining four areas represented areas downgradient of the landfill (Dunstable Brook north of Red Gate Road, Dunstable Brook south of Red Gate Road, Bridge Meadow Brook, and Flint Pond/Flint Pond Marsh).

TABLE 2-2. WILDLIFE SPECIES OBSERVED DURING NATURAL RESOURCE SURVEYS AT THE CHARLES GEORGE LANDFILL DURING OCTOBER 20 TO 22, 1993.

		LANDFILL-ADJACENT WETLANDS				DUNSTABLE BROOK		BRIDGE MEADOW BROOK	FLINT POND MARSH
SPECIES*	SCIENTIFIC NAME	NORTH	EAST	SOUTH	WEST	RED GATE W	RED GATE E		
BIRDS									
American black duck	*Anas rubripes*								ind
American goldfinch	*Carduelis tristis*							ind	
American robin	*Turdus migratorius*				ind	ind	ind	ind	
American woodcock	*Scolopax minor*						ind		
Belted kingfisher	*Ceryle alcyon*							ind	
Blue jay	*Cyanocitta cristata*				ind	ind	ind	ind	ind
Canada goose	*Branta canadesis*								ind
Black-capped chickadee	*Parus atricapillus*	ind		ind	ind	ind	ind	ind	ind
American crow	*Corvus brachyrhynchos*	ind				ind		ind	ind
Common grackle	*Quiscalus quiscula*	ind					ind		ind
Dark-eyed junco	*Junco hyemalis*	ind				ind	ind	ind	
Downy woodpecker	*Picoides pubescens*			ind	ind	ind		ind	ind
Golden-crowned kinglet	*Regulus satrapa*				ind				
Great blue heron	*Ardea herodias*								ind
Killdeer	*Charadrius vociferus*		ind		ind				
Mallard	*Anas platyrhynchos*					ind			ind
Mourning dove	*Zenaida macroura*								ind

*Observations are noted as to whether the individual animals was observed or its sign.

TABLE 2-2 continued. WILDLIFE SPECIES OBSERVED DURING NATURAL RESOURCE SURVEYS AT THE CHARLES GEORGE LANDFILL DURING OCTOBER 20 TO 22, 1993.

		LANDFILL-ADJACENT WETLANDS				DUNSTABLE BROOK		BRIDGE MEADOW BROOK	FLINT POND MARSH
SPECIES[*]	SCIENTIFIC NAME	NORTH	EAST	SOUTH	WEST	RED GATE W	RED GATE E		
BIRDS									
Northern cardinal	*Cardinalis cardinalis*								ind
Northern flicker	*Colaptes auratus*				ind	ind			
Northern mockingbird	*Mimus polyglottos*				ind				
Red-breasted nuthatch	*Sitta canadensis*			ind					
Ring-necked duck	*Aythya collaris*								ind
Ruby-crowned kinglet	*Regulus calendula*			ind	ind			ind	
Ruffed grouse	*Bonasa umbellus*						ind		
Song sparrow	*Melospiza melodia*	ind			ind	ind		ind	ind
Turkey vulture	*Cathartes aura*								ind
White-throated sparrow	*Zonotrichia albicollis*		ind		ind	ind		ind	ind
Wood duck	*Aix sponsa*								ind
Yellow-rumped warbler	*Dendroica coronata*			ind				ind	
TOTAL BIRD SPECIES		5	2	5	11	10	7	12	16

[*]Observations are noted as to whether the individual animals was observed or its sign.

TABLE 2-2 continued. WILDLIFE SPECIES OBSERVED DURING NATURAL RESOURCE SURVEYS AT THE CHARLES GEORGE LANDFILL DURING OCTOBER 20 TO 22, 1993.

		LANDFILL-ADJACENT WETLANDS				DUNSTABLE BROOK		BRIDGE MEADOW BROOK	FLINT POND MARSH
SPECIES[*]	SCIENTIFIC NAME	NORTH	EAST	SOUTH	WEST	RED GATE W	RED GATE E		
MAMMALS									
Beaver	*Castor canadensis*						cuttings, lodge	cuttings, lodge	cuttings, lodge
Eastern chipmunk	*Tamias striatus*	ind			ind			ind	
Deer mouse	*Peromyscus maniculatus*	ind							
Gray squirrel	*Sciurus carolinensis*		ind						
Mink	*Mustela vison*							scat	
Red fox	*Vulpes vulpes*	scat							
Red squirrel	*Tamiasciurus hudsonicus*								ind
White-tailed deer	*Odocoileus virginianus*	tracks, scrape	tracks	tracks	tracks	tracks	tracks, rub	tracks	tracks, scrape
Wild Canid (coyote??)	*Canis* sp.					scat	scat	scat	
TOTAL MAMMAL SPECIES		4	2	1	2	2	3	5	3
TOTAL SPECIES		9	4	6	13	12	10	17	19

[*]Observations are noted as to whether the individual animals was observed or its sign.

Ambient temperatures ranged from 40 to 50°F and it rained during the first two days of the survey. It was sunny on the last day of the survey (Flint Pond area). As such, during the majority of the survey, conditions were less than optimum for observing most wildlife due to diminished visibility and the obliteration of animal sign. The surveys were conducted between 7:30 AM and 5:30 PM EDT.

The site is surrounded to the north, east and south by a mixed deciduous and coniferous forest community, dominated by red maple, white pine and white oak. Numerous indigenous and migratory bird species were observed in these forested areas, along with eastern chipmunks (*Tamias striatus*), gray squirrels (*Sciurus carolinensis*) and recurrent signs of white-tailed deer (*Odocoileus virginianus*). Six wetland habitats occur as relatively small, isolated areas within this larger forested habitat (Section 2.1.4). The landfill is bordered on the west by Dunstable Road, with the Dunstable Brook forested wetland located farther west and southwest. A stand of dead trees was observed east of the landfill and west of Route 3. The cause of death was unknown. One dead deer mouse (*Peromyscus maniculatus*) was discovered west of the landfill, but the cause of death could not be ascertained. No other evidence of direct or indirect adverse impacts was visible in the upland communities adjacent to the landfill. The remainder of the ecological communities investigated downgradient of the site (Dunstable Brook, Bridge Meadow Brook, Flint Pond Marsh and Flint Pond) are described in the characterization of wetland habitats (Section 2.1.4).

2.1.6 Fish Tissue Sampling

Fish were collected for tissue analyses on 4 October, 1993 from three locations (Flint Pond, Between Dams, and Locust Pond; Figure 2-7). The Flint Pond and Between Dams locations were both considered potentially impacted by the site; Locust Pond served as the reference site. Both whole fish and fillet/offal samples were analyzed for metals in two fish species, yellow perch (*Perca flavescens*) and largemouth bass (*Micropterus salmoides*). Sample sizes were as follows:

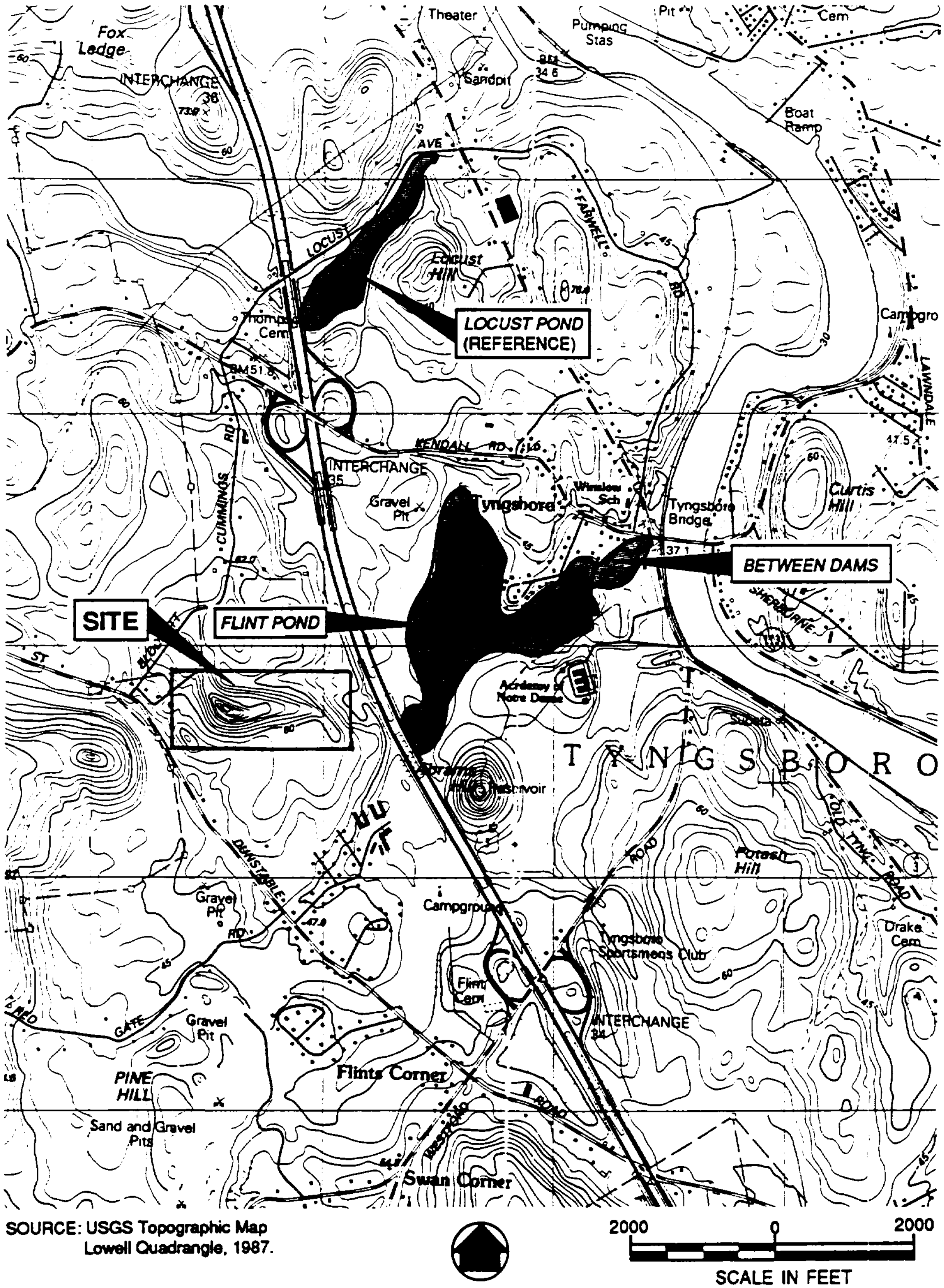


FIGURE 2-7. SAMPLING LOCATIONS FOR FISH TISSUE SAMPLES.

		Fillet	Offal	Whole	Total Fish
Yellow Perch	Flint Pond	5	5	5	10
	Between Dams	5	5	5	10
	Locust Pond	5	5	5	10
Largemouth Bass	Flint Pond	5	5	10	15
	Between Dams	0	0	5	5
	Locust Pond	5	5	5	10

Fish collection was conducted by U.S. Fish and Wildlife Service and U.S. Environmental Protection Agency biologists using electroshocking and gill netting techniques. Once individual fish were selected for analysis, total length (nearest 0.1 cm) and total weight (nearest 0.1 gram) were measured and the fish were examined for gross external abnormalities. For fish which were filleted, fillet and offal weights were also measured, sex was determined, and a brief internal examination was conducted to check for tumors and other gross abnormalities. Table 2-3 summarizes weight and length measurements for the fish collected as part of this sampling effort.

All filleting was conducted in the field using stainless steel filleting knives. Only fish flesh was included in fillet samples; skin was removed from fillets and included in the offal sample. A fresh pair of disposable nitrile gloves was used for each sample processed and all equipment (fillet knife, cutting board, forceps, pliers, etc) were decontaminated after each sample as follows: soapy water wash, tap water rinse, nitric acid (5%) rinse, DIUF-grade water rinse. Equipment blanks were taken after fish from each location were processed, for a total of three equipment blanks.

All fish samples were frozen in the field using dry ice following processing and packaging and were shipped overnight to the analytical laboratory. Fish samples were analyzed for 15 metals (arsenic, aluminum, barium, beryllium, cobalt, cadmium, chromium, copper, silver, lead, mercury, zinc, selenium, vanadium, and nickel) using Special Analytical Services (SAS) procedure IECOFish-01. Percent lipid and percent solids were also determined.

TABLE 2-3. CHARLES GEORGE RECLAMATION LANDFILL FISH SAMPLING DATA - 4 October 1993

Species	Location	M&E#	SAS#	Tag#	Total Length (cm)	Total Weight (g)	Fillet Weight (g)	Offal Weight (g)	Sex[a]
Yellow Perch	Flint Pond	YP-FP-F-01 YP-FP-O-01	SAB193 SAB194	68229 68231	28.7	255	63	181	F
Yellow Perch	Flint Pond	YP-FP-F-02 YP-FP-O-02	SAB195 SAB196	68232 68233	28.9	280	74	200	F
Yellow Perch	Flint Pond	YP-FP-F-03 YP-FP-O-03	SAB197 SAB198	68167 68168	28.1	264	70	185	F
Yellow Perch	Flint Pond	YP-FP-F-04 YP-FP-O-04	SAB199 SAB200	68189 68235	28.2	273	85	178	F
Yellow Perch	Flint Pond	YP-FP-F-05 YP-FP-O-05	SAB201 SAB202	68236 68202	28.5	261	73	179	F
Yellow Perch	Flint Pond	YP-FP-W-01	SAB212	68247	24.1	153			U
Yellow Perch	Flint Pond	YP-FP-W-02	SAB213	68248	22.7	133			U
Yellow Perch	Flint Pond	YP-FP-W-03	SAB214	68250	20.9	91			U
Yellow Perch	Flint Pond	YP-FP-W-04	SAB215	68230	21.0	103			U
Yellow Perch	Flint Pond	YP-FP-W-05	SAB216	68249	18.8	77			U
Largemouth Bass	Flint Pond	LB-FP-F-01 LB-FP-O-01	SAB187 SAB188	68221 68222	55.5	2920[b] (approx.)	212	2250	F
Largemouth Bass	Flint Pond	LB-FP-F-02 LB-FP-O-02	SAB189 SAB190	68223 68224	44.0	1253	132	1110	F
Largemouth Bass	Flint Pond	LB-FP-F-03 LB-FP-O-03	SAB191 SAB192	68225 68226	40.0	857	118	715	M

TABLE 2-3 continued. CHARLES GEORGE RECLAMATION LANDFILL FISH SAMPLING DATA - 4 October 1993

Species	Location	M&E#	SAS#	Tag#	Total Length (cm)	Total Weight (g)	Fillet Weight (g)	Offal Weight (g)	Sex
Largemouth Bass	Flint Pond	LB-FP-F-04 LB-FP-O-04	SAB203 SAB204	68238 68239	54.4	2265	193	2065	F
Largemouth Bass	Flint Pond	LB-FP-F-05 LB-FP-O-05	SAB205 SAB206	68240 68241	36.1	694	108	596	M
Largemouth Bass	Flint Pond	LB-FP-W-01	SAB207	68242	26.6	232			U
Largemouth Bass	Flint Pond	LB-FP-W-02	SAB208	68244	24.9	183			U
Largemouth Bass	Flint Pond	LB-FP-W-03	SAB209	68243	21.7	127			U
Largemouth Bass	Flint Pond	LB-FP-W-04	SAB210	68245	24.5	171			U
Largemouth Bass	Flint Pond	LB-FP-W-05	SAB211	68246	27.5	247			U
Largemouth Bass	Flint Pond	LB-FP-W-06	SAB252	68259	31.4	363			U
Largemouth Bass	Flint Pond	LB-FP-W-07	SAB253	68254	32.3	450			U
Largemouth Bass	Flint Pond	LB-FP-W-08	SAB254	68253	28.6	292			U
Largemouth Bass	Flint Pond	LB-FP-W-09	SAB255	68260	27.9	258			U
Largemouth Bass	Flint Pond	LB-FP-W-10	SAB256	68261	30.0	346			U
Yellow Perch	Locust Pond	YP-LP-F-01 YP-LP-O-01	SAB233 SAB234	68299 68300	27.8	247	67	176	F
Yellow Perch	Locust Pond	YP-LP-F-02 YP-LP-O-02	SAB235 SAB236	68322 68297	26.4	216	70	146	F
Yellow Perch	Locust Pond	YP-LP-F-03 YP-LP-O-03	SAB237 SAB238	68291 68292	27.1	220	80[c]	175[c]	F
Yellow Perch	Locust Pond	YP-LP-F-04 YP-LP-O-04	SAB239 SAB240	68251 68293	26.6	205	73[c]	145[c]	F

TABLE 2-3 continued. CHARLES GEORGE RECLAMATION LANDFILL FISH SAMPLING DATA - 4 October 1993

Species	Location	M&E#	SAS#	Tag#	Total Length (cm)	Total Weight (g)	Fillet Weight (g)	Offal Weight (g)	Sex
Yellow Perch	Locust Pond	YP-LP-F-05 YP-LP-O-05	SAB241 SAB242	68294 68295	26.6	215	59	153	U
Yellow Perch	Locust Pond	YP-LP-W-01	SAB222	68314	19.5	90			U
Yellow Perch	Locust Pond	YP-LP-W-02	SAB223	68315	22.4	125			U
Yellow Perch	Locust Pond	YP-LP-W-03	SAB224	68316	19.5	89			U
Yellow Perch	Locust Pond	YP-LP-W-04	SAB225	68301	20.6	105			U
Yellow Perch	Locust Pond	YP-LP-W-05	SAB226	68312	23.2	158			U
Largemouth Bass	Locust Pond	LB-LP-F-01 LB-LP-O-01	SAB227 SAB228	68281 68283	46.0	1145	179°	981°	F
Largemouth Bass	Locust Pond	LB-LP-F-02 LB-LP-O-02	SAB229 SAB230	68284 68282	39.8	933	119°	833°	F
Largemouth Bass	Locust Pond	LB-LP-F-03 LB-LP-O-03	SAB231 SAB232	68285 68286	34.3	502	92°	420°	M
Largemouth Bass	Locust Pond	LB-LP-F-04 LB-LP-O-04	SAB243 SAB244	68287 68289	49.0	1949	197	1741	U
Largemouth Bass	Locust Pond	LB-LP-F-05 LB-LP-O-05	SAB245 SAB246	68290 68298	48.4	1680	233	1430	F
Largemouth Bass	Locust Pond	LB-LP-W-01	SAB217	68308	25.0	209			U
Largemouth Bass	Locust Pond	LB-LP-W-02	SAB218	68309	24.7	191			U
Largemouth Bass	Locust Pond	LB-LP-W-03	SAB219	68310	24.7	199			U
Largemouth Bass	Locust Pond	LB-LP-W-04	SAB220	68311	26.7	247			U
Largemouth Bass	Locust Pond	LB-LP-W-05	SAB221	68312	21.1	120			U

TABLE 2-3 continued. CHARLES GEORGE RECLAMATION LANDFILL FISH SAMPLING DATA - 4 October 1993

Species	Location	M&E#	SAS#	Tag#	Total Length (cm)	Total Weight (g)	Fillet Weight (g)	Offal Weight (g)	Sex
Yellow Perch	Between Dams	YP-BD-F-01 YP-BD-O-01	SAB257 SAB258	68262 68263	28.2	251	62	182	F
Yellow Perch	Between Dams	YP-BD-F-02 YP-BD-O-02	SAB259 SAB260	68264 68265	27.0	236	89	145	F
Yellow Perch	Between Dams	YP-BD-F-03 YP-BD-O-03	SAB261 SAB262	68266 68267	26.7	233	67	163	F
Yellow Perch	Between Dams	YP-BD-F-04 YP-BD-O-04	SAB263 SAB264	68268 68269	24.1	144	57	85	F
Yellow Perch	Between Dams	YP-BD-F-05 YP-BD-O-05	SAB265 SAB266	68270 68288	24.0	163	54	103	M
Yellow Perch	Between Dams	YP-BD-W-01	SAB267	68276	23.0	112			U
Yellow Perch	Between Dams	YP-BD-W-02	SAB268	68277	22.8	138			U
Yellow Perch	Between Dams	YP-BD-W-03	SAB269	68278	19.7	80			U
Yellow Perch	Between Dams	YP-BD-W-04	SAB270	68279	22.7	122			U
Yellow Perch	Between Dams	YP-BD-W-05	SAB271	68280	23.3	135			U
Largemouth Bass	Between Dams	LB-BD-W-01	SAB247	68252	30.9	384			U
Largemouth Bass	Between Dams	LB-BD-W-02	SAB248	68255	30.7	366			U
Largemouth Bass	Between Dams	LB-BD-W-03	SAB249	68256	21.9	130			U
Largemouth Bass	Between Dams	LB-BD-W-04	SAB250	68257	23.4	153			U
Largemouth Bass	Between Dams	LB-BD-W-05	SAB251	68258	24.7	181			U

[a] F=female, M=male, U=unknown.
[b] Weighed with spring scale, not electric balance.
[c] The sum of fillet and offal weight exceeds total weight.

Equipment blanks were analyzed using Routine Analytical Services procedures for 23 TAL metals.

2.2 Analytical Results Summary

Sediment and fish tissue samples were collected and analyzed during the fall of 1993 as part of this five year review of the site. The purpose of the samples is to evaluate changes in concentration over time. This evaluation is incorporated into the review of remedial actions completed to date at the site to insure they remain protective of human health and the environment. The following sections present the analytical data with short discussions of the data validation, data trends and data distributions. Comparison of the data to historical levels, regulatory limits, ROD established levels, and other ARAR's is included in Section 3.0 Evaluation of Data (to be included in the Draft Five Year Review Report).

2.2.1 Sediment Results Summary

Nineteen locations were sampled and analyzed for several parameters. The breakdown of locations and number of samples is:

- Three locations in Dunstable Brook, including the site background location
- Five locations in Flint Pond Marsh
- Seven locations in Flint Pond
- Three locations downstream of the Flint Pond dam
- One control sample location at Saw Mill Pond in Concord, Massachusetts

The samples were analyzed for: volatile organics, semi-volatile organics, metals, polycyclic aromatic hydrocarbons, antimony and cadmium (low detection limit), and grain size. Each sample was also analyzed for either total organic carbon (TOC) or total combustible organics

(TCO) depending on its organic content. Visual inspection in the field during sampling was used to determine the appropriate organic content analysis. Low organic content sediments (sand) were analyzed for TOC and high organic content sediments (black pond mud) were analyzed for TCO.

Polycyclic aromatic hydrocarbons (PAHs) were analyzed because of their historic presence at the site and to reassess their contribution to site risk. Some risk factors (e.g., reference dose) have recently been updated for PAH's. Therefore, the risk associated with PAH's has changed since its calculation during the RI/FS stage. Evaluation of the change to the site risk is an element of the five year review. Semi-volatile organics analysis also produces results for PAH compounds. However, semi-volatile organics were analyzed by a Regular Analytical Services (RAS) method. Changes in the preparation of the sample due to matrix intereferences or sample material characteristics is not possible under the CLP program. Analyzing each sample for both PAH's and semi-volatile organics, although redundant, introduced flexibility to the analytical program and resulted in usable data.

A similar reasoning was used to introduce flexibility to the analytical program for metals in sediment. Antimony and cadmium have low ecological criteria limits in sediment. In order to achieve detection at the ecological criteria limits, sediment samples were analyzed for metals by a RAS method and a separate method which targets a lower detection limit. Unfortunately, the initial antimony data was rejected during data validation due to problems during sample digestion. However, adjustments to the digestion method have been agreed upon by M&E, EPA, and the laboratory. Sediment samples have been reanalyzed for antimony and the results are included in the tables.

Toxicity testing was performed on samples collected at seven locations. These locations were specified by EPA and assigned consecutive sample numbers (CGSED-1 through CGSED-7). However, their locations are spread throughout the sampling area. See Figure 2-1 and Section 2.1.2 for further details of each sampling location and analytical parameters.

Comparison of the data to background levels, reference location levels, regulatory limits, etc. is included in Section 3.1.1.

2.2.1.1 Volatile Organics. Volatile organic results are in Table 2-4. During data validation, samples CGSED-4, 5 6, 10, 11 and 13 had their non-detect results rejected due to high (greater than 70 percent) moisture contents. Detected results were retained but qualified as estimates. Sample CGSED-12 had all results rejected due to extremely high (greater than 90 percent) percent moisture values.

2.2.1.2 Semi-Volatile Organic. Semi-volatile organic results are in Table 2-5. Except for Bis(2-ethylhexyl)phthalate, the semi-volatile organics detected are also polycyclic aromatic hydrocarbons (PAHs). Three causes for rejection of semi-volatile organic data were identified during data validation. Similar to volatile organic results, some non-detected results were rejected due to elevated (above 70 percent) moisture contents. This occurred in sediments CGSED-5, 6, 11, 12, and 13. Two samples, CGSED-4 and CGSED-9 had values rejected because surrogate recoveries were outside the control limits. Five samples, CGSED-1, 8, 10, 18, and 21 had values rejected because their extraction dates exceeded the allowable holding time (7 days) by five to nine days.

2.2.1.3 Polycyclic Aromatic Hydrocarbons (PAHs). PAH results are in Table 2-6. The PAH analysis consistently achieved a lower detection limit than the semi-volatile organic analysis. No results were rejected during data validation. Therefore, this data set exhibits a more accurate representation of site conditions for the PAH compounds.

2.2.1.4 Metals. Metals in sediment results are in Table 2-7. The results indicate that at the detection limits reported, cadmium and antimony did not have any detections. However, in some cases, the detection limit was above the limit required for comparison to regulatory limits. These two compounds were analyzed separately with low detection limits targeted.

Table 2-4 Volatile Organics Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID: COMPOUND	CGSED-1 (ug/kg)	CGSED-2 (ug/kg)	CGSED-3 (ug/kg)	CGSED-4 (ug/kg)	CGSED-5 (ug/kg)	CGSED-6 (ug/kg)	CGSED-7 (ug/kg)
Methylene Chloride	140	13 U	12 U	R	R	R	21 U
Acetone	210 J	35	12	200 J	140 J	160 J	37 J
2-Butanone	20 J	13 U	12 U	R	R	R	21 UJ
Benzene	19 U	13 U	12 U	R	61 J	R	21 U
Toluene	19 UJ	13 U	12 U	R	R	R	21 U
Ethylbenzene	19 UJ	13 U	12 U	R	77 J	R	21 U
Total Xylenes	19 UJ	13 U	12 U	R	32 J	R	21 U
DILUTION FACTOR:	1	1	1	1	1	1	1
SAMPLE WEIGHT (g):	5	5	5	5	5	5	5
% MOISTURE:	48	21	14	80	74	71	53
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
DATE ANALYZED:	10-11-93	10-06-93	10-06-93	10-06-93	10-06-93	10-06-93	10-06-93
REMARKS:							

Footnotes:
- * - Medium soils are 120 times the value shown.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-4 Volatile Organics Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-8 (ug/kg)	CGSED-9 (ug/kg)	CGSED-10 (ug/kg)	CGSED-11 (ug/kg)	CGSED-12 (ug/kg)	CGSED-13 (ug/kg)
COMPOUND						
Methylene Chloride	160	17 U	R	70 J	R	R
Acetone	260 J	67 J	110 J	220 J	R	620 J
2-Butanone	37 J	17 UJ	R	R	R	150 J
Benzene	33 U	17 U	110 J	R	R	R
Toluene	33 U	17 U	R	R	R	R
Ethylbenzene	33 U	17 U	71 J	R	R	R
Total Xylenes	33 U	17 U	100 J	R	R	R
DILUTION FACTOR:	1	1	1	1	1	1
SAMPLE WEIGHT (g):	5	5	5	5	5	5
% MOISTURE:	70	40	80	81	92	89
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	10-01-93	09-28-93	09-28-93	09-29-93	09-29-93	09-29-93
DATE ANALYZED:	10-11-93	10-04-93	10-04-93	10-05-93	10-05-93	10-05-93
REMARKS:						

Footnotes:
- * - Medium soils are 120 times the value shown.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-4 Volatile Organics Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-14 (ug/kg)	CGSED-15 (ug/kg)	CGSED-16 (ug/kg)	CGSED-17 (ug/kg)	CGSED-18 (ug/kg)	CGSED-21 (ug/kg)
COMPOUND						
Methylene Chloride	27 U	20 U	25 U	12 U	14 U	55
Acetone	210	130	180	12 U	15 J	250 J
2-Butanone	39	20 U	30	12 U	14 UJ	29 J
Benzene	27 U	20 U	25 U	12 U	14 U	16 U
Toluene	27 U	20 U	25 U	12 U	14 U	4 J
Ethylbenzene	27 U	20 U	25 U	12 U	14 U	16 U
Total Xylenes	27 U	20 U	25 U	12 U	14 U	16 U
DILUTION FACTOR:	1	1	1	1	1	1
SAMPLE WEIGHT (g):	5	5	5	5	5	5
% MOISTURE:	63	50	60	18	27	39
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	09-29-93	09-29-93	09-29-93	09-29-93	09-28-93	10-01-93
DATE ANALYZED:	10-05-93	10-05-93	10-05-93	10-05-93	10-04-93	10-11-93
REMARKS:						CONTROL SAMP

Footnotes:
- * - Medium soils are 120 times the value shown.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-5 Semi-Volatile Organics Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-1 (ug/kg)	CGSED-2 (ug/kg)	CGSED-3 (ug/kg)	CGSED-4 (ug/kg)	CGSED-5 (ug/kg)	CGSED-6 (ug/kg)	CGSED-7 (ug/kg)
COMPOUND							
Phenanthrene	R	420 U	250 J	350 J	R	R	700 U
Anthracene	R	420 U	100 J	R	R	R	700 U
Fluoranthene	R	420 U	540 J	400 J	R	R	700 U
Pyrene	R	85 J	400 J	390 J	R	R	700 U
Benzo(a)anthracene	R	420 U	260 J	R	R	R	700 U
Chrysene	R	420 U	230 J	360 J	R	R	700 U
Bis(2-ethylhexyl)phthalate	140 J	150 J	380 UJ	1200 J	740 J	650 J	190 J
Benzo(b)fluoranthene	R	420 U	310 J	R	R	R	700 U
Benzo(a)pyrene	R	420 U	190 J	R	R	R	200 J
Indeno(1,2,3-cd)pyrene	R	420 U	120 J	R	R	R	700 U
Benzo(g,h,i)perylene	R	420 U	380 UJ	R	R	R	700 U
DILUTION FACTOR:	1	1	1	1	1	1	1
SAMPLE WEIGHT (g):	30	30	30	30	30	30	30
% MOISTURE:	49	21	14	80	74	71	53
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
DATE EXTRACTED:	10-13-93	10-06-93	10-06-93	10-06-93	10-06-93	10-06-93	10-06-93
DATE ANALYZED:	11-01-93	10-28-93	10-22-93	10-21-93	10-21-93	10-21-93	10-22-93
REMARKS:							

Footnotes:
- * - Medium soils are 31.25 times the CRQL shown, rounded to two significant figures.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-5 Semi-Volatile Organics Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID: COMPOUND	CGSED-8 (ug/kg)	CGSED-9 (ug/kg)	CGSED-10 (ug/kg)	CGSED-11 (ug/kg)	CGSED-12 (ug/kg)	CGSED-13 (ug/kg)
Phenanthrene	R	R	R	R	R	R
Anthracene	R	R	R	R	R	R
Fluoranthene	R	R	R	R	R	R
Pyrene	R	R	R	R	R	R
Benzo(a)anthracene	R	R	R	R	R	R
Chrysene	R	R	R	R	R	R
Bis(2-ethylhexyl)phthalate	260 J	R	R	880 J	R	R
Benzo(b)fluoranthene	R	R	R	R	R	R
Benzo(a)pyrene	R	R	R	R	R	R
Indeno(1,2,3-cd)pyrene	R	R	R	R	R	R
Benzo(g,h,i)perylene	R	R	R	R	R	R
DILUTION FACTOR:	1	1	1	1	1	1
SAMPLE WEIGHT (g):	30	30	30	30	30	30
% MOISTURE:	70	40	80	81	92	89
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	10-01-93	09-28-93	09-28-93	09-29-93	09-29-93	09-29-93
DATE EXTRACTED:	10-13-93	10-14-93	10-14-93	10-05-93	10-05-93	10-05-93
DATE ANALYZED:	11-01-93	10-28-93	10-28-93	10-28-93	11-01-93	11-01-93
REMARKS:						

Footnotes:
* - Medium soils are 31.25 times the CRQL shown, rounded to two significant figures.
CRQL - Contract Required Quantitation Limit.
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-5 Semi-Volatile Organics Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID: COMPOUND	CGSED-14 (ug/kg)	CGSED-15 (ug/kg)	CGSED-16 (ug/kg)	CGSED-17 (ug/kg)	CGSED-18 (ug/kg)	CGSED-21 (ug/kg)
Phenanthrene	890 U	670 U	830 UJ	400 U	R	R
Anthracene	890 U	670 U	830 UJ	400 U	R	R
Fluoranthene	890 U	670 U	830 UJ	400 U	R	R
Pyrene	890 U	670 U	330 UJ	400 U	R	R
Benzo(a)anthracene	890 U	670 U	330 UJ	400 U	R	R
Chrysene	890 U	670 U	330 UJ	400 U	R	R
Bis(2-ethylhexyl)phthalate	890 U	230 J	330 UJ	400 U	R	R
Benzo(b)fluoranthene	890 U	670 U	330 UJ	400 U	R	R
Benzo(a)pyrene	890 U	670 U	330 UJ	400 U	R	R
Indeno(1,2,3-cd)pyrene	890 U	670 U	330 UJ	400 U	R	R
Benzo(g,h,i)perylene	890 U	670 U	330 UJ	400 U	R	R
DILUTION FACTOR:	1	1	1	1	1	1
SAMPLE WEIGHT (g):	30	30	30	30	30	30
% MOISTURE:	63	51	60	18	27	39
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	09-29-93	09-29-93	09-29-93	09-29-93	09-28-93	10-01-93
DATE EXTRACTED:	10-05-93	10-05-93	10-05-93	10-05-93	10-14-93	10-13-93
DATE ANALYZED:	11-01-93	11-01-93	11-01-93	11-01-93	10-28-93	11-01-93
REMARKS:						CONTROL SAMP

Footnotes:
- * - Medium soils are 31.25 times the CRQL shown, rounded to two significant figures.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-6 Polycyclic Aromatic Hydrocarbon (PAH) Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-1 (ug/kg)	CGSED-2 (ug/kg)	CGSED-3 (ug/kg)	CGSED-4 (ug/kg)	CGSED-5 (ug/kg)	CGSED-6 (ug/kg)	CGSED-7 (ug/kg)
PAH COMPOUND							
Naphthalene	25 U	16 U	15 U	16 U	22 U	21 U	23 U
2-Methylnaphthalene	25 U	16 U	15 U	16 U	22 U	21 U	23 U
Acenaphthylene	25 U	8 J	15 U	16 U	22 U	21 U	23 U
Acenaphthene	25 U	16 U	15 U	16 U	22 U	21 U	23 U
Fluorene	25 U	16	5 J	16 U	22 U	21 U	23 U
Phenanthrene	8 J	86 J	42	44	19 J	20 J	28
Anthracene	25 U	15 J	6 J	16 U	22 U	21 U	23 U
Fluoranthene	17 J	120 J	61	92 J	35	37	66
Pyrene	22 J	260 J	68 J	140 J	45	46	98
Benzo(a)anthracene	6 J	60	27 J	30	11 J	12 J	26
Chrysene	12 J	68 J	32	47	19 J	21	33
Benzo(b)fluoranthene	11 J	59 J	35 J	45 J	23 J	24 J	32 J
Benzo(k)fluoranthene	25 UJ	48 J	15 J	36 J	7 J	8 J	35 J
Benzo(a)pyrene	9 J	62 J	28 J	39 J	13 J	120 J	32 J
Indeno(1,2,3-cd)pyrene	30 J	90 J	52 J	83 J	39 J	41 J	73 J
Dibenz(a,h)anthracene	25 J	45 J	35 J	28 J	28 J	28 J	23 UJ
Benzo(g,h,i)perylene	29 J	99 J	46 J	80 J	38 J	38 J	73 J
DILUTION FACTOR:	1	1	1	1	1	1	1
SAMPLE WEIGHT (g):	30.5	30.2	30.4	100	100	100	30.2
PERCENT SOLIDS:	51	82	84	24	18	19	55
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	10/01/93	10/01/93	10/01/93	10/01/93	10/01/93	10/01/93	10/01/93
DATE EXTRACTED:	10/07/93	10/07/93	10/07/93	10/07/93	10/07/93	10/07/93	10/07/93
DATE ANALYZED:	10/14/93	10/21/93	10/14/93	10/17/93	10/15/93	10/15/93	10/17/93
REMARKS:							

Footnotes:
PQL - Practical Quantitation Limit.
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-6 Polycyclic Aromatic Hydrocarbon (PAH) Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-8 (ug/kg)	CGSED-9 (ug/kg)	CGSED-10 (ug/kg)	CGSED-11 (ug/kg)	CGSED-12 (ug/kg)	CGSED-13 (ug/kg)
PAH COMPOUND						
Naphthalene	13 U	17 U	93 J	22 U	45 U	38 U
2-Methylnaphthalene	13 U	6 J	20 J	22 U	45 U	38 U
Acenaphthylene	13 U	17 U	20 U	22 U	45 U	38 U
Acenaphthene	13 U	17 U	20 U	22 U	45 U	38 U
Fluorene	13 U	8 J	20 U	22 U	45 U	38 U
Phenanthrene	42	22	28	26	43 J	49
Anthracene	13 U	17 U	20 U	22 U	45 U	38 U
Fluoranthene	83 J	11 J	46	50	48	61
Pyrene	190 J	26	110 J	49	44 J	50
Benzo(a)anthracene	36	17 U	14 J	22 U	45 U	38 U
Chrysene	55 J	8 J	24	28	45 U	25 J
Benzo(b)fluoranthene	52 J	6 J	21 J	25 J	45 UJ	22 J
Benzo(k)fluoranthene	30 J	6 J	21 J	13 J	45 UJ	38 UJ
Benzo(a)pyrene	45 J	6 J	21 J	14 J	45 UJ	38 UJ
Indeno(1,2,3-cd)pyrene	74 J	7 J	42 J	25 J	45 UJ	38 UJ
Dibenz(a,h)anthracene	35 J	17 UJ	20 UJ	22 UJ	45 UJ	38 UJ
Benzo(g,h,i)perylene	77 J	8 J	41 J	27 J	45 UJ	38 UJ
DILUTION FACTOR:	1	1	1	1	1	1
SAMPLE WEIGHT (g):	100.5	52.5	79.3	89.6	79.3	85.7
PERCENT SOLIDS:	31	44	24	20	11	12
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	10/01/93	9/28/93	9/28/93	9/29/93	9/29/93	9/29/93
DATE EXTRACTED:	10/07/93	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93
DATE ANALYZED:	10/21/93	10/20/93	10/17/93	10/17/93	10/17/93	10/17/93
REMARKS:						

Footnotes:
PQL - Practical Quantitation Limit.
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-6 Polycyclic Aromatic Hydrocarbon (PAH) Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-14 (ug/kg)	CGSED-15 (ug/kg)	CGSED-16 (ug/kg)	CGSED-17 (ug/kg)	CGSED-18 (ug/kg)	CGSED-21 (ug/kg)
PAH COMPOUND						
Naphthalene	17 U	17 U	13 J	16 U	25 J	20 UJ
2-Methylnaphthalene	17 U	17 U	17 U	16 U	10 J	20 UJ
Acenaphthylene	17 U	17 U	15 J	4 J	36 J	20 UJ
Acenaphthene	17 U	17 U	19	16 U	17 UJ	20 UJ
Fluorene	17 U	17 U	30	16 U	14 J	20 UJ
Phenanthrene	21	17	200 J	18	170 J	20 UJ
Anthracene	17 U	17 U	50	16 U	50 J	20 UJ
Fluoranthene	43	38	390 J	35	340 J	20 UJ
Pyrene	44	44	710 J	34	1300 J	15 J
Benzo(a)anthracene	12 J	13 J	190 J	17	310 J	20 UJ
Chrysene	20 J	19	210 J	20	280 J	20 UJ
Benzo(b)fluoranthene	31 J	24 J	180 J	18	270 J	20 UJ
Benzo(k)fluoranthene	18 J	20 J	130 J	39	500 J	20 UJ
Benzo(a)pyrene	18 J	16 J	190 J	18	290 J	20 UJ
Indeno(1,2,3-cd)pyrene	32 J	35 J	340 J	9 J	270 J	20 UJ
Dibenz(a,h)anthracene	17 UJ	17 UJ	150 J	4 J	100 J	20 UJ
Benzo(g,h,i)perylene	34 J	34 J	320 J	8 J	290 J	20 UJ
DILUTION FACTOR:	1	1	1	1	1	1
SAMPLE WEIGHT (g):	72.2	52.4	57.5	30.5	30.5	30.5
PERCENT SOLIDS:	32	45	40	82	76	64
LEVEL:	LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	9/29/93	9/29/93	9/29/93	9/28/93	9/28/93	10/01/93
DATE EXTRACTED:	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93	10/07/93
DATE ANALYZED:	10/17/93	10/17/93	10/17/93	10/17/93	11/01/93	11/02/93
REMARKS:						CONTROL SAMP

Footnotes:
PQL - Practical Quantitation Limit.
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-7 Metals Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:		CGSED-1 (mg/kg)	CGSED-2 (mg/kg)	CGSED-3 (mg/kg)	CGSED-4 (mg/kg)	CGSED-5 (mg/kg)	CGSED-6 (mg/kg)	CGSED-7 (mg/kg)
ANALYTES								
Aluminum	P	6640	6680	5290	13800 J	7360 J	8110 J	6870
Arsenic	P	4.1	26	11.6	20.3 J	18.9 J	19.3 J	13
Barium	P	44.8	48.7	28.4	83.9 J	46.9 J	51.8 J	24.7
Beryllium	P	0.08 U	0.2	0.04 U	R	0.72 J	0.87 J	0.08 U
Calcium	P	2720 J	2610 J	1260 J	4420 J	10500 J	11700 J	1300 J
Chromium	P	14.2	23.7	17.7	32.2 J	14.8 J	16.8 J	12.1
Cobalt	P	9.6	4.5	4.0	17.3 J	3.5 J	3.7 J	4.2
Copper	P	2.7	8.1	5.8	15.5 J	6.7 J	8.7 J	5.2
Iron	P	5220	21600	10300	14400 J	6170 J	6540 J	5580
Lead	P	10.9	8.8	5.5	60.4 J	27.5 J	29.3 J	19
Magnesium	P	1810	3890	3060	3940 J	840 J	889 J	1290
Manganese	P	718	196	168	707 J	437 J	443 J	433
Mercury	CV	0.11 U	0.06 U	0.05 U	R	R	R	0.09 U
Nickel	P	11.2	17.1	11.7	25.1 J	6.1 J	11.8 J	6.6
Potassium	P	392	1710	1520	1370 J	211 J	R	329
Silver	P	1.5 U	0.82	0.76 U	R	R	R	1.4 U
Sodium	P	238 U	173 U	142 U	R	R	R	146 U
Vanadium	P	10.8	17.8	14.6	30.7 J	4.1 J	7.9 J	11.2
Zinc	P	19.9	32.6	25.2	103 J	33.7 J	30.1 J	21.3
DATE SAMPLED:		10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
% SOLIDS:		45.8	82.2	85.8	19.5	17.6	15.7	48.1
ICP SAMPLE WT. (g):		1.1	1.11	1.13	1.02	1.11	1.04	1.07
Hg SAMPLE WT. (g):		0.2	0.21	0.22	0.2	0.2	0.21	0.22
REMARKS:								

Footnotes:

P - ICP/Flame AE
CV - Cold Vapor
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-7 Metals Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:		CGSED-8 (mg/kg)	CGSED-9 (mg/kg)	CGSED-10 (mg/kg)	CGSED-11 (mg/kg)	CGSED-12 (mg/kg)	CGSED-13 (mg/kg)	CGSED-14 (mg/kg)
ANALYTES								
Aluminum	P	9880 J	26700	17800 J	8930 J	R	1520 J	15200
Arsenic	P	21.8 J	69.7	41.4 J	8.3 J	R	8.4 J	19.4
Barium	P	56.6 J	121	67.5 J	46.4 J	R	37.3 J	61.4
Beryllium	P	R	1.2	R	1.1 J	R	R	0.65
Calcium	P	3360 J	8780 J	5550 J	9290 J	R	16500 J	3460 J
Chromium	P	25.7 J	68.1	54.7 J	16.4 J	R	11.8 J	15.2
Cobalt	P	22.3 J	21.1	50.5 J	4.1 J	R	R	4.8
Copper	P	11.7 J	42.6	R	R	R	R	6.5 U
Iron	P	10600 J	31900	18300 J	4710 J	R	2450 J	8600
Lead	P	40 J	20.4 J	64.7 J	R	R	R	32.3 J
Magnesium	P	3200 J	10700	7460 J	747 J	R	953 J	1540
Manganese	P	393 J	678	594 J	315 J	R	188 J	350
Mercury	CV	R	0.08 U	R	R	R	R	0.15 U
Nickel	P	21.2 J	64.2	45.1 J	7.7 J	R	9.5 J	9.2
Potassium	P	1090 J	5480	3360 J	R	R	R	708
Silver	P	R	1.8 U	R	R	R	R	2.0 U
Sodium	P	R	1060	R	R	R	R	151 U
Vanadium	P	25.1 J	53.4	51.2 J	8.2 J	R	7.2 J	14.6
Zinc	P	78 J	70.7	86 J	32.9 J	R	R	33
DATE SAMPLED:		10-01-93	9-28-93	9-28-93	9-29-93	9-29-93	9-29-93	9-29-93
% SOLIDS:		29.6	57.8	19.1	19.9	8.5	11.3	34
ICP SAMPLE WT. (g):		1.08	1.08	1.02	1.02	1.06	1	1.07
Hg SAMPLE WT. (g):		0.22	0.23	0.21	0.21	0.2	0.22	0.2
REMARKS:								

Footnotes:

P - ICP/Flame AE
CV - Cold Vapor
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Table 2-7 Metals Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:		CGSED-15 (mg/kg)	CGSED-16 (mg/kg)	CGSED-17 (mg/kg)	CGSED-18 (mg/kg)	CGSED-21 (mg/kg)
ANALYTES						
Aluminum	P	7070	8770	4500	3050	7060
Arsenic	P	15.1	23	6.7	3.8	5.1
Barium	P	33.9	33	16.2	16.9	40.6
Beryllium	P	0.09 U	0.1 U	0.05 U	0.05 U	0.31
Calcium	P	2330 J	2070 J	538 J	748 J	1040 J
Chromium	P	12.4	11.1	15.5	7.6	12
Cobalt	P	3.0	3.5	3.5	2.5	18.9
Copper	P	4.6 U	7.7 U	8.8 U	7.9 U	1.9
Iron	P	5520	5690	6410	5500	11900
Lead	P	20.6 J	56.2 J	23.7 J	10.2 J	7.1
Magnesium	P	1210	1260	2310	1080	1740
Manganese	P	426	343	132	143	206
Mercury	CV	0.12 U	0.11 U	0.06 U	0.07 U	0.09 U
Nickel	P	7.6	6.2	10.2	4.8	8.7
Potassium	P	445	503	716	640	337
Silver	P	1.7 U	1.9 U	0.93 U	0.95 U	1.3 U
Sodium	P	152 U	171 U	63.1 U	63.8 U	133 U
Vanadium	P	9.4	11.4	10.5	7.7	27
Zinc	P	23.8	43.2	18.3	27.7	17.2
DATE SAMPLED:		9-29-93	9-29-93	9-29-93	9-28-93	10-1-93
% SOLIDS:		40	38.3	79.5	73.9	55.1
ICP SAMPLE WT. (g):		1.08	1.02	1	1.05	1.05
Hg SAMPLE WT. (g):		0.21	0.23	0.21	0.2	0.21
REMARKS:						

Footnotes:
P -ICP/Flame AE
CV -Cold Vapor
J -Quantitation is approximate due to limitations identified in the quality control review.
U -Value reported is the sample detection limit.
R -Value is rejected
UJ -Sample detection limit is approximate due to limitations identified in the quality control review.

See Section 2.2.1.5. CGSED-4, 5, 6, 10, 11, and 13 each had the non-detected results rejected due to high moisture content. CGSED-12 had all results rejected due to its extremely high moisture content.

2.2.1.5 Antimony and Cadmium. Because of low ecological criteria levels, antimony and cadmium were analyzed separately and low detection limits were targeted. The initial antimony data was rejected during data validation due to a problem during sample digestion. Reanalysis of the samples has been performed. Results are in Table 2-8.

2.2.1.6 Organic Content and Grain Size

Two methods were used to determine the organic content of the samples. The accuracy of total organic carbon (TOC) analysis is questionable at high organic contents. Therefore, the total combustible organics (TCO) method was performed on high organic content sediments. Based on visual inspection of each sample, either TOC for low organic (sandy) sediments; or TCO for high organic (peat) sediments was chosen in the field. TOC results are in Table 2-9 and TCO results are in Table 2-10. Each sample, regardless of its sediment type, was analyzed for grain size distribution. The grain size results are in Table 2-11.

2.2.1.7 Toxicity Testing

Sediment samples were collected for toxicity testing from seven locations in the wetlands and open water areas near the site on 8 October, 1993 (Figure 2-1). Sediment toxicity testing by the Environmental Services Assistance Team (ESAT) was initiated on 12 October, 1993. The effect of sediment exposures on survival and growth were measured on two benthic invertebrates, *Hyallela azteca* (H. azteca) and *Chironomus tentas* (C. tentas). At the laboratory, sediments were homogenized and cleaned using a standard #10 sieve. Subsequently, 50 ml of sediment and approximately 200 ml of water were introduced into each test beaker. Sediment was allowed to settle for several hours prior to inoculation. For each species, there were generally four replicates from each sediment sampling station

Table 2-8 Antimony and Cadmium Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	GCSED-1 mg/Kg	CGSED-2 mg/Kg	CGSED-3 mg/Kg	GCSED-4 mg/Kg	GCSED-5 mg/Kg	CGSED-6 mg/Kg	CGSED-7 mg/Kg
Antimony	F	0.060 U	0.26	1.4	0.30	0.095	0.085	0.081
Cadmium	F	0.18	0.11	0.039	0.68	0.43	0.40	0.17
DATE SAMPLED:		10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
REMARKS:								

Footnotes:
F - Furnace
U - Value reported is the sample detection limit.
J - The value is approximate due to limitations identified during the quality control review.

Table 2-8 Cadmium Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	CGSED-8 mg/Kg	CGSED-9 mg/Kg	CGSED-10 mg/Kg	CGSED-11 mg/Kg	CGSED-12 mg/Kg	CGSED-13 mg/Kg
Antimony	F	0.28	0.18	0.26	0.14	0.46	0.15 J
Cadmium	F	0.95	0.13	0.55	0.44 J	0.58	0.29
DATE SAMPLED:		10-01-93	09-28-93	09-28-93	09-29-93	09-29-93	09-29-93
REMARKS:							

Footnotes:
- F - Furnace
- U - Value reported is the sample detection limit.
- J - The value is approximate due to limitations identified during the quality control review.

Table 2-8 Antimony and Cadmium Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	CGSED-14 mg/Kg	CGSED-15 mg/Kg	CGSED-16 mg/Kg	GCSED-17 mg/Kg	CGSED-18 mg/Kg	CGSED-21 mg/Kg
Antimony	F	0.16	0.10	0.42	0.064 U	0.072 U	0.060 U
Cadmium	F	0.27	0.22	0.32	0.032	0.096	0.062
DATE SAMPLED:		09-29-93	09-29-93	09-29-93	09-29-93	09-28-93	10-01-93
REMARKS:							

Footnotes:
- F - Furnace
- U - Value reported is the sample detection limit.
- J - The value is approximate due to limitations identified during the quality control review.

Table 2-9 Total Organic Carbon Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-2 (mg/Kg)	CGSED-3 (mg/Kg)	CGSED-9 (mg/Kg)	CGSED-17 (mg/Kg)	CGSED-18 (mg/Kg)
ANALYTES					
Total Organic Carbon	19000	1300	18000	3400 J	6100 J
DATE SAMPLED:	10-01-93	10-01-93	09-28-93	09-29-93	09-28-93
DATE ANALYZED:	10-05-93	10-05-93	10-05-93	10-05-93	10-05-93
REMARKS:					

Footnotes:
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- CRDL - Contract Required Detection Limit

Table 2-10 Total Combustible Organics Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-1	CGSED-4	CGSED-5	CGSED-6	CGSED-7	CGSED-8	CGSED-10
ANALYTE	% Organic	% Organic	% Organic	% Organic	% Organic	% Organic	% Organic
Total Combustible Organics	6.53	24.11	21.41	53.20	9.73	19.09	25.61
%SOLIDS (average of duplicate runs	47.94	21.10	28.24	15.66	45.27	25.88	17.28
DATE SAMPLED:	10/1/93	10/1/93	10/1/93	10/1/93	10/1/93	10/1/93	9/28/93
DATE ANALYZED:	10/19/93	10/18/93	10/22/93	10/15/95	10/14/93	10/20/93	10/11/13
REMARKS:							

Table 2-10 Total Combustible Organics Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-11	CGSED-12	CGSED-13	CGSED-14	CGSED-15	CGSED-16	CGSED-21
ANALYTE	% Organic	% Organic	% Organic	% Organic	% Organic	% Organic	% Organic
Total Combustible Organics	44.19	78.91	87.33	17.19	10.91	12.29	5.19
%SOLIDS (average of duplicate runs	11.28	7.84	10.48	37.35	42.50	39.22	63.12
DATE SAMPLED:	9/29/93	9/29/93	9/29/93	9/29/93	9/29/93	9/29/93	10/1/93
DATE ANALYZED:	10/14/93	10/14/93	10/14/93	10/13/93	10/12/93	----	10/20/93
REMARKS:							

Table 2-11 Grain Size Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-1 (percent)	CGSED-2 (percent)	CGSED-3 (percent)	CGSED-4 (percent)	CGSED-5 (percent)	CGSED-6 (percent)
SIEVE SIZE						
3" to No. 4	0.3	17.5	20.6	0.1	0.2	0.0
No.4 to No.200	75.2	66.0	72.3	27.4	53.1	40.8
0.074 to 0.005 mm	18.0	9.2	5.3	53.0	34.4	43.8
<0.005 mm	6.4	7.3	1.8	19.4	12.2	15.3
Maximium Particle Size	9.5	25	19	9.5	2	9.5
Hygroscopic Moisture Content %	121.02	26.08	16.02	385.14	213.84	527.49
Shape	*	Sub to Ang	Sub to Ang	Angular	Subangular	Subangular
Hardness	*	2	3	3	2	1
DATE SAMPLED:	10/1/93	10/1/93	10/1/93	10/1/93	10/1/93	10/1/93
DATE ANALYZED:	10/31/93	10/31/93	10/31/93	10/31/93	10/28/93	10/28/93
REMARKS:	-----	-----		-----	-----	-----

* Particles to small to observe shape and hardness.

Hardness Codes:
1- Crushed easily with light hammer blow.
2- Crushed with light hammer blow.
3- Crushed with moderate hammer blow.
4- Crushed with heavy hammer blow.

Table 2-11 Grain Size Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-7 (percent)	CGSED-8 (percent)	CGSED-9 (percent)	CGSED-10 (percent)	CGSED-11 (percent)	CGSED-12 (percent)
SIEVE SIZE						
3" to No. 4	1.1	0.8	0.1	0.2	0.0	0.1
No.4 to No.200	63.8	49.0	13.4	29.6	39.4	46.7
0.074 to 0.005 mm	25.3	34.3	65.7	57.9	50.2	44.5
<0.005 mm	9.7	15.8	20.7	12.2	10.3	8.7
Maximium Particle Size	9.5	38.1	9.5	9.5	2	9.5
Hygroscopic Moisture Content %	112.82	261.64	118.56	402.72	426.92	1180.47
Shape	Sub to Ang	*	Subangular	*	*	Subangular
Hardness	2	*	3	*	*	1
DATE SAMPLED:	10/1/93	10/1/93	9/28/93	9/28/93	9/29/93	9/29/93
DATE ANALYZED:	10/28/93	10/31/93	10/21/93	10/21/93	10/28/93	10/28/93
REMARKS:	-----	-----	-----	-----	-----	-----

* Particles to small to observe shape and hardness.
Hardness Codes:
1- Crushed easily with light hammer blow.
2- Crushed with light hammer blow.
3- Crushed with moderate hammer blow.
4- Crushed with heavy hammer blow.

Table 2-11 Grain Size Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-13 (percent)	CGSED-14 (percent)	CGSED-15 (percent)	CGSED-16 (percent)	CGSED-17 (percent)	CGSED-18 (percent)
SIEVE SIZE						
3" to No. 4	0.0	0.0	4.2	0.2	20.4	0.0
No.4 to No.200	65.7	14.2	47.4	27.7	67.6	92.8
0.074 to 0.005 mm	27.3	62.2	38.0	58.7	9.7	5.7
<0.005 mm	7.0	23.5	10.3	13.3	2.3	1.5
Maximium Particle Size	2	2	9.5	9.5	19	4.75
Hygroscopic Moisture Content %	996.39	144.5	125.9	121.73	18.95	42.95
Shape	Subangular	*	Subangular/Angular	*	Subround/Subangular	Subangular
Hardness	1	*	2	*	4	2
DATE SAMPLED:	9/29/93	9/29/93	9/29/93	9/29/93	9/29/93	9/28/93
DATE ANALYZED:	10/28/93	10/28/93	10/21 93	10/21/93	10/21/93	10/21 93
REMARKS:	-----	-----	-----	-----		-----

* Particles to small to observe shape and hardness.
Hardness Codes:
1- Crushed easily with light hammer blow.
2- Crushed with light hammer blow.
3- Crushed with moderate hammer blow.
4- Crushed with heavy hammer blow.

Table 2-11 Grain Size Analytical Results in Sediment
Charles George Reclamation Landfill
Five Year Review

M&E SAMPLE ID:	CGSED-21 (percent)
SIEVE SIZE	
3" to No. 4	4.8
No.4 to No.200	72.0
0.074 to 0.005 mm	17.1
<0.005 mm	6.1
Maximium Particle Size	19
Hygroscopic Moisture Content %	99.18
Shape	Sub to Ang
Hardness	2
DATE SAMPLED:	10/1/93
DATE ANALYZED:	10/31/93
REMARKS:	-----

* Particles to small to observe shape and hardness.

Hardness Codes:

1- Crushed easily with light hammer blow.
2- Crushed with light hammer blow.
3- Crushed with moderate hammer blow.
4- Crushed with heavy hammer blow.

(exceptions are noted in Tables 2-12 and 2-13). Ten *C. tentas* (age 12 to 14 or second instar) and 15 *H. azteca* (age 1 to 7 days or second/third instar) were introduced into each beaker for a ten day period. Both species were fed Tetramin. To evaluate toxicity, results were compared with data obtained from exposing *H. azteca* and *C. tentas* to a reference sample collected from Saw Mill Pond outfall, Concord, Massachusetts. Survivorship and growth data are summarized and reported in Tables 2-12 and 2-13, respectively.

2.2.2 Fish Tissue Results Summary

Eighty five fish tissue samples were collected and analyzed for metals. The original plan was to submit 90 samples from three locations (Flint Pond, Below the Flint Pond Dam, and Locust Pond). At each location, two types of fish were caught and prepared for analysis, largemouth bass and yellow perch. At each pond location 30 samples were prepared, 10 whole fish samples, 10 fillet samples, and 10 offal samples. Each group of 10 consisted of 5 largemouth bass and 5 yellow perch. However, an insufficient amount of largemouth bass were caught below the Flint Poind Dam (see Table 2-3). Instead, 10 whole largemouth bass from the pond were analyzed. No offal nor fillets of largemouth bass were obtained below the Flint Pond dam. Therefore, a total of 85 samples were collected and analyzed.

2.2.2.1 Metals. The results of the metals analyses are in Table 2-14. An evaluation of the data base similar to the evaluation presented for sediment is included in Section 3.1.2.

Table 2-12. Ten day survival percentages for *Hyallela azteca* and *Chironomus tentans* exposed to sediment collected from seven Charles George sampling stations and one reference station.

Sediment Sampling Station[1]	Percent Survival (%)[2]	
	H. azteca [3]	*C. tentans* [4]
1	80	98
2	26	55
3	41	38
4	91	98
5	71	90
6	100	83
7	76	94
Reference[5]	100	88

1. Sampling station locations depicted in Figure 2-1.
2. The survival percentage reported for sediment sampling station 7 (*C. tentans*) represents the mean of three replicates. Survival percentages for all other stations and the reference are the mean of four replicates.
3. Based on Steel's Many-One Rank Test, no differences in survival percentage existed between sediment sampling stations and the reference station. In contrast, Dunnett's test showed that the survival percentages at sediment sampling stations 2 and 3 were both significantly lower than the reference station.
4. Bonferroni-adjusted T-Tests indicated that survival percentages at sediment sampling stations 2 and 3 were the only sediments with significantly lower survivability than the reference station.
5. Reference sediment samples were collected from the Saw Mill Pond outflow, Concord, Massachusetts.

Table 2-13. Ten day growth data for *Hyallela azteca* and *Chironomus tentans* exposed to sediment collected from seven Charles George sampling stations and one reference station.

Sediment Sampling Station[1]	Mean Weight (mg)[2]	
	H. azteca [3]	*C. tentans* [4]
1	0.11	0.96
2	0.11	1.3
3	0.09	1.35
4	0.13	0.67
5	0.13	0.56
6	0.11	0.32
7	0.11	0.51
Reference[5]	0.11	0.40

[1] Sampling station locations depicted in Figure 2-1.

[2] Mean weights represent the mean of three replicates for sediment sampling stations 3 and 7 (*C. tentans*) and four replicates for all other stations and the reference.

[3] Based on a Dunnett's Test, no significant difference in growth existed between sediment sampling stations and the reference.

[4] Based on Bonferroni-adjusted T-Tests, no significant differences in growth existed between sampling stations and the reference.

[5] Reference sediment samples were collected from the Saw Mill Pond outflow, Concord, Massachusetts.

Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	YP-FP-F-01 (mg/Kg)	YP-FP-O-01 (mg/Kg)	YP-FP-F-02 (mg/Kg)	YP-FP-O-02 (mg/Kg)	YP-FP-F-03 (mg/Kg)	YP-FP-O-03 (mg/Kg)	YP-FP-F-04 (mg/Kg)	YP-FP-O-04 (mg/Kg)
Aluminum	P	--	3.2 U	--	1.2 U	--	2.3 U	--	--
Arsenic	F	0.07 UJ	0.07 UJ	0.08 UJ	0.08 UJ	0.07 UJ	0.06 UJ	0.08 UJ	0.07 UJ
Barium	P	0.08	2.0	0.10	2.8	0.25	2.6	0.03	2.5
Beryllium	P	--	0.01 U	--	0.01 U	--	--	--	0.01 U
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	0.20 U	0.71 U	0.21 U	0.73 U	0.30 U	0.67 U	0.18 U	0.73 U
Cobalt	P	2.0	0.27	0.58	0.16	24.9	0.50	0.55	--
Copper	P	0.13	0.43	0.16	0.30	0.14	0.48	0.11	0.51
Lead	F	--	0.07 U	--	0.10 U	--	--	--	--
Mercury	CV	0.62	0.21	0.61	0.26	0.88	0.28	0.57	0.23
Nickel	P	--	--	--	--	0.14	--	--	--
Selenium	F	0.14 J	--	0.17 J	0.57 J	0.12 J	0.41 J	0.13 J	0.41 J
Silver	P	0.12 UJ	0.13 UJ	0.13 UJ	0.13 UJ	0.12 UJ	0.13 UJ	0.13 UJ	0.13 UJ
Vanadium	P	--	0.13	--	0.14	--	0.15	--	0.13
Zinc	P	4.3	20.8	4.8	21.4	4.5	21.5	4.7	20.7
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		19.8	35.1	21.5	34.6	22.3	33.8	20.5	33.5
% LIPIDS		0.17	4.85	1.38	4.19	0.92	2.92	0.27	4.41
REMARKS:									

Footnotes:
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- P - ICP/Flame AE
- CV - Cold Vapor
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- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	YP-FP-F-05 (mg/Kg)	YP-FP-O-05 (mg/Kg)	YP-FP-W-01 (mg/Kg)	YP-FP-W-02 (mg/Kg)	YP-FP-W-03 (mg/Kg)	YP-FP-W-04 (mg/Kg)	YP-FP-W-05 (mg/Kg)	LB-FP-F-01 (mg/Kg)
Aluminum	P	--	1.7 U	10.30	2.9 U	--	2.8 U	13.9	--
Arsenic	F	0.10 UJ	0.09 UJ	0.11 UJ	0.18 UJ	0.09 UJ	0.17 UJ	0.29 UJ	0.08 UJ
Barium	P	0.14	1.7	2.5 J	1.7 J	0.66 J	0.75 J	0.94 J	--
Beryllium	P	--	0.01 U	--	--	--	--	--	--
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	0.24 U	0.65 U	0.54 J	0.50	0.44 J	0.43 J	0.45 J	0.16 U
Cobalt	P	0.46	--	0.10	--	0.20	0.29	0.33 U	0.24
Copper	P	0.13	0.35	0.15 U	0.23 U	0.18 U	0.23 U	0.82 J	0.20
Lead	F	--	--	0.28	0.06	0.05	0.08	0.07 U	--
Mercury	CV	0.39	0.12	0.06 J	0.15 J	0.06 J	0.12 J	0.12 J	1.5
Nickel	P	--	--	--	--	--	--	--	--
Selenium	F	0.19 J	0.45 J	0.47 U	0.42 UJ	0.35 UJ	0.38 UJ	0.31 UJ	0.19
Silver	P	0.13 UJ	0.13 UJ	--	--	--	--	--	0.12 UJ
Vanadium	P	--	--	0.20 J	--	--	0.10 J	0.07 J	--
Zinc	P	4.5	23.4	18.1 J	17.6 J	15.6 J	18.1 J	16.4 J	4.6
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		21.0	32.8	31.0	31.1	28.0	27.8	26.6	22.2
% LIPIDS		0.25	1.53	3.44	4.42	0.95	3.50	3.40	0.12
REMARKS:									

Footnotes:
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IDL - Instrument Detection Limit
SAS - Special Analytical Services
SRDL - SAS Required Detection Limit

Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	LB-FP-O-01 (mg/Kg)	LB-FP-F-02 (mg/Kg)	LB-FP-O-02 (mg/Kg)	LB-FP-F-03 (mg/Kg)	LB-FP-O-03 (mg/Kg)	LB-FP-F-04 (mg/Kg)	LB-FP-O-04 (mg/Kg)	LB-FP-F-05 (mg/Kg)
Aluminum	P	--	--	0.86 U	--	2.2 U	--	--	--
Arsenic	F	0.06 UJ	0.09 UJ	0.09 UJ	0.05 UJ	0.06 UJ	0.08 UJ	0.09 UJ	0.06 UJ
Barium	P	0.43	--	0.21 J	--	1.6	--	0.32 J	--
Beryllium	P	--	--	--	--	--	--	--	--
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	0.50 U	0.18 U	0.39 U	0.18 U	0.69 U	0.19 U	0.47 U	0.20 U
Cobalt	P	--	0.19	1.5	0.46	--	1.3	--	0.56
Copper	P	0.30	0.15	0.47	0.12	0.68	0.12	0.22	0.15
Lead	F	--	--	--	--	--	--	--	--
Mercury	CV	1.0	0.74	0.51	0.90	0.53	1.6	1.0	0.60
Nickel	P	--	--	--	--	--	--	--	--
Selenium	F	0.17	0.13	0.38 J	0.10	0.40 J	0.10	0.26 J	0.12 J
Silver	P	0.13 UJ	0.13 UJ	0.12 UJ	0.12 UJ	0.13 UJ	0.13 UJ	0.13 UJ	0.13 UJ
Vanadium	P	--	--	--	--	--	--	--	--
Zinc	P	14.9	3.2	13.8 J	3.0	19.4	3.5	14.7 J	3.6
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		33.5	21.0	26.3	20.6	28.7	21.1	32.8	20.9
% LIPIDS		7.74	0.11	1.03	2.43	1.12	0.23	2.53	0.16
REMARKS:									

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Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	LB-FP-O-05 (mg/Kg)	LB-FP-W-01 (mg/Kg)	LB-FP-W-02 (mg/Kg)	LB-FP-W-03 (mg/Kg)	LB-FP-W-04 (mg/Kg)	LB-FP-W-05 (mg/Kg)	LB-FP-W-06 (mg/Kg)	LB-FP-W-07 (mg/Kg)
Aluminum	P	--	--	--	--	--	--	1.0 U	--
Arsenic	F	0.08 UJ	0.12 UJ	0.12 UJ	0.15 UJ	0.16 UJ	0.14 UJ	0.15 UJ	0.19 UJ
Barium	P	0.23 J	0.22 J	0.21 J	0.40 J	0.27 J	0.44 J	0.29 J	0.25
Beryllium	P	--	--	--	--	--	--	--	--
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	0.39 U	0.31 U	0.34 U	0.33 U	0.41 J	0.52 J	0.42	0.43
Cobalt	P	0.11	0.13	--	--	--	--	--	--
Copper	P	0.24	0.30 U	0.26 U	0.19 U	0.18 U	0.11 U	0.28	0.22
Lead	F	--	--	0.06	0.05	--	0.07	0.11 U	0.17 U
Mercury	CV	0.38	0.12 J	0.20 J	0.15 J	0.14 J	0.24 J	0.33	0.25
Nickel	P	--	--	0.14	--	--	--	--	--
Selenium	F	0.37 J	0.31 UJ	0.36 UJ	0.32 UJ	0.39 UJ	0.60 UJ	0.23 U	0.24 U
Silver	P	0.11 UJ	--	--	--	--	--	--	--
Vanadium	P	--	--	--	--	--	--	--	--
Zinc	P	14.0 J	16.4 J	16.6 J	17.9 J	18.6 J	19.7 J	15.6 J	13.1 J
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		26.0	29.2	27.0	25.7	28.3	29.2	29.6	26.0
% LIPIDS		0.68	1.73	1.02	1.08	1.22	2.08	2.37	0.98
REMARKS:									

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Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	LB-FP-W-08 (mg/Kg)	LB-FP-W-09 (mg/Kg)	LB-FP-W-10 (mg/Kg)	YP-LP-F-01 (mg/Kg)	YP-LP-O-01 (mg/Kg)	YP-LP-F-02 (mg/Kg)	YP-LP-O-02 (mg/Kg)	YP-LP-F-03 (mg/Kg)
Aluminum	P	--	0.98 U	--	--	2.0 U	--	3.1 U	--
Arsenic	F	0.11 UJ	0.08 UJ	0.05 UJ	--	0.07 UJ	--	0.08 UJ	0.07 UJ
Barium	P	0.38	1.0 J	0.20 J	0.05	1.1	0.03	1.6	0.42 J
Beryllium	P	--	--	--	--	--	--	0.01 U	--
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	0.44	0.41	0.28	0.24 U	0.54 U	0.19 U	0.70 U	0.30 U
Cobalt	P	--	0.32	0.24	3.8	3.1	3.8	2.1	4.4
Copper	P	0.28	0.33	0.30	0.22	0.43	0.18	0.44	0.15
Lead	F	0.10 U	0.15 U	0.05 U	0.03 UJ	--	--	0.15 U	--
Mercury	CV	0.20	0.21	0.22	0.23	0.11	0.14	0.28	0.32
Nickel	P	--	--	--	--	--	--	0.10 U	--
Selenium	F	0.22 UJ	0.20 UJ	0.22 UJ	0.20	0.25	0.13	0.32 J	0.16 J
Silver	P	--	--	--	--	--	--	--	--
Vanadium	P	--	--	--	--	0.11	--	0.16	--
Zinc	P	17.8 J	15.7 J	12.8 J	5.0	23.8	4.3	21.5	5.5 J
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		32.9	29.4	25.4	22.6	38.2	22.2	33.7	24.7
% LIPIDS		4.69	1.62	0.84	0.69	7.71	0.18	5.32	3.25
REMARKS:									

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Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	YP-LP-O-03 (mg/Kg)	YP-LP-F-04 (mg/Kg)	YP-LP-O-04 (mg/Kg)	YP-LP-O-05 (mg/Kg)	YP-LP-O-05 (mg/Kg)	YP-LP-W-01 (mg/Kg)	YP-LP-W-02 (mg/Kg)	YP-LP-W-03 (mg/Kg)
Aluminum	P	2.3 U	--	5.8 U	1.2 U	2.9 U	--	5.1 U	--
Arsenic	F	0.08 UJ	--	0.84 UJ	--	0.09 UJ	0.11 UJ	0.10 UJ	0.12 UJ
Barium	P	1.0	0.05	2.3	0.05	1.3	0.59 J	1.4 J	0.53 J
Beryllium	P	--	--	0.01 U	--	0.01 U	--	--	--
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	0.49 U	0.20 U	0.78 U	0.16 U	0.70 U	0.38 J	0.56 J	0.43 J
Cobalt	P	1.5	1.4	1.1	1.1	0.99	0.53	0.11	0.54
Copper	P	0.36	0.64	0.55	0.22	0.43	0.20 U	0.19 U	0.19 U
Lead	F	0.16 U	--	0.30 U	--	0.08 U	--	0.19	--
Mercury	CV	0.14	0.17	0.04 U	0.31	0.08	0.10 J	0.14 J	0.09 J
Nickel	P	--	--	--	--	--	--	--	--
Selenium	F	0.25	0.16	0.37	0.15	0.35 J	0.49 UJ	0.36 UJ	0.29 UJ
Silver	P	--	--	--	--	--	--	--	--
Vanadium	P	0.12	--	0.15	--	0.13	--	0.10 J	--
Zinc	P	23.2	4.4	30.4	5.2	24.8	15.6 J	21.5 J	17.7 J
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		34.1	21.6	36.0	21.5	33.0	27.2	31.0	26.9
% LIPIDS		5.83	0.48	5.78	0.74	4.70	2.66	4.64	1.89
REMARKS:									

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Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	YP-LP-W-04 (mg/Kg)	YP-LP-W-05 (mg/Kg)	LB-LP-F-01 (mg/Kg)	LB-LP-O-01 (mg/Kg)	LB-LP-F-02 (mg/Kg)	LB-LP-O-02 (mg/Kg)	LB-LP-F-03 (mg/Kg)	LB-LP-O-03 (mg/Kg)
Aluminum	P	--	--	--	1.2 U	0.90 U	1.0 U	--	3.3 U
Arsenic	F	0.12 UJ	0.09 UJ	--	0.05 UJ	--	0.08 UJ	--	0.06 UJ
Barium	P	0.77 J	0.91 J	0.06	0.52	0.02	0.26 J	0.11	0.69
Beryllium	P	--	--	--	--	--	--	--	--
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	0.38 J	0.44 J	0.22 U	0.52 U	0.18 U	0.29 U	0.22 U	0.50 U
Cobalt	P	--	0.13	0.55	--	0.74	--	0.33	0.22
Copper	P	0.22 U	0.26 U	0.22	0.30	0.27	0.33	0.20	0.32
Lead	F	0.07	--	--	0.05 U	0.10 U	0.05 UJ	--	0.06 UJ
Mercury	CV	0.09 J	0.08 J	0.74	0.38	0.86	0.31	0.83	0.26
Nickel	P	0.20	--	--	--	--	--	--	--
Selenium	F	0.36 UJ	0.23 UJ	0.11 J	0.29 J	0.16 J	0.18 J	0.11 J	0.24 J
Silver	P	--	--	--	--	--	--	--	--
Vanadium	P	--	--	--	--	--	--	--	--
Zinc	P	17.9 J	19.1 J	4.1	17.9	4.3	14.5 J	4.9	18.5
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		28.2	29.6	24.3	29.4	22.6	29.5	20.3	30.0
% LIPIDS		3.46	4.40	1.33	3.26	0.24	5.45	0.17	0.35
REMARKS:									

Footnotes:
- F - Furnace AA
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- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	LB-LP-F-04 (mg/Kg)	LB-LP-O-04 (mg/Kg)	LB-LP-F-05 (mg/Kg)	LB-LP-O-05 (mg/Kg)	LB-LP-W-01 (mg/Kg)	LB-LP-W-02 (mg/Kg)	LB-LP-W-03 (mg/Kg)	LB-LP-W-04 (mg/Kg)
Aluminum	P	--	1.0 U	--	--	--	--	--	--
Arsenic	F	--	0.07 UJ	0.08 UJ	0.27 UJ	0.52	0.08 UJ	0.12 UJ	0.06 J
Barium	P	0.03	0.16 J	0.06	0.21 J	--	0.32 J	0.68 J	0.33 J
Beryllium	P	--	--	--	--	--	--	--	--
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	0.17 U	0.23 U	0.22 U	0.42 U	0.14 U	0.36 J	0.49 J	0.37 J
Cobalt	P	0.33	0.73	0.29	--	0.14	0.11	--	--
Copper	P	0.22	0.22	0.20	0.29	0.14 U	0.20 U	0.15 U	0.20 U
Lead	F	--	--	--	0.09 U	0.12	--	0.08	--
Mercury	CV	1.0	0.63	1.1	0.70	0.19 J	0.27 J	0.19 J	0.21 J
Nickel	P	--	0.16	--	--	--	--	--	--
Selenium	F	0.09	0.08 J	0.12 J	0.29 U	0.28 UJ	0.23 UJ	0.27 UJ	0.25 UJ
Silver	P	--	--	--	--	--	--	--	--
Vanadium	P	--	--	--	--	--	--	--	--
Zinc	P	4.0	8.5 J	4.5	14.8 J	6.6 J	15.5 J	15.8 J	16.6 J
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		21.5	28.5	23.6	31.2	32.6	29.9	29.1	28.3
% LIPIDS		0.14	1.26	2.48	2.00	2.12	1.27	1.82	3.76
REMARKS:									

Footnotes:
- F - Furnace AA
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- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	LB-LP-W-05 (mg/Kg)	YP-BD-F-01 (mg/Kg)	YP-BD-O-01 (mg/Kg)	YP-BD-F-02 (mg/Kg)	YP-BD-O-02 (mg/Kg)	YP-BD-F-03 (mg/Kg)	YP-BD-O-03 (mg/Kg)	YP-BD-F-04 (mg/Kg)
Aluminum	P	--	--	2.4 U	--	4.0 U	--	2.7 U	--
Arsenic	F	0.09 UJ	0.06 UJ	0.17 UJ	0.09 UJ	0.07 UJ	0.09 UJ	0.09 UJ	0.14 UJ
Barium	P	0.37 J	0.14	2.4	0.37	2.2	0.34	3.1	0.65 J
Beryllium	P	--	--	0.01 U	--	--	--	0.01 U	--
Cadmium	P	0.07 U	--	--	--	--	--	--	--
Chromium	P	0.30 U	0.27 U	0.74 U	0.28 U	0.56 U	0.23 U	0.71 U	0.32 U
Cobalt	P	--	5.5	3.0	3.0	7.4	3.9	0.83	4.6
Copper	P	0.21 U	0.12 U	0.45 U	0.14 U	0.38 U	0.17 U	0.39 U	0.91
Lead	F	--	0.06 U	0.61 U	0.12 U	0.19 U	--	0.30 U	0.06 U
Mercury	CV	0.15 J	0.78	0.19	0.48	0.21	0.38	0.19	0.29
Nickel	P	--	--	--	--	--	--	--	--
Selenium	F	0.30 UJ	0.20 U	0.13 U	0.23 UJ	0.26 U	0.21 UJ	0.28 UJ	0.25 UJ
Silver	P	--	--	--	--	--	--	--	--
Vanadium	P	--	--	0.20	--	0.18	--	0.18	R
Zinc	P	16.0 J	5.0 J	25.3 J	4.7 J	21.6 J	4.9 J	24.8 J	6.6 J
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		25.1	21.2	31.8	20.9	33.4	22.0	33.5	20.1
% LIPIDS		1.25	0.19	2.77	0.38	3.59	1.25	5.17	0.36
REMARKS:									

Footnotes:
F - Furnace AA
P - ICP/Flame AE
CV - Cold Vapor
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
SAS - Special Analytical Services
SRDL - SAS Required Detection Limit

Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	YP-BD-O-04 (mg/Kg)	YP-BD-F-05 (mg/Kg)	YP-BD-O-05 (mg/Kg)	LB-BD-W-01 (mg/Kg)	LB-BD-W-02 (mg/Kg)	LB-BD-W-03 (mg/Kg)	LB-BD-W-04 (mg/Kg)	LB-BD-W-05 (mg/Kg)
Aluminum	P	6.6 U	--	2.1 U	2.0 U	--	1.3 U	2.4 U	--
Arsenic	F	0.20 UJ	0.08 UJ	0.21 UJ	0.09 UJ	0.13 UJ	0.20 UJ	0.19 UJ	0.14 UJ
Barium	P	4.7	0.17	3.0	0.47 J	0.71 J	0.82	0.76 J	0.40 J
Beryllium	P	0.01 U	--	0.01 U	--	--	--	--	--
Cadmium	P	--	--	--	--	--	--	--	--
Chromium	P	1.0	0.25 U	0.75 U	0.27 U	0.41	0.57	0.45	0.37
Cobalt	P	3.3	4.5	2.3	0.34	0.38	0.84	1.3	0.34
Copper	P	0.35 U	0.15 U	0.44 U	1.4	0.24	0.23	0.28	0.31
Lead	F	0.43 U	0.05 U	0.26 U	--	0.08 U	0.14 U	0.17 U	0.05 U
Mercury	CV	0.11	0.33	0.10	0.31	0.17	0.19	0.16	0.20
Nickel	P	--	--	--	0.07	--	--	--	--
Selenium	F	0.26 UJ	0.33 UJ	0.31 UJ	0.16 J	0.34 U	0.29 U	0.33 U	0.31 UJ
Silver	P	--	--	--	--	--	--	--	--
Vanadium	P	0.37	--	0.28	--	--	--	--	--
Zinc	P	33.7 J	4.8 J	22.6 J	11.0 J	15.6 J	23.1 J	15.9 J	16.7 J
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		37.7	19.8	30.5	28.2	26.8	23.9	26.5	27.6
% LIPIDS		2.81	0.99	5.37	1.05	1.77	0.31	0.26	0.47
REMARKS:									

Footnotes:
F - Furnace AA
P - ICP/Flame AE
CV - Cold Vapor
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
SAS - Special Analytical Services
SRDL - SAS Required Detection Limit

Table 2-14 Metals in Fish Tissue Analytical Results
Charles George Reclamation Landfill
Five Year Review

ANALYTES	M&E SAMPLE ID:	YP-BD-W-01 (mg/Kg)	YP-BD-W-02 (mg/Kg)	YP-BD-W-03 (mg/Kg)	YP-BD-W-04 (mg/Kg)	YP-BD-W-05 (mg/Kg)
Aluminum	P	1.9	5.6	2.6	1.3	5.7
Arsenic	F	0.21 J	0.41 J	0.20 J	0.13 J	0.31 J
Barium	P	2.3 J	2.0 J	2.1 J	1.8 J	3.3 J
Beryllium	P	0.01	--	--	--	--
Cadmium	P	--	--	--	--	--
Chromium	P	0.58	0.52	0.52	0.56	0.65
Cobalt	P	0.51	0.15	0.30	0.3	0.40
Copper	P	0.10 U	0.16 U	0.28 U	0.18 U	0.18 U
Lead	F	0.15 J	0.14 J	0.30 J	--	0.13 J
Mercury	CV	0.22 J	0.19 J	0.10 UJ	0.18 J	0.25 J
Nickel	P	--	--	--	--	--
Selenium	F	0.35 UJ	0.44 UJ	0.39 U	0.39 UJ	0.48 UJ
Silver	P	--	--	--	--	--
Vanadium	P	0.11	0.19	--	0.10	0.22
Zinc	P	22.9 J	22.7 J	18.3 J	19.2 J	23.4 J
DILUTION FACTOR:		1	1	1	1	1
DATE SAMPLED:		10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS		24.7	28.8	27.2	28.6	30.1
% LIPIDS		2.88	1.81	2.12	3.03	3.89
REMARKS:						

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

3.0 EVALUATION OF DATA

The sediment data evaluation is in Section 3.1, the fish tissue data evaluation is in Section 3.2 and a comparison of site conditions to the RODs is in Section 3.3.

3.1 EVALUATION OF SEDIMENT DATA

This section describes the evaluation of analytical and toxicity data collected during this five-year review. Sediment analytical data is compared to the background and control location by area (Dunstable Brook, Flint Pond Marsh, Flint Pond, and Downstream of the Flint Pond Dam). The sediment toxicity is evaluated by two methods. Toxicity testing results are discussed and analytical data for metals in sediment are compared to ecological criteria. Changes in risk assessment factors since the RI was written are qualitatively evaluated to assess the change in sediment risk since the original decision was made by EPA not to dredge Dunstable Brook.

3.1.1 Evaluation of Sediment Analytical Data

For a description of each sediment sample location and field observations, see Section 2.1.2, Sediment Sampling. This evaluation is based on the maximum and minimum of each area. If both the maximum and minimum are above the background maximum and minimum, then the results are considered consistently above background. The same approach is used to determine if a compound is consistently lower than background. If the comparison is mixed, no definitive statement is made.

3.1.1.1 Volatile Organics. Table 3-1 has the volatile organics results summary. Each area is summarized showing the maximum result, minimum results and frequency of detection for each compound.

Table 3-1 Volatile Organics in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	BACKGROUND AND CONTROL SAMPLE			DUNSTABLE BROOK		
COMPOUND	Maximum ($\mu g/kg$)	Minimum ($\mu g/kg$)	Frequency (1) of Detection (detects/samps)	Maximum ($\mu g/kg$)	Minimum ($\mu g/kg$)	Frequency (1) of Detection (detects/samps)
Methylene Chloride	140	55	2/2	ND	ND	0/2
Acetone	250	210	2/2	35	12	2/2
2-Butanone	29	20	2/2	ND	ND	0/2
Benzene	ND	ND	0/2	ND	ND	0/2
Toluene	4	ND	1/2	ND	ND	0/2
Ethylbenzene	ND	ND	0/2	ND	ND	0/2
Total Xylenes	ND	ND	0/2	ND	ND	0/2

Footnotes:

ND – Not Detected

(1) – Frequency of detections does not include rejected results in the number of total samples

Table 3-1 Volatile Organics in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	FLINT POND MARSH			FLINT POND		
COMPOUND	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)
Methylene Chloride	160	ND	1/2	70	ND	2/4
Acetone	260	67	5/5	620	130	6/6
2-Butanone	37	17	2/2	150	ND	3/4
Benzene	110	ND	2/4	ND	ND	0/3
Toluene	ND	ND	0/2	ND	ND	0/3
Ethylbenzene	77	ND	2/4	ND	ND	0/3
Total Xylenes	100	ND	2/4	ND	ND	0/3

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total samples

Table 3-1 Volatile Organics in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	DOWNSTREAM OF FLINT POND DAM		
COMPOUND	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)
Methylene Chloride	ND	ND	0/3
Acetone	37	ND	2/3
2-Butanone	ND	ND	0/3
Benzene	ND	ND	0/3
Toluene	ND	ND	0/3
Ethylbenzene	ND	ND	0/3
Total Xylenes	ND	ND	0/3

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total samples

Background and Control Sample. The background location (CGSED-1) and control sample (CGSED-21) each have detectable levels of methylene chloride, acetone, and 2-butanone. The control sample also has a detectable level of toluene.

Dunstable Brook. Two samples were collected and analyzed in the Dunstable Brook area. One sample is in the unnamed stream (CGSED-2) near the west leachate pump station. The other (CGSED-3) is downstream of the confluence of the unnamed stream and Dunstable Brook. Both samples have detectable levels of acetone. The levels are lower than those detected in the background (210 μg/kg) and control sample (250 μg/kg).

Flint Pond Marsh. Five samples were collected and analyzed in the Flint Pond Marsh area. Two samples (CGSED-4 and CGSED-10) were collected in the center and north of the marsh respectively. One sample was collected at the culvert across Route 3 from the east leachate pump station (CGSED-9) one was collected at the culvert which delivers Dunstable Brook to the marsh (CGSED-8), and one was collected in the channel which feeds the marsh to Flint Pond (CGSED-5).

At the east leachate pump station culvert, only acetone was detected (67 μg/kg) but, at a lower level then background (210 μg/kg). At the Dunstable Brook culvert, the same three compounds (methylene chloride, acetone, and 2-butanone) were detected as at background. Each detection was at a slightly higher level than background.

In the center of the marsh (CGSED-4), only acetone (200 μg/kg) was detected. At the edges of the marsh (CGSED-10 to the north, CGSED-5 in the effluent channel), acetone, benzene, ethyl benzene and total xylenes were detected. Acetone was detected at lower levels than at the background. However, benzene, ethylbenzene and total xylenes were detected at levels above background.

Flint Pond. Some analytical results from Flint Pond sediment samples were rejected due to high moisture content values. Southern (CGSED-6 and 11) and western (CGSED-12 and 13) pond sampling locations each had their non-detected results rejected due to high moisture content values. At CGSED-12, all values were rejected due to an extremely high (greater than 90 percent) moisture content value. At the northeastern (CGSED-14, 15, and 16) sampling locations, all values were accepted.

At the southern and western areas, acetone was detected at similar (160 μg/kg at CGSED-6) or higher (up to 620 μg/kg at CGSED-13) levels than at background (210 μg/kg). Methylene chloride was detected at CGSED-11, the only location in the pond with a methylene chloride detection. 2-Butanone was detected at CGSED-13 (150 μg/kg) at a level higher than background (20 μg/kg). 2-Butanone was not detected at other southern or western pond locations.

In the three northeastern sampling locations, each sample contained acetone (up to 210 μg/kg) comparable to or slightly above background (140 μg/kg). CGSED-14 and 16 also contained 2-butanone (39 μg/kg and 30 μg/kg respectively) above the background level (20 μg/kg).

Downstream of the Flint Pond Dam. Low detections were reported downstream of the Flint Pond Dam. Two locations (CGSED-17 and CGSED-7) are prior to the center of town. Acetone (37 μg/kg) was detected in CGSED-7 at a level below background (210 μg/kg). CGSED-18 is downstream of the center of town just prior to the Merrimack River. Acetone (15 μg/kg) was also detected here at a level below background.

3.1.1.2 Semi-Volatile Organics. Table 3-2 is the semi-volatile organics results summary. Each area is summarized by the maximum result, minimum result, and frequency of detection for each compound.

Table 3-2 Semi-Volatile Organics in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	BACKGROUND AND CONTROL SAMPLE			DUNSTABLE BROOK		
COMPOUND	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)
Phenanthrene	--	--	0/0	250	ND	1/2
Anthracene	--	--	0/0	100	ND	1/2
Fluoranthene	--	--	0/0	540	ND	1/2
Pyrene	--	--	0/0	400	85	2/2
Benzo(a)anthracene	--	--	0/0	260	ND	1/2
Chrysene	--	--	0/0	230	ND	1/2
Bis(2-ethylhexyl)phthalate	140	140	1/1	380	150	1/2
Benzo(b)fluoranthene	--	--	0/0	310	ND	1/2
Benzo(a)pyrene	--	--	0/0	190	ND	1/2
Indeno(1,2,3-cd)pyrene	--	--	0/0	120	ND	1/2
Benzo(g,h,i)perylene	--	--	0/0	380	ND	1/2

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total ssamples

Table 3-2 Semi-Volatile Organics in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	FLINT POND MARSH			FLINT POND		
COMPOUND	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)
Phenanthrene	350	350	1/1	ND	ND	0/3
Anthracene	--	--	0/0	ND	ND	0/3
Fluoranthene	400	400	1/1	ND	ND	0/3
Pyrene	390	390	1/1	ND	ND	0/3
Benzo(a)anthracene	--	--	0/0	ND	ND	0/3
Chrysene	360	360	1/1	ND	ND	0/3
Bis(2-ethylhexyl)phthalate	1,200	260	3/3	880	ND	3/5
Benzo(b)fluoranthene	--	--	0/0	ND	ND	0/3
Benzo(a)pyrene	--	--	0/0	ND	ND	0/3
Indeno(1,2,3-cd)pyrene	--	--	0/0	ND	ND	0/3
Benzo(g,h,i)perylene	--	--	0/0	ND	ND	0/3

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total ssamples

Table 3-2 Semi-Volatile Organics in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	DOWNSTREAM OF FLINT POND DAM		
COMPOUND	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)
Phenanthrene	ND	ND	0/2
Anthracene	ND	ND	0/2
Fluoranthene	ND	ND	0/2
Pyrene	ND	ND	0/2
Benzo(a)anthracene	ND	ND	0/2
Chrysene	ND	ND	0/2
Bis(2-ethylhexyl)phthalate	190	ND	1/2
Benzo(b)fluoranthene	ND	ND	0/2
Benzo(a)pyrene	200	ND	1/2
Indeno(1,2,3-cd)pyrene	ND	ND	0/2
Benzo(g,h,i)perylene	ND	ND	0/2

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total ssamples

Background and Control Sample. One detection of bis(2-ethylhexyl)phthalate was reported (140 μg/kg) in the background sample. No detections were reported in the control sample. Because of rejection of non-detected values during data validation, comparison of other sample location results to background will be unavailable. Therefore, the data from each area are discussed independent of any comparison. The PAH data did not experience widespread rejection during data validation and are used to evaluate the sediment.

Dunstable Brook. Two semi-volatile organics were detected in the unnamed stream (CGSED-2). Pyrene (85 μg/kg) and bis(2-ethylhexyl)phthalate (150 μg/kg) were detected. In Dunstable Brook, (CGSED-3) nine semi-volatile organics were detected at levels up to 540 μg/kg (fluoranthene).

Flint Pond Marsh. In the center of Flint Pond Marsh (CGSED-4), five semi-volatile organics were detected (phenanthrene, fluoranthene, pyrene, chrysene, and bis(2-ethylhexyl)phalate). CGSED-5 and 8 also had detections of bis(2-ethylhexyl)phthalate (740 μg/kg and 260 μg/kg, respectively). The marsh receives runoff from Route 3 and this may influence the results.

Flint Pond. The southern and western sample locations within Flint Pond had their non-detect semi-volatile organic results rejected during data validation due to high moisture content. CGSED-12, in the center of the western section of the pond, had all results rejected due to extremely high (above 90 percent) moisture content. Therefore, bis(2-ethylhexyl)phthalate is the only detected semi-volatile organic in these areas of the pond (650 μg/kg an CGSED-6 and 880 μg/kg at CGSED-11).

In the northeastern section of the pond, bis(2-ethylhexyl)phthalate was the only semi-volatile detected. It was detected once (230 μg/kg at CGSED-15).

Downstream of the Flint Road Dam. CGSED-17 and 7 are located downstream of the Flint Pond Dam but prior to the center of town. CGSED-18 is located beyond the town center just prior to the Merrimack River. This location (CGSED-18) receives runoff from the center of town which may influence the semi-volatile organics levels. The results from CGSED-18 were rejected during data validation because the holding time prior to extraction was exceeded. At CGSED-7, bis(2-ethylhexyl)phthalate and benzo(a)pyrene were detected.

3.1.1.3 Polycyclic Aromatic Hydrocarbons (PAHs). Table 3-3 has the PAH results summary. Each area is summarized showing the maximum, minimum and frequency of detection. The following discussion focusses on comparison of results to the background and control samples.

Background and Control Sample. Ten PAHs were detected in the background sample (CGSED-1), only one (pyrene) was detected in the control sample (CGSED-21). The pyrene level in the background (22 μg/kg) is higher than the level in the control sample (15 μg/kg).

Dunstable Brook. Both Dunstable Brook locations; CGSED-2 in the unnamed stream, and CGSED-3 in the brook; have numerous PAH detections (14 and 13 respectively). Both samples consistently have detections higher than background and CGSED-2 has levels consistently higher than CGSED-3. The maximum PAH detection is 260 μg/kg of pyrene at CGSED-2.

Flint Pond Marsh. Flint Pond Marsh analytical results for PAHs have some unexpected trends. Given the runoff it receives from Route 3, the PAH levels were expected to be elevated. Although most are consistently above background, (CGSED-4, 5, 8 and 10) CGSED-9 frequently contained levels below background. Eleven compounds are detected in CGSED-9, six of those are below background.

Table 3-3 Polycyclic Aromatic Hydrocarbon (PAH) in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	BACKGROUND AND CONTROL SAMPLE			DUNSTABLE BROOK		
COMPOUND	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)
Naphthalene	ND	ND	0/2	ND	ND	0/2
2-Methylnaphthalene	ND	ND	0/2	ND	ND	0/2
Acenaphthylene	ND	ND	0/2	8	ND	1/2
Acenaphthene	ND	ND	0/2	ND	ND	0/2
Fluorene	ND	ND	0/2	16	5	2/2
Phenanthrene	8	ND	1/2	86	42	2/2
Anthracene	ND	ND	0/2	15	6	2/2
Fluoranthene	17	ND	1/2	120	61	2/2
Pyrene	22	15	2/2	260	68	2/2
Benzo(a)anthracene	6	ND	1/2	60	27	2/2
Chrysene	12	ND	1/2	68	32	2/2
Benzo(b)fluoranthene	11	ND	1/2	59	35	2/2
Benzo(k)fluoranthene	ND	ND	0/2	48	15	2/2
Benzo(a)pyrene	9	ND	1/2	62	28	2/2
Indeno(1,2,3-cd)pyrene	30	ND	1/2	90	52	2/2
Dibenz(a,h)anthracene	25	ND	1/2	45	35	2/2
Benzo(g,h,i)perylene	29	ND	1/2	99	46	2/2

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total samples

Table 3-3 Polycyclic Aromatic Hydrocarbon (PAH) in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	FLINT POND MARSH			FLINT POND		
COMPOUND	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)
Naphthalene	93	ND	1/5	13	ND	1/7
2-Methylnaphthalene	20	ND	2/5	ND	ND	0/7
Acenaphthylene	ND	ND	0/5	15	ND	1/7
Acenaphthene	ND	ND	0/5	19	ND	1/7
Fluorene	8	ND	1/5	30	ND	1/7
Phenanthrene	44	19	5/5	200	17	7/7
Anthracene	ND	ND	0/5	50	ND	1/7
Fluoranthene	92	11	5/5	390	37	7/7
Pyrene	190	26	5/5	710	44	7/7
Benzo(a)anthracene	36	11	5/5	190	ND	4/7
Chrysene	55	8	5/5	210	ND	6/7
Benzo(b)fluoranthene	52	6	5/5	180	ND	6/7
Benzo(k)fluoranthene	36	6	5/5	130	ND	5/7
Benzo(a)pyrene	45	6	5/5	190	ND	5/7
Indeno(1,2,3-cd)pyrene	83	7	5/5	340	ND	5/7
Dibenz(a,h)anthracene	35	ND	3/5	150	ND	2/7
Benzo(g,h,i)perylene	80	8	5/5	320	ND	5/7

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total samples

Table 3-3 Polycyclic Aromatic Hydrocarbon (PAH) in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	DOWNSTREAM OF FLINT POND DAM		
COMPOUND	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)
Naphthalene	25	ND	1/3
2-Methylnaphthalene	10	ND	1/3
Acenaphthylene	36	ND	2/3
Acenaphthene	ND	ND	0/3
Fluorene	14	ND	1/3
Phenanthrene	170	18	3/3
Anthracene	50	ND	1/3
Fluoranthene	340	35	3/3
Pyrene	1,300	34	3/3
Benzo(a)anthracene	310	17	3/3
Chrysene	280	20	3/3
Benzo(b)fluoranthene	270	18	3/3
Benzo(k)fluoranthene	500	35	3/3
Benzo(a)pyrene	290	18	3/3
Indeno(1,2,3-cd)pyrene	270	9	3/3
Dibenz(a,h)anthracene	100	ND	2/3
Benzo(g,h,i)perylene	290	8	3/3

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total samples

Flint Pond. In general, Flint Pond sample results are elevated above background. The levels reported are comparable to other sample locations under investigation, and do not exhibit any obvious trends or distribution. At CGSED-16, 16 compounds were detected, each of them represent the maximum of the PAH data set for the pond. Detected levels up to 710 μg/kg (pyrene) are reported in CGSED-16.

Downstream of the Flint Pond Dam. The PAHs exhibit a similar trend as the semivolatile organics at locations downstream of the Flint Pond Dam. Upstream of the town center (CGSED-7 and CGSED-17), levels are above background but comparable to the results from other sample areas. CGSED-18, on the other hand, has 16 detections, each represent the maximum of the PAH data set for this area. Levels up to 1,300 μg/kg (pyrene) are reported in CGSED-18. CGSED-18 is in a location which receives runoff from the town center and this may influence the PAH results.

3.1.1.4 Metals. Table 3-4 is the metals in sediment result summary. Each area is summarized showing the maximum, minimum, and frequency of detection for each area. The following compares the results to background and control sample levels. Metcalf & Eddy collected nineteen sediment samples during September and October 1993. These sediments were analyzed for 23 EPA target analyte list (TAL) metals including mercury in addition to other analytical parameters. All metals data were validated in accordance with EPA Region I data validation guidelines. Several metals including mercury were rejected in several of the samples. These metals were rejected solely on the basis of the percent solids content of the samples and not on any other quality control problems. EPA Region I policy for data validation includes a review of, and action regarding, the percent solids content of samples. If a soil/sediment has less than ten percent solids all data are rejected. If a soil/ sediment has greater than ten percent but less than thirty percent solids positive (detected) results are accepted but not detected results are rejected. If the solids content is greater than thirty percent no validation action is required for percent solids. These limitations apply to routine analytical services (RAS) analysis is planned and conducted for this project. Any

Table 3-4 Metals in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	BACKGROUND AND CONTROL SAMPLE			DUNSTABLE BROOK		
ELEMENT	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (μg/kg)	Minimum (μg/kg)	equency (1) of Detection (detects/samps)
Aluminum	7060	6640	2/2	6680	5290	2/2
Arsenic	5.1	4.1	2/2	26	11.6	2/2
Barium	44.8	40.6	2/2	48.7	28.4	2/2
Beryllium	0.31	ND	1/2	0.2	ND	1/2
Calcium	2720	1040	2/2	2610	1260	2/2
Chromium	14.2	12	2/2	23.7	17.7	2/2
Cobalt	18.9	9.6	2/2	4.5	4.0	2/2
Copper	2.7	1.9	2/2	8.1	5.8	2/2
Iron	11900	5220	2/2	21600	10300	2/2
Lead	10.9	7.1	2/2	8.8	5.5	2/2
Magnesium	1810	1740	2/2	3890	3060	2/2
Manganese	718	206	2/2	196	168	2/2
Mercury	ND	ND	0/2	ND	ND	0/2
Nickel	11.2	8.7	2/2	17.1	11.7	2/2
Potassium	392	337	2/2	1710	1520	2/2
Silver	ND	ND	0/2	0.82	ND	1/2
Sodium	ND	ND	0/2	ND	ND	0/2
Vanadium	27	10.8	2/2	17.8	14.6	2/2
Zinc	19.9	17.2	2/2	32.6	25.2	2/2

Footnotes:

ND – Not Detected

(1) – Frequency of Detections does not include rejected results in the number of total samples.

Table 3–4 Metals in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	FLINT POND MARSH			FLINT POND		
ELEMENT	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)
Aluminum	26700	7360	5/5	15200	1520	6/6
Arsenic	69.7	18.9	5/5	23	8.3	6/6
Barium	121	46.9	5/5	61.4	33	6/6
Beryllium	1.2	0.72	2/2	0.87	ND	3/5
Calcium	10500	3360	5/5	16500	2070	6/6
Chromium	68.1	14.8	5/5	16.8	11.1	6/6
Cobalt	50.5	3.5	5/5	4.8	3	5/5
Copper	42.6	6.7	4/4	8.7	ND	1/4
Iron	31900	6170	5/5	8600	2450	6/6
Lead	64.7	20.4	5/5	56.2	20.6	4/4
Magnesium	10700	840	5/5	1540	747	6/6
Manganese	707	393	5/5	443	118	6/6
Mercury	ND	ND	0/1	ND	ND	0/3
Nickel	64.2	6.1	5/5	11.8	6.2	6/6
Potassium	5480	211	5/5	708	445	3/3
Silver	ND	ND	0/1	ND	ND	0/3
Sodium	1060	1060	1/1	ND	ND	0/3
Vanadium	53.4	4.1	5/5	14.6	7.2	6/6
Zinc	103	33.7	5/5	43.2	23.8	5/5

Footnotes:

ND – Not Detected

(1) – Frequency of Detections does not include rejected results in the number of total samples

Table 3-4 Metals in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	DOWNSTREAM OF FLINT POND DAM		
ELEMENT	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)
Aluminum	6870	3050	3/3
Arsenic	13	3.8	3/3
Barium	24.7	16.2	3/3
Beryllium	ND	ND	0/3
Calcium	1300	538	3/3
Chromium	15.5	7.6	3/3
Cobalt	4.2	2.5	3/3
Copper	5.2	ND	1/3
Iron	6410	5500	3/3
Lead	23.7	10.2	3/3
Magnesium	2310	1080	3/3
Manganese	433	132	3/3
Mercury	ND	ND	0/3
Nickel	10.2	4.8	3/3
Potassium	716	329	3/3
Silver	ND	ND	0/3
Sodium	ND	ND	0/3
Vanadium	11.2	7.7	3/3
Zinc	27.7	18.3	3/3

Footnotes:

ND – Not Detected

(1) – Frequency of Detections does not include rejected results in the number of total samples

future sediment analyses will be conducted through the delivery of analytical services (DAS) program to overcome the low percent solids problem, unless otherwise directed by EPA.

Background and Control Sample. The metals results at the background and control sample locations are mixed. Of the 16 compounds detected, nine maximums from this area are in the background sample and seven maximums from this area are in the control sample. The manganese level (718 mg/kg) at CGSED-1 (background) represents the maximum of the total metals data set for that compound.

Dunstable Brook. The results at the two Dunstable Brook locations are also mixed, some are above background and some are below. Eight compounds (arsenic, chromium, copper, iron, magnesium, nickel, potassium and zinc) are consistently higher than background. Five compounds (aluminium, beryllium, cobalt, lead and manganese) are consistently below background.

Flint Pond Marsh. The results of the five Flint Pond Marsh locations indicate the marsh is consistently above background for 11 compounds (aluminum, arsenic, barium, beryllium, calcium, chromium, copper, iron, lead, sodium, and zinc). No metals in the marsh are consistently below background. CGSED-9 contains 12 of the maximums in the marsh. CGSED-5 contains 13 of the minimums in the marsh. However, 10 of the minimum levels in the marsh are above the maximum level in the background.

Flint Pond. The results at Flint Pond locations indicate that five metals (arsenic, beryllium, lead, potassium and zinc) are above background and four metals (cobalt, iron, magnesium, and vanadium) are below background. The pond maximums are concentrated in the southeast section. Twelve of the pond maximums are at CGSED-6 and CGSED-14. The pond minimums do not exhibit any obvious distribution trend.

Downstream of the Flint Pond Dam. The results downstream of the Flint Pond dam indicate that two metals (lead and zinc) are consistently above background while seven metals (aluminum, barium, calcium, cobalt, manganese, nickel, and vanadium) are consistently below background. Fifteen of the maximums from this area are at CGSED-7 and CGSED-17 which are both prior to the town center. The minimums from this area are primarily at CGSED-18 (nine minimums for this area).

3.1.1.5 Antimony and Cadmium. Table 3-5 is the antimony and cadmium results summary. These metals were analyzed with the full list of metals and also analyzed separately using a method which targets a lower detection limit. This was done because antimony and cadmium have low ecological criteria limits.

Background and Control Sample. The background cadmium level is 0.18 mg/kg and control sample cadmium level is 0.062 mg/kg. Both the background and control sample results for antimony were non-detects.

Dunstable Brook. The Dunstable Brook locations (CGSED-2 and 3) are consistently below the background level of cadmium. Antimony levels in the brook are consistently above the background results. The antimony concentration at CGSED-3 (1.4 mg/kg) represents the maximum antimony results in the brook.

Flint Pond Marsh. Flint Pond Marsh sample results for antimony and cadmium are consistently above background. Each compound was detected at each marsh location. There is no obvious distribution trend for the marsh maximums or minimums.

Flint Pond. The trend of antimony and cadmium levels at the pond locations are similar to that for PAHs. The Flint Pond antimony and cadmium results are consistently elevated above the background levels. The Flint Pond maximums are at CGSED-12 and the minimums are both of CGSED-15.

Table 3-5 Antimony and Cadmium in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	BACKGROUND AND CONTROL SAMPLE			DUNSTABLE BROOK		
COMPOUND	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)
Antimony	ND	ND	0/2	1.4	0.26	2/2
Cadmium	0.18	0.062	2/2	0.11	0.039	2/2

Footnotes:

ND - Not Detected

(1) - Frequency of detections does not include rejected results in the number of total samples

Table 3-5 Antimony and Cadmium in Sediment Summary
Charles George Reclamation Landfill
Five Year Review

AREA:	DOWNSTREAM OF FLINT POND DAM		
COMPOUND	Maximum (μg/kg)	Minimum (μg/kg)	Frequency (1) of Detection (detects/samps)
Antimony	0.081	ND	1/3
Cadmium	0.17	0.032	3/3

Footnotes:

ND – Not Detected

(1) – Frequency of detections does not include rejected results in the number of total samples

Table 3-5 *Antimony and Cadmium in Sediment Summary*
Charles George Reclamation Landfill
Five Year Review

AREA:	FLINT POND MARSH			FLINT POND		
COMPOUND	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)	Maximum (µg/kg)	Minimum (µg/kg)	Frequency (1) of Detection (detects/samps)
Antimony	0.3	0.095	5/5	0.46	0.1	7/7
Cadmium	0.95	0.13	5/5	0.58	0.22	7/7

Footnotes:

ND – Not Detected

(1) – Frequency of detections does not include rejected results in the number of total samples

Down Stream of the Flint Pond Dam. The three samples downstream of the Flint Pond Dam have results which are consistently below the background cadmium level. The antimony results downstream of the Flint Pond Dam are also very low, however, they are not consistently lower than background.

3.1.1.6 Organic Content and Grain Size. No summary table has been prepared for these data. The results of these analyses were used to qualitatively aid in data interpretation. The data do indicate sediment types at various locations (e.g., sandy).

Background and Control Sample. The background and control samples were analyzed using the TCO method for organic content. Results indicate that the background is 6.53 percent total combustible organics and the control sample is 5.19 percent total combustible organics. The grain size analysis results indicate both are more than 75 percent sand and gravel (75.5 percent at CGSED-1 and 76.8 percent at CGSED-21).

Dunstable Brook. The Dunstable Brook samples (CGSED-2 and 3) were analyzed for organic content using the TOC method. The results were 1.9 percent and 0.13 percent organic content respectively. Grain size results were 83.5 percent sand and gravel for CGSED-2 and 92.9 percent sand and gravel for CGSED-3.

Flint Pond Marsh. As expected in any marsh, the Flint Pond Marsh sediments have a low sand and gravel content and a high organic content. The organic content ranged from a low of 1.8 percent at CGSED-9 to a high of 25.61 percent at CGSED-10. Grain size distribution data indicates that only CGSED-8 contains more than 30 percent sand and gravel. Silt, clay and peat content of all samples was above 50 percent. The silt, clay and peat content of the Flint Pond Marsh samples ranged from 50.1 percent at CGSED-8 to 86.4 percent at CGSED-9.

Flint Pond. The southern and western areas of the pond were high organic, high peat content materials. TCO data for CGSED-6, 11, 12, and 13 show a range of 44.19 percent total combustible organics at CGSED-11 to 87.33 percent total combustible organics at CGSED-13. The northeastern area was also high in organics, but less than other Flint Pond locations. At CGSED-14, 15 and 16, the TCO results were 17.19 percent, 10.91 percent and 12.29 percent respectively.

The grain size data does not follow this pattern as strongly. CGSED-12 had 0.1 percent gravel. No other southern and western sample location had any gravel. Silt, clay and peat ranged from 34.3 percent in the sample from CGSED-13 to 60.5 percent in the sample from CGSED-11. In the northeast area, gravel contents were slightly higher; up to 4.2 percent sand and gravel in the sample from CGSED-15. Silt, clay and peat ranged from 48.3 percent at CGSED-15 to 85.7 percent at CGSED-14.

Downstream of the Flint Pond Dam. Downstream of the Flint Pond Dam, samples exhibit a low organic content where the flow velocity is high (at CGSED-17 and 18) and a higher organic content in the low flow area (CGSED-7). CGSED-17, immediately downstream of the dam, has a total organic content of 0.34 percent. The CGSED-7 sample location is just prior to the town center where the waterway widens and velocity slows. The total organic content at CGSED-7 is 9.73 percent. At the CGSED-18 location, the current is fairly swift and the flow path is channelized. The total organic content at CGSED-18 is 0.61 percent.

Grain size distribution follows this pattern also. The sediment from CGSED-17 is 88 percent sand and gravel. The sediment from CGSED-7 is 64.9 percent sand and gravel. The sediment from CGSED-18 is 92.8 percent sand and gravel.

3.1.2 Evaluation of Sediment Ecological Toxicity

Based on Dunnett's tests and t-tests that were Bonferroni-adjusted for multiple comparisons, the percent survivability for both *H. afteca* and *C. tentans* was significantly lower than the reference station at sediment locations CGSED-2 and 3 (Tables 2-12). At sediment locations CGSED-4 through 7, there was no significant difference in survivability compared to the reference station. In contrast, there were no significant differences in growth rate (Table 2-13) between all sediment sampling stations and the reference station for either species.

Another method of evaluating sediment toxicity is comparison of the metals data to ecological criteria in sediments. Table 3-6 provides the ecological criteria and sediment data. The data are organized by area to facilitate evaluation of each area.

Background and Control Samples. The background location is in Dunstable Brook upstream of the site. At the background location arsenic, barium and manganese exceed the ecological criteria. The control location is Saw Mill Pond in Concord, MA. The results for arsenic and barium exceed the ecological criteria of the control sample location. Although some ecological criteria are exceeded, the toxicity testing indicates metals are not readily available for ingestion by the species tested at these locations.

Dunstable Brook. Arsenic and barium levels in the unnamed stream (CGSED-2) and Dunstable Brook (CGSED-3) exceed the ecological criteria. The iron level in the unnamed stream also exceeds the ecological criteria. These results along with the high toxicity exhibited at these locations indicate that environmental contaminants at these locations are present and available for uptake by the species used during toxicity testing.

Table 3-6 Sediment Ecological Criteria and
1993 Metals in Sediment Concentrations
Charles George Reclamation Landfill

	Sediment Ecological Criteria	Site Background Sample	Reference Sediment Sample	Dunstable Brook	
Element	Criteria (mg/kg)	CGSED-1 (mg/kg)	CGSED-21 (mg/kg)	CGSED-2 (mg/kg)	CGSED-3 (mg/kg)
Aluminum	NA	6640	7060	6680	5290
Antimony (1)	2	0.060 U	0.060 U	0.26	1.4
Arsenic	3	4.1	5.1	26	11.6
Barium	20	44.8	40.6	48.7	28.4
Beryllium	2	0.08 U	0.31	0.2	0.04 U
Cadmium (1)	0.8	0.18	0.062	0.11	0.039
Calcium	NA	2720 J	1040 J	2610 J	1260 J
Chromium	25	14.2	12	23.7	17.7
Cobalt	25	9.6	18.9	4.5	4.0
Copper	19	2.7	1.9	8.1	5.8
Iron	17000	5220	11900	21600	10300
Lead	27	10.9	7.1	8.8	5.5
Magnesium	8500	1810	1740	3890	3060
Manganese	300	718	206	196	168
Mercury	0.5	0.11 U	0.09 U	0.06 U	0.05 U
Nickel	20	11.2	8.7	17.1	11.7
Potassium	4300	392	337	1710	1520
Selenium	2	1.1 U	0.97 U	0.61 U	0.58 U
Silver	1	1.5 U	1.3 U	0.82	0.76 U
Sodium	NA	238 U	133 U	173 U	142 U
Thallium	NA	0.64 U	0.61 U	0.82 U	0.33 U
Vanadium	150	10.8	27	17.8	14.6
Zinc	85	19.9	17.2	32.6	25.2

Footnotes:
(1) – Antimony and Cadmium data are reported from SAS methods, all others are data are RAS results

Shaded results are above the ecological criteria

Table 3-6 Sediment Ecological Criteria and
1993 Metals in Sediment Concentrations
Charles George Reclamation Landfill

Element	Sediment Ecological Criteria: Criteria (mg/kg)	Flint Pond Marsh: CGSED-4 (mg/kg)	CGSED-5 (mg/kg)	CGSED-8 (mg/kg)	CGSED-9 (mg/kg)	CGSED-10 (mg/kg)
Aluminum	NA	13800 J	7360 J	9880 J	26700	17800 J
Antimony (1)	2	0.30	0.095	0.28	0.18	0.26
Arsenic	3	20.3 J	18.9 J	21.8 J	69.7	41.4 J
Barium	20	83.9 J	46.9 J	56.6 J	121	67.5 J
Beryllium	2	R	0.72 J	R	1.2	R
Cadmium (1)	0.8	0.68	0.43	0.95	0.13	0.55
Calcium	NA	4420 J	10500 J	3360 J	8780 J	5550 J
Chromium	25	32.2 J	14.8 J	25.7 J	68.1	54.7 J
Cobalt	25	17.3 J	3.5 J	22.3 J	21.1	50.5 J
Copper	19	15.5 J	6.7 J	11.7 J	42.6	R
Iron	17000	14400 J	6170 J	10600 J	31900	18300 J
Lead	27	60.4 J	27.5 J	40 J	20.4 J	64.7 J
Magnesium	8500	3940 J	840 J	3200 J	10700	7460 J
Manganese	300	707 J	437 J	393 J	678	594 J
Mercury	0.5	R	R	R	0.08 U	R
Nickel	20	25.1 J	6.1 J	21.2 J	64.2	45.1 J
Potassium	4300	1370 J	211 J	1090 J	5480	3360 J
Selenium	2	R	R	R	0.9 U	R
Silver	1	R	R	R	1.8 U	R
Sodium	NA	R	R	R	1060	R
Thallium	NA	R	R	R	0.51 U	R
Vanadium	150	30.7 J	4.1 J	25.1 J	53.4	51.2 J
Zinc	85	103 J	33.7 J	78 J	70.7	86 J

Footnotes:
(1) – Antimony and Cadmium data are reported from SAS methods, all others are data are RAS results

Shaded results are above the ecological criteria

Table 3-6 Sediment Ecological Criteria and
1993 Metals in Sediment Concentrations
Charles George Reclamation Landfill

	Sediment Ecological Criteria	Flint Pond						
Element	Criteria (mg/kg)	CGSED-6 (mg/kg)	CGSED-11 (mg/kg)	CGSED-12 (mg/kg)	CGSED-13 (mg/kg)	CGSED-14 (mg/kg)	CGSED-15 (mg/kg)	CGSED-16 (mg/kg)
Aluminum	NA	8110 J	8930 J		1520 J	15200	7070	8770
Antimony (1)	2	0.085	0.14	0.46	0.15 J	0.16	0.10	0.42
Arsenic	3	19.3 J	8.3 J		8.4 J	19.4	15.1	23
Barium	20	51.8 J	46.4 J		37.3 J	61.4	33.9	33
Beryllium	2	0.87 J	1.1 J	R	R	0.65	0.09 U	0.1 U
Cadmium (1)	0.8	0.40	0.44 J	0.58	0.29	0.27	0.22	0.32
Calcium	NA	11700 J	9290 J		16500 J	3460 J	2330 J	2070 J
Chromium	25	16.8 J	16.4 J		11.8 J	15.2	12.4	11.1
Cobalt	25	3.7 J	4.1 J	R	R	4.8	3.0	3.5
Copper	19	8.7 J	R	R	R	6.5 U	4.6 U	7.7 U
Iron	17000	6540 J	4710 J		2450 J	8600	5520	5690
Lead	27	29.3 J	R	R	R	32.3 J	20.6 J	56.2 J
Magnesium	8500	889 J	747 J		953 J	1540	1210	1260
Manganese	300	443 J	315 J		188 J	350	426	343
Mercury	0.5	R	R	R	R	0.15 U	0.12 U	0.11 U
Nickel	20	11.8 J	7.7 J		9.5 J	9.2	7.6	6.2
Potassium	4300	R	R	R	R	708	445	503
Selenium	2	R	R	R	R	1.5 U	1.3 U	1.4 U
Silver	1	R	R	R	R	2.0 U	1.7 U	1.9 U
Sodium	NA	R	R	R	R	151 U	152 U	171 U
Thallium	NA	R	R	R	R	0.88 U	0.74 U	0.82 U
Vanadium	150	7.9 J	8.2 J		7.2 J	14.6	9.4	11.4
Zinc	85	30.1 J	32.9 J	R	R	33	23.8	43.2

Footnotes:
(1) - Antimony and Cadmium data are reported from SAS methods, all others are data are RAS results

Shaded results are above the ecological criteria

Table 3-6 Sediment Ecological Criteria and
1993 Metals in Sediment Concentrations
Charles George Reclamation Landfill

Element	Sediment Ecological Criteria	Downstream of Dam					
	Criteria (mg/kg)	CGSED-7 (mg/kg)		CGSED-17 (mg/kg)		CGSED-18 (mg/kg)	
Aluminum	NA	6870		4500		3050	
Antimony (1)	2	0.081		0.064	U	0.072	U
Arsenic	3	13		6.7		3.8	
Barium	20	24.7		16.2		16.9	
Beryllium	2	0.08	U	0.05	U	0.05	U
Cadmium (1)	0.8	0.17		0.032		0.096	
Calcium	NA	1300	J	538	J	748	J
Chromium	25	12.1		15.5		7.6	
Cobalt	25	4.2		3.5		2.5	
Copper	19	5.2		8.8	U	7.9	U
Iron	17000	5580		6410		5500	
Lead	27	19		23.7	J	10.2	J
Magnesium	8500	1290		2310		1080	
Manganese	300	433		132		143	
Mercury	0.5	0.09	U	0.06	U	0.07	U
Nickel	20	6.6		10.2		4.8	
Potassium	4300	329		716		640	
Selenium	2	1.1	U	0.7	U	0.72	U
Silver	1	1.4	U	0.93	U	0.95	U
Sodium	NA	146	U	63.1	U	63.8	U
Thallium	NA	0.62	U	0.4	U	0.41	U
Vanadium	150	11.2		10.5		7.7	
Zinc	85	21.3		18.3		27.7	

Footnotes:
(1) – Antimony and Cadmium data are reported fr
methods, all others are data are RAS results

Shaded results are above the ecological criteria

Flint Pond Marsh. Thirteen metals (arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, magnesium manganese, nickel, potassium and zinc) exceed the ecological criteria in at least one marsh sample. Arsenic, barium and manganese exceed the ecological criteria at all five marsh sample locations. However, the toxicity testing data indicates that despite the number and frequency of exceedances, toxicity is not significant in the marsh.

Flint Pond. Marshes tend to act as natural filters. The Flint Pond Marsh data indicates that it does indeed capture sediment contaminants. Although some exceptions do exist in the data base, metals levels in Flint Pond are generally lower than in Flint Pond Marsh. Four metals (arsenic, barium, lead and manganese) are present in Flint Pond sediments above the ecological criteria. Similar to the marsh, toxicity testing of the Flint Pond sediment indicates that these metals have limited availability for uptake by the species tested.

Downstream of the Flint Pond Dam. In this area, arsenic, barium and manganese are present above the ecological criteria. At CGSED-7, all three metals exceed the criteria while at the other two locations, only arsenic exceeds the ecological criteria. Toxicity testing results for this area indicate that the exceedances do not significantly contribute to toxicity.

3.1.3 Evaluation of Human Health Risk from Exposure to Sediment

Below is a qualitative evaluation of human health risk from exposure to sediments based on the 1993 contaminant concentrations detected in sediment at the Charles George Landfill. Sediment at the site has been resampled and these data have been compared to the previously detected contaminant concentrations, used in the 1988 risk assessment. Dose response data used in the RI, including chronic oral reference doses and slope factors, have been updated through April 1994 and these values have been compared to the previously used dose-response data. Current EPA Region I practice would be to evaluate dermal exposures to sediment qualitatively rather than quantitatively. Table 3-7 identifies changes in measured sediment concentrations between 1987/1988 and 1993. Table 3-8 identifies the changes in the dose-response data between 1988 and 1994. Table 3-9 shows how exposure parameters could change between 1987/1988 and 1994, if a quantitative assessment of exposure were to be undertaken.

The analytical data for sediments indicate that concentrations of some compounds have increased while concentrations of others have decreased since 1988. Both the average and maximum concentrations of bis(2-ethylhexyl)phthalate and 2-butanone have increased since 1988. Concentrations of di-n-butyl phthalate, toluene, and copper have all decreased since 1988. For the remaining compounds of concern (carcinogenic PAHs, arsenic and cadmium), concentrations in sediment at certain areas have increased while concentrations in other areas have decreased.

Reference doses are used to estimate risk based on noncarcinogenic effects. Risk estimates based on noncarcinogenic effects are inversely proportional to the magnitude of the reference dose. Therefore, if the reference dose for a particular compound has increased, this indicates that an individual may have a higher exposure level at which significant noncarcinogenic health effects are not expected.

The reference doses for bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, and copper have not changed since 1988. The reference doses for 2-butanone and cadmium have increased since 1988, indicating that risk estimates based on noncarcinogenic effects from exposure to these compounds are lower than previously estimated. The reference dose for toluene has decreased since 1988 indicating that risk estimates based on noncarcinogenic effects from exposure to toluene are higher than previously estimated. Reference doses which were not previously available are now available for fluoranthene, pyrene and arsenic. Newly calculated risk estimates based on noncarcinogenic effects from exposure to these three compounds may increase the total site risk estimate based on noncarcinogenic effects.

TABLE 3-7. SEDIMENT CONCENTRATIONS, 1987-1988-1993

CHEMICAL	1987 Concentrations from Alliance (mg/kg)		1988 Concentrations from ECJordan, by area (mg/kg)		1993 Concentrations, by area (mg/kg)[a]	
	Most-probable	Worst-case	Most-probable	Worst-case	Most-probable	RME[b]
Bis(2-ethylhexyl)phthalate	0.16	0.91			0.42	1.2
Di-n-butyl phthalate	0.0334	0.2			ND	ND
PAHs	0.393	6.32	-- (1)	11,000 (1)	0.67 (1)	4.3 (1)
			-- (2)	-- (2)	0.45 (2)	0.72 (2)
			-- (3)	5.3 (3)	0.74 (3)	1.04 (3)
2-butanone	0.0036	0.073			0.026	0.15
Toluene	0.0011	0.011			ND	ND
Arsenic	20	86	29.4 (1)	110 (1)	16 (1)	23 (1)
			30.4 (2)	300 (2)	34 (2)	70 (2)
			-- (3)	17.0 (3)	19 (3)	26 (3)
Cadmium	0.4	6.5	0.14 (1)	0.2 (1)	0.36 (1)	0.58 (1)
			2.1 (2)	6.5 (2)	0.55 (2)	0.95 (2)
			-- (3)	4.8 (3)	0.075 (3)	0.11 (3)
Copper	13	75			8.9	43

(a) 1993 PAH concentrations are for carcinogenic PAHs as listed in Table 5, RODIII (EPA, 1988)
(b) RME, reasonable maximum exposure, is defined by U.S. EPA Region I as representing maximum contaminant concentrations.
(1) Concentration in Flint Pond
(2) Concentration in Flint Pond Marsh
(3) Concentration in Dunstable Brook, carcinogenic PAHs only
-- No value provided

TABLE 3-8. CHANGES IN REFERENCE DOSES AND SLOPE FACTORS 1988-1994

CHEMICAL NAME	Noncarcinogenic Risk Reference Doses (mg/kg/day)			Carcinogenic Risk Slope Factors (/(mg/kg/day))			
	1988 Value	April 1994		1988 Value	April 1994		
		Value	Source		Group	Value	Source
Bis(2-ethylhexyl)phthalate	0.02	0.02	IRIS 2/93	6.8×10^{-4}	B2	1.4×10^{-2}	IRIS 2/93
Di-n-butyl phthalate	0.1	0.1	IRIS 2/93	--	D	--	IRIS 2/93
PAHs: fluoranthene	--	0.04	IRIS 7/93	--	D	--	IRIS 7/93
phenanthrene	--	--	IRIS 7/93	--	D	--	IRIS 7/93
pyrene	--	0.03	IRIS 7/93	--	D	--	IRIS 7/93
carcinogenic PAHs	--	--		11.5	B2	7.3	IRIS 3/94 Slope factor for B(a)P applies to all cPAHs, per EPA Region I
2-Butanone	0.05	0.6	IRIS 6/93	--	D	--	IRIS 6/93
Toluene	0.29	0.2	IRIS 2/94	--	D	--	IRIS 2/94
Arsenic	--	0.0003	IRIS 3/94	1.5	A	1.75	IRIS 3/94 Slope factor extrapolated from unit risk
Cadmium	0.00029 [a]	0.001 [b]	IRIS 2/94	--	[c]	--	IRIS 2/94
Copper	0.037 [a]	0.037 [a]	HEAST 93	--	D	--	IRIS 1/92

NOTES
Shaded values are changed since 1988
-- No value provided
a. Value shown is based on the drinking water action level and is not a reference dose
b. Cadmium RfD is 0.001 mg/kg/day in food, 0.0005 mg/kg/day in water
c. Cadmium is a Group B1 carcinogen by inhalation, but is not considered carcinogenic by ingestion

TABLE 3-9. POSSIBLE CHANGES IN EXPOSURE PARAMETERS, 1988-1994

Parameter	Alliance Selections, 1987	ECJordan Selections, 1988	Proposed, 1994	Source of 1994 parameter
Ages exposed	6-15 years	8-17 years	8-17 years	ECJordan
Average weight over period of exposure	35 kg	35 kg	47 kg	Calculated from EPA 1991 (EFH)
Frequency of contact: Most-probable Reasonable worst-case	 16 times/year 32 times/year	 16 times/year 32 times/year	 32 times/yr 32 times/yr	ECJordan (reasonable worst-case)
Years of exposure: Most-probable Reasonable worst-case	 1 year 5 years	 5 years 10 years	 10 years 10 years	ECJordan (reasonable worst-case)
Quantity of sediment contacted: Most-probable Reasonable worst-case	0.01 kg 0.02 kg	0.005 kg 0.01 kg	0.01 kg/day 0.01 kg/day	ECJordan (reasonable worst-case)
Relative absorption factor	-- [100%]	PAHs: 10% Others: 1% (most-probable); 10% (reasonable worst-case)	Alternative 1: phthalates: 2% (DEHP) PAHs: 2% to 29% MEK: 10% toluene: 12% As: 3% Cd: 14% Cu: 35% (from Ni) (MADEP, 1992)	Alternative 2: PAHs and, by extension, phthalates, 5%, MEK & toluene, 50%; metals, negligible (EPA, 1989)
Fraction of arsenic available for absorption	-- [100%]	5% 10%	-- [100%]	term assumed to be included in RAF term

Note: Shaded values would be changed from the parameters used in 1988.

Slope factors are used to estimate risk based on carcinogenic effects. Carcinogenic risk estimates are proportional to the magnitude of the slope factor. Therefore if the slope factor for a particular compound has increased, this indicates that an individual's exposure results in a higher carcinogenic risk than was previously estimated. Three slope factors have changed since 1988. The slope factors for bis(2-ethylhexyl)phthalate and arsenic have increased while the slope factor for carcinogenic PAHs has decreased, the latter indicating that carcinogenic risk estimates from exposure to carcinogenic PAHs are lower than previously estimated.

One objective of this five year review is to reassess the carcinogenic risk of PAHs in Dunstable Brook. Since the concentrations of carcinogenic PAHs in Dunstable Brook sediments have decreased, the slope factors for carcinogenic PAHs has decreased, and most of the exposure parameters are similar. For reasonable worst-case exposures, it can be qualitatively stated that carcinogenic risk from exposure to carcinogenic PAHs in sediment at Dunstable Brook is lower than previously estimated. However, because there are no consistent trends in sediment concentrations, the updated dose-response data, and exposure parameters for all compounds of concern, no overall consistent trend toward a decreased risk based on both carcinogenic and noncarcinogenic effects can be established. Also, additional analytes have been detected, not addressed in ROD III. Therefore, it cannot be confirmed that the risk estimates from exposure to all Dunstable Brook sediment contaminants have decreased.

Two sets of exposure parameters were selected in 1988, representing "most probable" and "reasonable worst case" exposures. A current evaluation would generally use only the latter. Evaluation of dermal absorption of contaminants would be different, if a quantitative evaluation were performed since RAF's have changed. For the conservative case, estimated absorption of some contaminants would be higher, and others lower.

3.2 EVALUATION OF FISH TISSUE DATA

A total of eight-five fish tissue samples were collected and analyzed for metals. Laboratory analyses were conducted in accordance with USEPA approved analytical procedures. Fish were collected from three locations, Flint Pond, between the dams in Flint Pond (Between Dams), and Locust Pond (Figure 2-7). Largemouth bass and yellow perch were caught and prepared for analysis at each location. For each site, the original sampling plan was to collect 5 whole fish samples, 5 fillet samples, and 5 offal samples of each species. However, an insufficient number of largemouth bass were caught at the Between Dams site in Flint Pond. The original plan was altered so that 5 whole largemouth bass and no offal and fillet samples were collected from the Between Dams site, and 10, rather than 5, whole largemouth bass were collected from Flint Pond.

Fish samples were analyzed for aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, vanadium, and zinc. Data were validated in accordance with USEPA protocols. Only positive detections of metals were included in summary tables. The complete validated data sets for metals are reported in Table 2-14.

For the purpose of evaluation, largemouth bass and yellow perch samples were reconstituted; reported concentrations detected in offal and fillet samples from the same fish were combined to obtain a single (whole body) value per fish. The relative contributions of the contaminants in offal and fillet samples were corrected for offal and fillet mass when combining for the whole body concentrations.

Standard summary statistics for metal concentrations detected in like samples (same location, species, and tissue type) are reported in Tables 3-10 through 3-15. A total of 11, 13, and 11 different metals were detected in fish collected from Flint Pond, Between Dams, and Locust Pond, respectively. Barium, chromium, cobalt, copper, mercury, and zinc were common to both species at all three locations. Among all detected metals, zinc was found in the highest

TABLE 3-10. SUMMARY OF FISH TISSUE INORGANIC RESULTS (MG/KG) FOR LOCUST POND LARGEMOUTH BASS.[1]

LOCUST POND - LARGEMOUTH BASS																
	Whole Body				Offal				Fillet				Offal + Fillet			
Analyte	freq	mean	std	max	freq	mean	std	max	freq	mean	std	max	freq[2]	mean	std	max
Arsenic	3/5	0.19	0.23	0.52	0/5				0/5				0/5			
Barium	4/5	0.42	0.14	0.68	5/5	0.36	0.20	0.69	5/5	0.05	0.03	0.11	5/5	0.31	0.18	0.58
Chromium	3/5	0.40	0.05	0.49	0/5				0/5				0/5			
Cobalt	2/5	0.12	0.01	0.14	2/5	0.47	0.25	0.73	5/5	0.44	0.17	0.74	5/5	0.22	0.26	0.68
Copper	0/5				5/5	0.29	0.03	0.33	5/5	0.22	0.02	0.27	5/5	0.27	0.04	0.32
Lead	2/5	0.10	0.02	0.12	0/5				0/5				0/5			
Mercury	5/5	0.20	0.03	0.27	5/5	0.45	0.07	0.7	5/5	0.90	0.12	1.1	5/5	0.51	0.17	0.75
Nickel	0/5				1/5			0.16	0/5				1/5			0.14
Selenium	0/5				4/5	0.19	0.07	0.29	5/5	0.11	0.02	0.16	5/5	0.14	0.09	0.26
Zinc	5/5	14.1	3.76	16.6	5/5	14.84	3.55	18.5	5/5	4.36	0.32	4.9	5/5	13.28	3.21	16.05

1 Concentrations in mg/kg wet weight.
2 Number of fish with a contaminant hit, regardless of whether contaminant was detected in offal only, fillet only, or in offal and fillet.

TABLE 3-11. SUMMARY OF FISH TISSUE INORGANIC RESULTS (MG/KG) FOR LOCUST POND YELLOW PERCH.[1]

LOCUST POND - YELLOW PERCH																
	Whole Body				Offal				Fillet				Offal + Fillet			
Analyte	freq	mean	std	max	freq	mean	std	max	freq	mean	std	max	freq[2]	mean	std	max
Barium	5/5	0.84	0.31	1.4	5/5	1.46	0.46	2.3	5/5	0.12	0.15	0.42	5/5	1.03	0.30	1.54
Chromium	5/5	0.43	0.06	0.56	0/5				0/5				0/5			
Cobalt	4/5	0.32	0.20	0.54	5/5	1.75	0.77	3.1	5/5	2.9	1.36	4.4	5/5	2.10	0.95	3.24
Copper	0/5				5/5	0.44	0.06	0.55	5/5	0.28	0.18	0.64	5/5	0.38	0.10	0.57
Lead	2/5	0.13	0.06	0.19	0/5				0/5				0/5			
Mercury	5/5	0.10	0.02	0.14	4/5	0.15	0.07	0.28	5/5	0.23	0.07	0.32	5/5	0.15	0.06	0.22
Nickel	1/5			0.20	0/5				0/5				0/5			
Selenium	0/5				5/5	0.30	0.04	0.37	5/5	0.16	0.02	0.20	5/5	0.55	0.64	1.71
Vanadium	1/5			0.10	5/5	0.13	0.01	0.16	0/5				5/5	0.09	0.01	0.10
Zinc	5/5	18.36	1.93	21.50	5/5	24.74	3.02	30.4	5/5	4.88	0.46	5.5	5/5	18.57	2.13	21.65

1 Concentrations in mg/kg wet weight.
2 Number of fish with a contaminant hit, regardless of whether contaminant was detected in offal only, fillet only, or in offal and fillet.

TABLE 3-12. SUMMARY OF FISH TISSUE INORGANIC RESULTS (MG/KG) FOR FLINT POND LARGEMOUTH BASS.[1]

FLINT POND - LARGEMOUTH BASS																
	Whole Body				Offal				Fillet				Offal + Fillet			
Analyte	freq	mean	std	max	freq	mean	std	max	freq	mean	std	max	freq[2]	mean	std	max
Barium	10/10	0.36	0.22	1.00	5/5	0.55	0.52	1.6	0/5				5/5	0.45	0.51	1.36
Chromium	7/10	0.41	0.06	0.52	0/5				0/5				0/5			
Cobalt	3/10	0.23	0.07	0.32	2/5	0.80	0.69	1.5	5/5	0.55	0.39	1.3	5/5	0.34	0.56	1.35
Copper	5/10	0.28	0.03	0.33	5/5	0.38	0.17	0.68	5/5	0.14	0.02	0.2	5/5	0.35	0.16	0.60
Lead	3/10	0.06	0.00	0.07	0/5				0/5				0/5			
Mercury	10/10	0.20	0.05	0.33	5/5	0.68	0.26	1.0	5/5	1.06	0.40	1.6	5/5	0.72	0.30	1.04
Nickel	1/10			0.14	0/5				0/5				0/5			
Selenium	0/10				5/5	0.31	0.08	0.40	5/5	0.12	0.03	0.19	5/5	0.29	0.08	0.35
Zinc	10/10	16.42	2.12	19.7	5/5	15.36	2.06	19.4	5/5	3.58	0.55	4.6	5/5	13.90	1.92	17.07

1 Concentrations in mg/kg wet weight.

2 Number of fish with a contaminant hit, regardless of whether contaminant was detected in offal only, fillet only, or in offal and fillet.

TABLE 3-13. SUMMARY OF FISH TISSUE INORGANIC RESULTS (MG/KG) FOR FLINT POND YELLOW PERCH.[1]

FLINT POND - YELLOW PERCH																
	Whole Body				Offal				Fillet				Offal + Fillet			
Analyte	freq	mean	std	max	freq	mean	std	max	freq	mean	std	max	freq[2]	mean	std	max
Aluminum	2/5	12.10	1.80	13.9	0/5				0/5				0/5			
Barium	5/5	1.31	0.69	2.5	5/5	2.32	0.40	2.8	5/5	0.12	0.07	0.25	5/5	1.68	0.32	2.06
Chromium	5/5	0.47	0.04	0.54	0/5				0/5				0/5			
Cobalt	3/5	0.19	0.07	0.29	3/5	0.31	0.14	0.5	5/5	5.69	9.61	24.9	5/5	1.69	3.07	7.17
Copper	1/5			0.82	5/5	0.41	0.07	0.51	5/5	0.13	0.01	0.16	5/5	0.32	0.05	0.37
Lead	4/5	0.11	0.09	0.28	0/5				0/5				0/5			
Mercury	5/5	0.10	0.03	0.15	5/5	0.22	0.05	0.28	5/5	0.61	0.15	0.88	5/5	0.32	0.08	0.35
Nickel	0/5				0/5				1/5			0.14	1/5			0.03
Selenium	0/5				4/5	0.46	0.06	0.57	5/5	0.15	0.02	0.19	5/5	0.30	0.15	0.45
Vanadium	3/5	0.12	0.05	0.2	4/5	0.13	0.00	0.15	0/5				4/5	0.09	0.008	0.10
Zinc	5/5	17.16	0.99	18.1	5/5	21.56	0.97	23.4	5/5	4.56	0.17	4.8	5/5	16.7	0.85	17.85

1 Concentrations in mg/kg wet weight.
2 Number of fish with a contaminant hit, regardless of whether contaminant was detected in offal only, fillet only, or in offal and fillet.

TABLE 3-14. SUMMARY OF FISH TISSUE INORGANIC RESULTS (MG/KG) FOR BETWEEN DAMS LARGEMOUTH BASS.[1]

BETWEEN DAMS - LARGEMOUTH BASS				
	Whole Body			
Analyte	freq	mean	std	max
Barium	5/5	0.63	0.17	0.82
Chromium	4/5	0.45	0.07	0.57
Cobalt	5/5	0.64	0.38	1.3
Copper	5/5	0.49	0.45	1.4
Mercury	5/5	0.21	0.05	0.31
Nickel	1/5			0.07
Selenium	1/5			0.16
Zinc	5/5	16.46	3.87	23.1

1 Concentrations in mg/kg wet weight.

TABLE 3-15. SUMMARY OF FISH TISSUE INORGANIC RESULTS (MG/KG) FOR BETWEEN DAMS YELLOW PERCH.[1]

BETWEEN DAMS - YELLOW PERCH																
	Whole Body				Offal				Fillet				Offal + Fillet			
Analyte	freq	mean	std	max	freq	mean	std	max	freq	mean	std	max	freq[2]	mean	std	max
Aluminum	5/5	3.42	1.86	5.7	0/5				0/5				0/5			
Arsenic	5/5	0.25	0.09	0.41	0/5				0/5				0/5			
Barium	5/5	2.30	0.52	3.3	5/5	3.08	0.87	4.7	5/5	0.33	0.18	0.65	5/5	2.13	0.59	3.07
Beryllium	1/5			0.01	0/5				0/5				0/5			
Chromium	5/5	0.56	0.04	0.65	1/5			1.0	0/5				1/5			0.59
Cobalt	5/5	0.33	0.11	0.51	5/5	3.36	2.18	7.4	5/5	4.30	0.82	5.5	5/5	3.57	1.43	5.68
Copper	0/5				0/5				1/5			0.91	1/5			0.35
Lead	4/5	0.18	0.06	0.3	0/5				0/5				0/5			
Mercury	4/5	0.21	0.02	0.25	5/5	0.16	0.04	0.21	5/5	0.45	0.17	0.78	5/5	0.23	0.07	0.44
Vanadium	4/5	0.15	0.05	0.22	5/5	0.24	0.07	0.37	0/5				5/5	0.15	0.04	0.21
Zinc	5/5	21.30	2.11	23.4	5/5	25.6	4.27	33.7	5/5	5.20	0.70	6.6	5/5	18.56	3.02	22.7

1 Concentrations in mg/kg wet weight.
2 Number of fish with a contaminant hit, regardless of whether contaminant was detected in offal only, fillet only, or in offal and fillet.

concentrations. Positive detection frequencies for like samples were greater than 50 percent for the majority of metals and detection frequencies were commonly 100 percent.

Relative to sediment, high concentrations of some metals were found in samples yellow perch and largemouth bass. This is likely due to adult fish having several years over which to accumulate mercury through the process of biomagnification.

Locust Pond

Locust Pond was chosen as the reference for evaluation of metals data collected from Flint Pond and Between Dams fish. Ten metals were detected in each species collected from Locust Pond, nine of them shared. Those not shared were arsenic in largemouth bass and vanadium in yellow perch. The largemouth bass data summary is in Table 3-10. The yellow perch data summary is in Table 3-11. Two of the largemouth bass fillets from Locust Pond exceed the FDA action limit for mercury (1 mg/kg). Therefore the mercury concentrations in the fillets from the other locations will be compared to the Locust Pond concentrations and the FDA action limit.

Flint Pond

Nine metals were detected in the largemouth bass collected from Flint Pond (Table 3-12). The same nine metals, plus aluminum and vanadium, were found in the yellow perch (Table 3-13). In the largemouth bass data base, eight metals (barium chromium, cobalt, copper, mercury, nickel, selenium and zinc) have higher averages or maximums than the average or maximum levels reported in the Locust Pond largemouth bass data base. Seven metals (aluminum, arsenic, beryllium, cadmium, lead, selenium, silver and vanadium) were either not detected in Flint Pond largemouth bass or consistently lower than the levels in Locust Pond largemouth bass. Also, two of the five largemouth bass fillets from Flint Pond exceeded the FDA action limit for mercury (1 mg/kg). The maximum mercury concentration in the largemouth bass fillets from Flint Pond is 1.6 mg/kg.

In the yellow perch data base, 10 metals (aluminum, barium, chromium, cobalt, copper, lead, mercury, nickel, selenium, and vanadium) have higher averages or maximums when compared to the average and maximum levels reported in the Locust Pond yellow perch data base. Five metals (arsenic, beryllium, cadmium, silver and zinc) were either not detected in Flint Pond yellow perch or their levels in Flint Pond yellow perch are consistently below the Locust Pond yellow perch levels. No yellow perch fillets exceed the FDA action limit for mercury.

Between the Flint Pond Dams

Eight metals, including mercury, were detected in the largemouth bass collected from the Between Dams site (Table 3-14). Eleven metals, including mercury, were detected in the yellow perch (Table 3-15). However, only six metals were shared between the two species. The metals not shared were selenium and nickel in largemouth bass, and aluminum, arsenic, beryllium, and vanadium in yellow perch.

In the largemouth base data base, only whole fish samples were collected between the Flint Pond Dams. Each of the eight metals detected (barium, chromium, cobalt, copper, mercury, nickel, selenium, and zinc) have higher averages or maximums when compared to the averages and maximum levels reported in the Locust Pond largemouth bass. None of the largemouth bass fillets collected between the Flint Pond dams exceed the FDA action limit for mercury.

In the yellow perch data base, each of the 11 metals detected (aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, vanadium and zinc) have higher averages or maximums when compared to the average and maximum levels reported in the Locust Pond yellow perch. None of the yellow perch fillets collected between the Flint Pond dams exceed the FDA action limit for mercury.

3.3 SITE COMPLIANCE

The site is being remediated and monitored under the guidance of three RODs. According to OSWER Directive 9355.7-02 regarding the structure and component of a five year review, the initial review must be conducted within five years of the first ROD. Therefore, although some remedial actions remain incomplete (e.g., combined groundwater and leachate treatment plant is under construction), a review of the original cleanup levels established in the ROD(s) and the effectiveness of the remedial technologies may be performed.

3.3.1 Compliance with ROD I

ROD I (EPA, 1983) provided for a permanent drinking water supply to local groundwater users by extending an existing water supply system. As built drawings (Hoyle, Tanner & Associates, January 1991) indicate that a permanent water line was installed to supply water from the City of Lowell to residents of Dunstable Road (west of Westford Road), Cannongate Road, Turnbuckle Lane and Axletree Road.

Originally, the ROD only included the Cannongate Condominiums to be serviced by the water line. However, on-going residential well monitoring by the State of Massachusetts and the EPA led to the addition of 24 residential services along Dunstable Road (EPA, 1988c). Ongoing residential well monitoring has indicated the sporadic presence of antimony and lead above their 1993 MCLs. Neither compound was included as a compound of concern in ROD I.

Although the original remedial action is in compliance with the ROD I requirements, changing regulatory standards and site conditions exist which may require an upgrade to the original action.

3.3.2 Compliance with ROD II

The remedial alternatives selected under ROD II were selected in order to manage the migration of contaminants from the site. This objective was achieved by the implementation of two control systems:

1) Landfill cap with 3:1 side slopes, a surface water collection and diversion system, and a passive landfill gas collection and venting system

2) Interim Leachate Management (ILM) system including a peripheral collection system, pump stations, leachate holding pond and intermittent treatment

These actions, while not completely mitigating the migration of contaminants, achieve the objective of controlling the migration of contaminants by minimizing stormwater percolation through the landfill, minimizing landfill gas venting by restricting the available area of venting, and controlling the offsite migration of contaminants in leachate via collection, holding and periodic treatment. ROD II provides for further remedial action if necessary through "an additional feasibility study to evaluate the groundwater and off-site remediation, whether the treatment of vent gases is required, and the effectiveness of the leachate handling option selected." (EPA, 1985)

The construction of the landfill cap and appurtenant systems was completed in October 1990. During the cap inspection conducted as part of this five-year review, the cap integrity was observed to be uncompromised. Some maintenance activities (e.g., reseeding) remain to be performed. These activities are planned and anticipated to be performed during 1994. Site security was observed to be maintained via a continuous fence surrounding the site, security gates to control site access, and, at the time, personnel tracking upon entrance. The landfill cap is in compliance with the requirements of ROD II.

The surface water diversion and collection system was observed to be functional during the cap inspection. The diversion swales and detention basins appeared to be performing as designed. Again, some maintenance activities (e.g., minor erosion gullies to be repaired) remain to be performed but they are also planned and anticipated to be performed during 1994. The surface water management system is in compliance with the requirements of ROD II.

The passive landfill gas venting system is no longer evident at the site. It has been upgraded under the remedial alternative selected in ROD III.

Information included in ROD II indicates that an estimated 36 million gallons per year of leachate was being generated under non-capped conditions. The leachate holding pond currently on-site has a capacity of approximately 3.5 million gallons (OHM, 1992). Intermittent leachate treatment is currently occurring at less than once per year. Therefore, leachate generation has been reduced under capped conditions.

The leachate interception system has experienced many problems since being placed in operation (CDM, 1992). Among the problems encountered are:

- Pump failure due to iron bacteria build-up resulting in pump motor burnout
- Lack of pump station access due to limited space and an hazardous atmosphere within the manhole caused by landfill gas (e.g., hydrogen sulfide) infiltration
- Equipment corrosion also due to hydrogen sulfide infiltration

Aluminum submersible pumps, which quickly corroded, were replaced by cast iron submersible pumps in 1985. In 1990, the system was updated as part of the cap installation. The system includes two pump stations (east and west pump stations) which tie the peripheral leachate collection system to the old leachate system. These pump stations deliver leachate to the holding pond on the north side of the landfill. Although pump performance increased as a result of the changes, the problems of corrosion and access persisted. The leachate pump stations were tied into the landfill gas collection system design (Law, 1991) as a temporary solution.

Currently, new pump stations have been designed (CDM, 1993) for implementation with the groundwater treatment plant. The new pump stations use the existing pump stations as sumps. The sumps will facilitate iron and other solids settlement. The new pump stations isolate the pumps from infiltrated landfill gas, reducing corrosion and providing easier access for pump O&M. The pumps are cast iron with stainless steel fasteners and bronze impellers. The use of stainless steel and bronze is expected to reduce corrosion of the pumps. The interim leachate management system is in compliance with the requirements of ROD II to date. Full compliance is expected to be demonstrated upon startup of the groundwater and leachate treatment plant.

3.3.3 Compliance with ROD III

The remedial alternatives selected in ROD III (EPA, 1988a) were selected to perform on-site remediation of groundwater, leachate, and landfill gas; perform off-site source removal of contaminated Dunstable Brook sediments; and perform long-term monitoring of the bedrock groundwater aquifer and off-site residential wells. The selected remedy for groundwater and leachate includes a groundwater collection trench along the south western side of the landfill, a groundwater collection system on the eastern side of the landfill capable of withdrawing overburden and shallow bedrock groundwater, a groundwater diversion trench upgradient (north) of the landfill, and a peripheral leachate collection system. The groundwater and leachate treatment plant will include biological treatment, metals precipitation, carbon absorption and if necessary ion exchange.

During the landfill inspection conducted as part of this five year review, the southwestern groundwater collection trench was observed to be installed. According to the USACE, this trench extends approximately 35 feet below grade to the top of the bedrock. Also observed during the landfill inspection was the installation of monitoring wells and observation wells along the eastern side of the landfill. The wells were installed in anticipation of a permeability test and a seven-day pump test of the overburden and shallow bedrock aquifers in that area. (CDM, 1993a). The schedule for design of the treatment plant indicates the design to be final and construction bidding to begin on April 15, 1994.

Under the OSWER guidance on five year reviews, groundwater and leachate remedial action is considered a Long Term Remedial Action (LTRA). Compliance with ARAR's is not necessary at each five year review because attainment of ARAR's is expected to require up to 30 years. The guidance does specify updating of ARAR's. Groundwater and leachate target cleanup goals given in Table 8 of ROD III have been updated and provided in Tables 1-2 and 1-4.

Two of the compounds included in ROD III as groundwater and leachate contaminates of concern did not have specified target cleanup goals at the time. Ethylbenzene and chromium currently have groundwater maximums above the most stringent 1993 ARAR (see Table 1-4). Furthermore five compounds which were not identified as contaminants of concern in 1988, currently have groundwater and/or leachate concentrations above their most stringent 1993 ARAR. Antimony, 1.2-dichloroethane, lead, methylene chloride and nickel each have concentrations above their most stringent 1993 ARAR (see Table 1-4).

Based on the design review, the treatment plant specified in ROD III is expected to handle the changes in groundwater and leachate quality. Final demonstration of compliance is expected to be performed upon startup of the treatment plant.

The landfill gas treatment system selected in ROD III is a fume incinerator operating at a minimum temperature of 1,200 degree Fahrenheit. The selected remedy allows for design and installation of the landfill gas collection system concurrent with the landfill cap installation. This system and an interim open flare were designed (Law, 1991), and built. During the landfill inspection conducted as part of this five year review, the interim flare was operational and continues to operate on an interim basis. Landfill gas quantity and quality will be monitored under capped conditions (M&E, 1992) prior to selection, design and implementation of a flare upgrade system.

Because of the nature of the open flare, stack gas monitoring cannot be performed and compliance with the target emission limits specified in ROD III cannot be demonstrated. ROD III does include annual on-site ambient air monitoring to assess compliance with National Secondary Ambient Air Quality Standards (NAAQS) and Massachusetts Acceptable Ambient Limits (AAL's). This monitoring is not planned as part of the interim remedial measure. Therefore, compliance with these standards has not been demonstrated at this time. It is expected that the final landfill gas treatment system performance test results will demonstrate compliance with the requirements of ROD III.

The selected remedy for sediments given in ROD III is dredging of the unnamed stream leading from the west leachate pump station area to Dunstable Brook and possibly some downstream reaches of the brook. Dredging was to occur to a depth of approximately one foot below grade. The sediments were to be placed on the landfill below the cap. The extent of dredging was to be determined by sampling and analysis. Sediments with total PAH concentrations above the risk based cleanup level of 1 mg/Kg would be dredged. This remedial action has not been performed.

In 1989 EPA revised the relative absorption factors for PAHs (see Table 1-11). These changes were expected to result in decreased risk associated with exposure to sediments. Although new risk calculations were not performed, EPA decided not to dredge the brook. As part of this five year review, Dunstable Brook sediments were sampled and analyzed for numerous parameters, including PAHs. The risk from exposure to Dunstable Brook sediments has been reevaluated. This reevaluation indicates that the PAH levels in Dunstable Brook have decreased. Also the slope factor used during calculation of carcinogenic risk has decreased. Therefore it can be qualitatively concluded that the carcinogenic risk from PAH's in Dunstable Brook has decreased. It has not, however, been determined if the overall current risk estimate has decreased to within an acceptable range. The risk factors (carcinogenic and non-carcinogenic) and 1993 sediment concentrations do not exhibit an overall consistent trend towards decreased risk.

Sediment toxicity has also been measured as part of this five year review. These measurements indicate that the Dunstable Brook sediments are toxic to the species tested.

Compliance with the ROD III requirement to dredge Dunstable Brook has not been demonstrated. Based on the evaluation conducted as part of this five year review, the anticipated decrease in risk on which the preliminary decision not to dredge Dunstable Brook sediments was based cannot be confirmed. It is recommended that recalculation of risks from contaminated sediment be considered by the agencies involved in Project Management.

4.0 RECOMMENDATIONS

The objective of this five year review is to confirm that the site's remedial actions completed to date adequately protect human health and the environment. For remedial actions not yet complete, the cleanup standards set in the RODs are reviewed as well as the technologies chosen for remedial action implementation. The recommendations are organized according to the ROD which governs each remedial action.

4.1 RECOMMENDED TECHNOLOGIES

4.1.1 ROD I

The remedial action technology implemented as a result of ROD I (EPA, 1983) was the installation of a new water supply line to well water users in the vicinity of the site. The original scope included hookup to the new water line of the Cannongate Condominiums and nearby homes. A total of 120 service hookups were installed. This usage rate represented approximately 47% of the available designed water supply capacity. An increased scope (EPA, 1988) was approved to supply an additional 24 service hookups.

The technologies implemented and the design capacity of the system are adequate. No new, updated, or supplemental technologies are recommended in response to the requirements of ROD I.

4.1.2 ROD II

The remedial action technologies implemented as a result of ROD II (EPA, 1985) were installation of on site source control measures. The remedial alternatives selected were a full synthetic membrane cap with 3:1 side slopes, a surface water management system, a peripheral leachate collection system and landfill gas vents. The technologies implemented are adequate.

The original landfill cover and appurtenant systems were completed in 1990. Since that time, the cap has demonstrated its effectiveness simply by its lack of failure. Subsidence sink holes have been repaired. The DEP has recently established a program to monitor the stability of the side slopes to address on-going concerns regarding erosion of the crushed stone side slopes. Presently there does not appear to be "creep" of the crushed stone, however, the monitoring program will verify this observation. Until data is available to verify the stability of the crushed stone, the DEP is withholding any conclusion as to the stability of the side slope.

The most persistent problems since implementation of ROD II has been the leachate pump stations. However, new pump stations have been designed (and installed) independently of the leachate and groundwater treatment plant. Therefore, no recommendations of leachate remedial technologies are necessary as a result of this five year review.

The original landfill gas remedial action specified in ROD II was a passive collection system with venting to the atmosphere. Per ROD III, this system has been updated to include a vacuum blower to actively collect landfill gas and deliver it to an open flare on an interim basis. Because of this upgrade, the technologies implemented as a result of ROD II exceed expectations. Furthermore, the interim flare is scheduled to be replaced with a permanent landfill gas treatment technology in the future. Therefore, no recommendations of landfill gas remedial technologies are necessary as a result of this five year review.

4.1.3 ROD III

It is believed that the quality and quantity of groundwater, leachate, and landfill gas of the site has been affected by installation of the landfill cap under ROD II. The remedial action technologies planned for implementation under ROD III are the combined groundwater and leachate treatment plant, thermal destruction of landfill gas, long term groundwater monitoring, and Dunstable Brook sediment dredging.

Because the treatment plant is a long term remedial action (LTRA), only the ARARs have been updated. Based on the changes to ARARs since 1988 and the on-site detection of additional compounds above their MCLs a review of the technologies specified in ROD III was performed. The additional compounds detected in site groundwater which were not compounds of concern in ROD III are 1,2-dichloroethane, methylene chloride, antimony, lead, nickel, and thallium. Biological treatment, metals precipitation and activated carbon remain viable treatment technologies for the groundwater and leachate present on-site. Compliance of the treatment plant with the requirements of ROD III cannot be demonstrated until start-up and effluent testing. However, the treatment technologies currently in design are expected to treat the additional compounds. No recommendations are made regarding groundwater and leachate treatment technologies as a result of this five year review.

The interim open flare presently destroying landfill gas is a common and proven treatment technology for landfill gas. A contract has been awarded by EPA to monitor the landfill gas quantity and quality for one-year and design a treatment upgrade, if necessary. Because the updated landfill gas data is not yet available and an upgrade recommendation may be made, no recommendations are made regarding landfill gas treatment as a result of this five year review.

ROD III does contain a requirement for on-site ambient air monitoring of the final landfill gas treatment system. There is currently no on-site ambient air data available to demonstrate compliance with ambient air standards. Therefore, monitoring of ambient air on an annual basis for the parameters listed in Section X.3 of ROD III during interim flare operation is recommended.

Long-term groundwater monitoring, including bedrock and residential wells, has been on-going since ROD I. A large database has been generated. The evaluation of the data base performed as part of this five year review has been limited to comparing the residential results to SDWA MCLs. An overwhelming majority of the results are below the MCLs. However, some results have been above the MCLs.

Sediment removal under ROD III has not been performed. Sediment sampling for volatile organics, semi-volatile organics, metals, PAHs, antimony and cadmium (low detection limit), grain size, organic content and sediment toxicity has been performed as part of this five year review. Also, fish tissue sampling and analysis for metals has been performed in Flint Pond, downstream of the Flint Pond dam and, as a control location, Locust Pond. The results are discussed in detail in Sections 2 and 3. The evaluation of the data indicates that some areas exhibit ecological toxicity. The evaluation could not confirm that human health risk has increased or decreased. Therefore, a recalculation of human health risk is recommended.

4.2 STATEMENT OF PROTECTIVENESS

4.2.1 ROD I

In order to evaluate protectiveness of the new water supply line installed under ROD I, the residential well database was reviewed for analytical results above the most stringent 1993 ARAR. The database consists of 127 samples collected at 64 locations between September, 1988 and April 1993.

This evaluation resulted in two compounds, antimony and lead, present above their ARAR. Neither compound was included as a chemical of concern in either ROD I, which targeted volatile organic compounds, or ROD III, which includes volatile organic compounds semi-volatile organic compounds and metals as groundwater chemicals of concern.

The analytical results for antimony include three detections above the 1993 SDWA MCL (6 ug/L). All three detections occurred during the October, 1990 sampling event. Each residential well was reanalyzed during the March 1991 sampling event. The antimony levels from 1990 were not confirmed during 1991. Two of the three locations were also sampled during October 1991 and March 1992. Neither location contained antimony above the MCL during these sampling events.

The analytical results for lead include 14 detections above the 1993 SDWA MCL for lead (15 ug/L). The 14 detections occurred at 13 locations between August 1989 and March 1992. At eight locations, samples collected after the initial detection indicate the levels did not remain above the MCL. At five locations, no samples have been collected since the initial detection. As stated above, no lead detections above the MCL have been reported since March 1992.

Based on the data base evaluation, protectiveness has been demonstrated for the ROD I (1988) compounds of concern. However, antimony and lead have been sporadically detected above their respective 1993 MCLs in residential wells since 1988. Neither compound exhibits a persistent trend. A statistical analysis of the database in accordance with 40 CFR 246.97-246.101 should be performed on the results to confirm the presence or non-presence of these contaminants at significant levels. This analysis is outside the scope at this five year review.

4.2.2 ROD II

In order to evaluate the protectiveness of the landfill cap under ROD II a cap inspection was performed. A detailed discussion of the inspection is in Section 2.1.1. Items requiring maintenance were identified during the inspection. Maintenance activities are planned and anticipated to be performed during 1994. Based on the cap inspection, protectiveness has been demonstrated regarding the landfill cap.

The landfill gas vents installed under ROD II were intended to passively vent to the atmosphere. As an interim remedial measure, the landfill gas is being destroyed by an open flare. Based on the installation and operation of the interim flare, the landfill gas requirements of ROD II have been met and exceeded. However, demonstration of compliance with the ROD III requirements for landfill gas have yet to be performed.

Although the leachate collection system has experienced problems due to site conditions, leachate is being collected and periodically treated on-site. A leachate collection system upgrade design has been performed and will be implemented as part of the groundwater and leachate treatment plant remedial action. Therefore, based on the actual and planned leachate controls, protectiveness with the ROD II requirements has been demonstrated.

4.2.3 ROD III

Because the selected remedies under ROD III have not been fully implemented, protectiveness has also not yet been fully demonstrated. However, the five year review guidance does not require full demonstration of LTRA's protectiveness at each five year review. Groundwater, leachate and landfill gas treatment are each considered LTRAs, and their final remedial actions have yet to be implemented.

Leachate and landfill gas have been partially remediated by interim remedial measures. The leachate holding pond has been treated and discharged in compliance with the requirements of ROD III. The landfill gas is being treated and discharged to the atmosphere although ambient air monitoring has not been performed to demonstrate compliance. Ambient air monitoring on an annual basis is recommended (see section 4.1.3.). Compliance with the ROD III requirements for landfill gas have not been demonstrated.

The sediment remedial action has also not been implemented. Protectiveness has not been confirmed via sediment analysis, and the evaluations performed as part of this five year review. Ecological criteria and toxicity testing indicate the sediment in Dunstable Brook is toxic to ecological receptors. A qualitative evaluation of the human health risk from Dunstable Brook sediments indicate that risks from some compounds may have increased and some may have decreased. The cumulative risk change has not been calculated. It is recommended that the agencies involved in project management consider recalculation of risk from contaminated sediment.

The long-term groundwater monitoring requirements of ROD III are intended to track progress of the treatment plant effectiveness. Therefore, since a statement of long-term treatment plant protectiveness is not required for this five year review, no statement of protectiveness is given for the monitoring program.

Review of previous investigations and the five-year site walkover have indicated that wetland areas have been damaged by remedial activities. It is recommended that agencies involved in project management consider options for wetlands mitigation.

4.3 NEXT REVIEW

4.3.1 ROD I

It is anticipated that once the groundwater and leachate treatment plant is in operation, off-site migration of contaminants will be reduced and natural attenuation will occur. Therefore, the residential well database developed in the next five years should be evaluated separately from the existing database. This will allow the effects of on-site treatment on off-site groundwater quality to be evaluated. No residential wells have been impacted by any plume originating on-site.

The documents received during this five year review focussed on the residential service hookups provided by EPA. Other residents may have elected to tie in to the water main. An analysis of all users of the new water supply line and their impact to the system (e.g., percent of system capacity) should be evaluated during the next review to ensure the remedy remains effective.

4.3.2 ROD II

Two of the remedial actions specified in ROD II (landfill gas venting and leachate collection) have been superseded by the remedial actions specified in ROD III (thermal destruction of landfill gas and leachate treatment). Therefore, the next five year review should focus on the effectiveness of the ROD III criteria for landfill gas and leachate.

The landfill cap is expected to undergo long term O & M activities during the next five years. Therefore, a cap inspection should be included, at a minimum, in the next review.

4.3.3 ROD III

It is anticipated that the groundwater and leachate treatment plant, and the final landfill gas treatment system will be operational prior to the next five year review. At that time, the effectiveness of the systems and data to demonstrate compliance with discharge limits will be available. Also groundwater and residential well data collected during treatment plant operation will be available for analysis. This data should be used to evaluate the effectiveness of the groundwater and leachate collection systems.

Sediment dredging may or may not be performed prior to the next five year review. If the recommendations to recalculate risk is accepted, the calculations should be reviewed. If a decision is made based on the new risk values, the decision should be reviewed. If no action is taken, sediments should be resampled, analyzed and evaluated with recalculation of risk.

4.4 IMPLEMENTATION REQUIREMENTS

4.4.1 ROD I

Since no new technologies are recommended under ROD I, no requirements for their implementation exist. The data evaluation recommended (e.g. statistical analysis of the residential well database) may be implemented in a number of ways:

- Internal evaluation by EPA

- Evaluation by the DEP as a component of long-term operation and maintenance management
- Evaluation by the agency, consultant or laboratory performing the sample collection, analysis and validation management.

4.4.2 ROD II

Since the technologies implemented under ROD II are adequate, no implementation requirements exist. Implementation of the long term O & M requirements for the landfill cap and appurtenant systems should maintain the cap effectiveness. Implementation of a final landfill gas collection and treatment system as well as O & M of the system under ROD III should maintain protectiveness of the ROD II landfill gas collection requirements. Installation of the new leachate pump stations combined with leachate treatment plant O & M should provide an adequate level of protection regarding leachate.

4.4.3 ROD III

At this time, groundwater and leachate treatment technologies are being designed. No technology improvements have been recommended and, therefore, no implementation requirements exist.

An ambient air monitoring program has been recommended to demonstrate compliance of the interim flare. This program should be implemented with the quarterly landfill gas monitoring planned in anticipation of a landfill gas treatment system upgrade design.

The need to implement the sediment remedial action remains unresolved. Due to mixed results of the ecological evaluation and the qualitative risk assessment, a definitive statement of protectiveness has not been presented. A recalculation of human health risk from sediments has been recommended and should be implemented to resolve the issue.

SECTION 5.0

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APPENDIX A

ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

AAL	Massachusetts Ambient Air Level
ACL	Alternate Concentration Level
AIC	Acceptable Intake - Chronic
AIS	Acceptable Intake - Subchronic
ARAR	Applicable or Relevant and Applicable Requirements
ARCS	Alternative Remedial Contract Services
AWQC	Ambient Water Quality Criteria
CAA	Clear Air Act
CAG	Carcinogen Assessment Group
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGRL	Charles George Reclamation Landfill
CMR	Code of Massachusetts Regulations
COC	Contaminant of Concern
CWA	Clean Water Act
DEHP	Di(ethylhexyl)phthalate
DEP	Massachusetts Department of Environmental Protection
EPA	Environmental Protection Agency
EO	Executive Order
ESAT	Environmental Services Assistant Team
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GCA	GCA Corporation
HEA	Health Effects Assessment
HEAST	Health Effects Assessment Summary Tables
HMM	HMM Associates, Inc.
IRIS	Integrated Risk Information System
Kg	Kilogram
LDR	Land Disposal Restrictions
MANHESP	Natural Heritage and Endangered Species Program, Massachusetts Division of Fish and Wildlife
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Limit Goals
MCP	Massachusetts Contingency Plan
MEK	Methylethyl Ketone
MGL	Massachusetts General Laws
mg/L	Milligrams per Liter
NAAQC	National Ambient Air Quality Standards
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NTCHS	National Technical Committee for Hydric Soils

ACRONYMS AND ABBREVIATIONS (Continued)

NUS	NUS Corporation
NWI	National Wetlands Inventory
O&M	Operation and Maintenance
ORSG	Massachusetts Office of Research and Standards Guidelines
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Polycyclic Aromatic Hydrocarbon
POTW	Publicly Owned Treatment Works
RAF	Relative Absorption Factor
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
TBC	To Be Considered
TCE	Trichloroethylene
TLV	Threshold Limit Value
ug/kg	Micrograms per Kilogram
USACOE	Unites States Army Corps of Engineers
USDA/SCS	United States Department of Agriculture/Soil Conservation Service
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

APPENDIX B

1993 ARARS EVALUATION:
CHARLES GEORGE LANDFILL, MASSACHUSETTS

#10630

This appendix provides a summary of the 1993 ARARs evaluation conducted for the Charles George Land Reclamation Trust Landfill in Tyngsboro, Massachusetts.

TABLE B-1
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA AND AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
Groundwater			
Federal Regulatory Requirements	SDWA - Maximum Contaminant Levels (MCLs) (40 CFR 141.11 - 141.16)	Relevant and Appropriate	MCLs have been promulgated for a number of common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but under CERCLA Sec. 121(d) may also be considered relevant and appropriate for site groundwater aquifers. MCLs and non-zero MCLGs have the status of ARAR at CGL for *areas not directly overlain by waste. Current* MCLs and MCLGs are listed in Table B-2. Sampling between 1990 and 1992 showed concentrations of benzene, ethylbenzene, trichloroethane, arsenic, cadmium, 1,2-dichloroethane, methylene chloride, antimony, and nickel that exceeded the MCL in several locations. Groundwater requires remediation under this rule.
	RCRA - Subpart F, Groundwater Protection Standards, Concentration Limits (40 CFR 264.94(a))	Relevant and Appropriate	Standards for 14 toxic compounds have been adopted as part of RCRA groundwater protection standards. These limits were originally set at MCLs. RCRA sets the limit for organic constituents at background levels. Site COCs arsenic, chromium, mercury and cadmium are included in the 14 toxic compounds for which standards have been adopted. Currently, only cadmium has a RCRA MCL (0.01 mg/L) that differs from the SDWA MCL (0.005 mg/L). Constituents in site groundwater exceed RCRA MCLs for arsenic and chromium, and exceed background concentrations for all organic COCs. Groundwater requires remediation under this rule.

TABLE B-1. (Continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA AND AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
Groundwater (cont.)	RCRA - Subpart F Groundwater Protection Standards, Alternate Concentration Levels (ACLs) (40 CFR 264.94(b))	Relevant and Appropriate	ACLs are one of three possible standards (aside from MCLs and background concentrations) available under Subpart F for setting a clean-up level for remediation groundwater contamination from a RCRA facility. ACLs may be relevant and appropriate if certain conditions relating to transport and exposure are met. ACLs may need to be determined by EPA. Procedures for developing ACLs are outlined in RCRA Subpart F, Section 264.94(b). At this time, ACLs are not being sought.
Massachusetts Regulatory Requirements	Massachusetts Groundwater Quality Standard (314 CMR 6.00)	Applicable	Massachusetts Groundwater Quality Standards have been promulgated for a number of contaminants. When state levels are more stringent than federal levels, the state levels will be used. Concentrations of arsenic and chromium exceeded these standards at least one location during sampling between 1990 and 1992. Site groundwater requires remediation under this rule.
	Massachusetts Drinking Water Requirements (310 CMR 22.05 to 22.09)	Relevant and Appropriate	Because the site is within 500 feet of a private water supply well that was in use at the time of site discovery, drinking water requirements are relevant and appropriate. Massachusetts MCLs are listed on Table B-2. Groundwater requires remediation under this rule.
Federal Criteria, Advisories, and Guidance	SDWA - Maximum Contaminant Level Goals (MCLGs)	Relevant Appropriate/ To Be Considered	MCLGs are health-based criteria that are to be considered for drinking water sources as a result of SARA. These goals are available for a number of organic and inorganic contaminants.

TABLE B-1. (Continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA AND AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
Groundwater (cont.)			
			Non-zero MCLGs have the status of ARAR for areas not directly overlain by waste. Zero MCLGs cannot have the status of ARARs but are, however, to be considered in developing site remedies. For benzene and TCE, MCLGs are set at zero. MCLGs for site chemicals are listed in Table B-2.
			Concentrations of benzene, ethylbenzene, trichloroethene, arsenic, cadmium, 1,2-dichloroethane, methylene chloride, antimony, lead, and nickel all exceeded MCLGs in at least one location. Groundwater requires remediation under this rule.
	Health Advisories (EPA Office of Drinking Water)	To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. Health Advisories were considered for contaminants in groundwater that may be used for drinking water.
			Table B-2 provides the latest US EPA health advisories for all COCs for which values are available.
	EPA Office of Water Guidance - Water-related Fate of 129 Priority Pollutants (1979)	To Be Considered	This guidance manual gives transport and fate information for 129 priority pollutants. The manual was used to assess the transport and fate of a variety of contaminants.

TABLE B-1. (Continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA AND AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
Groundwater (cont.)			
Massachusetts Criteria, Advisories, and Guidance	Massachusetts ORSGs	To Be Considered	The Massachusetts DEP Office of Research and Standards issues guidelines for chemicals for which state MCLs have not yet been promulgated. These guidelines apply to non-chlorinated water supplies and represent a level at or below which adverse, non-cancer health effects are not expected to occur, and which generally has associated with it an excess lifetime cancer risk of less than or equal to one in one million. These criteria are included on Table B-2.
Discharge to Publicly Owned Treatment Works			
Federal Regulatory Requirements	RCRA - Pretreatment Standards (40 CFR 403) - GLSD POTW Approved Pretreatment Program Requirements	Potentially Applicable	Discharges to a POTW must comply with the POTW's EPA-approved pretreatment requirements. POTWs in the area with approved pretreatment programs are being identified and the discharge must be treated to those levels required by the program. There are no discharges currently occurring to the POTW. These standards would be applicable should any discharges be planned in the future.
Surface Water			
Federal Requirements	Federal Ambient Water Quality Criteria (AWQC) under the Clean Water Act	Relevant and Appropriate	Federal AWQC are health-based and environmentally based criteria which have been developed for 95 carcinogenic and non-carcinogenic compounds.

TABLE B-1. (Continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA AND AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
Surface Water (cont.)			AWQC were considered in characterizing public health risks to aquatic organisms due to contaminant concentrations in surface water at Flint Pond. Because this water is not used as a drinking water source, the criteria developed for aquatic organism protection and ingestion of contaminant aquatic organisms were considered. CERCLA Sec. 121 (d)(2)(A) specifically states that remedial actions shall at least attain federal AWQC established under the Clean Water Act if they are relevant and appropriate. Current AWQC are listed in Table B-2. These criteria are ARAR for establishing discharge limits to the Merrimack River, Bridge Meadow Brook, Flint Marsh, Flint Pond, and the Merrimack River.
Massachusetts Regulatory Requirements	Massachusetts Surface Water Quality Standards (314 CMR 4.05)	Applicable	These regulations classify the surface waters of the Commonwealth according to the uses of those waters. The Merrimack River has a Class B waterway classification. Class B waters are designated as habitat for fish, other aquatic and wildlife , and for primary and secondary contact recreation. The state surface water minimum criteria for Class B waters are consistent with federal AWQC. These rules are applicable to the Merrimack River, Bridge Meadow Brook, Dunstable Brook, Flint Marsh, and Flint Pond. DEP Surface Water Quality Standards are given for dissolved oxygen, temperature increase, pH, and total coliform and there is a narrative requirement for toxicants in toxic amounts. In the absence of a numeric state standard for a compound, federal AWQC would be appropriate.

TABLE B-1. (Continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA AND AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
Surface Water (cont.)			Requirements were considered; however, no numerical standards exist for contaminants found in CGLRT groundwater which would be discharged to surface water. Federal AWQC will be used in the absence of narrative standards.
Massachusetts Regulatory Requirements	MADEP Surface Water Discharge Permit Program (314 CMR 3.00)	Applicable	These regulations identify the list of toxic pollutants to be controlled with effluent limitations and are applicable to any current or planned discharge to Bridge Meadow Brook, Dunstable Brook or Flint Marsh.
Air			
Federal Regulatory Requirements	CAA - National Ambient Air Quality Standards (NAAQS) - 40 CFR 40	Relevant and Appropriate	These standards were primarily developed to regulate stack and automobile emissions. Standards for sulfur dioxide, carbon monoxide and nitrogen dioxide will be complied with. NAAQS need to be used in establishing discharges to the atmosphere. This includes the landfill gas treatment system.
Massachusetts Regulatory Requirements	Massachusetts - Air Quality, Air Pollution (310 CMR 6.00 - 8.00)	Relevant and Appropriate	310 CMR 6.00 provides ambient air quality standards for the Commonwealth, standards for dust are contained in 310 CMR 7.09. 310 CMR 7.08 provides incinerator standards. These standards need to be used in establishing discharge limits from the landfill gas treatment system.
Federal Criteria, Advisories, and Guidance	Threshold Limit Values (TLVs)	To Be Considered	These standards were issued as consensus standards for controlling air quality in workplace environments.

TABLE B-1. (Continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA AND AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
Air (cont.)			TLVs could be used to assessing site inhalation risks for soil removal operations.
Massachusetts Criteria, Advisories, and Guidance	Massachusetts Guidance on Acceptable Ambient Air Levels (AALs)	To Be Considered	These are guidelines in emission permit writing. AALs were considered when assessing the significance of monitored and modeled residential contamination.
Soil and Sediment			
Federal Regulatory Requirements	There are no set maximum allowable residual levels for chemicals in soil or sediments under federal law.		
Massachusetts Regulatory Requirements	Massachusetts Contingency Plan - Soil Limits (310 CMR 40.0900)	Applicable	The revised MCP (July 1993) identifies reportable concentrations and applicable standards in soil. Site soil at CGL is categorized as S-3 due to its low accessibility. The MCP Method 1 soil standards consider both the potential risk of harm resulting from direct exposure to the contaminated soil and potential impacts on groundwater at the site. Method 2 soil standards consider both the potential risk of harm resulting from direct contact with the contaminated soil and the potential for contamination to leach to groundwater. Method 3 sets upper concentration limits in soil which, if exceeded, indicate future potential harm to public welfare and the environment. Soil standards for site COCs, for groundwater classification GW-1 and soil category S-3, Method 1, are presented in Table SOIL. There are no set reportable concentrations for soil categorized as S-3.

TABLE B-2. FIVE-YEAR UPDATE OF NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA[A] FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN WITH CURRENT STANDARDS AND CRITERIA, CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in mg/L)

CHEMICAL[B]	SDWA[C] MCL	SDWA[C] MCLG	U. S. EPA Health Advisories[D] One-Day	10-Day	Longer-Term	Life-Time	314 CMR 5.10 and 314 CMR 6.06[E]	Mass[G] ORSGs[F]	Mass[G] MCLs (310 CMR 22.00)[G]	MCP (310 CMR 40)[H]
acetone	--	--	--	--	--	--	--	3.0	--	3
benzene	0.005	0	0.2	0.2	--	--	--	--	0.005	0.005
benzoic acid	--	--	--	--	--	--	--	--	--	--
2-butanone (MEK)	--	--	--	--	--	--	--	0.35	--	0.35
1,2-dichloroethane	0.005	0	0.7	0.7	0.7	--	--	--	0.005	0.005
1,1-dichloroethene	0.007	0.007	2	1	1	0.007	--	--	0.007	0.007
ethylbenzene	0.7	0.7	30	3	1	0.7	--	--	0.7	0.7
methylene chloride	0.005	0	10	2	--	--	--	0.005	--	0.005
4-methyl,2-pentanone	--	--	--	--	--	--	--	--	--	--
4-methylphenol	--	--	--	--	--	--	--	--	--	--
2-methylphenol	--	--	--	--	--	--	--	--	--	--
phenol	--	--	6	6	6	4	--	--	--	4
toluene	1	1	20	2	2	1	--	--	1	1
trichloroethene	0.005	0	--	--	--	--	--	--	0.005	0.005
antimony	0.006	0.006	0.015	0.015	0.015	0.003	--	0.006	--	0.006
arsenic	0.05	**	--	--	--	--	0.05	--	0.05	0.05
cadmium	0.005	0.005	0.4	0.04	0.005	0.005	0.01	--	0.005	0.005
chromium (total)	0.1	0.1	1	1	0.2	0.1	0.05	--	0.1	0.1
copper	*	1.3	--	--	--	--	1.0***	--	1.3	--
lead	*	0	--	--	--	--	0.05	--	0.015	0.015
mercury	0.002	0.002	--	--	--	0.002	0.002	--	0.002	0.002
nickel	0.1	0.1	1	1	0.5	0.1	--	0.1	--	0.1

[A] This table provides the 1993 update of the regulations and criteria identified in Table 2-1 of the feasibility study (EBASCO, 1988) regulations and criteria.

[B] Chemicals listed are from Table COCs-1. They include chemicals of concern drawn from 1988 Record of Decision, Table 6, entitled *CGL Contaminants of Concern - Phase III* and other chemicals that were identified as being present at levels greater than MCLs during sampling between 8/90 and 11/92.

[C] Federal Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs). 40 CFR 141, National Primary Drinking Water Standards.

[D] U.S. Environmental Protection Agency, Drinking Water Regulations and Health Advisories, May 1993. One-day, ten-day, longer-term advisories are for 10 kg child; lifetime advisory is for 70 kg adult. May 1993.

[E] The standards listed are under both sets of Massachusetts Department of Environmental Protection Division of Water Pollution Control regulations and are based on Class I and II groundwaters. 314 CMR 5.10, Groundwater Discharge Program, water quality based effluent limitations (primary and secondary). Toxic pollutants without listed limits are subject to Health Advisory criteria. 314 CMR 6.06, Groundwater Quality Standards, provides minimum groundwater quality criteria for Class I and II.

[F] Massachusetts Department of Environmental Protection, Office of Research and Standards Guidelines, drinking water guidelines. Spring 1993.

[G] Massachusetts Department of Environmental Protection, 310 CMR 22.00, Drinking Water Regulations, Massachusetts maximum contaminant levels.

[H] Massachusetts Contingency Plan, 310 CMR 40.0974(2) Table 1, Class GW-1 Groundwater Standards for a Method 1 risk assessment, per 310 CMR 40.0932.

* An action level of 1.3 mg/L for copper and 0.0015 mg/L for lead is provided for in the SDWA regulations. These levels are not MCLs.

** Under review

*** This is a secondary effluent limitation

TABLE B-3. FIVE-YEAR UPDATE OF NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA[A] FOR SURFACE WATER AND SEDIMENT CHEMICALS OF CONCERN[B], CHARLES GEORGE LANDFILL, MASSACHUSETTS
(All criteria in mg/L)

CHEMICAL	AMBIENT WATER QUALITY CRITERIA[C]			
	Aquatic Life[D]		Public Health[E]	
	Acute	Chronic	Fish Consumption	Water & Fish Ing.
2-butanone (MEK)				
toluene	17.5[F]		300	10
acetone				
benzene	5.3[F]		$7.1x10^{-2}$	$1.2x10^{-3}$
4-methyl,2-pentanone				
ethylbenzene	32[F]		29	3.1
1,1-dichloroethene			$3.2x10^{-3}$	$5.7x10^{-5}$
trichloroethene	45[F]	21.9[F]	$8.1x10^{-2}$	$2.7x10^{-3}$
benzoic acid				
4-methylphenol		2.12		
2-methylphenol				
phenol	10.2[F]	2.56[F]	4,600	21
PAHs			$3.11x10^{-5}$	$2.8x10^{-6}$
bis(2-ethylhexyl) phthalate	0.94[F]	0.003[F]	$5.9x10^{-3}$	$1.8x10^{-3}$
arsenic (trivalent)	0.36	0.19	0 ($1.8x10^{-5}$)	0 ($1.4x10^{-4}$)
arsenic (pentavalent)	0.85			
chromium (III)	1.7+	0.21+	670	33
chromium (VI)	0.016	0.011	0.17	3.4
copper	0.018+	0.012+		1.3
mercury	$2.4x10^{-3}$	$1.2x10^{-5}$	$1.5x10^{-4}$	$1.4x10^{-4}$
cadmium	$3.9x10^{-3}$+	$1.1x10^{-3}$+	0.17	$1.0x10^{-2}$

[A] This table provides the 1993 update of the surface water regulatory criteria identified in Table 2-1 of the feasibility study (EBASCO, 1988) regulations and criteria.

[B] Chemicals of Concern (COCs) drawn from 1988 Record of Decision, Table 6, entitled *CGL Contaminants of Concern - Phase III*. ROD-specified criteria are from Table 2-1 of the Draft Final Feasibility Study Report, Charles George Landfill (EBASCO, 1988).

[C] Ambient Water Quality Criteria (AWQC). From Code of Massachusetts Regulation, Title 314, Section 4.05(5)(e) and/or U.S. Environmental Protection Agency, 57 FR 60848, December 22, 1992.

[D] Acute criteria are one-hour average concentrations not to be exceeded more than once every three years. Chronic criteria are four-day average concentrations not to be exceeded more than once every three years. Freshwater criteria are shown.

[E] The criterion value of zero for potential carcinogens is listed in the table. Concentrations in the parenthesis for potential carcinogens correspond to a risk of 10^{-6}.

[F] Value represented is the Lowest Observed Effect Level.

+ Hardness-dependent criteria (100 mg/L as $CaCO_3$ used).

TABLE B-4. POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

SITE FEATURE AND AUTHORITY	REQUIREMENT (Citation)	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
Wetlands			
Federal Regulatory Requirements	Clean Water Act (40 CFR 6.302(a), and Appendix A)	Applicable	Under these requirements, no activity that adversely affects a wetland shall be permitted if a practicable alternative that has less effect is available. Whenever possible, federal agency actions must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values. Agencies should particularly avoid new construction in wetland areas unless there are no practicable alternatives. Federal agencies must incorporate wetlands protection considerations into planning, regulatory, and decision-making processes.
	Clean Water Act §404 (40 CFR Part 230; 33 CFR 320-330)	Applicable	Action must be taken to avoid degradation or destruction of wetlands to the extent possible. Discharges for which there are practicable alternatives with less adverse impacts or those which would cause or contribute to significant degradation are prohibited. If adverse impacts are unavoidable, action must be taken to enhance, restore, or create alternative wetlands.
	Fish and Wildlife Coordination Act (16 U.S.C. 661)	Applicable	This regulation requires that any federal agency proposing to modify a body of water must consult with the U.S. Fish and Wildlife Services. This requirement is addressed under CWA Section 404 requirements. The effects of water-related projects on fish and wildlife resources must be considered.
State Regulatory Requirements	Massachusetts Wetlands Protection (310 CMR 10.00)	Applicable	These requirements are promulgated under Wetlands Protection Laws, which regulate dredging, filling, altering, or polluting inland wetlands. Work within 100 feet of a wetland is regulated under this requirement. The requirement also defines wetlands based on vegetation type and requires that effects on wetlands be mitigated. If alternatives require that work be completed within 100 feet of a defined wetland, these regulations will be considered. Mitigation of impacts on wetlands will be addressed under CWA §404.

TABLE B-4 (Continued). POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

SITE FEATURE AND AUTHORITY	REQUIREMENT (Citation)	STATUS	REQUIREMENT SYNOPSIS AND CONSIDERATION
	Hazardous Waste Facility Siting Regulations (990 CMR 1.00)	Relevant and Appropriate	These regulations outline the criteria for the construction, operation, and maintenance of a new facility or increase in an existing facility for the storage, treatment, or disposal of hazardous waste. Specifically, no portion of the site may be located within a wetland or bordering a vegetated wetland. These regulations will be addressed during the design phase of the treatment facility construction.
Federal Requirements to be Considered	Wetlands Executive Order (EO 11990)	To Be Considered	Under this regulation, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. The requirements of this executive order are codified under CWA 40 CFR 6, Appendix A.
<u>Floodplains</u>			
Federal Regulatory Requirements	RCRA location, standards (40 CFR 264.18(b))	Relevant and Appropriate	RCRA-defined listed or characteristic hazardous waste (40 CFR 261) facility must be designed, constructed, operated, and maintained to prevent washout by 100-year flood.
	Executive Order 11988; Clean Water Act (40 CFR 6.302(b), Appendix A)	Applicable	Federal agencies shall take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values of floodplains. Federal agencies shall also evaluate potential effects of actions in floodplains and ensure consideration of flood hazards and floodplain management. If action is taken in floodplains, alternatives to avoid adverse effects, incompatible development, and minimize potential harm must be taken.
State Regulatory Requirements	Massachusetts Wetlands Protection (310 CMR 10.57(2), 10.04)	Applicable	Actions in "bordering land subject to flooding" shall provide compensatory storage for flood storage volume lost as a result of the project, shall not restrict flows so as to cause an increase in flood stage or velocity, and shall not impair its capacity to provide important wildlife habitat. Actions in "isolated land subject to flooding" shall not result in flood damage because of lateral displacement of water that would otherwise be confined within the area, adverse effects on water supply, adverse effects on the capacity of the area to prevent groundwater pollution, or adverse effects on vernal pool habitat.

TABLE B-4 (Continued). POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

SITE FEATURE AND AUTHORITY	REQUIREMENT (Citation)	STATUS	REQUIREMENT SYNOPSIS AND C[illegible]DERATION
	Massachusetts Hazardous Waste Facility Location Standards (310 CMR 30.701)	Relevant and Appropriate	Active portions of new treatment or storage facil[illegible] prohibited within the boundary of land subject to flooding from the stat[illegible] 100-year frequency storm. Active portion of surface impoundments ar[illegible]rohibited within the boundary of land subject to flooding from the statistical 500-year frequency storm.

TABLE B-5
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Federal Regulatory Requirements			
RCRA - Standards for Owners and Operators of Permitted Hazardous Waste Facilities (40 CFR 264.10 - 264.18)	Relevant and Appropriate	General facility requirements outline general waste analysis, security measures, inspections, and training requirements. All facilities on-site must be constructed, fenced, posted, and operated in accordance with this requirement. All workers must be properly trained. Process wastes will be evaluated for the characteristics of hazardous wastes to assess further requirements.	These requirements remain relevant and appropriate, and are being complied with. Treatment residuals from wastewater treatment will be disposed of according to RCRA Subtitle C.
RCRA - Preparedness and Prevention (40 CFR 264.30-264.37)	Relevant and Appropriate	This regulation outlines safety equipment and spill control requirements for hazardous waste facilities. Part of the regulation includes a requirement that facilities be designed, maintained, constructed, and operated so that the possibility of an unplanned release which could threaten public health or the environment is minimized.	Safety and communication equipment has been installed at the site; local authorities have been familiarized with site operations. RCRA requirements must be considered when evaluating extensions to the present landfill.
RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50-264.56)	Relevant and Appropriate	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc. This regulation also requires that threats to public health and the environment be minimized.	Plans will be developed and implemented during site work including installation of monitoring wells, and implementation of site remedies. Copies of the plans will be kept on-site. RCRA requirements must be considered when evaluating extensions to the present landfill.
RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70-264.77)	Relevant and Appropriate	This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	Records of facility activities will be developed and maintained during remedial actions.

TABLE B-5 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
RCRA - Groundwater Protection (40 CFR 264.90-264.109)	Relevant and Appropriate	This regulation details requirements for a groundwater monitoring program to be installed at the site.	A groundwater monitoring program has been implemented at the site. The compliance of the program with regulatory requirements has not been evaluated due to time and budget constraints.
RCRA - Closure and Post-Closure (40 CFR 264.110-264.120)	Relevant and Appropriate	This regulation details specific requirements for closure and post-closure of hazardous waste facilities.	Those parts of the regulations concerned with long-term monitoring and maintenance of the site will be considered during remedial design. A post-closure plan will be developed.
RCRA - EPA Regulations on Land Disposal Restrictions (40 CFR 268)	Relevant and Appropriate	This regulation outlines land disposal requirements and restrictions for hazardous wastes. Regulations require contaminated soils to be treated to the Best Demonstrated Available Technology levels before being placed or replaced on the land. Hazardous waste cannot be stored except when accumulated for recovery, treatment, or disposal.	Land disposal restrictions apply (or are relevant and appropriate) only to wastes being placed on the land and not to wastes already in place. These rules may be applied only to new wastes generated on-site as a result of treatment or to wastes excavated or dredged that meet RCRA characteristics for hazardous wastes. LDR criteria have been developed for most site contaminants.
CWA - 40 CFR Parts 122, 125	Applicable	Any point source discharges must meet NPDES permitting requirements, which include compliance with applicable water quality standards; establishment of a discharge monitoring system; and routine completion of discharge monitoring records. If groundwater that has been treated by on-site treatment processes is discharged to surface waters on-site, treated groundwater must be in compliance with applicable water quality standards. In addition, a discharge monitoring program must be implemented. Routine discharge monitoring records must be completed.	Leachate collection was implemented in 1991. Collected leachate is periodically treated and discharged to Bridge Meadow Brook. Discharges are monitored, although no specific monitoring program is documented. A groundwater collection and treatment program is under construction. Upon its completion, leachate treatment will be combined with groundwater treatment. A discharge monitoring program for the combined flows must them be implemented.

TABLE B-5 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
CWA - 40 CFR Part 230	Applicable	This regulation outlines requirements for discharges of dredged or fill material. Under this requirement, no activity that impacts a wetland will be permitted if a practicable alternative that has less impact on the wetland is available. If there is no other practicable alternative, impacts must be mitigated.	An evaluation of the effects of remedial actions on wetlands is on-going. Wetlands mitigation efforts will continue throughout remediation.
CAA - NAAQS for Total Suspended Particulates (40 CFR 129.105,750)	Applicable	This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	Fugitive dust emissions from site excavation activities will be maintained below 260 $\mu g/m^3$ (primary standard) by dust suppressants, if necessary.
Protection of Archeological Resources (32 CFR Part 229, 229.4; 43 CFR Parts 107, 171.1-171.5)	Not presently ARAR	This regulation develops procedures for the protection of archeological resources.	If archeological resources are encountered during soil excavation, work will stop until the area has been reviewed by federal and state archaeologists. No archeological resources have been, or are expected to be encountered at the site.
DOT Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171.1-171.5)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transportation of hazardous materials.	Contaminated materials shipped off-site will be packaged, manifested, and transported to a licensed off-site disposal facility in compliance with these regulations.
State Regulatory Requirements			
Massachusetts Hazardous Waste Regulations, Phase I and II (310 CMR 30.000, MGL Ch. 21C)	Relevant and Appropriate	These regulations provide a comprehensive program for the handling, storage, and recordkeeping at hazardous waste facilities. They supplement RCRA regulations.	Because these requirements supplement RCRA hazardous waste regulations, they must also be considered at the CGLRT site.

TABLE B-5 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Massachusetts General Laws, Ch. III, Sec. 150B	Relevant and Appropriate	Under this regulation, the local board of health may require a local site assignment for hazardous waste treatment, storage, and/or disposal facilities.	The local board of health is aware of all site activities and has been a participant in remediation efforts.
Acts of 1982, Ch. 232, Sec. 150A and 150B. (Now Codified in Massachusetts Solid Waste Management regulations at 310 CMR 19.141)	Applicable	This regulation requires that notice be recorded in the Registry of Deeds whenever certain types of solid or hazardous waste activity occur on property.	Notification of remedial actions will be given to the County Registry of Deeds.
Massachusetts - Air Quality, Air Pollution (310 CMR 6.00 - 8.00)	Applicable	This regulation outlines the standards and requirements for air pollution control in Massachusetts; all provisions, procedures, and definitions are described. Particulate matter emissions from site excavation activities must be maintained at an annual geometric mean of 75 $\mu g/m_3$, and a maximum 24-hour concentration of 40 mg/m^3 (primary standards).	Application of water, seed, cover, or other treatment is required over the landfill to prevent excessive emissions of particulate matter (310 CMR 7.09).
Massachusetts Wetlands Protection (310 CMR 10.00)	Applicable	This regulation outlines the requirements necessary to work within 100 feet of a costal or inland wetland. The act sets forth a public review and decision-making process by which activities affecting waters of the state are to be regulated to contribute to their protection.	Wetland remediation will comply with the substantive but not the administrative requirements for wetland protection.

TABLE B-5 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Massachusetts Surface Water Discharge Permit Program (314 CMR 2.00 - 4.00)	Applicable	This section outlines the requirements for obtaining an NPDES permit in Massachusetts. 314 CMR 3.00 establishes the program whereby discharges of pollutants to surface waters are regulated. Outlets for such discharges and any associated treatment works are also regulated. Surface water at the site is classified "B - warm water, treated water supply" under 314 CMR 4.06.	Pollutant discharges to surface water must comply with NPDES permit requirements. Permit conditions and standards for different classes of water are specified. Since the planned wastewater treatment facility will address, and possibly discharge, toxic pollutants listed under 314 CMR 3.16, these rules apply. Although a permit is not required, its substantive equivalent is.
Certification for Dredging, Dredged Material Disposal, and Filling in Waters (314 CMR 9.00, MGL Ch. 21, ss. 26-53)	Not presently ARAR	This regulation is promulgated to establish procedures, criteria, and standards for the water quality certification of dredging and dredged material disposal.	Applications for proposed dredging/fill work need to be submitted and approved before work commences. Three categories have been established for dredge or fill material based on the chemical constituents. Approved methods for dredging, handling, and disposal options for the three categories must be met. No dredging, discharge of dredge material, or filling in of navigable waters is occurring or planned to occur. However, during remedial actions the discharge of pollutants into surface water bodies will occur; this situation triggers Wetlands Protection Act (MGL C. 131) and waterways (MGL C. 91) requirements.

TABLE B-5 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works, and Indirect Discharges (314 CMR 12.00)	Applicable	The regulations establish requirements that ensure the proper operation and maintenance of wastewater facilities within the Commonwealth.	A wastewater treatment facility would be operated and maintained in compliance with this regulation. No indirect discharges to a POTW have occurred or are planned. A wastewater treatment facility is currently under construction for the treatment of collected groundwater and leachate. The wastewater treatment facility would discharge directly on-site. These rules require any wastewater treatment facility to adopt and keep current an operation and maintenance manual in accordance with 314 CMR 12.04(1). An O&M manual is planned for the future facility.
Implementation of M.G.L. C.111F, Employee and Community "Right to Know" (310 CMR 33.00)	Applicable	The regulations establish rules and requirements for the dissemination of information related to toxic and hazardous substances to the public.	The EPA has implemented an active community relations program to disseminate information about the site to the local community.
Worker "Right to Know" (441 CMR 21.00)	Applicable	These regulations establish requirements for worker "Right to Know."	These requirements apply to all site workers and must be followed during all site work.
Massachusetts Solid Waste Management Regulations under MGL Ch. 21D (310 CMR 19.130)	Applicable	Maintenance requirements of a solid waste landfill identified here include: prevention of unauthorized access by fences and other barriers; locked gates at all points of entry; and posting of warning signs.	Maintenance requirements are being met.
Massachusetts Solid Waste Management Regulations under MGL Ch. 21D (310 CMR 19.110)	Applicable	Groundwater protection systems are specified to control migration of leachate out of the landfill and into the groundwater.	A leachate collection system has been installed at CGL.

TABLE B-5 (Continued)
POTENTIAL ACTION-SPECIFIC ARARS
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

ARAR	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Massachusetts Solid Waste Management Regulations under MGL Ch. 21D (310 CMR 19.118, 19.132, 19.133)	Applicable	All solid waste landfills must include groundwater, surface water and gas monitoring systems designed, operated, and maintained in accordance with applicable rules.	The CGL landfill system is designed to meet the more stringent requirements for a hazardous waste landfill and, thus, achieves compliance with solid waste rules. Not all components of these requirements have been installed as yet.
Massachusetts Solid Waste Management Regulations under MGL Ch. 21D (310 CMR 19.112, 19.140, 19.142)	Applicable	Final cover system standards and landfill closure/post-closure care requirements are applicable to CGL. Applicable post-closure care requirements include: monitor the site during the post-closure period in order to ensure the integrity of the closure measures and to detect and prevent any adverse impacts of the site on public health, safety or the environment; take corrective actions in response to any conditions which would compromise the integrity and purpose of the final cover; maintain the integrity of the liner system and final cover system; collect leachate from and monitor and maintain leachate collection systems; monitor and maintain the surface water, groundwater, and air quality monitoring systems; maintain landfill gas control systems; maintain access roads; protect and maintain surveyed benchmarks.	The CGL cap is designed to meet the more stringent requirements for a hazardous waste landfill and, thus, achieves compliance with solid waste rules. Not all components of these requirements have been installed as yet.

APPENDIX C

WETLAND RESOURCE MAPS FROM PREVIOUS CGRL STUDIES

#13111

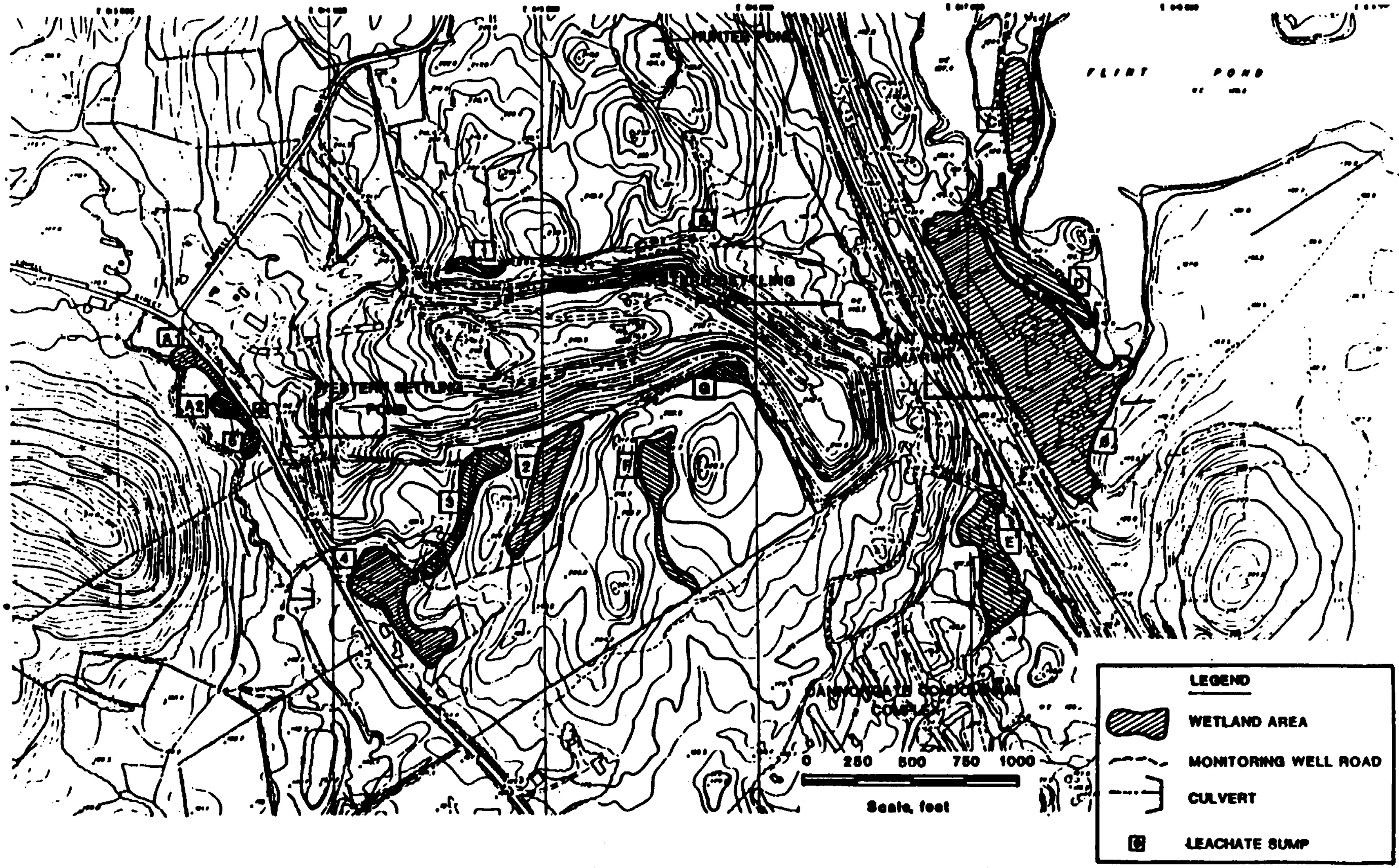


FIGURE C-1. LOCATION OF WETLAND AREAS NEAR CHARLES GEORGE LANDFILL SITE. FIGURE APPEARED AS FIGURE 2-3 IN THE 1986 REPORT BY THE GCA CORPORATION ENTITLED *CHARLES GEORGE LANDFILL SITE: WETLANDS ASSESSMENT, FINAL REPORT*.

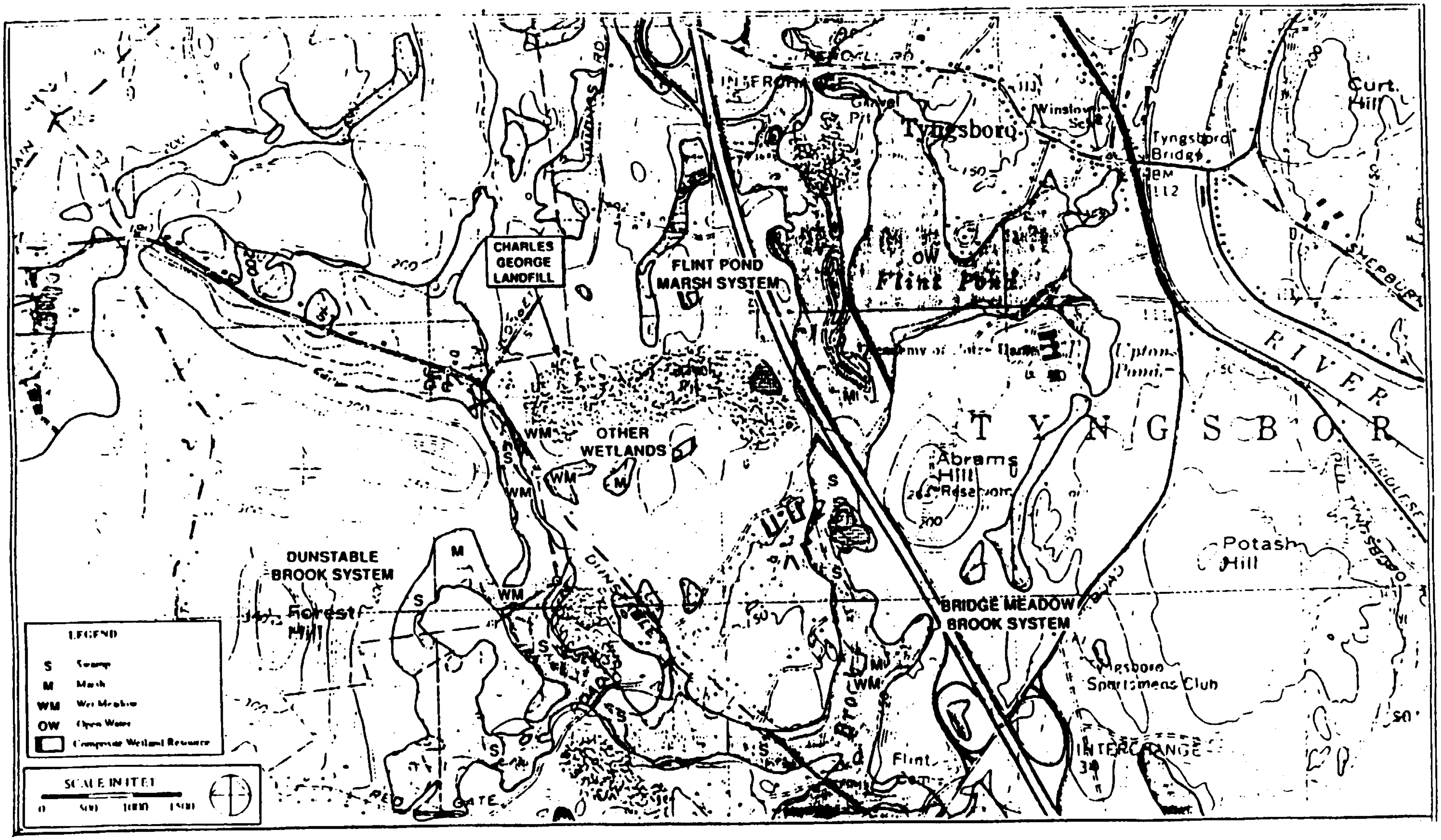


FIGURE C-2. COMPOSITE WETLAND RESOURCE MAP FOR THE CHARLES GEORGE LANDFILL SITE.
FIGURE APPEARED AS FIG. 2-4 IN THE 1990 REPORT BY HMM ASSOCIATES ENTITLED *WETLAND DAMAGES ASSESSMENT, CHARLES GEORGE LANDFILL.*
SOURCES USED TO GENERATE MAP INCLUDED THE MIDDLESEX CONSERVATION DISTRICT, FEMA, NATIONAL WETLANDS INVENTORY, AND HMM ASSOCIATES.

APPENDIX D

CORRESPONDENCE WITH STATE AND FEDERAL AGENCIES

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Offices
400 Ralph Pill Marketplace
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4901

October 20, 1993

Jonathon A. Weier
Metcalf & Eddy
P.O. Box 4043
Woburn, MA 01888-4043

Dear Mr. Weier:

This responds to your letter dated September 22, 1993 requesting information on the presence of Federally listed and proposed endangered or threatened species in relation to the downgradient areas of the Charles George Reclamation Landfill near Tyngsborough, Massachusetts.

Based on information currently available to us, no Federally listed or proposed threatened and endangered species under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area, with the exception of occasional transient endangered bald eagles (*Haliaeetus leucocephalus*) or peregrine falcons (*Falco peregrinus anatum*). However, we suggest that you contact Pat Huckery of the Massachusetts Natural Heritage Program, Division of Fisheries and Wildlife at 100 Cambridge St., Boston, MA 02202, (617) 727-9194 for information on state listed species that may be present.

A list of Federally designated endangered and threatened species in Massachusetts is included for your information. Thank you for your cooperation and please contact Susi von Oettingen of this office at (603) 225-1411 if we can be of further assistance.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor
New England Field Offices

Inclosure

Commonwealth of Massachusetts
Division of Fisheries and Wildlife
100 Cambridge Street
Boston, MA 02202

Natural Heritage and
Endangered Species Program

tel (617) 727-9194
fax (617) 727-7288

12 October 1993

Jonathon A. Weier
Metcalf & Eddy
P.O. Box 4043
Woburn, MA 01888-4043

Re: Request for rare species information
Charles George Reclamation Landfill
Tyngsborough, MA
NHESP File No. 93-767

Dear Mr. Weier,

Thank you for contacting the Natural Heritage and Endangered Species Program for information regarding rare or endangered species in the vicinity of the site referred to above.

At this time we are not aware of any rare or endangered plants or animals or exemplary natural communities in the vicinity of this site.

This review concerns only rare or endangered species of plants and animals and ecologically significant natural communities for which the Program maintains site-specific records. This review does not rule out the possibility that more common wildlife or vegetation might be in the vicinity, especially if consits of or in near undeveloped areas. Should new rare species information become available, this evaluation may have to be reconsidered. Please call me if you have any questions.

Sincerely,

Jay Copeland
Environmental Reviewer

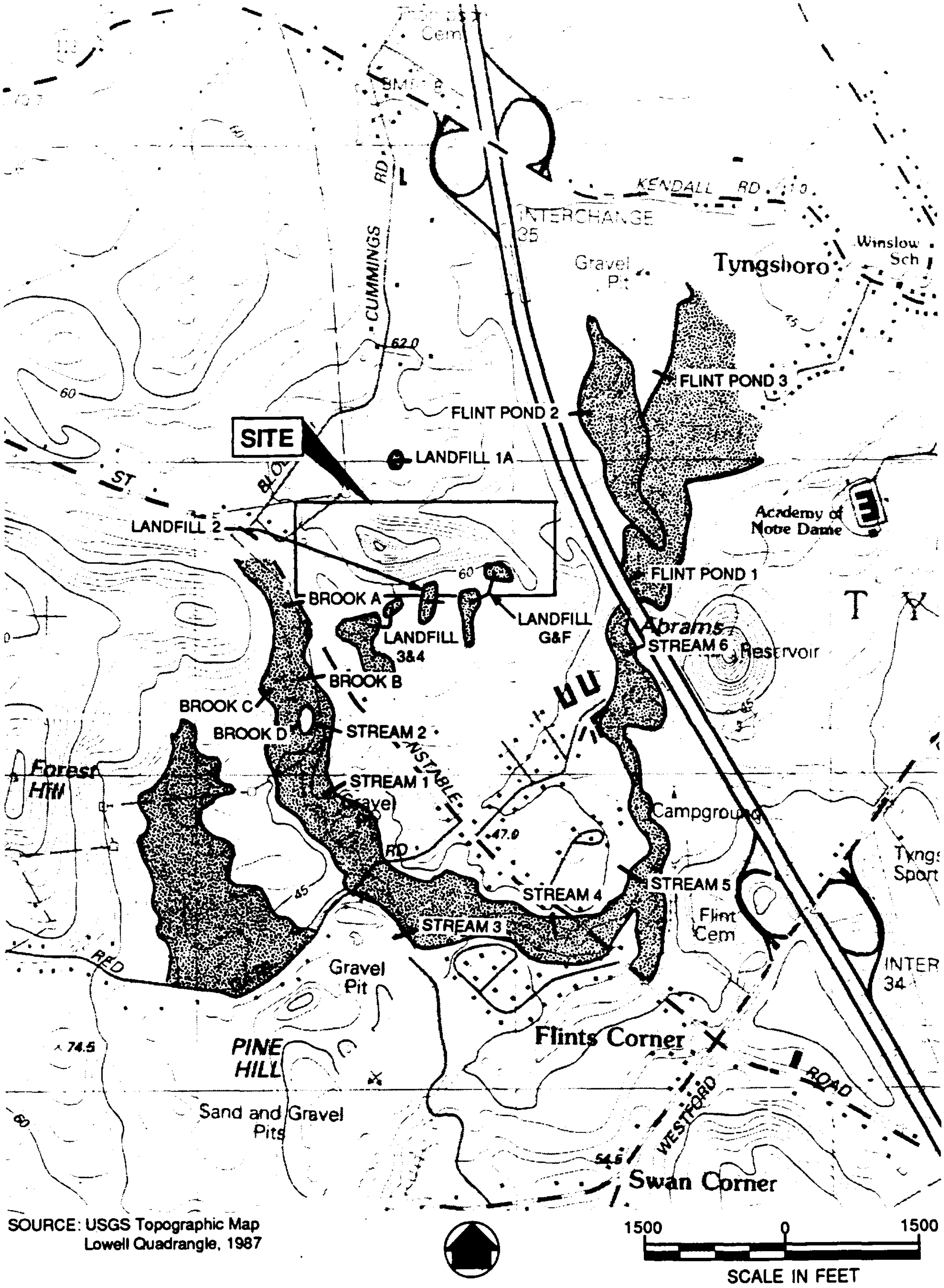
Form: ISITENP.JC

This response to your request for rare species information has been prepared for you as a free service. However, funding for this service comes largely from voluntary contributions. Those wishing to help support the program's work, including the preparation of responses to requests for rare species information such as this, can do so by making out a check to the "Natural Heritage and Endangered Species Fund" and sending it to: THE NHES FUND, 100 Cambridge Street, Room 1902-MDFW-HP, Boston, MA 02202. *Contributions are tax deductible on federal income tax returns. Thank you for your support.*

APPENDIX E

THREE PARAMETER WETLAND DELINEATION
SUMMARY SHEETS

#13111



SOURCE: USGS Topographic Map
Lowell Quadrangle, 1987

FIGURE E-1. LOCATION OF WETLAND/UPLAND TRANSECTS

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill | USFWS Classification: FO4

Sample Location: Landfill – Upland 1A | Date: 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	30/30	100	FACU
Lianas:			
Saplings:			
Betula populifolia	20/65	30.8	FAC
Acer rubrum	30/65	46.2	FAC
Quercus alba	15/65	23.1	FACU–
Shrubs:			
Seedlings and Herbs:			
Osmunda cinnamomea	15/15	100	FACW
Mosses and Liverworts:			

Tally:	OBL	FACW 1	FAC 2	FAC–	FACU 2	UPL	SUM 5

{OBL+FACW+FAC} / SUM X 100 =

3/5 = 60%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Landfill – Upland 1A

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
______ inch 0–12 inch	10 YR 4/3		
______ inch			
______ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

______ NTCHS List ______ Organic Soil ______ High Organic Content in Surface Horizon

______ Histic Epipedon ______ Sulfidic Material ______ Aquic Moisture Regime

______ Peraquic Moisture Regime ______ Reducing Condition ______ Iron Concretions

______ Manganese Concretions ______ Gleyed ______ Wet Spodosols

______ Dark Vertical Streaking of Subsurface Horizons ______ OBL Plants

______ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

______ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

______ Inundation (Depth)

______ Saturation in Upper 12 Inches (Depth)

______ Watermarks

______ Driftlines

______ Sediment Deposits

______ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

______ Oxidized Root Channels in Upper 12 Inches

______ Water–Stained Leaves

______ Local Soil Survey

______ FAC Neutral Test

______ Other (Buttressed Trees, Stooling)

CONCLUSIONS

Yes	Hydrophytes Prevalent	No	Hydric Soils
No	Wetland Hydrology	No	Wetland?

Wetlands Technician(s):

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist:

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill	**USFWS Classification: PEM1E**
Sample Location: Landfill – Wetland 1A	**Date: 10/20/93**

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Lianas:			
Saplings:			
Shrubs:			
Seedlings and Herbs:			
Scirpus cyperinus	15/80	18.8	
Carex stricta	20/80	25	OBL
Thelypteris thelypteroides	30/80	37.5	FACW+
Spirea tomentosa	15/80	18.8	
Mosses and Liverworts:			

Tally:	OBL 1	FACW 1	FAC	FAC–	FACU	UPL	SUM 2

{OBL+FACW+FAC} X 100 = SUM 2/2 = 100%	**Area Disturbed?** ______ YES ___X___ NO **Describe:**

Continued on other side

Landfill – Wetland 1A

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–6 inch	1" fibrous 10 YR 3/2, no mottles		
6–14 inch			sand
14–18 inch	2.5 YR 5/4 – matrix 10 YR 5/6 – mottles		

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

X ____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

X ____ Other (Stooling)

CONCLUSIONS

Yes ____ Hydrophytes Prevalent

Yes ____ Wetland Hydrology

Yes ____ Hydric Soils

Yes ____ Wetland?

Wetlands Technician(s):

Wetlands Scientist(s):

Wetlands Technical Specialist:

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — USFWS Classification: FO1/4

Sample Location: Landfill – Upland 2 — Date: 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	40/80	50	FACU
Quercus rubra	40/80	50	FACU–
Lianas:			
Saplings:			
Acer rubrum	20/50	40	FAC
Quercus alba	10/50	20	FACU–
Pinus strobus	20/50	40	FACU
Shrubs:			
Vaccinium augustifolium	10/10	100	FACU–
Seedlings and Herbs:			
Quercus alba	5/5	100	FACU–
Mosses and Liverworts:			

Tally:	OBL	FACW	FAC 1	FAC–	FACU 6	UPL	SUM 7

{OBL+FACW+FAC} X 100 =
SUM

1/7 = 14.3%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Landfill Upland – 2

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–2 inch	10 YR 3/3		
2–12 inch	10 YR 5/6		
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No Hydrophytes Prevalent

No Wetland Hydrology

No Hydric Soils

No Wetland?

Wetlands Technician(s):

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist:

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification:** POW, PFO5

Sample Location: Landfill – Wetland 2 — **Date:** 10/20/93

VEGETATION

DOMINANTS BY STRATUM		Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:				
Pinus strobus	dead	50/60	83.3	FACU
Betula populifolia		10/60	16.7	
Lianas:				
Saplings:				
Betula populifolia				
Pinus strobus		20/40	50	FAC
		20/40	50	FACU
Shrubs:				
Seedlings and Herbs:				
Typha latifolia		20/40	50	OBL
Carex stricta		10/40	25	OBL
Lythrum salicaria		5/40	12.5	
Carex lurida		5/40	12.5	
Mosses and Liverworts:				

Tally:	OBL 2	FACW	FAC 1	FAC–	FACU 2	UPL	SUM 5

{OBL+FACW+FAC} X 100 =
SUM

3/5 = 60%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Landfill – Wetland 2

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
______ inch			
0–12 inch	10 YR 2/1		organic soil
______ inch			
______ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

______ **NTCHS List**
X ______ **Organic Soil**
______ **High Organic Content in Surface Horizon**
______ **Histic Epipedon**
______ **Sulfidic Material**
______ **Aquic Moisture Regime**
______ **Peraquic Moisture Regime**
______ **Reducing Condition**
______ **Iron Concretions**
______ **Manganese Concretions**
______ **Gleyed**
______ **Wet Spodosols**
______ **Dark Vertical Streaking of Subsurface Horizons**
______ **OBL Plants**
______ **OBL and FACW Plants and Wetland/Upland Boundary Abrupt**

HYDROLOGY

______ **Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season**

Source: **Dated:**

PRIMARY INDICATORS:

X ______ **Inundation (Depth = 10")**
______ **Saturation in Upper 12 Inches (Depth)**
______ **Watermarks**
______ **Driftlines**
______ **Sediment Deposits**
______ **Drainage Patterns**

SECONDARY INDICATORS: (2 or more required)

______ **Oxidized Root Channels in Upper 12 Inches**
X ______ **Water–Stained Leaves**
______ **Local Soil Survey**
______ **FAC Neutral Test**
X ______ **Other (Stooling)**

CONCLUSIONS

Yes	**Hydrophytes Prevalent**	Yes	**Hydric Soils**
Yes	**Wetland Hydrology**	Yes	**Wetland?**

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan [signature]
Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — USFWS Classification: FO1/4

Sample Location: Landfill – Upland 3 and 4 — Date: 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Quercus alba	20/60	33.3	FACU–
Acer saccharum	20/60	33.3	FACU–
Pinus strobus	20/60	33.3	FACU
Lianas:			
Saplings:			
Pinus strobus	5/15	33.3	FACU
Ulmus americana	5/15	33.3	FACW–
Acer saccharum	5/15	33.3	FACU–
Shrubs:			
Quercus alba	2/20	20	FACU–
Pinus strobus	2/20	20	FACU
Acer spicatum	2/20	20	FACU–
Prunus serotina	2/20	20	FACU
Juniperus virginiana	2/20	20	FACU
Seedlings and Herbs:			
Gramineae spp.	70/80	87.5	UPL
Solidago sp.	5/80	6.3	
Mitchella repens	5/80	6.3	
Mosses and Liverworts:			
Moss spp.	5/5	100	

Tally:	OBL	FACW 1	FAC	FAC–	FACU 10	UPL 1	SUM 12

{OBL+FACW+FAC} X 100 =
SUM

1/12 = 8.3%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Landfill – Upland 3 and 4

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–12 inch	7.5 YR 3/4		
____ inch			
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List
____ Organic Soil
____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)
____ Saturation in Upper 12 Inches (Depth)
____ Watermarks
____ Driftlines
____ Sediment Deposits
____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No ____ Hydrophytes Prevalent
No ____ Wetland Hydrology
No ____ Hydric Soils
No ____ Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill | **USFWS Classification:** PFO/SS1

Sample Location: Landfill – Wetland 3 | **Date:** 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Acer rubrum	10/10	100	FAC
Lianas:			
Saplings:			
Shrubs:			
Pinus strobus	2/10	20	FACU
Ulmus americana	2/10	20	FACW–
Polulus deltoides	2/10	20	FAC
Fraxinus pennsylvanica	2/10	20	FACW
Prunus serotina	2/10	20	FACU
Seedlings and Herbs:			
Lythrum salicaria	35/95	36.8	FACW+
Solidago sp.	15/95	15.8	?
Carex stricta	15/95	15.8	OBL
Gramineae spp	10/95	10.5	
Typha latifolia	5/95	5.3	
Arisaema stewardsonii	5/95	5.3	
Osmunda cinnamomea	5/95	5.3	
Osmunda regalis	5/95	5.3	
Mosses and Liverworts:			

Tally:	OBL 1	FACW 3	FAC 2	FAC–	FACU 2	UPL	SUM 8

{OBL+FACW+FAC} X 100 =
SUM

6/8 = 75%

Area Disturbed? X YES ____ NO

Describe:
Orange residue visible in top 4" of soil.

Continued on other side

Landfill – Wetland 3

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
______ inch 0–12 inch	7.5 YR 2/1		saturated to surface
______ inch			
______ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

______ NTCHS List ______ Organic Soil ______ High Organic Content in Surface Horizon

______ Histic Epipedon ______ Sulfidic Material ______ Aquic Moisture Regime

______ Peraquic Moisture Regime ______ Reducing Condition ______ Iron Concretions

______ Manganese Concretions ______ Gleyed ______ Wet Spodosols

______ Dark Vertical Streaking of Subsurface Horizons ______ OBL Plants

______ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

______ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

______ Inundation (Depth)

X ______ Saturation in Upper 12 Inches (Depth = 0")

______ Watermarks

______ Driftlines

______ Sediment Deposits

______ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

______ Oxidized Root Channels in Upper 12 Inches

X ______ Water–Stained Leaves

______ Local Soil Survey

______ FAC Neutral Test

X ______ Other (Stooling)

CONCLUSIONS

Yes ______ Hydrophytes Prevalent

Yes ______ Wetland Hydrology

Yes ______ Hydric Soils

Yes ______ Wetland?

Wetlands Technician(s):

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: Robert Ruld

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification:** PEM1

Sample Location: Landfill – Wetland 4 — **Date:** 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Acer rubrum dead	20/20	100	FAC
Lianas:			
Saplings:			
Shrubs:			
Seedlings and Herbs:			
Lythrum salicaria	90/100	90	FACW+
Typha latifolia	4/100	4	
Scirpus americanus	2/100	2	
Carex alopecoidea	2/100	2	
Solidago sp.	2/100	2	
Mosses and Liverworts:			

Tally:	OBL	FACW 1	FAC 1	FAC–	FACU	UPL	SUM 2

{OBL+FACW+FAC} X 100 =
SUM

2/2 = 100%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Landfill – Wetland 4

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–12 inch	10 YR 5/2		saturated to surface with drainage from landfill
____ inch			
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List
____ Organic Soil
____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

X ____ Inundation (Depth = 1")
____ Saturation in Upper 12 Inches (Depth)
____ Watermarks
____ Driftlines
____ Sediment Deposits
X ____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
____ Water-Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
X ____ Other (Stooling)

CONCLUSIONS

Yes ____ Hydrophytes Prevalent
Yes ____ Wetland Hydrology
Yes ____ Hydric Soils
Yes ____ Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hoggan
Wetlands Technical Specialist: Robert J. Pennell

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill **USFWS Classification: FO1/4**

Sample Location: Landfill – Upland G and F **Date: 10/20/93**

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	30/90	33.3	FACU
Acer rubrum	30/90	33.3	FAC
Quercus rubra	30/90	33.3	FACU–
Lianas:			
Saplings:			
Acer rubrum	20/35	57.1	FAC
Pinus strobus	15/35	42.9	FACU
Shrubs:			
Pinus strobus	50/95	52.6	FACU
Vaccinium augustifolium	40/95	42.1	FACU–
Smilax walteri	5/95	5.3	
Seedlings and Herbs:			
Mosses and Liverworts:			

Tally:	OBL	FACW	FAC 2	FAC–	FACU 5	UPL	SUM 7

{OBL+FACW+FAC} X 100 =
SUM

2/7 = 28.6%

Area Disturbed? ____ YES X NO
Describe:

Continued on other side

Landfill – Upland G and F

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–12 inch	10 YR 5/6		
____ inch			
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ **NTCHS List** ____ **Organic Soil** ____ **High Organic Content in Surface Horizon**

____ **Histic Epipedon** ____ **Sulfidic Material** ____ **Aquic Moisture Regime**

____ **Peraquic Moisture Regime** ____ **Reducing Condition** ____ **Iron Concretions**

____ **Manganese Concretions** ____ **Gleyed** ____ **Wet Spodosols**

____ **Dark Vertical Streaking of Subsurface Horizons** ____ **OBL Plants**

____ **OBL and FACW Plants and Wetland/Upland Boundary Abrupt**

HYDROLOGY

____ **Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season**

Source: **Dated:**

PRIMARY INDICATORS:

____ **Inundation (Depth)**

____ **Saturation in Upper 12 Inches (Depth)**

____ **Watermarks**

____ **Driftlines**

____ **Sediment Deposits**

____ **Drainage Patterns**

SECONDARY INDICATORS: (2 or more required)

____ **Oxidized Root Channels in Upper 12 Inches**

____ **Water–Stained Leaves**

____ **Local Soil Survey**

____ **FAC Neutral Test**

____ **Other (Buttressed Trees, Stooling)**

CONCLUSIONS

No	**Hydrophytes Prevalent**	No	**Hydric Soils**
No	**Wetland Hydrology**	No	**Wetland?**

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogans

Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill

USFWS Classification: PEM/SS1, PFO1 to south

Sample Location: Landfill – Wetland F

Date: 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Acer rubrum	10/10	100	FAC
Lianas:			
Saplings:			
Shrubs:			
Vaccinium corymbosum	20/20	100	FACW–
Seedlings and Herbs:			
Carex stricta	70/80	87.5	OBL
Spirea alba	10/80	12.5	
Mosses and Liverworts:			
Moss spp.	15/15	100	

Tally:	OBL 1	FACW 1	FAC 1	FAC–	FACU	UPL	SUM 3

{OBL+FACW+FAC} / SUM X 100 =

3/3 = 100%

Area Disturbed? YES ___ X NO

Describe:

Continued on other side

Landfill – Wetland F

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–10 inch	10 YR 2/1		
10–14 inch	10 YR 2/0		
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List
____ Organic Soil
X ____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

____ Inundation (Depth)
____ Saturation in Upper 12 Inches (Depth)
X ____ Watermarks
____ Driftlines
____ Sediment Deposits
X ____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
X ____ Other (Shallow Root Systems, Stooling)

CONCLUSIONS

Yes ____ Hydrophytes Prevalent
Yes ____ Wetland Hydrology
Yes ____ Hydric Soils
Yes ____ Wetland?

Wetlands Technician(s):
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist:

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification:** PEM1

Sample Location: Landfill – Wetland G — **Date:** 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus dead	25/25	100	FACU
Lianas:			
Saplings:			
Shrubs:			
Quercus rubra	5/10	50	FACU–
Acer rubrum	5/10	50	FAC
Seedlings and Herbs:			
Lythrum salicaria	60/95	63.2	FACW+
Scirpus cyperinus	15/95	15.8	
Thelypteris thelypteroides	10/95	10.5	
Solidago sp.	10/95	10.5	
Mosses and Liverworts:			
Moss spp.	20/20	100	

Tally:	OBL	FACW 1	FAC 1	FAC–	FACU 2	UPL	SUM 4

{OBL+FACW+FAC} X 100 =
SUM

2/4 = 50%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Landfill – Wetland G

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–7 inch	2.5 YR 5/2 – matrix 7.5 YR 4/4 – mottles		clay soils, mottles faint from 6"–7"
7–11 inch	10 YR 3/2		
11–18 inch	10 YR 4/4		

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

____ Inundation (Depth)

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

X ____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

X ____ Other (Stooling)

CONCLUSIONS

Yes	Hydrophytes Prevalent	Yes	Hydric Soils
Yes	Wetland Hydrology	Yes	Wetland?

Wetlands Technician(s):

Wetlands Scientist(s):

Wetlands Technical Specialist:

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill **USFWS Classification:** FO1/4

Sample Location: Brook System – Upland A **Date:** 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	50/90	55.6	FACU
Quercus rubra	30/90	33.3	FACU–
Acer rubrum	5/90	5.6	
Ulmus americana	5/90	5.6	
Lianas:			
Saplings:			
Quercus rubra	5/14	35.7	FACU–
Ulmus americana	5/14	35.7	FACW–
Carya XXX	2/14	14.3	
Prunus sp.	2/14	14.3	
Shrubs:			
Viburnum dentatum	5/12	41.7	FAC
Quercus alba	5/12	41.7	FACU–
Prunus sp.	2/12	16.7	
Seedlings and Herbs:			
Viburnum dentatum	20/50	40	FAC
Osmunda cinnamomea	15/50	30	FACW
Pinus strobus	5/50	10	
Quercus alba	5/50	10	
Acer saccharum	5/50	10	
Mosses and Liverworts:			

Tally:	OBL	FACW 2	FAC 2	FAC–	FACU 4	UPL	SUM 8

{OBL+FACW+FAC} X 100 =
SUM

4/8 = 50%

Area Disturbed? YES ____ X NO

Describe:

Continued on other side

Brook System – Upland A

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–12 inch	10 YR 5/6		
____ inch			
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ **NTCHS List** ____ **Organic Soil** ____ **High Organic Content in Surface Horizon**

____ **Histic Epipedon** ____ **Sulfidic Material** ____ **Aquic Moisture Regime**

____ **Peraquic Moisture Regime** ____ **Reducing Condition** ____ **Iron Concretions**

____ **Manganese Concretions** ____ **Gleyed** ____ **Wet Spodosols**

____ **Dark Vertical Streaking of Subsurface Horizons** ____ **OBL Plants**

____ **OBL and FACW Plants and Wetland/Upland Boundary Abrupt**

HYDROLOGY

____ **Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season**

Source: **Dated:**

PRIMARY INDICATORS:

____ **Inundation (Depth)**

____ **Saturation in Upper 12 Inches (Depth)**

____ **Watermarks**

____ **Driftlines**

____ **Sediment Deposits**

____ **Drainage Patterns**

SECONDARY INDICATORS: (2 or more required)

____ **Oxidized Root Channels in Upper 12 Inches**

____ **Water–Stained Leaves**

____ **Local Soil Survey**

____ **FAC Neutral Test**

____ **Other (Buttressed Trees, Stooling)**

CONCLUSIONS

Yes	**Hydrophytes Prevalent**	No	**Hydric Soils**
No	**Wetland Hydrology**	No	**Wetland?**

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hagan

Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill **USFWS Classification:** PFO1/4

Sample Location: Brook System – Wetland A **Date:** 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	20/60	33.3	FACU
Acer rubrum	20/60	33.3	FAC
Quercus rubra	20/60	33.3	FACU–
Lianas:			
Saplings:			
Pinus strobus	15/30	50	FACU
Acer rubrum	15/30	50	FAC
Shrubs:			
Viburnum dentatum	20/30	66.6	FAC
Quercus rubra	5/30	16.7	
Fagus sp.	5/30	16.7	
Seedlings and Herbs:			
Osmunda cinnamomea	30/47	63.8	FACW
Typha latifolia	5/47	10.6	
Solidago sp.	10/47	21.3	?
Arisaema stewardsonii	2/47	4.3	
Mosses and Liverworts:			

Tally:	OBL	FACW 1	FAC 3	FAC–	FACU 3	UPL	SUM 7

{OBL+FACW+FAC} X 100 =
SUM

4/7 = 57.1%

Area Disturbed? X YES ____ NO

Describe:
Oil sheen on stream surface. Rust visible on stream bottom.

Continued on other side

Brook System – Wetland A

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–12 inch	7.5 YR 2/1 – matrix 7.5 YR 4/4 – mottles		
____ inch			
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

- ____ NTCHS List
- ____ Organic Soil
- ____ High Organic Content in Surface Horizon
- ____ Histic Epipedon
- ____ Sulfidic Material
- ____ Aquic Moisture Regime
- ____ Peraquic Moisture Regime
- ____ Reducing Condition
- ____ Iron Concretions
- ____ Manganese Concretions
- ____ Gleyed
- ____ Wet Spodosols
- ____ Dark Vertical Streaking of Subsurface Horizons
- ____ OBL Plants
- ____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

- ____ Inundation (Depth)
- ____ Saturation in Upper 12 Inches (Depth)
- X ____ Watermarks
- ____ Driftlines
- ____ Sediment Deposits
- X ____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

- ____ Oxidized Root Channels in Upper 12 Inches
- X ____ Water–Stained Leaves
- ____ Local Soil Survey
- ____ FAC Neutral Test
- X ____ Other (Stooling)

CONCLUSIONS

Yes	Hydrophytes Prevalent	Yes	Hydric Soils
Yes	Wetland Hydrology	Yes	Wetland?

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan [signature]

Wetlands Technical Specialist: Robert J. Rennell [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification:** FO1/4

Sample Location: Brook System – Upland B — **Date:** 10/21/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Acer saccharum	40/80	50	FACU–
Pinus strobus	20/80	25	FACU
Acer rubrum	20/80	25	FAC
Lianas:			
Saplings:			
Malus pumila	5/5	100	UPL
Shrubs:			
Fraxinus americana	2/6	33.3	FACU
Acer rubrum	2/6	33.3	FAC
Viburnum dentatum	2/6	33.3	FAC
Seedlings and Herbs:			
Gramineae spp.	80/100	80	UPL
Pinus strobus	5/100	5	
Viburnum dentatum	5/100	5	
Juniperus virginiana	5/100	5	
Vaccinium sp.	5/100	5	
Mosses and Liverworts:			

Tally:	OBL	FACW	FAC 3	FAC–	FACU 3	UPL 2	SUM 8

{OBL+FACW+FAC} X 100 =
SUM

3/8 = 37.5%

Area Disturbed? ____ YES ___X___ NO

Describe:

Continued on other side

Brook System – Upland B

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–12 inch	10 YR 3/3		
____ inch			
____ inch			

Soil Pedigree: | Permeability:

Series and Phase: | Drainage Class:

____ NTCHS List
____ Organic Soil
____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)
____ Saturation in Upper 12 Inches (Depth)
____ Watermarks
____ Driftlines
____ Sediment Deposits
____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No	Hydrophytes Prevalent	No	Hydric Soils
No	Wetland Hydrology	No	Wetland?

Wetlands Technician(s):
Wetlands Scientist(s):
Wetlands Technical Specialist:

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill		USFWS Classification: FO1/4	
Sample Location: Brook System – Upland C		Date: 10/20/93	
VEGETATION			
DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	32/80	40	FACU
Acer rubrum	48/80	60	FAC
Lianas:			
Saplings:			
Acer rubrum	21/30	70	FAC
Pinus strobus	7.5/30	25	FACU
Malus pumila	1.5/30	5	
Shrubs:			
Pinus strobus	5/15	33.3	FACU
Acer rubrum	5/15	33.3	FAC
Ulmus americana	5/15	33.3	FACW–
Seedlings and Herbs:			
Pinus strobus	20/90	22.2	FACU
Juniperus virginiana	20/90	22.2	FACU
Quercus alba	3/90	3.3	
Solidago sp.	3/90	3.3	
Lonicera tatarica	2/90	2.2	
Prunus sp.	2/90	2.2	
Vaccinium corymboseum	5/90	5.6	
Gramineae spp.	35/90	38.9	UPL
Mosses and Liverworts:			

Tally:	OBL	FACW 1	FAC 3	FAC–	FACU 5	UPL 1	SUM 8

{OBL+FACW+FAC} X 100 = SUM 4/8 = 50%	Area Disturbed? ____ YES __X__ NO Describe:

Continued on other side

Brook System – Upland C

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–9 inch	10 YR 3/3		
9–12 inch	10 YR 3/3 – matrix 10 YR 4/6 – mottles		
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

Yes	Hydrophytes Prevalent	No	Hydric Soils
No	Wetland Hydrology	No	Wetland?

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: Robert J. Russell

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill **USFWS Classification:** PEM1

Sample Location: Brook System – Wetland B **Date:** 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Lianas:			
Saplings:			
Shrubs:			
Vaccinium augustifolium	10/10	100	FACU–
Seedlings and Herbs:			
Elymus virginicus	50/100	50	FACW–
Gramineae spp.	30/100	30	?
Lythrum salicaria	20/100	20	FACW+
Mosses and Liverworts:			

Tally:	OBL	FACW 2	FAC	FAC–	FACU 1	UPL	SUM 3

$\frac{\{OBL+FACW+FAC\}}{SUM} \times 100 =$

2/3 = 66.6%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Brook System – Wetland B

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–7 inch	7.5 YR 3/0 – matrix 7.5 YR 4/6 – mottles		
7–12 inch	10 YR 4/1		sandy soils
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ **NTCHS List** ____ **Organic Soil** ____ **High Organic Content in Surface Horizon**

____ **Histic Epipedon** ____ **Sulfidic Material** ____ **Aquic Moisture Regime**

____ **Peraquic Moisture Regime** ____ **Reducing Condition** ____ **Iron Concretions**

____ **Manganese Concretions** ____ **Gleyed** ____ **Wet Spodosols**

____ **Dark Vertical Streaking of Subsurface Horizons** ____ **OBL Plants**

____ **OBL and FACW Plants and Wetland/Upland Boundary Abrupt**

HYDROLOGY

____ **Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season**

Source: **Dated:**

PRIMARY INDICATORS:

____ **Inundation (Depth)**

____ **Saturation in Upper 12 Inches (Depth)**

____ **Watermarks**

____ **Driftlines**

____ **Sediment Deposits**

X ____ **Drainage Patterns**

SECONDARY INDICATORS:
(2 or more required)

____ **Oxidized Root Channels in Upper 12 Inches**

____ **Water–Stained Leaves**

____ **Local Soil Survey**

____ **FAC Neutral Test**

X ____ **Other (Stooling)**

CONCLUSIONS

Yes ____ **Hydrophytes Prevalent** Yes ____ **Hydric Soils**

Yes ____ **Wetland Hydrology** Yes ____ **Wetland?**

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification:** PFO1

Sample Location: Stream 1 Wetland — **Date:** 10/21/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Acer rubrum	90/90	100	FAC
Lianas:			
Saplings:			
Betula populifolia	5/5	100	FAC
Shrubs:			
Alnus rugosa	12/20	60	FACW+
Acer rubrum	8/20	40	FAC
Seedlings and Herbs:			
Carex stricta	60/100	60	OBL
Scirpus americana	20/100	20	OBL
Osmunda cinnamomea	10/100	10	
Bidens connata	5/100	5	
Gramineae spp.	2/100	2	
Solidago sp.	2/100	2	
Mosses and Liverworts:			

Tally:	OBL 2	FACW 1	FAC 3	FAC−	FACU	UPL	SUM 6

{OBL+FACW+FAC} X 100 =
SUM

6/6 = 100%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Stream 1 Wetland

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
______ inch 0–1 inch	10 YR 2/2		
1–11 inch	10 YR 4/1 – matrix 10 YR 5/6 – mottles		
______ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

______ NTCHS List
______ Organic Soil
X ______ High Organic Content in Surface Horizon
______ Histic Epipedon
______ Sulfidic Material
______ Aquic Moisture Regime
______ Peraquic Moisture Regime
______ Reducing Condition
______ Iron Concretions
______ Manganese Concretions
______ Gleyed
______ Wet Spodosols
______ Dark Vertical Streaking of Subsurface Horizons
______ OBL Plants
______ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

______ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

______ Inundation (Depth)
______ Saturation in Upper 12 Inches (Depth)
X ______ Watermarks
______ Driftlines
______ Sediment Deposits
X ______ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

______ Oxidized Root Channels in Upper 12 Inches
X ______ Water–Stained Leaves
______ Local Soil Survey
______ FAC Neutral Test
X ______ Other (Stooling)

CONCLUSIONS

Yes Hydrophytes Prevalent
Yes Wetland Hydrology
Yes Hydric Soils
Yes Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist: Robert J. Reynolds

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification:** FO1/4

Sample Location: Stream 1 Upland — **Date:** 10/21/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	35/90	38.9	FACU
Quercus alba	35/90	38.9	FACU–
Fraxinus pennsylvanica	10/90	11.1	
Acer rubrum	10/90	11.1	
Lianas:			
Saplings:			
Pinus strobus	20/60	33.3	FACU
Quercus alba	20/60	33.3	FACU–
Fraxinus pennsylvanica	20/60	33.3	FACW
Shrubs:			
Viburnum dentatum	15/20	75	FAC
Fraxinus pennsylvanica	5/20	25	FACW
Seedlings and Herbs:			
Lonicera tatarica	5/10	50	FACU
Quercus alba	3/10	30	FACU–
Fraxinus pennsylvanica	2/10	20	FACW
Mosses and Liverworts:			

Tally:	OBL	FACW 3	FAC 1	FAC–	FACU 6	UPL	SUM 10

{OBL+FACW+FAC} X 100 =
SUM

4/10 = 40%

Area Disturbed? YES ____ X NO

Describe:

Continued on other side

Stream 1 Upland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–12 inch	10 YR 3/4		
____ inch			
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List
____ Organic Soil
____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

____ Inundation (Depth)
____ Saturation in Upper 12 Inches (Depth)
____ Watermarks
____ Driftlines
____ Sediment Deposits
____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No **Hydrophytes Prevalent**
No **Hydric Soils**
No **Wetland Hydrology**
No **Wetland?**

Wetlands Technician(s): [signature]
Wetlands Scientist(s): [signature] M. Hogan
Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill **USFWS Classification:** PFO1/4

Sample Location: Brook System – Wetland D **Date:** 10/20/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Acer rubrum	50/90	55.6	FAC
Pinus strobus	20/90	22.2	FACU
Ulmus americana	20/90	22.2	FACW–
Lianas:			
Saplings:			
Acer rubrum	20/40	50	FAC
Ulmus americana	10/40	25	FACW–
Fraxinus pennsylvanica	10/40	25	FACW
Shrubs:	10/10	100	FAC
Viburnum dentatum			
Seedlings and Herbs:			
Solidago sp.	10/10	100	?
Mosses and Liverworts:			

Tally:	OBL	FACW 3	FAC 3	FAC–	FACU 1	UPL	SUM 7

{OBL+FACW+FAC} X 100 =
SUM

6/7 = 85.7%

Area Disturbed? YES X NO

Describe:

Continued on other side

Brook System – Wetland D

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–18 inch	7.5 YR 2/0		standing water at 2"
____ inch			
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

X ____ Inundation (Depth = 2")

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

X ____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

X ____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

Yes ____ Hydrophytes Prevalent Yes ____ Hydric Soils

Yes ____ Wetland Hydrology Yes ____ Wetland?

Wetlands Technician(s):

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist:

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill	**USFWS Classification: Pasture**		
Sample Location: Brook System – Upland D and Stream 2 Upland	**Date: 10/21/93**		
VEGETATION			
DOMINANTS BY STRATUM	**Dominance Ratio**	**Percent Dominance**	**NWI Status of Dominants**
Trees:			
Lianas:			
Saplings:			
Pinus strobus	10/10	100	FACU
Shrubs:			
Juniperus virginiana	40/40	100	FACU
Seedlings and Herbs:			
Gramineae spp.	60/65	92.3	UPL
crab grass	5/65	7.7	
Mosses and Liverworts:			
Moss spp.			

Tally:	**OBL**	**FACW**	**FAC**	**FAC–**	**FACU** 2	**UPL** 1	**SUM** 3

{OBL+FACW+FAC} X 100 = SUM 0/3 = 0%	**Area Disturbed?** ____ YES X NO **Describe:**

Continued on other side

Brook System – Upland D and Stream 2 Upland

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
______ inch			
0–10 inch	10 YR 3/3		grazed pasture
______ inch			
______ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

______ NTCHS List
______ Organic Soil
______ High Organic Content in Surface Horizon
______ Histic Epipedon
______ Sulfidic Material
______ Aquic Moisture Regime
______ Peraquic Moisture Regime
______ Reducing Condition
______ Iron Concretions
______ Manganese Concretions
______ Gleyed
______ Wet Spodosols
______ Dark Vertical Streaking of Subsurface Horizons
______ OBL Plants
______ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

______ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

______ Inundation (Depth)
______ Saturation in Upper 12 Inches (Depth)
______ Watermarks
______ Driftlines
______ Sediment Deposits
______ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

______ Oxidized Root Channels in Upper 12 Inches
______ Water–Stained Leaves
______ Local Soil Survey
______ FAC Neutral Test
______ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No	Hydrophytes Prevalent	No	Hydric Soils
No	Wetland Hydrology	No	Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist: Robert S. Reynolds

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill		**USFWS Classification: PSS1**	
Sample Location: Brook System -- Wetland C		**Date: 10/20/93**	
VEGETATION			
DOMINANTS BY STRATUM	**Dominance Ratio**	**Percent Dominance**	**NWI Status of Dominants**
Trees:			
Lianas:			
Saplings:			
Shrubs:			
Alnus rugosa	50/60	83.3	FACW+
Viburnum dentatum	10/60	16.7	
Seedlings and Herbs:			
Carex stricta	15/85	17.6	
Lythrum salicaria	5/85	5.9	
Panicum virgatum	65/85	76.5	FAC
Mosses and Liverworts:			

Tally:	OBL	FACW 1	FAC 1	FAC-	FACU	UPL	SUM 2

{OBL+FACW+FAC} X 100 = SUM 2/2 = 100%	**Area Disturbed?** ____ YES __X__ NO **Describe:**

Continued on other side

Brook System – Wetland C

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–8 inch	10 YR 3/3		groundwater at 3" organic soil
____ inch			
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List
____ Organic Soil
X ____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)
X ____ Saturation in Upper 12 Inches (Depth)
____ Watermarks
____ Driftlines
____ Sediment Deposits
____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
X ____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
X ____ Other (Stooling)

CONCLUSIONS

Yes	Hydrophytes Prevalent	Yes	Hydric Soils
Yes	Wetland Hydrology	Yes	Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist: [signature]

Stream 2 Wetland

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–10 inch	10 YR 4/1 – matrix 7.5 YR 4/6 – mottles		clay soil, goundwater at 4"
10–12 inch	10 YR 3/1		
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ **NTCHS List** ____ **Organic Soil** ____ **High Organic Content in Surface Horizon**

____ **Histic Epipedon** ____ **Sulfidic Material** ____ **Aquic Moisture Regime**

____ **Peraquic Moisture Regime** ____ **Reducing Condition** ____ **Iron Concretions**

____ **Manganese Concretions** ____ **Gleyed** ____ **Wet Spodosols**

____ **Dark Vertical Streaking of Subsurface Horizons** ____ **OBL Plants**

____ **OBL and FACW Plants and Wetland/Upland Boundary Abrupt**

HYDROLOGY

____ **Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season**

Source: **Dated:**

PRIMARY INDICATORS:

____ **Inundation (Depth)**

X____ **Saturation in Upper 12 Inches (Depth = 4")**

____ **Watermarks**

____ **Driftlines**

____ **Sediment Deposits**

X____ **Drainage Patterns**

SECONDARY INDICATORS: (2 or more required)

____ **Oxidized Root Channels in Upper 12 Inches**

X____ **Water–Stained Leaves**

____ **Local Soil Survey**

____ **FAC Neutral Test**

X____ **Other (Stooling)**

CONCLUSIONS

Yes	**Hydrophytes Prevalent**	Yes	**Hydric Soils**
Yes	**Wetland Hydrology**	Yes	**Wetland?**

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — USFWS Classification: PEMIE

Sample Location: Stream 2 Wetland — Date: 10/21/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Lianas:			
Saplings:			
Acer rubrum	5/5	100	FAC
Shrubs:			
Viburnum dentatum	5/10	50	FAC
Alnus rugosa	5/10	50	FACW+
Seedlings and Herbs:			
Lythrum salicaria	60/90	66.6	FACW+
Carex stricta	30/90	33.3	OBL
Mosses and Liverworts:			

Tally:	OBL 1	FACW 2	FAC 2	FAC–	FACU	UPL	SUM 5

{OBL+FACW+FAC} X 100 =
SUM

5/5 = 100%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill		**USFWS Classification:** FO1/4	
Sample Location: Stream 3 Upland		**Date:** 10/21/93	
VEGETATION			
DOMINANTS BY STRATUM	**Dominance Ratio**	**Percent Dominance**	**NWI Status of Dominants**
Trees:			
Tsuga canadensis	21/30	70	FACU
Quercus alba	9/30	30	FACU–
Lianas:			
Saplings:			
Acer saccharum	20/50	40	FACU–
Tsuga canadensis	20/50	40	FACU
Betula papyrifera	5/50	10	
Betula alleghaniensis	5/50	10	
Shrubs:			
Acer rubrum	30/60	50	FAC
Ulumus americana	10/60	16.7	
Pinus strobus	10/60	16.7	
Betula alleghaniensis	10/60	16.7	
Seedlings and Herbs:			
Acer rubrum	40/70	57.1	FAC
Ulmus americana	10/70	14.3	
Betula papyrifera	10/70	14.3	
Gramineae spp.	10/70	14.3	
Mosses and Liverworts:			

Tally:	OBL	FACW	FAC 2	FAC–	FACU 4	UPL	SUM 6

{OBL+FACW+FAC} X 100 = SUM 2/6 = 33.3%	**Area Disturbed?** YES X NO **Describe:**

Continued on other side

Stream 3 Upland

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
______ inch 0–2 inch	10 YR 4/4		sandy soils
2–12 inch	10 YR 6/4		
______ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

______ **NTCHS List** ______ **Organic Soil** ______ **High Organic Content in Surface Horizon**

______ **Histic Epipedon** ______ **Sulfidic Material** ______ **Aquic Moisture Regime**

______ **Peraquic Moisture Regime** ______ **Reducing Condition** ______ **Iron Concretions**

______ **Manganese Concretions** ______ **Gleyed** ______ **Wet Spodosols**

______ **Dark Vertical Streaking of Subsurface Horizons** ______ **OBL Plants**

______ **OBL and FACW Plants and Wetland/Upland Boundary Abrupt**

HYDROLOGY

______ **Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season**

Source: **Dated:**

PRIMARY INDICATORS:

______ **Inundation (Depth)**

______ **Saturation in Upper 12 Inches (Depth)**

______ **Watermarks**

______ **Driftlines**

______ **Sediment Deposits**

______ **Drainage Patterns**

SECONDARY INDICATORS: (2 or more required)

______ **Oxidized Root Channels in Upper 12 Inches**

______ **Water–Stained Leaves**

______ **Local Soil Survey**

______ **FAC Neutral Test**

______ **Other (Buttressed Trees, Stooling)**

CONCLUSIONS

No	**Hydrophytes Prevalent**	No	**Hydric Soils**
No	**Wetland Hydrology**	No	**Wetland?**

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M Hogan

Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill | **USFWS Classification:** PFO1/4

Sample Location: Stream 3 Wetland | **Date:** 10/21/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Acer rubrum	48/80	60	FAC
Tsuga canadensis	24/80	30	FACU
Quercus palustris	8/80	10	
Lianas:			
Saplings:			
Tsuga canadensis	10/20	50	FACU
Acer rubrum	10/20	50	FAC
Shrubs:			
Carpinus caroliniana	5/15	33.3	FAC
Tsuga canadensis	5/15	33.3	FACU
Ulmus americana	5/15	33.3	FACW–
Seedlings and Herbs:			
Mitchella repens	10/30	33.3	FACU
Ulmus americana	5/30	16.7	FACW–
Osmunda cinnamomea	5/30	16.7	FACW
Elymus virginicus	5/30	16.7	FACW–
Bidens connata	5/30	16.7	FACW
Mosses and Liverworts:			
Moss spp.			

Tally:	OBL	FACW 5	FAC 3	FAC–	FACU 4	UPL	SUM 12

{OBL+FACW+FAC} X 100 =
SUM

8/12 = 66.6%

Area Disturbed? ______ YES __X__ NO

Describe:

Continued on other side

Stream 3 Wetland

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–2 inch	10 YR 2/1		groundwater at 2"
2–10 inch	7.5 YR 2/0		sandy soils
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List
____ Organic Soil
____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

____ Inundation (Depth)
X ____ Saturation in Upper 12 Inches (Depth = 2")
____ Watermarks
____ Driftlines
____ Sediment Deposits
____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
X ____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
X ____ Other (Shallow Root Systems, Stooling)

CONCLUSIONS

Yes	Hydrophytes Prevalent	Yes	Hydric Soils
Yes	Wetland Hydrology	Yes	Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist: Robert J. Reinwald

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification:** PFO1/4b

Sample Location: Stream 4 Wetland — **Date:** 10/21/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Acer rubrum	70/70	100	FAC
Lianas:			
Saplings:			
Acer rubrum	5/10	50	FAC
Betula papyrifera	5/10	50	FACU
Shrubs:			
Cornus stolonifera	30/70	42.9	FACW+
Viburnum dentatum	20/70	28.6	FAC
Viburnum sp.	10/70	14.3	
Acer rubrum	10/70	14.3	
Seedlings and Herbs:			
Onoclea sensibilis	20/95	21.1	FACW
Carex stricta	40/95	42.1	OBL
Lythrum salicaria	20/95	21.1	FACW+
Osmunda cinnamomea	10/95	10.5	
Chelone glabra	5/95	5.3	
Mosses and Liverworts:			

Tally:	OBL	FACW	FAC	FAC−	FACU	UPL	SUM
	1	3	3		1		8

{OBL+FACW+FAC} X 100 =
SUM

7/8 = 88%

Area Disturbed? YES ___ X NO

Describe:

Note: No upland plot was investigated on this transect because the floodplain extended to the rear edge of residential lots (private lawns).

Continued on other side

Stream 4 Wetland

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–12 inch	10 YR 2/0		groundwater at 1"
____ inch			
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List
____ Organic Soil
____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)
X ____ Saturation in Upper 12 Inches (Depth = 1")
____ Watermarks
____ Driftlines
____ Sediment Deposits
X ____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
X ____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
X ____ Other (Shallow Root Systems, Stooling)

CONCLUSIONS

Yes ____ Hydrophytes Prevalent
Yes ____ Wetland Hydrology
Yes ____ Hydric Soils
Yes ____ Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist: [signature]

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification: FO4**

Sample Location: Stream 5 Upland — **Date: 10/21/93**

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	50/50	100	FACU
Lianas:			
Saplings:			
Pinus strobus	10/30	33.3	FACU
Acer rubrum	20/30	66.6	FAC
Shrubs:			
Pinus strobus	60/75	80	FACU
Betula populifolia	10/75	13.3	
Quercus alba	5/75	6.7	
Seedlings and Herbs:			
Pinus strobus	20/35	57.1	FACU
Betula populifolia	5/35	14.3	
Quercus alba	5/35	14.3	
Solidago sp.	2/35	5.7	
Mitchella repens	3/35	8.6	
Mosses and Liverworts:			

Tally:	OBL	FACW	FAC 1	FAC–	FACU 4	UPL	SUM 5

{OBL+FACW+FAC} X 100 =
SUM

1/5 = 20%

Area Disturbed? YES ___ X NO

Describe:

Continued on other side

Stream 5 Upland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–10 inch	10 YR 3/3		sandy soils
____ inch			
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No Hydrophytes Prevalent

No Wetland Hydrology

No Hydric Soils

No Wetland?

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: Robert Kennel

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill		USFWS Classification: PSS1b	
Sample Location: Stream 5 Wetland		Date: 10/21/93	
VEGETATION			
DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Lianas:			
Saplings:			
Shrubs:			
Alnus rugosa	45/55	81.8	FACW+
Viburnum dentatum	3/55	5.5	
Cornus stolonifera	3/55	5.5	
Acer rubrum	2/55	3.6	
Populus deltoides	2/55	3.6	
Seedlings and Herbs:			
Ambrosia sp.	20/60	33.3	?
Carex stricta	20/60	33.3	OBL
Rubus sp.	5/60	8.3	
Lythrum salicaria	10/60	16.7	
Solidago sp.	5/60	8.3	
Mosses and Liverworts:			

Tally:	OBL 1	FACW 1	FAC	FAC–	FACU	UPL	SUM 2

{OBL+FACW+FAC} X 100 = SUM 2/2 = 100%	Area Disturbed? ____ YES X NO Describe:

Continued on other side

Stream 5 Wetland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–6 inch	7.5 YR 3/1		groundwater at 5"
6–12 inch	7.5 YR 3/1 – matrix 10 YR 5/1 – mottles		
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List
____ Organic Soil
____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

____ Inundation (Depth)
____ Saturation in Upper 12 Inches (Depth = 5")
____ Watermarks
____ Driftlines
____ Sediment Deposits
X ____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
X ____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
X ____ Other (Stooling)

CONCLUSIONS

Yes	Hydrophytes Prevalent	Yes	Hydric Soils
Yes	Wetland Hydrology	Yes	Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist: Robert J. Reynolds

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill | **USFWS Classification:** FO4

Sample Location: Stream 6 Upland | **Date:** 10/21/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Quercus alba	70/90	77.8	FACU–
Pinus strobus	10/90	11.1	
Tilia americana	10/90	11.1	
Lianas:			
Saplings:			
Quercus alba	15/20	75	FACU–
Ulmus americana	5/20	25	FACW–
Shrubs:			
Pinus strobus	10/35	28.6	FACU
Viburnum dentatum	10/35	28.6	FAC
Quercus alba	5/35	14.3	
Cornus alternifiora	4/35	11.4	
Cornus stolonifera	3/35	8.6	
Viburnum sp.	3/35	8.6	
Seedlings and Herbs:			
Gramineae spp.	85/95	89.5	UPL
Pinus strobus	2/95	2.1	
Quercus alba	2/95	2.1	
Cornus alternifiora	2/95	2.1	
Vaccinium coryboeum	2/95	2.1	
Acer rubrum	2/95	2.1	
Mosses and Liverworts:			

Tally:	OBL	FACW 1	FAC 1	FAC–	FACU 3	UPL 1	SUM 6

{OBL+FACW+FAC} X 100 =
SUM

2/6 = 33.3%

Area Disturbed? ____ YES X NO
Describe:

Continued on other side

Stream 6 Upland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
___ inch			
0–12 inch	10 YR 3/3		
2–12 inch	10 YR 4/4		
___ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

___ NTCHS List
___ Organic Soil
___ High Organic Content in Surface Horizon
___ Histic Epipedon
___ Sulfidic Material
___ Aquic Moisture Regime
___ Peraquic Moisture Regime
___ Reducing Condition
___ Iron Concretions
___ Manganese Concretions
___ Gleyed
___ Wet Spodosols
___ Dark Vertical Streaking of Subsurface Horizons
___ OBL Plants
___ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

___ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

___ Inundation (Depth)
___ Saturation in Upper 12 Inches (Depth)
___ Watermarks
___ Driftlines
___ Sediment Deposits
___ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

___ Oxidized Root Channels in Upper 12 Inches
___ Water–Stained Leaves
___ Local Soil Survey
___ FAC Neutral Test
___ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No Hydrophytes Prevalent
No Wetland Hydrology
No Hydric Soils
No Wetland?

Wetlands Technician(s): [signature]
Wetlands Scientist(s): Jennifer M. Hogan
Wetlands Technical Specialist: Robert Reinold

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — **USFWS Classification:** PFO1

Sample Location: Stream 6 Wetland — **Date:** 10/21/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Quercus alba	32/80	40	FACU−
Acer rubrum	48/80	60	FAC
Lianas:			
Smilax walteri	5/5	100	OBL
Saplings:			
Quercus alba	5/15	33.3	FACU−
Acer rubrum	5/15	33.3	FAC
Ulmus americana	5/15	33.3	FACW−
Shrubs:			
Pinus strobus	5/20	25	FACU
Viburnum dentatum	10/20	50	FAC
Prunus pensylvanica	3/20	15	
Cornus alternifiora	2/20	10	
Seedlings and Herbs:			
Osmunda regalis	10/60	16.7	
Lythrum salicaria	20/60	33.3	FACW+
Carex stricta	15/60	25	OBL
Galium tinctorium	5/60	8.3	
Vaccinium corymbosum	5/60	8.3	
Solidago sp.	5/60	8.3	
Mosses and Liverworts:			

Tally:	OBL 2	FACW 2	FAC 3	FAC−	FACU 3	UPL	SUM 10

{OBL+FACW+FAC} X 100 =
SUM

7/10 = 70%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Stream 6 Wetland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch 0–12 inch	10 YR 3/1		sandy soils
____ inch			
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

X ____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

X ____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

X ____ Other (Shallow Root Systems, Stooling)

CONCLUSIONS

Yes ____ Hydrophytes Prevalent

Yes ____ Wetland Hydrology

Yes ____ Hydric Soils

Yes ____ Wetland?

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: Robert J. Rennell

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill	**USFWS Classification: FO1/4**		
Sample Location: Flint Pond 1 Upland		**Date: 10/22/93**	
VEGETATION			
DOMINANTS BY STRATUM	**Dominance Ratio**	**Percent Dominance**	**NWI Status of Dominants**
Trees:			
Pinus strobus	40/90	44.4	FACU
Quercus alba	40/90	44.4	FACU–
Quercus palustris	10/90	11.1	
Lianas:			
Saplings:			
Pinus strobus	15/20	75	FACU
Quercus alba	5/20	25	FACU–
Shrubs:			
Pinus strobus	25/30	83.3	FACU
Quercus alba	5/30	16.7	
Seedlings and Herbs:			
Lycopodium sp.	12/30	40	?
Pinus strobus	8/30	26.7	FACU
Quercus alba	5/30	16.7	
Quercus palustris	5/30	16.7	
Mosses and Liverworts:			

Tally:	OBL	FACW	FAC	FAC–	FACU 6	UPL	SUM 6

{OBL+FACW+FAC} X 100 = SUM 0/6 = 0%	**Area Disturbed?** ____ YES ____X NO **Describe:**

Continued on other side

Flint Pond 1 Upland

SOIL			
Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–1 inch	10 YR 3/3		
1–7 inch	10 YR 3/4		
7–16 inch	10 YR 4/6		

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

____ Inundation (Depth)

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No	Hydrophytes Prevalent	No	Hydric Soils
No	Wetland Hydrology	No	Wetland?

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: Robert J. Bennett

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill			USFWS Classification: PEM1
Sample Location: Flint Pond 1 Wetland			Date: 10/22/93
VEGETATION			
DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Lianas:			
Saplings:			
Shrubs:			
Seedlings and Herbs:			
Typha latifolia	70/100	70	OBL
Lythrum salicaria	25/100	25	FACW+
Carex stricta	5/100	5	
Mosses and Liverworts:			

Tally:	OBL 1	FACW 1	FAC	FAC−	FACU	UPL	SUM 2

{OBL+FACW+FAC} X 100 = SUM 2/2 = 100%	Area Disturbed? ___ YES X NO Describe:

Continued on other side

Flint Pond 2 Upland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0–10 inch	10 YR 3/4		
10–15 inch	10 YR 4/6		
____ inch			

Soil Pedigree: Permeability:

Series and Phase: Drainage Class:

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: Dated:

PRIMARY INDICATORS:

____ Inundation (Depth)

____ Saturation in Upper 12 Inches (Depth)

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS:
(2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

____ Other (Buttressed Trees, Stooling)

CONCLUSIONS

No	Hydrophytes Prevalent	No	Hydric Soils
No	Wetland Hydrology	No	Wetland?

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: Robert J. Reinold

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill	**USFWS Classification:** PFO1/4		
Sample Location: Flint Pond 2 Wetland	**Date:** 10/22/93		
VEGETATION			
DOMINANTS BY STRATUM	**Dominance Ratio**	**Percent Dominance**	**NWI Status of Dominants**
Trees:			
Quercus alba	32/80	40	FACU−
Quercus rubra	32/80	40	FACU−
Pinus strobus	12/80	15	
Acer rubrum	4/80	5	
Lianas:			
Saplings:			
Acer rubrum	5/10	50	FAC
Pinus strobus	5/10	50	FACU
Shrubs:			
Pinus strobus	5/10	50	FACU
Quercus rubra	3/10	30	FACU−
Acer rubrum	2/10	20	FAC
Seedlings and Herbs:			
Carex stricta	5/30	16.7	OBL
Acer rubrum	2/30	6.7	
Quercus rubra	2/30	6.7	
Pinus strobus	2/30	6.7	
Osmunda cinnamomea	5/30	16.7	FACW
Prunus sp.	2/30	6.7	
Solanum dulcamara	2/30	6.7	
Lythrum salicaria	10/30	33.3	FACW+
Mosses and Liverworts:			

Tally: OBL 2	FACW 1	FAC 2	FAC−	FACU 5	UPL	SUM 10

{OBL+FACW+FAC} X 100 =
SUM

5/10 = 50%

Area Disturbed? ______ **YES** __X__ **NO**

Describe:

Continued on other side

Flint Pond 2 Wetland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
1 inch	fibrous		
0–4 inch	10 YR 3/1		groundwater at 3"
4–11 inch	10 YR 4/2		
11–16 inch	2.5 YR 5/2		

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List ____ Organic Soil ____ High Organic Content in Surface Horizon

____ Histic Epipedon ____ Sulfidic Material ____ Aquic Moisture Regime

____ Peraquic Moisture Regime ____ Reducing Condition ____ Iron Concretions

____ Manganese Concretions ____ Gleyed ____ Wet Spodosols

____ Dark Vertical Streaking of Subsurface Horizons ____ OBL Plants

____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

____ Inundation (Depth)

X____ Saturation in Upper 12 Inches (Depth = 3")

____ Watermarks

____ Driftlines

____ Sediment Deposits

____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches

X____ Water–Stained Leaves

____ Local Soil Survey

____ FAC Neutral Test

X____ Other (Shallow Root Systems)

CONCLUSIONS

Yes	Hydrophytes Prevalent	Yes	Hydric Soils
Yes	Wetland Hydrology	Yes	Wetland?

Wetlands Technician(s):

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist:

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill		USFWS Classification: FO1/4	
Sample Location: Flint Pond 3 Upland		Date: 10/22/93	

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	55/90	61.1	FACU
Quercus rubra	35/90	38.9	FACU–
Lianas:			
Saplings:			
Quercus rubra	25/30	83.3	FACU–
Pinus strobus	5/30	16.7	
Shrubs:			
Acer spicatum	35/50	70	FACU–
Prunus serotina	10/50	20	FACU–
Quercus rubra	3/50	6	
Acer rubrum	2/50	4	
Seedlings and Herbs:			
Acer spicatum	20/40	50	FACU–
Mitchella repens	10/40	25	FACU
Acer rubrum	5/40	12.5	
Cornus rugosa	3/40	7.5	
Prunus serotina	2/40	5	
Mosses and Liverworts:			

Tally:	OBL	FACW	FAC	FAC–	FACU 7	UPL	SUM 7

{OBL+FACW+FAC} X 100 =
SUM

0/7 = 0%

Area Disturbed? ____ YES __X__ NO

Describe:

Continued on other side

Flint Pond 3 Upland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			
0-12 inch	10 YR 3/4		
____ inch			
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

______ NTCHS List ______ Organic Soil ______ High Organic Content in Surface Horizon

______ Histic Epipedon ______ Sulfidic Material ______ Aquic Moisture Regime

______ Peraquic Moisture Regime ______ Reducing Condition ______ Iron Concretions

______ Manganese Concretions ______ Gleyed ______ Wet Spodosols

______ Dark Vertical Streaking of Subsurface Horizons ______ OBL Plants

______ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

______ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

______ Inundation (Depth)

______ Saturation in Upper 12 Inches (Depth)

______ Watermarks

______ Driftlines

______ Sediment Deposits

______ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

______ Oxidized Root Channels in Upper 12 Inches

______ Water-Stained Leaves

______ Local Soil Survey

______ FAC Neutral Test

X ______ Other (Stooling)

CONCLUSIONS

No	Hydrophytes Prevalent	No	Hydric Soils
No	Wetland Hydrology	No	Wetland?

Wetlands Technician(s): [signature]

Wetlands Scientist(s): Jennifer M. Hogan

Wetlands Technical Specialist: Robert J. Reinolds

3 PARAMETER WETLAND DELINEATION
SUMMARY SHEET

Project Title: Charles George Landfill — USFWS Classification: PFO/SS1/4

Sample Location: Flint Pond 3 Wetland — Date: 10/22/93

VEGETATION

DOMINANTS BY STRATUM	Dominance Ratio	Percent Dominance	NWI Status of Dominants
Trees:			
Pinus strobus	20/30	66.6	FACU
Quercus rubra	10/30	33.3	FACU−
Lianas:			
Saplings:			
Quercus rubra	3/15	20	FACU−
Acer rubrum	10/15	66.6	FAC
Pinus strobus	2/15	13.3	
Shrubs:			
Vaccinium corymbosum	45/70	64.3	FACW−
Ilex verticillata	15/70	21.4	FACW+
Viburnum dentatum	5/70	7.1	
Quercus rubra	5/70	7.1	
Seedlings and Herbs:			
Vaccinium corymbosum	45/60	75	FACW−
Carex stricta	10/60	16.7	
Viburnum dentatum	3/60	5	
Quercus rubra	2/60	3.3	
Mosses and Liverworts:			

Tally:	OBL	FACW 3	FAC 1	FAC−	FACU 3	UPL	SUM 7

{OBL+FACW+FAC} X 100 =
SUM

4/7 = 57.1%

Area Disturbed? YES X NO
Describe:

Continued on other side

Flint Pond 3 Wetland

SOIL

Depth	Munsell Color (Wet) Matrix/Mottle	USDA Texture (Wet)	Remarks
____ inch			organic peat
0–14 inch	7.5 YR 2/0		groundwater at 10"
____ inch			
____ inch			

Soil Pedigree: **Permeability:**

Series and Phase: **Drainage Class:**

____ NTCHS List
____ Organic Soil
X ____ High Organic Content in Surface Horizon
____ Histic Epipedon
____ Sulfidic Material
____ Aquic Moisture Regime
____ Peraquic Moisture Regime
____ Reducing Condition
____ Iron Concretions
____ Manganese Concretions
____ Gleyed
____ Wet Spodosols
____ Dark Vertical Streaking of Subsurface Horizons
____ OBL Plants
____ OBL and FACW Plants and Wetland/Upland Boundary Abrupt

HYDROLOGY

____ Recorded Data Indicating Inundation or Saturation for Extended Period During the Growing Season

Source: **Dated:**

PRIMARY INDICATORS:

____ Inundation (Depth)
X ____ Saturation in Upper 12 Inches (Depth = 10")
____ Watermarks
____ Driftlines
____ Sediment Deposits
____ Drainage Patterns

SECONDARY INDICATORS: (2 or more required)

____ Oxidized Root Channels in Upper 12 Inches
____ Water–Stained Leaves
____ Local Soil Survey
____ FAC Neutral Test
X ____ Other (Shallow Root Systems, Stooling)

CONCLUSIONS

Yes	Hydrophytes Prevalent	Yes	Hydric Soils
Yes	Wetland Hydrology	Yes	Wetland?

Wetlands Technician(s):

Wetlands Scientist(s):

Wetlands Technical Specialist:

APPENDIX F

ANALYTICAL DATA

#13111

PREPARED FOR
U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I
BOSTON, MASSACHUSETTS

EPA Contract No. 68-WP-0036
Work Assignment No. 34-1R16

EPA Project Officer: Diana King
EPA Remedial Project Manager: Elaine Stanley

TECHNICAL MEMORANDUM:

RESPONSE TO REVIEW COMMENTS
FIVE-YEAR REVIEW REPORT
DRAFT SUBMITTAL

Charles George Reclamation Landfill Superfund Site
Tyngsborough, Massachusetts

15 June 1995

Prepared by

METCALF & EDDY, INC.
30 Harvard Mill Square
Wakefield, Massachusetts 01880

Metcalf & Eddy

TECHNICAL MEMORANDUM:

RESPONSE TO REVIEW COMMENTS
FIVE-YEAR REVIEW REPORT
DRAFT SUBMITTAL

Metcalf & Eddy has prepared responses to comments received on the *Draft Five-Year Review Report for the Charles George Reclamation Landfill Superfund Site*, prepared by Metcalf & Eddy, Inc., Wakefield, Massachusetts, April 1994.

Review comments for this document were submitted by the following parties:

Elaine Stanley, Remedial Project Manager, U.S. Environmental Protection Agency (EPA). April 11, 1995.

David Buckley, Project Manager; Dale Young, Branch Chief; Jay Naparstek, Section Chief; Massachusetts Department of Environmental Protection (DEP). August 2, 1994. November 2, 1994.

Kenneth Finkelstein, Ph.D., National Oceanic and Atmospheric Administration (NOAA). October 6, 1994.

Kenneth C. Carr, Acting Supervisor, New England Field Office, U.S. Department of the Interior, Fish and Wildlife Service (FWS). April 5, 1995.

These comments were consolidated to aid with addressing them in an organized manner. The comment responses below are organized in the order of their appearance within the document being revised. References appear at the end of each comment that refer to the commenter.

Reference	Comment Description (identification of commenter in parentheses[1]) followed by *Response*

Table of Contents

List of Figures	Figure 2-7 Sampling Locations for Fish Tissue Samples is on Page 2-46 (EPA Comment #1) *Pagination and the identification of page numbers in the table of contents has been checked and corrected.*
List of Tables	Table 1-4 is on page 1-28 and Table 1-5 is on page 1-31. (EPA Comment #2a) *Pagination and the identification of page numbers in the table of contents has been checked and corrected.*
	Table 1-10 should be Changes not Changed. (EPA Comment #2b) *This typographical error has been corrected.*
	Table 2-8 - Summary should be changed from sediment. (EPA Comment # 2c) *This typographical error has been corrected.*
	Table 2-10 is on page 2-72. (EPA Comment #2d) *Pagination and the identification of page numbers in the table of contents has been checked and corrected.*

[1] Commenters are identified as follows:

EPA - Elaine Stanley, Remedial Project Manager, U.S. Environmental Protection Agency

DEP - David Buckley, Project Manager; Dale Young, Branch Chief; Jay Naparstek, Section Chief; Massachusetts Department of Environmental Protection

NOAA- Kenneth Finkelstein, Ph.D., National Oceanic and Atmospheric Administration

FWS - Kenneth C. Carr, Acting Supervisor, New England Field Office, U.S. Department of the Interior, Fish and Wildlife Service

Section 1

Page 1-3	2nd paragraph under 1.1.2 - Reword with "The landfill itself contains municipal and industrial waste..." (EPA Comment #3a) *This editorial change has been made.*
	3rd paragraph - 2nd bullet - add at end of sentence "(i.e., cap the landfill gas and collect the leachate)". (EPA Comment # 3b) *This editorial change has been made.*
	3rd bullet - Reword with "Provide treatment of groundwater, leachate and landfill gas and provide removal of Dunstable Brook sediments as the selected source removal remedy. ROD III covered both Operable Unit #3 (management of migration) and Operable Unit #4 (leachate treatment)." (EPA Comment #3c) *This editorial change has been made.*
Figure 1-2	This figure does not show the gas collection and flare systems. I can provide you with an appropriate drawing if needed. (EPA Comment #4) *The figure will be changed to one provided by EPA.*
Page 1-5	3rd paragraph - ROD II included a landfill gas venting system, not collection system. (EPA Comment #5a) *The text has been corrected as requested.*
	3rd paragraph, last sentence - The gas collection system and flare are under ROD III, not ROD II. (EPA Comment # 5b) *The text has been corrected as requested.*
	5th paragraph, last sentence - same as comment above. (EPA Comment #5c) *The text has been changed as requested.*

Reference	Comment Description (identification of commenter in parentheses) followed by *Response*
Page 1-6	1st paragraph - Strike last sentence. The southwest groundwater collection trench has been constructed and operating since October 1993. In addition, the residential well monitoring program started in 1989 and continues to date. (EPA Comment #5d) *The referenced sentence has been deleted and text edited accordingly.*
	2nd paragraph, 3rd sentence - The leachate toe-drain was installed under ROD II, not ROD III. (EPA Comment #5e) *The text has been corrected as requested.*
	2nd paragraph, last sentence - The eastern groundwater remediation is currently in design. (EPA Comment #5f) *The text has been changed as requested.*
	4th paragraph, 5th sentence - insert "human health" between decreased and risk. (EPA Comment #5g) *The text has been changed as requested.*
	4th paragraph - Provide a description of post-ROD monitoring which showed levels close to original target level, i.e., total cPAH < 1 ppm. (EPA Comment #5h) *Total cPAH data will be added to the tables and a discussion included in the text.*
Page 1-7	Section 1.2, ROD I - The objective of the new water main......, was to provide an uncontaminated alternative water service to the residents of Cannongate Condominium complex and surrounding area. (EPA Comment #6) *The text has been changed as requested.*
Page 1-8	last paragraph - Initial groundwater monitoring was conducted in 1979 and 1980. (EPA Comment #7a) *The text has been changed accordingly.*
	last paragraph - The data reviewed during this five year period....prior to those in the documents.... (EPA Comment #7b) *The text has been changed accordingly.*

last paragraph - Delete last sentence on page 1-8. (EPA Comment #7c)
The text has been changed as requested.

Page 1-9

The first sentence on this page is confusing. I recommend using two separate sentences regarding the basis for the water supply design and the on-site pump station and flow design. (EPA Comment #8a)
The text has been changed accordingly.

The next sentence should include the phase "(except for HDPE compatability studies)." (EPA Comment #8b)
The text has been changed accordingly.

Groundwater - Analytes of concern are identified in both RODs II and III. Also, semivolatiles have been included in the recent (1990 to date) groundwater monitoring program both residential and on- and off-site monitoring wells. (EPA Comment #8c)
The text has been changed accordingly.

Leachate - The leachate collection pond has a capacity of approximately 3.5 million gallons. Omit any reference to OHM. On an interim basis, (1991, 1992 and 1994), the USACE has contracted out to treat and discharge contents of the holding pond. (EPA Comment #8d)
The text has been changed accordingly.

Page 1-10

1st paragraph - The last sentence, "samples of the effluent..." should be put just before the sentence "The maximum and minimum...". In addition, a sentence should be added stating that the leachate has historically had trouble meeting the whole-effluent toxicity standards (NOEL = 100%), although improvements have been made with time. Through several Toxic Identification Evaluation studies conducted by CDM, it appears that ammonia is the major cause of toxicity. (EPA Comment #9a)
The text has been modified accordingly.

Page 1-10	Under Section 1.3.2 - In the text starting from "During treatment and discharge of the leachate... to... The results for four acute and three chronic.... are not relevant to sediments, including the table on page 1-11. This is, however, relevant to the Leachate section on page 1-9. (EPA Comment #9b) *This paragraph has been moved accordingly.* Although sediment toxicity test details are included in Section 2.0, there are no details provided for the effluent toxicity tests. Therefore, test organism and results can not be verified. The wide range of effluent concentrations required to produce a 24-hour and 48-hour LC50s suggests the potential for acute effects on a consistent basis. Consistently low effluent-diluent ratios may be responsible for LC50 values and warrant more frequent monitoring for levels that exceed MCLs. Chronic toxicity data also suggest that current effluent treatment is insufficient to provide protection of biota in receiving waters. (FWS) *More information will be provided on effluent toxicity tests. The effluent treatment is mobile and short term. Therefore, it is not recommended that more frequent toxicity monitoring of effluent be conducted.*
Page 1-11	Section 1.3.3, ARARs Review: The following is a list of ARARs the Department has identified as having been adopted or amended since the OU III Record of Decision and previous RODs that were not identified in Metcalf & Eddy's Preliminary Draft Five Year Review in the Attachment. (DEP, 8/2/95) □ Page 1-42, Table 1-8, Air Pollution Control Regulations: 310 CMR 7.02 (2)(a)(2)(g) and (b)(2)(g) Best Available Control Technology (BACT) Determinations (Applicable). All air emissions facilities as defined in 310 CMR 7.02 must meet BACT requirements. A determination will be required to identify whether the current flare meets BACT. *The Charles George site remediation does not include any facilities as defined by 310 CMR 7.02 that emit greater than 1 ton/yr VOCs. The definition of a "Contaminated Groundwater Treatment System (CGTS)" is restricted to the "stripping of VOC from the water..." The groundwater treatment system includes*

biological treatment, metals precipitation, carbon adsorption, and, if necessary, ion exchange. Air stripping of VOCs is not known to be included in the design, however if the design does include a VOC stripper, this rule would become applicable. Table 1-8 has been revised to accommodate this concern.

The definition of a "Contaminated Soil Venting System" specifically excludes the venting of landfills and is, therefore, not applicable. However, MA DAQC has stated that the preferred treatment option for best available control technology for treatment of landfill gas is construction of an enclosed gas flare. The "Off-Gas Treatment of Point-Source Remedial Air Emissions" policy (#WSC-94-150), dated May 25, 1994, has been added to Table 1-8.

- Page 1-42, Table 1-8, Air Pollution Control Regulations: 310 CMR 7.03 Plan Application Exemption Construction Requirements (Applicable). This section outlines the requirements for all contaminated groundwater/soil venting treatment systems (CGTS). If the permanent wastewater treatment system is designed to vent VOCs to the atmosphere, the system should be able to reduce VOCs in air effluent by a minimum of 95% (by weight) prior to discharge if greater than one ton total VOCs will be released annually.
  This requirement is not applicable. Please refer to the previous comment and response regarding the CGTS. In addition, preliminary calculations prepared for the Charles George Technology Assessment Report showed that, without any treatment, total VOCs emitted would be less than 0.368 tons per year.

- Page 1-42, Table 1-8, Air Pollution Control Regulations: 310 CMR 7.13 Stack Testing (Applicable). This section requires stack testing to be conducted at emission facilities when required by the Department.
  This requirement is not applicable. Stack testing cannot be conducted on an open flare.

- Page 1-46, Table 1-8, Solid Waste Management Facility Regulations: 310 CMR 19.117 Air Quality Protection Systems (Applicable). The section required that an air quality protection system be capable of controlling explosive gases to no greater than 25% LEL within on-site structures or at the property boundary.
  Massachusetts Solid Waste Management Regulations are identified in Table 1-8 as applicable action-specific ARARs. This discussion has been expanded to include the specific concerns of the commenter.

- Page 1-46, Table 1-8, Solid Waste Management Facility Regulations: 310 CMR 19.143 Post-Closure Use of Landfills (Applicable). This section identifies the requirements for post-closure use of the landfill. The limitations on post-closure construction and use are outlined.
  Massachusetts Solid Waste Management Regulations are identified in Table 1-8 as applicable action-specific ARARs. Landfill closure design does not include a proposal for alternative end uses. Use restrictions, such as deed restrictions, should be provided for after completion of remedial activities. Post-closure requirements have been specifically added to the table discussion.

Page 1-14	Table 1-1: This section identifies the Massachusetts Contingency Plan (310 CMR 40) as "Applicable". In accordance with 310 CMR 40.0111, sites regulated under the Federal Superfund Program in which the Department has concurred with the ROD are considered adequately regulated and not subject to the MCP. (DEP, 8/2/94) **Note: this comment was rescinded by DEP in a telephone conversation 6/14/95.** *This requirement remains in the report.*
Page 1-18	Table 1-2: Thallium, tetrahydrofuran and 1,4-dioxane should be added to the "Other Chemicals" category. Both constituents have been detected in groundwater and can be considered constituents of concern. (DEP, 8/2/94) *These constituents have been added to Table 1-2.*

Page 1-23	Table 1-2: Please note, the Massachusetts drinking water standards and guidelines have been updated. The most recent publication is dated Spring, 1993. The Massachusetts Maximum Contaminant Level (MMCL) for thallium has been set at 0.002 mg/L, and the Massachusetts Drinking Water Guideline for tetrahydrofuran is 1.3 mg/L and for dioxane is 0.05 mg/L. (DEP, 8/2/94) *Since the comment was made, the Massachusetts DEP Office of Research and Standards has issued a more recent publication. The data provided in Table 1-2 has been updated to reflect the Autumn 1994 publication.*
	Table 1-2: MMCLs have also been assigned for methylene chloride (0.005 mg/L), antimony (0.006 mg/L), and nickel (0.1 mg/L). (DEP, 8/2/94) *The table has been modified accordingly.*
Page 1-23	Table 1-4: The value for acetone under column TBC should be changed to 3000 μg/L. (DEP, 8/2/94) *This typographical error has been corrected.*
	Table 1-4: Thallium, tetrahydrofuran and 1,4-dioxane should be added to the "Other Chemicals" column. (DEP, 8/2/94) *To ensure that future reviews consider these constituents, they have been added to the list of "other chemicals" in Table 1-4. Historical data, however, was unavailable in some cases, as indicated in footnotes to the table.*
Page 1-33	Table 1-7: Adversely impacted wetlands have not been remediated. (FWS) *Wetland areas have been damaged by remedial activities. Wetlands mitigation should be considered by the agencies involved in project management. No change to the table is necessary.*
Page 1-34	Table 1-8: Site generated hazardous wastes have been classified as RCRA listed F039 as defined in 40 CFR 261. Therefore, the Land Disposal Restrictions should be applied to F039 wastes, and not to characteristic wastes unless a further determination by EPA reclassifies the waste. (DEP, 8/2/94)

Table 1-8 begins on page 1-38. Table 1-7 references RCRA defined wastes on page 1-34, however, no change to the text is necessary based on the comment. RCRA LDR rules are referenced on page 1-40 in Table 1-8. The text here has been modified to accommodate the new Universal Treatment Standards and the comment.

Page 1-40 Table 1-8: Treated leachate discharges are noted to be monitored but not documented. We would like to receive reports documenting contaminant concentrations in treated effluent. In light of the potential acute and chronic impacts from effluent discharges, a structured monitoring program with toxicity testing may be appropriate. (FWS)
Toxicity on surface water runoff is being conducted biannually. Any leachate breakouts that impact surface water bodies are thus being monitored. Discharges from the sedimentation basins are being monitored. Table 1-8 has been edited to state that documentation of these activities is desireable.

Page 1-40 Table 1-8: The Department would like to address and emphasize the landfill gas monitoring requirements in 310 CMR 30.118 and 310 CMR 30.132(4). Metcalf and Eddy has appropriately identified 310 CMR 30.132 as an Applicable requirement. These sections outline the requirements for landfill gas monitoring and constituent limitations. The Department has requested EPA in correspondence to develop and implement a gas monitoring program capable of detecting and monitoring any potential off-site migration of landfill gas. As this is an applicable requirement, the Department will again request EPA implement a landfill gas monitoring program. (DEP, 8/2/94)
No change to the document is required.

Page 1-48 Discharge standards have been established for the leachate and groundwater treated effluent. These standards were developed by the MA DEP and have given EPA a window of 5 years to discharge starting in 1992 and ending in 1996. Determination as to the feasibility of groundwater reinjection (ROD III remedy) must be made (with MA-DEP approval) prior to extending this discharge allowance by the state. In addition, the state conducts periodic sampling of surface water runoff from the site and sediments in the sedimentation ponds as part of its O&M responsibilities under OU #2 (ROD II). (EPA Comment #10)

	The text has been changed to reflect the above statement.
Page 1-49	Section 1.3.3.2: Adversely impacted wetlands have not been remediated. (FWS) *Wetland areas have been damaged by remedial activities. Wetlands mitigation should be considered by the agencies involved in project management. No change to the text in this section is necessary.*

Section 2

Page 2-2	top paragraph, last sentence - The USACE was present as site construction managers. (EPA Comment #11) *The text has been changed accordingly.*
Page 2-3	Vegetative growth - in parentheses - e.g., an area where preventative maintenance occurred to repair substantial, but not critical, subsidence (EPA Comment #12a) *The text has been changed accordingly.*
	Last paragraph - Specify where along the haybales was the geofabric layer exposed. (EPA Comment #12b) *East of west sedimentation basin, at the corner of Blodgett and Dunstable Road, on the Dunstable side of the road.*
Page 2-4	Last paragraph - MA DEP has O&M responsibilities of the sedimentation basins, not the USACE. (EPA Comment #13) *The text has been changed accordingly.*
Page 2-11	Wetlands have been impacted from remedial actions and discharge of other materials. Discuss what restoration or mitigation activities may be necessary. (EPA Comment #14) *Wetland areas have been damaged by remedial activities. Wetlands mitigation should be considered by the agencies involved in project management. A statement to this regard has been added at the end of section 4.2.3.*
Page 2-20	Section 2.1.3.2: Adversely impacted wetlands have not been remediated. (FWS)

	Wetland areas have been damaged by remedial activities. Wetlands mitigation should be considered by the agencies involved in project management. No change to the referenced text is necessary. Recommendations for wetlands remediation have been added to section 4.2.3.
Page 2-64	Mercury data was not included in Table 2-7 (Metals in sediment). (FWS) *Where appropriate, the tables will be edited to include mercury concentrations detected in sediment.*

Section 3

Page 3-15	Section 3.1.1.4 and page 3-25 - Section 3.1.2 - There is no discussion regarding mercury results and also the numerous rejected metals data, especially for mercury. Since this metal is of significant concern to the Trustees and to the public, recommendations for additional sampling should be made. (EPA Comment #16) *A discussion regarding mercury results will be added to the document, and further recommendations made.*
Page 3-16	Mercury data was not included in Table 3-4 (Metals in sediment). (FWS) Why isn't mercury in this table? (EPA Comment #15) *Where appropriate, the tables will be edited to include mercury concentrations detected in sediment.*
Page 3-50	Section 3.3: ROD III measures to remediate sediment in the unnamed stream and some downstream areas of Dunstable Brook have not been conducted. (FWS) *Recalculation of the ecological risk posed by sediments should be considered by the agencies involved in project management. Page 3-51 has been edited to recommend recalculation of ecological risks. Also, in Section 4.2.3 of the Draft Five Year Review, it is recommended that the risks from contaminated sediments be recalculated.*

Section 4

Page 4-6	Risk to natural resources should be recalculated for the sediment of Dunstable Brook, the tributary to Dunstable Brook, and Flint Pond Marsh. (MADEP, 11/2/94) *In Section 4.2.3 of the Draft Five Year Review Report, it is recommended that the risks from contaminated sediments be recalculated. Recalculation of the ecological risk posed by sediments should be considered by the agencies involved in project management.*
Page 3-36	It is not known whether tissue analyses were poorly conducted; (NOAA) *Tissue analyses were conducted and validated in accordance with USEPA procedures and protocols. This statement has been added to the text.*
Page 3-37	It is not known whether high concentrations of mercury are naturally present; (NOAA) *It is unlikely that the source of mercury is not anthropogenic.* It is not known whether the landfill impacts both Locust and Flint Pond; (NOAA) *Based on site hydrogeology, it is unlikely that mercury from CGRL is impacting Locust Pond.* It is not known whether a separate source of mercury exists. (NOAA) *A site-specific definitive link between sediment mercury and fish tissue mercury is presumed. Significantly higher mercury concentrations in fish tissue in the next five year review (1999), might be indicative of an additional mercury source not related to CGRL.* Mercury levels in sediment would be expected to be higher given that mercury concentrations in fish tissue samples were relatively high. (NOAA) *Analytical data for sediment mercury were rejected in 9 of 19 samples. However, no mercury was detected in the 10 samples that were not rejected. Reasons why mercury data in sediment were rejected will be provided in the Final Five Year Review Report.*

A comparison of the RI and Five-Year Review data indicated that sediment mercury contamination in Flint Pond was higher in 1987 than in 1994 suggesting that remedial efforts are working. The high mercury concentrations in the tissues of adult fish may be due to biomagnification through the food chain. For example, the largest adult perch that was collected was 30 cm long which is indicative of approximately seven years of age. This indicates that adult perch have had several years to accumulate mercury. The same is true for the adult largemouth bass that were sampled. Text has been added to page 3-37.

It is requested that, in the event mercury is found in the sediment of Flint and Locust Pond, toxicity tests be conducted at several stations within both ponds (the Five-Year Review included one test in Flint Pond - negative result) followed by Toxicity Identification Evaluation (TIE). (NOAA)
Additional analyses for mercury in Locust Pond and Flint Pond fish and sediment is not recommended. No change to the text has been made.

It is recommended that USEPA evaluate the fish collection and field survey logs to determine if enough data are available to provide some indication of the fish community in the basin. (NOAA)
The size data for yellow perch and largemouth base suggest that the system is productive. Further study of the fish community is not recommended because many factors, besides CGRL contaminants, influence the fish community in the Flint Pond basin. Without an intensive investigation, no reliable conclusions could be drawn regarding the relationship between the status of the fish community and CGRL contaminants. No change to the text has been made.

Page 4-2

1st paragraph - Please explain how it was determined that limited damage to the underlying membrane has occurred. (EPA Comment #17a)
This paragraph has been rewritten to clarify findings during the site visit.

The new pump stations have been designed and (installed) independently of the leachate and groundwater treatment plant. (EPA Comment #17b)

The text has been changed accordingly.

The two leachate pump stations will require complete replacement. (DEP, 4/4/94)
New pump stations have been designed and installed.

3rd paragraph, 2nd sentence - add Per ROD III, this system has been updated.... (EPA Comment #17c)
The text has been changed accordingly.

4th paragraph, first sentence - This statement is rather vague and requires further justification. (EPA Comment #17d)
The text will be revised for clarity.

Page 4-2 Section 4.1.2, ROD II: Rephrase the statement "... concerns regarding erosion of the crushed stone side slopes has waned..." to indicate the ongoing program to monitor the stability of the side slope. The Department has recently established a program to monitor the stability of the side slopes to address on-going concerns. Presently there does not appear to be "creep" of the crushed stone; however, the monitoring program will verify this observation. Until data is available to verify the stability of the crushed stone, the Department will withhold any conclusion as to the stability of the side slope. (DEP, 11/2/94)
The text has been changed accordingly.

Page 4-3 last paragraph - There have been very few residential water well results showing exceedences in the MCLs and, therefore, a statistical analysis does not seem warranted. There have, however, been exceedences in the MCLs in groundwater for certain off-site monitoring wells. (EPA Comment #18)
The referenced paragraph has been modified to address this comment; the recommendation for statistical analysis has been deleted.

Page 4-4 first paragraph - Include the mercury as a TAL for sediments. (EPA Comment #19)
Mercury was a TAL metal and is included under metals. The test has been modified to provide clarity.

Reference	Comment Description (identification of commenter in parentheses) followed by *Response*
Page 4-7	2nd paragraph - It should be noted here that the residential wells have not been impacted by any plume originating on-site. (EPA Comment #20) *The text has been changed accordingly.*
Page 4-7	The collapsed northeast section of the toe drain that is causing the leachate breakouts in the perimeter drainage swale at clean-out #2 will require a major repair effort. (DEP 4/4/94) *This is scheduled for this summer.*

Volatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER: / M&E SAMPLE ID:		AFM30 CGSED-18	AFM31 CGSED-19	AFM33 CGSED-10	AFM34 CGSED-9	AFM36 CGSED-11	AFM37RE CGSED-12
COMPOUND	CRQL *						
Chloromethane	10	14 U	13 U	R	17 U	R	R
Bromomethane	10	14 U	13 U	R	17 U	R	R
Vinyl Chloride	10	14 U	13 U	R	17 U	R	R
Chloroethane	10	14 U	13 U	R	17 U	R	R
Methylene Chloride	10	14 U	13 U	R	17 U	70 J	R
Acetone	10	15 J	23 J	110 J	67 J	220 J	R
Carbon Disulfide	10	14 U	13 U	R	17 U	R	R
1,1-Dichloroethene	10	14 U	13 U	R	17 U	R	R
1,1-Dichloroethane	10	14 U	13 U	R	17 U	R	R
1,2-Dichloroethene(total)	10	14 U	13 U	R	17 U	R	R
Chloroform	10	14 U	13 U	R	17 U	R	R
1,2-Dichloroethane	10	14 U	13 U	R	17 U	R	R
2-Butanone	10	14 UJ	14 J	R	17 UJ	R	R
1,1,1-Trichloroethane	10	14 U	13 U	R	17 U	R	R
Carbon Tetrachloride	10	14 U	13 U	R	17 U	R	R
Bromodichloromethane	10	14 U	13 U	R	17 U	R	R
1,2-Dichloropropane	10	14 U	13 U	R	17 U	R	R
cis-1,3-Dichloropropene	10	14 U	13 U	R	17 U	R	R
Trichloroethene	10	14 U	13 U	R	17 U	R	R
Dibromochloromethane	10	14 U	13 U	R	17 U	R	R
1,1,2-Trichloroethane	10	14 U	13 U	R	17 U	R	R
Benzene	10	14 U	13 U	110 J	17 U	R	R
trans-1,3-Dichloropropene	10	14 U	13 U	R	17 U	R	R
Bromoform	10	14 U	13 U	R	17 U	R	R
4-Methyl-2-pentanone	10	14 U	13 U	R	17 U	R	R
2-Hexanone	10	14 U	13 U	R	17 U	R	R
Tetrachloroethene	10	14 U	13 U	R	17 U	R	R
Toluene	10	14 U	13 U	R	17 U	R	R
1,1,2,2-Tetrachloroethane	10	14 U	13 U	R	17 U	R	R
Chlorobenzene	10	14 U	13 U	R	17 U	R	R
Ethylbenzene	10	14 U	13 U	71 J	17 U	R	R
Styrene	10	14 U	13 U	R	17 U	R	R
Total Xylenes	10	14 U	13 U	100 J	17 U	R	R
DILUTION FACTOR:		1	1	1	1	1	1
SAMPLE WEIGHT (g):		5	5	5	5	5	5
% MOISTURE:		27	24	80	40	81	92
LEVEL:		LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:		09-28-93	09-28-93	09-28-93	09-28-93	09-29-93	09-29-93
DATE ANALYZED:		10-04-93	10-04-93	10-04-93	10-04-93	10-05-93	10-05-93
REMARKS:		FIELD DUP	FIELD DUP				

Footnotes:
- * - Medium soils are 120 times the value shown.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Volatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFM38	AFM39	AFM40	AFM41	AFM42	AFM50
M&E SAMPLE ID:		CGSED-13	CGSED-14	CGSED-15	CGSED-16	CGSED-17	CGSED-1
COMPOUND	CRQL *						
Chloromethane	10	R	27 U	20 U	25 U	12 U	19 U
Bromomethane	10	R	27 U	20 U	25 U	12 U	19 U
Vinyl Chloride	10	R	27 U	20 U	25 U	12 U	19 U
Chloroethane	10	R	27 U	20 U	25 U	12 U	19 U
Methylene Chloride	10	R	27 U	20 U	25 U	12 U	140
Acetone	10	620 J	210	130	180	12 U	210 J
Carbon Disulfide	10	R	27 U	20 U	25 U	12 U	19 U
1,1-Dichloroethene	10	R	27 U	20 U	25 U	12 U	19 U
1,1-Dichloroethane	10	R	27 U	20 U	25 U	12 U	19 U
1,2-Dichloroethene(total)	10	R	27 U	20 U	25 U	12 U	19 U
Chloroform	10	R	27 U	20 U	25 U	12 U	19 U
1,2-Dichloroethane	10	R	27 U	20 U	25 U	12 U	19 U
2-Butanone	10	150 J	39	20 U	30	12 U	20 J
1,1,1-Trichloroethane	10	R	27 U	20 U	25 U	12 U	19 U
Carbon Tetrachloride	10	R	27 U	20 U	25 U	12 U	19 U
Bromodichloromethane	10	R	27 U	20 U	25 U	12 U	19 U
1,2-Dichloropropane	10	R	27 U	20 U	25 U	12 U	19 U
cis-1,3-Dichloropropene	10	R	27 U	20 U	25 U	12 U	19 U
Trichloroethene	10	R	27 U	20 U	25 U	12 U	19 U
Dibromochloromethane	10	R	27 U	20 U	25 U	12 U	19 U
1,1,2-Trichloroethane	10	R	27 U	20 U	25 U	12 U	19 U
Benzene	10	R	27 U	20 U	25 U	12 U	19 U
trans-1,3-Dichloropropene	10	R	27 U	20 U	25 U	12 U	19 U
Bromoform	10	R	27 U	20 U	25 U	12 U	19 U
4-Methyl-2-pentanone	10	R	27 U	20 U	25 U	12 U	19 UJ
2-Hexanone	10	R	27 U	20 U	25 U	12 U	19 UJ
Tetrachloroethene	10	R	27 U	20 U	25 U	12 U	19 UJ
Toluene	10	R	27 U	20 U	25 U	12 U	19 UJ
1,1,2,2-Tetrachloroethane	10	R	27 U	20 U	25 U	12 U	19 UJ
Chlorobenzene	10	R	27 U	20 U	25 U	12 U	19 UJ
Ethylbenzene	10	R	27 U	20 U	25 U	12 U	19 UJ
Styrene	10	R	27 U	20 U	25 U	12 U	19 UJ
Total Xylenes	10	R	27 U	20 U	25 U	12 U	19 UJ
DILUTION FACTOR:		1	1	1	1	1	1
SAMPLE WEIGHT (g):		5	5	5	5	5	5
% MOISTURE:		89	63	50	60	18	48
LEVEL:		LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:		09-29-93	09-29-93	09-29-93	09-29-93	09-29-93	10-01-93
DATE ANALYZED:		10-05-93	10-05-93	10-05-93	10-05-93	10-05-93	10-11-93
REMARKS:							

Footnotes:
* - Medium soils are 120 times the value shown.
CRQL - Contract Required Quantitation Limit.
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Volatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFQ24	AFQ25	AFQ28
M&E SAMPLE ID:		CGSED-8	CGSED-20	CGSED-21
COMPOUND	CRQL *			
Chloromethane	10	33 U	R	16 U
Bromomethane	10	33 U	R	16 U
Vinyl Chloride	10	33 U	R	16 U
Chloroethane	10	33 U	R	16 U
Methylene Chloride	10	160	120 J	55
Acetone	10	260 J	530 J	250 J
Carbon Disulfide	10	33 U	R	16 U
1,1-Dichloroethene	10	33 U	R	16 U
1,1-Dichloroethane	10	33 U	R	16 U
1,2-Dichloroethene(total)	10	33 U	R	16 U
Chloroform	10	33 U	R	16 U
1,2-Dichloroethane	10	33 U	R	16 U
2-Butanone	10	37 J	60 J	29 J
1,1,1-Trichloroethane	10	33 U	R	16 U
Carbon Tetrachloride	10	33 U	R	16 U
Bromodichloromethane	10	33 U	R	16 U
1,2-Dichloropropane	10	33 U	R	16 U
cis-1,3-Dichloropropene	10	33 U	R	16 U
Trichloroethene	10	33 U	R	16 U
Dibromochloromethane	10	33 U	R	16 U
1,1,2-Trichloroethane	10	33 U	R	16 U
Benzene	10	33 U	R	16 U
trans-1,3-Dichloropropene	10	33 U	R	16 U
Bromoform	10	33 U	R	16 U
4-Methyl-2-pentanone	10	33 U	R	16 U
2-Hexanone	10	33 U	R	16 U
Tetrachloroethene	10	33 U	R	16 U
Toluene	10	33 U	R	4 J
1,1,2,2-Tetrachloroethane	10	33 U	R	16 U
Chlorobenzene	10	33 U	R	16 U
Ethylbenzene	10	33 U	R	16 U
Styrene	10	33 U	R	16 U
Total Xylenes	10	33 U	R	16 U
DILUTION FACTOR:		1	1	1
SAMPLE WEIGHT (g):		5	5	5
% MOISTURE:		70	74	39
LEVEL:		LOW	LOW	LOW
DATE SAMPLED:		10-01-93	10-01-93	10-01-93
DATE ANALYZED:		10-11-93	10-11-93	10-11-93
REMARKS:				

Footnotes:
- * - Medium soils are 120 times the value shown.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Volatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM44

TRAFFIC REPORT NUMBER: / M&E SAMPLE ID:		AFM44 CGSED-7	AFM45 CGSED-6	AFM46 CGSED-5	AFM47 CGSED-4	AFM48 CGSED-3	AFM49 CGSED-2
COMPOUND	CRQL *						
Chloromethane	10	21 U	R	R	R	12 U	13 U
Bromomethane	10	21 U	R	R	R	12 U	13 U
Vinyl Chloride	10	21 U	R	R	R	12 U	13 U
Chloroethane	10	21 U	R	R	R	12 U	13 U
Methylene Chloride	10	21 U	R	R	R	12 U	13 U
Acetone	10	37 J	160 J	140 J	200 J	12	35
Carbon Disulfide	10	21 U	R	R	R	12 U	13 U
1,1-Dichloroethene	10	21 U	R	R	R	12 U	13 U
1,1-Dichloroethane	10	21 U	R	R	R	12 U	13 U
1,2-Dichloroethene(total)	10	21 U	R	R	R	12 U	13 U
Chloroform	10	21 U	R	R	R	12 U	13 U
1,2-Dichloroethane	10	21 U	R	R	R	12 U	13 U
2-Butanone	10	21 UJ	R	R	R	12 U	13 U
1,1,1-Trichloroethane	10	21 U	R	R	R	12 U	13 U
Carbon Tetrachloride	10	21 U	R	R	R	12 U	13 U
Bromodichloromethane	10	21 U	R	R	R	12 U	13 U
1,2-Dichloropropane	10	21 U	R	R	R	12 U	13 U
cis-1,3-Dichloropropene	10	21 U	R	R	R	12 U	13 U
Trichloroethene	10	21 U	R	R	R	12 U	13 U
Dibromochloromethane	10	21 U	R	R	R	12 U	13 U
1,1,2-Trichloroethane	10	21 U	R	R	R	12 U	13 U
Benzene	10	21 U	R	61 J	R	12 U	13 U
trans-1,3-Dichloropropene	10	21 U	R	R	R	12 U	13 U
Bromoform	10	21 U	R	R	R	12 U	13 U
4-Methyl-2-pentanone	10	21 U	R	R	R	12 U	13 U
2-Hexanone	10	21 U	R	R	R	12 U	13 U
Tetrachloroethene	10	21 U	R	R	R	12 U	13 U
Toluene	10	21 U	R	R	R	12 U	13 U
1,1,2,2-Tetrachloroethane	10	21 U	R	R	R	12 U	13 U
Chlorobenzene	10	21 U	R	R	R	12 U	13 U
Ethylbenzene	10	21 U	R	77 J	R	12 U	13 U
Styrene	10	21 U	R	R	R	12 U	13 U
Total Xylenes	10	21 U	R	32 J	R	12 U	13 U
DILUTION FACTOR:		1	1	1	1	1	1
SAMPLE WEIGHT (g):		5	5	5	5	5	5
% MOISTURE:		53	71	74	80	14	21
LEVEL:		LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:		10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
DATE ANALYZED:		10-06-93	10-06-93	10-06-93	10-06-93	10-06-93	10-06-93
REMARKS:							

Footnotes:
- * - Medium soils are 120 times the value shown.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Volatile Water Analysis
ug/L
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFM32	AFM35	AFM43	AFQ26	AFQ27
M&E SAMPLE ID:		CGSED-EB1	CGSEDTB1	CGSED-TB2	CGSED-TB3	CGSED-EB2
COMPOUND	CRQL					
Chloromethane	10	10 U	10 U	10 U	19 J	10 U
Bromomethane	10	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	10	10 U	10 U	10 U	10 U	10 U
Acetone	10	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	10	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethene	10	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	10	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene(total)	10	10 U	10 U	10 U	10 U	10 U
Chloroform	10	13	14	13	19	11
1,2-Dichloroethane	10	10 U	10 U	10 U	10 U	10 U
2-Butanone	10	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	10	10 U	10 U	10 U	10 U	10 U
Carbon Tetrachloride	10	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	10	10 U	10 U	10 U	10 U	10 U
1,2-Dichloropropane	10	10 U	10 U	10 U	10 U	10 U
cis-1,3-Dichloropropene	10	10 U	10 U	10 U	10 U	10 U
Trichloroethene	10	10 U	10 U	10 U	10 U	10 U
Dibromochloromethane	10	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10	10 U	10 U	10 U	10 U	10 U
Benzene	10	10 U	10 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	10	10 U	10 U	10 U	10 U	10 U
Bromoform	10	10 U	5 J	10 U	10 U	10 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	10	10 U	10 U	10 U	10 U	10 U
Toluene	10	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10	10 U	3 J	10 U	10 U	10 U
Chlorobenzene	10	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	10	10 U	10 U	10 U	10 U	10 U
Styrene	10	10 U	10 U	10 U	10 U	10 U
Total Xylenes	10	10 U	10 U	10 U	10 U	10 U
DILUTION FACTOR:		1	1	1	1	1
DATE SAMPLED:		09-28-93	09-28-93	09-29-93	10-01-93	10-01-93
DATE ANALYZED:		10-06-93	10-06-93	10-06-93	10-06-93	10-06-93
REMARKS:		EQUIP. BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK	EQUIPMENT BLANK

Footnotes:
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Semivolatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFM30	AFM31	AFM33	AFM34	AFM36	AFM37
M&E SAMPLE ID:		CGSED-18	CGSED-19	CGSED-10	CGSED-9	CGSED-11	CGSED-12
COMPOUND	CRQL *						
Phenol	330	R	R	R	R	R	R
Bis(2-chloroethyl)ether	330	R	R	R	R	R	R
2-Chlorophenol	330	R	R	R	R	R	R
1,3-Dichlorobenzene	330	R	R	R	R	R	R
1,4-Dichlorobenzene	330	R	R	R	R	R	R
1,2-Dichlorobenzene	330	R	R	R	R	R	R
2-Methylphenol	330	R	R	R	R	R	R
2,2'-Oxybis(1-chloropropane)	330	R	R	R	R	R	R
4-Methylphenol	330	R	R	R	R	R	R
N-Nitroso-di-n-propylamine	330	R	R	R	R	R	R
Hexachloroethane	330	R	R	R	R	R	R
Nitrobenzene	330	R	R	R	R	R	R
Isophorone	330	R	R	R	R	R	R
2-Nitrophenol	330	R	R	R	R	R	R
2,4-Dimethylphenol	330	R	R	R	R	R	R
Bis(2-chloroethoxy)methane	330	R	R	R	R	R	R
2,4-Dichlorophenol	330	R	R	R	R	R	R
1,2,4-Trichlorobenzene	330	R	R	R	R	R	R
Naphthalene	330	R	R	R	R	R	R
4-Chloroaniline	330	R	R	R	R	R	R
Hexachlorobutadiene	330	R	R	R	R	R	R
4-Chloro-3-methylphenol	330	R	R	R	R	R	R
2-Methylnaphthalene	330	R	R	R	R	R	R
Hexachlorocyclopentadiene	330	R	R	R	R	R	R
2,4,6-Trichlorophenol	330	R	R	R	R	R	R
2,4,5-Trichlorophenol	800	R	R	R	R	R	R
2-Chloronaphthalene	330	R	R	R	R	R	R
2-Nitroaniline	800	R	R	R	R	R	R
Dimethylphthalate	330	R	R	R	R	R	R
Acenaphthylene	330	R	R	R	R	R	R
2,6-Dinitrotoluene	330	R	R	R	R	R	R
3-Nitroaniline	800	R	R	R	R	R	R
Acenaphthene	330	R	R	R	R	R	R
2,4-Dinitrophenol	800	R	R	R	R	R	R
4-Nitrophenol	800	R	R	R	R	R	R
Dibenzofuran	330	R	R	R	R	R	R
2,4-Dinitrotoluene	330	R	R	R	R	R	R
Diethylphthalate	330	R	R	R	R	R	R
4-Chlorophenyl-phenylether	330	R	R	R	R	R	R
Fluorene	330	R	R	R	R	R	R
4-Nitroaniline	800	R	R	R	R	R	R
4,6-Dinitro-2-methylphenol	800	R	R	R	R	R	R
N-Nitrosodiphenylamine	330	R	R	R	R	R	R
4-Bromophenyl-phenylether	330	R	R	R	R	R	R
Hexachlorobenzene	330	R	R	R	R	R	R
Pentachlorophenol	800	R	R	R	R	R	R
Phenanthrene	330	R	R	R	R	R	R
Anthracene	330	R	R	R	R	R	R
Carbazole	330	R	R	R	R	R	R
Di-n-butylphthalate	330	R	R	R	R	R	R

Semivolatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFM30	AFM31	AFM33	AFM34	AFM36	AFM37
M&E SAMPLE ID:		CGSED-18	CGSED-19	CGSED-10	CGSED-9	CGSED-11	CGSED-12
COMPOUND	CRQL *						
Fluoranthene	330	R	R	R	R	R	R
Pyrene	330	R	R	R	R	R	R
Butylbenzylphthalate	330	R	R	R	R	R	R
3,3'-Dichlorobenzidine	330	R	R	R	R	R	R
Benzo(a)anthracene	330	R	R	R	R	R	R
Chrysene	330	R	R	R	R	R	R
Bis(2-ethylhexyl)phthalate	330	R	R	R	R	880 J	R
Di-n-octylphthalate	330	R	R	R	R	R	R
Benzo(b)fluoranthene	330	R	R	R	R	R	R
Benzo(k)fluoranthene	330	R	R	R	R	R	R
Benzo(a)pyrene	330	R	R	R	R	R	R
Indeno(1,2,3-cd)pyrene	330	R	R	R	R	R	R
Dibenz(a,h)anthracene	330	R	R	R	R	R	R
Benzo(g,h,i)perylene	330	R	R	R	R	R	R
DILUTION FACTOR:		1	1	1	1	1	1
SAMPLE WEIGHT (g):		30	30	30	30	30	30
% MOISTURE:		27	24	80	40	81	92
LEVEL:		LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:		09-28-93	09-28-93	09-28-93	09-28-93	09-29-93	09-29-93
DATE EXTRACTED:		10-14-93	10-14-93	10-14-93	10-14-93	10-05-93	10-05-93
DATE ANALYZED:		10-28-93	10-28-93	10-28-93	10-28-93	10-28-93	11-01-93
REMARKS:		FIELD DUP	FIELD DUP				

Footnotes:
* - Medium soils are 31.25 times the CRQL shown, rounded to two significant figures.
CRQL - Contract Required Quantitation Limit.
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Semivolatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFM38	AFM39	AFM40	AFM41	AFM42	AFM50
M&E SAMPLE ID:		CGSED-13	CGSED-14	CGSED-15	CGSED-16	CGSED-17	CGSED-1
COMPOUND	CRQL *						
Phenol	330	R	890 UJ	670 U	830 UJ	400 U	R
Bis(2-chloroethyl)ether	330	R	890 U	670 U	830 UJ	400 U	R
2-Chlorophenol	330	R	890 UJ	670 U	830 UJ	400 U	R
1,3-Dichlorobenzene	330	R	890 U	670 U	830 UJ	400 U	R
1,4-Dichlorobenzene	330	R	890 U	670 U	830 UJ	400 U	R
1,2-Dichlorobenzene	330	R	890 U	670 U	830 UJ	400 U	R
2-Methylphenol	330	R	890 UJ	670 U	830 UJ	400 U	R
2,2'-Oxybis(1-chloropropane)	330	R	890 U	670 U	830 UJ	400 U	R
4-Methylphenol	330	R	890 UJ	670 U	830 UJ	400 U	R
N-Nitroso-di-n-propylamine	330	R	890 U	670 U	830 UJ	400 U	R
Hexachloroethane	330	R	890 U	670 U	830 UJ	400 U	R
Nitrobenzene	330	R	890 U	670 U	830 UJ	400 U	R
Isophorone	330	R	890 U	670 U	830 UJ	400 U	R
2-Nitrophenol	330	R	890 UJ	670 U	830 UJ	400 U	R
2,4-Dimethylphenol	330	R	890 UJ	670 U	830 UJ	400 U	R
Bis(2-chloroethoxy)methane	330	R	890 U	670 U	830 UJ	400 U	R
2,4-Dichlorophenol	330	R	890 UJ	670 U	830 UJ	400 U	R
1,2,4-Trichlorobenzene	330	R	890 U	670 U	830 UJ	400 U	R
Naphthalene	330	R	890 U	670 U	830 UJ	400 U	R
4-Chloroaniline	330	R	890 U	670 U	830 UJ	400 U	R
Hexachlorobutadiene	330	R	890 U	670 U	830 UJ	400 U	R
4-Chloro-3-methylphenol	330	R	890 UJ	670 U	830 UJ	400 U	R
2-Methylnaphthalene	330	R	890 U	670 U	830 UJ	400 U	R
Hexachlorocyclopentadiene	330	R	890 U	670 U	830 UJ	400 U	R
2,4,6-Trichlorophenol	330	R	890 UJ	670 U	830 UJ	400 U	R
2,4,5-Trichlorophenol	800	R	2200 UJ	1600 U	2000 UJ	980 U	R
2-Chloronaphthalene	330	R	890 U	670 U	830 UJ	400 U	R
2-Nitroaniline	800	R	2200 U	1600 U	2000 UJ	980 U	R
Dimethylphthalate	330	R	890 U	670 U	830 UJ	400 U	R
Acenaphthylene	330	R	890 U	670 U	830 UJ	400 U	R
2,6-Dinitrotoluene	330	R	890 U	670 U	830 UJ	400 U	R
3-Nitroaniline	800	R	2200 U	1600 U	2000 UJ	980 U	R
Acenaphthene	330	R	890 U	670 U	830 UJ	400 U	R
2,4-Dinitrophenol	800	R	2200 UJ	1600 U	2000 UJ	980 U	R
4-Nitrophenol	800	R	2200 UJ	1600 U	2000 UJ	980 U	R
Dibenzofuran	330	R	890 U	670 U	830 UJ	400 U	R
2,4-Dinitrotoluene	330	R	890 U	670 U	830 UJ	400 U	R
Diethylphthalate	330	R	890 U	670 U	830 UJ	400 U	R
4-Chlorophenyl-phenylether	330	R	890 U	670 U	830 UJ	400 U	R
Fluorene	330	R	890 U	670 U	830 UJ	400 U	R
4-Nitroaniline	800	R	2200 U	1600 U	2000 UJ	980 U	R
4,6-Dinitro-2-methylphenol	800	R	2200 UJ	1600 U	2000 UJ	980 U	R
N-Nitrosodiphenylamine	330	R	890 U	670 U	830 UJ	400 U	R
4-Bromophenyl-phenylether	330	R	890 U	670 U	830 UJ	400 U	R
Hexachlorobenzene	330	R	890 U	670 U	830 UJ	400 U	R
Pentachlorophenol	800	R	2200 UJ	1600 U	2000 UJ	980 U	R
Phenanthrene	330	R	890 U	670 U	830 UJ	400 U	R
Anthracene	330	R	890 U	670 U	830 UJ	400 U	R
Carbazole	330	R	890 U	670 U	830 UJ	400 U	R
Di-n-butylphthalate	330	R	1200 U	1000 U	830 UJ	780 U	R

Semivolatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFM38	AFM39	AFM40	AFM41	AFM42	AFM50
M&E SAMPLE ID:		CGSED-13	CGSED-14	CGSED-15	CGSED-16	CGSED-17	CGSED-1
COMPOUND	CRQL *						
Fluoranthene	330	R	890 U	670 U	830 UJ	400 U	R
Pyrene	330	R	890 U	670 U	330 UJ	400 U	R
Butylbenzylphthalate	330	R	890 U	670 U	330 UJ	400 U	R
3,3'-Dichlorobenzidine	330	R	890 U	670 U	330 UJ	400 U	R
Benzo(a)anthracene	330	R	890 U	670 U	330 UJ	400 U	R
Chrysene	330	R	890 U	670 U	330 UJ	400 U	R
Bis(2-ethylhexyl)phthalate	330	R	890 U	230 J	330 UJ	400 U	140 J
Di-n-octylphthalate	330	R	890 U	670 U	330 UJ	400 U	R
Benzo(b)fluoranthene	330	R	890 U	670 U	330 UJ	400 U	R
Benzo(k)fluoranthene	330	R	890 U	670 U	330 UJ	400 U	R
Benzo(a)pyrene	330	R	890 U	670 U	330 UJ	400 U	R
Indeno(1,2,3-cd)pyrene	330	R	890 U	670 U	330 UJ	400 U	R
Dibenz(a,h)anthracene	330	R	890 U	670 U	330 UJ	400 U	R
Benzo(g,h,i)perylene	330	R	890 U	670 U	330 UJ	400 U	R
DILUTION FACTOR:		1	1	1	1	1	1
SAMPLE WEIGHT (g):		30	30	30	30	30	30
% MOISTURE:		89	63	51	60	18	49
LEVEL:		LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:		09-29-93	09-29-93	09-29-93	09-29-93	09-29-93	10-01-93
DATE EXTRACTED:		10-05-93	10-05-93	10-05-93	10-05-93	10-05-93	10-13-93
DATE ANALYZED:		11-01-93	11-01-93	11-01-93	11-01-93	11-01-93	11-01-93
REMARKS:							

Footnotes:
* - Medium soils are 31.25 times the CRQL shown, rounded to two significant figures.
CRQL - Contract Required Quantitation Limit.
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Semivolatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFQ24	AFQ25	AFQ28
M&E SAMPLE ID:		CGSED-8	CGSED-20	CGSED-21
COMPOUND	CRQL *			
Phenol	330	R	R	R
Bis(2-chloroethyl)ether	330	R	R	R
2-Chlorophenol	330	R	R	R
1,3-Dichlorobenzene	330	R	R	R
1,4-Dichlorobenzene	330	R	R	R
1,2-Dichlorobenzene	330	R	R	R
2-Methylphenol	330	R	R	R
2,2'-Oxybis(1-chloropropane)	330	R	R	R
4-Methylphenol	330	R	R	R
N-Nitroso-di-n-propylamine	330	R	R	R
Hexachloroethane	330	R	R	R
Nitrobenzene	330	R	R	R
Isophorone	330	R	R	R
2-Nitrophenol	330	R	R	R
2,4-Dimethylphenol	330	R	R	R
Bis(2-chloroethoxy)methane	330	R	R	R
2,4-Dichlorophenol	330	R	R	R
1,2,4-Trichlorobenzene	330	R	R	R
Naphthalene	330	R	R	R
4-Chloroaniline	330	R	R	R
Hexachlorobutadiene	330	R	R	R
4-Chloro-3-methylphenol	330	R	R	R
2-Methylnaphthalene	330	R	R	R
Hexachlorocyclopentadiene	330	R	R	R
2,4,6-Trichlorophenol	330	R	R	R
2,4,5-Trichlorophenol	800	R	R	R
2-Chloronaphthalene	330	R	R	R
2-Nitroaniline	800	R	R	R
Dimethylphthalate	330	R	R	R
Acenaphthylene	330	R	R	R
2,6-Dinitrotoluene	330	R	R	R
3-Nitroaniline	800	R	R	R
Acenaphthene	330	R	R	R
2,4-Dinitrophenol	800	R	R	R
4-Nitrophenol	800	R	R	R
Dibenzofuran	330	R	R	R
2,4-Dinitrotoluene	330	R	R	R
Diethylphthalate	330	R	R	R
4-Chlorophenyl-phenylether	330	R	R	R
Fluorene	330	R	R	R
4-Nitroaniline	800	R	R	R
4,6-Dinitro-2-methylphenol	800	R	R	R
N-Nitrosodiphenylamine	330	R	R	R
4-Bromophenyl-phenylether	330	R	R	R
Hexachlorobenzene	330	R	R	R
Pentachlorophenol	800	R	R	R
Phenanthrene	330	R	R	R
Anthracene	330	R	R	R
Carbazole	330	R	R	R
Di-n-butylphthalate	330	R	R	R

Semivolatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFQ24	AFQ25	AFQ28
M&E SAMPLE ID:		CGSED-3	CGSED-20	CGSED-21
COMPOUND	CRQL *			
Fluoranthene	330	R	R	R
Pyrene	330	R	R	R
Butylbenzylphthalate	330	R	R	R
3,3'-Dichlorobenzidine	330	R	R	R
Benzo(a)anthracene	330	R	R	R
Chrysene	330	R	R	R
Bis(2-ethylhexyl)phthalate	330	260 J	R	R
Di-n-octylphthalate	330	R	R	R
Benzo(b)fluoranthene	330	R	R	R
Benzo(k)fluoranthene	330	R	R	R
Benzo(a)pyrene	330	R	R	R
Indeno(1,2,3-cd)pyrene	330	R	R	R
Dibenz(a,h)anthracene	330	R	R	R
Benzo(g,h,i)perylene	330	R	R	R
DILUTION FACTOR:		1	1	1
SAMPLE WEIGHT (g):		30	30	30
% MOISTURE:		70	74	39
LEVEL:		LOW	LOW	LOW
DATE SAMPLED:		10-01-93	10-01-93	10-01-93
DATE EXTRACTED:		10-13-93	10-13-93	10-13-93
DATE ANALYZED:		11-01-93	11-01-93	11-01-93
REMARKS:				

Footnotes:
- * - Medium soils are 31.25 times the CRQL shown, rounded to two significant figures.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Semivolatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM44

TRAFFIC REPORT NUMBER:		AFM44	AFM45	AFM46	AFM47	AFM48	AFM49
M&E SAMPLE ID:		CGSED-7	CGSED-6	CGSED-5	CGSED-4	CGSED-3	CGSED-2
COMPOUND	CRQL *						
Phenol	330	700 U	R	R	R	380 UJ	420 U
Bis(2-chloroethyl)ether	330	700 U	R	R	R	380 UJ	420 U
2-Chlorophenol	330	700 U	R	R	R	380 UJ	420 U
1,3-Dichlorobenzene	330	700 U	R	R	R	380 UJ	420 U
1,4-Dichlorobenzene	330	700 U	R	R	R	380 UJ	420 U
1,2-Dichlorobenzene	330	700 U	R	R	R	380 UJ	420 U
2-Methylphenol	330	700 U	R	R	R	380 UJ	420 U
2,2'-Oxybis(1-chloropropane)	330	700 U	R	R	R	380 UJ	420 U
4-Methylphenol	330	700 U	R	R	R	380 UJ	420 U
N-Nitroso-di-n-propylamine	330	700 U	R	R	R	380 UJ	420 U
Hexachloroethane	330	700 U	R	R	R	380 UJ	420 U
Nitrobenzene	330	700 U	R	R	R	380 UJ	420 U
Isophorone	330	700 U	R	R	R	380 UJ	420 U
2-Nitrophenol	330	700 U	R	R	R	380 UJ	420 U
2,4-Dimethylphenol	330	700 U	R	R	R	380 UJ	420 U
Bis(2-chloroethoxy)methane	330	700 U	R	R	R	380 UJ	420 U
2,4-Dichlorophenol	330	700 U	R	R	R	380 UJ	420 U
1,2,4-Trichlorobenzene	330	700 U	R	R	R	380 UJ	420 U
Naphthalene	330	700 U	R	R	R	380 UJ	420 U
4-Chloroaniline	330	700 U	R	R	R	380 UJ	420 U
Hexachlorobutadiene	330	700 U	R	R	R	380 UJ	420 U
4-Chloro-3-methylphenol	330	700 U	R	R	R	380 UJ	420 U
2-Methylnaphthalene	330	700 U	R	R	R	380 UJ	420 U
Hexachlorocyclopentadiene	330	700 U	R	R	R	380 UJ	420 U
2,4,6-Trichlorophenol	330	700 U	R	R	R	380 UJ	420 U
2,4,5-Trichlorophenol	800	1700 U	R	R	R	930 UJ	1000 U
2-Chloronaphthalene	330	700 U	R	R	R	380 UJ	420 U
2-Nitroaniline	800	1700 U	R	R	R	930 UJ	1000 U
Dimethylphthalate	330	700 U	R	R	R	380 UJ	420 U
Acenaphthylene	330	700 U	R	R	R	380 UJ	420 U
2,6-Dinitrotoluene	330	700 U	R	R	R	380 UJ	420 U
3-Nitroaniline	800	1700 U	R	R	R	930 UJ	1000 U
Acenaphthene	330	700 U	R	R	R	380 UJ	420 U
2,4-Dinitrophenol	800	1700 U	R	R	R	930 UJ	1000 U
4-Nitrophenol	800	1700 UJ	R	R	R	930 UJ	1000 UJ
Dibenzofuran	330	700 U	R	R	R	380 UJ	420 U
2,4-Dinitrotoluene	330	700 U	R	R	R	380 UJ	420 U
Diethylphthalate	330	700 U	R	R	R	380 UJ	420 U
4-Chlorophenyl-phenylether	330	700 U	R	R	R	380 UJ	420 U
Fluorene	330	700 U	R	R	R	380 UJ	420 U
4-Nitroaniline	800	1700 U	R	R	R	930 UJ	1000 U

Semivolatile Sediment Analysis
ug/kg
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM44

TRAFFIC REPORT NUMBER:		AFM44	AFM45	AFM46	AFM47	AFM48	AFM49
M&E SAMPLE ID:		CGSED-7	CGSED-6	CGSED-5	CGSED-4	CGSED-3	CGSED-2
COMPOUND	CRQL *						
4,6-Dinitro-2-methylphenol	800	1700 U	R	R	R	930 UJ	1000 U
N-Nitrosodiphenylamine	330	700 U	R	R	R	380 UJ	420 U
4-Bromophenyl-phenylether	330	700 U	R	R	R	380 UJ	420 U
Hexachlorobenzene	330	700 U	R	R	R	380 UJ	420 U
Pentachlorophenol	800	1700 UJ	R	R	R	930 UJ	1000 U
Phenanthrene	330	700 U	R	R	350 J	250 J	420 U
Anthracene	330	700 U	R	R	R	100 J	420 U
Carbazole	330	700 U	R	R	R	380 UJ	420 U
Di-n-butylphthalate	330	700 U	R	R	R	380 U	420 U
Fluoranthene	330	700 U	R	R	400 J	540 J	420 U
Pyrene	330	700 U	R	R	390 J	400 J	85 J
Butylbenzylphthalate	330	700 U	R	R	R	380 UJ	420 U
3,3'-Dichlorobenzidine	330	700 U	R	R	R	380 UJ	420 U
Benzo(a)anthracene	330	700 U	R	R	R	260 J	420 U
Chrysene	330	700 U	R	R	360 J	230 J	420 U
Bis(2-ethylhexyl)phthalate	330	190 J	650 J	740 J	1200 J	380 UJ	150 J
Di-n-octylphthalate	330	700 U	R	R	R	380 UJ	420 U
Benzo(b)fluoranthene	330	700 U	R	R	R	310 J	420 U
Benzo(k)fluoranthene	330	700 U	R	R	R	380 UJ	420 U
Benzo(a)pyrene	330	200 J	R	R	R	190 J	420 U
Indeno(1,2,3-cd)pyrene	330	700 U	R	R	R	120 J	420 U
Dibenz(a,h)anthracene	330	700 U	R	R	R	380 UJ	420 U
Benzo(g,h,i)perylene	330	700 U	R	R	R	380 UJ	420 U
DILUTION FACTOR:		1	1	1	1	1	1
SAMPLE WEIGHT (g):		30	30	30	30	30	30
% MOISTURE:		53	71	74	80	14	21
LEVEL:		LOW	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:		10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
DATE EXTRACTED:		10-06-93	10-06-93	10-06-93	10-06-93	10-06-93	10-06-93
DATE ANALYZED:		10-22-93	10-21-93	10-21-93	10-21-93	10-22-93	10-28-93
REMARKS:							

Footnotes:
- * - Medium soils are 31.25 times the CRQL shown, rounded to two significant figures.
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Semivolatile Water Analysis

ug/L
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFM32	AFQ27
M&E SAMPLE ID:		CGSED-EB1	CGSED-EB2
COMPOUND	CRQL		
Phenol	10	R	10 U
Bis(2-chloroethyl)ether	10	R	10 U
2-Chlorophenol	10	R	10 U
1,3-Dichlorobenzene	10	R	10 U
1,4-Dichlorobenzene	10	R	10 U
1,2-Dichlorobenzene	10	R	10 U
2-Methylphenol	10	R	10 U
2,2'-Oxybis(1-chloropropene)	10	R	10 U
4-Methylphenol	10	R	10 U
N-Nitroso-di-n-propylamine	10	R	10 U
Hexachloroethane	10	R	10 U
Nitrobenzene	10	R	10 U
Isophorone	10	R	10 U
2-Nitrophenol	10	R	10 U
2,4-Dimethylphenol	10	R	10 U
Bis(2-chloroethoxy)methane	10	R	10 U
2,4-Dichlorophenol	10	R	10 U
1,2,4-Trichlorobenzene	10	R	10 U
Naphthalene	10	R	10 U
4-Chloroaniline	10	R	10 U
Hexachlorobutadiene	10	R	10 U
4-Chloro-3-methylphenol	10	R	10 U
2-Methylnaphthalene	10	R	10 U
Hexachlorocyclopentadiene	10	R	10 U
2,4,6-Trichlorophenol	10	R	10 U
2,4,5-Trichlorophenol	25	R	25 U
2-Chloronaphthalene	10	R	10 U
2-Nitroaniline	25	R	25 U
Dimethylphthalate	10	R	10 U
Acenaphthylene	10	R	10 U
2,6-Dinitrotoluene	10	R	10 U
3-Nitroaniline	25	R	25 U
Acenaphthene	10	R	10 U
2,4-Dinitrophenol	25	R	25 U
4-Nitrophenol	25	R	25 U
Dibenzofuran	10	R	10 U
2,4-Dinitrotoluene	10	R	10 U
Diethylphthalate	10	R	2 J
4-Chlorophenyl-phenylether	10	R	10 U
Fluorene	10	R	10 U
4-Nitroaniline	25	R	25 U

Semivolatile Water Analysis
ug/L
(SOW:OLM01.8)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: AFM30

TRAFFIC REPORT NUMBER:		AFM32	AFQ27
M&E SAMPLE ID:		CGSED-EB1	CGSED-EB2
COMPOUND	CRQL		
4,6-Dinitro-2-methylphenol	25	R	25 U
N-Nitrosodiphenylamine	10	R	10 U
4-Bromophenyl-phenylether	10	R	10 U
Hexachlorobenzene	10	R	10 U
Pentachlorophenol	25	R	25 U
Phenanthrene	10	R	10 U
Anthracene	10	R	10 U
Carbazole	10	R	10 U
Di-n-butylphthalate	10	R	5 J
Fluoranthene	10	R	10 U
Pyrene	10	R	10 U
Butylbenzylphthalate	10	R	10 U
3,3'-Dichlorobenzidine	10	R	10 U
Benzo(a)anthracene	10	R	10 U
Chrysene	10	R	10 U
Bis(2-ethylhexyl)phthalate	10	R	10 U
Di-n-octylphthalate	10	R	10 U
Benzo(b)fluoranthene	10	R	10 U
Benzo(k)fluoranthene	10	R	10 U
Benzo(a)pyrene	10	R	10 U
Indeno(1,2,3-cd)pyrene	10	R	10 U
Dibenz(a,h)anthracene	10	R	10 U
Benzo(g,h,i)perylene	10	R	10 U
DILUTION FACTOR:		1	1
DATE SAMPLED:		09-28-93	10-01-93
DATE EXTRACTED:		10-14-93	10-08-93
DATE ANALYZED:		11-01-93	10-28-93
REMARKS:		EQUIP. BLANK	TRIP BLANK

Footnotes:
- CRQL - Contract Required Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Polycyclic Aromatic Hydrocarbon (PAH) Sediment Analysis
ug/Kg for Sediments, ug/L for Aqueous QC Samples

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-01 SDG NO.: SAA374

TRAFFIC REPORT NUMBER: / M&E SAMPLE ID:			SAA374 CGSED-20	SAA376 CGSED-EB2	SAA378 CGSED-21
PAH COMPOUND	Soil PQL (ug/Kg)	Aqueous PQL (ug/L)			
Naphthalene	6.6	0.2	13 U	0.1 U	20 UJ
2-Methylnaphthalene	6.6	0.2	13 U	0.1 U	20 UJ
2-Chloronaphthalene	6.6	0.2	13 UJ	0.1 U	20 UJ
Acenaphthylene	6.6	0.2	13 UJ	0.1 U	20 UJ
Acenaphthene	6.6	0.2	13 UJ	0.1 U	20 UJ
Fluorene	6.6	0.2	13 UJ	0.1 U	20 UJ
Phenanthrene	6.6	0.2	37 J	0.1 U	20 UJ
Anthracene	6.6	0.2	13 UJ	0.1 U	20 UJ
Fluoranthene	6.6	0.2	81 J	0.1 U	20 UJ
Pyrene	6.6	0.2	270 J	0.1 U	15 J
Benzo(a)anthracene	6.6	0.2	34	0.1 U	20 UJ
Chrysene	6.6	0.2	46	0.1 U	20 UJ
Benzo(b)fluoranthene	6.6	0.2	39 J	0.1 U	20 UJ
Benzo(k)fluoranthene	6.6	0.2	34 J	0.1 U	20 UJ
Benzo(a)pyrene	6.6	0.2	40 J	0.1 U	20 UJ
Indeno(1,2,3-cd)pyrene	6.6	0.2	82 J	0.1 U	20 UJ
Dibenz(a,h)anthracene	6.6	0.2	38 J	0.1 U	20 UJ
Benzo(g,h,i)perylene	6.6	0.2	84 J	0.1 U	20 UJ

DILUTION FACTOR:	1	1	1
SAMPLE WEIGHT (g):	100	1000 ml	30.5
PERCENT SOLIDS:	31	NA	64
LEVEL:	LOW	LOW	LOW
DATE SAMPLED:	10/01/93	10/01/93	10/01/93
DATE EXTRACTED:	10/07/93	10/05/93	10/07/93
DATE ANALYZED:	10/17/93	10/14/93	11/02/93
REMARKS:	Duplicate of SAA372	Equipment Blank	

Footnotes:
- PQL - Practical Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Polycyclic Aromatic Hydrocarbon (PAH) Sediment Analysis
ug/Kg for Sediments, ug/L for Aqueous QC Samples

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-01 SDG NO.: SAA334

TRAFFIC REPORT NUMBER: M&E SAMPLE ID:			SAA334 CGSED-18	SAA335 CGSED-19	SAA338 CGSED-EB1	SAA340 CGSED-10	SAA342RE CGSED-9
PAH COMPOUND	Soil PQL (ug/Kg)	Aqueous PQL (ug/L)					
Naphthalene	6.6	0.2	25 J	16 J	0.1 U	93 J	17 U
2-Methylnaphthalene	6.6	0.2	10 J	9 J	0.1 U	20 J	6 J
2-Chloronaphthalene	6.6	0.2	17 UJ	17 U	0.1 U	20 U	17 U
Acenaphthylene	6.6	0.2	36 J	56	0.1 U	20 U	17 U
Acenaphthene	6.6	0.2	17 UJ	14 J	0.1 U	20 U	17 U
Fluorene	6.6	0.2	14 J	21	0.1 U	20 U	8 J
Phenanthrene	6.6	0.2	170 J	260 J	0.1 U	28	22
Anthracene	6.6	0.2	50 J	87 J	0.1 U	20 U	17 U
Fluoranthene	6.6	0.2	340 J	670 J	0.1 U	46	11 J
Pyrene	6.6	0.2	1300 J	870 J	0.1 U	110 J	26
Benzo(a)anthracene	6.6	0.2	310 J	450 J	0.1 U	14 J	17 U
Chrysene	6.6	0.2	280 J	420 J	0.1 U	24	8 J
Benzo(b)fluoranthene	6.6	0.2	270 J	480 J	0.1 U	21 J	6 J
Benzo(k)fluoranthene	6.6	0.2	500 J	430 J	0.1 U	21 J	6 J
Benzo(a)pyrene	6.6	0.2	290 J	520 J	0.1 U	21 J	6 J
Indeno(1,2,3-cd)pyrene	6.6	0.2	270 J	800 J	0.1 U	42 J	7 J
Dibenz(a,h)anthracene	6.6	0.2	100 J	320 J	0.1 U	20 UJ	17 UJ
Benzo(g,h,i)perylene	6.6	0.2	290 J	750 J	0.1 U	41 J	8 J

DILUTION FACTOR:	1	1	1	1	1
SAMPLE WEIGHT (g):	30.5	30.5	1000 ml	79.3	52.5
PERCENT SOLIDS:	76	74	NA	24	44
LEVEL:	LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:	9/28/93	9/28/93	9/28/93	9/28/93	9/28/93
DATE EXTRACTED:	10/05/93	10/05/93	10/05/93	10/05/93	10/05/93
DATE ANALYZED:	11/01/93	10/17/93	10/14/93	10/17/93	10/20/93
REMARKS:			Equipment Blank		

Footnotes:
- PQL - Practical Quantitation Limit.
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- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Polycyclic Aromatic Hydrocarbon (PAH) Sediment Analysis
ug/Kg for Sediments, ug/L for Aqueous QC Samples

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-01 SDG NO.: SAA334

TRAFFIC REPORT NUMBER:			SAA344	SAA346	SAA348	SAA350	SAA352
M&E SAMPLE ID:			CGSED-17	CGSED-16	CGSED-15	CGSED-14	CGSED-13
PAH COMPOUND	Soil PQL (ug/Kg)	Aqueous PQL (ug/L)					
Naphthalene	6.6	0.2	16 U	13 J	17 U	17 U	38 U
2-Methylnaphthalene	6.6	0.2	16 U	17 U	17 U	17 U	38 U
2-Chloronaphthalene	6.6	0.2	16 U	17 U	17 U	17 U	38 U
Acenaphthylene	6.6	0.2	4 J	15 J	17 U	17 U	38 U
Acenaphthene	6.6	0.2	16 U	19	17 U	17 U	38 U
Fluorene	6.6	0.2	16 U	30	17 U	17 U	38 U
Phenanthrene	6.6	0.2	18	200 J	17	21	49
Anthracene	6.6	0.2	16 U	50	17 U	17 U	38 U
Fluoranthene	6.6	0.2	35	390 J	38	43	61
Pyrene	6.6	0.2	34	710 J	44	44	50
Benzo(a)anthracene	6.6	0.2	17	190 J	13 J	12 J	38 U
Chrysene	6.6	0.2	20	210 J	19	20 J	25 J
Benzo(b)fluoranthene	6.6	0.2	18	180 J	24 J	31 J	22 J
Benzo(k)fluoranthene	6.6	0.2	39	130 J	20 J	18 J	38 UJ
Benzo(a)pyrene	6.6	0.2	18	190 J	16 J	18 J	38 UJ
Indeno(1,2,3-cd)pyrene	6.6	0.2	9 J	340 J	35 J	32 J	38 UJ
Dibenz(a,h)anthracene	6.6	0.2	4 J	150 J	17 UJ	17 UJ	38 UJ
Benzo(g,h,i)perylene	6.6	0.2	8 J	320 J	34 J	34 J	38 UJ
DILUTION FACTOR:			1	1	1	1	1
SAMPLE WEIGHT (g):			30.5	57.5	52.4	72.2	85.7
PERCENT SOLIDS:			82	40	45	32	12
LEVEL:			LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:			9/28/93	9/29/93	9/29/93	9/29/93	9/29/93
DATE EXTRACTED:			10/05/93	10/05/93	10/05/93	10/05/93	10/05/93
DATE ANALYZED:			10/17/93	10/17/93	10/17/93	10/17/93	10/17/93
REMARKS:							

Footnotes:
- PQL - Practical Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Polycyclic Aromatic Hydrocarbon (PAH) Sediment Analysis
ug/Kg for Sediments, ug/L for Aqueous QC Samples

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-01 SDG NO.: SAA334

TRAFFIC REPORT NUMBER:			SAA354	SAA356	SAA358	SAA360	SAA362
M&E SAMPLE ID:			CGSED-12	CGSED-11	CGSED-7	CGSED-6	CGSED-5
PAH COMPOUND	Soil PQL (ug/Kg)	Aqueous PQL (ug/L)					
Naphthalene	6.6	0.2	45 U	22 U	23 U	21 U	22 U
2-Methylnaphthalene	6.6	0.2	45 U	22 U	23 U	21 U	22 U
2-Chloronaphthalene	6.6	0.2	45 U	22 U	23 U	21 U	22 U
Acenaphthylene	6.6	0.2	45 U	22 U	23 U	21 U	22 U
Acenaphthene	6.6	0.2	45 U	22 U	23 U	21 U	22 U
Fluorene	6.6	0.2	45 U	22 U	23 U	21 U	22 U
Phenanthrene	6.6	0.2	43 J	26	28	20 J	19 J
Anthracene	6.6	0.2	45 U	22 U	23 U	21 U	22 U
Fluoranthene	6.6	0.2	48	50	66	37	35
Pyrene	6.6	0.2	44 J	49	98	46	45
Benzo(a)anthracene	6.6	0.2	45 U	22 U	26	12 J	11 J
Chrysene	6.6	0.2	45 U	28	33	21	19 J
Benzo(b)fluoranthene	6.6	0.2	45 UJ	25 J	32 J	24 J	23 J
Benzo(k)fluoranthene	6.6	0.2	45 UJ	13 J	35 J	8 J	7 J
Benzo(a)pyrene	6.6	0.2	45 UJ	14 J	32 J	120 J	13 J
Indeno(1,2,3-cd)pyrene	6.6	0.2	45 UJ	25 J	73 J	41 J	39 J
Dibenz(a,h)anthracene	6.6	0.2	45 UJ	22 UJ	23 UJ	28 J	28 J
Benzo(g,h,i)perylene	6.6	0.2	45 UJ	27 J	73 J	38 J	38 J
DILUTION FACTOR:			1	1	1	1	1
SAMPLE WEIGHT (g):			79.3	89.6	30.2	100	100
PERCENT SOLIDS:			11	20	55	19	18
LEVEL:			LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:			9/29/93	9/29/93	10/01/93	10/01/93	10/01/93
DATE EXTRACTED:			10/05/93	10/05/93	10/07/93	10/07/93	10/07/93
DATE ANALYZED:			10/17/93	10/17/93	10/17/93	10/15/93	10/15/93
REMARKS:							

Footnotes:
- PQL - Practical Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Polycyclic Aromatic Hydrocarbon (PAH) Sediment Analysis
ug/Kg for Sediments, ug/L for Aqueous QC Samples

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-01 SDG NO.: SAA334

TRAFFIC REPORT NUMBER:			SAA364	SAA366	SAA368RE	SAA370	SAA372
M&E SAMPLE ID:			CGSED-4	CGSED-3	CGSED-2	CGSED-1	CGSED-8
PAH COMPOUND	Soil PQL (ug/Kg)	Aqueous PQL (ug/L)					
Naphthalene	6.6	0.2	16 U	15 U	16 U	25 U	13 U
2-Methylnaphthalene	6.6	0.2	16 U	15 U	16 U	25 U	13 U
2-Chloronaphthalene	6.6	0.2	16 U	15 U	16 U	25 U	13 U
Acenaphthylene	6.6	0.2	16 U	15 U	8 J	25 U	13 U
Acenaphthene	6.6	0.2	16 U	15 U	16 U	25 U	13 U
Fluorene	6.6	0.2	16 U	5 J	16	25 U	13 U
Phenanthrene	6.6	0.2	44	42	86 J	8 J	42
Anthracene	6.6	0.2	16 U	6 J	15 J	25 U	13 U
Fluoranthene	6.6	0.2	92 J	61	120 J	17 J	83 J
Pyrene	6.6	0.2	140 J	68 J	260 J	22 J	190 J
Benzo(a)anthracene	6.6	0.2	30	27 J	60	6 J	36
Chrysene	6.6	0.2	47	32	68 J	12 J	55 J
Benzo(b)fluoranthene	6.6	0.2	45 J	35 J	59 J	11 J	52 J
Benzo(k)fluoranthene	6.6	0.2	36 J	15 J	48 J	25 UJ	30 J
Benzo(a)pyrene	6.6	0.2	39 J	28 J	62 J	9 J	45 J
Indeno(1,2,3-cd)pyrene	6.6	0.2	83 J	52 J	90 J	30 J	74 J
Dibenz(a,h)anthracene	6.6	0.2	28 J	35 J	45 J	25 J	35 J
Benzo(g,h,i)perylene	6.6	0.2	80 J	46 J	99 J	29 J	77 J
DILUTION FACTOR:			1	1	1	1	1
SAMPLE WEIGHT (g):			100	30.4	30.2	30.5	100.5
PERCENT SOLIDS:			24	84	82	51	31
LEVEL:			LOW	LOW	LOW	LOW	LOW
DATE SAMPLED:			10/01/93	10/01/93	10/01/93	10/01/93	10/01/93
DATE EXTRACTED:			10/07/93	10/07/93	10/07/93	10/07/93	10/07/93
DATE ANALYZED:			10/17/93	10/14/93	10/21/93	10/14/93	10/21/93
REMARKS:							Duplicate of SAA374

Footnotes:
- PQL - Practical Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Inorganic Soil Analy
mg/kg
(SOW:ILM02.1)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: MAAC16

ANALYTES		CRDL (ug/L)	IDL (ug/L)	MAAC27	MAAC76
TRAFFIC REPORT NUMBER:				MAAC27	MAAC76
M&E SAMPLE ID:				CGSED-17	90-005-TT 1392
Aluminum	P	200	15.5	4500	158
Antimony	P	60	9.2	2.3 U	6.0 U
Arsenic	P	10	2.1	6.7	31.4
Barium	P	200	3.6	16.2	3.5 U
Beryllium	P	5	0.2	0.05 U	0.04 U
Cadmium	P	5	1	0.25 U	2.1
Calcium	P	5,000	24.2	538 J	176000 J
Chromium	P	10	4.1	15.5	5.6
Cobalt	P	50	3	3.5	7.5
Copper	P	25	2.9	8.8 U	90.8
Iron	P	100	9.2	6410	5540
Lead	P	3	2.9	23.7 J	330
Magnesium	P	5,000	32.3	2310	114000
Manganese	P	15	1.3	132	381
Mercury	CV	0.2	0.1	0.06 U	26.3
Nickel	P	40	3.9	10.2	6.3
Potassium	P	5,000	125.3	716	72.7 U
Selenium	P	5	2.8	0.7 U	0.56 U
Silver	P	10	3.7	0.93 U	0.74 U
Sodium	P	5,000	41.2	63.1 U	79 U
Thallium	P	10	1.6	0.4 U	0.32 U
Vanadium	P	50	2.6	10.5	26.8
Zinc	P	20	8.5	18.3	219
DATE SAMPLED:				9-29-93	9-28-93
% SOLIDS				79.5	99.5
ICP SAMPLE WT. (g)				1	1
HG SAMPLE WT. (g)				0.21	0.2
REMARKS:					PE SAMPLE

Footnotes:
- F - Furnace AA
- P - !CP/Flame AE
- CV - Cold Vapor
- CA - Semi Automated
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit
- ** - Specific sample detection limits are listed on the accompanying table.

Inorganic Sediment Analysis
mg/kg
(SOW:ILM02.1)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: MAAC28

TRAFFIC REPORT NUMBER:				MAAC28	MAAC29	MAAC30	MAAC31	MAAC32
M&E SAMPLE ID:				CGSED-7	CGSED-6	CGSED-5	CGSED-4	CGSED-3
ANALYTES		CRDL (ug/L)	IDL (ug/L)					
Aluminum	P	200	15.5	6870	8110 J	7360 J	13800 J	5290
Antimony	P	60	9.2	3.6 U	R	R	R	1.9 U
Arsenic	P	10	2.1	13	19.3 J	18.9 J	20.3 J	11.6
Barium	P	200	3.6	24.7	51.8 J	46.9 J	83.9 J	28.4
Beryllium	P	5	0.2	0.08 U	0.87 J	0.72 J	R	0.04 U
Cadmium	P	5	1	0.39 U	R	R	R	0.21 U
Calcium	P	5,000	24.2	1300 J	11700 J	10500 J	4420 J	1260 J
Chromium	P	10	4.1	12.1	16.8 J	14.8 J	32.2 J	17.7
Cobalt	P	50	3	4.2	3.7 J	3.5 J	17.3 J	4.0
Copper	P	25	2.9	5.2	8.7 J	6.7 J	15.5 J	5.8
Iron	P	100	9.2	5580	6540 J	6170 J	14400 J	10300
Lead	P	3	2.9	19	29.3 J	27.5 J	60.4 J	5.5
Magnesium	P	5,000	32.3	1290	889 J	840 J	3940 J	3060
Manganese	P	15	1.3	433	443 J	437 J	707 J	168
Mercury	CV	0.2	0.1	0.09 U	R	R	R	0.05 U
Nickel	P	40	3.9	6.6	11.8 J	6.1 J	25.1 J	11.7
Potassium	P	5,000	125.3	329	R	211 J	1370 J	1520
Selenium	P	5	2.8	1.1 U	R	R	R	0.58 U
Silver	P	10	3.7	1.4 U	R	R	R	0.76 U
Sodium	P	5,000	41.2	146 U	R	R	R	142 U
Thallium	P	10	1.6	0.62 U	R	R	R	0.33 U
Vanadium	P	50	2.6	11.2	7.9 J	4.1 J	30.7 J	14.6
Zinc	P	20	8.5	21.3	30.1 J	33.7 J	103 J	25.2
DATE SAMPLED:				10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
% SOLIDS				48.1	15.7	17.6	19.5	85.8
ICP SAMPLE WT. (g)				1.07	1.04	1.11	1.02	1.13
HG SAMPLE WT. (g)				0.22	0.21	0.2	0.2	0.22
REMARKS:								

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- CA - Semi Automated
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit
- ** - Specific sample detection limits are listed on the accompanying table.

Inorganic Sediment Analysis
mg/kg
(SOW:ILM02.1)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: MAAC28

TRAFFIC REPORT NUMBER: / M&E SAMPLE ID:				MAAC33 CGSED-2	MAAC34 CGSED-1	MAAC35 CGSED-8	MAAC36 CGSED-20	MAAC38 CGSED-21
ANALYTES		CRDL (ug/L)	IDL (ug/L)					
Aluminum	P	200	15.5	6680	6640	9880 J	11000 J	7060
Antimony	P	60	9.2	2.0 U	3.7 U	R	R	3.2 U
Arsenic	P	10	2.1	26	4.1	21.8 J	18.9 J	5.1
Barium	P	200	3.6	48.7	44.8	56.6 J	65 J	40.6
Beryllium	P	5	0.2	0.2	0.08 U	R	R	0.31
Cadmium	P	5	1	0.22 U	0.4 U	R	R	0.35 U
Calcium	P	5,000	24.2	2610 J	2720 J	3360 J	4300 J	1040 J
Chromium	P	10	4.1	23.7	14.2	25.7 J	30.9 J	12
Cobalt	P	50	3	4.5	9.6	22.3 J	16.5 J	18.9
Copper	P	25	2.9	8.1	2.7	11.7 J	12.5 J	1.9
Iron	P	100	9.2	21600	5220	10600 J	12000 J	11900
Lead	P	3	2.9	8.8	10.9	40 J	62.5 J	7.1
Magnesium	P	5,000	32.3	3890	1810	3200 J	3640 J	1740
Manganese	P	15	1.3	196	718	393 J	477 J	206
Mercury	CV	0.2	0.1	0.06 U	0.11 U	R	R	0.09 U
Nickel	P	40	3.9	17.1	11.2	21.2 J	20.2 J	8.7
Potassium	P	5,000	125.3	1710	392	1090 J	1170 J	337
Selenium	P	5	2.8	0.61 U	1.1 U	R	R	0.97 U
Silver	P	10	3.7	0.82	1.5 U	R	R	1.3 U
Sodium	P	5,000	41.2	173 U	238 U	R	R	133 U
Thallium	P	10	1.6	0.82 U	0.64 U	R	R	0.61 U
Vanadium	P	50	2.6	17.8	10.8	25.1 J	26.4 J	27
Zinc	P	20	8.5	32.6	19.9	78 J	88.6 J	17.2
DATE SAMPLED:				10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
% SOLIDS				82.2	45.8	29.6	25.3	55.1
ICP SAMPLE WT. (g)				1.11	1.1	1.08	1.03	1.05
HG SAMPLE WT. (g)				0.21	0.2	0.22	0.22	0.21
REMARKS:						DUPLICATE OF MAAC36	DUPLICATE OF MAAC35	

Footnotes:
F - Furnace AA
P - ICP/Flame AE
CV - Cold Vapor
CA - Semi Automated
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
CRDL - Contract Required Detection Limit
** - Specific sample detection limits are listed on the accompanying table.

Inorganic Sediment Analysis
mg/kg
(SOW:ILM02.1)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: MAAC16

TRAFFIC REPORT NUMBER:				MAAC16	MAAC17	MAAC19	MAAC20	MAAC21
M&E SAMPLE ID:				CGSED-18	CGSED-19	CGSED-10	CGSED-9	CGSED-11
ANALYTES		CRDL (ug/L)	IDL (ug/L)					
Aluminum	P	200	15.5	3050	3360	17800 J	26700	8930 J
Antimony	P	60	9.2	2.4 U	2.4 U	R	6.1 U	R
Arsenic	P	10	2.1	3.8	4.4	41.4 J	69.7	8.3 J
Barium	P	200	3.6	16.9	20.3	67.5 J	121	46.4 J
Beryllium	P	5	0.2	0.05 U	0.05 U	R	1.2	1.1 J
Cadmium	P	5	1	0.26 U	0.26 U	R	0.32 U	R
Calcium	P	5,000	24.2	748 J	731 J	5550 J	8780 J	9290 J
Chromium	P	10	4.1	7.6	8.0	54.7 J	68.1	16.4 J
Cobalt	P	50	3	2.5	2.4	50.5 J	21.1	4.1 J
Copper	P	25	2.9	7.9 U	6.7 U	R	42.6	R
Iron	P	100	9.2	5500	5570	18300 J	31900	4710 J
Lead	P	3	2.9	10.2 J	12.8 J	64.7 J	20.4 J	R
Magnesium	P	5,000	32.3	1080	1150	7460 J	10700	747 J
Manganese	P	15	1.3	143	202	594 J	678	315 J
Mercury	CV	0.2	0.1	0.07 U	0.06 U	R	0.08 U	R
Nickel	P	40	3.9	4.8	4.4	45.1 J	64.2	7.7 J
Potassium	P	5,000	125.3	640	742	3360 J	5480	R
Selenium	P	5	2.8	0.72 U	0.74 U	R	0.9 U	R
Silver	P	10	3.7	0.95 U	0.98 U	R	1.8 U	R
Sodium	P	5,000	41.2	63.8 U	76.4 U	R	1060	R
Thallium	P	10	1.6	0.41 U	0.42 U	R	0.51 U	R
Vanadium	P	50	2.6	7.7	7.9	51.2 J	53.4	8.2 J
Zinc	P	20	8.5	27.7	31.1	86 J	70.7	32.9 J
DATE SAMPLED:				9-28-93	9-28-93	9-28-93	9-28-93	9-29-93
% SOLIDS				73.9	72.1	19.1	57.8	19.9
ICP SAMPLE WT. (g)				1.05	1.05	1.02	1.08	1.02
HG SAMPLE WT. (g)				0.2	0.22	0.21	0.23	0.21
REMARKS:				DUPLICATE OF MAAC17	DUPLICATE OF MAAC16			

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- CA - Semi Automated
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit
- ** - Specific sample detection limits are listed on the accompanying table.

Inorganic Sediment Analysis
mg/kg
(SOW:ILM02.1)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: MAAC16

TRAFFIC REPORT NUMBER:				MAAC22	MAAC23	MAAC24	MAAC25	MAAC26
M&E SAMPLE ID:				CGSED-12	CGSED-13	CGSED-14	CGSED-15	CGSED-16
ANALYTES		CRDL (ug/L)	IDL (ug/L)					
Aluminum	P	200	15.5	R	1520 J	15200	7070	8770
Antimony	P	60	9.2	R	R	5.1 U	6.1 U	4.7 U
Arsenic	P	10	2.1	R	8.4 J	19.4	15.1	23
Barium	P	200	3.6	R	37.3 J	61.4	33.9	33
Beryllium	P	5	0.2	R	R	0.65	0.09 U	0.1 U
Cadmium	P	5	1	R	R	0.55 U	0.46 U	0.51 U
Calcium	P	5,000	24.2	R	16500 J	3460 J	2330 J	2070 J
Chromium	P	10	4.1	R	11.8 J	15.2	12.4	11.1
Cobalt	P	50	3	R	R	4.8	3.0	3.5
Copper	P	25	2.9	R	R	6.5 U	4.6 U	7.7 U
Iron	P	100	9.2	R	2450 J	8600	5520	5690
Lead	P	3	2.9	R	R	32.3 J	20.6 J	56.2 J
Magnesium	P	5,000	32.3	R	953 J	1540	1210	1260
Manganese	P	15	1.3	R	188 J	350	426	343
Mercury	CV	0.2	0.1	R	R	0.15 U	0.12 U	0.11 U
Nickel	P	40	3.9	R	9.5 J	9.2	7.6	6.2
Potassium	P	5,000	125.3	R	R	708	445	503
Selenium	P	5	2.8	R	R	1.5 U	1.3 U	1.4 U
Silver	P	10	3.7	R	R	2.0 U	1.7 U	1.9 U
Sodium	P	5,000	41.2	R	R	151 U	152 U	171 U
Thallium	P	10	1.6	R	R	0.88 U	0.74 U	0.82 U
Vanadium	P	50	2.6	R	7.2 J	14.6	9.4	11.4
Zinc	P	20	8.5	R	R	33	23.8	43.2
DATE SAMPLED:				9-29-93	9-29-93	9-29-93	9-29-93	9-29-93
% SOLIDS				8.5	11.3	34	40	38.3
ICP SAMPLE WT. (g)				1.06	1	1.07	1.08	1.02
HG SAMPLE WT. (g)				0.2	0.22	0.2	0.21	0.23
REMARKS:								

Footnotes:
F - Furnace AA
P - ICP/Flame AE
CV - Cold Vapor
CA - Semi Automated
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
CRDL - Contract Required Detection Limit
** - Specific sample detection limits are listed on the accompanying table.

Inorganic Aqueous Analysis
ug/L
(SOW:ILM02.1)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: MAAC16

ANALYTES		CRDL (ug/L)	IDL (ug/L)	TRAFFIC REPORT NUMBER: MAAC18 M&E SAMPLE ID: CGSED-EB1
Aluminum	P	200	15.5	116
Antimony	P	60	9.2	--
Arsenic	P	10	2.1	--
Barium	P	200	3.6	--
Beryllium	P	5	0.2	--
Cadmium	P	5	1	--
Calcium	P	5,000	24.2	28
Chromium	P	10	4.1	--
Cobalt	P	50	3	--
Copper	P	25	2.9	9
Iron	P	100	9.2	155
Lead	P	3	2.9	6.3
Magnesium	P	5,000	32.3	91.2
Manganese	P	1,500	1.3	3.3
Mercury	CV	0.2	0.1	--
Nickel	P	40	3.9	--
Potassium	P	5,000	125.3	--
Selenium	P	5	2.8	--
Silver	P	10	3.7	--
Sodium	P	5,000	41.2	542
Thallium	P	10	1.6	--
Vanadium	P	50	2.6	--
Zinc	P	20	8.5	--
Cyanide	CA	10		NA

DATE SAMPLED: 09-28-93
REMARKS: EQUIPMENT BLANK

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- CA - Semi Automated
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit

Inorganic Aqueous Analysis
ug/L
(SOW:ILM02.1)

SITE: CHARLES GEORGE
CASE NO.: 20885 SDG NO.: MAAC28

TRAFFIC REPORT NUMBER:				MAAC37
M&E SAMPLE ID:				CGSED-EB2
ANALYTES		CRDL (ug/L)	IDL (ug/L)	
Aluminum	P	200	15.5	19.2
Antimony	P	60	9.2	9.2 U
Arsenic	P	10	2.1	2.1 U
Barium	P	200	3.6	3.6 U
Beryllium	P	5	0.2	0.2 U
Cadmium	P	5	1	1 U
Calcium	P	5,000	24.2	24.2 U
Chromium	P	10	4.1	4.1 U
Cobalt	P	50	3	3 U
Copper	P	25	2.9	2.9 U
Iron	P	100	9.2	351
Lead	P	3	2.9	3.7
Magnesium	P	5,000	32.3	60.4
Manganese	P	1,500	1.3	5.4
Mercury	CV	0.2	0.1	0.1 U
Nickel	P	40	3.9	3.9 U
Potassium	P	5,000	125.3	125.3 U
Selenium	P	5	2.8	2.8 U
Silver	P	10	3.7	3.7 U
Sodium	P	5,000	41.2	636
Thallium	P	10	1.6	1.6 U
Vanadium	P	50	2.6	2.6 U
Zinc	P	20	8.5	8.5 U
Cyanide	CA	10		NA

==

DATE SAMPLED:	10-01-93
REMARKS:	EQUIPMENT BLANK

Footnotes:
F - Furnace AA
P - ICP/Flame AE
CV - Cold Vapor
CA - Semi Automated
CRDL - Contract Required Detection Limit

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 8118-A-02   SDG NO.: SAA361

TRAFFIC REPORT NUMBER:				SAA361	SAA363	SAA365	SAA367	SAA369	SAA371
M&E SAMPLE ID:				CGSED-6	CGSED-5	GCSED-4	CGSED-3	CGSED-2	GCSED-1
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)						
Antimony	F	15.0	0.69						
Cadmium	F	0.50	0.044	0.40 R	0.43 R	0.68 R	0.039 R	0.11 R	0.18 R
DATE SAMPLED:				10-01-93	10-01-93	10-01-93	10-01-93	10-01-93	10-01-93
REMARKS:									

Footnotes:
- F - Furnace
- P - ICP/Flame AA
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 8118-A-02 SDG NO.: SAA361

TRAFFIC REPORT NUMBER:				SAA373	SAA375	SAA377	SAA379
M&E SAMPLE ID:				CGSED-8	CGSED-20	CGSED-EB2	CGSED-21
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)				
Antimony	F	15.0	0.69	R	R	R	R
Cadmium	F	0.50	0.044	0.95	0.81	0.044 U	0.062
DATE SAMPLED:				10-01-93	10-01-93	10-01-93	10-01-93
REMARKS:				Duplicate of SAA375	Duplicate of SAA373	Equipment Blank Results in ug/L	

Footnotes:
- F - Furnace
- P - ICP/Flame AA
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit

Aqueous Inorganic Analysis
ug/L
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 8118-A-02   SDG NO.: SAA336

TRAFFIC REPORT NUMBER:				SAA339
M&E SAMPLE ID:				GCSED-EB1
ANALYTES		CRDL (ug/L)	IDL (ug/L)	
Antimony	F	15.0	0.69	R
Cadmium	F	0.50	0.044	0.044 U

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DATE SAMPLED:	09-28-93
REMARKS:	Equipment Blank

Footnotes:
- F - Furnace
- P - ICP/Flame AA
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 8118A-02 SDG NO.: SAA336

TRAFFIC REPORT NUMBER:				SAA336	SAA337	SAA341	SAA343	SAA345	SAA347
M&E SAMPLE ID:				CGSED-18	CGSED-19	CGSED-10	CGSED-9	GCSED-17	CGSED-16
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)						
Antimony	F	3.0	0.069	R	R	R	R	R	R
Cadmium	F	0.2	0.0044	0.096	0.057	0.55	0.13	0.032	0.32
DATE SAMPLED:				09-28-93	09-28-93	09-28-93	09-28-93	09-29-93	09-29-93
REMARKS:									

Footnotes:
- F - Furnace
- P - ICP/Flame AA
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 8118A-02   SDG NO.: SAA336

TRAFFIC REPORT NUMBER:				SAA349	SAA351	SAA353	SAA355	SAA357
M&E SAMPLE ID:				CGSED-15	CGSED-14	CGSED-13	CGSED-12	CGSED-11
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)					
Antimony	F	3.0	0.069	R	R	R	R	R
Cadmium	F	0.2	0.0044	0.22	0.27	0.29	0.58	0.44 J
DATE SAMPLED:				09-29-93	09-29-93	09-29-93	09-29-93	09-29-93
REMARKS:								

Footnotes:
- F - Furnace
- P - ICP/Flame AA
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 8118A-02   SDG NO.: SAA336

TRAFFIC REPORT NUMBER:				SAA335
M&E SAMPLE ID:				CGSED-7
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)	
Antimony	F	3.0	0.069	R
Cadmium	F	0.2	0.0044	0.17

===

DATE SAMPLED: 10-01-93
REMARKS:

Footnotes:
- F - Furnace
- P - ICP/Flame AA
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-03 SDG NO.: SAA336

TRAFFIC REPORT NUMBER: / M&E SAMPLE ID:		CRDL (mg/Kg)	IDL (mg/Kg)**	SAA336 CGSED-18	SAA337 CGSED-19	SAA341 CGSED-10	SAA343 CGSED-9	SAA345 GCSED-17	SAA347 CGSED-16
ANALYTES									
Antimony	F	1.5	0.069	0.072 U	0.13	0.26	0.18	0.064 U	0.42
DATE SAMPLED:				09-28-93	09-28-93	09-28-93	09-28-93	09-29-93	09-29-93
% SOLIDS:				76.5	75.3	29.6	57.5	83.6	40.8
SAMPLE WEIGHT (gm):				1.27	1.33	3.49	1.79	1.30	2.55
REMARKS:									

Footnotes:
- F - Furnace
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit
- ** - Sample specific detection limits are provided in the accompanying table.

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-03 SDG NO.: SAA336

TRAFFIC REPORT NUMBER; M&E SAMPLE ID:				SAA349 CGSED-15	SAA351 CGSED-14	SAA353 CGSED-13
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)**			
Antimony	F	1.5	0.069	0.10	0.16	0.15 J
DATE SAMPLED:				09-29-93	09-29-93	09-29-93
% SOLIDS:				45.8	36.8	14.1
SAMPLE WEIGHT (gm):				2.21	2.68	6.63
REMARKS:						

Footnotes:
- F - Furnace
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit
- ** - Sample specific detection limits are provided in the accompanying table.

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-03 SDG NO.: SAA355

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

TRAFFIC REPORT NUMBER:				SAA355	SAA357	SAA359	SAA361	SAA363	SAA365
M&E SAMPLE ID:				CGSED-12	CGSED-11	CGSED-7	CGSED-6	CGSED-5	GCSED-4
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)**						
Antimony	F	1.5	0.069	0.46	0.14	0.081	0.085	0.095	0.30
DATE SAMPLED:				09-29-93	09-29-93	10-01-93	10-01-93	10-01-93	10-01-93
% SOLIDS:				9.1	24.7	48.4	33.8	37.5	28.1
SAMPLE WEIGHT (gm):				11.0	4.14	2.31	3.18	2.83	3.69
REMARKS:									

Footnotes:
F - Furnace Atomic Absorption
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
CRDL - Contract Required Detection Limit
** - Sample specific detection limits are provided in the accompanying table.

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-03 SDG NO.: SAA355

TRAFFIC REPORT NUMBER: / M&E SAMPLE ID:				SAA367 CGSED-3	SAA369 CGSED-2	SAA371 GCSED-1	SAA373 CGSED-8
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)**				
Antimony	F	1.5	0.069	1.4	0.26	0.060 U	0.28 J
DATE SAMPLED:				10-01-93	10-01-93	10-01-93	10-01-93
% SOLIDS:				86.5	79.2	53.5	37.7
SAMPLE WEIGHT (gm):				1.47	1.54	2.17	2.78
REMARKS:							Duplicate of SAA375

Footnotes:
- F - Furnace Atomic Absorption
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit
- ** - Sample specific detection limits are provided in the accompanying table.

Sediment Inorganic Analysis
mg/Kg
(ILM02.0 SOW)

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 8118A-03 SDG NO.: SAA375

TRAFFIC REPORT NUMBER:				SAA375	SAA379
M&E SAMPLE ID:				CGSED-20	CGSED-21
ANALYTES		CRDL (mg/Kg)	IDL (mg/Kg)**		
Antimony	F	1.5	0.069	0.37	0.060 U
DATE SAMPLED:				10-01-93	10-01-93
% SOLIDS:				39.4	64.1
SAMPLE WEIGHT (gm):				2.48	1.82
REMARKS:				Duplicate of SAA373	

Footnotes:
- F - Furnace
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit
- ** - Sample specific detection limits are provided in the accompanying table.

Organic Soil Analysis
mg/Kg
(Lloyd Kahn Method)

SITE: Charles Geprge Reclamation Landfill
DAS No: 0002M SDG NO.: DAM501

TRAFFIC REPORT NUMBER: M&E SAMPLE ID:		DAM501 GCSED-18	DAM502 GCSED-19	DAM507 GCSED-9	DAM522 GCSED-17	DAM536 GCSED-3	DAM538 GCSED-2
ANALYTES	CRDL (mg/Kg)						
Total Organic Carbon	100	6100 J	22000 J	18000	3400 J	1300	19000
DATE SAMPLED:		09-28-93	09-28-93	09-28-93	09-29-93	10-01-93	10-01-93
DATE ANALYZED:		10-05-93	10-05-93	10-05-93	10-05-93	10-05-93	10-05-93
REMARKS:		Duplicate of DAM502	Duplicate of DAM501				

Footnotes:
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- CRDL - Contract Required Detection Limit

Total Combustible Organic Analyses
ASTM D-2974
% Organic Matter

SITE: CHARLES GEORGE LANDFILL

DAS SAMPLE ID:	DAM526	DAM528	DAM530	DAM532	DAM523
M&E SAMPLE ID:	CGSED-7	CGSED-6	CGSED-5	CGSED-4	CGSED-8
ANALYTE					
Total Combustible Organics	9.73	53.20	21.41	24.11	19.09
%SOLIDS (average of duplicate runs	45.27	15.66	28.24	21.10	25.88
DATE SAMPLED:	10/1/93	10/1/93	10/1/93	10/1/93	10/1/93
DATE ANALYZED:	10/14/93	10/15/95	10/22/93	10/18/93	10/20/93
REMARKS:	-----				

SITE: CHARLES GEORGE LANDFILL

DAS SAMPLE ID:	DAM534	DAM540	DAM542
M&E SAMPLE ID:	CGSED-20	CGSED-1	CGSED-21
ANALYTE			
Total Combustible Organics	20.24	6.53	5.19
%SOLIDS (average of duplicate runs	28.13	47.94	63.12
DATE SAMPLED:	10/1/93	10/1/93	10/1/93
DATE ANALYZED:	10/18/93	10/19/93	10/20/93
REMARKS:			

Total Combustible Organic Analyses
ASTM D-2974
% Organic Matter

SITE: CHARLES GEORGE LANDFILL

DAS SAMPLE ID:	DAM510	DAM512	DAM514	DAM516	DAM518
M&E SAMPLE ID:	CGSED-11	CGSED-12	CGSED-13	CGSED-14	CGSED-15
ANALYTE					
Total Combustible Organics	44.19	78.91	87.33	17.19	10.91
%SOLIDS (average of duplicate runs	11.28	7.84	10.48	37.35	42.50
DATE SAMPLED:	9/29/93	9/29/93	9/29/93	9/29/93	9/29/93
DATE ANALYZED:	10/14/93	10/14/93	10/14/93	10/13/93	10/12/93
REMARKS:	-----				

SITE: CHARLES GEORGE LANDFILL

DAS SAMPLE ID:	DAM520	DAM534	DAM540	DAM542
M&E SAMPLE ID:	CGSED-16	CGSED-20	CGSED-1	CGSED-21
ANALYTE				
Total Combustible Organics	12.29	20.24	6.53	5.19
%SOLIDS (average of duplicate runs	39.22	28.13	47.94	63.12
DATE SAMPLED:	9/29/93	10/1/93	10/1/93	10/1/93
DATE ANALYZED:	----	10/18/93	10/19/93	10/20/93
REMARKS:				

Total Combustible Organics

SITE: CHARLES GEORGE LANDFILL

DAS SAMPLE ID:	DAM505
M&E SAMPLE ID:	CGSED-10

ANALYTE	
Total Combustible Organics	25.61
%SOLIDS (average of duplicate runs	17.28

===

DATE SAMPLED:	9/28/93
DATE ANALYZED:	10/11/13
REMARKS:	-----

Grain Size Analyses
ASTM D-422
(percent finer than listed sieve size)

Charles George Landfill

DAS SAMPLE ID:	DAM503	DAM504	DAM506	DAM508
M&E SAMPLE ID:	CGSED-18	CGSED-19	CGSED-10	CGSED-9
SIEVE SIZE SIZE (mm)				
3" to No. 4	0.0	0.0	0.2	0.1
No.4 to No.200	92.8	93.4	29.6	13.4
0.074 to 0.005	5.7	4.9	57.9	65.7
<0.005 mm	1.5	1.7	12.2	20.7
Maximium Particle Size	4.75	4.75	9.5	9.5
Hygroscopic Moisture Content %	42.95	31.56	402.72	118.56
Shape	subangular	subangular	*	subangular
Hardness	2	2	*	3
DATE SAMPLED:	9/28/93	9/28/93	9/28/93	9/28/93
DATE ANALYZED:	10/21 93	10/21/93	10/21/93	10/21/93
REMARKS:	-----	-----	-----	-----

* Particles to small to observe shape and hardness.

Hardness Codes:

1- Crushed easily with light hammer blow.
2- Crushed with light hammer blow.
3- Crushed with moderate hammer blow.
4- Crushed with heavy hammer blow.

Grain Size Analyses
ASTM D-422
(percent finer than listed sieve size)

Charles George Landfill

DAS SAMPLE ID:		DAM509	DAM511	DAM513	DAM515	DAM517
M&E SAMPLE ID:		CGSED-11	CGSED-12	CGSED-13	CGSED-14	CGSED-15
SIEVE SIZE	SIZE (mm)					
3" to No. 4	4.760	0.0	0.1	0.0	0.0	4.2
No.4 to No.200	2.000	39.4	46.7	65.7	14.2	47.4
0.074 to 0.005	0.840	50.2	44.5	27.3	62.2	38.0
<0.005 mm	0.420	10.3	8.7	7.0	23.5	10.3
Maximium Particle Size		2	9.5	2	2	9.5
Hygroscopic Moisture Content %		426.92	1180.47	996.39	144.5	125.9
Shape		*	subangular	subangular	*	SUBANGULAR/ANGULAR
Hardness		*	1	1	*	2
DATE SAMPLED:		9/29/93	9/29/93	9/29/93	9/29/93	9/29/93
DATE ANALYZED:		10/28/93	10/28/93	10/28/93	10/28/93	10/21 93
REMARKS:		-----	-----	-----	-----	-----

* Particles to small to observe shape and hardness.

Hardness Codes:

1- Crushed easily with light hammer blow
2- Crushed with light hammer blow
3- Crushed with moderate hammer blow
4- Crushed with heavy hammer blow

Charles George Landfill

SIEVE SIZE	SIZE (mm)	DAS SAMPLE ID: DAM519 M&E SAMPLE ID: CGSED-16	DAM521 CGSED-17
3" to No. 4	4.760	0.2	20.4
No.4 to No.200	2.000	27.7	67.6
0.074 to 0.005	0.840	58.7	9.7
<0.005 mm	0.420	13.3	2.3
Maximium Particle Size		9.5	19
Hygroscopic Moisture Content %		121.73	18.95
Shape		*	SUBROUND/SUBANGULAR
Hardness		*	4
DATE SAMPLED:		9/29/93	9/29/93
DATE ANALYZED:		10/21/93	10/21/93
REMARKS:		-----	

* Particles to small to observe shape and hardness.

Hardness Codes:
1- Crushed easily with light hammer blow
2- Crushed with light hammer blow
3- Crushed with moderate hammer blow
4- Crushed with heavy hammer blow

Grain Size Analyses
ASTM D-422
(percent finer than listed sieve size)

Charles George Landfill

DAS SAMPLE ID:		DAM525	DAM527	DAM529	DAM531	DAM524
M&E SAMPLE ID:		CGSED-7	CGSED-6	CGSED-5	CGSED-4	CGSED-8
SIEVE SIZE	SIZE (mm)					
3" to No. 4	4.760	1.1	0.0	0.2	0.1	0.8
No.4 to No.200	2.000	63.8	40.8	53.1	27.4	49.0
0.074 to 0.005	0.840	25.3	43.8	34.4	53.0	34.3
<0.005 mm	0.420	9.7	15.3	12.2	19.4	15.8
Maximium Particle Size		9.5	9.5	2	9.5	38.1
Hygroscopic Moisture Content %		112.82	527.49	213.84	385.14	261.64
Shape		sub to ang	subangular	subangular	angular	*
Hardness		2	1	2	3	*
DATE SAMPLED:		10/1/93	10/1/93	10/1/93	10/1/93	10/1/93
DATE ANALYZED:		10/28/93	10/28/93	10/28/93	10/31/93	10/31/93
REMARKS:		-----	-----	-----	-----	-----

* Particles to small to observe shape and hardness.

Hardness Codes:
1- Crushed easily with light hammer blow
2- Crushed with light hammer blow
3- Crushed with moderate hammer blow
4- Crushed with heavy hammer blow

Grain Size Analyses
ASTM D-422
(percent finer than listed sieve size)

Charles George Landfill

DAS SAMPLE ID:		DAM533	DAM535	DAM537	DAM539	DAM541
M&E SAMPLE ID:		CGSED-20	CGSED-3	CGSED-2	CGSED-1	CGSED-21
SIEVE SIZE	SIZE (mm)					
3" to No. 4	4.760	1.3	20.6	17.5	0.3	4.8
No.4 to No.200	2.000	48.8	72.3	66.0	75.2	72.0
0.074 to 0.005	0.840	38.0	5.3	9.2	18.0	17.1
<0.005 mm	0.420	11.8	1.8	7.3	6.4	6.1
Maximium Particle Size		38.1	19	25	9.5	19
Hygroscopic Moisture Content %		272.31	16.02	26.08	121.02	99.18
Shape		*	sub to ang	sub to ang	*	sub to ang
Hardness		*	3	2	*	2
DATE SAMPLED:		10/1/93	10/1/93	10/1/93	10/1/93	10/1/93
DATE ANALYZED:		10/31/93	10/31/93	10/31/93	10/31/93	10/31/93
REMARKS:		-----		-----	-----	-----

* Particles to small to observe shape and hardness.

Hardness Codes:

1- Crushed easily with light hammer blow
2- Crushed with light hammer blow
3- Crushed with moderate hammer blow
4- Crushed with heavy hammer blow

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB207
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER:				SAB207	SAB208	SAB209	SAB210	SAB211	SAB212
M&E SAMPLE ID:				LB-FP-W-01	LB-FP-W-02	LB-FP-W-03	LB-FP-W-04	LB-FP-W-05	YP-FP-W-01
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)						
Aluminum	P	3.0	0.90	--	--	--	--	--	10.30
Arsenic	F	1.0	0.10	0.12 UJ	0.12 UJ	0.15 UJ	0.16 UJ	0.14 UJ	0.11 UJ
Barium	P	0.2	0.018	0.22 J	0.21 J	0.40 J	0.27 J	0.44 J	2.5 J
Beryllium	P	0.1	0.006	--	--	--	--	--	--
Cadmium	P	1.0	0.066	--	--	--	--	--	--
Chromium	P	0.2	0.050	0.31 U	0.34 U	0.33 U	0.41 J	0.52 J	0.54 J
Cobalt	P	0.2	0.098	0.13	--	--	--	--	0.10
Copper	P	0.3	0.074	0.30 U	0.26 U	0.19 U	0.18 U	0.11 U	0.15 U
Lead	F	1.0	0.060	--	0.06	0.05	--	0.07	0.28
Mercury	CV	0.2	0.010	0.12 J	0.20 J	0.15 J	0.14 J	0.24 J	0.06 J
Nickel	P	0.5	0.082	--	0.14	--	--	--	--
Selenium	F	1.0	0.080	0.31 UJ	0.36 UJ	0.32 UJ	0.39 UJ	0.60 UJ	0.47 U
Silver	P	0.2	0.134	--	--	--	--	--	--
Vanadium	P	0.3	0.066	--	--	--	--	--	0.20 J
Zinc	P	0.3	0.062	16.4 J	16.6 J	17.9 J	18.6 J	19.7 J	18.1 J
DILUTION FACTOR:				1	1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				29.2	27.0	25.7	28.3	29.2	31.0
% LIPIDS				1.73	1.02	1.08	1.22	2.08	3.44
REMARKS:									

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB207
CASE NO.: 20974

TRAFFIC REPORT NUMBER:				SAB213	SAB214	SAB215	SAB216	SAB217
M&E SAMPLE ID:				YP-FP-W-02	YP-FP-W-03	YP-FP-W-04	YP-FP-W-05	LB-LP-W-01
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)					
Aluminum	P	3.0	0.90	2.9 U	--	2.8 U	13.9	--
Arsenic	F	1.0	0.10	0.18 UJ	0.09 UJ	0.17 UJ	0.29 UJ	0.52
Barium	P	0.2	0.018	1.7 J	0.66 J	0.75 J	0.94 J	--
Beryllium	P	0.1	0.006	--	--	--	--	--
Cadmium	P	1.0	0.066	--	--	--	--	--
Chromium	P	0.2	0.050	0.50	0.44 J	0.43 J	0.45 J	0.14 U
Cobalt	P	0.2	0.098	--	0.20	0.29	0.33 U	0.14
Copper	P	0.3	0.074	0.23 U	0.18 U	0.23 U	0.82 J	0.14 U
Lead	F	1.0	0.060	0.06	0.05	0.08	0.07 U	0.12
Mercury	CV	0.2	0.010	0.15 J	0.06 J	0.12 J	0.12 J	0.19 J
Nickel	P	0.5	0.082	--	--	--	--	--
Selenium	F	1.0	0.080	0.42 UJ	0.35 UJ	0.38 UJ	0.31 UJ	0.28 UJ
Silver	P	0.2	0.134	--	--	--	--	--
Vanadium	P	0.3	0.066	--	--	0.10 J	0.07 J	--
Zinc	P	0.3	0.062	17.6 J	15.6 J	18.1 J	16.4 J	6.6 J
DILUTION FACTOR:				1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				31.1	28.0	27.8	26.6	32.6
% LIPIDS				4.42	0.95	3.50	3.40	2.12
REMARKS:								

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB207
CASE NO.: 20974

ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)	TRAFFIC REPORT NUMBER: SAB218 M&E SAMPLE ID: LB-LP-W-02	SAB219 LB-LP-W-03	SAB220 LB-LP-W-04	SAB221 LB-LP-W-05	SAB222 YP-LP-W-01	SAB223 YP-LP-W-02
Aluminum	P	3.0	0.90	--	--	--	--	--	5.1 U
Arsenic	F	1.0	0.10	0.08 UJ	0.12 UJ	0.06 J	0.09 UJ	0.11 UJ	0.10 UJ
Barium	P	0.2	0.018	0.32 J	0.68 J	0.33 J	0.37 J	0.59 J	1.4 J
Beryllium	P	0.1	0.006	--	--	--	--	--	--
Cadmium	P	1.0	0.066	--	--	--	0.07 U	--	--
Chromium	P	0.2	0.050	0.36 J	0.49 J	0.37 J	0.30 U	0.38 J	0.56 J
Cobalt	P	0.2	0.098	0.11	--	--	--	0.53	0.11
Copper	P	0.3	0.074	0.20 U	0.15 U	0.20 U	0.21 U	0.20 U	0.19 U
Lead	F	1.0	0.060	--	0.08	--	--	--	0.19
Mercury	CV	0.2	0.010	0.27 J	0.19 J	0.21 J	0.15 J	0.10 J	0.14 J
Nickel	P	0.5	0.082	--	--	--	--	--	--
Selenium	F	1.0	0.080	0.23 UJ	0.27 UJ	0.25 UJ	0.30 UJ	0.49 UJ	0.36 UJ
Silver	P	0.2	0.134	--	--	--	--	--	--
Vanadium	P	0.3	0.066	--	--	--	--	--	0.10 J
Zinc	P	0.3	0.062	15.5 J	15.8 J	16.6 J	16.0 J	15.6 J	21.5 J
DILUTION FACTOR:				1	1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				29.9	29.1	28.3	25.1	27.2	31.0
% LIPIDS				1.27	1.82	3.76	1.25	2.66	4.64
REMARKS:									

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

SITE: CHARLES GEORGE RECLAIMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB207
CASE NO.: 20974

ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)	TRAFFIC REPORT NUMBER: SAB224 M&E SAMPLE ID: YP-LP-W-03	SAB225 YP-LP-W-04	SAB226 YP-LP-W-05
Aluminum	P	3.0	0.90	--	--	--
Arsenic	F	1.0	0.10	0.12 UJ	0.12 UJ	0.09 UJ
Barium	P	0.2	0.018	0.53 J	0.77 J	0.91 J
Beryllium	P	0.1	0.006	--	--	--
Cadmium	P	1.0	0.066	--	--	--
Chromium	P	0.2	0.050	0.43 J	0.38 J	0.44 J
Cobalt	P	0.2	0.098	0.54	--	0.13
Copper	P	0.3	0.074	0.19 U	0.22 U	0.26 U
Lead	F	1.0	0.060	--	0.07	--
Mercury	CV	0.2	0.010	0.09 J	0.09 J	0.08 J
Nickel	P	0.5	0.082	--	0.20	--
Selenium	F	1.0	0.080	0.29 UJ	0.36 UJ	0.23 UJ
Silver	P	0.2	0.134	--	--	--
Vanadium	P	0.3	0.066	--	--	--
Zinc	P	0.3	0.062	17.7 J	17.9 J	19.1 J
DILUTION FACTOR:				1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93
% SOLIDS				26.9	28.2	29.6
% LIPIDS				1.89	3.46	4.40
REMARKS:						

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB187
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER: / M&E SAMPLE ID:				SAB187 LB-FP-F-01	SAB188 LB-FP-O-01	SAB189 LB-FP-F-02	SAB190 LB-FP-O-02	SAB191 LB-FP-F-03	SAB192 LB-FP-O-03
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)						
Aluminum	P	3.0	0.90	--	--	--	0.86 U	--	2.2 U
Arsenic	F	1.0	0.10	0.08 UJ	0.06 UJ	0.09 UJ	0.09 UJ	0.05 UJ	0.06 UJ
Barium	P	0.2	0.018	--	0.43	--	0.21 J	--	1.6
Beryllium	P	0.1	0.006	--	--	--	--	--	--
Cadmium	P	1.0	0.066	--	--	--	--	--	--
Chromium	P	0.2	0.050	0.16 U	0.50 U	0.18 U	0.39 U	0.18 U	0.69 U
Cobalt	P	0.2	0.098	0.24	--	0.19	1.5	0.46	--
Copper	P	0.3	0.074	0.20	0.30	0.15	0.47	0.12	0.68
Lead	F	1.0	0.060	--	--	--	--	--	--
Mercury	CV	0.2	0.010	1.5	1.0	0.74	0.51	0.90	0.53
Nickel	P	0.5	0.082	--	--	--	--	--	--
Selenium	F	1.0	0.080	0.19	0.17	0.13	0.38 J	0.10	0.40 J
Silver	P	0.2	0.134	0.12 UJ	0.13 UJ	0.13 UJ	0.12 UJ	0.12 UJ	0.13 UJ
Vanadium	P	0.3	0.066	--	--	--	--	--	--
Zinc	P	0.3	0.062	4.6	14.9	3.2	13.8 J	3.0	19.4
DILUTION FACTOR:				1	1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				22.2	33.5	21.0	26.3	20.6	28.7
% LIPIDS				0.12	7.74	0.11	1.03	2.43	1.12
REMARKS:									

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB187
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER:				SAB193	SAB194	SAB195	SAB196	SAB197
M&E SAMPLE ID:				YP-FP-F-01	YP-FP-O-01	YP-FP-F-02	YP-FP-O-02	YP-FP-F-03
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)					
Aluminum	P	3.0	0.90	--	3.2 U	--	1.2 U	--
Arsenic	F	1.0	0.10	0.07 UJ	0.07 UJ	0.08 UJ	0.08 UJ	0.07 UJ
Barium	P	0.2	0.018	0.08	2.0	0.10	2.8	0.25
Beryllium	P	0.1	0.006	--	0.01 U	--	0.01 U	--
Cadmium	P	1.0	0.066	--	--	--	--	--
Chromium	P	0.2	0.050	0.20 U	0.71 U	0.21 U	0.73 U	0.30 U
Cobalt	P	0.2	0.098	2.0	0.27	0.58	0.16	24.9
Copper	P	0.3	0.074	0.13	0.43	0.16	0.30	0.14
Lead	F	1.0	0.060	--	0.07 U	--	0.10 U	--
Mercury	CV	0.2	0.010	0.62	0.21	0.61	0.26	0.88
Nickel	P	0.5	0.082	--	--	--	--	0.14
Selenium	F	1.0	0.080	0.14 J	--	0.17 J	0.57 J	0.12 J
Silver	P	0.2	0.134	0.12 UJ	0.13 UJ	0.13 UJ	0.13 UJ	0.12 UJ
Vanadium	P	0.3	0.066	--	0.13	--	0.14	--
Zinc	P	0.3	0.062	4.3	20.8	4.8	21.4	4.5
DILUTION FACTOR:				1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				19.8	35.1	21.5	34.6	22.3
% LIPIDS				0.17	4.85	1.38	4.19	0.92
REMARKS:								

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
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- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02   SDG NO.: SAB187
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER:				SAB198	SAB199	SAB200	SAB201	SAB202	SAB203
M&E SAMPLE ID:				YP-FP-O-03	YP-FP-F-04	YP-FP-O-04	YP-FP-F-05	YP-FP-O-05	LB-FP-F-04
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)						
Aluminum	P	3.0	0.90	2.3 U	--	--	--	1.7 U	--
Arsenic	F	1.0	0.10	0.06 UJ	0.08 UJ	0.07 UJ	0.10 UJ	0.09 UJ	0.08 UJ
Barium	P	0.2	0.018	2.6	0.03	2.5	0.14	1.7	--
Beryllium	P	0.1	0.006	--	--	0.01 U	--	0.01 U	--
Cadmium	P	1.0	0.066	--	--	--	--	--	--
Chromium	P	0.2	0.050	0.67 U	0.18 U	0.73 U	0.24 U	0.65 U	0.19 U
Cobalt	P	0.2	0.098	0.50	0.55	--	0.46	--	1.3
Copper	P	0.3	0.074	0.48	0.11	0.51	0.13	0.35	0.12
Lead	F	1.0	0.060	--	--	--	--	--	--
Mercury	CV	0.2	0.010	0.28	0.57	0.23	0.39	0.12	1.6
Nickel	P	0.5	0.082	--	--	--	--	--	--
Selenium	F	1.0	0.080	0.41 J	0.13 J	0.41 J	0.19 J	0.45 J	0.10
Silver	P	0.2	0.134	0.13 UJ	0.13 UJ	0.13 UJ	0.13 UJ	0.13 UJ	0.13 UJ
Vanadium	P	0.3	0.066	0.15	--	0.13	--	--	--
Zinc	P	0.3	0.062	21.5	4.7	20.7	4.5	23.4	3.5
DILUTION FACTOR:				1	1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				33.8	20.5	33.5	21.0	32.8	21.1
% LIPIDS				2.92	0.27	4.41	0.25	1.53	0.23
REMARKS:									

Footnotes:
F - Furnace AA
P - ICP/Flame AE
CV - Cold Vapor
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
SAS - Special Analytical Services
SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB187
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER:				SAB204	SAB205	SAB206
M&E SAMPLE ID:				LB-FP-O-04	LB-FP-F-05	LB-FP-O-05
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)			
Aluminum	P	3.0	0.90	--	--	--
Arsenic	F	1.0	0.10	0.09 UJ	0.06 UJ	0.08 UJ
Barium	P	0.2	0.018	0.32 J	--	0.23 J
Beryllium	P	0.1	0.006	--	--	--
Cadmium	P	1.0	0.066	--	--	--
Chromium	P	0.2	0.050	0.47 U	0.20 U	0.39 U
Cobalt	P	0.2	0.098	--	0.56	0.11
Copper	P	0.3	0.074	0.22	0.15	0.24
Lead	F	1.0	0.060	--	--	--
Mercury	CV	0.2	0.010	1.0	0.60	0.38
Nickel	P	0.5	0.082	--	--	--
Selenium	F	1.0	0.080	0.26 J	0.12 J	0.37 J
Silver	P	0.2	0.134	0.13 UJ	0.13 UJ	0.11 UJ
Vanadium	P	0.3	0.066	--	--	--
Zinc	P	0.3	0.062	14.7 J	3.6	14.0 J
DILUTION FACTOR:				1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93
% SOLIDS				32.8	20.9	26.0
% LIPIDS				2.53	0.16	0.68
REMARKS:						

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB246
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER; M&E SAMPLE ID:				SAB246 LB-LP-O-05	SAB248 LB-BD-W-02	SAB249 LB-BD-W-03	SAB250 LB-BD-W-04	SAB251 LB-BD-W-05	SAB252 LB-FP-W-06
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)						
Aluminum	P	3.0	0.90	--	--	1.3 U	2.4 U	--	1.0 U
Arsenic	F	1.0	0.10	0.27 UJ	0.13 UJ	0.20 UJ	0.19 UJ	0.14 UJ	0.15 UJ
Barium	P	0.2	0.018	0.21 J	0.71 J	0.82	0.76 J	0.40 J	0.29 J
Beryllium	P	0.1	0.006	--	--	--	--	--	--
Cadmium	P	1.0	0.066	--	--	--	--	--	--
Chromium	P	0.2	0.050	0.42 U	0.41	0.57	0.45	0.37	0.42
Cobalt	P	0.2	0.098	--	0.38	0.84	1.3	0.34	--
Copper	P	0.3	0.074	0.29	0.24	0.23	0.28	0.31	0.28
Lead	F	1.0	0.060	0.09 U	0.08 U	0.14 U	0.17 U	0.05 U	0.11 U
Mercury	CV	0.2	0.010	0.70	0.17	0.19	0.16	0.20	0.33
Nickel	P	0.5	0.082	--	--	--	--	--	--
Selenium	F	1.0	0.080	0.29 U	0.34 U	0.29 U	0.33 U	0.31 UJ	0.23 U
Silver	P	0.2	0.134	--	--	--	--	--	--
Vanadium	P	0.3	0.066	--	--	--	--	--	--
Zinc	P	0.3	0.062	14.8 J	15.6 J	23.1 J	15.9 J	16.7 J	15.6 J
DILUTION FACTOR:				1	1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				31.2	26.8	23.9	26.5	27.6	29.6
% LIPIDS				2.00	1.77	0.31	0.26	0.47	2.37
REMARKS:									

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB246
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER: M&E SAMPLE ID:				SAB253 LB-FP-W-07	SAB254 LB-FP-W-08	SAB255 LB-FP-W-09	SAB256 LB-FP-W-10	SAB257 YP-BD-F-01
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)					
Aluminum	P	3.0	0.90	--	--	0.98 U	--	--
Arsenic	F	1.0	0.10	0.19 UJ	0.11 UJ	0.08 UJ	0.05 UJ	0.06 UJ
Barium	P	0.2	0.018	0.25	0.38	1.0 J	0.20 J	0.14
Beryllium	P	0.1	0.006	--	--	--	--	--
Cadmium	P	1.0	0.066	--	--	--	--	--
Chromium	P	0.2	0.050	0.43	0.44	0.41	0.28	0.27 U
Cobalt	P	0.2	0.098	--	--	0.32	0.24	5.5
Copper	P	0.3	0.074	0.22	0.28	0.33	0.30	0.12 U
Lead	F	1.0	0.060	0.17 U	0.10 U	0.15 U	0.05 U	0.06 U
Mercury	CV	0.2	0.010	0.25	0.20	0.21	0.22	0.78
Nickel	P	0.5	0.082	--	--	--	--	--
Selenium	F	1.0	0.080	0.24 U	0.22 UJ	0.20 UJ	0.22 UJ	0.20 U
Silver	P	0.2	0.134	--	--	--	--	--
Vanadium	P	0.3	0.066	--	--	--	--	--
Zinc	P	0.3	0.062	13.1 J	17.8 J	15.7 J	12.8 J	5.0 J
DILUTION FACTOR:				1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				26.0	32.9	29.4	25.4	21.2
% LIPIDS				0.98	4.69	1.62	0.84	0.19
REMARKS:								

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB246
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER:				SAB258	SAB259	SAB260	SAB261	SAB262	SAB263
M&E SAMPLE ID:				YP-BD-O-01	YP-BD-F-02	YP-BD-O-02	YP-BD-F-03	YP-BD-O-03	YP-BD-F-04
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)						
Aluminum	P	3.0	0.90	2.4 U	--	4.0 U	--	2.7 U	--
Arsenic	F	1.0	0.10	0.17 UJ	0.09 UJ	0.07 UJ	0.09 UJ	0.09 UJ	0.14 UJ
Barium	P	0.2	0.018	2.4	0.37	2.2	0.34	3.1	0.65 J
Beryllium	P	0.1	0.006	0.01 U	--	--	--	0.01 U	--
Cadmium	P	1.0	0.066	--	--	--	--	--	--
Chromium	P	0.2	0.050	0.74 U	0.28 U	0.56 U	0.23 U	0.71 U	0.32 U
Cobalt	P	0.2	0.098	3.0	3.0	7.4	3.9	0.83	4.6
Copper	P	0.3	0.074	0.45 U	0.14 U	0.38 U	0.17 U	0.39 U	0.91
Lead	F	1.0	0.060	0.61 U	0.12 U	0.19 U	--	0.30 U	0.06 U
Mercury	CV	0.2	0.010	0.19	0.48	0.21	0.38	0.19	0.29
Nickel	P	0.5	0.082	--	--	--	--	--	--
Selenium	F	1.0	0.080	0.13 U	0.23 UJ	0.26 U	0.21 UJ	0.28 UJ	0.25 UJ
Silver	P	0.2	0.134	--	--	--	--	--	--
Vanadium	P	0.3	0.066	0.20	--	0.18	--	0.18	R
Zinc	P	0.3	0.062	25.3 J	4.7 J	21.6 J	4.9 J	24.8 J	6.6 J
DILUTION FACTOR:				1	1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				31.8	20.9	33.4	22.0	33.5	20.1
% LIPIDS				2.77	0.38	3.59	1.25	5.17	0.36
REMARKS:									

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB246
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER:				SAB264	SAB265	SAB266
M&E SAMPLE ID:				YP-BD-O-04	YP-BD-F-05	YP-BD-O-05
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)			
Aluminum	P	3.0	0.90	6.6 U	--	2.1 U
Arsenic	F	1.0	0.10	0.20 UJ	0.08 UJ	0.21 UJ
Barium	P	0.2	0.018	4.7	0.17	3.0
Beryllium	P	0.1	0.006	0.01 U	--	0.01 U
Cadmium	P	1.0	0.066	--	--	--
Chromium	P	0.2	0.050	1.0	0.25 U	0.75 U
Cobalt	P	0.2	0.098	3.3	4.5	2.3
Copper	P	0.3	0.074	0.35 U	0.15 U	0.44 U
Lead	F	1.0	0.060	0.43 U	0.05 U	0.26 U
Mercury	CV	0.2	0.010	0.11	0.33	0.10
Nickel	P	0.5	0.082	--	--	--
Selenium	F	1.0	0.080	0.26 UJ	0.33 UJ	0.31 UJ
Silver	P	0.2	0.134	--	--	--
Vanadium	P	0.3	0.066	0.37	--	0.28
Zinc	P	0.3	0.062	33.7 J	4.8 J	22.6 J

DILUTION FACTOR:	1	1	1
DATE SAMPLED:	10-04-93	10-04-93	10-04-93
% SOLIDS	37.7	19.8	30.5
% LIPIDS	2.81	0.99	5.37
REMARKS:			

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB227
CASE NO.: 20974

TRAFFIC REPORT NUMBER:				SAB227	SAB228	SAB229	SAB230	SAB231	SAB232
M&E SAMPLE ID:				LB-LP-F-01	LB-LP-O-01	LB-LP-F-02	LB-LP-O-02	LB-LP-F-03	LB-LP-O-03
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)						
Aluminum	P	3.0	0.90	--	1.2 U	0.90 U	1.0 U	--	3.3 U
Arsenic	F	1.0	0.10	--	0.05 UJ	--	0.08 UJ	--	0.06 UJ
Barium	P	0.2	0.018	0.06	0.52	0.02	0.26 J	0.11	0.69
Beryllium	P	0.1	0.006	--	--	--	--	--	--
Cadmium	P	1.0	0.066	--	--	--	--	--	--
Chromium	P	0.2	0.050	0.22 U	0.52 U	0.18 U	0.29 U	0.22 U	0.50 U
Cobalt	P	0.2	0.098	0.55	--	0.74	--	0.33	0.22
Copper	P	0.3	0.074	0.22	0.30	0.27	0.33	0.20	0.32
Lead	F	1.0	0.060	--	0.05 U	0.10 U	0.05 UJ	--	0.06 UJ
Mercury	CV	0.2	0.010	0.74	0.38	0.86	0.31	0.83	0.26
Nickel	P	0.5	0.082	--	--	--	--	--	--
Selenium	F	1.0	0.080	0.11 J	0.29 J	0.16 J	0.18 J	0.11 J	0.24 J
Silver	P	0.2	0.134	--	--	--	--	--	--
Vanadium	P	0.3	0.066	--	--	--	--	--	--
Zinc	P	0.3	0.062	4.1	17.9	4.3	14.5 J	4.9	18.5
DILUTION FACTOR:				1	1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				24.3	29.4	22.6	29.5	20.3	30.0
% LIPIDS				1.33	3.26	0.24	5.45	0.17	0.35
REMARKS:									

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB227
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER: M&E SAMPLE ID:				SAB233 YP-LP-F-01	SAB234 YP-LP-O-01	SAB235 YP-LP-F-02	SAB236 YP-LP-O-02	SAB237 YP-LP-F-03
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)					
Aluminum	P	3.0	0.90	--	2.0 U	--	3.1 U	--
Arsenic	F	1.0	0.10	--	0.07 UJ	--	0.08 UJ	0.07 UJ
Barium	P	0.2	0.018	0.05	1.1	0.03	1.6	0.42 J
Beryllium	P	0.1	0.006	--	--	--	0.01 U	--
Cadmium	P	1.0	0.066	--	--	--	--	--
Chromium	P	0.2	0.050	0.24 U	0.54 U	0.19 U	0.70 U	0.30 U
Cobalt	P	0.2	0.098	3.8	3.1	3.8	2.1	4.4
Copper	P	0.3	0.074	0.22	0.43	0.18	0.44	0.15
Lead	F	1.0	0.060	0.03 UJ	--	--	0.15 U	--
Mercury	CV	0.2	0.010	0.23	0.11	0.14	0.28	0.32
Nickel	P	0.5	0.082	--	--	--	0.10 U	--
Selenium	F	1.0	0.080	0.20	0.25	0.13	0.32 J	0.16 J
Silver	P	0.2	0.134	--	--	--	--	--
Vanadium	P	0.3	0.066	--	0.11	--	0.16	--
Zinc	P	0.3	0.062	5.0	23.8	4.3	21.5	5.5 J
DILUTION FACTOR:				1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				22.6	38.2	22.2	33.7	24.7
% LIPIDS				0.69	7.71	0.18	5.32	3.25
REMARKS:								

Footnotes:
- F - Furnace AA
- P - ICP/Flame AE
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- SAS - Special Analytical Services
- SRDL - SAS Required Detection Limit

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB227
CASE NO.: 20974

TRAFFIC REPORT NUMBER:				SAB238	SAB239	SAB240	SAB241	SAB242	SAB243
M&E SAMPLE ID:				YP-LP-O-03	YP-LP-F-04	YP-LP-O-04	YP-LP-O-05	YP-LP-O-05	LB-LP-F-04
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)						
Aluminum	P	3.0	0.90	2.3 U	--	5.8 U	1.2 U	2.9 U	--
Arsenic	F	1.0	0.10	0.08 UJ	--	0.84 UJ	--	0.09 UJ	--
Barium	P	0.2	0.018	1.0	0.05	2.3	0.05	1.3	0.03
Beryllium	P	0.1	0.006	--	--	0.01 U	--	0.01 U	--
Cadmium	P	1.0	0.066	--	--	--	--	--	--
Chromium	P	0.2	0.050	0.49 U	0.20 U	0.78 U	0.16 U	0.70 U	0.17 U
Cobalt	P	0.2	0.098	1.5	1.4	1.1	1.1	0.99	0.33
Copper	P	0.3	0.074	0.36	0.64	0.55	0.22	0.43	0.22
Lead	F	1.0	0.060	0.16 U	--	0.30 U	--	0.08 U	--
Mercury	CV	0.2	0.010	0.14	0.17	0.04 U	0.31	0.08	1.0
Nickel	P	0.5	0.082	--	--	--	--	--	--
Selenium	F	1.0	0.080	0.25	0.16	0.37	0.15	0.35 J	0.09
Silver	P	0.2	0.134	--	--	--	--	--	--
Vanadium	P	0.3	0.066	0.12	--	0.15	--	0.13	--
Zinc	P	0.3	0.062	23.2	4.4	30.4	5.2	24.8	4.0
DILUTION FACTOR:				1	1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				34.1	21.6	36.0	21.5	33.0	21.5
% LIPIDS				5.83	0.48	5.78	0.74	4.70	0.14
REMARKS:									

Footnotes:
F - Furnace AA
P - ICP/Flame AE
CV - Cold Vapor
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
SAS - Special Analytical Services
SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB267
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER:				SAB267	SAB268	SAB269	SAB270	SAB271
M&E SAMPLE ID:				YP-BD-W-01	YP-BD-W-02	YP-BD-W-03	YP-BD-W-04	YP-BD-W-05
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)					
Aluminum	P	3.0	0.90	1.9	5.6	2.6	1.3	5.7
Arsenic	F	1.0	0.10	0.21 J	0.41 J	0.20 J	0.13 J	0.31 J
Barium	P	0.2	0.018	2.3 J	2.0 J	2.1 J	1.8 J	3.3 J
Beryllium	P	0.1	0.006	0.01	--	--	--	--
Cadmium	P	1.0	0.066	--	--	--	--	--
Chromium	P	0.2	0.050	0.58	0.52	0.52	0.56	0.65
Cobalt	P	0.2	0.098	0.51	0.15	0.30	0.3	0.40
Copper	P	0.3	0.074	0.10 U	0.16 U	0.28 U	0.18 U	0.18 U
Lead	F	1.0	0.060	0.15 J	0.14 J	0.30 J	--	0.13 J
Mercury	CV	0.2	0.010	0.22 J	0.19 J	0.10 UJ	0.18 J	0.25 J
Nickel	P	0.5	0.082	--	--	--	--	--
Selenium	F	1.0	0.080	0.35 UJ	0.44 UJ	0.39 U	0.39 UJ	0.48 UJ
Silver	P	0.2	0.134	--	--	--	--	--
Vanadium	P	0.3	0.066	0.11	0.19	--	0.10	0.22
Zinc	P	0.3	0.062	22.9 J	22.7 J	18.3 J	19.2 J	23.4 J
DILUTION FACTOR:				1	1	1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93	10-04-93	10-04-93
% SOLIDS				24.7	28.8	27.2	28.6	30.1
% LIPIDS				2.88	1.81	2.12	3.03	3.89
REMARKS:								

Footnotes:
F - Furnace AA
P - ICP/Flame AE
CV - Cold Vapor
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
SAS - Special Analytical Services
SRDL - SAS Required Detection Limit

SITE: CHARLES GEORGE RECLAMATION LANDFILL
SAS NO.: 7988A-02 SDG NO.: SAB227
CASE NO.: 20974

Fish Tissue Inorganic Analysis
(mg/Kg wet weight)
(ILM02.1 SOW)

TRAFFIC REPORT NUMBER:				SAB244	SAB245	SAB247
M&E SAMPLE ID:				LB-LP-O-04	LB-LP-F-05	LB-BD-W-01
ANALYTES		SRDL (mg/Kg)	IDL (mg/Kg)			
Aluminum	P	3.0	0.90	1.0 U	--	2.0 U
Arsenic	F	1.0	0.10	0.07 UJ	0.08 UJ	0.09 UJ
Barium	P	0.2	0.018	0.16 J	0.06	0.47 J
Beryllium	P	0.1	0.006	--	--	--
Cadmium	P	1.0	0.066	--	--	--
Chromium	P	0.2	0.050	0.23 U	0.22 U	0.27 U
Cobalt	P	0.2	0.098	0.73	0.29	0.34
Copper	P	0.3	0.074	0.22	0.20	1.4
Lead	F	1.0	0.060	--	--	--
Mercury	CV	0.2	0.010	0.63	1.1	0.31
Nickel	P	0.5	0.082	0.16	--	0.07
Selenium	F	1.0	0.080	0.08 J	0.12 J	0.16 J
Silver	P	0.2	0.134	--	--	--
Vanadium	P	0.3	0.066	--	--	--
Zinc	P	0.3	0.062	8.5 J	4.5	11.0 J
DILUTION FACTOR:				1	1	1
DATE SAMPLED:				10-04-93	10-04-93	10-04-93
% SOLIDS				28.5	23.6	28.2
% LIPIDS				1.26	2.48	1.05
REMARKS:						

Footnotes:
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P - ICP/Flame AE
CV - Cold Vapor
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit
SAS - Special Analytical Services
SRDL - SAS Required Detection Limit

Aqueous Inorganic Analysis
ug/L
(ILM02.1 SOW)

SITE: CHARLES GEORGE RECLAMATION LANDFILL
CASE NO.: 20948 SDG NO.: MAAC44

ANALYTES		CRDL (ug/L)	IDL (ug/L) /L)	MAAC44 EB-FP-01	MAAC45 EB-LP-02	MAAC46 EB-BD-03
TRAFFIC REPORT NUMBER: / M&E SAMPLE ID:				MAAC44 / EB-FP-01	MAAC45 / EB-LP-02	MAAC46 / EB-BD-03
Aluminum	P	200	15.5	75.2	36.0	28.2
Antimony	P	60	9.2	--	--	--
Arsenic	P	10	2.1	--	--	--
Barium	P	200	3.6	--	--	--
Beryllium	P	5	0.2	0.37 U	0.37 U	--
Cadmium	P	5	1.0	1.1 U	--	--
Calcium	P	5000	24.2	333	422	672
Chromium	P	10	4.1	8.1	8.1	8.9
Cobalt	P	50	3.0	--	--	--
Copper	P	25	2.9	--	--	5.1 U
Iron	P	100	9.2	118	110	81.5
Lead	P	3	2.9	11.6	3.0	4.5
Magnesium	P	5000	32.3	73.5	64.3	55.1
Manganese	P	15	1.3	4.3	2.1	1.4
Mercury	CV	0.2	0.2	--	--	--
Nickel	P	40	3.9	--	--	--
Potassium	P	5000	125	--	--	206
Selenium	P	5	2.8	--	--	--
Silver	P	10	3.7	--	--	--
Sodium	P	5000	41.2	851	1000	1060
Thallium	P	10	1.6	--	2.2 U	--
Vanadium	P	50	2.6	--	--	--
Zinc	P	20	8.5	--	8.5	11.2
DATE SAMPLED:				10-04-93	10-04-93	10-04-93
REMARKS:				Equipment Blank	Equipment Blank	Equipment Blank

Footnotes:
- F - Furnace
- P - ICP/Flame AA
- CV - Cold Vapor
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.
- IDL - Instrument Detection Limit
- CRDL - Contract Required Detection Limit