115184

Engineering Report

DESIGN ANALYSIS REPORT
SITE SPECIFIC QUALITY MANAGEMENT PLAN
HEALTH AND SAFETY DESIGN ANALYSIS

CAP CONSTRUCTION AND FLOOD RETENTION BASIN
HAZARDOUS WASTE CLEANUP
MILLCREEK SUPERFUND SITE
ERIE COUNTY, PENNSYLVANIA
CONTRACT NO. DACW45-89-C-0190

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For:
U.S. Army Engineer District, Omaha
Corps of Engineers
Omaha, Nebraska

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MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

AR004436

MALCOLM PIRNIE

CAP CONSTRUCTION AND FLOOD RETENTION BASIN
HAZARDOUS WASTE CLEANUP
MILLCREEK SUPERFUND SITE
ERIE COUNTY, PENNSYLVANIA

FINAL DESIGN

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FINAL DESIGN ANALYSIS REPORT

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NOVEMBER 1991

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PART 1 - GENERAL DESCRIPTION

1.1 PURPOSE

The Millcreek Superfund Site was formerly a freshwater wetland. The site encompasses 78.4 acres, as determined by verified property boundary limits. According to historical information presented in previous investigation reports, all but four acres of the site have been filled with foundry sand and industrial waste. Extensive site investigations have revealed soil sediment and surface water contamination on site. Major classes of compounds detected include: polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), phthalates, volatile organics, phenols and metals such as copper and lead.

Details concerning the type and extent of contamination can be found in the Remedial Investigation/Feasibility Study Report (RI/FS), August 1985 (Ref. 1), the USEPA Record of Decision (ROD), May 1986 (Ref. 2), and the Remedial Clean-up Treatability Study, August 1989 (Ref. 3), for the Millcreek Superfund Site.

The recommended remedial actions, which include ground water extraction/ treatment and capping with flood retention, were selected to:

- prevent the air dispersion and off-site transport of contaminants;
- prevent direct contact with contaminants by humans and wildlife; and
- reduce soil, sediment, surface water and ground water contaminant concentrations to levels acceptable to the USEPA and Pennsylvania Department of Environmental Resources (PADER).

This 90% Design Analysis Report presents design criteria for a portion of the remedial actions including the cap and flood retention basin (FRB). Capping the site will minimize the potential for direct contact with and ingestion of the contaminated waste fill/soil, minimize the potential for release of airborne contaminants and erosion-based sediment transport of contaminants, and reduce the amount of precipitation which currently infiltrates directly into the waste fill. Construction of the cap will involve clearing and grubbing, grading the site to promote runoff, eliminate erosion due to steep slopes, placing a topsoil cap, and promoting the growth of vegetation.

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The FRB will serve to minimize downstream flooding along Marshall's Run. Construction of the FRB will involve construction of a levee embankment to form a storm water retention basin with a controlled discharge and downstream improvements of the Marshall's Run drainage channel up to the 12th Street Bridge. Separate Final Design Analysis Reports (Refs. 6 and 7) were previously prepared for the Ground Water Extraction System and Ground Water Treatment Facility.

1.2 AUTHORITY

Malcolm Pirnie has been authorized to design a cap and a FRB for the Millcreek Superfund Site (Contract No. DACW45-89-C-0190 Scope of Services, Appendix "A"). The extent of the work was defined in the USEPA's Record of Decision, May 1986 (Ref. 2) and the Remedial Cleanup Treatability Study Report for Millcreek Superfund Site, Erie County, Pennsylvania, August 1989 (Ref. 3).

1.3 APPLICABLE CRITERIA

The following is a list of general references for design criteria used during design:

- Architect Engineer Instruction Manual for Design of Military Projects, U.S. Army Corps of Engineers, Omaha, Nebraska, January 1991, AEIM 13;
- Guide Specifications for Military Construction, U.S. Army Corps of Engineers, Omaha District, October 1990;
- Record of Decision, Remedial/Alternative Selection, Millcreek Superfund Site, Erie County, Pennsylvania, USEPA, May 1986;
- Remedial Cleanup Treatability Study, Millcreek Superfund Site, Erie County, Pennsylvania, Malcolm Pirnie, Inc., August 1989; and
- Title 25 Rules and Regulations, Pennsylvania Department of Environmental Resources, April 1988.

Preparation of this 90% Design Analysis Report and design plans were augmented by incorporating, where appropriate or applicable, comments generated during the project kick-off meeting and 35% preliminary design review. Kick-off meeting minutes and responses to USACE 35% review comments are contained in Appendices D and C, respectively.

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1.4 PROJECT DESCRIPTION

1.4.1 Description

The project involves the design of a cap and flood retention basin for the Millcreek Superfund Site. Cap construction will involve regrading the site to consolidate wastes, eliminate ponding and reduce infiltration, eliminating steep slopes, placement of a 12-inch thick soil cap, and establishing a vegetative cover. The FRB will be situated at the southeast corner of the site to reduce the potential for downstream flooding along Marshall's Run.

1.4.2 Rationale for Project

The remedial approach recommended in the ROD specified construction of a ground water extraction and treatment system to remediate contaminated ground water, selective excavation and consolidation of contaminated fill/soils and sediments under a RCRA cap; and grading and vegetative soil covering of "low-level" or uncontaminated fill/soil to limit surface infiltration of water and to act as a physical barrier minimizing receptor exposure and contaminant migration. The ROD, and the RI/FS upon which the ROD was based, did not define contaminant levels or quantities of fill/soil/sediment to be placed under the RCRA cap. As such, the predesign studies involved evaluations of remedial capping alternatives to determine the effectiveness of selected cap alternatives relative to the overall remedial objectives. The alternatives which were considered were:

- a minimum six-inch topsoil cap with site regrading (referred to herein as the "topsoil cap").
- a topsoil/clay cap consisting of a minimum 6-inch topsoil layer placed over a minimum 18-inch thick clay barrier layer after site regrading (referred to herein as the "topsoil/clay cap"); and
- a RCRA guidance cap consisting of site regrading, a minimum 6-inch topsoil layer, 24-inch soil protective layer, geotextile layer, 12-inch sand drainage layer, 30-mil thick synthetic liner, a 6-inch sand protective layer and a 24-inch recompacted soil barrier layer (referred to herein as the RCRA cap).

The intent of the ROD would be achieved with all of the above capping alternatives, since potential environmental and human health impacts due to air dispersal of contaminated soil, erosion and surface water transport of contaminated soil, and direct contact risk are

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eliminated by the addition of a topsoil cap. The following computer models were used to evaluate the cap alternatives relative to the objectives of the ROD including:

- the Hydrologic Evaluation of Landfill Performance (HELP) Model to simulate hydrogeologic performance (primarily infiltration rates) of the various alternatives;
- the Seasonal Soil Compartment Model (SESOIL) which is a mathematical model for a long-term environmental pollutant fate simulations designed to describe chemical migration through the vadose (unsaturated) zone;
- the Prickett-Lonquist Aquifer Simulation Model (PLASM) to simulate steady-state shallow ground water flow; and
- the RANDOM WALK mass transport model to simulate contaminant transport in the shallow ground water.

The models were used in concert to evaluate the performance of the various cap alternatives. Detailed discussions of the models, model inputs and model results are presented in the Remedial Cleanup Treatability Study Report (Ref. 3).

The HELP Model was used to simulate the hydrologic performance of the Millcreek site in its existing state and for the three alternative caps. The HELP model predicted that addition of the topsoil cap would increase runoff slightly. Evapotranspiration increased due to the introduction of a good grass cover which serves to reduce the amount of water available for percolation through the waste fill to the ground water. The top soil/clay cap increased runoff due to the low permeability of the recompacted clay barrier layer. The clay barrier layer also increased the rate of evapotranspiration and served to further reduce the amount of percolation through the waste fill. The RCRA cap decreased the percolation rate to essentially zero due to the addition of the sand drainage layer and the synthetic liner barrier layer.

SESOIL was also used to estimate the contribution of the vadose zone contaminants to the ground water in conjunction with various remedial capping alternatives. The results indicated that the topsoil and topsoil/clay caps provide no significant reduction of pollutant load to ground water. The RCRA cap was not evaluated since no infiltration from the cap to the ground water through the fill would be expected. The RCRA cap would virtually eliminate pollutant load contributions from unsaturated waste fill eliminating percolation and leaching.

The hydrologic effect of the topsoil/clay cap was evaluated using the PLASM flow model. Five ground water collection segments or trenches were simulated in conjunction with the topsoil/clay cap in order to evaluate the effect of capping on the ground water collection system. A comparison of the flow lines for the 5 collection segments under existing conditions and a topsoil/clay cap indicated that the effect of placing a topsoil/clay cap over the site coupled with a ground water collection system would not affect the general flow patterns that currently exist (i.e., no cap) and would result in a minor (i.e., 12%) reduction of the collected ground water flow rate over that estimated by the model for the same collection system without a cap.

Overall, SESOIL model results for soil pollutant fate in the unsaturated zone indicated that contaminant loadings to ground water under maximum ("worst-case") and average conditions over a twenty-five year simulation period would not be significantly reduced with the placement of a low permeability cover such as the topsoil/clay or RCRA caps even though the infiltration rate would be reduced significantly. A RCRA cap over localized areas with high soil contaminant concentrations would virtually eliminate contaminant loading to the ground water. However, based on the solute transport model (RANDOM WALK) predictions, the reduction in contaminant loadings from selectively excavated and capped areas does not significantly alter the need for ground water treatment. Furthermore, selective excavation does not appear to be feasible based upon wide-spread and erratic soil contaminant distribution. The limiting step to determining the period of operation for a ground water collection and treatment system appears to depend upon the time required to recapture the existing contamination in the ground water both on-site and off-site. Consequently, the means of soil remediation (e.g., selective excavation versus capping), the type of cap and the establishment of soil remediation criteria is not important from the perspective of ground water quality, provided that ground water is effectively captured and treated.

PART 2 - DESIGN REQUIREMENTS AND PROVISIONS

2.1 CAP AND FLOOD RETENTION BASIN DESIGN

2.1.1 Cap Design Criteria

The Remedial Cleanup Treatability Study (Ref. 3) provided data necessary for the evaluation of remedial capping alternatives. As a result of this predesign study, it was determined that a RCRA or other low-permeability barrier type of cap would not significantly affect ground water quality or the quantity of ground water collected for treatment. Consequently, a graded vegetated topsoil cap was recommended to act as a physical barrier to mitigate direct exposure of humans and wildlife to contaminated fill materials; and to minimize further migration of contaminated sediment from the site via surface water/flood erosion and wind-borne dust. PADER subsequently recommended that the cap be a minimum 12-inch thickness (see Appendix A). Design and implementation of the selected cap for the Millcreek Superfund Site addressed this request by PADER as well as other applicable or relevant and appropriate regulations (ARARs).

The grading plan logic previously delineated in the Remedial Cleanup Treatability Study and Value Engineering Report, as approved by the USEPA, PADER, and the U.S. Army Corps of Engineers, was used in developing the subgrade grading plan. The grading plan incorporates PADER's Title 25 Rules and Regulations for land disposal sites which specify a minimum slope of 3% to prevent ponding and a maximum slope of 25% to limit erosion, and a perimeter access road for inspection and maintenance activities. These requirements are considered State ARARs. The grading plan was also developed with the objectives of minimizing both cut (to minimize waste disturbance and the probability of encountering drums) and fill (to minimize the amount of fill which must be trucked in, the associated material costs and environmental impacts associated with roadway truck traffic, mining, etc.).

The cap design also addresses the Federal Flood Plain Management Regulation (EO11988) as an ARAR by incorporating a flood retention basin (FRB) that is designed primarily to mitigate downstream flooding of Marshall's Run. The flooding contribution associated with the project site is minimal with respect to the watershed upstream of the site. Design of the FRB also incorporates State ARARs on Dam Safety and Waterway Management.

Construction of the cap will involve cutting, grading, and minor filling in a flood plain. However, Marshall's Run and the north ditch which border the site will be improved by clearing, widening and placement of riprap and other erosion control materials in the channels. Marshall's Run will be realigned to minimize encroachment on adjacent private properties. The stream/ditch embankments will also be cut back to reduce excessive slopes along the drainage channels which are prone to erosion. The clearing and widening of the drainage channels will improve the flood plain characteristics. The flood plain areas bordering Marshall's Run and the north ditch are currently inundated during flood storm events. Construction of the FRB will reduce the areal extent of the existing flood-prone areas, thereby negating flood plain construction impacts. Thus, the FRB and channel improvements, in conjunction with the topsoil cap, will have an overall beneficial impact on flood plain management.

The subgrade grading plan was also developed with the objective of limiting filling of wetland areas. However, in order to minimize cap construction problems, covering of wetlands will inevitably occur. Some wetlands loss will be mitigated through excavation associated with the FRB as well as by grading back irregular cap limit boundaries. The wetlands loss (viz. currently estimated at approximately one acre) is significantly less than the wetlands loss previously proposed as part of the conceptual capping plans presented in the August 1989 Remedial Cleanup Treatability Study and less than that proposed in the ROD which recommended damming several of the wetland embayments for sedimentation purposes. Covering of the exposed fill material will mitigate the continued erosion of potentially contaminated soil and fill from the site into the wetlands.

Additional data and criteria required to design the cap and FRB were collected and/or established based on additional surveys and investigations performed as part of the detailed design. These tasks included completion of a landfill limits survey, wetlands delineation, surface debris survey, a geotechnical investigation, and a creek profile survey along Marshall's Run. Detailed discussions of the results of these surveys and investigations are presented in the following paragraphs.

2.1.2 Fill Limits Survey

Preliminary limits of fill for capping were previously identified in the ROD. A limits-of-fill survey was required to finalize cap limits on the construction plans.

The limits-of-fill survey initially involved a survey crew placing stakes along cap limits identified in the ROD. Particular attention was given to establishing limits based on the existing boundaries of mature treed areas situated in the northeast section of the site. As determined in the ROD, this mature treed area will not be capped. The surveyed limits were to be verified and refined as required by excavating shallow test pits along the staked limits.

Hand-excavated test pits along the staked limits in the northeast section revealed that the fill limits extend northward through the treed area, beyond ground water extracting trenches No. 1 and 5 to the drainage channel along the northeast property boundary (North Ditch) and easterly beyond trenches No. 2 and 4 to the western bank of Marshall's Run. This encompasses the entire area that was not initially planned to be capped. Inspection of boring logs from monitoring wells installed in this area and conversations with geologists present during previous site investigations confirmed the presence of fill within this entire area. Fill was also encountered during installation of the ground water extraction trenches. It was concluded that fill limits in this area extend to the drainage channel along the northeastern property boundary and to the western bank of Marshall's Run. The extent and nature of fill in other areas beyond property limits is unknown. No known assessments have been conducted outside the property limits.

Inspection of the treed area in the northeast section of the site revealed that a portion of the trees were removed for construction of the extraction trenches. Those areas disturbed as part of the extraction trench construction will be graded and capped to minimize infiltration impacts on the quality of water collected by the ground water extraction trenches. Capping these areas will also minimize the potential for direct contact with the fill exposed during construction.

The limits of fill and prepared capping limits were established based on the results of test pits and field observations. In general, the fill limits either follow property boundary lines or edge of wetlands, as determined by the wetland survey (see Section 2.1.3). It appears that the remaining on-site wetland areas are unfilled portions of the original wetland area. Determination of wetland areas as well as bordering fill limits was facilitated

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by abrupt change in grade caused by filling. The results of the fill limits survey were incorporated into the design plans.

2.1.3 Wetlands Delineation

The site contains wetlands areas, some of which will be lost as a result of capping. In order to develop mitigation measures to the extent possible, a wetlands survey was conducted to delineate wetland limits in accordance with accepted methodologies. Wetlands boundary limits were determined by visual observations of wetland edges determined by a Malcolm Pirnie wetlands specialist. Wetland boundaries were flagged and numbered consecutively in the field and were subsequently located with respect to the horizontal grid system established for the site using survey field instruments. The wetland limits and corresponding survey designations are indicated on the existing site plan drawing.

The results of the wetlands delineation survey are contained in Appendix B, which includes a narrative of the delineation methodology, characterization results, photolog, and corresponding site plan.

2.1.4 Surface Debris Survey

The site contains some large bulky metallic debris (viz. dump trucks, car bodies, refrigerators). The debris must be removed from the site and properly disposed of in order to construct the cap. A surface debris survey was conducted to provide the Cap Contractor with information on the location and type of surface debris which must be removed during cap construction. The location and description of this debris is presented in tabular form on the existing site plan drawing to facilitate the bidding process. The debris list is being provided for bidding purposes and is qualified to reflect that it is the Contractor's responsibility to verify the accuracy and completeness of the list.

It is anticipated that the bulky debris will be loaded onto transport vehicles and decontaminated by high pressure steam-cleaning prior to leaving the site. Wipe sampling of debris will not be required before removal of debris off-site. Metallic objects can then be salvaged for recyclable metals.

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2.1.5 FRB Design and Improvements to Marshall's Run

2.1.5.1 General

Portions of the Town of Erie experience flooding problems along Marshall's Run. In order to minimize the potential for flooding along Marshall's Run adjacent to and downstream of the site, improvements will be made to the existing channel and adjoining wetlands. These improvements consist of construction of a flood retention basin (FRB), realigning the channel and raising the channel embankments.

The contribution of overland storm water flow from the Site to the FRB is small compared to the impact of upstream watersheds. Of this contribution from the Site, approximately 40 percent will drain to Marshall's Run through the FRB, while most of the remainder will drain through existing wetlands through to the North Ditch, a tributary to Marshall's Run. The North Ditch is located at the northern boundary of the Site, approximately 1,500 feet downstream of the FRB, and drains storm flow from adjacent residential properties (see Vicinity Map, App. G).

2.1.5.2 Hydraulic and Hydrologic Analysis

The watershed contributing to Marshall's Run has a surface area of 1.55 square miles. The watershed is mostly urbanized and served with a network of storm drains and natural drainage channels.

Design of the FRB required hydraulic and hydrologic analysis of the influent watershed and receiving stream, respectively, as well as selection and design of flood retention and flow control structures based on site characteristics. The following tasks were undertaken to support the hydraulic and hydrologic analysis:

TASK	DESCRIPTION
1	Estimation of runoff corresponding to various return frequency storms.
2	Estimation of the existing capacity of Marshall's Run.
3	Design of channel improvements and hydraulic control structures to contain the design flood flows within the FRB and Marshall's Run (Design Concept).

2.1.5.2.1 Estimation of Runoff

An estimation of the runoff corresponding to various return frequency storms was performed. Hydrologic models of the watersheds tributary to Marshall's Run and the FRB were developed using the USACE HEC-1 computer program (Version 4.0 - September 1990). The FRB receives flow from two areas: the predominantly urban watershed which discharges into Marshall's Run south of the railroad tracks, and the much smaller Site landfill cap watershed which discharges directly to the FRB. The urban watershed was subdivided into two main subbasins, and two additional smaller subbasins. Each of the main subbasins were further subdivided into smaller watershed areas. A total of 16 subwatersheds were factored into the hydrologic analysis (refer to Marshall's Run Drainage Boundaries Map, Appendix G).

Modeling of tributary flows to Marshall's Run was also performed using the HEC-1 program. These flows consist of runoff from the Site and adjacent properties influent to the North Ditch, which in turn discharges to Marshall's Run downstream of the FRB.

Runoff from the watersheds was developed using the kinematic wave method, while the interception/infiltration losses were estimated by the SCS curve number method. The SCS curve numbers were based on the land use and soil types within the watersheds, as determined by the September 1974 hydrologic study. A 24-hour Type II rainfall distribution was considered for the 10- and 50-year frequency storms. A hard copy of the HEC-1 computer-generated runoff summaries for the 10-year and 50-year return period storms is included in Appendix F.

2.1.5.2.2 Marshall's Run Stream Flow Analysis

An estimation of the capacity of Marshall's Run from the railroad tracks just south of the site to Lake Road (Alt. Rt. 5) was completed using the USACE HEC-2 Water Surface Profile computer program. Field survey data obtained included stationing, cross-sectional dimensions, and channel bottom elevations based on the existing datum for the site. The locations, materials, invert elevations, and sizes of existing culverts within the channel were determined. Plan and profile drawings of Marshall's Run, showing HEC-2 cross-sections and bank and channel bottom elevations are included in Appendix I.

Channel and overbank characteristics were evaluated to determine the Manning's "n" value used in calculating water surface elevations. Refer to the Table 1 for a description of the channel conditions used in the computer program. Cross-sections correspond to those shown on the Hydraulic Profile and plan view maps contained in Appendix I.

TABLE 1
EXISTING MARSHALL'S RUN CHANNEL DESCRIPTION

Channel	Cross Section	Description	"n"
Channel adjacent to Site (existing condition)	35-72	Grass covered channel. Moderate wooded obstructions.	0.07
Channel north of site to 5.5' by 3.5' box culvert	12-35	Grass covered channel, clean. Little vegetation.	0.025
5.5' by 3.5' box culvert to West Lake Rd. (Alt.5)	11-1	Mud Covered Channel	0.027
(see description column)	34, 35	12' by 6' concrete box culvert	0.017
(see description column)	25, 26	5' dia. culvert	0.011
(see description column)	14, 15	6' by 4' oval corrugated metal pipe	0.024
(see description column)	8, 9	3.5' by 5.5' concrete box culvert	0.017

The existing channel capacity of Marshall's Run directly adjacent to the site, from the N.Y. Central Railroad grade to West 12th St., was determined to be limited to 15 cfs at cross-section 57. This station is where the runoff from a trucking company lot discharges into Marshall's Run. The second most limiting reach in this area was determined to be at cross section 43, where the discharge capacity was 60 cfs.

Downstream of West 12th St., the capacity of Marshall's Run increases. Between West 12th Street and Lake Road (Alt. Rt. 5), the capacity of the channel was determined to be 150 cfs before overtopping occurred at the 6-ft. x 4-ft. oval corrugated metal pipe under Oregon Avenue (cross-sections 14 and 15). With improvements to the culverts and 1000 to 2000 feet of embankment, the carrying capacity of Marshall's Run in this area could conceivably be increased to 350 cfs or more (see Marshall's Run Hydraulic Profile, Appendix I). It should be noted that while 350 cfs might theoretically be contained within the channel immediately upstream of Oregon St., the "channel" in that vicinity includes residential lawns which are routinely flooded.

2.1.5.3 Design Concept and Criteria

2.1.5.3.1 General

Marshall's Run flows north-northwesterly adjacent to the Site. On the east bank of Marshall's Run, opposite the Site, are truck loading facilities, warehouses and residential homes. The proposed FRB will be located adjacent to the west bank near the southeast corner of the Site, within existing wetlands.

The design operation concept for the FRB is to utilize these wetlands, and other wetlands south of the Site, to retain flood flows from Marshall's Run. The "excess" incoming flows from Marshall's Run will be diverted into the FRB along with overland flows from the capped southern portion of the Site. Diversion of channel flows will be accomplished by a control structure constructed across Marshall's Run south of the fill area. The control structure will contain a culvert designed to pass storm flows up to the culvert's design capacity. When storm flow in Marshall's Run upstream of the control structure exceeds the capacity of the control structure culvert, the water levels in Marshall's Run will start rising and excess flow will spill into the FRB and contiguous wetland area over a side-discharge weir. Once the storage capacity of the FRB is reached, the stored water elevation will rise above the crest of the emergency discharge spillway. All flows in excess of the FRB design capacity will thereafter be discharged over the spillway and through the submerged culvert to the downstream channel, after having been retained in the FRB. This operating concept, which is designed to attenuate peak flows while allowing "base" flows to pass freely, is a modification of the on-line basin concept, in which all flows are stored and attenuated prior to discharge. The "on-line" concept necessarily required a larger storage volume than the modified on-line design.

2.1.5.3.2 Flood Retention Basin

Design of the flood retention basin was based on the HEC-1 influent hydrographs developed both for overland drainage from the cap and influent flows from Marshall's Run. However, current conditions in Marshall's Run interfere with the development of the natural hydrograph. The existing culverts under the railroad tracks south (viz. upstream) of the Site

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are undersized and do not permit the peak flows to pass through. These undersized culverts act as hydraulic control structures, generating head losses of several feet and contributing to upstream flooding. Improvement of these structures to allow peak storm flows to pass is not included in the scope of the Millcreek project, but nonetheless constitutes a basic assumption pertaining to the design, operation and performance of the new FRB facility.

The existing wetland elevations in the FRB impoundment area gradually vary from elevation 713 feet to 715 feet above average mean sea level (MSL), with groundwater elevations ranging from 709.5 to 712 feet (Refs. 2 and 3). The wetlands is frequently flooded, and no excavation is anticipated for the FRB. Additionally, the areas upstream of the FRB and railroad have topographic elevations of less than 720 feet. This limits the storage capacity of the FRB, since water surface elevations cannot be increased to the point where upstream flooding occurs. A map of the flood area impounded in the FRB during the 10-year and 50-year storm events is provided in Appendix G.

Two hydraulic control structures are required to enable the FRB to operate as designed within the limitations presented by the high ground water and low available head. The first control structure is a side-discharge weir which forms the eastern boundary of the FRB. The purpose of the weir is to transfer peak flows to the FRB while maintaining minimum water levels in the wetlands. In order to lessen the potential for localized erosion that would effectively lower the water level in the wetlands, the side discharge weir has a concrete core wall. This concrete wall extends below the elevation of the invert of Marshall's Run channel to minimize the potential for water to flow directly from the FRB into Marshall's Run.

The second hydraulic structure is the low-level outlet which is to be constructed across Marshall's Run. The low-level outlet is designed to regulate effluent flow from the FRB by partially obstructing the flow in Marshall's Run during routine storm events, while preventing upstream flooding during extreme storm events by allowing the water to escape via an emergency overflow weir. During flood events in excess of the capacity of the low-level outlet, stored storm water may exceed the level of the side-discharge weir and back up into Marshall's Run. During these periods, which include the design storm (viz., 10-year), the low level outlet lies within the area impounded by the control structure and functions in concert with the FRB to attenuate peak flood flows.

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The outlet is designed as a wide base concrete-fill gravity retaining structure to minimize erosive damage and provide a margin of safety against foundation failure. A bar screen is provided on the upstream side to intercept large debris which might otherwise become lodged in the culvert or reduce the capacity of the downstream channel. Concrete aprons are provided on both the upstream and downstream sides to minimize damage from high approach and exit velocities to and from the culvert, and to minimize the potential for piping of subsurface water. The emergency overflow weir is sized and located at an elevation so as to avoid flooding upstream areas during extreme rainfall events. Retaining walls are provided on either side of the outlet structure to couple the outlet structure with the earthen embankments of Marshall's Run.

Design criteria for the FRB outlet structure are listed in Table 2 below:

TABLE 2

FRB SIDE DISCHARGE WEIR AND OUTLET STRUCTURE DESIGN SPECIFICATIONS

Elevation of Side Discharge Weir	714.0 ft.
Length of Side Discharge Weir	760 ft.
Invert of Culvert	709.5 ft.
Dimensions of Culvert	4.5 ft.(W) x 2.5 ft.(H)
Crest of Emergency Spillway	717.50 ft.
Length of Emergency Spillway	4 ft.
Width of Emergency Spillway	30 ft.
Spacing of Screen Bars	6 in.

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Performance criteria for the FRB are listed in Table 3 below:

TABLE 3

FRB PERFORMANCE CRITERIA

Description	10-yr Storm	50-yr Storm	100-yr Storm
Peak influent flows (from Marshall's Run and Site runoff)	887 cfs	1534 cfs	1736 cfs
Peak outlet flow	157 cfs	327 cfs	390 cfs
Flow-through culvert (max.)	157 cfs	173 cfs	176 cfs
Flow-over emergency spillway (max.)	0	154 cfs	214 cfs
Area impounded by FRB	19.4 acres	25.9 acres	26.6 acres
Water level in FRB (max.)	717.4 ft.	718.9 ft.	719.2
Water level in downstream Marshall's Run	712.8 ft.	714.9 ft.	715.5
Head loss generated by FRB (side discharge weir, culvert, emergency overflow, and bar screen)	4.6 ft.	4.0 ft.	3.7

Based on these design specifications and performance criteria, the FRB will begin to store storm water at flows greater than 100 cfs, which is less than the existing downstream capacity of Marshall's Run below West 12th Street (see Discussion, Section 2.1.5.2.2). Upstream of West 12th Street, Marshall's Run channel will be improved to increase its carrying capacity (see Discussion, Section 2.1.5.3.3). Thus, flooding conditions downstream will be improved by the FRB.

The buildup of water in the FRB could have an impact on the stability of the cap and could result in some loss or slippage of soil especially after numerous and/or extended storm events. The granular nature of the slag (viz., well drained) and the proposed grade will serve to minimize potential stability problems. Since the cap consists entirely of topsoil, the loss of topsoil would be a long-term post-closure maintenance issue. Additional topsoil and reseeding may be required to maintain desired grades if soil loss occurs.

The potential exists for the FRB low-level outlet bar screen to become clogged with debris washed down the channel. The clogged bar screen would have different hydraulic characteristics and could potentially effect the performance of the FRB. A sensitivity analysis was performed on the hydrologic routing computer model to determine the net effect of a partially clogged bar screen on FRB flood stage and downstream flows.

The methodology used in the sensitivity analysis was as follows: a reduced culvert area, which yielded the same headloss as that generated by a 50% clogged bar screen and the design culvert (viz., 4'-6"W x 2'-6"H), was calculated. This reduced culvert area was then input into the HEC-1 computer routing model to determine the new FRB performance criteria. These criteria are summarized in the table below:

TABLE 4

SENSITIVITY ANALYSIS OF FRB OUTLET STRUCTURE BAR SCREEN CLOGGING POTENTIAL

Description	10-Year Storm	50-Year Storm	100-Year Storm
FRB Peak Stage:			
Clean Screen	717.38	718.90	719.24
50% Clogged Screen (1)	717.41	718.91	719.25
Culvert Peak Flow:			
Clean Screen	157	170	176
50% Clogged Screen(1)	154	170	176

(1) Culvert area adjusted from 11.25 s.f. to 11.08 s.f. to simulate clogged screen.

The sensitivity analysis suggests that a 50% clogged bar screen will have a negligible effect on the performance of the FRB outlet structure. In order to minimize the potential for clogging, the bar screen has been designed to extend up to the spillway at a 30° incline from vertical, to facilitate manual cleaning.

The potential structural failure of the FRB outlet structure at various times during a storm event was investigated to determine peak flows to the downstream channel. The resultant peak flows were compared to peak flows under existing (no dam) conditions to determine the relative impacts on downstream property owners. The hydrologic computer

Model HEC-1 was used for the dam break analysis, and the condition evaluated was the probable maximum flow (PMF).

The computer mode permits the user to declare the stage at which dam failure will occur. By observing the trends in the effluent hydrographs, stages were chosen to envelope all dam break potentials. It was assumed that the dam would fail to an elevation of 714, a width of 60 feet, and side slope of 2 vertical on 1 horizontal. Fifteen minutes was specified for the dam to reach failure geometry.

Peak flow is defined as the sum of flows through the low level culvert, over the spillway (el. 717.5), over the dam berms (el. 720), and across the failed dam. For comparison, peak flow entering the reservoir for the PMF was determined to be 14,651 cfs. In the event no structure was constructed across Marshall's Run to impound floodwater, this is the flow that would progress downstream. Table 5 illustrates the stage, time and peak flow for each of seven dam failure scenarios.

TABLE 5

DAM BREAK ANALYSIS: DETERMINATION OF PMF FLOWS IN MARSHALL'S RUN DOWNSTREAM OF THE FRB

Stage at Break (ft)	Time at Break (hrs)	Peak Flow (cfs)
720.0	13.33	13,808
720.5	13.50	13,809
720.8	15.33	12,992
721.0	15.50	14,940
721.5	15.58	14,342
722.0	15.63	14,072
722.3	15.67	14,072

Table 5 shows that the maximum flow in Marshall's Run as a result of FRB dam failure would be 14,940 cfs, less than two (2) percent greater than peak flows in the channel prior to construction of the FRB. Based on this analysis, it is concluded that the potential for increased adverse impact of a dam failure on downstream property owners would be negligible, compared with existing conditions.

2.1.5.3.3 Marshall's Run

The capacity of Marshall's Run has been improved both upstream and downstream of FRB to accommodate the projected peak flows. Both the east and west banks of the channel have been elevated to provide additional capacity. The banks have a 3 horizontal to 1 vertical slope in conformance with PADER criteria for earthen structures.

The original design intent for improvements to Marshall's Run was to design to the capacity of the downstream channel. Following discussions with USACE personnel, it was determined that Marshall's Run should be improved to convey flows in excess of the existing downstream capacity, in order to allow for potential future channel improvements by local authorities.

The east bank of Marshall's Run will be built up to prevent the discharge of backwater into the trucking company lot on the southern half of the site boundary, and into residential properties on the northern half. Raising the east bank of Marshall's Run requires measures to convey overland flows which currently drain by gravity into the channel. Diversion swales on adjacent properties will direct flows through conduits in the bank into Marshall's Run. In order to prevent channel flow from discharging back through the conduits into the lower areas east of the Site, backflow prevention devices will be installed on gravity drain pipes lain through the banks.

Two existing storm water lines at 15th Street and 17th Street currently drain directly into Marshall's Run at Stations 54 and 62, respectively. These storm water lines will also be retrofit with conduits through the east bank of Marshall's Run and flap gates to prevent return channel flows into the storm water collection system. However, it should be noted that field surveys have determined the existing inverts of the storm lines are up to 18 inches lower than the channel bottom in Marshall's Run. The interconnecting manholes to be installed under the Millcreek Cap and FRB project to join existing stormwater piping to conduits through the Marshall's Run berm will necessarily have outlet inverts higher than inlet inverts, guaranteeing partially surcharged pipes in the upstream storm water collection system even under dry weather conditions. This situation does not constitute a changed site condition, since storm water pipes are currently surcharged as a result of localized ponding at the pipe outlets in Marshall's Run. Improvements to the existing storm water collection system to alleviate the surcharge conditions should be undertaken by local authorities.

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Diverting storm flows from adjacent properties to a lift station was considered as an alternative solution. This option was ruled out due to additional capital, operation and maintenance costs.

The trucking company adjacent to the southeastern boundary of the Site has expressed an interest in discharging flows from a mitigated wetlands into Marshall's Run. In order to minimize the relatively large water level fluctuations inherent in draining the wetlands to the FRB south of the outlet structure, a conduit has been designed in the east bank of Marshall's Run to convey wetlands flows north of the FRB. A backflow preventer (flap valve) will be installed on the pipe to prevent communication of channel flows with the mitigated wetlands.

The elevation of the west bank of the channel upstream of the low level outlet structure (i.e. the side discharge weir) was selected to maintain minimum water elevation in the wetlands. The elevation of the east bank of the channel upstream of the outlet is designed to have a 1.3 foot freeboard at the 50-year storm flow, while the freeboard on the downstream channel banks is 0.5 feet for the same storm event. The apparent reduced margin of safety against overtopping the downstream banks is justified by the flow control afforded by the outlet structure, and also results in minimized encroachment of the east bank onto adjacent private properties.

The storm flows discharged into Marshall's Run downstream of the FRB outlet control structure are impacted by the influent flows to the FRB from Marshall's Run and from overland site drainage; by the attenuation of influent flows provided by the FRB; and by the flow contribution from the North Ditch Culvert (see discussion under Section 2.1.8.2) and the Water Treatment Plant. The design flows to Marshall's Run are summarized in Table 6 below. Cross-sections correspond to those shown on the plan and profile drawings contained in Appendix I.

TABLE 6 DESIGN FLOWS IN MARSHALL'S RUN DOWNSTREAM OF THE FRB			
Channel Cross-Section	**10-year**	**50-year**	**Ultimate Capacity (no Freeboard)**
64 to 50	157 cfs	327 cfs	350 cfs
50 to 35	173 cfs	338 cfs	350 cfs

The USACE has determined that construction associated with the Cap and FRB project should be confined within the Site boundaries as much as practical. This has been largely accomplished by relocating the improved Marshall's Run channel approximately 40 feet west. However, maintaining the channel within Site boundaries adjacent to the Groundwater Treatment Plant required construction of a 200-foot long concrete box culvert. The box culvert will be closed to prevent accidental falls into the six foot deep structure.

Rip rap has been provided along the banks and bottom of the improved channel. The rip rap has several functions: it will serve to define the channel boundaries; it will provide a measure of erosion control during flood events; it will reduce maintenance (i.e., grass cutting and repair of gully erosion); and it will enhance the visual appearance of the channel, which might otherwise become overgrown with vegetation.

Lining the channel with rip rap is desirable where construction on natural and imported fill allows equipment to be used to economically place the material, and where communication with ground water is of secondary concern. However, additional protection against subsurface infiltration of the channel flows is required where the channel parallels Trench Numbers 2 and 4 in order to prevent migration of uncontaminated surface water into the ground water extraction system. In this area, which extends from the FRB control structure to the WTP bypass culvert, a continuous liner will be placed in the channel. The channel in the lined section will be underlain by a permeable drainage layer and constructed with subsurface drain lines to relieve potential ground water pressure and prevent failure of the liner due to hydrostatic lift. Calculations for prevention of hydrostatic lift are included in Appendix N.

An economic comparison was performed to determine the merits of two continuous liner concepts. A concrete-lined channel was compared with HDPE overlain by erosion protection. The analysis revealed that the HDPE liner was significantly less expensive at $200,000 versus $500,000 for concrete. The type of erosion protection selected was shallow mesh gabions, since additional safety against puncturing the liner during construction may be achieved by filling the gabions with relatively small stone media. Additionally, the gabions may be tied together and supported from the gabions placed at the bottom of the channel, and as such would be less likely to fail because of slippage off the HDPE liner. In addition to fulfilling the functions of riprap described above, the gabions also serve to anchor and protect the HDPE liner.

The channel embankments beneath the riprap and liner components are designed as homogenous levees constructed of one material. The materials of construction for the channel embankments are as determined by the geotechnical investigation report (see Appendix E). These materials are readily available in the area and are less susceptible to piping damage (soil loss) than fine-grained cohesive soils. Two materials are specified; one for the lined portion of the channel, and another for the unlined portion. The material for the unlined portion has a higher percentage of fines, which make it less permeable. In order to prevent any contamination of channel flows by contact with contaminated material, all embankment fill materials will be provided from off-site borrow areas, which in turn will be investigated to determine whether past contamination from industrial activity may have occurred.

The State of Pennsylvania requires that constructed slopes be no steeper than 3H on IV. The reference Design of Small Dams indicates that these slopes need be no flatter. Conservative calculations for slope stability, which are included in Appendix N, result in safety factors greater than 1.5 for both cohesive and non-cohesive embankment fill material. The calculations and safety factors for slope stability also apply to riprap placed on geotextile along the unlined portion of the channel.

In order to reduce the likelihood of seepage from the embankment face, as well as reduce the likelihood of piping beneath the embankment, a toe drain will be installed on the landward side of the embankment. The amount of seepage intercepted by the toe drain is expected to be minimal; considering the relatively short time to peak and subsidence for the design flood stage, and the low gradients (less than five feet of head for the design storm).

The liner components for the lined portion of the channel consist of two layers of geotextile sandwiching a drainage layer of permeable material (the bottom layer to protect the drainage material from intrusion of fines, and the top layer to protect the HDPE); an 80-mil HDPE liner (specified for durability and resistance to puncture during placement of the gabion mattresses); and a final geotextile protective layer upon which the gabion mattresses are placed. Maximum tensile stress on the liner components have been calculated and are included in Appendix N. The minimum factor of safety of the liner components against tensile failure is 3.3.

The geotextile and HDPE will be keyed into the top of the embankment to stabilize the liner components. As discussed above, an adequate factor of safety exists for liner tensile strength when fully loaded with gabion mattresses. The liner anchor trench is not designed to fail before the liner as would be the practice in landfill construction where fill loading places additional stress on liner components. Based on previous design experience, the anchor trench detailed on the drawings offers a total resistive force against pullout substantially greater than the expected tensile loading on the liner components.

A description of the channel hydraulic characteristics used in the HEC-2 water surface profile analysis for the improved Marshall's Run channel adjacent to the Millcreek Site is presented in Table 7. Cross sections correspond to those shown on the plan and profile drawings contained in Appendix I.

TABLE 7

IMPROVED MARSHALL'S RUN CHANNEL DESCRIPTION

Channel	Cross Section	Description	"n"
Channel adjacent to Site	34-45, 67-72	riprap-covered channel	0.029
Channel adjacent to Site	46-67	stone-filled gabions	0.029
17th St. culvert	62-63	12'x 6' concrete box culvert	0.011
WTP culvert	45-46	12'x 6' concrete box culvert	0.011

2.1.6 FRB Geotechnical Design Analysis

As discussed above, design of the FRB will include construction of a levee embankment to retain storm flows, realignment of Marshall's Run to situate the channel within the impoundment area, and construction of control structure to regulate storm flows.

A geotechnical investigation was conducted by Haley & Aldrich, Inc. of New York in the proximity of the FRB to obtain site specific information to adequately determine:

- the suitability of the underlying soils for embankments, abutments and basin construction;
- requirements for embankment materials;
- any required improvements to the underlying soils; and
- construction considerations for proposed structures.

The geotechnical investigation and design analysis was expanded subsequent to the 35% submittal to include additional information concerning the side discharge weir and water treatment plant bypass culvert.

This information is required to establish design criteria for the FRB embankments and control structure. A geotechnical design analysis report prepared by H & A is included in Appendix E, and contains data from field investigations and laboratory test results. Major observations of the investigation were:

- the embankment bearing grades are generally granular fill and are suitable for the type of construction anticipated;
- the character of the granular fill is likely to be variable, and special attention should be given to measures to resist the subsurface erosion and loss of soil due to water transport (i.e., piping);
- all earthwork should be performed in the dry to prevent damage to the fine grained material;
- any low-permeability lining should be underlain by a drainage layer with relief of accumulated ground water; and
- embankment fill must be imported from off-site.

2.1.7 Settlement Evaluation

A qualitative settlement evaluation was conducted to determine the probability and significance of settlement. Appreciable settlement is not anticipated for the following reasons:

- the waste fill is primarily composed of foundry sand and slag which are granular in nature and readily compact under their own weight;

- since the waste fill has been in place for a minimum of 10 years, most of the settlement associated with the waste fill, if any, should have already occurred; and

- during cap construction, all on-site fill will be compacted with a minimum of three (3) passes and all off-site fill will be compacted to 90% of the Standard Proctor density. Surcharge loads from compaction and construction equipment, and fill placed to achieve desired grades will promote primary settlement, if any, of loosely compacted subfill. Should settlement occur during grading/filling operations, the Contractor will be required to place additional fill in settled area to achieve desired grades.

Since the cap consists entirely of topsoil, differential settlement is not a concern. Settlement after completion of capping (i.e., subgrade preparation, topsoil placement, and turf establishment) activities will be long-term post-closure maintenance issue. Additional topsoil and reseeding may be required to maintain desired grades if settlement occurs.

Damage to concrete structures by settlement will be minimized by design and construction measures. Specifications require that the soil be dewatered prior to pouring cast-in-place concrete. Expansion joints are provided on the 200-foot long culvert adjacent to the Water Treatment Plant, and construction joints are provided at frequent intervals along the length of the side discharge weir upstream of the Flood Retention Basin control structure.

2.1.8 Cap and FRB Grading Plans

2.1.8.1 General

The cap and FRB grading plans and details were prepared in accordance with cap design criteria presented in Paragraph 2.1.1. The cap design and features incorporate features presented in the pre-design study (Ref.3) with the following exceptions:

- expansion of the capping limits to include areas (cleared during extraction trench construction) located at the northeast section of the site;

- southward relocation of the FRB; and

- realignment of Marshall's Run.

Review of information collected during the limits of fill survey and construction of the ground water extraction trenches revealed that waste fill extends throughout the northeast section of the site up to the drainage ditch along the northern property line, and to Marshall's Run at the eastern property line. Shallow test pits excavated within the wooded area indicated that there is little, if any, soil cover over the waste fill. The preliminary grading plan (presented in the Remedial Cleanup Treatability Study Report) was developed using assumed capping limits and with the goal of minimizing disturbance of mature trees. However, construction of the extraction trenches resulted in clearing and disturbance of portions of the wooded area. Consequently, capping limits have been extended to encompass these cleared areas. The additional areas to be capped are a total of approximately 7 acres in size.

The FRB was offset southward from its previous location to maximize the separation distance from Trench No. 4 to reduce the potential influence of the FRB on the routine operation of the ground water extraction system. The pump test data indicated that the zone of influence for Trench No. 4 extends approximately 250 feet.

The USACE generated comments regarding cap and FRB design were incorporated into the plans and specifications, where appropriate. The design review comments and Malcolm Pirnie responses to these comments are contained in Appendix C. Where appropriate or applicable, comments concerning design issues have been incorporated into this Design Analysis Report.

The 90% subgrade grading plan contours submitted for 90% design review remain essentially unchanged from the preliminary concept plan with the following exceptions:

- the majority of the treed area identified in the ROD will not be capped;
- areas disturbed by extraction trench construction will be capped;
- the FRB has been relocated further south;
- Marshall's Run will be realigned and improved; and
- the grading plan reflects additional shaving of high and steeply-sloped areas, and flattening of associated grades to reduce the amount of clean fill required.

The subgrade grading plan also includes modifications to the FRB. An embankment levee with control structure is situated along Marshall's Run at the southeast corner of the Site. The levee embankment will have 1V to 3H slopes. Marshall's Run will be realigned within the FRB and FRB embankments.

Wetlands which will be lost due to capping consist of perimeter lenses in the "A" and "B" embayments located in the central portion of the Site. Approximately one acre of wetland will be covered by the final topsoil grade in these areas. The loss of wetlands is significantly less than the wetlands loss previously proposed as part of the conceptual capping plans presented in the August 1989 Remedial Cleanup Treatability Study (Ref. 3) and less than that proposed in the ROD (Ref. 1) which recommended damming several of the wetland embayments for sedimentation purposes.

The subgrade plan also includes a proposed alignment for a perimeter maintenance road and fencing limits for site security. A perimeter security fence is required to restrict unauthorized access of motorized vehicles which could potentially cause severe damage to the cap.

The subgrade grading plan was prepared in accordance with applicable design criteria. Grading the site to the proposed subgrade plan involves clearing approximately 60 acres of mature trees, small trees and brush. The total area to be capped is approximately 57 acres. Cut and fill volumes are approximately 72,000 and 150,000 cubic yards (in-place), respectively. The preliminary volumes presented in the Remedial Cleanup Treatability Study (Ref. 3) indicated 60,000 and 140,000 cubic yards respectively. The increase in cut volumes can be attributed to grading a larger capped area and from increased shaving from the steeply-sloped areas. The increase in clean fill is directly attributed to the inclusion of the 7 acres disturbed during ground water extraction system construction, as well as construction of embankments for the realigned and improved Marshall's Run channel. The balance of fill required to grade the site in accordance with the design plans will come from off-site borrow sources. As a measure to prevent the possible introduction of additional contaminants, the cap construction contractor will be required to import clean fill from USACE-approved borrow sources.

2.1.8.2 Drainage Improvements

The cap will be constructed to minimize the concentration of runoff into point discharges, which would encourage localized erosion of the protective cap. Instead, sheet flow is encouraged by the gradually contoured design.

Where required, culverts will be provided under the perimeter maintenance road to facilitate localized drainage. Where surface drainage is directed into Marshall's Run or the

North Ditch, flap gates will be installed to prevent backflow of water during extreme storm events.

Two culverts will be installed on the eastern end of the North Ditch to permit runoff to drain under the Water Treatment Plant access road and into Marshall's Run. Design of the culverts is such that peak flows from the 10-year storm event will generate a backwater with sufficient head to permit flows to enter Marshall's Run, while limiting water surface elevations in the channel from flooding the Water Treatment Plant facilities (design channel headwater depths are elevation 711.8 for the 10-year flood, while the access road crown and treatment building floor are both at elevation 714.0).

At flood flows greater than the 10-year storm event, the water surface elevation in Marshall's Run during peak flows will temporarily exceed water surface elevations in the North Ditch. Backflow prevention (flap gates) will be provided where the North Ditch culvert empties into Marshall's Run. As the flood stage recedes in the Flood Retention Basin and discharge through the FRB control structure decreases, Marshall's Run water surface elevations will lower and water impounded in the North Ditch and contributing areas will gradually be released.

The North Ditch will be improved by widening the channel and extending the berms. Overland flows from the Site will drain directly into the North Ditch. The existing residential areas north of the North Ditch are generally at lower elevations than the Site, and will be drained into the North Ditch conduits through the berm. As with all conduits through channel berms, flap gates will prevent backflow of water from the channel into the residential areas. In this manner, Site surface drainage is contained and prevented from flowing onto adjacent properties.

The table below summarizes the design specifications and performance criteria for the North Ditch channel and Water Treatment Plant access road culvert:

TABLE 8

IMPROVED NORTH DITCH CHANNEL AND CULVERT DESCRIPTION

Drainage Area (acres)	48
Upstream invert El.	710.5
Width of Channel Bottom (feet)	10
Berm Slope	3:1
Top of Berm Elevation	713
Culvert:	
Size (inches)	42
Number	2
Inlet Invert El	708.8
Outlet Invert El	708.4
Length (feet)	150
"n" value	0.012
Inlet Condition	Square edge with headwall
Design Flows (cfs):	
10-year storm	49
50-year storm	94
North Ditch Water Surface Elevations:	
10-year storm:	
at culvert	711.8
upstream	712.3
50-year storm(1):	
at culvert	712.5
upstream	713.0

(1) Assumes free flow into Marshall's Run. As discussed above, 50-year flows will be temporarily retained until flood stage in Marshall's Run recedes.

Hydrologic calculations used in evaluating the runoff into the North Ditch are included in Appendix F. North Ditch computer-assisted culvert design calculations are included in Appendix H.

2.1.8.3 Ancillary Facilities

2.1.8.3.1 Chain Link Security Fence and Gates

The overall Site will be fenced as part of this contract. Temporary chain link security fence and gates will also be required around the staging areas for security purposes. Twenty-four hour site security will also be required during construction as specified in the Security Specification. The location of the security fencing is shown on the drawings.

The fencing requirements are specified in the Chain Link Security Fence and Gates Specification. The fence will be chain link, eight feet high with barbed wire and posts in concrete footings. Existing security fencing will be salvaged and reused for perimeter fencing provided that fence fabric and posts are in good condition and are properly decontaminated. Gates will be located as required for access by the Contractor.

2.1.8.3.2 Perimeter Maintenance Roads

A perimeter maintenance road will be constructed to facilitate routine operations on the finished Site, including access to monitoring wells and hydraulic control structures. The road will be graded gravel, underlain by a nonwoven geotextile for structural integrity.

2.1.8.3.3 Permanent Staging Area

A permanent staging area approximately 100 feet by 200 feet will be constructed off the Water Treatment Plant access road and in close proximity to the FRB. The staging area will be constructed of geotextile under graded gravel, and will serve as a center of operations for the cap and FRB construction project. All material hauling operations will involve access to the Site from this location, allowing trucks to unload on clean fill and exit without the need for decontamination. The staging area will remain on the Site after construction to support post-closure activities.

2.1.9 Sedimentation Ponds

Design features incorporated into the construction plans to control erosion include limiting of steep slopes, routing runoff to surface water drainage channels and limiting design flow velocities in drainage channels. Due to the relative flatness of the site and gentle slopes, the design and use of constructed sedimentation basins for sediment control is not considered necessary. Erosion and sediment losses during construction can be effectively controlled by using temporary control measures (i.e. silt fences and/or hay bales).

2.1.10 Landfill Gas

Generation of methane and or other gases is a concern at landfills containing degradable organic material. Historical information combined with field data suggests there is little degradable organic material present at the site. The existing abundant and vigorous plant growth on the site supports the conclusion that methane is snot present in appreciable quantities at the Millcreek Site. If in the unlikely event that construction activities (e.g., burial of wood debris) results in the generation of substantial quantities of methane gas which inhibit vegetative growth, gas vents could be installed in problem areas to facilitate gas venting and maintain vegetative growth.

2.1.11 Availability of Fill Materials

Preparation of construction cost estimates involved contacting several local topsoil/fill/gravel suppliers to obtain material prices and availabilities. Each supplier was provided information on the types of material and quantities required based on preliminary estimates. Each supplier indicated sufficient availability of clean subgrade fill and gravel. Availability of the extensive quantity of topsoil may pose a problem depending on the quality of topsoil required. Sufficient quantities of soil capable of propagating and supporting vegetation are available. High quality shredded and screened topsoil is available in limited quantities.

2.1.12 Topsoil

The 12-inch topsoil layer will consist entirely of friable loamy soil capable of propagating and supporting vigorous plant growth. The primary design criterion for the topsoil is suitability for vegetative growth which will be controlled through the following topsoil specification:

> Fertile, friable, natural loam soil, capable of sustaining vigorous plant growth, free of any admixture of subsoil, clods of hard earth, plants or roots, sticks or other extraneous material harmful to plant growth with the following analysis:

a.

Sieve Size	Percent Passing by Weight
3-inch	100
1-inch	85 - 100
¼-inch	65 - 90
No.200	20 - 80

b. Clay content of material passing #200 sieve not greater tan 30 percent, as determined by hydrometer tests.

c. pH 5.5 to pH 7.6. If approved by Contracting Officer, natural topsoil not having the specified pH value may be amended by Contractor at his own expense.

d. Organic content ranging from 2.5 to 6 percent, as determined by ignition loss.

e. Free of pests and pest larvae.

f. Soluble salt content not greater than 500 ppm.

g. Liquid limit less than 50.

Gradation of the topsoil is important because too high a fines content can hamper growth, and cause excessive erosion problems (finer soils are more easily eroded), and too high a sand/gravel content reduces the amount of soil moisture which can be maintained during dry periods.

2.1.13 Evaluation of Potential for Migration and Mobility of Contaminants

Erosion could lead to contaminant migration once the topsoil layer is completely eroded and the subgrade/waste material is exposed. Erosion during construction and construction erosion control measures are discussed in the Erosion Control Plan (Ref. 8). Post construction erosion control is addressed in the Site Maintenance Plan (Ref. 9). Implementation of erosion control measures presented in the above plans will reduce the potential for erosion-based contaminant migration.

The potential for migration and mobility of contaminants is also dependent on many factors (other than erosion), including:

- contaminants of concern present,
- advective transport (driving mechanisms),
- adsorption,
- soil porosity,
- soil dispersivity,
- retardance factors, and
- site conditions, etc..

An extensive contaminant fate and transport analysis for the Millcreek site was conducted as part of the predesign study and is presented in the August 1989 Remedial Cleanup Treatability Study Report (Ref. 3). The analysis determined that the volatile

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organics trichloroethylene (TCE) and 1,2-dichloroethylene (1,2-DCE) were the primary contaminants of concern under existing conditions. Both compounds were determined to be relatively mobile at the site. Other contaminants of concern, such as semi-volatile compounds, PCBs and metals, were determined to be appreciably less mobile due to their low solubility and would not be expected to be significantly affected by capillary action. Upward mobility is a function of diffusion and, to a greater extent, capillarity. Capillarity is dependent on soil type, thickness, compaction, and quality of vegetative cover. Fine-grain soils and good vegetative cover enhance capillarity. Capillary transport of volatile organics vertically upward through the cap is only feasible around the periphery of the capped site where the topsoil cover is thinned and distance to the ground water is small. If capillary action does contribute to upward mobility of volatile contaminants around the site periphery, they would quickly volatilize once they migrate through the topsoil layer as evidenced by the results of the previous soil gas survey and on-site air monitoring. The release of volatile organics from the site fill was not determined to be significant from a public health or air quality perspective. Placement of a cap will, if anything, further reduce the upward mobility of these contaminants.

Root zone penetration into waste material could potentially result in upward migration of less mobile contaminants such as semi-volatiles and metals via biological uptake. The site is to be vegetated with grasses and maintained such that secondary growth does not become established. Root zone depth associated with grasses is typically several inches up to two feet. Therefore, uptake of contaminants as a result of vegetative growth should be minimal.

2.1.14 Monitoring Wells

As a result of the grading and cap construction activities, several monitoring wells located within the capping limits will be modified with extended surface riser pipes and protective casings to maintain accessible riser heights. The affected monitoring wells will be modified accordingly (extended or lowered) to maintain a minimum two-foot, six-inch (2'-6") rise above final grades. Modification of risers and casings will require the use of materials and techniques which will not jeopardize the integrity of the modified well. Modification requirements is addressed in the Technical Specifications and presented on the Construction Plans.

Wells not scheduled for future monitoring or observation uses will be abandoned accordingly by cutting the riser tops and casings, and filling the monitoring well with a bentonite grout slurry.

Realignment of Marshall's Run will require abandoning several trench performance monitoring wells scheduled to remain in service. Therefore, new monitoring wells will be required to replace these wells. The Technical Specifications and Construction Plans also detail requirements for the replacement of monitoring wells.

2.1.15 Ground Water Extraction Trench Structures

Existing sumps, valve boxes, and monitoring wells associated with the ground water extraction system will be extended as part of cap and FRB construction activities to provide for riser extensions following regrading and topsoil placement in these areas. A schedule of elevations for the ground water trench structures and for those monitoring wells selected to serve as permanent sampling stations following construction are included in the Plans along with the required riser extension elevations.

2.2 STRUCTURAL

2.2.1 General Description

The functional designs of the FRB outlet control structure, side discharge weir, and culverts are based on hydraulic and hydrologic considerations. Information contained in the Geotechnical Engineering Investigation prepared by H&A of New York, Inc. indicates that the Site is suitable and capable of supporting the proposed hydraulic structures.

The box culverts designed adjacent to the Water Treatment Plant and under the 17th Street Access Road will be designed for H-20 traffic loads. The FRB Outlet Control Structure is a low-head gravity retaining dam. The side-discharge weir has no structural function other than resisting erosion from water discharging over its crest. All drainage culverts will be designed for 15,000-pound single-wheel loading conditions.

2.2.2 Materials of Construction

The box culverts, FRB outlet control structure and side-discharge weir will be constructed of reinforced cast-in-place concrete. Drainage culverts will be precast reinforced concrete. The embankments of the improved Marshall's Run channel will be constructed of earthen fill. Channel protection will consist of riprap, stone-filled gabions, and a synthetic HDPE liner.

2.2.3 Structural Design Criteria

GROUND WATER CONDITIONS:

A. Maximum 100-year flood elevation: Not applicable

B. Normal high ground water elevation: EL 711.00

LATERAL EARTH PRESSURES
(Based on using granular backfill [see Geotechnical Investigation, Appendix E]):

Unit Weight (pcf):	
Above Water Table	120
Below Water Table	60
Equivalent Fluid Density (pcf):	
Above Water Table	60
Below Water Table	30

A. Use 300 psf surcharge adjacent to structures. For short duration against walls use 600 psf with increase in allowable stresses by 33%.

FOUNDATION CRITERIA:

A. Min. slab on ground: 6 inches

B. Soil data:
Allowable Bearing Pressures: 3,000 psf max.
Coefficient friction on granular fill = 0.40
Coefficient friction on virgin soil = 0.40

C. Frost penetration depth below grade = 4 ft.
Extend all frost walls 4 ft. min. below finished grade.

ANALYSIS AND DESIGN FOR REINFORCED CONCRETE:

Sanitary Engineering Structures as defined in the scope of the ACI Committee 350 Report shall be in accordance with the alternate design method requirements of the Building Code ACI STD 318-83. Design for all other structures shall be in accordance with the Building Code ACI STD 318-83 and latest supplements.

Exceptions to the above will be noted as design progresses.

A. Concrete

1.	Comp fc	1,350 psi
2.	TENS fc	88 psi
3.	Shear Diagonal Tension Beams: without WEB Reinf.	60 psi
4.	Shear-Punching Shear	110 psi
5.	Bearing:	
	on full area	750 psi
	on one-third area or less	1,125 psi

B. Reinforcing Steel

Tension due to bending:

1. Non-water bearing structures: 24,000 psi

2. Water bearing structure in accordance with ACI Committee 350 recommendations for Environmental Engineering Concrete Structures.

3. Direct Tension: 20,000 psi

4. Embedment lengths & lap splices shall be based on:
   fc = 4,000 psi
   fy = 60,000 psi.

C. Minimum lap splice and embedment lengths shall be in conformance with ACI 318-83. The minimum length of laps for splices shall be as given in the table for Class "B" laps.

CONCRETE COVER:

A. Surface inside basins: 2" min.

B. Footing and slab on ground: 3"

C. Formed surfaces exposed to weather or in contact with soil: 2" min.

D. Formed surfaces not exposed to weather or in contact with soil: 1-1/2" min.

DESIGN FOR STRUCTURAL STEEL:

AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, dated November 1, 1978 fy = 36 KSI.

FACTOR OR SAFETY:

Overturning:
Service loads: FS_{ot} = 1.5
Min. frequency ("once in a lifetime") loads of short duration: FS_{sl} = 1.25

Sliding:
Service loads: FS_{os} = 1.5
Min. frequency ("once in a lifetime") loads of short duration: FS_{os} = 1.15

Computation:

FS_{ot} = RM / OTM

where RM (resisting moments) includes uplift
and OTM (overturning moments) may include the effect of active ("earth at rest") pressure but not passive pressure.

FS_{sl} = u V / H

where V (vertical forces) includes uplift
and H (horizontal forces) may include active pressure
u is the coefficient of friction

BUILDING CODES:

State: Pennsylvania, ANSI, UBC
Year: Latest Edition

EARTHQUAKE:

Zone: 3 per MBMA

2.3 SITE CONSTRUCTION

2.3.1 General

It is assumed that all other remedial construction contracts will be completed prior to initiation of cap construction. The Contractor will be required to verify site conditions and factor in on-going construction activities as part of the bid process.

2.3.2 Clearing, Grubbing and Brush Removal

Clearing, grubbing and brush removal will be performed on an as-needed basis in accordance with the Construction Plans and Clearing and Grubbing Specification. Clearing and grubbing limits will include all areas to be capped and any peripheral areas for drainage improvements, access and security as-needed by the contractor for the performance of the required work. In general, clearing limits will follow the capping limits and are indicated on the Construction Plans.

The Contractor will have the option of on-site or off-site disposal of large trees (viz. greater than 3 inches in diameter). Brush, stumps and tree logs less than 3 inches in diameter will be chipped and disposed of on-site and buried directly beneath the topsoil layer in a maximum 3-inch chipped wood lift. If the amount of chipped material is greater than 24,000 cubic yards (60 acres x 3 inches depth), the excess material will be buried in a manner similar to the large logs. Disposal of logs on-site will require cutting the logs to lengths not exceeding 4 feet in length and placing only one layer of logs in any given area. The Contractor will also be required to maintain the buried trees or excess chipped material a minimum of one foot below subgrade.

Logs greater than 3 inches in diameter may be removed off-site. The Contractor will be required to properly decontaminate logs that have contacted waste fill prior to leaving the site.

2.3.3 Off-Site Disposal of Bulky Debris

Removal and salvage of bulky debris (junk cars, abandoned machinery, bulky metallic demolition debris) will be performed in accordance with the Debris Removal Specification. Bulky metallic debris removed for salvage or proper off-site disposal will be decontaminated before leaving the site. Wipe sampling of bulky debris will not be required.

2.3.4 On-Site Debris Disposal

Surface debris, drums of slag and non-hazardous solid wastes that were excavated and placed on the eastern portion of the site by the USEPA in 1982, drummed drilling spoils and discarded field supplies at the site, and other such materials will be consolidated for placement under the soil cap in areas designated to receive fill to achieve desired subgrades. The debris disposal areas will be indicated on the construction plans for reference by the Contractor. In general, buried debris will be covered with at least one foot of fill soil followed by one foot of topsoil. Fill soil covering the debris will be compacted to not less than 90% Standard Proctor density. Debris will be crushed, placed, and compacted by similar methods utilized to compact sanitary refuse (-5 passes with a dozer or trash compactor). The Contractor will be required to limit the thickness of the debris material to less than five (5) feet to minimize the long-term potential for settlement.

2.3.5 Drum Removal and Disposal

During subgrade preparation, buried drums may be encountered. Prior to construction, the Contractor will be required to submit a Drum Handling Plan for USACE review and approval. The Contractor's Drum Handling Plan will address excavation, handling, storage, sampling and disposal of drums. The following subsections outline procedures and requirements the Contractor will be required to adhere to during construction.

2.3.5.1 Drum Excavation And Handling

The Contractor will exhume drums and containers encountered during site grading and preparation. The Contractor will place exhumed drums in overpacks as necessary, log them, and immediately transport them to the on-site drum accumulation area for sampling and analysis prior to final disposition. Movement and handling of drums and containers will be specified to be kept to a minimum. If buried drums and containers are damaged in place or during removal and materials are released, the Contractor will collect these materials to the maximum extent practical and place the released materials in clean drums. The Contractor will transfer the drummed materials to the on-site accumulation area for subsequent sampling prior to final disposal.

In general, drum excavation will proceed from the downwind end of the area towards the upwind end. The operators are to work from the upwind side. Therefore, operators and workers will not be exposed to any vapors encountered during excavation and from excavated areas. The excavation area will be monitored for volatile organic vapors. At this time, a USACE representative may also log materials and collect samples for chemical analysis. The Contractor's foreman will direct the Contractor's personnel and equipment during the drum excavation. Other personnel, with the exception of the USACE representative will stand clear of the immediate area during the drum excavation. All work will proceed in a slow controlled manner so as to minimize the potential dangers associated with excavation and extraction of buried drums or other forms of waste materials. All drum excavation work shall be conducted in accordance with OSHA interim standard, 29 CFR 1910.120, (Hazardous Waste Site Operation and Emergency Response).

2.3.5.2 Interim Waste And Drum Accumulation

The Contractor will construct an interim on-site waste and drum accumulation area in a USACE approved location for temporary storage. This area will be bermed to prevent off-site migration of contaminants, covered with an asphalt liner, and secured by a chain link security fence and lockable gate. At a minimum, this area will have capacity to accumulate up to 100 overpacked drums stacked two high on wooden pallets. Non overpacked drums shall be stacked one high on pallets.

Following removal and off-site disposal of all wastes from the interim waste and drum accumulation area, the Contractor shall close this area. This closure will include removal of berms and security fencing.

2.3.5.3 Drum Sampling and Analytical Program

The Contractor will be required to sample liquid and solid materials contained in excavated drums in accordance with procedures set forth in the USEPA document EPA/600/2-86/013 "Drum Handling Procedures at Hazardous Waste Sites". The Contractor will be required to provide all sample containers and be responsible for sample compositing, packing, preservation and transport. The Contractor will be required to maintain field log documentation of all drum sampling and chain of custody. Split samples will be made available to the USACE on-site representative or representatives of regulatory agencies upon request. The objective of analyzing drum contents is to characterize the wastes as required to:

- Determine treatment and disposal requirements;
- Allow transportation of wastes in accordance with all regulatory requirements; and
- Allow waste bulking or recontainerization as necessary to provide the most timely and cost-effective program for waste disposal.

The Contractor will be required to provide data in a time frame that will allow expedient removal, off-site transportation and disposal of drums. The Contractor will also be required to perform all sampling and analytical procedures in accordance with USEPA approved protocols. At a minimum, the Contractors sampling and analytical program shall address:

- waste compatibility testing procedures, protocols and analytical parameters,
- waste segregation criteria,
- waste composite sample procedures and methodology,
- analytical parameters and procedures to determine treatment/disposal alternatives,
- schedule of all activities including assessment of treatment/disposal options, waste consolidation if appropriate, and off-site disposal, and
- methods and procedures for sampling and analysis of drums containing heterogeneous wastes (i.e. sample jars, refuse, miscellaneous wastes).

The results of all analytical testing performed by the Contractor shall be made available to the USACE immediately upon completion of final data reports and in no case greater than 30 days from the day of sampling or less than 14 days prior to transportation of wastes off-site.

2.3.5.4 Disposal of Drummed and Contaminated Materials

On-Site Disposal - In the event that the Contractor is required to regrade a portion of the landfill due to settlement or erosion, there is a possibility that contaminated materials may be generated or encountered. With the exception of drums containing RCRA hazardous materials excavated from the site, wastes that have been excavated subsequent to placement of the topsoil layer of the cap, are to be disposed of on-site and placed at least one (1) foot below the bottom of the topsoil layer. Empty drums will be crushed prior to disposal and shall be deposited in one lift not to exceed 5 feet. The location for on-site disposal of wastes which do not exhibit the RCRA Characteristics of Hazardous Waste (i.e., ignitability, corrosivity, reactivity, and toxicity characteristic-TCLP) as described in 40 CFR 261.24, July 1, 1990, shall be proposed by the Contractor as part of the Contractor's Drum and Contaminated Materials Handling Plan.

Off-Site Disposal - All drums containing materials characterized as hazardous materials are to be disposed of off-site in a permitted disposal facility. All contaminated material to be disposed off-site shall be disposed of in accordance with RCRA approved methods. Drums and containers will be inspected prior to being moved. All employees who have a potential to be exposed to hazardous substances as a result of the transfer operation shall be notified of the potential hazards associated with the contents of the drums or containers. The name and location of the Contractor's selected disposal facility(s) and copies of all off-site disposal manifests shall be submitted to the Contracting Officer as part of the Drum and Contaminated Materials Handling Plan.

2.3.6 Decontamination Pad

Significant excavation of potentially contaminated waste fill and soils and contact with potentially contaminated ground and surface water will take place during construction of the cap and FRB. Some contamination may be encountered in completion of the site work such as clearing and grubbing and construction of access roadways. Equipment utilized in a potentially contaminated area will be decontaminated according to the procedures provided in the Contractor's Site Safety and Health Plan (SSHP). The Contractor will be required to provide facilities such that decontamination of potentially contaminated equipment will be completed on-site so that potentially contaminated materials remain on-site.

The Contractor will submit details for the decon facility in conjunction with his SHERP. The approximate location of the required decontamination pad is shown on the drawings.

2.3.7 Site Access Roads

Site access will be accomplished via a temporary access road to be constructed parallel to and immediately south of the existing 17th Street ground water treatment plant access road located at the south end of the site. Construction of this temporary road will permit continued access to the site while the existing 17th Street culvert is reconstructed within the improved Marshall's Run channel alignment. The Site access road will be designed for continuous heavy load truck traffic. Alternate access from Marshall's Drive

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may be possible pending a decision by the Town of Millcreek relative to the condition of an adjacent brick sewer.

Special local weight restriction limits are not imposed on Millcreek Town roads. The Contractor will be restricted to Pennsylvania Department of Transportation gross vehicle weight limits.

2.3.8 Survey and Control

Vertical and horizontal control has been established for the site during previous studies. Vertical control is based on United States Coastal and Geodetic Survey (B&GS) datum and horizontal control is based on the Pennsylvania State Plane Coordinate System. Elevations and coordinates are shown on the drawings. The site topography is based on aerial photography and stereophotogrammetric mapping completed by TVGA Associates in January of 1989. The January 1989 mapping was photogrammetrically revised by TVGA in December 1990 by adding the south bordering wetlands and by Malcolm Pirnie, Inc. in February and July 1991 using field instruments to update site conditions (viz. extraction trenches, new tree limits, fenced staging areas, drainage culverts, etc.).

The locations, property lines and markers on the site have been verified in the field by a property boundary survey conducted by Robert A. Lucas, RS in February 1990. Properly boundary limits determined by Lucas are shown on the existing Site Plan. Additional control points were installed at key locations around the site to augment existing benchmarks and control points. Property lines and bearings used on the extraction trench and treatment plant construction drawings were based on a previous control survey completed for the site by Greenhorne and O'Meara using State Plane Coordinate Monuments, and additional field control work based on that survey. Distances and angles for property boundaries are as shown on the Township of Millcreek Tax Maps.

2.3.9 Contaminated Soils

All soils excavated during grading will be moved to areas requiring fill under the proposed cap. The location of cut and fill areas are shown on the subgrading grading plan. The Contractor's responsibilities for regrading of fill and soils is addressed in the Specifications. The Contractor will be required to provide erosion and sedimentation control for the project to meet the published requirements of the Pennsylvania Department of Environmen-

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tal Resources and approved Erosion Control Plan (Ref. 8). Control measures will include methods to control migration of contaminated silt and dust such as a silt fences, straw bail traps, vegetative cover and construction phasing.

2.3.10 Contaminated Water

Potentially contaminated water may be encountered and/or generated during cap and FRB construction and during equipment decontamination. When dewatering of ground water is required, pumped ground water is to be discharged back to the site in depressions created on an as needed basis to be located in USACE-approved locations on the site. Decomtamination water is to be discharged in the same manner. This is consistent with practices utilized during previous construction activities. The volume of water is small when compared to the overall ground water flow rate through the site.

2.3.11 Drainage

The Contractor may have to temporarily divert flow from the Existing Marshall's Run channel using pumps and overland piping in order to complete construction activities. The specifications state that the drainage facilities are subject to review, and refer the Contractor to the Erosion Control Plan (Section 1200). Specifically, the Contractor is required to prepare a Surface Water Bypass Pumping Plan indicating sequence of events and methodology (Paragraph 14, Section 02210 GRADING). This plan must be approved by the Contracting Officer.

2.3.12 Chemical Quality Management

As part of the remedial construction at the Site, sampling and analysis of soil, water, air and possibly drums of waste exposed during construction may be required. The Specifications include requirements for sampling and chemical analysis.

The preliminary cap construction Site Specific Quality Management Plan and Chemical Data Quality Management Specification describe requirements to be implemented by the Contractor during the performance of the work.

2.3.13 Erosion Control

Erosion could lead to contaminant migration once the topsoil layer is completely eroded and the subgrade/waste material is exposed. Erosion during construction and construction erosion control measures are discussed in the Erosion Control Plan (Ref. 8). Post-construction erosion control is addressed in the Site Maintenance Plan (Ref. 9). Implementation of erosion control measures presented in the above plans will reduce the potential for erosion-based contaminant migration.

2.3.14 Geotextiles

Geotextiles will be used at the Site for construction of the maintenance road and staging area; and for protection of the HDPE liner on portions of Marshall's Run.

Woven geotextile are typically used for separation reinforcement and filtering such as in roadway construction. Nonwoven geotextiles are typically used for separation and filtering such as in cap drainage layers, subdrains, etc. Material strength characteristics based on the intended use of the geotextile, typical geotextile application and the general strength characteristics of available geotextiles on the market were considered in specifying geotextile materials. The design rationale for geotextiles is contained in Appendix N.

2.3.15 Synthetic Channel Liner

A synthetic channel liner will be installed to reduce the potential for infiltration of surface water from Marshall's Run into the extraction trenches. Consideration of materials was based on experience and material qualities. HDPE was selected over other synthetic materials for several reasons including durability, compatibility with known wastes and constructability. HDPE, compared with PVC or VLDPE is more durable, less susceptible to ultraviolet degradation, more compatible with a greater variety of chemicals and contaminants and has comparable installation requirements.

Selection of an 80-mil thickness is based on previous expense on similar projects. Contractors generally prefer to work with 80 or 100-mil liner due to reduced puncture potential and the cost of purchase/installation is only slightly higher than for reduced thickness.

2.4 HEALTH AND SAFETY

The Contractor will be required to develop and implement an SSHP as part of the work. Requirements for the Contractor's health and safety program are described in the Specifications. The cap construction Health and Safety Design Analysis, dated March 1991, provides a basis for the development of the Specification as well as guidelines for the review of the Contractor's health and safety program.

PART 3 - O & M PROVISIONS

A separate project document entitled "Site Maintenance Plan" (Ref. 9) addresses site maintenance operations and procedures. The Site Maintenance Plan outlines measures intended to ensure that proper site maintenance care occurs at the disposal site after closure. It includes routine post-closure maintenance activities, inspection and maintenance frequencies and reporting requirements.

Provisions have been incorporated into the design of the cap and FRB to facilitate maintenance of the site. These provisions include a perimeter access road, minimizing steep slopes, drainage ditches configured for maintainability, use of erosion protection as needed, and hardy vegetative cover.

REFERENCES

1. NUS Corporation, August 1985, Remedial Investigation/Feasibility Study Report, Millcreek Superfund Site, Erie County, Pennsylvania, August 1985.

2. USEPA, May 1986, Record of Decision, Remedial Alternative Selection, Millcreek Superfund Site, Erie County, Pennsylvania.

3. Malcolm Pirnie,Inc., August 1989, Remedial Cleanup Treatability Study, Millcreek Superfund Site, Erie County, Pennsylvania.

4. USACE, January 1991, Architect Engineer Instruction Manual for Design of Military Projects, AEIM 13.

5. Pennsylvania Department of Environmental Resource, April 1988, Title 25 Rules and Regulations.

6. Malcolm Pirnie, Inc., July 1989, Final Design Analysis Report, Groundwater Extraction System, Millcreek Superfund Site, Erie County, Pennsylvania.

7. Malcolm Pirnie, Inc., August 1989, Final Design Analysis Report, Ground Water Treatment System, Millcreek Superfund Site, Erie County, Pennsylvania.

8. Malcolm Pirnie, Inc., July 1991, Erosion Control Plan, Millcreek Superfund Site, Erie County, Pennsylvania.

9. Malcolm Pirnie, Inc., July 1991, Site Maintenance Plan, Millcreek Superfund Site, Erie County, Pennsylvania.

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MALCOLM PIRNIE

APPENDIX A

PADER NOTICE OF CAP RECOMMENDATIONS

AR004491

PENNSYLVANIA DER

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
1012 Water Street
Meadville, Pennsylvania 16335
Telephone: A. C. 814/724-8526
August 15, 1989

Subject: Millcreek Site
Erie County, Pennsylvania

Mr. Anthony Koller
Remedial Project Manager
Environmental Protection Agency
Region III
841 Chestnut Building
Philadelphia, PA 19107

Dear Mr. Koller:

This letter is being written in reference to the remedial capping alternatives which have been developed for the Millcreek Site, Erie County, Pennsylvania. These are described in the Final Engineering Report - Remedial Cleanup Treatibility Study prepared by Malcolm Pirnie, Inc. (draft - June 1988).

The Department has determined that the six (6) - inch topsoil cap will be acceptable for the site. However, the clean fill layer beneath the topsoil should be at least six (6) inches. The above document describes this layer as ranging from zero (0) inches to nine (9) feet in depth.

It is acceptable to the Department to accomplish this by deepening the "cut" areas as shown on the cut and fill isopach (drawing - 5-5 of the treatibility study) where needed in order to achieve the proper "clean fill" depth and also to maintain the final grade as shown on the final grading plan for the topsoil alternative (drawing 5-2 of the treatibility study).

Should you have any questions, please do not hesitate to call me at this office.

Sincerely,

Anita M. Stainbrook

Anita M. Stainbrook
Project Manager
Hazardous Sites Cleanup Program
Bureau of Waste Management

AMS/jb

cc: Captain Christopher Young
—Malcolm Pirnie Engineers, Inc.
Don Becker

MALCOLM PIRNIE

APPENDIX B

WETLANDS DELINEATION NARRATIVE

0285-33-2

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WETLAND DELINEATION NARRATIVE

FOR THE

MILLCREEK SUPERFUND SITE

MILLCREEK TOWNSHIP
ERIE COUNTY, PENNSYLVANIA

MARCH 1991

MALCOLM PIRNIE, INC.

11832 Rock Landing Drive
Suite 400
Newport News, Virginia 23606

0285-33-2112

AR004494

TABLE OF CONTENTS

LIST OF ATTACHMENTS

INTRODUCTION

This document has been prepared in conjunction with remedial activities being performed at the Millcreek Superfund Site, located in Millcreek Township, Erie County, Pennsylvania. Malcolm Pirnie has been retained by the U.S. Army Corps of Engineers to delineate the extent of wetlands on the approximately 84.5-acre site. Results presented in this report are based upon field work completed on December 11-13, 1990.

SITE DESCRIPTION

The site is an irregularly shaped east-west oriented parcel located approximately 1¼ mile west of the City of Erie, 1¼ mile south of Presque Isle State Park, and ½ mile east of the Erie Airport. The site is bounded by West 12th Street and residential land to the north, an unnamed tributary to Lake Erie to the east, the Norfolk and Western - Penn Central Railroad to the south and an athletic field and forested land to the west. The site has been used extensively as an industrial waste disposal facility over the past 40 years. Between 1,000 and 2,000 drums are reported to have been dumped on the site, which had previously contained an extensive wetland area (U.S. EPA, "Site Investigation: Millcreek Township, Erie County, Pa.," 1983).

VEGETATION COMMUNITIES

The site is comprised of a relatively diverse assemblage of upland and wetland plant communities. Former land uses such as clearing and filling have influenced the successional stages and plant species composition of the site. The disturbed northern, northeastern, central, and southwestern portions of the site are generally vegetated by upland old field and successional plant communities. The low-lying land adjacent to these disturbed areas are predominantly forested wetlands. The extreme southern and southwestern portions of the site have not been recently disturbed and have grown up in successional and mature forest, respectively.

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Upland Plant Communities

Successional forest and mature forest are the predominant upland communities on site. The mature forest represents an older, less disturbed vegetation community than the successional forest. Mature forest is dominated by climax species which eventually replace the pioneer species found in successional forest. Dominant trees of the mature forest in the extreme southwestern part of the site include oak, maple, birch, and tulip poplar. These species are representative of the Northern Hardwood and Beech-Maple Forest Associations typically found on the Lake Erie Plain.

Successional forest contains few of the canopy tree species typical of mature forest. Fast growing pioneer trees predominate. Common trees of the successional forest in the northern, northeastern and extreme southern portions of the site include cottonwood, gray birch, black cherry, white birch, and staghorn sumac. Dense thickets of shrubs and brambles occur where trees have not yet established. Honeysuckle, blackberry, black raspberry, multiflora rose and red osier dogwood are common in these thickets.

The northern and northeastern portions of the site were disturbed during the early 1950's, much earlier than the central and western parts of the site. Successional forest dominated by cottonwood and honeysuckle has become established in this older fill area.

Recently disturbed areas on the site, including haul roads, cleared areas, waste and rubble disposal areas, and fill areas, contain herbaceous vegetation typical of the old field plant community. Examples include yarrow, mullein, goldenrods, aster, and knapweed.

Upland vegetation found on the site is identified in Attachment A at the end of the report.

Wetland Plant Communities

In most portions of the site, wetland areas are identifiable solely through vegetative, hydrologic, and topographic indicators. The wetland/non-wetland boundary is, in general, situated at the toe of slope of fill areas throughout the site. Soil samples were taken utilizing a soil auger in the extreme southwestern corner of the site. The wetland/non-wetland boundary was difficult to determine in this area because of subtle topographical changes and extensive integration of facultative upland and wetland vegetation.

These types of palustrine wetlands occur on the Millcreek site: forested deciduous (PFO1), palustrine emergent wetland (PEM), and open water (POW). Vegetation occurring within each of the delineated wetlands is typical of those species associated with palustrine systems found throughout the northeastern U.S. The palustrine forested wetlands are dominated by facultative trees such as red maple, ash, and willow, and facultative shrubs such as red osier dogwood, highbush cranberry, and northern arrowwood. The palustrine emergent wetland is dominated by herbaceous vegetation and such as rushes and sedges. The open water wetlands are characterized by standing water with obligate and facultative emergent and shrubby vegetation growing in the water. Three drainage ditches on the site are included in this category. All wetlands on site are shown on Map A. Wetland vegetation found on the site is identified in Attachment B at the end of the report.

DELINEATION METHODOLOGY

The Unified Federal Method adopted in January 1989 was utilized to identify wetland boundaries on the site. Given that the wetland and upland vegetation communities on the site were well-segregated and marked by distinctive topographic boundaries, the routine on-site wetland determination method was followed using the plant community assessment procedure.

The first step was to walk the project area identifying plant community types. Particular attention was paid to topographic changes and fill areas on the site.

The second step was to determine whether natural environmental conditions exist on the site. There was no evidence of vegetative stress due to fluctuations in precipitation, surface water, or ground water levels on the site.

The next steps were to select several representative observation areas and characterize the plant communities within each wetland. Within each plant community, the dominant plant species were visually estimated for each vegetative strata, including tree, shrub and herb strata. Dominant species are defined as those species in each stratum, that, when ranked in decreasing order of abundance and cumulatively totaled, immediately exceed 50 percent of the total dominance measure for that stratum, plus any additional species comprising 20 percent or more of the total dominance measure for that stratum. The indicator status for each dominant species was then obtained from the U.S. Fish and Wildlife Service national list of wetland plants occurring in the Northeast U.S. Those areas where more than 50 percent of the dominants had an indicator status of obligate, facultative wetland and/or facultative were considered to have hydrophytic vegetation.

Most wetland areas on the site contained dominant species with indicator status of obligate or facultative wetland and wetland boundaries delineated by abrupt changes in topography. In these areas hydric soils were assumed to be present. After characterizing the vegetation, field indicators of wetland hydrology were documented. Each plant community meeting the hydrophytic vegetation, hydric soil, and wetland hydrology criteria were considered wetland.

RESULTS

Area A consists of a forested wetland dominated by red maple, green ash, and black willow. The overall character of the deciduous swamp can be described as having a dense canopy, a moderately dense shrub layer, very little herbaceous ground cover and standing water varying from 6 to 12 inches in depth. The lack of ground cover may be due to the time of year when the survey was completed. The canopy trees are medium - aged with diameters ranging from 6 to 18 inches dbh. Common shrubs in the wetland included highbush cranberry, northern arrowwood, red osier dogwood, and spicebush. The herbaceous layer is dominated by common reed, cattails, and reed canary grass. Wetland A is shown in Photos 1-5.

Area B is a small isolated wetland, dominated by red maple and green ash, as shown in Photo 6. The wetland was formerly connected to Areas A and F. The placement of fill at its east and west end has isolated the wetland.

Area C has been separated from Wetland A by the construction of a haul road as shown on Map A. Based on aerial photography interpretation, the haul road was built at some time between 1975 and 1982 (U.S. EPA, "Site Investigation: Millcreed Township, Erie County, Pa.,"). Wetland C is a deciduous swamp located at the south end of the site. The wetland is dominated by red maple, green ash, and black willow trees. The swamp has a moderately dense canopy, a dense shrub layer, very little herbaceous ground cover and standing water varying from 1 to 2½ feet in depth. The canopy trees are medium-aged. Common shrubs in the wetland include highbush cranberry, northern arrowwood, red osier dogwood, spicebush, silky dogwood, and speckled alder. Herbaceous vegetation is quite dense, in certain portions of Area C, and is dominated by cattails, common reed, and reed canary grass. Other emergents identified in Area C include water plantain, sedges, spike rush, water horehound, bur reed, and duckweed. Wetland C is shown in Photos 7 - 10.

Wetland D is a deciduous swamp dominated by red maple and green ash. This wetland contains about 1-foot of standing water, few shrubs and almost no herbaceous understory (Photo 11).

Area E is dominated by rushes, flat sedges, common reed, and reed canary grass. The area is in a topographic depression which has been disturbed by the construction of natural gas well (Photo 12).

It appears that fill has been placed in the area adjacent to the well. Soils consist of yellowish-orange (10YR6/8, 10YR6/7) clays and clayey loams. However, there is evidence of wetland hydrology. During the site visit, there was 2 to 5 inches of standing water in the wetland and the soils were saturated. Due to the presence of hydrophytic vegetation and wetland hydrology, this area should be considered a jurisdictional wetland.

Wetland F is a crescent-shaped forested wetland bounded by the property line and a road on the west, and fill areas on the north, east, south, and southwest. The wetland is dominated by red maple, green ash, and black willow trees. The swamp has a moderately dense canopy, has very little shrubs or understory, and contains 6 to 12 inches of standing water. Common shrubs in the wetland include highbush cranberry, red osier

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dogwood, and spicebush. The herbaceous layer is dominated by cattails, common reed, and reed canary grass (Photo 13).

Wetlands G, H and I are drainage ditches containing obligate and facultative emergent and shrubby vegetation. Area G conveys runoff from Wetland D into Wetland F. Area H conveys runoff from Area A into Area I, which is located at the eastern edge of the site. Area I flows towards the north, eventually emptying into Lake Erie.

ATTACHMENT A

UPLAND VEGETATION BY ECOLOGICAL SYSTEM
MILLCREEK SITE

Scientific Name	Common Name	Designation
Acer rubrum	Red Maple	FAC
Aster spp.	Asters	---
Betula papyrifera	White Birch	FACU
Betula populifolia	Gray Birch	FAC
Centaurea maculosa	Spotted Knapweed	U
Cornus stolonifera	Red-osier Dogwood	FACW
Lindera benzoin	Spicebush	FACW
Liriodendron tulipifera	Tulip Poplar	FACU
Lonicera sp.	Honeysuckles	---
Populus deltoides	Eastern Cottonwood	FAC
Prunus serotina	Black Cherry	FACU
Quercus Rubra	Red Oak	FACU
Rhus typhina	Staghorn Sumac	U
Rosa multiflora	Rose	FACU
Solidago sp.	Goldenrod	---
Verbascum thapsus	Common mullein	U

ATTACHMENT B

WETLAND VEGETATION BY ECOLOGICAL SYSTEM
MILLCREEK SITE

Paulstrine Forested Wetland Brood-Leaved Deciduous (PF01)

Scientific Name	Common Name	Designation
Acer rubrum	Red Maple	FAC
Alisma plantago-aquatica	N. Water Plantain	OBL
Alnus rugosa	Speckled Alder	FACW
Aster spp.	Asters	---
Carex crinita	Fringed Sedge	OBL
Carex spp.	Sedges	OBL,FACW
Carex stricta	Tussock Sedge	OBL
Cornus amomum	Silky Dogwood	FACW
Cornus stolonifera	Red osier Dogwood	FACW
Cyperus sp.	Flat sedge	OBL, FACW,FAC
Eleocharis sp.	Spike-rush	OBL,FACW
Epilobeum sp.	Willow-herb	OBL,FAC
Equisentum sp.	Horsetails	---
Fraxinus pennsylvanica	Green Ash	FACW
Lindera benzoin	Spicebush	FACW
Lycopus virginia	Water horehound	OBL
Onoclea sensibilis	Sensitive Fern	FACW
Penthorum sedoides	Ditch Stonecrop	OBL
Phalaris arundinacea	Reed Canary Grass	FACW
Phragmites communis	Common Reed	FACW
Podophyllum peltatum	May Apple	FACU
Populus daltoides	Cottonwood	FAC
Rosa palustris	Swamp Rose	OBL
Salix discolor	Pussy Willow	FACW
Salix nigra	Black Willow	FACW
Scirpus cyperinus	Woolgrass bulrush	FACW
Sparganium sp.	Burreed	OBL
Spirodela sp.	Duckweed	OBL
Thelypteris thelypteroides	Marsh Fern	OBL
Typha spp.	Cattails	OBL
Ulmus americana	American Elm	FACW
Viburnum cassinoides	N. Wild Raisin	FACW
Viburnum recognitum	Northern Arrowwood	FACW
Viburnum trilobum	Highbush Cranberry	FACW

Palustrine Open Water Wetland (POW)

Carex spp.	Sedges	FACW,OBL
Cornus stolonifera	Red-osier Dogwood	FACW
Salix nigra	Black Willow	FACW
Typha sp.	Cattail	OBL

0285-33-2112

ATTACHMENT C

PHOTOLOG

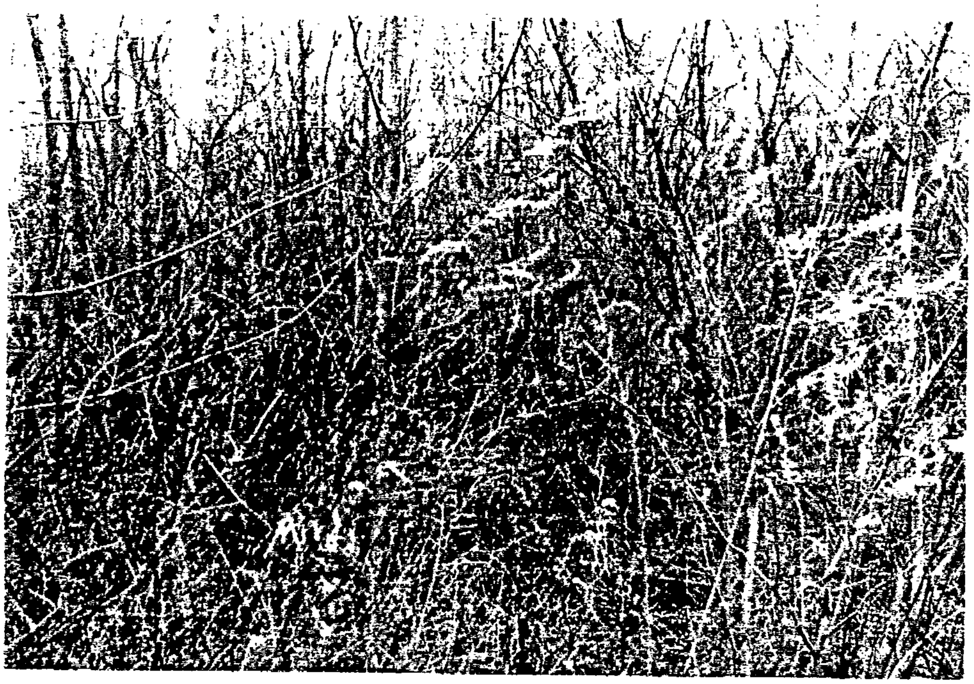
PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 1
Photo of Wetland A
taken at Point 1
(Map A) facing
north.

COMMENTS

PHOTO BY R. T. Sankey



PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 2
Photo of Wetland A
taken at Point 2
(Map A) facing
north.

COMMENTS

PHOTO BY R. T. Sankey

 MALCOLM PIRNIE

PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 3

Photo of Wetland A taken at Point 3 (Map A) facing northwest.

COMMENTS

PHOTO BY R. T. Sankey

PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 4

Photo of Wetland A taken at Point 4 (Map A) facing north.

COMMENTS

PHOTO BY R. T. Sankey

MALCOLM PIRNIE

PROJECT Mill Creek

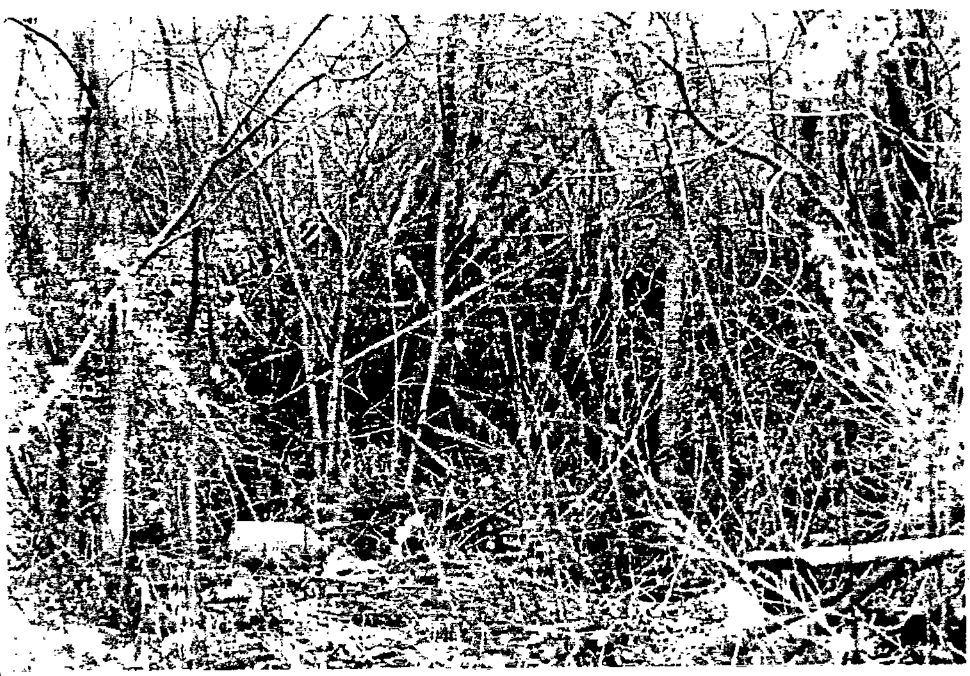
DATE 12/90

DESCRIPTION Photo 5

Photo of Wetland A taken at Point 5 (Map A) facing west.

COMMENTS

PHOTO BY R. T. Sankey



PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 6

Photo of Wetland B taken at Point 6 (Map A) facing north.

COMMENTS

PHOTO BY R. T. Sankey

MALCOLM PIRNIE

PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 7

Photo of Wetland C taken at Point 7 (Map A) facing southeast.

COMMENTS

PHOTO BY R. T. Sankey

PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 8

Photo of Wetland C taken at Point 8 (Map A) facing east.

COMMENTS

PHOTO BY R. T. Sankey

MALCOLM PIRNIE

PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 9

Photo of Wetland C taken at Point 9 (Map A) facing north.

COMMENTS

PHOTO BY R. T. Sankey

PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 10

Photo of Wetland C taken at Point 10 (Map A) facing southwest.

COMMENTS

PHOTO BY R. T. Sankey

MALCOLM PIRNIE

PROJECT Mill Creek

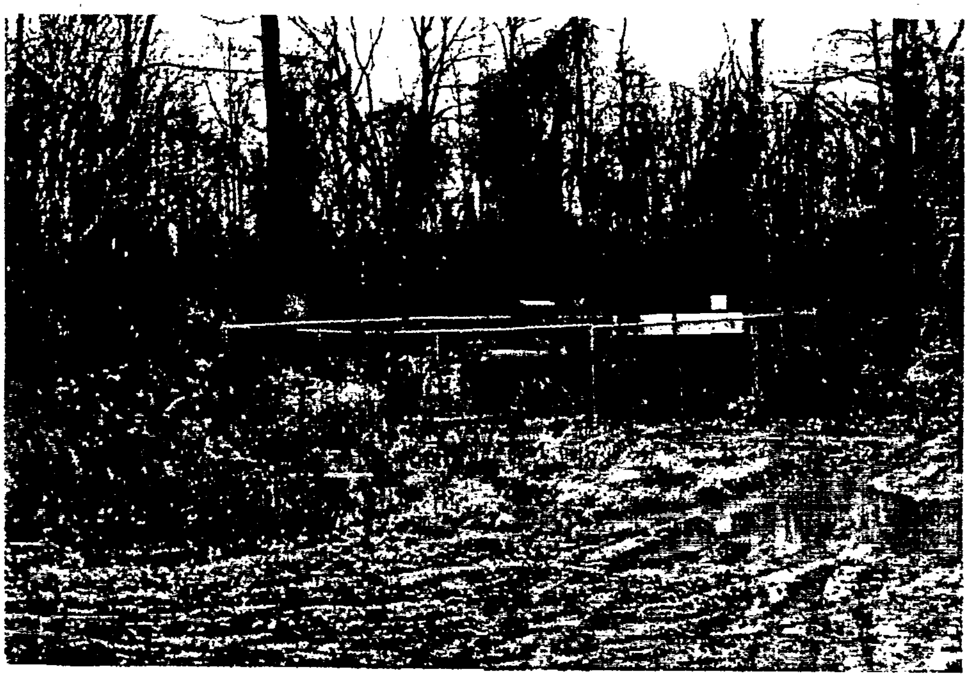
DATE 12/90

DESCRIPTION Photo 11

Photo of Wetland D taken at Point 11 (Map A) facing northeast.

COMMENTS

PHOTO BY R. T. Sankey



PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 12

Photo of Wetland E taken at Point 12 (Map A) facing southwest.

COMMENTS

PHOTO BY R. T. Sankey

MALCOLM PIRNIE

PROJECT Mill Creek

DATE 12/90

DESCRIPTION Photo 13

Photo of Wetland F taken at Point 13 (Map A) facing southeast.

COMMENTS

PHOTO BY R. T. Sankey

PROJECT

DATE

DESCRIPTION

COMMENTS

PHOTO BY

MALCOLM PIRNIE

EPA REGION III
SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOC ID 115184
PAGE # Ar004512

IMAGERY COVER SHEET
UNSCANNABLE ITEM

SITE NAME Millcreek Dump

OPERABLE UNIT ____

ADMINISTRATIVE RECORDS- SECTION UAO **VOLUME** IX

REPORT OR DOCUMENT TITLE Engineering report Design analysis report. site specific Quality Management Plan.

DATE OF DOCUMENT NOV. 1,91

DESCRIPTON OF IMAGERY Hazardous waste Cleanup Wetland Delineation Plan Map A

NUMBER AND TYPE OF IMAGERY ITEM(S) 1 oversized Map

MALCOLM PIRNIE

APPENDIX C

DESIGN REVIEW COMMENTS/RESPONSE

AR004513

100% REVIEW COMMENTS

MILLCREEK SUPERFUND SITE
CAP AND FLOOD RETENTION BASIN DESIGN
ERIE COUNTY, PENNSYLVANIA

The following responses address comments regarding the 100% project submittals for above-referenced site and project. These responses were prepared for review and inclusion in the Design Analysis Report.

A. The following responses address comments prepared by Craig R. Olson, CEMRO-ED-DK:

Design Analysis:

Comment A1: ***Para. 2.3.10: Contaminated Water***
Include in this paragraph the disposition of decontamination water.

Response: Paragraph 2.3.10 has been modified to include disposition of decontamination water.

Comment A2: ***Para. 2.3.11***
Delete the options listed as they are irrelevant if the choice is completely up to the Contractor. If there are any specific requirements, the contractor must fulfill (i.e., regulatory, local ordinances, flood control provisions, etc.) during the temporary diversion of Marshall's Run, they should be included in the specifications.

Response: The paragraph has been modified to refer to the required submittal "Surface Water Bypass Pumping Plan" (Section 02210, GRADING). Suggested bypass options have been deleted.

HSD Analysis:

Comment A3: ***Para. 8.1, page 8-1:***
Fourth Paragraph; eliminate the option to discharge to the treatment facility as this is not allowed in the specifications which clearly require the contractor to discharge decon water only to on-site ponds to be maintained by the contractor.

Response: The paragraph has been modified to delete the option of discharging decon water to the ground water treatment facility.

AR004514

Drawings:

Comment A4: *Sht. C-10*
Correct the numbering of Trench Number 2. Verify that all trench numbers depicted on this sheet coincide with those listed in detail A on sheet C-22.

Response: Numbering has been corrected and verified.

Comment A5: *Sht. C-10*
Clearly identify areas appropriate for the contractor to create "on-site ponds" for the disposal of decon water and dewatering water. Are there any special requirements for these ponds such as liners, etc...?

Response: A suitable area has been designated on Sheet C-10. There are no special requirements for disposal of decon and dewatering water.

Comment A6: *Sht. C-11*
Call out the decon area on this sheet. Indicate any specific requirements the contractor must consider when submitting decon facilities as required in Spec 01420.

Response: Decon area has been designated on Sheet C-11.

Comment A7: *Sht. C-22*
Detail A: The detail is very unclear as to what is existing and what is new. All items should be labeled "new" or "existing" as some are presently. Definitive line weights could also help. Please clarify the following:

a. is the pump new?
b. is the discharge piping new?
c. is the valve and recycle line new?
d. is the drainpipe new?
e. etc.

Contractors that aren't familiar with the job will be required to know this.

Response: The detail has been clarified to show new items.

Comment A8: *General*
New waterline work should be shown on the drawings.

Response: Water service has been added to Sheets C-10 and C-11.

AR004515

Specifications:

Comment A9:	*Section 01420, Para. 4* *The water supply hydrant must be shown on the drawings.*
Response:	The water supply hydrant has been added to Sheet C-11.
Comment A10:	*Section 02221-2, Para. 2.4* *Determine whether rock is likely to be encountered. If based on geotechnical investigations it is not, delete references to rock throughout this specification as it will reduce contractor suspicion during bidding and lower bid amounts.*
Response:	References to rock have been deleted throughout the referenced Section since borings did not encounter rock.
Comment A11:	*Section 02113* *Add this spec section to the index.*
Response:	Section 02113 has been added to the Index.
Comment A12:	*Section 02713, Para. 5.1* *Increase the cover for waterlines to 5-0" in accordance with the guidance given in NFPA 24. These lines will be intermittently used and will freeze if used during winter months.*
Response:	The specified cover for waterlines has been increased to 5'-0".

AR004516

B. The following responses address comments prepared by Bob Gunkelman, CEMRO-ED-DJ:

Comment B1: *Reference 90% Cmt. D1*
Specifications need to specifically require a plan for temporary diversion of Marshall's Run.

Response: Paragraph 14 of Section 02210, GRADING, requires a Category II submittal of a Surface Water Bypass Pumping Plan.

Comment B2: *Reference 90% Cmt. D7*
Complete horizontal control for the maintenance road (Coordinates, curve information, stationing, etc.) is necessary for the Contractor to lay out the road. If this information is not provided on the plans, the Contractor will have to somehow generate this himself. It is not possible to build this road without some horiz. control for staking it out. Providing horizontal control will make the Contractor's job much easier.

Response: Sheet C-30 "Maintenance Access Road Layout" has been added to the Drawings.

Comment B3: *Reference 90% Cmt. D8*
These contours still do not look right. Compare to Sheet C-13.

Response: The contours have been corrected.

Comment B4: *Reference 90% Cmt. D10*
Show the new gate with a heavy line wt. Also, the note needs to be a heavy line wt. to indicate that the gate is new.

Response: The gate note has been added.

Comment B5: *Reference 90% Cmt. D11*
No existing road is indicated on Sheet C-11.

Response: The 17th St. roadway has been added.

AR004517

Comment B6: *Reference 90% Cmt. D12*

*a. **Sheets C-24, 26** - Where is steel manproofing required? Will this interfere with flap gates? Indicate on Schedule all headwalls to receive manproofing.*

*b. **Sheet C-27** - Indicate inside dimensions of Catch Basins.*

Response: a. See Legend, Sheet C-26 for clarifications.

b. Height dimension varies with location. Width and length are as indicated, rim and invert el's are given on Sheet C-26.

Comment B7: *Reference 90% Cmt. D18*
I could not find where these items were addressed on the plans. Particularly the light poles(?) at the east end of the channel.

Response: Bid Item 15 and an applicable General Note have been added to the Contract Documents.

Comment B8: *Reference 90% Cmt. D34C*

a. Delete the Specifications attachments.

b. Use fence designation notes per the fence legends on Sheets C-28 & 29 on the layout plans. Need to use the designations to specify fabric width, top wire, etc.

c. Fix title of Sheet C-28.

Response: a. Attachments deleted.

b. Sheet C-28 and C-29 corrected to indicate correct fence type.

c. Title of Sheets C-28 and C-29 are as per USACE standard details and legend.

AR004518

C. The following responses address comments prepared by O. P. Patney, CEMR‹·ED-DF:

Comment C1: *‵‵: C-17, Section 5*
F. ..perature reinforcement for 10" wall per ACI 318 change #5 @ 12" to #4 ‿ 12".

Response: Reinforcement details have been changed as requested.

Comment C2: *Sht. C-18, Section 2*
Same Comment for 12" wall.

Response: We feel #4 @ 12" will not control temperature and shrinkage cracking to the degree necessar for a structure exposed to running water. Refer to ACI Committee Re...rt 350.

Comment C3: **Sht. C-18, Exterior wall reinforcement in Section 2 for Box Culvert:**
Clarify what is correct. One leg of bar shows #7 @ 12" and the other leg #6 @ 12".

Response: Correct as shown. Dowels into culvert slab are #7 @ 12". Top reinforcing in slab is #6 @ 12".

Comment C4: ***Sht. C-24, Pipe Culvert (Plan)***
For 6" thick wall 2-layers of #4 bars are too much. Please revise to change to 1-layer #4 bars.

Response: ın currently shows one layer of #4 bars. Bar "J" shown on plan is .tually located in base slab. Refer to section on Pipe 4.

D. *The following responses address comments prepared by R. B. Sedlak, CEMRO-ED-CC:*

Comment D1: ***90% Comment H3:***
Quantity Takeoff Sheets were not included in the 100% cost estimate. These sheets need to be submitted immediately.

Response: Material takeoffs are provided for the reinforced concrete quantities (listed on p. 10, item 8), and for soil cut and fill (listed on p. 3, item 3). Takeoffs are located at the end of the final cost estimate volume.

Comment D2: ***90% Comment H7***
Most of the Price Quotes were related. Most prices remained the same. Quote #10 was updated, but no price was included. Were the quotes actually updated?

Response: Quote #10 will be confirmed and the price included. Price quotes which are indicated as updated were in fact confirmed subsequent to the 90 percent submittal, as requested.

Comment D3: ***90% Comment H9, Development of Home Office Expense & Profit***
This was not done and is still required.

Response: As discussed by phone, an acceptable allowance of 5% for Home Office Expense is made on the Cost Estimate Analysis Sheet for each Bid Item.

Comment D4: ***Page 2 of 26***
Item No. 1 - Recap shows a cost of $137,250. No backup for this number nor is it included in the totals.

Response: The correct number is $166,000. Backup for this number is given on page 26 of 26.

Comment D5: ***Page 5 of 26***
Is survey crew needed for this length of time?

Response: *Survey crew hours have been reduced to 2,078/man for the project.*

Comment D6: ***Page 5 of 26***
Site Security - Specs indicate 2 yr - 24 hr/day = 17,520 hrs. Estimate uses 13,300 m-hr & 17,337 hr for pickup truck. Which is correct?

Response: For backup of 13,300 miles/hour see bottom of page 5 of 26. The hours for pickup truck will be changed to 17,520.

AR004520

Comment D7: *Page 17 of 26*
PPE material costs do not agree with costs of p.5 of 26. Suits 4/day or 1/per day? All items that show cost for PPE need to be reviewed.

Response: Page 17 PPE costs are for decon laborer, as indicated. Page 5 does not contain PPE costs. Page 7 PPE costs are for COE employees and visitors, as indicated.

Comment D8: *Page 25 of 26*
Cost for truck appears very high. No cost shown for truck driver. Review and revise as required.

Response: No dedicated truck driver is anticipated for the water truck. Backup for the truck cost is included in the Final Cost Estimate.

Comment D9: *90% Comment H17a & H17b, p. 2, 3, & 7 of 17*
Item No. 7 comments were not complied with. These quantities do not agree with Design Documents. A-E needs to explain why these changes were not done. Review and revise as required.

Response: Quantities shown on the Final Cost Estimate are in agreement with the Final Design Documents.

Comment D10: *Page 11 of 17*
Item No. 7 - Estimate indicates street lights are Government-furnished. Specs do not show this requirement. It appears specs should be revised showing GFE.

Response: Street lights are GFE. Refer to Spec Section 16402, Para. 12.

Comment D11: *90% Comment No. H18a*
Item No. 8 - Quantity take-off sheets are still required. None were submitted.

Response: See Response to Comment D1.

Comment D12: *Page 3 of 4*
Item No. 9 - Material cost of $2,500/Ac. Verify that this is not a cost to Prime Price with labor, equipment and material already included.

Response: Material cost of $2,500/AC does include labor, equipment and material. Cost estimate has been revised.

Comment D13: *Page 3 of 8*
Item No. 13 - Highlight on Quote Sheet from lab items used.

Response: Quote sheets have been highlighted as requested.

Comment D14: *Drawings show modification to collection sumps. No cost shown in estimate for this work. Is this required?*

Response: Costs for sump modifications have been included in the Final Cost Estimate.

Comment D15: *For Bid Estimate labor cost will be current Davis-Bacon rates.*

Response: Labor rates are from Department of Labor localized for Erie, PA; as directed by USACE Project Manager 3/11/91.

Comment D16: *For Bid Estimate rates will be based on COE Equipment Manual dated August 1991.*

Response: As previously directed by USACE, source for equipment rates is the COE Equipment Manual dated 1988.

Comment D17: *Reproduction quality is very poor. Many sheets are hard to read. More care needs to be taken for the bid estimate.*

Response: Care will be taken to improve reproduction quality.

Comment D18: *Bid Estimate will be based on advertised plans, specs and bid schedule, not the 100% design documents.*

Response: Final cost estimate will be based on Final Construction Documents.

AR004522

E. *The following responses address comments prepared by Debra Morrisey, CEMRO-ED-EF.*

Construction Cost Estimate:

Comment E1: ***General:***
Per 1910.120 use the terminology Site Safety and Health Plan (SSHP) rather than Health and Safety Plan (HASP) or Safety, Health, and Emergency Response Plan (SHERP). Please correct this terminology throughout these Design documents.

Response: Terminology has been corrected to indicate Site Safety and Health Plan (SSHP).

Comment E2: ***Item 2, Sheet 13***
Per phone conversations with Gary Lang (CENAP-COF-NA) and Virginia Wall, the Harvard Graphics are not needed in this work effort. Delete this cost.

Response: Costs for Harvard Graphics have been deleted.

Comment E3: ***General***
It shall be stated in the specifications that at the end of this 24-month construction period all of the copier and computer equipment will be turned over to the government.

Response: The Specifications have been modified to reflect this requirement.

Comment E4: ***Item 7, Sheet 6.***
Delete the "Level D+".

Response: Corrected as requested.

Comment E5: ***Item 13, Sheet 2***
It shall be stated in the specifications that at the end of this 24-month construction period all of the monitoring instruments and chemical testing equipment will be turned over to the government.

Response: The Specifications have been modified to reflect this requirement.

AR004523

Design Analysis Report:

Comment E6: *Section 2.4, page 44*
See Comment #1, Construction Cost Estimate.

Response: SHERP has been changed to SSHP.

AR004524

F. The following responses address comments prepared by Jeff McClenathan, CEMRO-EDHD:

Comment F1: *Riprap meets sizing standards for 9" layer thickness but construction experience indicates difficulty in uniformly placing a riprap layer less than 12" thick and bedding less than 6" thick.*

Response: Drawings and Specifications have been changed to reflect 12" riprap, 12" gabions and 6" gravel bedding.

Comment F2: *The standard Corps riprap graduation for a 12" riprap layer is:*

D100	*10-26 lbs*
D50	*5-11 lbs*
D15	*2-5 lbs*

This riprap size will be adequate to replace the 9" gabions placed downstream of the FRB in Marshall's Run.

Response: The gradation above for 12" riprap layer has been incorporated in Specification Section 02223. It is recommended that the gabions remain where indicated, for ease of installation and reduced risk of damaging the HDPE liner (see discussion in Design Analysis Report).

Comment F3: *The flow velocities present in Marshall's Run upstream of the FRB do not appear to warrant riprap erosion protection.*

Response: The design rationale for placing riprap upstream of the FRB is as follows:

- it will minimize localized erosion as impounded stormwater crests back over the side discharge weir into the channel;
- it will also define channel boundaries, which will facilitate routine channel cleaning and minimize the potential for over-excavation into potentially contaminated subgrades and embankments;
- it will enhance the visual appearance of the channel, which might otherwise become overgrown with vegetation; and
- it will minimize maintenance of the channel (i.e., cutting the grass, repair of gully erosion).

Recommend maintaining riprap as designed.

AR004525

Comment F4: *Recommend that riprap placement be terminated at the 10-year water surface elevation. Localized velocities above this height will not warrant riprap placement.*

Response: The difference between the 10-year water surface and top of embankments is only 3 feet vertical, on average. For the comparatively small incremental cost involved in extending the riprap to the top of the embankment relative to total project costs, and for the reasons listed in the response to Comment F3 above, we recommend maintaining riprap as designed.

AR004526

G. The following responses address comments prepared by Bill Doan CEMRO-ED-HE.

Comment G1: *Request PADER dam safety comments be forwarded once they have been received.*

Response: PADER dam safety comments are included with this comment set. With respect to the ARAR comment: The FRB will pass a 100-year flood, as analyzed by HEC-1 hydrologic and hydraulic computer routing model. Table 3 of the Design Analysis Report has been expanded to provide FRB performance criteria for the 100-year storm.

1. The 0.5 discrepancy in the outlet invert has negligible effect on HEC-1 routing results.

2. A slightly coarser filter material has been specified to conform to the referenced 1986 USACOE criteria:

   d_{50f} = No. 10 = 2 mm.
   ave. slot width = 1/16 inches = 1.6 mm.
   d_{50f}/slot width > 1.2

3. The sieve analysis performed by the geotechnical subconsultant indicated that the site soils are sandy. A good nonwoven fabric would be suitable for such conditions. The Contractor is, however, required to submit samples and specifications for the geotextile and test reports of the embankment fill; and furthermore, to install the geotextile in accordance with manufacturer's recommendations.

4. Paragraph 14 of Section 02210, GRADING, requires that the embankment fill specified for the unlined portions of the channel be placed to 10 feet from any structure and compacted to 95 percent maximum density.

AR004527

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
FIELD OPERATIONS - WASTE MANAGEMENT
1012 Water Street
Meadville, Pennsylvania 16335
Telephone: A. C. 814/332-6848

November 7, 1991

Subject: Millcreek Superfund Site
Erie County

Mr. Anthony Koller (3HW21)
Remedial Project Manager
U.S. Environmental Protection Agency
Region III
841 Chestnut Building
Philadelphia, PA 19107

Dear Mr. Koller:

The Pennsylvania Department of Environmental Resources (PA DER) has completed its review of the portions of the Millcreek Superfund Site Construction and Flood Retention Basin (FRB) Design Report that would be regulated by the Pennsylvania Dam Safety & Encroachments Act. The following comment is a State Applicable or Relevant and Appropriate Requirement (ARAR):

- The Department's Chapter 105 Rules & Regulations would require a minimum design storm of 100-year return period for a dam with this classification. The dam may be able to safely pass the 100-year storm, but the information submitted does not demonstrate this. No calculations are shown for the 100-year flood. Since the dam is being built as a flood retention basin, the probable downstream hazard potential classification is 2.

The following comments are not State ARARs but should be considered in the FRB design:

1)
- There is a discrepancy in the invert of this 2.5/ft. by 4.5/ft. low-level outlet. It is given as 709.5 in Table 2 on Page 15 of the 100% Submittal Design Analysis Report and is shown as 709.5 on the "FRB CONTROL STRUCTURE PLAN" on Sheet C-16, but 709.0 is used in the routing (See HEC-1 input, line 171). It is acknowledged that the effect of this discrepancy on the routing would be negligible.

- The degradation of filter material versus the specified perforation of the pipe is questionable according to U.S. Bureau of Reclamation (USBR) and U.S. Army Corps of Engineers (USACOE) guidelines. The following criteria are not met:

2)

  o D85f/Max. pipe opening > 2 (USBR, 1987)

  D50f/Slot width > 1.2 (USACOE, 1986)

AR004528

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(3) • The design of the geotextile selected for the toe drain should be based on the embankment fill material properties regardless of source.

(4) • A fine grained soil should be specified for structural backfill along the FRB control structure.

If you have any questions, please contact me at this office.

Sincerely,

Nancy L. Snyder

Nancy L. Snyder
Project Manager
Hazardous Sites Cleanup Program
Northwest Region

NLS/sn

cc: Mr. Japp
Mr. Miller
Mr. Leaver
Mr. Gorman

H. The following responses address comments prepared by Barry, CEMRO-ED-GF.

Comment H1: ***Specification 02210 & 02245***
The relationship of topsoil specified in Section 02210 Grading Paragraphs 2.4 - "Acceptable Topsoil"; Par. 5 - "Conservation of Topsoil"; and "Placing Topsoil" and the Specification 02245 "Topsoil Cap" is still confusing. If topsoil does not exist on the site, why have a paragraph titled "Conservation of Topsoil". If acceptable topsoil is not used in Section 02210, why have paragraphs to conserve and place topsoil in this Section? I do not understand the A-E's explanation of the annotated comments from the 90% review. The Contractor bidding this job will probably be as confused as I without the benefit of A-E explanation made in Design Review comments.

Response: Paragraph 5 - "Conservation of Topsoil" in Section 02210 has been deleted.

Comment H2: ***Specification 02210, paragraphs 12 & 15***
Is it the intent to have the levee and retention basin earthen berm embankments specified in paragraph 15 - "Finished Excavation Fills and Embankments" and par. 12 - "Fill". These are weak specs for flood control features. Special considerations should be made for compaction, zoning, scarification of lifts, kneading together of lifts, and under-seepage considerations, etc.

Response: Revised specifications for levees have been included in the Final Documents.

Comment H3: ***Specification 02210, para. 12***
Paragraph 12 indicates that suitable fill should be used for embankments, which means cohesive or cohesionless soil. The cross-section of levee and embankments reflects a IV on 3H sideslope. This sideslope cannot be equally suited to both cohesive and cohesionless soils. For example, the toe drain shown may not be needed for cohesionless soil.

Response: Slope stability was considered in the report from the Geotechnical Subconsultant (see Appendix E of the Design Analysis Report). The revised specifications for levees (paragraph 14, Section 02210, GRADING) includes information on fill gradations and quality, subgrade preparation, fill placement, and compaction.

The State of Pennsylvania requires that slopes be no steeper than 1 on 3. Design of Small Dams indicates that these slopes need be no flatter. Conservative calculations result in safety factors greater than 1.5, for both cohesive and granular (cohesionless) cases. These calculations are included in Appendix N of the Design Analysis Report.

The gradation specifications for embankment fill in paragraph 14, Section: GRADING result in a sandy or gravelly cohesive or cohesionless soil for

AR004530

the lined part of the channel; and soil group GM, GC, SM or SC (which are generally defined as cohesive) for the unlined part of the channel. If required by the Corps, all embankment fill can be specified as a cohesive soil. However, a requirement for cohesive materials ML, CL, MH or CH will preclude use of the soil gradations recommended by the geotechnical consultant; and specifying sandy or gravelly embankment fill to contain fines of high plasticity may increase the cost of the material. Additionally, the soils specified will be less susceptible to piping damage than fine-grained cohesive soils. For these reasons, it is recommended that the specified embankment gradation criteria be used.

The 1′ by 5′ toe drain was designed on the basis of experience, judgment, and the nature of the embankment. Its purposes include reducing the likelihood of seepage from the embankment face, and reducing the likelihood of piping (soil loss) beneath the embankment. Its capacity depends on the gradient.

Comment H4: ***Specification 02210, para. 3, 4 & 12***
Paragraphs 3, 4 and 12 indicate that excavated material from the site can be used for fill and embankments, without any consideration made for contaminated soil. No testing of soil for contamination is considered either. Recommend some thought be given of this and revise specifications as required to address contaminated soil.

Response: Paragraphs 4 and 12 have been modified to delete reference to use of on-site material in the embankments. Paragraph 14 has been added, which specifically requires off-site material be used in the embankments.

Comment H5: ***Specification 02275, para. 5.2, "Seams"***
If the shaded part of this paragraph is deleted and the underlined part is added, the sewing option will not be specified. Rectify!!

Response: The paragraph has been modified to permit sewing.

Drawings:

Comment H6: ***Shts. C-3 through C-14 inclusive***
There are still symbols on these drawings that are not shown in the legend. The symbols --- and ...-...-...- are not shown in the legend, for example. There may be others. Provide a legend for all symbols. are not shown in the legend for example. There may be others. Provide a legend for all symbols.

Response: Missing symbols have been added. See also sheet G-2.

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Comment H7: *Sht. C-21*
The pipe boot detail does not identify all features. Do so!

Response: Detail has been clarified.

Comment H8: *Sht. C-21*
Identify all features of the toe detail.

Response: All features have been identified.

Comment H9: *Sht. C-21*
Where are the outlets from the toe drain located? How many are there? What do they look like?

Response: See sheet C-11. Toe drain daylights into drainage swale immediately upstream of headwall structure 132.

Design Analysis:

Comment H10: *Comments 2, 3, and 4 above should be reflected in the Design Analysis. An explanation of design criteria should be reflected in the design analysis for all work efforts discussed in the referenced specification sections.*

Response: A discussion of embankment construction, material, stability and components has been included in the Design Analysis Report, Sections 2.1.5.3 and 2.1.6.

Comment H11: *The Details on Drawing C-21, Typical Riprap Section and Typical HDPE/ Gabion Mattress show components not addressed in the Design Analysis. The rationale for using individual components as well as the total composite cross-section should be addressed in the Design Analysis.*

Response: See response to Comment H10. A discussion of rationale for HDPE/gabion mattress and riprap was included in the 100% Design Analysis Report Section 2.1.5.3, and has been expanded in the Final Design Analysis Report to include drainage layer and geotextile.

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Comment H12: *Sht. C-21*

The Toe Drain Detail references "Granular Subdrain Material". Is this the same as "Granular Subdrain Material". Is this the same as "Granular Subdrain Filter Material" specified in Section 02410? Is the "toe drain" the same as the "subdrain system" specified in Section 02410? Be consistent in terminology!

Response: Details and Specification 02410 have been coordinated for terminology.

Comment H13: *Design Analysis*

Both the typical Riprap-Lined Channel section and the Typical HDPE/Gabion Mattress-lined Channel section have 1 on 3 sideslopes. Provide calculations and explanations in the design for slope stability, hydraulic stability, use of the gravel drain system behind the FML, friction angles between the separate component interfaces, and any tension factors considered in the materials. A 1V on 3H slope with these various interfaces is highly questionable. The 16 oz/sy nonwoven geotextile and the 80 mil HDPE as well as 80 mil HDPE and 3" granular subdrain, bedding layer are also suspect for stability. Geotextile and riprap stability and interfaces should also be discussed for the FRB levee embankment.

Response: Tensile strength of the HDPE and geotextile; riprap stability; slope stability; and friction angles are all considered in the calculations referenced in the response to Comment H3. All have suitable factors of safety as designed.

Comment H14: *Design Analysis*

Provide calculations and explanation of the anchor trench at the Typical HDPE/Gabion Mattress-Lined Channel Detail.

Response: The anchor trench is intended to stabilize the liner components, not protect the liner components from tensile failure due to loading stresses (see response to Comment H15). Section 2.1.5.3.3 has been expanded to include this discussion.

Comment H15: *Drawing Sht. C-21*

The anchor trench should be detailed more clearly. The width, depth and type of fill should be specified or shown on the Detail.

Response: The anchor trench is detailed on Sheet C-21. The intent of the anchor trench is to stabilize the liner. In contrast, anchor trenches for landfills are designed to yield prior to liner failure, which might be induced by filling. Malcolm Pirnie engineers recommended the anchor trench detailed on Sheet C-21 based on design experience, which indicate more than adequate resistance to slippage of the liner during construction is provided.

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Substantial factors of safety against failure of the liner is also present (see Appendix N, Design Analysis).

Comment H16: ***Design Analysis***
The levee and earthen flood retention embankments should be discussed in the Design Analysis. How were the cross-sections designed? What does the toe drain do? Provide rationale for cohesive and/or cohesionless materials in the embankment.

Response: See response to Comment H3. Section 2.1.5.3.3 has been expanded to include a discussion of design rationale for the embankment materials and cross-section.

Comment H17: ***Design Analysis***
How were levee and flood retention embankment elevations selected? Provide hydraulic rationale. Is there freeboard?

Response: Refer to Section 2.1.5.3.2 and 2.1.5.3.3 for discussion of FRB and Marshall's Run hydraulic design. In summary, elevations were selected to contain design flood flows while minimizing encroachment of the channels onto either contaminated site soils, or adjacent properties.

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I. The following responses address comments prepared by McPherran, CEMRO-ED-GB:

Specifications:

Comment I1: ***Sec. 02223, Rip and Bedding***
Add quality and sources of material.

Response: Riprap and bedding will be supplied from off-site sources. Material specifications for Section 02223 are formatted in a similar manner as other material specifications (i.e., Sections 02245 and 02410). Additionally, paragraph 2.2 requires that Category II Compliance Certificates be submitted.

Comment I2: ***Sec. 02210, Grading***
Cross-sections and zoning of materials.

Response: Reference new paragraph 14, "Special Considerations for Embankments."

Comment I3: ***Sec. 02210, Grading***
Add Category Two submittal for laboratory and density test results of contractor-selected borrow sites.

Response: Submittal has been added.

Comment I4: ***Sec. 02201, Excavation, Filling and Backfilling***
Number of days before backfill can be placed is referenced to Section 03300. Not clear. Should call out number of days or give exact paragraph in Section 03300.

Response: Section 02201, paragraph 8 has been modified to prohibit backfill until concrete has reached full strength.

Comment I5: ***Sec. 02201***
Can Contractor use heavy equipment after structure is covered a certain distance?

Response: No. Heavy compaction equipment will exceed the design surcharge regardless of backfill depth.

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Comment I6: *Sec. 02201*
Grid node control elevations - they aren't all shown on Drawings.

Response: Grid node elevations are given in the Specifications, Appendix B.

Drawings:

Comment I7: *Sht. C-9*
Slope hatches are shown on Plan, but slopes are not called out.

Response: Channel slopes are detailed on subsequent sheets.

Comment I8: *Sht. C-9*
Top of Plan on right side grading should transition to meet existing ground.

Response: See detail on Sheet C-10.

Comment I9: *Sht. C-10*
Top of Plan on right Side. Add Note: For continuation of grading see Sheet C-3.

Response: Sheet C-3 is for subgrade. Sheet C-10 is final grade. Grading is continued on Sheets C-14 and C-11, as per the key map.

Comment I10: *Sht. C-10*
All grid nodes should be identified on Drawings.

Response: See Comment I6 response. Coordinate alpha values are given for every node.

Comment I11: *Sht. C-10*
Need some typical sections.

Response: See sheets C-21 through C-29 for details of Marshall's Run, stormwater structures, box culverts, etc.

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Comment I12: ***Sht. C-10***
Show typical levee section showing zoning of materials.

Response: Zoning of materials is addressed in Specification 02210. Embankment material is from off-site areas. Gradation for embankments is specified in Section 02210.

Comment I13: ***Sht. C-11***
Need location for structures.

Response: Manholes have been stationed. The 50-scale grid was intended to facilitate location of structures and fill grades without confusing coordinates indicated for each.

Comment I14: ***Sht. C-11***
Need some curves on center line of channel.

Response: There are no curves for the channel. Coordinates are provided at each change in direction.

Comment I15: ***Sht. C-11***
- - - symbol not in Legend - may be wetlands or fence.

Response: Symbol for subdrain has been corrected.

Comment I16: ***Sht. C-11***
Need excavation plans and sections for structures.

Response: Refer to structural elevations, Sheets C-16, C-17, C-18.

Comment I17: ***Sht. C-11***
No control for gravel covered perimeter road.

Response: A new drawing Sheet C-30, Maintenance Access Road Layout has been added.

Comment I18: ***Sht. C-20***
No stationing called out for manholes, structures, and control for excavations; also toe drain.

Response: Refer to response to Comment C-11.

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Comment I19: ***Specifications***
Guide specification for levees is enclosed for use for levees and FRB embankment.

Response: Pertinent sections have been incorporated into Specification Section 02210, Grading.

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J. The following responses address comments prepared by Jerry Trease, CEMRO-ED-EG Chemistry:

Comments J1 through J70: *Design Analysis Report; Site Specific Quality Management Plan; Specifications 1350, 1460, 1600, 1800, 02212 and 02671.*

Response: The comments were phrased as directives. No exceptions were taken, and all comments have been incorporated into the referenced documents. With respect to Comment 57b, "PCB is not a TCLP parameter", PCB has been removed from the list of hazardous parameters to be tested for at the Millcreek Site.

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APPENDIX D

NOT USED

AR004540

MALCOLM PIRNIE

APPENDIX E

GEOTECHNICAL INVESTIGATION

AR004541

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED FLOOD RETENTION BASIN
MILLCREEK SUPERFUND SITE
ERIE, PENNSYLVANIA

By

H&A of New York
Rochester, New York

For

Malcolm Pirnie, Inc.
Buffalo, New York

File No. 70179-40
September 1991

AR004542

H & A OF NEW YORK

Geotechnical Engineers &
Environmental Consultants

26 September 1991
File No. 70179-40

Malcolm Pirnie, Inc.
S. 3515 Abbott Road
P.O. Box 1938
Buffalo, New York 14219

Attention: Mr. Kent McManus

Subject: Geotechnical Engineering Investigation
Proposed Flood Retention Basin
Millcreek Superfund Site
Erie, Pennsylvania

Gentlemen:

This report summarizes the results of subsurface investigations, presents geotechnical design recommendations, and provides comments on construction considerations for the proposed flood retention basin at the Millcreek Superfund Site in Erie, Pennsylvania. This work was undertaken in accordance with our revised proposal dated 26 April 1990, as authorized by the agreement dated 23 January 1991. Preliminary comments on a previous design scheme were presented in our memorandum dated 19 March 1991. Additional services were provided in accordance with our letter proposal dated 12 June 1991.

The general location of the proposed retention basin is shown on the Project Locus, Figure 1. It lies in the southeast corner of the Superfund site.

We understand that the flood retention basin will be formed by constructing berms along its north and east sides. These berms have proposed crest elevations of 720, crest widths of 10 feet, and inboard and outboard slopes of one vertical on three horizontal. As part of the berm construction, a westward realignment of Marshall's Run is also proposed, such that it will flow north within the basin, immediately west of the east dike. The portion of the channel within the basin will have a bottom width of approximately 10 feet, and bottom elevations between approximately 710 and 711.

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Within the basin, a side-discharge weir will be constructed along the west bank of realigned Marshall's Run. It is presently anticipated that the weir will consist of a reinforced concrete core wall, with an earthen berm on each side. The core wall has a proposed crest elevation of 714, and a crest width of one foot. It is also proposed that the wall be supported by a 2-foot-wide strip footing, bearing at elevation 708. Berm slopes of one vertical on three horizontal are planned.

Flow exiting the basin will pass through a reinforced concrete control structure. This structure will include a conduit with an invert elevation of 709.5 (for low and normal flows), and an overflow weir with a crest elevation of 717 (for high flows).

Two reinforced concrete box culverts will be constructed north of (downstream from) the control structure. Each will have an inside width and height of approximately 12 and 6 feet respectively. The southern culvert will have a length of approximately 30 feet and an invert elevation of approximately 709, and will convey Marshall's Run beneath the water treatment plant access road. The northern culvert will have a length of approximately 200 feet and an invert elevation of approximately 708, and will convey Marshall's Run past the water treatment plant itself.

A low-permeability lining of a portion of Marshall's Run is also being considered. This lining may consist of either reinforced concrete or a geomembrane, and may extend from the control structure north to the water treatment plant bypass culvert.

The objectives of our work on this project have been to characterize subsurface conditions, and to develop geotechnical design recommendations and construction considerations for the proposed basin and its related structures. To fulfill these objectives, we performed the following work:

- Accumulated and evaluated readily available information on subsurface conditions at and near the site. Included in this effort was a review of the logs of previous explorations performed by others, provided to us by Malcolm Pirnie.

- Prepared, coordinated, and monitored a two-phased program of subsurface explorations. The field work was conducted in accordance with a health and safety plan prepared by Malcolm Pirnie.

- o Performed a limited program of laboratory testing, to aid in soil classification and the estimation of geotechnical engineering properties.
- o Reviewed and summarized the information accumulated, performed analyses related to the geotechnical engineering aspects of design and construction, and developed recommendations.
- o Prepared this engineering report summarizing our work.

FIELD AND LABORATORY INVESTIGATIONS

Subsurface Explorations

Subsurface explorations performed at the site for this study consisted of nine test borings. Test Borings SB101 through SB104 were performed by Pittsburgh Testing Laboratories between 18 and 21 February 1991, before the basin's location and configuration were finalized. A CME 55 truck-mounted drill rig was used for this initial phase of explorations. Test Borings SB105 through SB109 were performed by Empire Soils Investigations between 17 and 19 June 1991, after additional planning by Malcolm Pirnie. A CME 55 track-mounted rig was used for this second phase.

The test borings were advanced to depths ranging from 27.0 to 49.5 feet below the ground surface, using hollow-stem augers. The drilling was conducted in accordance with generally accepted practices, under the observation of H&A of New York personnel.

The explorations were performed at the approximate locations shown on the Subsurface Exploration Plan, Figure 2. Locations and ground surface elevations of the completed explorations were surveyed by Malcolm Pirnie. All elevations in this report are expressed in feet, and are referenced to National Geodetic Vertical Datum (NGVD).

Soil samples were obtained with Standard Split Spoon Samplers (2.0 inch O.D., 1.375 inch I.D.) in accordance with ASTM D1586. Field measurement of in situ soil conditions consisted of the Standard Penetration Test (SPT). The Standard Penetration Resistance (N) is defined as the number of blows necessary to drive the Standard Split Spoon Sampler one foot into undisturbed soil using a 140-pound weight falling freely for 30 inches.

In some instances when no or very poor soil recovery in the Standard Split Spoon Sampler was experienced, a three-inch O.D. split spoon was employed to increase sample recovery. Because no soft cohesive soils were encountered, no undisturbed Shelby tube samples were taken.

Soil samples obtained from the test borings were visually examined and classified by H&A of New York personnel. Descriptions of the soil samples from each test boring are presented on the Test Boring Reports, which were prepared by H&A of New York and are contained in Appendix A. Standard Penetration Resistance (N) values can be determined from data presented on the Test Boring Reports.

One groundwater observation well (MW104) was installed in the completed borehole of Test Boring SB104. The well consisted of a 10-foot length of 1.5-inch diameter PVC well screen, packed in quartz filter sand, attached to a PVC riser pipe extending to the ground surface. A bentonite seal was placed above the sand filter to retard the infiltration of surface water. The details of the installation are presented in Appendix B. A summary of groundwater levels in this and other wells, read during the field program, is presented in Table 1.

Laboratory Testing

A limited program of laboratory testing was performed to aid in soil classification and estimating geotechnical engineering properties. The tests included:

- Five natural water content determinations (ASTM D2216).
- Five sieve analyses (ASTM D422).
- Two hydrometer analyses (ASTM D422).
- Five Atterberg Limits tests (ASTM D4318).

Laboratory test results are contained in Appendix C.

SITE AND SUBSURFACE CONDITIONS

Surface Conditions

The study area is in the southeast corner of an 78.4-acre former wetland. In general, the ground surface is heavily vegetated with grass, brush, and mature trees. This area lies within the floodplain of Marshall's Run, a stream which borders the east side of the site.

Access was difficult during the explorations in February 1991, and many areas of the site were flooded by as much as 4 feet of water. Much less flooding and generally dryer conditions, however, were observed in June 1991.

Subsurface Soil Conditions

The nine test borings were terminated at depths ranging from 27.0 to 49.5 feet. A summary of soil strata encountered by the borings is presented below in order of occurrence from the ground surface downward. Not all strata described were encountered at all boring locations.

Topsoil, fill (including foundry sand), and/or former topsoil (representing the previous ground surface) were encountered in all nine test borings, to depths as great as approximately 9 feet. These materials consist primarily of varying quantities of sand, gravel, and silt, with varying lesser quantities of clay, brick, slag, concrete, glass, wood, roots, and other organic matter. Standard Penetration Test N values range from 2 to 35, and average approximately 9 blows per foot. These values suggest that the relative density of the topsoil and fill varies from very loose to dense, and is generally loose overall.

Soil deposits described as glaciolacustrine were encountered in all nine test borings. At the boring locations, the thickness of these deposits ranges from approximately 13 to 25 feet, with an average of approximately 17 feet. The soils consist primarily of sand and silt, with varying lesser quantities of gravel and clay. Standard Penetration Test N values range from zero (weight of hammer or rods) to 33, and average approximately 16 blows per foot. These data suggest that the relative density of the deposits varies from very loose to dense, and is generally medium dense overall. (For a saturated granular soil, an N value of zero should not be interpreted as an indication of zero strength. Rather, it usually results from a semi-buoyant condition created at the point of sampling by the method of borehole advancement.)

Glacial till was encountered in all nine test borings. Approximate depths to the top of this deposit range from 16 to 31 feet, with an average of 22 feet. The till consists primarily of silt and sand, with varying lesser quantities of gravel and clay. Standard Penetration Test N values range from 16 to greater than 100, and average approximately 74 blows per foot. These values suggest that the relative density of the till varies from medium dense to very dense, and is generally very dense overall.

Eight of the nine test borings were terminated within the glacial till. After penetrating through approximately 20 feet of the till, however, Test Boring SB101 was terminated at a depth of 49.5 feet, in what appeared to be severely weathered shale.

Groundwater

Groundwater observations are presented on the Test Boring Reports in Appendix A. A summary of groundwater levels in observation wells, read during the February 1991 phase of the field program, is presented in Table 1.

The observed depths to groundwater ranged from approximately 2 to 8 feet, and averaged approximately 5 feet below the ground surface. It should be noted that groundwater levels will vary with location, time, seasonal and precipitational changes, and changes in the levels of nearby surface waters (such as Marshall's Run).

IMPLICATIONS OF SUBSURFACE CONDITIONS

The subsurface explorations and laboratory test results indicate that the natural soils at this site are generally granular (non-cohesive) in nature, and will therefore derive their strength primarily from internal friction. For slopes, embankments, and wide foundations on such soils, the factors of safety against deep bearing capacity failures are commonly very high, even for relatively small angles of internal friction. For these reasons, the performance of triaxial shear strength testing was deemed unnecessary for the construction proposed.

The explorations also suggest that much of the proposed earthwork will be performed in or on randomly placed fill materials. Because the character and quality of these materials is likely to be variable, special attention should be given to the preparation of subgrades, including measures to resist the development of piping (the subsurface erosion and loss of soil).

More detailed discussions are provided in subsequent sections of this report.

DESIGN RECOMMENDATIONS

Cut Slopes and Stream Channel

Cut slopes in existing fill materials will be necessary to form the realignment of Marshall's Run. These slopes should be no steeper than one vertical on three horizontal, as currently planned.

It will be necessary to protect the cut slopes and channel bottom from the erosive action of flowing water. Also, as previously noted, a portion of the realigned channel may be provided with a low-permeability lining.

Based on discussions with Malcolm Pirnie's project personnel, we understand that erosion protection in unlined portions of the channel will consist of either riprap stone or some type of unitized revetment (such as gabion mattresses). The size and thickness of the protective material should be determined on the basis of hydraulic considerations, but the thickness should in no case be less than 1 foot. A suitable non-woven geotextile should be placed between the protective material and the underlying soil. If riprap is used, and depending on its size, one or more additional layers of smaller stone may be necessary between the riprap and the geotextile.

It is understood that, in any lined portions of the channel, the low-permeability lining will consist of either reinforced concrete or a geomembrane. If concrete, no additional erosion protection is anticipated. If a geomembrane, erosion protection will consist of riprap or a revetment as described above. Additional protection, above and beneath the geomembrane itself, should be provided in accordance with the manufacturer's recommendations.

To help prevent the development of excessive hydrostatic uplift pressures and failure (heave) of the channel bottom, any low-permeability lining should be underlain by a granular or synthetic groundwater drainage layer, which in turn should be separated from the underlying soils by a non-woven geotextile. Relief ports (weepholes) with one-way flap valves should be provided along both sides of the channel at horizontal spacings of 50 feet or less. The elevations of the ports will depend on the thickness of erosion protection material, but should be established such that the ports will begin to function before the factor of safety against hydrostatic uplift becomes less than 1.5. An empty channel should be assumed.

Embankments

Inboard and outboard embankment slopes should be no steeper than one vertical on three horizontal, as currently planned.

Depending on the presence or absence of an adjacent low-permeability channel lining, embankment fill should consist of inorganic material conforming to the following gradational limits:

Sieve Size	Percent Finer by Weight Lined	Unlined
3 in.	100	100
No. 4	30 - 70	30 - 70
No. 200	0 - 50	12 - 50

Requirements for the placement and compaction of embankment fill materials are presented in a subsequent section of this report.

Because the inboard slopes of the basin will be unlined, continuous toe drains should be installed on the subgrade beneath the outboard slopes. These drains should consist of 4-inch diameter perforated PVC pipe, surrounded by 1/2 to 1-inch crushed stone, in an envelope of non-woven geotextile. The crushed stone layer should be 1 foot in thickness and 5 feet in width. No toe drains appear to be necessary along the channel downstream of the basin, where lower water levels will lessen the likelihood of piping.

The portions of embankments exposed to flowing water should be protected from erosion, as previously described for cut slopes and the stream channel. Portions not exposed to flowing water should be vegetated by hearty native grasses. At least one foot of freeboard should be maintained between the embankment crest and design high water elevations.

Side-Discharge Weir

The side-discharge weir may be designed and constructed as currently planned, including the reinforced concrete core wall and strip footing. The berms on each side should consist of either type of embankment fill, as described above. Erosion protection should be provided on both berms, as previously described for cut slopes and the stream channel.

Control Structure

The reinforced concrete control structure should bear on firm natural soil or compacted embankment fill (as previously described), placed after the removal of any unsuitable materials.

Based on the subsurface conditions encountered by Test Boring SB108, an allowable bearing pressure of 3,000 pounds per square foot appears appropriate for this location, which exceeds that required for the control structure. It also appears that the bottom-of-structure elevation will be near or below the existing bottom-of-fill elevation, and that little overexcavation of unsuitable materials will therefore be required.

The normal frost-protection depth for foundations in Erie, Pennsylvania is approximately 3.5 feet, and soils beneath the control structure will be saturated. Any portions of the structure seated within approximately 3.5 feet of an exposed surface, therefore, should be designed to accommodate periodic frost heaving.

Four-foot concrete cutoff walls are currently planned beneath the heal and toe of the control structure. To provide further resistance to piping, the upstream and downstream erosion protection and/or lining materials (including geosynthetics) should tightly abut the control structure.

All fill around the control structure should consist of compacted embankment fill. A summary of approximate lateral earth pressure parameters, as requested by Malcolm Pirnie, is as follows:

	Active	At-Rest	Passive
Lateral coefficient	0.33	0.50	3.00
Drained Equivalent Fluid Density (pcf)	40	60	360
Submerged Equivalent Fluid Density (pcf)			
o Soil	20	30	180
o Soil and Water	80	90	240

It is cautioned that structural displacements are necessary to develop both the active and passive cases, and that the at-rest case is therefore recommended. Conservatism should be applied if submergence levels will vary. A lateral coefficient of 0.5 should also be applied to any vertical surcharge loads.

Box Culverts

The two box culverts should be designed in general accordance with the recommendations presented above for the control structure. Based on the subsurface conditions encountered by Test Borings SB103 and SB109, little overexcavation for removal of unsuitable materials is expected.

Seismicity and Liquefaction Potential

A seismic risk map of the United States was prepared by Algermissen in 1969, and is presented by the Bureau of Reclamation in their Design of Small Dams (1977). This map divides the country into zones of four levels of severity (0 through 3). Erie, Pennsylvania lies on the borderline of a Zone 2 and a Zone 3, indicating that "moderate" to "major" earthquake damage is possible. Given the seismic history of Erie and the nature of this project, however, it appears that the risk of earthquake damage is minor, if modern construction techniques are followed.

The potential for liquefaction during a seismic event is greatest for relatively uniform fine sands at low relative densities. Given the gradational and density characteristics of the soils at this site, as well as the seismic history of Erie, the potential for liquefaction is considered to be low.

CONSTRUCTION CONSIDERATIONS

Comments in this section are directed toward excavation, fill placement, foundation construction, and other geotechnical engineering aspects of the proposed construction. It is emphasized that prospective contractors must evaluate potential construction problems on the basis of their own knowledge and experience, taking into account their own proposed construction methods and procedures.

Based on the subsurface explorations, it is estimated that most of the required excavation can be performed with conventional excavating equipment. It should be noted, however, that obstructions, including cobbles and boulders, may be encountered within both the fill and natural soils. Demolition debris may be present in the fill.

All earthwork, foundation concrete placement, and channel construction should be performed in-the-dry. Because excavations will be advanced near and below observed groundwater levels, it is anticipated that some type of pumped subsurface dewatering system will be necessary. It is cautioned that the soils at this site contain significant quantities of fine-grained material, and that they will be sensitive to disturbance. Bearing grades, therefore, should be kept free of water, should be subjected to a minimum amount of construction traffic, should be left exposed no longer than necessary, and should not be permitted to freeze.

Construction areas should be stripped of all surface topsoil. Prior to placing any fill or foundation concrete, the exposed bearing grade should be thoroughly examined, tamped, and (where possible) proofrolled with a heavy roller. Any loose, soft, wet, frozen, organic, or otherwise unsuitable materials should be removed and replaced with compacted embankment fill.

The existing fill materials may generally be left in place beneath embankments, the realigned stream channel, and the side-discharge weir. Any fill materials beneath the concrete control structure or box culverts, however, should be removed and replaced with compacted embankment fill.

The gradational requirements recommended for embankment fill are presented in a previous section. It appears that much of the excavated on-site fill and natural soil may be suitable for re-use as embankment fill, if desired. Embankment fill should be spread in uniform horizontal layers not exceeding 8 inches in loose thickness. In general, embankment fill should be compacted to at least 90 percent of the maximum dry density determined by ASTM D 1557 (latest edition). For any fill beneath or within 10 feet of the control structure or either box culvert, however, the percent compaction should be increased to 95.

CLOSING

Professional services for this investigation were performed, findings obtained, and the recommendations prepared in accordance with generally accepted geotechnical engineering practices, exclusively for the proposed retention basin and its related structures. No other warranty, expressed or implied, is made.

Subsurface conditions described in this report have been inferred from a relatively small number of widely spaced explorations. Conditions between and beyond these explorations are likely to vary. If conditions revealed during construction appear to differ materially from those described, H&A of New York should be given the opportunity to observe those conditions and evaluate their possible impact on our recommendations.

It is also recommended that H&A assist in preparing the geotechnical-related portions of the project drawings and specifications, and provide on-site monitoring and consultation during earthwork and foundation construction.

It has been a pleasure assisting you with this investigation. If you have questions or comments, or if you require additional information, please do not hesitate to contact us.

Sincerely yours,
H&A OF NEW YORK

Ray M. Teeter, P.E.
Senior Engineer

Stanley E. Walker, P.E.
Vice President

RMT/SEW/cad:rmt35

Attachments:	Table 1	- Summary of Groundwater Levels
	Figure 1	- Project Locus
	Figure 2	- Subsurface Exploration Plan
	Appendix A	- Test Boring Reports
	Appendix B	- Observation Well Report
	Appendix C	- Laboratory Test Results

TABLE 1

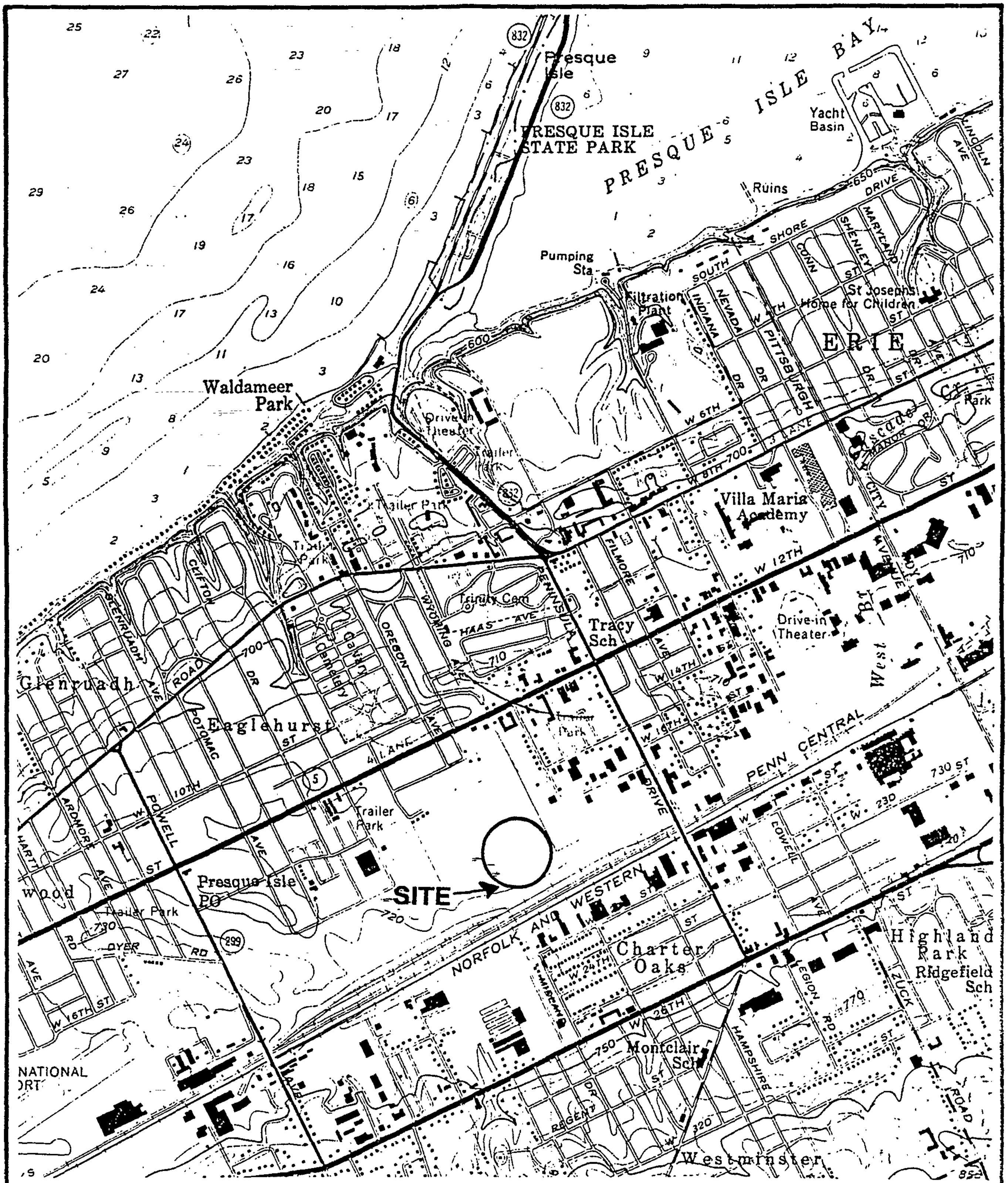
SUMMARY OF GROUNDWATER LEVELS

Well Number	Ground Surface Elevation	Groundwater Depth (feet)	Groundwater Elevation
MW-1	717.0	6.9	710.1
MW-2	715.4	5.2	710.2
MW-3	713.4	2.6	710.8
MW-4	713.9	3.9	710.0
MW-33A	715.2	4.0	711.2
MW-33B	715.3	4.1	711.2
MW-34	717.6	6.1	711.5
MW-104	717.1	7.2	709.9

NOTE:

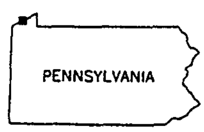
1. Groundwater levels were read on 21 February 1991.
2. Well number MW-104 was installed under the observation of H&A of New York personnel. Other wells were installed previously by others.
3. Ground surface elevations were provided by Malcolm Pirnie.

rmt41



LONGITUDE: 80° 08' 58" LATITUDE: 42° 05' 31"

N



QUADRANGLE LOCATION

USGS QUADRANGLE: SWANVILLE, PA.

H & A of New York

Consulting Geotechnical Engineers, Geologists and Hydrogeologists

MILLCREEK SUPERFUND SITE
ERIE, PENNSYLVANIA

PROJECT LOCUS

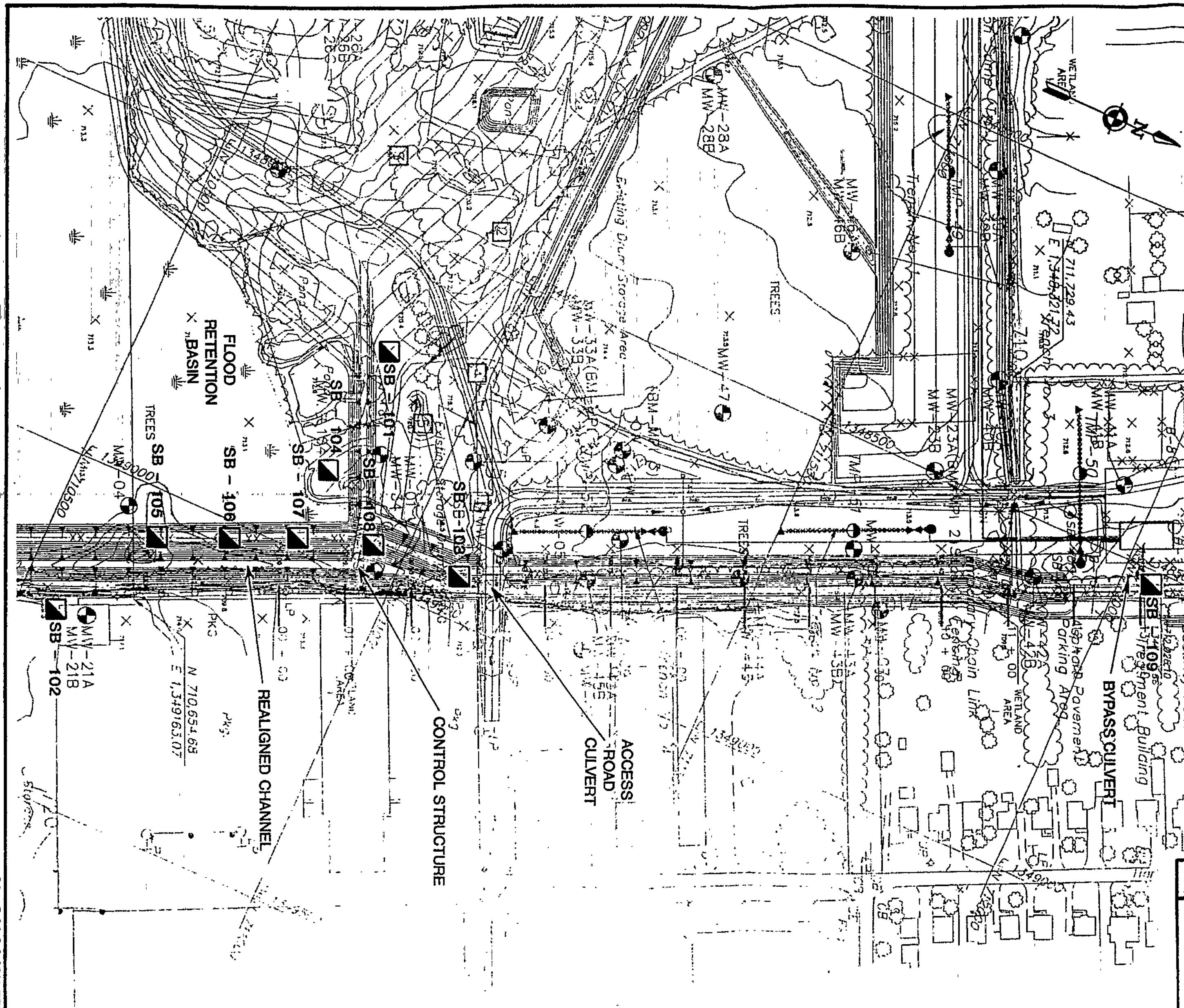
SCALE: 1 IN. = 2000 FT. FEBRUARY 1991

FILE NO. 70179-40

CHARRETTE

AR004556

FIGURE 1



NOTES:

1. TEST BORINGS SB-101 THROUGH SB-104 WERE PERFORMED BY PITTSBURGH TESTING LABORATORIES, BETWEEN 18 AND 21 FEBRUARY 1991, UNDER THE OBSERVATION OF H&A OF NEW YORK FIELD PERSONNEL.
2. TEST BORINGS SB-105 THROUGH SB-109 WERE PERFORMED BY EMPIRE SOILS INVESTIGATIONS, BETWEEN 17 AND 19 JUNE 1991, UNDER THE OBSERVATION OF H&A OF NEW YORK FIELD PERSONNEL.
3. PREVIOUS EXPLORATIONS WERE PERFORMED AND OBSERVED BY OTHERS.
4. TEST BORING LOCATIONS WERE SURVEYED BY MALCOLM PIRNIE.
5. THIS PLAN WAS ADAPTED FROM A DRAWING PROVIDED BY MALCOLM PIRNIE.
6. SEE THE ACCOMPANYING REPORT FOR ADDITIONAL INFORMATION.

LEGEND:

SB - 102 APPROXIMATE LOCATION AND NUMBER OF TEST BORING OBSERVED BY H&A

H & A of New York
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

MILLCREEK SUPERFUND SITE
ERIE, PENNSYLVANIA

SUBSURFACE EXPLORATION PLAN

SCALE: 1 IN. = 150 FT. SEPTEMBER 1991

FIGURE 2

FILE NO. 70179-40

CHARRETTE

AR004557

APPENDIX A

Test Boring Reports

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-101

PROJECT: MILLCREEK SUPERFUND SITE
CLIENT: MALCOLM PIRNIE
CONTRACTOR: PITTSBURGH TESTING LABORATORIES

FILE NO. 70179-40
SHEET NO. 1 OF 2
LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL
TYPE	Augers	S	---
INSIDE DIAMETER (IN)	3-1/4	1-3/8	---
HAMMER WEIGHT (LB)	---	140	---
HAMMER FALL (IN)	---	30	---

DRILLING EQUIPMENT & PROCEDURES

RIG TYPE: CME 55, Truck Mounted
BIT TYPE: 2-7/8 tri-cone roller bit
DRILL MUD: potable water
OTHER: None

ELEVATION: 715.6
DATUM: NGVD
START: 18 February 1991
FINISH: 19 February 1991
DRILLER: J. Jenkins
H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		5 6 5 3	S1 15"/24"	0.0 - 2.0		Loose black to brown silty fine SAND, little fine gravel, trace clay with brick and root fibers, damp. (SM) -FILL-
		2 2 2 4	S2 12"/24"	2.0 - 4.0	4.0	Same, except very loose, brown, wet. -FILL-
5		14 2 2 3	S3 10"/24"	4.0 - 6.0	6.0	Very loose gray fine SAND, little silt, trace medium sand with peat layer from 4.3 ft. to 4.5 ft., wet. (SM) -FILL AND FORMER TOPSOIL-
		4 3 4 4	S4 17"/24"	6.0 - 8.0		Loose gray silty fine SAND, trace medium sand, trace fine gravel with root fibers, wet. (SM)
		10 12 14 14	S5 18"/24"	8.0 - 10.0		Medium dense gray coarse to fine sandy GRAVEL, some silt, wet. (GM)
10		9 10 9 9	S6 8"/24"	10.0 - 12.0		Same. -GLACIOLACUSTRINE-
		9 9 7 7	S7 15"/24"	12.0 - 14.0		Medium dense gray to red coarse to fine sandy GRAVEL, trace silt, wet. (GP)
15		8 15 12 13	S8 15"/24"	14.0 - 16.0		Medium dense gray silty medium to fine SAND, trace fine gravel, trace coarse sand, trace clay, wet. (SM)
		14 11 9 9	S9 24"/24"	16.0 - 18.0		Medium dense gray medium to fine SAND, trace silt. (SP) -GLACIOLACUSTRINE-
		5 3 4 4	S10 15"/24"	18.0 - 20.0		Loose gray silty fine SAND, trace coarse sand, trace clay, wet. (SM)
20		6 9 9 12	S11 16"/24"	20.0 - 22.0		Same, except medium dense with layer of gray coarse sand from 20.7 ft. to 21.5 ft., wet.
		7 13 13 26	S12 15"/24"	22.0 - 24.0		Same, except medium dense, with gray fine gravel layer from 22.0 ft. to 22.7 ft. wet. -GLACIOLACUSTRINE-
25		5 15	S13	24.0		Dense gray, gravelly coarse to fine SAND, wet. (SP)

WATER LEVEL DATA

DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER
2/18	---	---	0.0	4.0	2.0
2/19	---	---	48.0	49.5	2.0

SAMPLE IDENTIFICATION

- O Open End Rod
- T Thin Wall Tube
- U Undisturbed Sample
- S Split Spoon

SUMMARY

OVERBURDEN (LIN FT): 48.2 ft.
ROCK CORED (LIN FT): ---
SAMPLES: 22S
BORING NO. SB-101

AR004559

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-101 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		16 30	13"/24"	26.0		
		25 15 17 30	S14 17"/24"	26.0 28.0	27.6	Same, with fine sand layer from 27.6 ft. to 28.0 ft. -GLACIOLACUSTRINE Dense gray SILT, little fine sand, moist. (ML)
30		21 30 30 36	S15 17"/24"	28.0 30.0		-GLACIAL TILL-
		30 24 24 30	S16 17"/24"	30.0 32.0		Very dense gray coarse to fine sandy SILT, moist. (ML)
35		30 27 67 67	S17 16"/24"	33.0 35.0		Advanced augers to 33.0 ft. Same, except with rock fragments, damp.
		50 57 67 50	S18 17"/24"	36.0 38.0		Advanced augers to 36.0 ft. Same. -GLACIAL TILL-
40		36 46 41 100	S19 17"/24"	39.0 41.0		Advanced augers to 39.0 ft. Same.
		52 62 70 90	S20 12"/24"	42.0 44.0		Advanced augers to 42.0 ft. Very dense gray clayey SILT, trace fine sand with rock fragments, wet. (ML)
45		20 30 30 75	S21 15"/24"	45.0 47.0		Advanced augers to 45.0 ft. Very dense gray SILT, little fine sand, trace clay, wet. (ML
		100/.2	S22	48.0-48.2	48.0	Advanced augers to 48.0 ft. -GLACIAL TILL-
50						Very dense gray severely weathered SHALE, dry. Advanced 2-7/8 inch roller bit into rock at 49.5 ft. -WEATHERED SHALE-
						Bottom of Exploration at 49.5 ft. Notes: 1. Borehole grouted to ground surface.
55						
60						

AR004560

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-102

PROJECT: MILLCREEK SUPERFUND SITE
CLIENT: MALCOLM PIRNIE
CONTRACTOR: PITTSBURGH TESTING LABORATORIES

FILE NO. 70179-40
SHEET NO. 1 OF 2
LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL
TYPE	Augers	S	---
INSIDE DIAMETER (IN)	3-1/4	1-3/8	---
HAMMER WEIGHT (LB)	---	140	---
HAMMER FALL (IN)	---	30	---

DRILLING EQUIPMENT & PROCEDURES
RIG TYPE: CME 55, Truck Mounted
BIT TYPE: ---
DRILL MUD: ---
OTHER: ---

ELEVATION: 717.7
DATUM: NGVD
START: 19 February 1991
FINISH: 20 February 1991
DRILLER: J. Jenkins
H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		12 8 9 8	S1 4"/24"	0.0 2.0		Medium dense brown coarse to fine sandy GRAVEL, with brick fragments, damp. (GP) -FILL-
		5 5 6 4	S2 9"/24"	2.0 4.0		Medium dense gray silty fine SAND, little fine gravel, little coarse sand, trace medium sand, damp. (SM) -FILL-
5		4 2 1 1	S3 5"/24"	4.0 6.0	6.0	Same, except very loose with wood fragments. -FILL-
		2 2 2 2	S4 8"/24"	6.0 8.0	8.0	Loose brown to gray medium to fine SAND, little coarse sand, little clay, trace fine gravel with organic material, wet. (SM) -FORMER TOPSOIL-
		5 8 13 17	S5 13"/24"	8.0 10.0		Medium dense brown to gray coarse SAND, little fine gravel, little medium to fine sand, trace silt, wet. (SP)
10		18 8 11 23	S6 0"/24"	10.0 12.0		No recovery. (Advanced augers to 12.0 ft.)
		18 13 10 8	S7* 0"/24"	12.0 14.0		Medium dense brown medium to fine sandy GRAVEL, little silt, wet. (GM) -GLACIOLACUSTRINE-
15		14 10 7 11	S8 8"/24"	14.0 16.0		(* Sample recovered using 3 inch spoon. Blow counts from 140 lb. hammer with 2 inch spoon.)
		6 5 6 12	S9 13"/24"	16.0 18.0		Medium dense gray fine sandy SILT, trace clay, wet. (ML) -GLACIOLACUSTRINE-
		7 6 6 9	S10 15"/24"	18.0 20.0		Same.
20		3 5 9 15	S11 14"/24"	20.0 22.0	22.0	Same.
		25 46 60 80	S12 14"/24"	22.0 24.0		Medium gray coarse to medium SAND, little silt, trace fine gravel, wet. (SM) Same. -GLACIOLACUSTRINE-
25		50 83	S13	24.0		Very dense gray SILT, little fine gravel, little fine sand, dry. (ML) -GLACIAL TILL-

WATER LEVEL DATA

DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER
2/19	---	---	6.0	8.0	6.0

SAMPLE IDENTIFICATION
O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon

SUMMARY
OVERBURDEN (LIN FT): 40.5 ft.
ROCK CORED (LIN FT): ---
SAMPLES: 18S
BORING NO. SB-102

AR004561

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-102 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		60 90	17"/24"	26.0		Very dense gray SILT, trace medium sand, dry. (ML) -GLACIAL TILL-
		32 40 35 60	S14 18"/24"	26.0 28.0		Same, except trace clay, dry.
30		35 45 60 119	S15 17"/24"	28.0 30.0		Same, dry.
		45 33 47 65	S16 20"/24"	30.0 32.0		Same, dry. -GLACIAL TILL-
35		22 46 47 27	S17 22"/24"	33.0 35.0		Advanced augers to 33.0 ft. Same, with rock fragments.
		45 45 47 25	S18 22"/24"	36.0 38.0		Advanced augers to 36.0 ft. Same, with rock fragments.
40		30 50 67	S19 12"/18"	39.0 40.5		Advanced augers to 39.0 ft. Same. -GLACIAL TILL-
45						Bottom of Exploration at 40.5 ft. Notes: 1. Borehole grouted to ground surface.
50						
55						
60						

AR004562

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-103

PROJECT: MILLCREEK SUPERFUND SITE
CLIENT: MALCOLM PIRNIE
CONTRACTOR: PITTSBURGH TESTING LABORATORIES

FILE NO. 70179-40
SHEET NO. 1 OF 2
LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL
TYPE	Augers	S	---
INSIDE DIAMETER (IN)	3-1/4	1-3/8	---
HAMMER WEIGHT (LB)	---	140	---
HAMMER FALL (IN)	---	30	---

DRILLING EQUIPMENT & PROCEDURES

RIG TYPE: CME 55, Truck Mounted
BIT TYPE: ---
DRILL MUD: ---
OTHER: ---

ELEVATION: 715.1
DATUM: NGVD
START: 20 February 1991
FINISH: 21 February 1991
DRILLER: J. Jenkins
H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		7 12 14 9	S1 10"/24"	0.0 2.0		Medium dense brown to black coarse to fine SAND, with slag, dry. (SP) -FILL-
		5 12 23 14	S2 10"/24"	2.0 4.0	4.0	Dense brown to black coarse to fine SAND, trace gravel with root fibers, wood fragments, slag, concrete and topsoil. (SP)
5		2 2 1 2	S3 2"/24"	4.0 6.0		Very loose black SILT with root fibers, wood fragments, slag, wet. (ML)
		4 3 5 12	S4 9"/24"	6.0 8.0	8.0	Same. -FILL AND FORMER TOPSOIL-
10		9 10 12 11	S5 12"/24"	8.0 10.0		Medium dense dark gray gravelly coarse to fine SAND, trace silt, wet. (SP) -GLACIOLACUSTRINE-
		3 4 6 7	S6 12"/24"	10.0 12.0		Same.
		7 7 7 7	S7 13"/24"	12.0 14.0		Same. Medium dense gray fine SAND, little silt, trace medium sand, wet. (SM)
15		8 9 11 9	S8 15"/24"	14.0 16.0		Same. -GLACIOLACUSTRINE-
		10 10 10 16	S9 14"/24"	16.0 18.0		Medium dense gray SILT, trace medium sand, wet. (ML) GLACIOLACUSTRINE-
20		12 13 13 14	S10 15"/24"	18.0 20.0		Medium dense gray SILT, trace clay, wet. (ML)
		7 5 7 40	S11 17"/24"	20.0 22.0		Same.
		15 15 15 18	S12 18"/24"	22.0 24.0	24.0	Dense gray silty fine SAND, trace clay, moist. (SM) -GLACIOLACUSTRINE-
25		21 18	S13	24.0		Dense gray silty coarse to fine SAND, little fine gravel, moist. (SM) -GLACIAL TILL-

WATER LEVEL DATA

DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER
2/20	---	---	4.0	6.0	4.0

SAMPLE IDENTIFICATION

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon

SUMMARY

OVERBURDEN (LIN FT): 30.0 ft.
ROCK CORED (LIN FT): ---
SAMPLES: 15S
BORING NO. SB-103

AR004563

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-103 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		21 20	12"/24"	26.0		Dense gray silty coarse to fine SAND, little fine gravel, moist. (SM)
		16 24 28 36	S14 16"/24"	26.0 28.0		Same, except dense.
30		15 20 24 35	S15 18"/24"	28.0 30.0		Same. -GLACIAL TILL-
35						Bottom of Exploration at 30.0 ft. Notes: 1. Borehole grouted to ground surface.
40						
45						
50						
55						
60						

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-104

PROJECT: MILLCREEK SUPERFUND SITE
CLIENT: MALCOLM PIRNIE
CONTRACTOR: PITTSBURGH TESTING LABORATORIES

FILE NO. 70179-40
SHEET NO. 1 OF 2
LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL
TYPE	Augers	S	---
INSIDE DIAMETER (IN)	3-1/4	1-3/8	---
HAMMER WEIGHT (LB)	---	140	---
HAMMER FALL (IN)	---	30	---

DRILLING EQUIPMENT & PROCEDURES
RIG TYPE: CME 55, Truck Mounted
BIT TYPE: ---
DRILL MUD: ---
OTHER: ---

ELEVATION: 717.1
DATUM: NGVD
START: 20 February 1991
FINISH: 20 February 1991
DRILLER: J. Jenkins
H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		2 2 5 4	S1 19"/24"	0.0 2.0		Loose black fine SAND, little silt, trace coarse to medium sand, damp. (SM) -FOUNDRY SAND FILL-
		4 4 3 3	S2 18"/24"	2.0 4.0		Same.
5		2 1 1 1	S3 22"/24"	4.0 6.0		Same, except moist.
		1 2 4 4	S4 20"/24"	6.0 8.0	7.0	Same, except wet. -FOUNDRY SAND FILL-
						Loose black to gray fine sandy SILT, trace medium sand, wet. (ML)
		2 2 3 3	S5 15"/24"	8.0 10.0	9.0	Same -FILL-
10						Loose gray silty coarse to fine SAND, little fine gravel, wet. (SM)
		3 4 5 5	S6 10"/24"	10.0 12.0		Same, except trace fine gravel. -GLACIOLACUSTRINE-
		8 7 11 9	S7 13"/24"	12.0 14.0		Medium dense gray coarse to fine SAND, little silt, trace clay, wet. (SM)
15		8 8 9 13	S8 10"/24"	14.0 16.0		Medium dense gray coarse to fine SAND, little coarse gravel, wet. (SP) -GLACIOLACUSTRINE-
		7 5 9 9	S9 14"/24"	16.0 18.0		Medium dense gray silty fine SAND, trace medium sand, wet. (SM)
		9 5 5 6	S10 13"/24"	18.0 20.0		Loose gray fine silty SAND, wet. (SM)
20		3 3 3 10	S11 16"/24"	20.0 22.0	22.0	Loose gray fine sandy SILT, wet. (ML) -GLACIOLACUSTRINE-
		15 20 40 60	S12 14"/24"	22.0 24.0		Very dense gray coarse to fine SAND, trace gravel, trace silt, wet. (SP)
25		34 30	S13	24.0		-GLACIAL TILL-

WATER LEVEL DATA

DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER
2/20	---	---	6.0	8.0	6.0

SAMPLE IDENTIFICATION
O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon

SUMMARY
OVERBURDEN (LIN FT): 28.0 ft.
ROCK CORED (LIN FT): ---
SAMPLES: 14S
BORING NO. SB-104

AR004565

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-104 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		50 60	15"/24"	26.0		Very dense gray medium to coarse SAND, little fire sand, trac fine gravel, wet. (SP)
		17 30 50 90	S14 15"/24"	26.0 28.0		Very dense gray fine sandy SILT, trace coarse sand, moist. (M -GLACIAL TILL-
30						Bottom of Exploration at 28.0 ft.
35						
40						
45						
50						
55						
60						

Notes:

1. Borehole grouted to ground surface.
2. Offset well installed. See Overburden Groundwater Monitoring Well Report for MW-104.

AR004566

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-105

PROJECT: MILLCREEK SUPERFUND SITE
CLIENT: MALCOLM PIRNIE
CONTRACTOR: EMPIRE SOILS INVESTIGATIONS

FILE NO. 70179-40
SHEET NO. 1 OF 2
LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL
TYPE	Auger	S	---
INSIDE DIAMETER (IN)	4-1/4	1-3/8	---
HAMMER WEIGHT (LB)	---	140	---
HAMMER FALL (IN)	---	30	---

DRILLING EQUIPMENT & PROCEDURES
RIG TYPE: CME 55 Track-Mount
BIT TYPE: ---
DRILL MUD: ---
OTHER: ---

ELEVATION: 715.7
DATUM: NGVD
START: 17 June 1991
FINISH: 18 June 1991
DRILLER: A. Koske
H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		2 3 4 5	S1 12"/24"	0.0 2.0	2.0	Loose black fine SAND, little silt, trace coarse to medium sand, damp. (SM) -FOUNDRY SAND FILL-
		4 3 3 4	S2 3"/24"	2.0 4.0		Loose gray to gray brown fine SAND, little silt, little clay, damp. (SM) -GLACIOLACUSTRINE-
5		3 4 6 8	S3 14"/24"	4.0 6.0		Same, damp.
		12 12 18 36	S4 6"/24"	6.0 8.0		Dense gray coarse to fine SAND, little silt, trace clay, wet. (SM)
		6 12 17 17	S5 8"/24"	8.0 10.0		Same, wet.
10		3 4 6 9	S6 16"/24"	10.0 12.0		Loose gray coarse to fine SAND, trace silt, wet. (SP)
		4 4 6 8	S7 15"/24"	12.0 14.0		Same, with 0.2 ft. layer of fine sand at 13.0 ft., wet. -GLACIOLACUSTRINE-
15		7 10 12 21	S8 18"/24"	14.0 16.0		Medium dense gray silty fine SAND, trace clay, moist. (SM) Dense gray SILT, little clay, trace fine sand, moist. (ML)
		4 7 16 18	S9 18"/24"	16.0 18.0		Same, except medium dense, damp.
20		3 14 10 10	S10 14"/24"	18.0 20.0		Same, except medium dense, damp. Medium dense coarse to fine SAND, little silt, trace gravel, moist. (SM)
		19 34 68 100/.2	S11 18"/20"	20.0 21.7	21.0	Same, moist. -GLACIOLACUSTRINE- Very dense gray SILT, trace sand and clay, dry. (ML) -GLACIAL TILL- Advanced augers to 25.0 ft. Very dense conditions.
25						

WATER LEVEL DATA					
DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER
6-17-91	---	---	6.0	8.0	6.0

SAMPLE IDENTIFICATION
O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon

SUMMARY
OVERBURDEN (LIN FT): 32.0
ROCK CORED (LIN FT): --
SAMPLES: 13S
BORING NO. SB-105

AR004567

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-105 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		27 100/.2	S12 8"/11"	25.0 25.9		Same, with horizontal fragments of shale at 25.8 ft., dry. Advanced augers to 30.0 ft.
30		20 36 44 75	S13 22"/24"	30.0 32.0		Same, except trace coarse sand, dry. -GLACIAL TILL-
						Bottom of Exploration at 32.0 ft. Note: 1. Borehole grouted to ground surface.
35						
40						
45						
50						
55						
60						

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-106

PROJECT: MILLCREEK SUPERFUND SITE
CLIENT: MALCOLM PIRNIE
CONTRACTOR: EMPIRE SOILS INVESTIGATIONS

FILE NO. 70179-40

LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL
TYPE	Auger	S	---
INSIDE DIAMETER (IN)	4-1/4	1-3/8	---
HAMMER WEIGHT (LB)	---	140	---
HAMMER FALL (IN)	---	30	---

DRILLING EQUIPMENT & PROCEDURES
RIG TYPE: CME 55 Track-Mount
BIT TYPE: ---
DRILL MUD: ---
OTHER: ---

ELEVATION: 712.0
DATUM: NGVD
START: 18 June 1991
FINISH: 18 June 1991
DRILLER: A. Koske
H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		2 1 3 4	S1 18"/24"	0.0 2.0		Very loose brown to gray fine sandy SILT, some clay with roots, grass and decomposed organic debris, moist. (ML)
		6 8 9 14	S2 16"/24"	2.0 4.0	3.0	Same, moist. -TOPSOIL-
						Medium dense gray silty coarse to fine SAND, little fine gravel, trace clay, wet. (SM)
5		5 9 10 11	S3 8"/24"	4.0 6.0		Same, except little fine gravel, wet. -GLACIOLACUSTRINE-
		16 10 16 22	S4 22"/24"	6.0 8.0		Same, except little fine gravel, wet. Dense gray silty fine SAND, little gravel, moist. (SM)
		8 6 7 6	S5 15"/24"	8.0 10.0		Medium dense gray coarse to fine SAND, little gravel, little silt, wet. (SM)
10		6 7 6 9	S6 15"/24"	10.0 12.0		Same, wet. Medium dense gray silty fine SAND, wet. (SM)
		6 8 11 14	S7 23"/24"	12.0 14.0		Same, moist. -GLACIOLACUSTRINE-
15		6 6 5 10	S8 20"/24"	14.0 16.0		Same, except trace fine sand, moist.
		4 12 13 21	S9 22"/24"	16.0 18.0		Medium dense gray fine SAND, little silt, trace coarse to medium sand, trace fine gravel, moist. (SM)
		7 10 14 28	S10 24"/24"	18.0 20.0	19.5	Same, moist. -GLACIOLACUSTRINE-
20						Very dense gray SILT, trace medium sand, trace clay, damp. (ML)
		10 28 35 43	S11 18"/24"	20.0 22.0		Same, with fragments of shale, damp. -GLACIAL TILL-
						Advanced augers to 25.0 ft.
25						

WATER LEVEL DATA

DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER
6/18/91	---	---	2.0	4.0	3.0

SAMPLE IDENTIFICATION
O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon

SUMMARY
OVERBURDEN (LIN FT): 27.0
ROCK CORED (LIN FT): --
SAMPLES: 12S
BORING NO. SB-106

AR004569

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-106 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		25 35 50 81	S12 24"/24"	25.0 27.0		Same, with fragments of shale, damp. -GLACIAL TILL-
						Bottom of Exploration at 27.0 ft.
						Note:
30						1. Borehole grouted to ground surface.
35						
40						
45						
50						
55						
60						

AR004570

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-107

PROJECT: MILLCREEK SUPERFUND SITE
CLIENT: MALCOLM PIRNIE
CONTRACTOR: EMPIRE SOILS INVESTIGATIONS

FILE NO. 70179-40
SHEET NO. 1 OF 2
LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL
TYPE	Auger	S	---
INSIDE DIAMETER (IN)	4-1/4	1-3/8	---
HAMMER WEIGHT (LB)	---	140	---
HAMMER FALL (IN)	---	30	---

DRILLING EQUIPMENT & PROCEDURES
RIG TYPE: CME 55 Track-Mount
BIT TYPE: ---
DRILL MUD: ---
OTHER: ---

ELEVATION: 711.8
DATUM: NGVD
START: 18 June 1991
FINISH: 18 June 1991
DRILLER: A. Koske
H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		2 3 4 4	S1 12"/24"	0.0 – 2.0	2.0	Loose gray to black clayey SILT, little coarse to fine sand, trace fine gravel, moist. (ML) -FOUNDRY SAND FILL AND TOPSOIL-
		3 4 4 5	S2 15"/24"	2.0 – 4.0		Loose gray silty coarse to fine SAND, trace fine gravel, moist. (ML) -GLACIOLACUSTRINE-
5		2 5 6 7	S3 18"/24"	4.0 – 6.0		Medium dense gray coarse to fine SAND, trace silt, wet. (SP)
		8 8 10 11	S4 20"/24"	6.0 – 8.0		Same, except trace fine gravel, wet.
		5 15 18 16	S5 20"/24"	8.0 – 10.0		Same, except dense, trace fine gravel, wet.
10		6 7 8 18	S6 16"/24"	10.0 – 12.0		Same, except trace fine gravel, wet. -GLACIOLACUSTRINE- Medium dense gray fine sandy SILT, trace coarse to medium sand, trace clay, moist. (ML)
		6 8 10 13	S7 20"/24"	12.0 – 14.0		Medium dense gray SILT, trace fine sand, moist. -GLACIOLACUSTRINE-
15		3 2 3 4	S8 16"/24"	14.0 – 16.0	16.0	Same, with thin 1-3 mm layers of black silt, wet. -GLACIOLACUSTRINE-
		10 28 25 30	S9 18"/24"	16.0 – 18.0		Very dense gray coarse to fine SAND, trace gravel, trace silt, moist. (SP) -GLACIAL TILL-
		12 32 38 44	S10 24"/24"	18.0 – 20.0		Very dense gray coarse to fine sandy SILT, trace gravel with fragments of shale, damp. (ML)
20		21 64 67 100	S11 24"/24"	20.0 – 22.0		Very dense gray SILT, little coarse to fine sand with fragments of shale, damp. (ML) Advanced augers to 25.0 ft.
25						

WATER LEVEL DATA

DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER
6/18/91	---	---	4.0	6.0	4.0

SAMPLE IDENTIFICATION
O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon

SUMMARY
OVERBURDEN (LIN FT): 27.0
ROCK CORED (LIN FT): ---
SAMPLES: 12S
BORING NO. SB-107

AR004571

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-107 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		21 52 67 97	S12 24"/24"	25.0 27.0		Very dense gray coarse to fine sandy SILT, trace fine gravel, damp. (ML) -GLACIAL TILL-
30						Bottom of Exploration at 27.0 ft. Note: 1. Borehole grouted to ground surface.
35						
40						
45						
50						
55						
60						

AR004572

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-108

PROJECT: MILLCREEK SUPERFUND SITE CLIENT: MALCOLM PIRNIE CONTRACTOR: EMPIRE SOILS INVESTIGATIONS	FILE NO. 70179-40 SHEET NO. 1 OF 2 LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL	DRILLING EQUIPMENT & PROCEDURES	
TYPE	Auger	S	---	RIG TYPE: CME 55 Track-Mount	ELEVATION: 712.1
INSIDE DIAMETER (IN)	4-1/4	1-3/8	---	BIT TYPE: ---	DATUM: NGVD
HAMMER WEIGHT (LB)	---	140	---	DRILL MUD: ---	START: 19 June 1991
HAMMER FALL (IN)	---	30	---	OTHER: ---	FINISH: 19 June 1991
					DRILLER: A. Koske
					H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		1 2 2 3	S1 24"/24"	0.0 - 2.0	1.0	Very loose black fine SAND, little silt, trace coarse to medium sand, dry. (SM) -FOUNDRY SAND FILL-
		3 4 3 5	S2 16"/24"	2.0 - 4.0		Loose brown to gray clayey SILT, trace fine sand, with roots, and decomposed organic matter, damp. (ML) Loose brown to gray SILT, little fine sand, trace clay with roots and decomposed organic matter, damp. (ML)
5		3 3 8 11	S3 15"/24"	4.0 - 6.0	5.0	Same, moist. -FILL AND FORMER TOPSOIL- Medium dense coarse to fine SAND, little silt, trace gravel, wet. (SM) -GLACIOLACUSTRINE-
		12 12 13 12	S4 24"/24"	6.0 - 8.0		Same, except little gravel, wet.
10		8 9 7 21	S5 24"/24"	8.0 - 10.0		Same, with layer of dense gray SILT from 9.4 ft. to 9.9 ft., wet.
		7 9 6 8	S6 20"/24"	10.0 - 12.0		Same, wet. Medium dense gray fine SAND, little silt, wet. (SM) -GLACIOLACUSTRINE-
		6 8 8 10	S7 20"/24"	12.0 - 14.0		Same, moist.
15		5 4 3 5	S8 16"/24"	14.0 - 16.0		Same, except loose with little clay from 15.0 ft. to 15.5 ft., wet.
		4 3 5 12	S9 20"/24"	16.0 - 18.0	17.5	Same, except loose, wet. -GLACIOLACUSTRINE- Medium dense gray coarse to fine SAND, little silt, trace fine gravel, wet. (SM)
20		12 22 22 23	S10 24"/24"	18.0 - 20.0		Dense gray fine SAND, little medium sand, trace coarse sand to fine gravel, moist. (SP) -GLACIAL TILL-
		12 20 17 18	S11 24"/24"	20.0 - 22.0		Dense gray silty fine SAND, trace coarse sand, wet. (SM) Advanced augers to 25.0 ft.
25						

WATER LEVEL DATA						SAMPLE IDENTIFICATION	SUMMARY
DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER	O Open End Rod T Thin Wall Tube U Undisturbed Sample S Split Spoon	OVERBURDEN (LIN FT): 32.0 ROCK CORED (LIN FT): --- SAMPLES: 13S
6/19/91	---	---	4.0	6.0	5.0		BORING NO. SB-108

AR004573

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-108 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		13 25 30 36	S12 20"/24"	25.0 27.0		Very dense gray fine sandy SILT, little medium to coarse sand, moist. (ML) -GLACIAL TILL-
30		15 31 42 47	S13 22"/24"	30.0 32.0		Very dense gray SILT, trace coarse to medium sand. (ML) -GLACIAL TILL-
						Bottom of Exploration at 32.0 ft. Note: 1. Borehole grouted to ground surface.
35						
40						
45						
50						
55						
60						

AR004574

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-109

PROJECT: MILLCREEK SUPERFUND SITE
CLIENT: MALCOLM PIRNIE
CONTRACTOR: EMPIRE SOILS INVESTIGATIONS

FILE NO. 70179-40
SHEET NO. 1 OF 2
LOCATION: See Plan

ITEM	CASING	DRIVE SAMPLER	CORE BARREL
TYPE	Auger	S	---
INSIDE DIAMETER (IN)	4-1/4	1-3/8	---
HAMMER WEIGHT (LB)	---	140	---
HAMMER FALL (IN)	---	30	---

DRILLING EQUIPMENT & PROCEDURES

RIG TYPE: CME 55 Track-Mount
BIT TYPE: ---
DRILL MUD: ---
OTHER: ---

ELEVATION: 713.1
DATUM: NGVD
START: 19 June 1991
FINISH: 19 June 1991
DRILLER: A. Koske
H&A REP: T. Cleary

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		2 4 6 9	S1 16"/24"	0.0 2.0	1.0	Loose brown to tan coarse sandy SILT, trace clay, dry. (ML) -FILL-
		6 4 6 4	S2 12"/24"	2.0 4.0		Medium dense black to gray SILT with brick, glass, and slag, dry. (ML) Same, dry. -FOUNDRY SAND FILL-
5		4 3 3 5	S3 20"/24"	4.0 6.0	4.0	Loose brown to gray SILT, little clay, trace sand with roots, damp. (ML) -FORMER TOPSOIL-
		6 5 6 4	S4 16"/24"	6.0 8.0	6.0	Same, except little coarse sand, no roots, damp. -GLACIOLACUSTRINE-
		WOH WOH WOH WOH	S5 0"/24"	8.0 10.0		No Recovery, wet.
10		WOR WOR WOR WOR	S6 2"/24"	10.0 12.0		Very loose gray silty coarse to fine SAND, trace fine gravel, wet. (SM)
		WOR WOR WOR WOR	S7 2"/24"	12.0 14.0		Same, wet.
15		WOR 1 5 4	S8 10"/24"	14.0 16.0		Same, wet. Loose fine sandy SILT, trace medium sand, trace clay, wet. (ML)
		5 9 9	S9 24"/24"	16.0 18.0		Medium dense silty coarse to fine SAND, trace fine gravel, trace clay, wet. (SM) Dense gray fine sandy SILT, trace medium sand, wet. (ML)
20		11 6 10 19	S10 13/24"	18.0 20.0		Same, wet. -GLACIOLACUSTRINE- Medium dense gray coarse to fine sandy GRAVEL, some silt, moist. (GM)
		7 12 16 13	S11 14"/24"	20.0 22.0		Same, with fragments of shale, moist. Advanced augers to 25.0 ft.
25						

WATER LEVEL DATA

DATE	TIME	ELAPSED TIME (HR)	DEPTH (FT) TO: BOTTOM OF CASING	BOTTOM OF HOLE	WATER
6/19/91	---	---	8.0	10.0	8.0

SAMPLE IDENTIFICATION

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon
WOH Weight of Hammer
WOR Weight of Rods

SUMMARY

OVERBURDEN (LIN FT): 42.0
ROCK CORED (LIN FT): ---
SAMPLES: 15S
BORING NO. SB-109

AR004575

H&A OF NEW YORK, ROCHESTER, NEW YORK Consulting Geotechnical Engineers, Geologists and Hydrogeologists	TEST BORING REPORT	BORING NO. SB-109 FILE NO. 70179-40 SHEET NO. 2 OF 2

DEPTH (FT)	CASING BLOWS PER FT	SAMPLER BLOWS PER 6 IN	SAMPLE NUMBER & RECOVERY	SAMPLE DEPTH (FT)	STRATA CHANGE (FT)	VISUAL CLASSIFICATION AND REMARKS
		2 3 5 15	S12 24"/24"	25.0 27.0		Loose fine SAND, little silt, moist to wet. (SM) -GLACIOLACUSTRINE- Advanced augers to 30.0 ft.
30		5 9 15 15	S13 24"/24"	30.0 32.0	31.0	Same, wet. -GLACIOLACUSTRINE- Dense gray SILT, trace coarse to medium sand with fragments c shale, moist. (ML) -GLACIAL TILL- Advanced augers to 34.0 ft.
35		8 6 10 12	S14 24"/24"	34.0 36.0		Same, except medium dense, moist to wet. Advanced augers to 40.0 ft.
40		18 26 20 31	S15 24"/24"	40.0 42.0		Same, moist. -GLACIAL TILL-
						Bottom of Exploration at 42.0 ft. Note: 1. Borehole grouted to ground surface.
45						
50						
55						
60						

AR004576

APPENDIX B

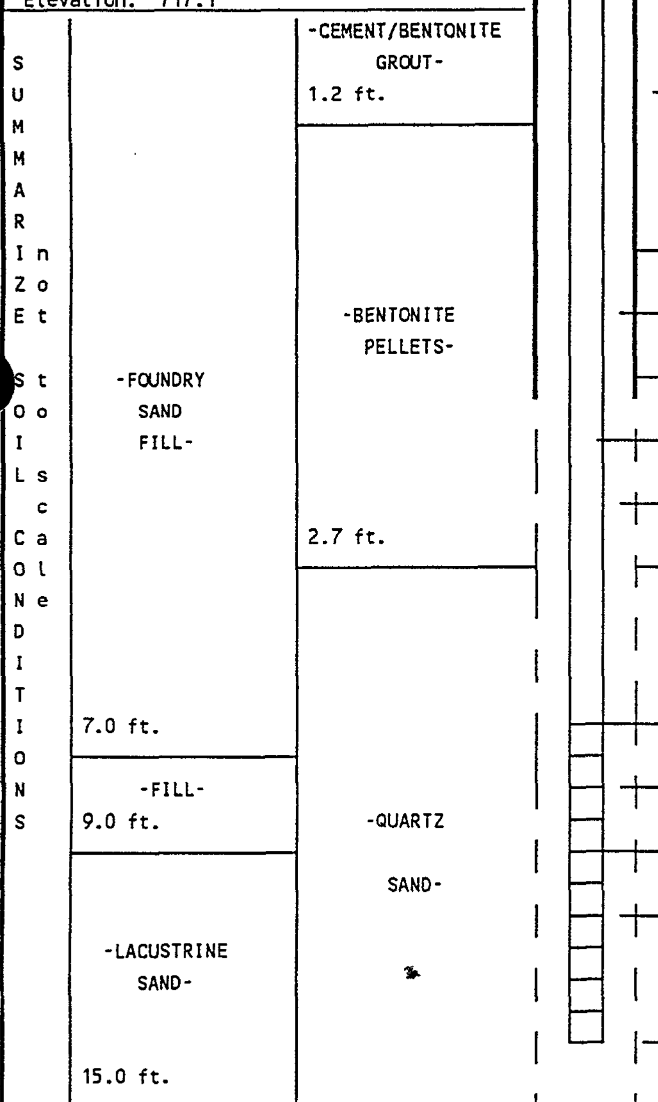
Observation Well Report

H&A OF NEW YORK CONSULTING GEOTECHNICAL ENGINEERS GEOLOGISTS AND HYDROGEOLOGISTS	OVERBURDEN GROUNDWATER MONITORING WELL REPORT

PROJECT:	MILLCREEK SUPERFUND SITE	FILE NO.:	70179-40
LOCATION:	ERIE, PENNSYLVANIA	WELL NO.:	MW-104
CLIENT:	MALCOLM PIRNIE	LOCATION:	See Plan
CONTRACTOR:	PITTSBURGH TESTING LABORATORIES		
DRILLER:	J. JENKINS RIG TYPE: CME-55, TRUCK MOUNTED	SHEET:	1 OF 1
INSTALLATION DATE:	21 FEBRUARY 1991	H&A REP:	T. CLEARY

Survey Datum NGVD

Ground Elevation: 717.1



Depth/Stickup above/below ground surface of protective casing.	None
Stickup above/ground surface of riser pipe.	2.5 ft.
Thickness of Surface Seal	1.5 ft.
Type of Surface Seal [indicated all seals showing depth, thickness and type]	Cement/Bentonite Grout
Type of Protective Casing	None
Inside Diameter of Protective Casing	None
Depth of Bottom of Protective Casing	None
Inside Diameter of Riser Pipe	1.5 in.
Type of Backfill Around Riser	Bentonite Pellets
Diameter of Borehole	5-1/2 in.
Type of coupling (threaded, welded, etc.)	Threaded
Depth of Bottom of Riser	4.8 ft.
Type of Wellscreen	Slotted PVC
Screen Slot Size	0.01 in.
Diameter of Wellscreen	2.0 in.
Type of Backfill Around Wellscreen	Quartz Sand
Depth of Bottom of Wellscreen	14.8 ft.
Depth of Bottom of Borehole	15.0 ft.

Remarks:

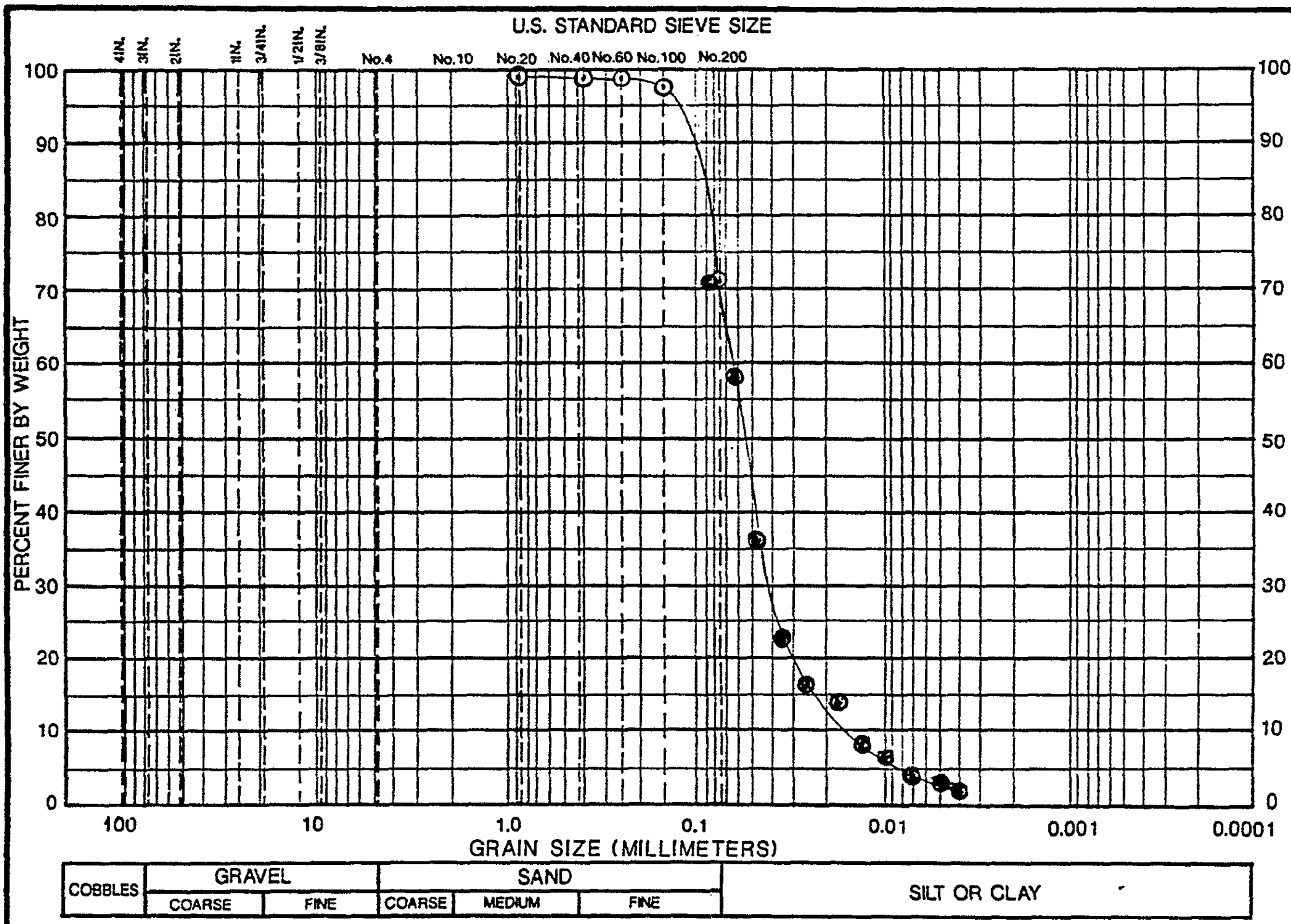
AR004578

Well No. MW-104

APPENDIX C

Laboratory Test Results

H&A FORM No. 505 JUNE 1988



UNIFIED SOIL CLASSIFICATION SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
○	SB101	S15	28.0-30.0			Gray SILT, little fine sand.

SYMBOL	EXPL. NO.	SAMPLE NO.	C_u	C_c	NATURAL WATER CONTENT(%)	ATTERBERG LIMITS (%) W_L W_p I_p	LOI (% by wgt.)	
○	SB101	S15			10.4	Non-Plastic		

Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

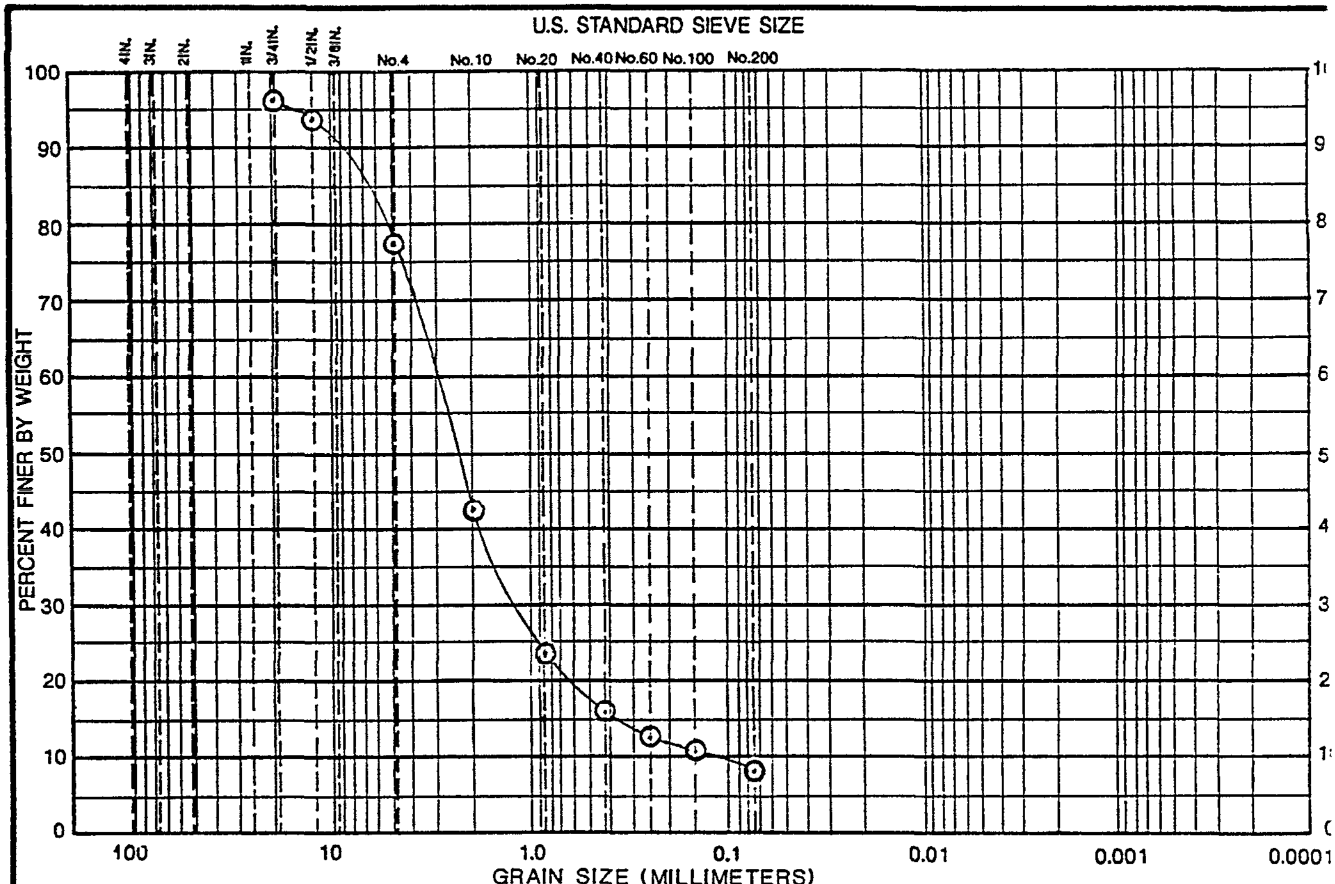
MILLCREEK SUPERFUND SITE
ERIE, PENNSYLVANIA

GRAIN SIZE DISTRIBUTION

FILE NO. 70179-40 DATE: Feb. 1991

AR004580

H&A FORM No. 505 JUNE 1988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

UNIFIED SOIL CLASSIFICATION SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
○	SB102	S5	8.0-10.0			Gray coarse SAND, little fi gravel, little medium to fi sand, trace silt.

SYMBOL	EXPL. NO.	SAMPLE NO.	C_u	C_c	NATURAL WATER CONTENT(%)	ATTERBERG LIMITS (%) W_L W_p I_p	LOI (% by wgt.)	
○	SB102	S5			13.1	Non-Plastic		

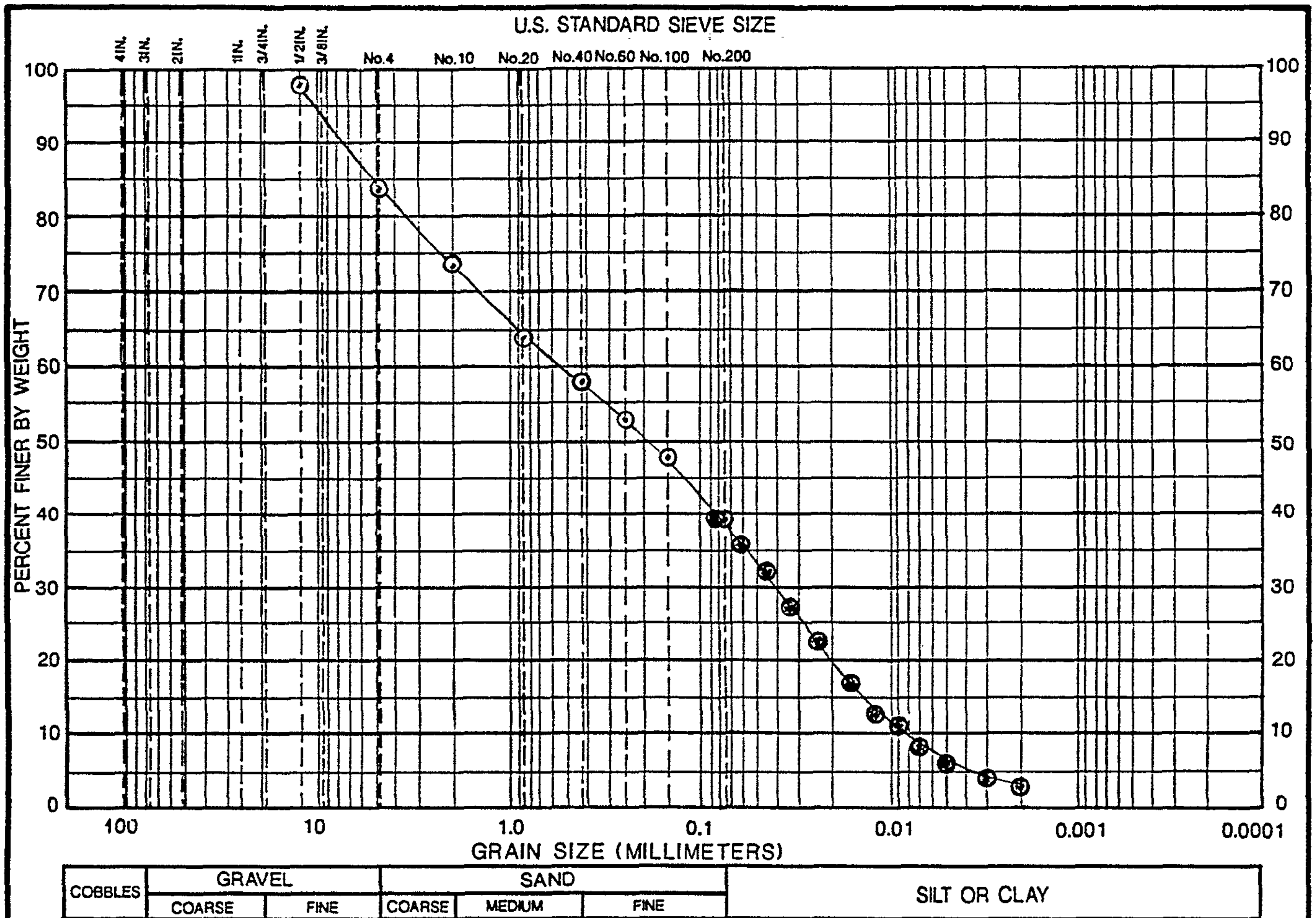
Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

MILLCREEK SUPERFUND SITE
ERIE, PENNSYLVANIA

GRAIN SIZE DISTRIBUTION

FILE NO. 70179-40 AR304581 DATE: Feb. 1991

H&A FORM No. 505 JUNE 1988



UNIFIED SOIL CLASSIFICATION SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
○	SB103	S14	12.0-14.0			Gray silty coarse to fine SAND, little fine gravel.

SYMBOL	EXPL. NO.	SAMPLE NO.	C_u	C_c	NATURAL WATER CONTENT(%)	ATTERBERG LIMITS (%) W_L W_p I_p	LOI (% by wgt.)	
○	SB103	S14			20.2	Non-Plastic		

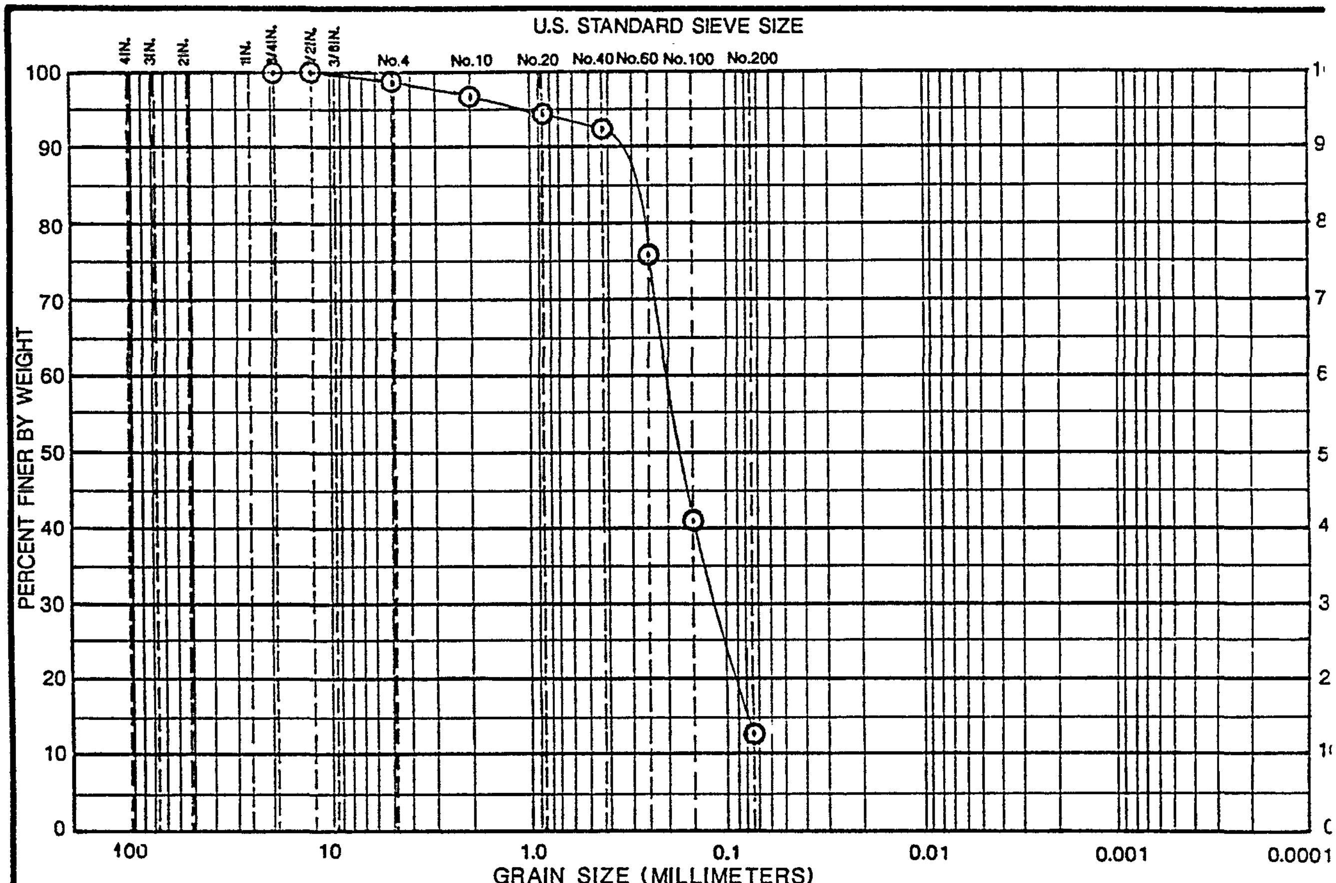
Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

MILLCREEK SUPERFUND SITE
ERIE, PENNSYLVANIA

GRAIN SIZE DISTRIBUTION

FILE NO. 70179-40 AR004582 DATE: Feb. 1991

H&A FORM No. 505 JUNE 1988



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

UNIFIED SOIL CLASSIFICATION SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
○	SB104	S2	2.0-4.0			Black fine SAND, little silt, trace coarse to medium sand.

SYMBOL	EXPL. NO.	SAMPLE NO.	C_u	C_c	NATURAL WATER CONTENT(%)	ATTERBERG LIMITS (%) W_L W_p I_p	L O I (% by wgt.)	
○	SB104	S2			19.6	Non-Plastic		

Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

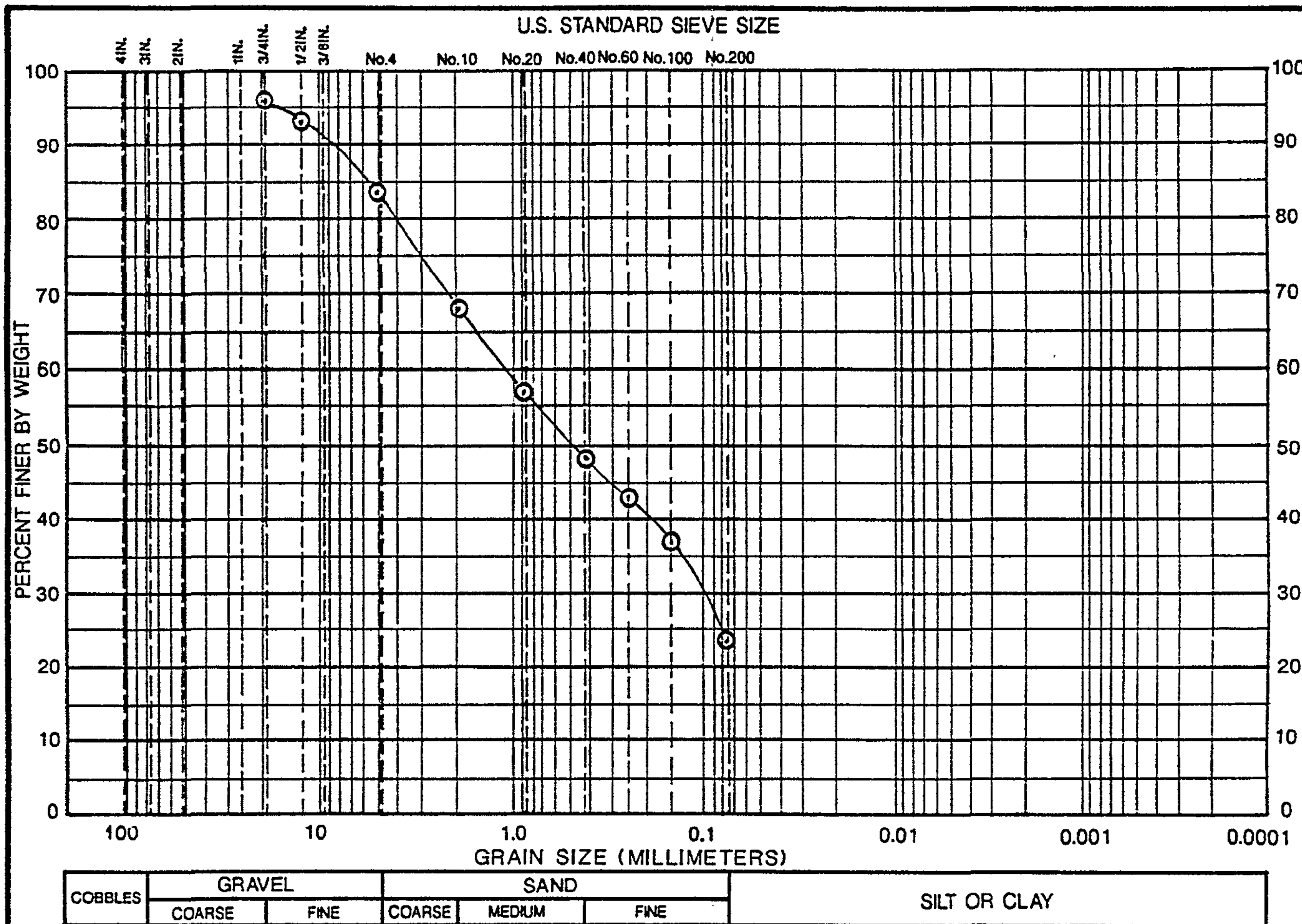
MILLCREEK SUPERFUND SITE
ERIE, PENNSYLVANIA

GRAIN SIZE DISTRIBUTION

FILE NO. 70179-40 DATE: Feb. 1991

AR004583

H&A FORM No. 505 JUNE 1988



UNIFIED SOIL CLASSIFICATION SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
○	SB104	S6	10.0-12.0			Gray silty coarse to fine SAND, little fine gravel.

SYMBOL	EXPL. NO.	SAMPLE NO.	C_u	C_c	NATURAL WATER CONTENT(%)	ATTERBERG LIMITS (%) W_L W_p I_p	L O I (% by wgt.)	
○	SB104	S6			15.5	Non-Plastic		

Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

MILLCREEK SUPERFUND SITE
ERIE, PENNSYLVANIA
GRAIN SIZE DISTRIBUTION

FILE NO. 70179-40 DATE: Feb. 1991

AR004584

APPENDIX F

HYDROLOGIC CALCULATIONS (HEC-1 COMPUTER SIMULATIONS)

(on computer disk unless otherwise noted)

File Name	Type	Description
10FINAL.HC1 10FINAL.Out 50FINAL.HC1 50FINAL.Out	HEC-1 Data HEC-1 Output HEC-1 Data HEC-1 Output	Data and output files for the 10 and 50-year events. These HEC-1 files include all contributing areas upstream of the FRB, contributing areas from capped landfill, routed flows through the FRB, Water Treatment Plant and North Ditch contributing flows. Within the output file, two subareas are especially important: (1) Subarea Rout - This is the routed outflow from the FRB. (2) Subarea NDTOT - This is the combined hydrograph of the FRB routed flows and the total North Ditch flows. It is here at which Marshall's Run peak flows are governed.
2ND42.PC 2ND42.OUT	HY8 Input HY8 Output(1)	Input and output files for the North Ditch Culvert files.
FRB.PC FRB.OUT	HY8 Input HY8 Output(1)	Input and output files for the FRB Control Structure. In the output file, a performance curve table indicates the tailwater elevation, inlet control head, and outlet control head vs. flow.

(1) *HY8 output files are not stored in memory. Therefore, a hard copy of the file is included separate from disks.*

FRB.OUT

ULVERTNALYSISERSION

JRRENT DATE	EURRENT TIME	EILE NAME	EILE DATE
09-30-19	08:36:54	FRB	9/30/91

ERFORMANCEURVEISCHARGEANGE
FLOWSNALYZED

MINUMUM	DISCHARGE (CFS)	0
DESIGN	DISCHARGE (CFS)	150
MAXIMUM	DISCHARGE (CFS)	200

A - SITE DATA			B - CULVERT SHAPE, MATERIAL, INLET				
INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANN. N	INLET TYPE
709.00	708.99	11.00	1 - RCB	4.50	2.50	.012	CONVENTIONAL

AR004586

URRENT DATE	URRENT TIME	ILE NAME	ILE DATE
09-30-19	08:36:54	FRB	9/30/91

CULVERT NUMBER: 1

ULVERTNVERTATA

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	709.00
OUTLET STATION (FT)	11.00
OUTLET ELEVATION (FT)	708.99
NUMBER OF BARRELS	1.00
SLOPE (V-FT/H-FT)	0.0009
CULVERT LENGTH ALONG SLOPE (FT)	11.00

BARREL SHAPE: 4.50 FT X 2.50 FT BOX
BARREL MATERIAL: CONCRETE
WITH A MANNING'S N OF 0.012
INLET TYPE: CONVENTIONAL
INLET EDGE AND WALL: SQUARE EDGE (30-75 DEG. FLARE)
INLET DEPRESSION: NONE

TAILWATER RATING CURVE

FLOW(CFS)	W.S.E.(FT)
0	708.99
20	709.50
40	709.95
60	710.40
80	710.90
100	711.40
120	711.85
140	712.35
150	712.60
180	713.10
200	713.30

SELECTED OVERTOPPING CREST

ROADWAY SURFACE: PAVED

EMBANKMENT TOP WIDTH (FT): 720.00

CONSTANT ROADWAY ELEVATION PROFILE

CREST LENGTH (FT) 100.00

AR004587

RRENT DATEURRENT TIMEILE NAMEILE DATE
09-30-19 08:36:54 FRB 9/30/91

UMMARY OF CULVERT FLOWS (CFS) FILE: FRB DATE: 9/30/91

LEV (FT)	TOTAL	1	2	3	4	5	6	OVERTOP	ITER
709.00	0	0	0	0	0	0	0	0	0
710.43	20	20	0	0	0	0	0	0	2
711.27	40	40	0	0	0	0	0	0	2
711.97	60	60	0	0	0	0	0	0	2
712.63	80	80	0	0	0	0	0	0	2
713.69	100	100	0	0	0	0	0	0	2
715.00	120	120	0	0	0	0	0	0	2
716.57	140	140	0	0	0	0	0	0	2
717.44	150	150	0	0	0	0	0	0	2
720.40	180	180	0	0	0	0	0	0	2
722.64	200	200	0	0	0	0	0	0	2

URRENT DATE	URRENT TIME	ILE NAME	ILE DATE
09-30-19	08:36:54	FRB	9/30/91

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	CCE (ft)	FCE (ft)	TCE (ft)	(f
0	709.00	708.99	0.00	-0.01	-0.01	709.00	708.98	
20	710.43	709.50	1.31	1.43	1.43	0.00	0.00	
40	711.27	709.95	2.09	2.27	2.27	0.00	0.00	
60	711.97	710.40	2.80	2.97	2.97	0.00	0.00	
80	712.63	710.90	3.63	3.59	3.59	0.00	0.00	
100	713.69	711.40	4.69	4.21	4.21	0.00	0.00	
120	715.00	711.85	6.00	5.43	5.43	0.00	0.00	
140	716.57	712.35	7.57	6.86	6.86	0.00	0.00	
150	717.44	712.60	8.44	7.63	7.63	0.00	0.00	
180	720.40	713.10	11.40	9.91	9.91	0.00	0.00	
200	722.64	713.30	13.64	11.47	11.47	0.00	0.00	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: FRB DATE: 9/30/9

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
709.00	0.00	0	0	0.00
710.43	0.00	20	0	0.00
711.27	0.00	40	0	0.00
711.97	0.00	60	0	0.00
712.63	0.00	80	0	0.00
713.69	0.00	100	0	0.00
715.00	0.00	120	0	0.00
716.57	0.00	140	0	0.00
717.44	0.00	150	0	0.00
720.40	0.00	180	0	0.00
722.64	0.00	200	0	0.00

2ND42.OUT

ULVERTNALYSISERSION

RRENT DATEURRENT TIMEILE NAMEILE DATE
10-02-19 11:27:27 2ND42 9/23/91

ERFORMANCEURVEISCHARGEANGE
FLOWSNALYZED

MINUMUM	DISCHARGE (CFS)	0
DESIGN	DISCHARGE (CFS)	50
MAXIMUM	DISCHARGE (CFS)	150

A - SITE DATA			B - CULVERT SHAPE, MATERIAL, INLET				
INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANN. N	INLET TYPE
708.80	708.40	150.00	1 - RCP	3.50	3.50	.012	CONVENTIONAL
708.80	708.40	150.00	1 - RCP	3.50	3.50	.012	CONVENTIONAL

AR004590

URRENT DATE	URRENT TIME	ILE NAME	ILE DATE
10-02-19	11:27:27	2ND42	9/23/91

CULVERT NUMBER: 1

ULVERTNVERTATA

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	708.80
OUTLET STATION (FT)	150.00
OUTLET ELEVATION (FT)	708.40
NUMBER OF BARRELS	1.00
SLOPE (V-FT/H-FT)	0.0027
CULVERT LENGTH ALONG SLOPE (FT)	150.00

BARREL SHAPE: CIRCULAR 3.50 FT IN DIAMETER
BARREL MATERIAL:
WITH A MANNING'S N OF 0.012
INLET TYPE: CONVENTIONAL
INLET EDGE AND WALL: SQUARE EDGE WITH HEADWALL
INLET DEPRESSION: NONE

URRENT DATEURRENT	TIMEILE	NAMEILE	DATE
10-02-19	11:27:27	2ND42	9/23/91

CULVERT NUMBER: 2

ULVERTNVERTATA

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	708.80
OUTLET STATION (FT)	150.00
OUTLET ELEVATION (FT)	708.40
NUMBER OF BARRELS	1.00
SLOPE (V-FT/H-FT)	0.0027
CULVERT LENGTH ALONG SLOPE (FT)	150.00

BARREL SHAPE: CIRCULAR 3.50 FT IN DIAMETER
BARREL MATERIAL:
WITH A MANNING'S N OF 0.012
INLET TYPE: CONVENTIONAL
INLET EDGE AND WALL: SQUARE EDGE WITH HEADWALL
INLET DEPRESSION: NONE

CONSTANT WATER SURFACE ELEVATION
711.50

SELECTED OVERTOPPING CREST

ROADWAY SURFACE:	PAVED
EMBANKMENT TOP WIDTH (FT):	50.00

CONSTANT ROADWAY ELEVATION PROFILE

CREST LENGTH (FT)	150.00
OVERTOPPING CREST ELEVATION (FT)	714.00

ɾRENT DATEURRENT TIMEILE NAMEILE DATE
10-02-19 11:27:27 2ND42 9/23/91

MMARY OF CULVERT FLOWS (CFS) FILE: 2ND42 DATE: 9/23/9

EV (FT)	TOTAL	1	2	3	4	5	6	OVERTOP IT
708.80	0	0	0	0	0	0	0	0
711.53	15	7	8	0	0	0	0	0
711.60	30	15	15	0	0	0	0	0
711.72	45	22	23	0	0	0	0	0
711.77	50	25	25	0	0	0	0	0
712.10	75	37	38	0	0	0	0	0
712.35	90	45	45	0	0	0	0	0
712.63	105	52	53	0	0	0	0	0
712.83	120	60	60	0	0	0	0	0
713.20	135	68	68	0	0	0	0	0
713.60	150	75	75	0	0	0	0	0

RRENT DATEURRENT TIMEILE NAMEILE DATE
10-02-19 11:27:27 2ND42 9/23/91

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARREL(S)

Q cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	711.50	711.50	0.00	2.70	2.70	708.80	0.00	0.00
7	711.53	711.50	1.02	2.73	2.73	0.00	0.00	0.83
15	711.60	711.50	1.60	2.80	2.80	0.00	0.00	1.67
22	711.72	711.50	2.07	2.92	2.92	0.00	0.00	2.50
25	711.77	711.50	2.22	2.97	2.97	0.00	0.00	2.78
37	712.10	711.50	2.84	3.30	3.30	0.00	0.00	4.17
45	712.35	711.50	3.19	3.55	3.55	0.00	0.00	5.00
52	712.63	711.50	3.54	3.83	3.83	0.00	0.00	5.84
60	712.83	711.50	3.91	4.03	4.03	0.00	0.00	6.67
68	713.20	711.50	4.31	4.40	4.40	0.00	0.00	7.50
75	713.60	711.50	4.76	4.80	4.80	0.00	0.00	8.34

RRENT DATEURRENT TIMEILE NAMEILE DATE
10-02-19 11:27:27 2ND42 9/23/91

CULVERT # 2 PERFORMANCE CURVE
FOR 1 BARREL(S)

Q cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	CCE (ft)	FCE (ft)	TCE (ft)	V((fp:
0	711.50	711.50	0.00	2.70	2.70	708.80	0.00	(
8	711.53	711.50	1.02	2.73	2.73	0.00	0.00	(
15	711.60	711.50	1.60	2.80	2.80	0.00	0.00	:
23	711.72	711.50	2.08	2.92	2.92	0.00	0.00	2
25	711.77	711.50	2.22	2.97	2.97	0.00	0.00	2
38	712.10	711.50	2.84	3.30	3.30	0.00	0.00	4
45	712.35	711.50	3.19	3.55	3.55	0.00	0.00	5
53	712.63	711.50	3.54	3.83	3.83	0.00	0.00	5
60	712.83	711.50	3.91	4.03	4.03	0.00	0.00	6
68	713.20	711.50	4.31	4.40	4.40	0.00	0.00	7
75	713.60	711.50	4.76	4.80	4.80	0.00	0.00	8

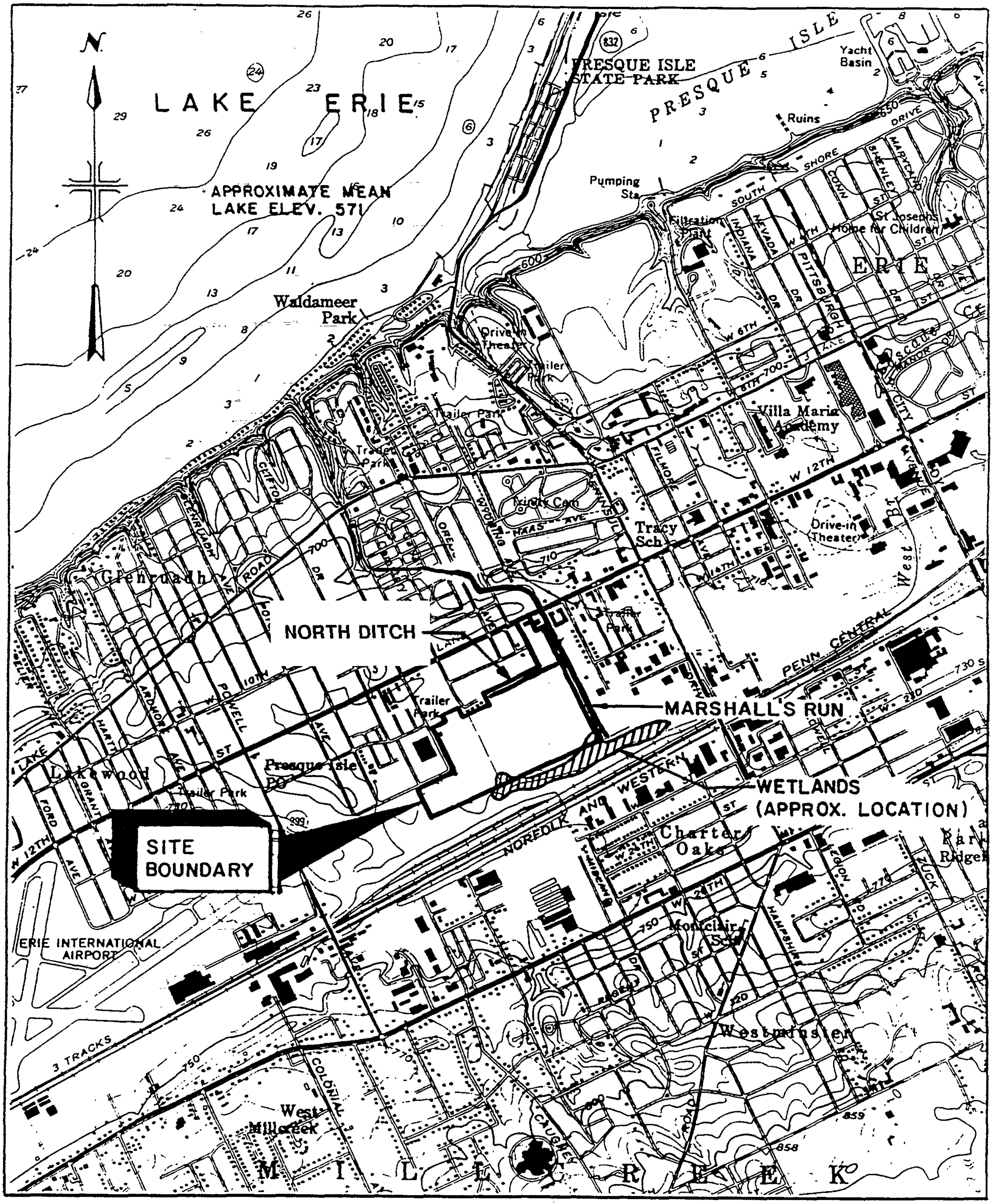
MMARY OF ITERATIVE SOLUTION ERRORS FILE: 2ND42 DATE: 9/23/91

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
708.80	0.00	0	0	0.00
711.53	0.00	15	-0	-0.00
711.60	0.00	30	-0	-0.01
711.72	0.00	45	-0	-0.01
711.77	0.00	50	-0	-0.01
712.10	0.00	75	-0	-0.01
712.35	0.00	90	-0	-0.01
712.63	0.00	105	-0	-0.00
712.83	0.00	120	-0	-0.00
713.20	0.00	135	0	0.00
713.60	0.00	150	-0	-0.00

MALCOLM PIRNIE

APPENDIX G

FRB MAPS



NOTE: PORTION OF U.S.G.S. SWANVILLE, PA.
7.5 MINUTE SERIES, 1957, PHOTOREVISED
1969 & 1975. CONTOUR INTERVAL IS 10'.

U.S. ARMY CORPS OF ENGINEERS

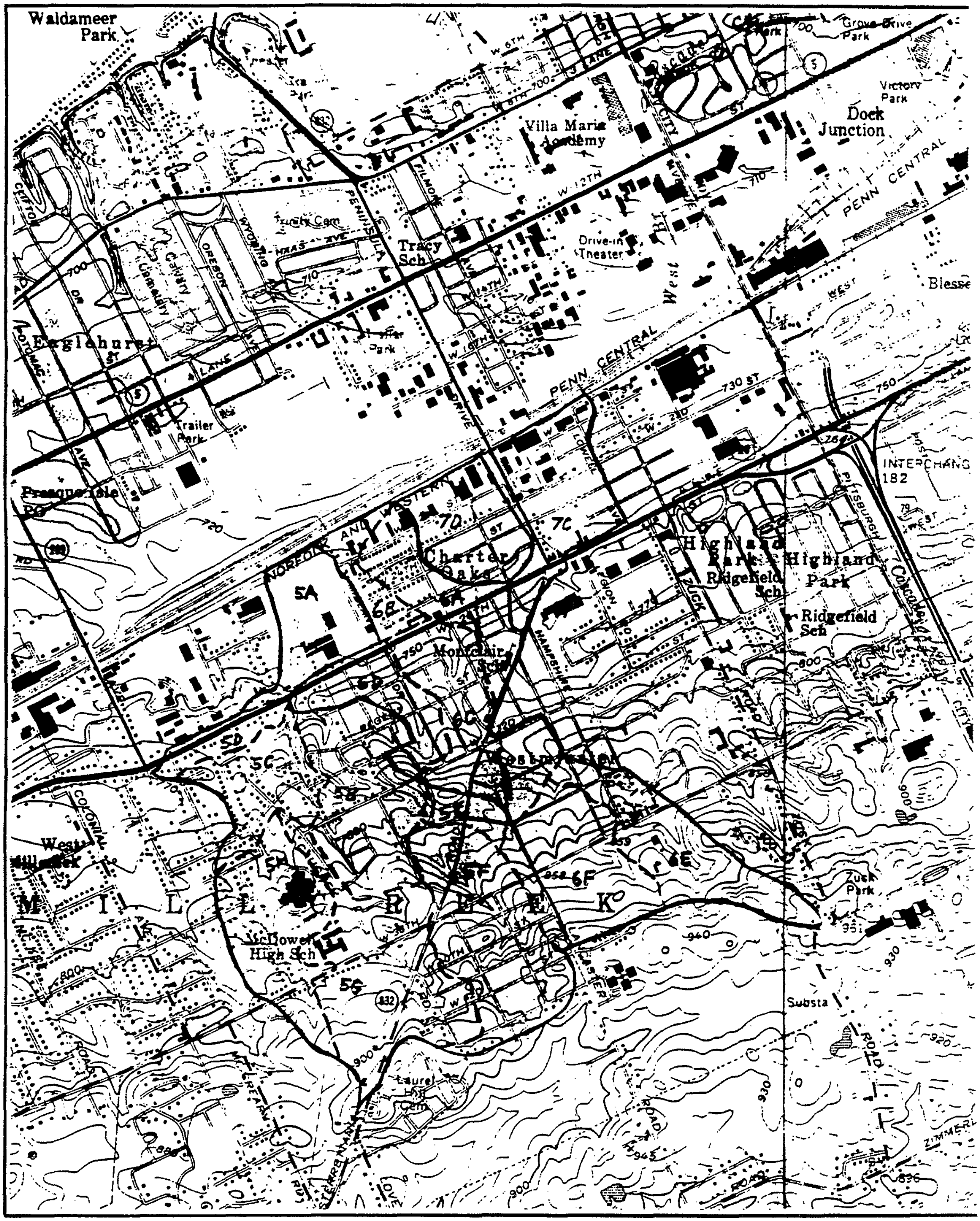
VICINITY MAP

REEK SUPERFUND SITE

SCALE : 1" = 2000'

MALCOLM
PIRNIE

AR004597



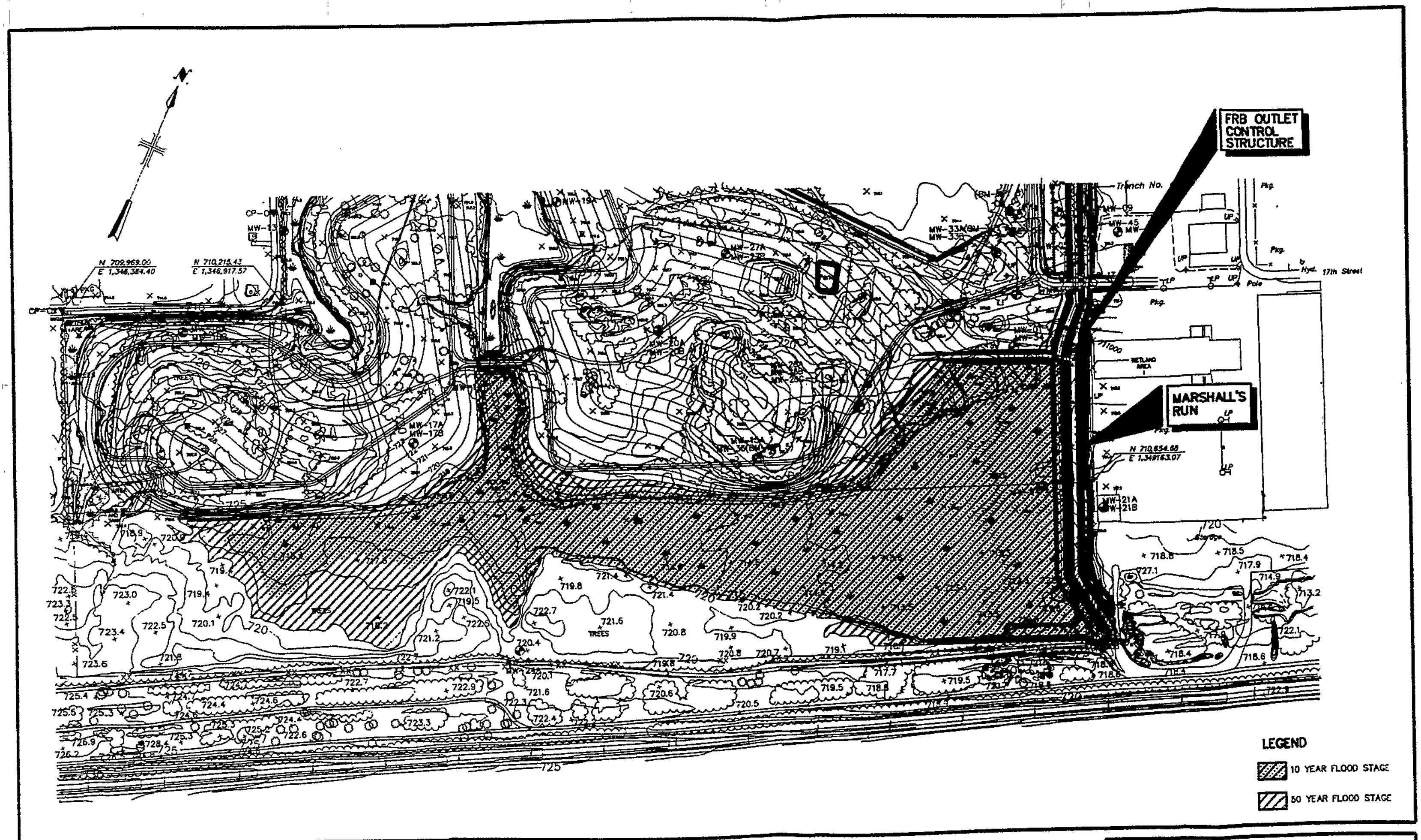
DESIGN ANALSIS REPORT
MARSHALL'S RUN DRAINAGE
BOUNDARY MAP

MALCOLM PIRNIE

MIL - 33

AR004598

MY CORPS OF ENGINEERS JULY 199



MALCOLM PIRNIE

DESIGN ANALYSIS REPORT

FRB IMPACT AREA

U.S. ARMY CORPS OF ENGINEERS SEPTEMBER 1991

ML-33-F1A

AR004599

APPENDIX H

HYDRAULIC CALCULATIONS (HEC-2 COMPUTER SIMULATIONS)

(on computer disk)

File Name	Type	Description
		10-yr Storm Flows in Marshall's Run:
10YRDNDP.OUT	HEC-2 Output	Sections 1 to 23, supercritical
10YRDNDB.OUT	HEC-2 Output	Sections 23 to 47, subcritical
10YRUNDB.OUT	HEC-2 Output	Sections 50 to 67, subcritical
		50-yr Storm Flows in Marshall's Run:
50YRDNDB.OUT	HEC-2 Output	Sections 13 to 47, subcritical
50YRUND.OUT	HEC-2 Output	Sections 50 to 67, subcritical
10YRDNDP.HC2	HEC-2 Data	Data files for above output files.
10YRDNDB.HC2	HEC-2 Data	
10YRUNDB.HC2	HEC-2 Data	
50YRDNDB.HC2	HEC-2 Data	
50YRUND.OUT.HC	HEC-2 Data	
ULTUND.HC2	HEC-2 Data	Data file for Marshall's Run maximum capacity flows upstream of the North Ditch.
ULTDND.HC2	HEC-2 Data	Data file for Marshall's Run maximum capacity flows downstream of the North Ditch
ULTUND.OUT	HEC-2 Output	Output files for maximum capacity flows in Marshall's Run.
ULTDND.OUT	HEC-2 Output	
NDESIGN6.HC2	HEC-2 Data	Data and output files for the 10,50, and 100-year flows in the North Ditch. These HEC-2 files indicate water surface elevations in the North Ditch at different flow events.
NDESIGN6.OUT	HEC-2 Output	

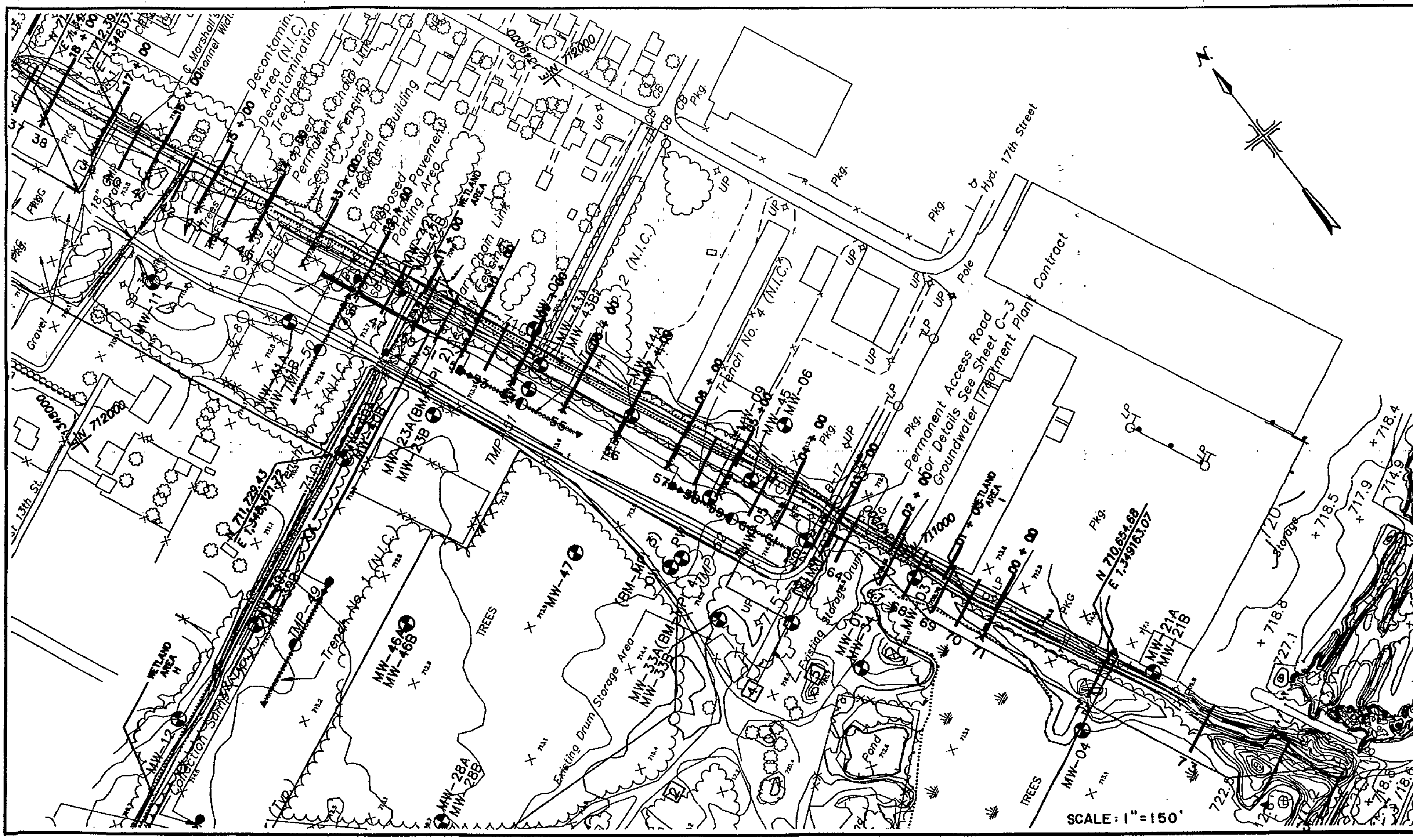
ALCOLM
IRNIE

APPENDIX I

MARSHALL'S RUN HYDRAULIC ANALYSIS MAPS

AR004601

FIGURE 1



MALCOLM PIRNIE

MIL - 33

AR004602

DESIGN ANALYSIS REPORT

MARSHALL'S RUN EXISTING CONDITIONS CROSS SECTIONS FOR HEC-2 ANALYSIS

U.S. ARMY CORPS OF ENGINEERS JULY 1991

EPA REGION III
SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOC ID 115184
PAGE # Ar004603

IMAGERY COVER SHEET
UNSCANNABLE ITEM

SITE NAME Millcreek Dump

OPERABLE UNIT

ADMINISTRATIVE RECORDS- SECTION UAO VOLUME IX

REPORT OR DOCUMENT TITLE Engineering Report: Design Analysis Report, site specific, Quality Management Plan.

DATE OF DOCUMENT 11·1·91

DESCRIPTON OF IMAGERY Site Map

NUMBER AND TYPE OF IMAGERY ITEM(S) 1 Oversized Map