WHITEMAN, OSTERMAN & HANNA
ALBANY, NEW YORK

FEASIBILITY REPORT

FOR

BEAVER SMELTING SITE

May 1988

LMSE-88/0211&442/016

LAWLER, MATUSKY & SKELLY ENGINEERS
Environmental Science & Engineering Consultants
One Blue Hill Plaza
Pearl River, New York 10965

TABLE OF CONTENTS

	Page No.
LIST OF FIGURES	ii
LIST OF TABLES	iii
1 INTRODUCTION	1-1
1.1 Site Description	1-1
1.2 Remedial Investigation	1-4
1.3 Groundwater Chemistry	1-6
1.4 Seep Chemistry	1-8
1.5 Surface Waters	1-9
1.6 Treatability Study	1-11
1.7 Pathway for Metals Migration	1-12
2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS	2-1
2.1 Introduction	2-1
2.2 National Contingency Plan	2-3
2.3 Groundwater Standards	2-4
2.4 Ambient Surface Water Quality Standards	2-5
2.5 Health and Safety	2-6
3 FORMULATION AND EVALUATION OF ALTERNATIVES	3-1
3.1 Introduction	3-1
3.2 No Action (Alternative A)	3-2
3.3 Off-Site Disposal (Alternative B)	3-2
3.4 Cap (Alternative C)	3-4
3.5 Impervious Cap and Groundwater Remediation (Alternative D)	3-10
3.6 Summary	3-11
4 ENVIRONMENTAL MONITORING	4-1
4.1 Far Fill Groundwater	4-1
4.2 Back Fill Groundwater	4-1
4.3 Main Fill Groundwater	4-2
4.4 Estimated Costs	4-2
4.5 Summary	4-3

APPENDICES

A - Summary Tables From Prior LMS Reports
B - Fall 1987 Drilling Program
C - Treatability Study
D - Liner Specifications
E - Lime Specifications

LIST OF FIGURES

Figure No.	Title	Page No.
1-1	Site Location	1-1A
3-1	Ash Contours for Enlarged Main Fill	3-5A
3-2	Cross Section at N+3000 of Enlarged Main Fill With Cap and PVC Liner	3-7B

LIST OF TABLES

Table No.	Title	Page No.
2-1	Federal and State Standards Applicable to Groundwaters	2-4A
2-2	New York State Ambient Surface Water Standards for Class B and D Surface Waters	2-5A
3-1	Formulation of Remedial Action Alternatives	3-1A
3-2	Components of Remedial Action Alternatives	3-1B
3-3	Cost Estimate for Off-Site Disposal (Alternative B)	3-3A
3-4	Estimated Costs to Restore Far and Back Fills	3-4A
3-5	Cost Estimate for Synthetic Cap (Alternative C1)	3-7A
3-6	Cost Estimate for Clay Cap (Alternative C2)	3-8A
3-7	Cost Estimate for Synthetic Cap With Lime (Alternative C3)	3-8B
3-8	Cost Estimate for Soil Cap (Alternative C4)	3-9A
3-9	Cost Estimate for Soil Cap With Lime (Alternative C5)	3-9B
3-10	Cost Estimate for Soil Cap With Lime and Groundwater Recovery (Alternative D)	3-11A1
3-11	Summary of Alternatives	3-11B
4-1	Environmental Monitoring	4-3A

CHAPTER 1

INTRODUCTION

1.1 SITE DESCRIPTION

Location

The Beaver Smelting site is located on Beaver Lane Road (aka Hornbeck Road) in Woodbourne, an unincorporated area of the Town of Fallsburg, Sullivan County, New York (Figure 1-1). The site has been used for recycling and smelting scrap metals.

Ash Fills

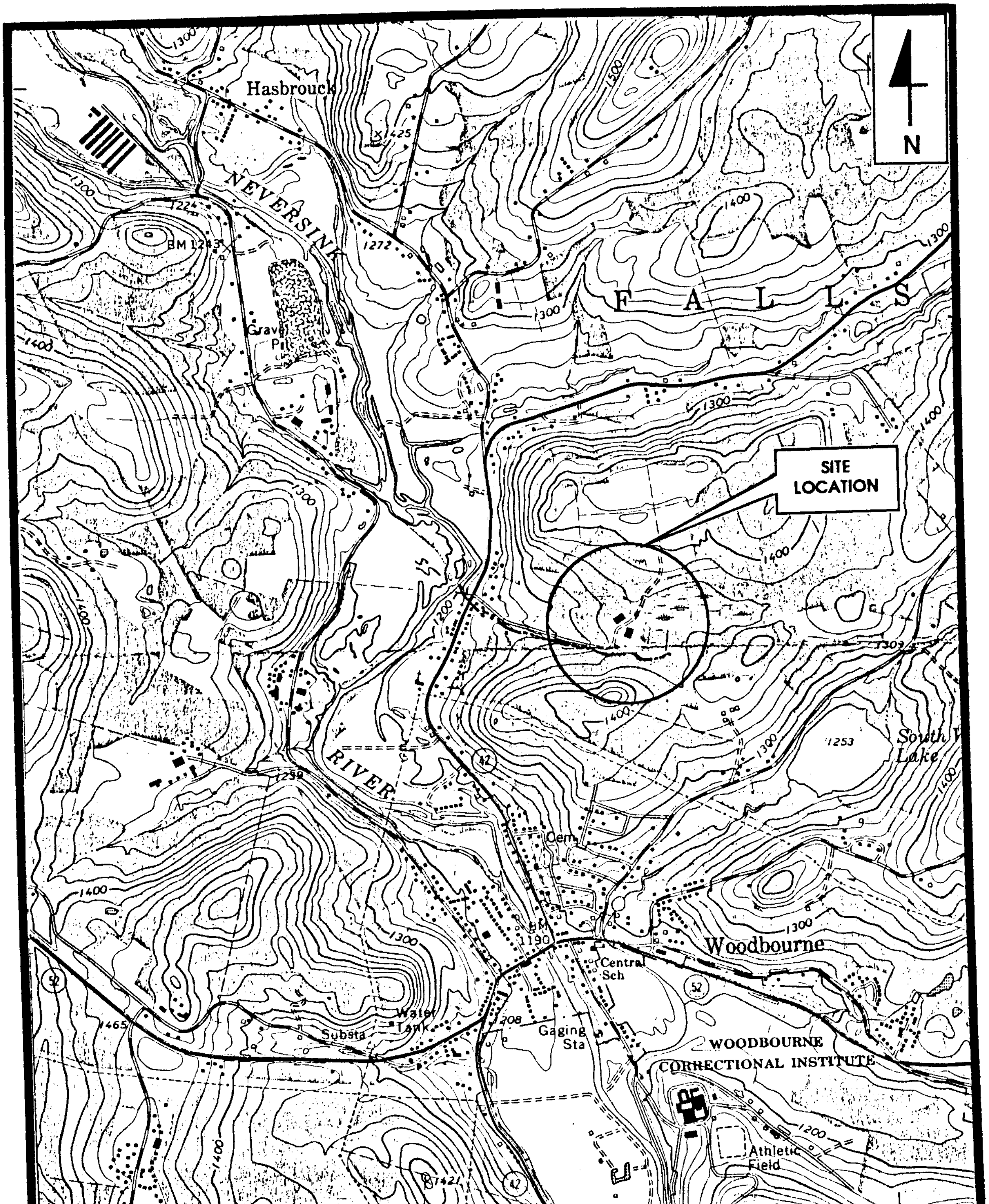
There are three smelting ash fills on the site (Plate 1 at the back of this report). The largest, with an estimated volume of 7000 yd^3, is located along Beaver Lane Road in front of the facility and is referred to as the Main Fill. The fill is wedge shaped in cross section (thinner to the east and deeper to the west) because it was placed over the westward sloping land. The surface is relatively level and supplements the available space for the temporary storage of scrap materials.

Behind the main processing building, on the west side of the site, is a smaller (1100 yd^3) fill, referred to as the Back Fill. This fill is more uniform in depth (generally around 4 ft) than the wedge-shaped Main Fill and is located in a marshy area. The surface is relatively level and is also used for temporary scrap storage.

The Far Fill, some 800 ft to the north of the other two fills, contains about 570 yd^3 of ash placed in two mounds on top of the south sloping land.

FIGURE 1-1

SITE LOCATION



SOURCE: USGS Grahamsville, N.Y. Quadrangle 1966 (photorevised 1982)

Drainage

The site drains to an unnamed brook (referred to as Beaver Smelting Stream) that flows west some 2000 ft to the Neversink River. The brook originates in the previously mentioned marshy area of the Back Fill, southeast of the processing building. As shown in Plate 1, there is a small impoundment in the brook. The vertical fall of the brook from the site to its confluence with the Neversink River is 140 ft.

Geology and Soils

The site is underlain by rocks of the Hamilton Group that are of estuarine origin and consist mainly of graywacke sandstones, although they include variations of gray and red shales and coarse conglomerates. The Hamilton Group rocks are middle to late Devonian in age and were deposited as an extremely complex delta known as the Catskill Delta. This delta was spread out as a broad apron of sediments and formed along the western foothills of a newly created eastern highlands. These rocks later formed the region known as the Catskill plateau, which was dissected and subsequently formed what is known today as the Catskill Mountains. These sandstones range from red to gray. The alternating shales, sandstones, and conglomerates lie almost horizontal, but dip in various directions, forming gentle folds that are most pronounced to the east and die out to the west.

The thick, layered series of shales of the Hamilton Group are rich in clay. As such, they carry the potential for high ion exchange and metal ion retention. Most surfaces of this formation display casts of sperifer brachiopod fossils whose solid carbonate parts have been weathered. Additionally, these shales have calcite-cemented zones beneath the weathered layers. Beneath the zones of weathering, carbonate matter in the rock will undoubtedly increase the ground and vadose water pH. Common carbonates require pH values of approximately 8 before a cement precipitate develops. Such high vadose water pH values will diminish ion mobility in vadose waters in the rock, should cations escape exchange with the abundant clays available in the shale matrix.

Overlying the Hamilton Group are glacial tills and soils. Depths to bedrock in the vicinity range from 10 to 20 ft, although there are variations throughout the site and the region. The soil recovered from the borings drilled by LMS into the till exhibits unmistakable evidence of a fragipan, determined by the large number of blow counts (see drilling logs), perched water table (following section), and survey of area soils. This fragipan characteristically causes a low vertical permeability on the order of 0.03-0.1 ft/day. Overriding this pan surface are soils whose lateral permeabilities ordinarily reach from 20 to 50 in./hr, depending on the soil texture. As a result, most of the precipitation runs off the surface of the site toward the brook.

Groundwater

Two distinct water tables underlie the site. The upper table is located in the soil and ranges from several inches to several feet in depth below grade, depending on precipitation. The water in the soil shows little vertical mobility, as indicated by the continued saturated condition of the soil, even on areas of moderate slopes. This type of groundwater condition is referred to as a "perched" water table and is believed to be caused by the occurrence of the dense subsurface layer of soil (fragipan) beneath the perched water table. No known groundwater wells in the area utilize this aquifer.

The second water table lies under the surface at depths of over 300 ft. The on-site well was drilled into this bedrock aquifer to a depth of over 350 ft. A well to the west of the property was drilled into the bedrock to a depth of approximately 400 ft before the water table was reached. The site well showed an artesian condition, i.e., a confined aquifer pressure condition. The water in the well was under pressure and as soon as the water bearing zone was intersected, this pressure allowed the water level to rise 250 ft in the well to within 100 ft of the ground surface. The elevation of the bottom of the on-site well is 1050 ft above sea level and the well to the west of the property is 1000 ft above sea level. Both of these elevations are between 100 and 150 ft below that of the nearby river level. It is unlikely that the aquifer is being recharged from the river as the water levels in the wells reach higher than the valley base. The higher water levels may be a result of the geologic structure of the rocks that underlie the site. These rocks dip gently to the west, with the dip gradually increasing toward the east, thus creating a situation in which pressures may exist below the confining beds that underlie the site. The recharge area is unknown, but the geologic structure of the region suggests that recharge may be from the higher elevations to the east.

Water Supply

The site and properties in its vicinity are served by individual supply wells. Woodbourne is served by a public water system supplied by wells; the nearest is 0.7 miles from the site.

1.2 REMEDIAL INVESTIGATION

A remedial investigation was conducted by Lawler, Matusky & Skelly Engineers (LMS) at the request of Whiteman, Osterman & Hanna, counsel for Beaver Smelting Co. as part of the legal defense in the Federal court action entitled "State of New York vs Beaver Smelting and Refining Co., Inc., et al." The field investigation involved the following activities:

Fall 1986

1. Construction of 11 shallow (12-20 ft deep) groundwater monitoring wells in the sediment adjacent to the three ash fills
2. Drilling of five additional borings in the ash and sediment to depths of 2-17 ft below grade
3. Collection of 11 water samples from the groundwater monitoring wells, eight from the seeps at the bases of the fills, and five from the brook
4. Collection of three sediment samples from the site pond
5. Laboratory analyses of all water and pond sediment samples for heavy metals and some groundwater samples for volatile organic compounds (VOCs)
6. Laboratory analyses of soil samples for cation exchange capacity (CEC)

Summer 1987

1. Resampling of ground and surface waters for heavy metals
2. Aerial photography (spring 1987) and photogrammetric mapping of the site (including horizontal and vertical survey of monitoring wells)

Fall 1987

1. Drilling of 10 borings in each of the three fills (to determine the depth of ash in each) and collection of ash samples
2. Bench-scale, chemical treatability study

Except for the slug testing of the monitoring wells to provide data on aquifer permeability, these investigations were completed in conformance with "Plan for Field Investigations at Beaver Smelting Site" prepared by LMS in August 1986 and amended by subsequent correspondence with New York State Department of Law (NYSDOL). The results of the fall 1986 investigation are reported in "Preliminary Report on Field Investigations at Beaver Smelting Site" (February 1987). The results of the summer 1987 investigation are reported in "Report on July Groundwater and Surface Water Sampling at Beaver Smelting Site" (October 1987). For reader convenience, Appendix A presents the summaries of the analytical data in those two reports. The findings for the drilling and treatability study have not been reported previously, and are presented in Appendices B, and C, respectively.

In addition to the aforementioned activities, New York State Department of Environmental Conservation (NYSDEC) staff collected six split samples that were subsequently analyzed by a NYSDEC contract laboratory. The results of these analyses were incorporated into the two prior LMS reports.

1.3 GROUNDWATER CHEMISTRY

Main Fill

Two upgradient and three downgradient groundwater wells were constructed in the soil around this fill. Because of the clay and silt in the till, the water samples tended to be turbid, so filtered (dissolved) and unfiltered (total) metals samples were collected. The dissolved metals concentrations are considered more representative of the groundwater chemistry. Selenium was found in both upgradient and downgradient wells at dissolved concentrations in excess of New York State groundwater standards. (Selenium is discussed in more detail below.) Otherwise, no contravention of groundwater standards was observed in the filtered (dissolved) metals samples collected by LMS. One lead excursion was observed in one unfiltered (total) sample (sample - 26 ug/l; standard - 25 ug/l).

Although within standards, downgradient concentrations for dissolved cadmium and dissolved nickel were greater than upgradient concentrations. Conductivity in the upgradient wells was 25-50% of that in the downgradient wells. The downgradient concentration for total iron was 11 mg/l in a NYSDEC sample. Although no upgradient sample was collected, the magnitude of the iron concentration and findings for cadmium, nickel, and conductivity suggest that the Main Fill has had an impact upon the groundwater in the soil.

Far Fill

One upgradient and two downgradient groundwater monitoring wells were constructed in the soil around this fill. Except for selenium, no contraventions of groundwater standards were observed in the filtered samples collected in this area. For the total (unfiltered) metals sample, excursions were observed for downgradient chromium, but not upgradient. Total lead was detected upgradient and downgradient. However, only the upgradient value exceeded standards: that may be a result of the turbidity of this unfiltered sample rather than the condition of the groundwater.

Downgradient conductivity was approximately double the upgradient conductivity. This finding, together with the NYSDEC finding of a downgradient iron concentration of 46 mg/l, suggests that the Far Fill has had an impact upon the groundwater in the soil.

Back Fill

One upgradient and two downgradient monitoring wells were constructed in the soil around this fill. Lead and cadmium were not detected upgradient, but were found downgradient at concentrations two to three times the groundwater standards. The downgradient zinc concentrations were over 200 times the upgradient concentrations. One downgradient zinc concentration exceeded groundwater standards.

Selenium

As indicated previously, selenium was detected in several monitoring wells. At the Main Fill, the upgradient concentrations were in the 5-195 ug/l range, whereas the downgradient concentrations were in the 8-58 ug/l range. The groundwater standard is 10 ug/l. These findings suggest the presence of an upgradient or background source. At the Far Fill, selenium concentrations were <5 ug/l upgradient and 415-645 ug/l downgradient. As detailed in Appendix C, however, little selenium was found in the EP toxicity tests conducted on the ash and no selenium was detected in the EP toxicity tests conducted by NYSDEC's laboratory. Therefore, the pathway by which the selenium has entered the groundwater is unknown.

VOCs

No volatiles were detected in the samples collected from the groundwater monitoring wells.

1.4 SEEP CHEMISTRY

Because the ash is porous, rainwater readily percolates through the fill, encounters the hardpan till, moves horizontally along this relatively impermeable layer, and then emerges as seeps along the downhill edges of the fills. Depressions in the tilly soil tend to retain puddles of this water. The concentrations of cadmium (<5-18 ug/l) and lead (29-235 ug/l) in the Main Fill seeps were greater than those in the Main Fill monitoring wells. The pH of the seeps ranged from 4.4 to 8.8 and was inversely correlated with the lead concentrations. No lead or cadmium was detected in the Far Fill seep.

The concentrations of cadmium (<5-29 ug/l), lead (5-30 ug/l), and zinc (118-7200 ug/l) in the Back Fill seeps were similar to those measured in the groundwater.

1.5 SURFACE WATERS

Water samples were collected from Beaver Smelting Stream at five sampling stations in November 1986 and eight stations in July 1987. The Neversink River was sampled only in July. Cadmium was not detected (5 ug/l method detection limit) in November. The only detections in July were just above the detection limit - 6 ug/l at the start of stream flow (Station S-1) and 7 ug/l below the Main Fill (Station S-4).

Lead concentrations increase as the brook flows past the site. Farther downstream the concentrations are lower, suggesting that there is no additional lead load and that interbasin flow provides some dilution, or that the metal has settled with the solids in quiescent zones in the streambed.

The zinc pattern is similar to that for lead: increase in concentration as the brook flows past the site and dilution farther downstream. However, the impact of this dilution is not as marked as it is for lead, which may be a result of random laboratory/sampling variation, an additional source of zinc farther downstream, or less streambed deposition since zinc does not have as high an affinity for solids as lead does.

Samples were collected from the Neversink River upstream and downstream of its confluence with the brook. Both upstream and downstream concentrations for all three metals (cadmium, lead, and zinc) were below the method detection limit.

The area surface waters are markedly soft. The start of flow of the brook exhibits a hardness of only 4.6 mg/l; the hardness gradually increases toward the mouth of the stream (29.1 mg/l). The hardness of the Neversink River is in the 7.5 to 9.6 mg/l range.

The Neversink River is a Class B water. Beaver Smelting Stream is unclassified and intermittent. It has the general characteristics of Class D waters. The water quality standards for Class D waters, however, are based, in part, on fish survival. As it is intermittent and contains no known pools, the stream is probably not capable of providing a suitable habitat for fish survival. The New York surface water quality standards for the three metals of concern are dependent on hardness (except for the Class B zinc standard, which is 30 ug/l). Low hardness results in more stringent standards. The calculated standard for cadmium at all sampling locations is less than 1 ug/l. This concentration is below the method detection limit.

The standards for lead are somewhat less stringent than those for cadmium, but because of the softness of the waters, the standards are still in the low part-per-billion range. As a result, the samples at all locations on Beaver Smelting Stream (both upstream and downstream) exceed the calculated standards for a Class D water. At the start of streamflow (upstream of the Main Fill, but downstream of the Back Fill), the lead concentration is nine times the standard. At the mouth of the stream the excursion is reduced to only three to four times. The lead standard for the Neversink River is far less than the method detection limit (5 ug/l). In any event, no lead was detected in the Neversink River at the 5 ug/l detection limit and therefore there is no measurable impact.

1.6 TREATABILITY STUDY

The results of a treatability study conducted on the ash are presented in Appendix C and summarized in this section. The study's objective was to evaluate the potential for the ash fills to leach metals under the worst case conditions expected to occur at the site and to evaluate the feasibility of placing lime on top of the ash fills to reduce the leaching of metals by acid rain. The study involved the percolation of acid (pH of 3.5) and lime-treated rain (pH of 12.5) through an ash column. The equivalent of one year of infiltration was studied. Column depths of 1 ft and 5 ft were utilized. Leachate samples were tested for lead, cadmium, iron, and pH.

The ash has a high buffering capacity. With a dosing of 3.5 pH rainfall, the leachate pH never fell below 7.6 for the 5-ft column and 8.0 for the 1-ft column.

The leachate samples were analyzed initially by flame atomic adsorption with detection limits of 5 ug/l (cadmium), 100 ug/l (lead), and 30 ug/l (iron). No metals were found in the leachate of treated and untreated ashes at these detection limits.

Lead samples collected at the beginning and end of the tests were then reanalyzed by furnace atomic adsorption to achieve a low (5 ug/l) detection limit. For the untreated ash in the 5-ft column, the beginning-of-test (after the equivalent of 8 in. of infiltration) lead concentration in the leachate was 96 ug/l. For the 1-ft column, the beginning-of-test (3 in. of infiltration) concentration was 37 ug/l. At the end of the test (the equivalent of one year of infiltration), concentrations were 5 ug/l for both columns. No lead was detected (5 ug/l detection limit) in the leachate of the column with lime-treated rainfall.

The treatability study demonstrates that liming the surface (the top 6 in.) of the fills will reduce (or eliminate) the leaching of lead from the ash. In addition, the study demonstrated that the ash is not prone to leaching metals from the percolation of acid rain. This finding is considered further in the next section.

1.7 PATHWAY FOR METALS MIGRATION

Ash

Three mechanisms are believed to account for the movement of metals from the ash fills into the adjacent seeps, groundwater, and surface water. The first is that acid rain infiltrates the porous fills, leaches metals, and then emerges as seeps at the downhill toe of the fills. The treatability study indicates that acid rain is buffered by the ash and that this mechanism (leaching by acid rain) can account for only a portion of the lead observed in the seeps and groundwater and does not account for any of the cadmium or iron (other metals were not tested).

The second mechanism, applicable to the Main and Far Fills, is erosion of ash into the soil and puddled acid seeps downhill of the fills. Being in relatively continuous contact with the acid environment, the eroded ash would loose its buffering capacity and leach metals.

The third mechanism is applicable to the Back Fill. The pH of the seeps or standing water adjacent to this fill ranges from 3.8 to 5.2, lower than measured around the other fills. The pH of the groundwater (4.3 to 4.6) in this marshy area is comparable to the surface water pH. Here the ash was placed directly into the marshy area. Because of the continual submergence of the ash in the low pH environment, the concentrations of metals in the adjacent groundwater monitoring wells are higher than those for the down-gradient wells adjacent to the other two fills.

In summary, the mobility of the metals from the ash appears to be related to leaching by rain and erosion or placement in an acid environment, as in the case of the Back Fill.

Ground and Surface Waters

Background. The previous section indicated that the hardpan till results in a locally perched water table. Most precipitation runs off the land to the brook or evapotranspires. The little infiltration that does occur will migrate primarily toward the brook through the more porous 1-2 ft of soil on top of the till. Some small fraction of infiltration enters the till from which groundwater movement is believed to be primarily toward the brook. Seepage from the till to the bedrock aquifer is not believed to be significant because of the low vertical permeability of the till, depth to the bedrock water bearing zones, and apparent lack of hydraulic communication between the shallow and the pressurized water bearing rock.

Back Fill. The topography and water levels in the monitoring wells indicate that the groundwater affected by the Back Fill seeps is influent to the pond to the southwest. However, no lead has been detected in the influent to the pond. This finding may be a result of adsorption of lead in the staturated soil and/or dilution by the additional ground and surface water flows.

Main Fill. Although the dissolved concentrations of several metals in the groundwater are higher downgradient of the fill than upgradient, the downgradient toxic metals groundwater standards are not violated. (The data are anomalous for selenium.) However, the metals concentrations in the brook downstream of this fill are too high to be a result of the concentrations observed in the groundwater.

A possible cause for the metals observed in the stream is seepage of water through the porous shallow soil above the much less permeable (glacial till) saturated groundwater zone in which the monitoring wells are screened. The concentrations in this shallow seepage may be similar to those observed in the samples collected from the seeps in November (29-235 ug/l lead; <5-18 ug/l cadmium; and 235-1550 ug/l zinc).

Far Fill. Except for selenium, the concentrations of toxic metals in the groundwater downgradient of this fill appear to be within groundwater standards. The one seep sample collected in November was free of toxic metals.

CHAPTER 2

LEGAL CONSIDERATION AND REPORT OBJECTIVES

2.1 INTRODUCTION

Having established that the primary chemicals of concern (lead, selenium, cadmium, and zinc) are being transported from the site via the shallow, nonpotable groundwater and via surface water run-off and streams, the next step in the feasibility study process is the selection of the appropriate remedial alternative. LMS has been advised by counsel for Beaver Smelting Company that the following legal considerations should govern the selection of alternatives.

Congress has adopted amendments to the comprehensive Environmental Response, Compensation and Liability Act (CERCLA), sometimes referred to as Superfund. These amendments were enacted 17 October 1986 in Public Law No. 99-499, which is referred to as the Superfund Amendments and Reauthorization Act of 1986 (SARA). It is uncertain which of SARA's provisions apply where a state, rather than the Federal government, is pursuing an action for injunctive relief and damages. In the Federal Court action, in addition to CERCLA, the state is proceeding for abatement of an alleged public nuisance. Because of multiple causes of actions, it is not clear what standards govern the selection of remedial alternatives. In the light of these uncertainties, counsel directed LMS to proceed to prepare this report on the assumptions stated below.

The remedial alternatives should assure protection of public health and the environment. Among alternatives that do so, the most cost effective is to be recommended. If a remedial alternative will provide adequate protection for public health and the environment, it should not be rejected in favor of another alternative that is more expensive even though it is more protective of public health and the environment.

These conclusions are based on the following:

Section 121(a) of SARA provides that remedial programs shall be selected in accordance with the cleanup standards provided by that section and "to the extent practicable, the national contingency plan, and provide for cost-effective response."

The Congressional Conference Report on this provision explained it as follows:

> The provision that actions under both sections 104 and 106 must be cost-effective is a recognition of EPA's existing policy as embodied in the National Contingency Plan. The term "cost-effective" means that in determining the appropriate level of cleanup, the President first determines the appropriate level of environmental and health protection to be achieved and then selects the cost-efficient means of achieving that goal. Only after the President determines, by selection of applicable or relevant and appropriate requirements, that adequate protection of human health and the environment will be achieved, is it appropriate to consider cost effectiveness.

EPA, in issuing the current National Contingency Plan, pointed out that a remedial alternative need not be selected if it is more expensive merely because it is "more protective." In the Preamble to the National Contingency Plan, EPA stated:

> The approach embodied in today's rule is to select a cost-effective alternative from a range of remedies that protects the public health and welfare and the environment. First, it is clear that if all the remedies examined are equally feasible, reliable, and provide the same level of protection, the lead agency will select the least expensive remedy. Second, where all factors are not equal, the lead agency must evalu-

> ate the cost, level of protection, and reliability of each alternative...Finally, the lead agency would not always select the most protective option, regardless of cost. The lead agency would instead consider costs, technology, reliability, administrative, and other concerns, and their effects on public health and welfare and the environment. This allows selection of an alternative that is most appropriate for the specific site in question [50 Fed. Reg. 47921 (20 November 1985)]. (Emphasis supplied.)

The applicable, relevant, and appropriate requirements (ARARs) for the chemicals of concern in the identified pathways are discussed in the following sections.

2.2 NATIONAL CONTINGENCY PLAN (NCP)

The NCP presents a list of factors that should be considered when setting site-specific cleanup goals. The NCP suggests that alternative remedial actions be developed that achieve or attempt to achieve the generic objectives in each of the following five categories:

- No or minimal action
- Alternatives for treatment or disposal at an off-site facility approved or approvable by EPA
- Alternatives that attain applicable and relevant Federal public health or environmental standards
- Alternatives that exceed (do better than) applicable and relevant public health or environmental standards
- Alternatives that do not attain all applicable or relevant public health or environmental standards but will reduce the likelihood of present and future threats from hazardous substances and that provide significant protection to public health and welfare and the environment

While this report does not purport to be a formal feasibility study prepared in accordance in the NCP, the framework for analysis of remedial alternatives contained in the NCP will be followed herein.

2.3 GROUNDWATER STANDARDS

Under 6 NYCRR 703.5, quality standards for groundwaters are defined as the most stringent of:

i the items and specifications applicable to such waters found in this section

ii the maximum contaminant levels for drinking water promulgated by the Commissioner of Health as found in 10 NYCRR Subpart 5-1, Public Water Supplies or any subsequent revision thereto or replacement thereof;

iii the maximum contaminant levels for drinking water promulgated by the administrator under the Safe Drinking Water Act (SDWA)... and 40 CFR Part 141, effective July 1, 1978...; and

iv the standards for raw water quality promulgated by the Commissioner of Health as found in 10 NYCRR Part 170, Sources of Water Supply or any subsequent revision thereto or replacement thereof."

Table 2-1 defines the metals concentrations for these standards. With the exception of standards for copper, selenium, and zinc, the New York groundwater quality standards are as stringent as (or more stringent than) the maximum contaminant levels (MCLs) promulgated under the New York community public drinking water supplies, the Safe Drinking Water Act (SDWA), and the New York water quality standards for sources of raw water. The standard for copper is most stringent under the New York standards for raw water quality, <0.2 mg/l. The most stringent standard for selenium is in both the

TABLE 2-1

FEDERAL AND STATE STANDARDS APPLICABLE TO GROUNDWATERS[a]

CONTAMINANT	NEW YORK GROUNDWATER QUALITY STANDARD CLASS GA	MAXIMUM CONTAMINANT LEVELS: NEW YORK PUBLIC WATER SUPPLY DRINKING WATER	MAXIMUM CONTAMINANT LEVELS: (FEDERAL) SDWA	NEW YORK SOURCES OF WATER SUPPLY RAW WATER QUALITY	NEW YORK EFFLUENT STANDARDS
Aluminum	NS	NS	NS	NS	2.0
Arsenic	0.025[c]	0.05	0.050	0.05	0.05
Barium	1.0[c]	1.0	NS	1.0	2.0
Cadmium	0.01[c]	0.010	0.010	0.01	0.02
Chromium	0.05[bc]	0.05	0.050	0.05[b]	0.10[b]
Copper	1.0	1.0	NS	<0.2[c]	1.0
Iron	0.3[c]	0.3	NS	NS	0.6
Lead	0.025[c]	0.05	0.050	0.05	0.05
Manganese	0.3[c]	0.3	NS	NS	0.6
Mercury	0.002[c]	0.002	0.002	0.005	0.004
Nickel	NS	NS	NS	NS	2.0
Selenium	0.02	0.01	0.010	0.01[c]	0.04
Silver	0.05[c]	0.05	0.050	0.05	0.1
Zinc	5.0	5.0	NS	<0.3[c]	5.0

NS - No standard.

[a]All units in mg/l.
[b]Hexavalent.
[c]Most stringent standard.

Federal MCLs and the New York water quality standards for sources of raw water (0.01 mg/l). The most stringent standard for zinc, <0.3 mg/l, is promulgated by the New York water quality standards for sources of raw water.

Also included in Table 2-1 are the New York metals standards for effluent discharges to Class GA groundwaters. Aluminum and nickel are the only two metals that have discharge but not water quality standards. The groundwater sampling results at the site are summarized and compared with the standards in Chapter 1.

All groundwater in the State of New York is classified as either "GA" (nonsaline) or GSA" (saline). The groundwater at the site is thus classified as GA. The purpose of the groundwater quality standards is to protect the groundwaters for use as a potable water supply (see 6 NYCRR 703.2). The groundwater table impacted by the ash fills, i.e., the upper table located in soil, is a perched water table that is not known to be used as a potable water supply. Water movement is believed to be primarily toward the brook. Seepage from the till to the bedrock is not believed to be significant because of the low permeability of the till, the depth to bedrock water-bearing zones, and the apparent lack of hydraulic communication between the shallow and the pressurized water-bearing rock.

2.4 AMBIENT SURFACE WATER QUALITY STANDARDS

Ambient surface water quality standards are defined in 6 NYCRR 701.14 based on classes of fresh surface waters as defined in 6 NYCRR 701.19. The Beaver Smelting Stream is unclassified, but it has the general characteristics of Class D surface waters, with the exception, discussed previously, that it is probably not suitable for fish survival. The Neversink River, into which the Beaver Smelting Stream drains, is a Class B surface water. Table 2-2 sum-

TABLE 2-2

NEW YORK STATE AMBIENT SURFACE WATER STANDARDS FOR CLASS B AND D SURFACE WATERS

CONTAMINANT	CLASS B STANDARD (mg/l)	CLASS D STANDARD (mg/l)
Aluminum	100	NS
Arsenic	190	360
Barium	NS	NS
Beryllium	11[a]	NS
Boron	10,000	NS
Cadmium[b]	exp (0.7852 [ln(ppm hardness]-3.49)	exp (1.128[ln(ppm hardness)]-3.828)
Chromium[b]	exp (0.819 [ln(ppm hardness)]+1.561)	exp (0.819 [ln(ppm hardness)]+3.688)
Cobalt	5	NS
Copper[b]	exp (0.8545 [ln(ppm hardness)]-1.465)	exp (0.9422 [ln(ppm hardness)]-1.464)
Iron	300	300
Lead[b]	exp (1.266 [ln(ppm hardness)]-4.661)	exp (1.266 [ln(ppm hardness)]-1.416)
Magnesium	NS	NS
Manganese	NS	NS
Mercury	NS	NS
Nickel	exp (0.76 [ln(ppm hardness)]+1.06)	exp (0.76 [ln(ppm hardness)]+4.02)
Selenium	1	NS
Silver [d]	0.1[c]	exp (1.72 [ln(ppm hardness)]-6.52)
Thallium	8	20
Vanadium	14	190
Zinc	30	exp (0.83 [ln(ppm hardness)]+1.95)

NS - No standard.
exp - Exponent base "e."

[a]When hardness is less than or equal to 75 ppm.
[b]Standards hardness dependent as indicated by formula.
[c]Ionic silver.
[d]Standard for Class D hardness dependent as indicated.

marizes the ambient water quality standards for Class B and D surface waters. These standards are compared with measured surface water quality at the site and summarized in Chapter 1. With regard to the on-site stream and assuming a D classification, violations are shown both upstream and downstream of the site for such metals as cadmium, lead, and zinc based to some extent on the softness of these surface waters (standards for several metals are hardness dependent and more stringent as the softness of the water increases).

It should be noted, however, the water quality standards for Class D are based, in part, on standards for fish survival (see 6 NYCRR 701.8; 701.10, and Appendix 31). Plant personnel report that the stream is intermittent with little or no flow during significant portions of the summer months. Although a biological reconnaissance has not been conducted, the stream is not considered a fisheries resource because of the intermittent flow.

2.5 HEALTH AND SAFETY

A site-specific safety and health plan will be prepared for the remedial response. The Safety and Health Plan will address the safety and health hazards posed by the operations and activities necessary to implement the selected remedial plan. The Safety and Health Plan will include the names of those responsible for assuring that safe practices and procedures are followed on the site; employee training assignments; required personal protective equipment for each work task and operation; site control measures and contingency planning.

In developing the cost estimates for the remedial alternatives, it was assumed that most, if not all, of the remedial activity could be conducted by a local contractor. The construction activities such as the construction or placement of temporary facilities, road building for site access, erosion control, and the placement of cover will be done in accordance with the construction activity standards of OSHA, i.e., 29 CRF Part 1926, to the extent applicable rather than requirements of 29 CRF Part 1910.120 (see 51 Fed. Reg. 45655).

CHAPTER 3

FORMULATION AND EVALUATION OF ALTERNATIVES

3.1 INTRODUCTION

Eight remedial alternatives within four categories have been formulated. The categories are:

1. No or minimal action (one alternative)
2. Disposal of the ash at an off-site facility approved by EPA (one alternative)
3. Capping of the ash on-site (five alternatives)
4. Capping of the ash on-site and groundwater remediation (one alternative)

A number of technical measures potentially applicable to the eight alternatives were screened. For the sake of report brevity and clarity, these measures are discussed with the text that describes the formation and evaluation of the alternatives.

The alternatives are summarized in Table 3-1. A more detailed description of the technical components of each alternative is presented in Table 3-2.

3.2 NO ACTION (ALTERNATIVE A)

Under this alternative the three fills would be left in place and no further action would be taken. There would be no placement of additional ash on the fills.

Because the fills have been in place for the past few decades, there is no reason to believe that future environmental conditions

TABLE 3-1

FORMULATION OF REMEDIAL ACTION ALTERNATIVES

CATEGORY	ALTERNATIVE
1. No remedial action	A. No action
2. Off-site disposal	B. Excavate ash for disposal at RCRA secure landfill.
3. Cap	C. Consolidate materials into a single fill and cap. Riprap to control erosion. Alternatives for the cap include: <u>Impervious Cap</u> C1 - synthetic (PVC) cap C2 - clay cap C3 - treatment of ash with lime and placement of a synthetic cap <u>Soil Cap</u> C4 - soil cap C5 - treatment of ash with lime and placement of a soil cap
4. Cap and groundwater remediation	D. Cap in accordance with Alternative C3 and collect groundwater for off-site disposal.

TABLE 3-2

COMPONENTS OF REMEDIAL ACTION ALTERNATIVES

COMPONENT	A NO ACTION	B OFF-SITE DISPOSAL	C CAP C1	C CAP C2	C CAP C3	C CAP C4	C CAP C5	D CAP & GW REMEDIATION
1. Excavation		X	X	X	X	X	X	X
2. Consolidation			X	X	X	X	X	X
3. Off-site ash disposal		X						
4. Erosion control								
A. Grading			X	X	X	X	X	X
B. Riprap			X	X	X	X	X	X
5. Lime treatment					X		X	X
6. Cap								
A. Clay				X				
B. Synthetic			X		X			X
C. Till			X	X	X	X	X	
D. Top soil			X	X	X	X	X	X
7. Septic relocation			X	X	X	X	X	X
8. Groundwater recovery								X
9. Off-site water disposal								X
10. Environmental monitoring		X	X	X	X	X	X	X

will be different from those observed during the remedial investigation. Therefore, there would be no need for future environmental monitoring.

Environmental conditions would be as described in Chapter 1. There would be numerical violations of New York groundwater standards in the till about the fills. However, the groundwater in this till is not used for water supply nor does it flow to a water supply aquifer. Therefore, there would be no adverse impact on water supply.

There would be continuing numerical violations of New York surface water standards in Beaver Smelting Stream. This stream is unclassified, however, and does not appear to be a fisheries resource. Therefore, the impact of these violations would be insignificant. There would be no measurable impact on the Neversink River.

3.3 OFF-SITE DISPOSAL (ALTERNATIVE B)

This alternative requires that the ash in the three fills be excavated and hauled to a RCRA landfill for secure burial. For the purpose of this evaluation it is assumed that all ash is hazardous waste. However, if this alternative was implemented, there could be sampling to allow disposal of the ash at separate hazardous and nonhazardous disposal sites. The ash in the Far Fill could be placed directly in lined 15-yd^3 roll-offs and carted off-site. At the Main and Back Fills, the metal scrap currently in place would have to be relocated. It is assumed that the Back Fill material would be excavated with a backhoe, placed in a dump truck, and then placed on top of the Main Fill. This action would allow the Back Fill ash to dewater, thereby eliminating the need for bulking. The leachate from the dewatering operation would be neutralized by the Main Fill ash, which has considerable buffering capacity. The treatability study indicates that there may be some short-term release of lead. The estimated costs to accomplish this alternative are presented in Table 3-3. The prices are those that prevailed on 1 January 1988 (Engineering News-Record Index 20 Cities Average of 4,457).

Low-grade iron scrap currently stored on the Main Fill will have to be relocated; the costs are detailed below:

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
1.	Cut and preparation	Ton	500	20	10,000
2.	Loading (crane and operator) (based on two 20-ton loads/day)	Day	12.5	400	5,000
3.	Trucking	Ton	500	20	10,000
	Subtotal				25,000
4.	Low-grade iron salvage	Ton	500	25	(12,500)
	Total (net capital cost)				12,500

The $25,000 cost for preparation, loading, and trucking of the scrap is ~~less~~ more than the $12,500 salvage value. The net capital cost of $12,500 is presented as "net scrap removal cost" on Line 7 of Table 3-3.

Unlike that on the Main Fill, the scrap adjacent to the Back Fill has a salvage value greater than the cost of preparation, loading, and trucking. This material could therefore be removed as part of the normal course of business by Beaver Smelting Co.

TABLE 3-3

COST ESTIMATE FOR OFF-SITE DISPOSAL (ALTERNATIVE B)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
Capital Costs					
1	Excavate Far Fill	yd^3	600	1.90	1,140
2	Excavate Back Fill and dewater	yd^3	1100	5.15	5,665
3	Excavate Main Fill (enlarged)	yd^3	8100	1.90	15,390
4	Transportation to disposal site	yd^3	8700	120.00	1,044,000
5	Hazardous waste disposal	yd^3	8700	195.00	1,696,500
6	Nonhazardous waste disposal	yd^3	0	45.00	0
7	Net scrap removal cost	Lump sum	1	12,500.00	12,500
					2,775,195
		Contingencies @ 15%			416,279
					3,191,474
	Eng'g, legal, administrative @ 15%				478,721
					3,670,195
Annual Costs (except monitoring)					0

The cost for future environmental monitoring is not included in Table 3-3. Monitoring is common to all of the alternatives (except No Action) and is addressed in Chapter 4.

Not included in the cost estimates are the following items:

1. Restoration of the Back and Far Fill grounds after excavation. The need to restore these areas has not been established. The estimated costs ($80,170) for restoration are presented in Table 3-4.

2. Lost value of the Main and Back Fills as storage areas.

This alternative would eliminate the source of metals to the groundwater. However, the concentrations of metals already in the groundwater would decline slowly as the aquifer is flushed by infiltrated precipitation. Since the upper 2 ft of soil is more porous, flushing would occur more rapidly here. In the relatively impervious till, flushing would be more time consuming.

3.4 CAP (ALTERNATIVE C)

General

As indicated in Chapter 1, metals are released from the three fills by a combination of acid rain leaching through the ash and erosion of ash into acidic puddles. Isolation of this ash from the rain and control of erosion on the steeper slopes of the fills should therefore eliminate the release of metals. These controls can be established by capping the fills and placing riprap and stone on the slopes. Much of the ash in the Back Fill is placed in direct contact with acidic groundwater. Therefore, to isolate this material, the ash must be excavated.

TABLE 3-4

ESTIMATED COSTS TO RESTORE FAR AND BACK FILLS

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
Capital Costs					
Far Fill					
1	Place subgrade (0.5-ft average depth)	yd^3	450	8.00	3,600
2	Fine grade	yd^2	2,600	0.25	650
3	Furnish, place topsoil	yd^3	450	20.00	9,000
4	Mulching, seeding	ft^2	24,000	0.18	4,320
					17,570
Back Fill					
1	Place subgrade (4-ft average depth)	yd^3	3,800	8.00	30,400
2	Fine grade	yd^2	2,900	0.25	725
3	Furnish, place topsoil	yd^3	500	20.00	10,000
4	Mulching, seeding	ft^2	26,000	0.18	4,680
					45,805
		Total estimated construction cost:			63,375
		Contingencies @ 10%			6,338
					69,713
		Eng'g, legal, administrative @ 15%			10,457
					80,170
Annual Costs					0

The cost for caps is largely dependent on the total surface area. Therefore, this alternative specifies that the two small fills (1600 yd^3 in volume) be consolidated with the Main Fill (7000 yd^3). As explained below, this consolidation can be achieved without increasing the surface area of the Main Fill.

The existing on-site septic tank (or cesspool) located just east of the Main Fill is believed to be a small source of groundwater flow into the Main Fill. Therefore, this alternative (and others that would cap the Main Fill) specifies that the tank be relocated to the south of the processing building.

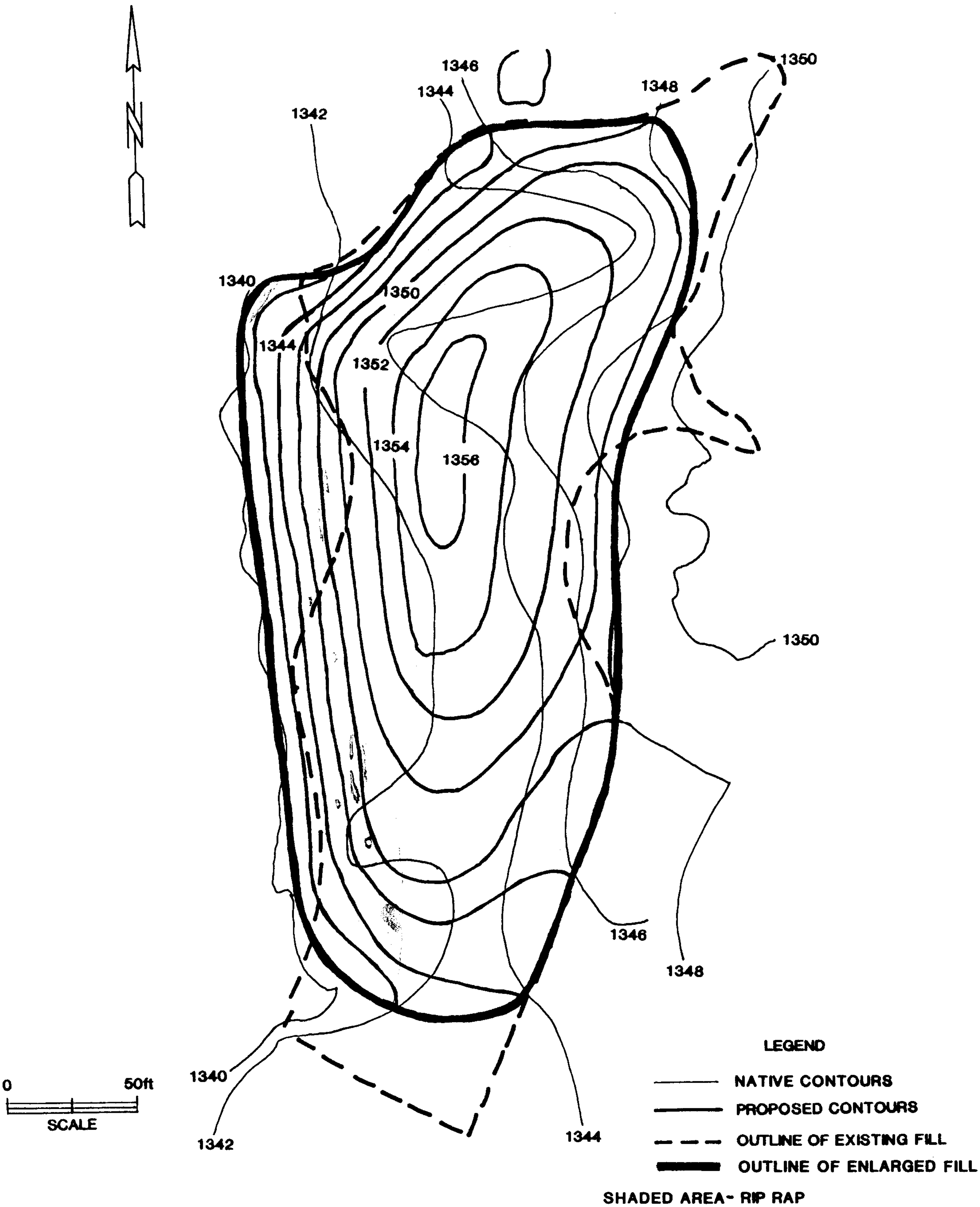
The local topography (Plate 1) and static water elevations measured in the monitoring wells during the remedial investigation indicate that there is no available groundwater flow through the till below the Main Fill. Because groundwater appears to flow radially away from the main processing area, there is no reason to install a groundwater barrier (e.g., slurry wall) upgradient of the Main Fill.

Proposed grades for the consolidated, capped Main Fill are depicted in Figure 3-1. The relatively steep western slope would be stabilized with stone riprap. The alternative to riprap would be to extend the fill to the west, which would increase the area of the fill and cost of the cap without any environmental benefit.

Figure 3-1 demonstrates that the eastward-sloping portion of the cap would not require riprap. Most of the runoff from precipitation falling on the cap here would drain to the east. Other site drainage is diverted around the cap. Straw, or a similar material, would have to be placed on the cap to prevent erosion during the initial growth of the vegetative cover.

FIGURE 3-1

ASH CONTOURS FOR ENLARGED MAIN FILL



Ash consolidation activities would entail:

1. Relocation of metal scrap on the Back and Main Fills and the access roads to these areas

2. Movement by bucket loader of Far Fill ash onto the Main Fill

3. Excavation of Back Fill ash with a backhoe (progressing from east to west), placement onto a dump truck, and transport to the Main Fill.

Consolidation also entails regrading of the existing ash in the Main Fill. This activity involves (1) eliminating high spots, (2) excavating the thin southernmost and northernmost deposits of ash and placement on top of the fill, and (3) extending the western edge of the fill. To isolate the ash from the moist native soil, 1-ft deep common borrow would be placed in this area before the ash fill is extended.

The ash has a sand consistency. Therefore, there is no need to place a special liner subcourse to act as a bed for placement of the liner.

Alternatives With an Impermeable Cap

Five alternatives for capping the fill were formulated. Alternative C1 provides a synthetic liner; C2, a clay liner. These two alternatives are reviewed to evaluate the relative advantages of a synthetic liner vs a clay liner.

Because of the relatively small size of the fill (about 1 acre), good foundation properties of the ash (no settling), and buffering offered by the ash, there is no need for examining more elaborate capping technologies, such as the so-called RCRA cap.

The costs for Alternative C1 (synthetic cap) are presented in Table 3-5. The costs provide for placing 60 mil PVC fabric directly on top of the ash. Sand for drainage and screened borrow excavated from the site would be placed to a depth of 0.8 ft over the plastic. Top soil (0.5 ft thick) would be placed over the borrow. Example specifications for the plastic used as a basis for the cost estimate are presented in Appendix D. It is anticipated that the specified material, when placed on the ash, will be sufficiently durable to withstand movement by light, rubber-tired vehicles during construction. There is no need for gas venting since no volatile organics, methane, or other gases are emitted by the fills. Figure 3-2 is a cross section of the fill with a synthetic cap.

As for Alternative B, the estimated costs for Alternative C1 include (Line 12 of Table 3-5) relocation of the scrap, but do not include restoration of the Far and Back Fill areas or lost value of the Main and Back Fills for storage. However, restoration about the Main Fill following placement of the cap is provided for (Line 11). The ash is well drained; therefore, there should be no frost heaving below the ash to impact upon the integrity of the PVC fabric. The ash is well compacted and has the consistency of sand, so there should be no settlement of the fill.

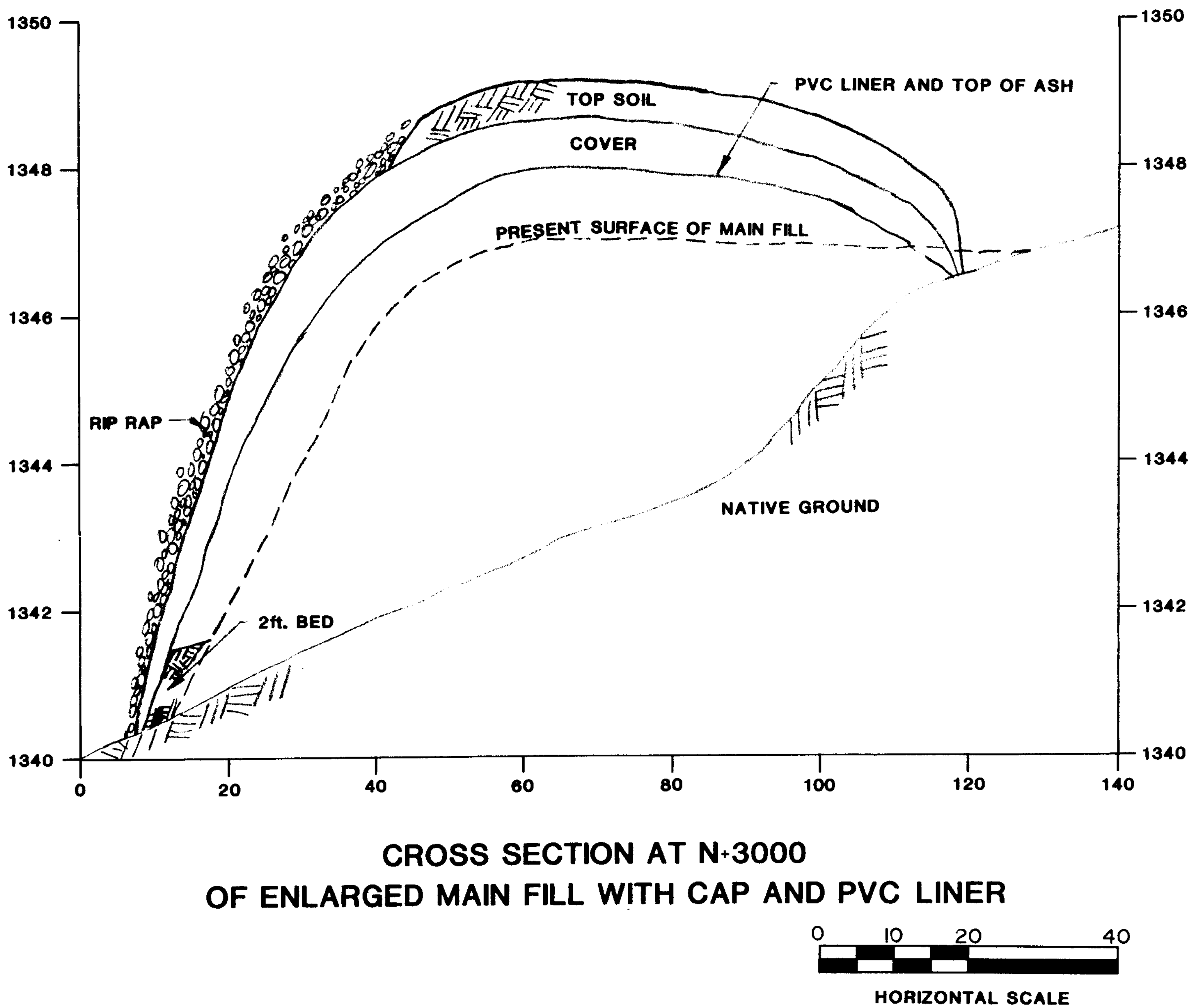
Root penetration by trees and puncture by burrowing animals may impact upon the integrity of the PVC fabric. Since the fill borders a wooded area, burrowing may become a significant problem unless steps are implemented to reduce the cap as a hospitable environment. At a minimum, the grass on the cap should be cut and maintained four times per year. The costs also provide for an annual engineering inspection. It is assumed that repair of the cap will be needed at the rate of once per year per 5 acres (0.2 per year per acre).

TABLE 3-5

COST ESTIMATE FOR SYNTHETIC CAP (ALTERNATIVE C1)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
Capital Costs					
1	Grade existing Main Fill	yd^3	2,500	2.00	5,000
2	Haul, place Far Fill	yd^3	600	1.90	1,140
3	Haul, place Back Fill	yd^3	1,100	5.15	5,665
4	Furnish, place synthetic membrane	ft^2	44,000	1.00	44,000
5	Borrow, place cover course	yd^3	1,200	6.50	7,800
6	Furnish, place topsoil (east slope)	yd^3	550	20.00	11,000
7	Furnish, place stone (west slope)	yd^3	300	29.50	8,850
8	Erosion control courses	yd^3	75	40.50	3,037
9	Mulching, seeding	ft^2	32,000	0.18	5,760
10	Replace sewage disposal system	Lump sum	1	4,000.00	4,000
11	Site restoration	Lump sum	1	6,000.00	6,000
12	Net scrap removal cost	Lump sum	1	12,500.00	12,500
					114,752
			Contingencies @ 20%		22,950
					137,702
		Eng'g, legal, administrative @ 30%			41,311
					179,013
Annual Costs (except monitoring)					
1	Mowing	Lump sum	4	25.00	100
2	Inspection	Lump sum	1	500.00	500
3	Repair (every 5 yrs)	Lump sum	0.2	500.00	100
					700

FIGURE 3-2



CROSS SECTION AT N+3000
OF ENLARGED MAIN FILL WITH CAP AND PVC LINER

The costs for Alternative C2 (clay cap) are presented in Table 3-6. The costs provide for 1 ft of clay, 2.8 ft of drainage sand and screened borrow from the site, and 0.5 ft of top soil. Comparison of Tables 3-6 and 3-5 indicates that the clay cap alternative costs five times the synthetic cap alternative. Hence, the formulation/evaluation of subsequent alternatives is based on a synthetic cap.

Alternative C3 provides for liming the ash prior to placement of a synthetic cap. Compared to Alternative C1 (synthetic cap), this step will provide greater assurance that there will be no release of lead if there is an unnoticed or unrepaired breach of the plastic fabric. The treatability study indicated that even without lime, there would be no measurable release of iron or cadmium if the cap were breached.

The estimated costs for Alternative C3 are presented in Table 3-7. The costs provide for disking 6 in. of lime into the top of the ash. As justified by the treatability study presented in Appendix C, lime powder is the selected type of lime. The specifications for this lime are presented in Appendix E.

Comparison of Tables 3-5 and 3-7 indicates that the lime would add $24,645 (including incremental contingencies, engineering, legal, and administrative costs), or 14%, to the cost of the synthetic cap alternative.

Alternatives With a Soil Cap

These alternatives would eliminate erosion of ash and minimize, but not fully eliminate, rainwater percolation through an enlarged Main Fill. The Back and Far Fills would be eliminated as sources of metals to the groundwater by excavating that material and consoli-

TABLE 3-6

COST ESTIMATE FOR CLAY CAP (ALTERNATIVE C2)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
Capital Costs					
1	Grade existing Main Fill	yd^3	2,500	2.00	5,000
2	Haul, place Far Fill	yd^3	600	1.90	1,140
3	Haul, place Back Fill	yd^3	1,100	5.15	5,665
4	Furnish, place clay liner	ft^2	44,000	10.00	440,000
5	Borrow, place cover course	yd^3	4,500	5.25	23,625
6	Furnish, place topsoil (east slope)	yd^3	550	20.00	11,000
7	Furnish, place stone (west slope)	yd^3	300	29.50	8,850
8	Erosion control courses	yd^3	100	40.50	4,050
9	Mulching, seeding	ft^2	32,000	0.18	5,760
10	Replace sewage disposal system	Lump sum	1	4,000.00	4,000
11	Site restoration	Lump sum	1	6,000.00	6,000
12	Net scrap relocation cost	Lump sum	1	12,500.00	12,500
					527,590
				Contingencies @ 20%	105,518
					633,108
				Eng'g., legal, administrative @ 30%	189,932
					823,040
Annual Costs (except monitoring)					
1	Mowing	Lump sum	4	25.00	100
2	Inspection	Lump sum	1	500.00	500
3	Repair (every 5 yrs)	Lump sum	0.2	500.00	500
					700

TABLE 3-7

COST ESTIMATE FOR SYNTHETIC CAP WITH LIME (ALTERNATIVE C3)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
Capital Costs					
1	Grade existing Main Fill	yd^3	2,500	2.00	5,000
2	Haul, place Far Fill	yd^3	600	1.90	1,140
3	Haul, place Back Fill	yd^3	1,100	5.15	5,665
4	Purchase lime	Ton	600	7.50	4,500
5	Deliver lime	Ton	600	12.33	7,398
6	Spread lime	Ton	600	6.50	3,900
7	Furnish, place synthetic membrane	ft^2	44,000	1.00	44,000
8	Borrow, place cover course	yd^3	1,200	6.50	7,800
9	Furnish, place topsoil (east slope)	yd^3	550	20.00	11,000
10	Furnish, place stone (west slope)	yd^3	300	29.50	8,850
11	Erosion control courses	yd^3	75	40.50	3,037
12	Mulching, seeding	ft^2	32,000	0.18	5,760
13	Replace sewage disposal system	Lump sum	1	4,000.00	4,000
14	Site restoration	Lump sum	1	6,000.00	6,000
15	Net scrap relocation cost	Lump sum	1	12,500.00	12,500
					130,550
			Contingencies @ 20%		26,110
					156,660
		Eng'g, Legal, Administrative @ 30%			46,998
					203,658
Annual Costs (except monitoring)					
1	Mowing	Lump sum	4	25.00	100
2	Inspection	Lump sum	1	500.00	500
3	Repair (every 5 yrs)	Lump sum	0.2	500.00	100
					700

dating it with the Main Fill. With time, the groundwater in these areas would be cleaned to within groundwater standards by natural recharge.

The consolidated Main Fill would be stabilized with riprap and capped with 1.2 ft of common borrow, i.e., till obtained from the site. The thickness of this cap is 50% more than that for the previously discussed alternatives. (The top soil thickness is the same). This provision would eliminate erosion as a source of metals to the environment and reduce, but not eliminate, acid rain infiltration by an estimated 70%. As indicated by the treatability study, the remaining infiltration would mobilize some lead. The lead concentrations would be in the 5-100 ug/l range. The New York State effluent limit for the discharge of lead to groundwater is 50 ug/l. Assuming acid rain and erosion account equally for the present lead downgradient of the Main Fill, this alternative would reduce the lead release by approximately 85% (ignoring the incremental load from the consolidated ash from the Back and Far Fills).

The estimated cost for this Alternative (C4) is presented in Table 3-8. As with the other alternatives that provide a cap, these costs do not include restoration of the Back and Far Fill areas, and value of lost storage space on the Main and Back Fills. As cap integrity would not have to be addressed, the annual program specifies semiannual vegetative maintenance and biennial engineering inspection. No cap repair would be needed.

Alternative C5 (Table 3-9) is comparable to Alternative E1 except that 6 in. of lime would be disked into the top of the ash before the cap is placed. The lime is that described for Alternative C3 (synthetic cap and lime). The impact of the lime would be to eliminate the leaching of lead by infiltration during rain. Assuming

TABLE 3-8

COST ESTIMATE FOR SOIL CAP (ALTERNATIVE C4)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
Capital Costs					
1	Grade existing Main Fill	yd^3	2500	2.00	6,250
2	Haul, place Far Fill	yd^3	600	1.90	1,140
3	Haul, place Back Fill	yd^3	1100	5.15	5,665
4	Borrow, place cover course	yd^3	1800	5.25	9,450
5	Furnish, place topsoil (East slope)	yd^3	550	20.00	11,000
6	Furnish, place stone (West slope)	yd^3	300	29.50	8,850
7	Erosion control courses	yd^3	75	40.50	3,037
8	Mulching, seeding	ft^2	32000	0.18	5,760
9	Replace sewage disposal system	Lump sum	1	4,000.00	4,000
10	Site restoration	Lump sum	1	6,000.00	6,000
11	Net scrap relocation cost	Lump sum	1	12,500.00	12,500
					73,652
				Contingencies @ 20%:	14,730
					88,382
				Eng'g, legal, administrative @ 30%:	26,515
					114,897
Annual Costs (except monitoring)					
1	Mowing	Lump sum	2	25.00	100
2	Inspection	Lump sum	0.5	500.00	250
					350

TABLE 3-9

COST ESTIMATE FOR SOIL CAP WITH LIME (ALTERNATIVE C5)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
Capital Costs					
✓ 1	Grade existing Main Fill	yd^3	2500	2.00	6,250
2	Haul, place Far Fill	yd^3	600	1.90	1,140
3	Haul, place Back Fill	yd^3	1100	5.15	5,665
4	Purchase lime	Ton	600	7.50	4,500
5	Deliver lime	Ton	600	12.33	7,398
6	Spread lime	Ton	600	6.50	3,900
7	Borrow, place cover course	yd^3	1800	5.25	9,450
8	Furnish, place topsoil (East slope)	yd^3	550	20.00	11,000
9	Furnish, place stone (West slope)	yd^3	300	29.50	8,850
10	Erosion control courses	yd^3	75	40.50	3,037
11	Mulching, seeding	ft^2	32000	0.18	5,760
12	Replace sewage disposal system	Lump sum	1	4,000.00	4,000
13	Site restoration	Lump sum	1	6,000.00	6,000
14	Net scrap relocation cost	Lump sum	1	12,500.00	12,500
					89,450
				Contingencies @ 20%:	17,890
					107,340
				Eng'g, Legal, Administrative @ 30%:	32,202
					139,542
Annual Costs (except monitoring)					
1	Mowing	Lump sum	4	25.00	100
2	Inspection	Lump sum	0.5	500.00	250
					350

15 in./yr of infiltration, the lime would not be exhausted until after 500 years (see Appendix C - Treatability Study).

Regeneration of the lime after exhaustion could be accomplished by one of the following means:

1. Pump lime slurry with injection points through the surface of the cap to the top of the ash
2. Excavate all or a portion of the cap, reline, recap, and resod.

Pumping should be more cost-effective.

The reduced infiltration, together with the use of lime, should result in leachate that meets the standards for discharge to groundwater (50 ug/l). Accordingly, the reduced load, when mixed with other waters, should result in the achievement of the lead groundwater standard at some future date.

3.5 IMPERVIOUS CAP AND GROUNDWATER REMEDIATION (ALTERNATIVE D)

The alternative provides for a synthetic cap and liming of the fill as described in Alternative C3. To speed the cleaning of the surficial aquifer, Alternative D also provides for groundwater recovery at the three fill sites. Recovery would be accomplished by the installation of sand-packed tile drains downgradient of each fill. The drains would discharge to a sump from which the recovered groundwater would be pumped to a covered holding basin. Water would then be removed to an off-site disposal facility by a tanker truck. Alternatively, an on-site treatment facility could be constructed that might be more cost-effective than off-site disposal. However, since it is unlikely that sufficient treatment could be provided to achieve effluent metals concentrations of less than one part per billion to meet stream standards, on-site treatment was not evaluated.

The groundwater yields downgradient of each fill are estimated to be in the range of 2000-3000 gal/day. Based on these projections, a 30,000-gal covered storage basin would be required.

The estimated costs for this alternative are presented in Table 3-10. For the purposes of cost estimation, it is assumed that groundwater recovery would continue for 20 years.

3.6 SUMMARY

The costs for the alternatives are summarized in Table 3-11. Present worth and equivalent annual cost are calculated with a 10% interest rate. These costs to not include environmental monitoring described in Chapter 4.

TABLE 3-10 (Page 1 of 2)

COST ESTIMATE FOR SYNTHETIC CAP WITH LIME AND GROUNDWATER RECOVERY (ALTERNATIVE D)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
Capital Costs					
1	Grade existing Main Fill	yd^3	2,500	2.00	5,000
2	Haul, place Far Fill	yd^3	600	1.90	1,140
3	Haul, place Back Fill	yd^3	1,100	5.15	5,665
4	Purchase lime	Ton	600	7.50	4,500
5	Deliver lime	Ton	600	12.33	7,398
6	Spread lime	Ton	600	6.50	3,900
7	Furnish, place synthetic membrane	ft^2	44,000	1.00	44,000
8	Borrow, place cover course	yd^3	1200	6.50	7,800
9	Furnish, place topsoil (east slope)	yd^3	550	20.00	11,000
10	Furnish, place stone (west slope)	yd^3	300	29.50	8,850
11	Erosion control courses	yd^3	75	40.50	3,038
12	Mulching, seeding	ft^2	32,000	0.18	5,760
13	Replace sewage disposal system	Lump sum	1	4,000.00	4,000
14	Site restoration	Lump sum	1	6,000.00	6,000
15	Excavate drainage trench	yd^3	745	3.18	2,369
16	Install drainage pipe	ft	840	5.09	4,276
17	Gravel Back Fill	yd^3	1,182	3.41	4,031
18	Trench shoring (Far Back Fill)	ft^2	6,000	7.60	45,600
19	Manholes (incl. exc., etc.)	Each	3	1780.80	5,342
20	Dewatering	8-hr shift	6 shifts (2 days)	106.00	636
21	Electrical trench and cable	ft	1,060	0.93	986
22	Sump pump and installation	Each	3	192.00	576
23	Discharge drain	ft	1,240	3.70	4,588

TABLE 3-10 (Page 2 of 2)

COST ESTIMATE FOR SYNTHETIC CAP WITH LIME AND GROUNDWATER RECOVERY (ALTERNATIVE D)

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE ($)	AMOUNT ($)
24	30,000-gal holding tank	Each	1	34,980.00	34,980
25	Move earth to insulate tank	yd^3	745	1.81	1,348
26	Net scrap relocation cost	Lump sum	1	12,500.00	12,500
					235,283
			Contingencies @ 20%:		47,057
					282,340
		Eng'g, legal, administrative @ 30%:			84,702
TOTAL					367,042
ANNUAL COSTS (except monitoring)					
1	Mowing	Lump sum	4	25.00	100
2	Inspection	Lump sum	1	500.00	500
3	Water trucking	Gal	900,000	0.50	450,000
4	Water treatment	Gal	900,000	1.50	1,350,000
TOTAL ANNUAL COSTS					1,800,600

TABLE 3-11

SUMMARY OF ALTERNATIVES

ALTERNATIVE	CAPITAL COST ($)	ANNUAL COST ($/yr)	PRESENT WORTH ($)	EQA ($/yr)
A No action	0	0	0	0
B Off-site disposal	3,670,195	0	3,670,195	374,727
C Cap				
C1 Synthetic cap	179,013	700	185,612	19,690
C2 Clay cap	823,040	700	829,639	88,008
C3 Synthetic cap and lime	203,658	700	210,257	22,304
C4 Soil cap	114,897	350	118,196	12,539
C5 Soil cap with lime	139,542	350	142,841	15,152
D Synthetic cap with lime and groundwater recovery	367,042	1,800,600[a]	17,010,934	1,804,520
E Soil cap				

EQA - Equivalent annual cost.

Cost estimates are based on prices that prevailed on 1 January 1988 (Engineering News-Record Index 20 Cities Average of 4,457).

Present worth and EQA based on 10% interest and 30-year time period.

Costs do not include environmental monitoring (Chapter 4).

[a]20 years for groundwater recovery.

CHAPTER 4

ENVIRONMENTAL MONITORING

4.1 FAR FILL GROUNDWATER

The three monitoring wells should be sampled for conductivity and pH once during each of years 1, 3 and 5 after completion of the selected remedial alternative. Additionally, during the last sampling, there should be testing for the metals of concern identified during the remedial investigation:

Lead
Selenium
Aluminium
Iron
Manganese

Total metals (unfiltered) should be tested.

4.2 BACK FILL GROUNDWATER

The three monitoring wells should be sampled for conductivity and pH once during each of years 1, 3 and 5 after completion of the selected remedial alternative. Additionally, during the last sampling, there should be testing for the metals of concern identified during the remedial investigation:

Cadmium
Lead
Zinc
Aluminium
Iron
Manganese

Total metals (unfiltered) should be tested.

4.3 MAIN FILL GROUNDWATER

The five monitoring wells should be sampled for 25 years for conductivity, pH, and any metals of concern identified for this or the other two fills:

Cadmium
Lead
Zinc
Aluminium
Iron
Manganese

Total metals should be tested. The frequency of sampling should be once during each of years 1, 3 and 5 after completion of the selected remedial alternative, and then once every five years, thereafter.

4.4 ESTIMATED COSTS

Estimated costs for sampling and analyses during years 1 and 3 (consisting of pH and conductivity at all monitoring wells and cadmium, lead, zinc, aluminum, iron, and manganese at the Main Fill monitoring wells) are:

Sampling, management, and report	$2,900
Supplies, expenses	300
Analytical costs	100
	$3,300
Contingencies @ 20%	700
	$4,000
Legal, engineering @ 30%	1,200
Total	$5,200

The estimated cost for sampling and analysis during year 5 (consisting of the annual program plus a final analysis for lead, selenium, aluminum, iron, and manganese at the Far Fill monitoring wells and analysis of cadmium, lead, zinc, aluminum, iron, and manganese at the Back Fill monitoring wells) would cost:

Sampling, management, and report	$3,000
Supplies, expenses	300
Analytical costs	300
	$3,600
Contingencies @ 20%	700
	$4,300
Legal, engineering @ 30%	1,300
Total	$5,600

This estimate is based on costs that prevailed on 1 January 1988. After the initial five year monitoring program, sampling would be conducted only at the Main Fill monitoring wells. The estimated costs are:

Sampling, management, and report	$2,700
Supplies, expenses	300
Analytical costs	100
	$3,100
Contingencies @ 20%	600
	$3,700
Legal, engineering @ 30%	1,100
Total	$4,800

4.5 SUMMARY

Table 4-1 summarizes the environmental monitoring.

TABLE 4-1

ENVIRONMENTAL MONITORING

YEAR	ACTIVITY		ESTIMATED ANNUAL COST ($)[a]
	FAR AND BACK FILLS	MAIN FILL	
1	pH and conductivity	pH, conductivity, metals	5,200
3	pH and conductivity	pH, conductivity, metals	5,200
5	pH, conductivity, metals	pH, conductivity, metals	5,600
10		pH, conductivity, metals	4,800
15		pH, conductivity, metals	4,800
20		pH, conductivity, metals	4,800
25		pH, conductivity, metals	4,800
	Total cost		35,200

[a]Cost estimates are based on prices as of 1 January 1988.

APPENDIX A

SUMMARY TABLES FROM PRIOR LMS REPORTS

TABLE A-1

SUMMARY OF RESULTS FOR GROUNDWATER SAMPLES

November 1986

STANDARD OR LOCATION		CONCENTRATION (ug/l)									
		As	Ba	Cd	Cr[a]	Pb	Hg	Ni	Zn	pH S.U.	Conductivity (umhos/cm)
GROUNDWATER STANDARD		25	1000	10	NS	25	2	2000[b]	5000	6.5-8.5	NS
MAIN (NORTH) FILL											
Upgradient:	MW1	LT 5	80	LT 5	LT 25	9	LT 0.2	LT 25	130	5.0	70
	MW2	LT 5	130	LT 5	LT 25	LT 5	LT 0.2	LT 25	50	6.0	260
Downgradient:	MW3	LT 5	130	8	LT 25	LT 5	LT 0.2	62	80	5.4	1020
	MW4	LT 5	200	8	LT 25	LT 5	LT 0.2	31	30	5.9	700
	MW5	LT 5	200	LT 5	LT 25	LT 5	LT 0.2	31	90	5.0	350
BACK (SOUTH) FILL											
Upgradient:	MW8	LT 5	400	LT 5	LT 25	LT 5	LT 0.2	LT 25	20	NT	NT
Downgradient:	MW6	LT 5	600	18[c]	LT 25	73[c]	LT 0.2	62	3200	4.3	210
	MW7	LT 5	600	31[c]	LT 25	6	LT 0.2	178	4900	4.6	410
FAR (EAST) FILL											
Upgradient:	MW9	LT 5	100	LT 5	LT 25	LT 5	LT 0.2	LT 25	10	6.4	50
Downgradient:	MW10	LT 5	50	LT 5	LT 25	LT 5	LT 0.2	LT 25	25	7.2	90
	MW11	LT 5	180	LT 5	LT 25	LT 5	LT 0.2	LT 25	33	6.4	180
SUPPLY WELL PW1		LT 5	180	LT 5	LT 25	LT 5	LT 0.2	LT 25	30	NT	NT

NOTE: All analyses conducted on filtered samples.

LT - less than.
NT - not tested.
NS - no standard.

[a]There is no groundwater standard for total chromium. The standard for hexavalent chromium is 50 ug/l.
[b]No standard; tabulated value is NYCRR Part 703 limit for discharge to groundwater.
[c]Exceeds standard.

TABLE A-2

COMPARISON OF RESULTS FOR FILTERED AND UNFILTERED GROUNDWATER SAMPLES

November 1986

STANDARD OR LOCATION	As	Ba	Cd	Cr[a]	Pb	Hg	Ni	Zn
	CONCENTRATION (ug/l)							
GROUNDWATER STANDARD	25	1000	10	NS	25	2	2000[b]	5000
MAIN (NORTH) FILL								
Downgradient								
MW4 - dissolved	LT 5	200	8	LT 25	LT 5	LT 0.2	31	30
- total (CAMO)	LT 5	390	10	83	21	LT 0.2	91	110
MW5 - dissolved	LT 5	200	LT 5	LT 25	LT 5	LT 0.2	31	90
- total (CAMO)	LT 5	300	5	LT 25	10	LT 0.2	46	160
- total (Versar)	20	NA	LT 10	16	LT 50[c]	LT 0.2	28	145
BACK (SOUTH) FILL								
Downgradient								
MW6 - dissolved	LT 5	520	18[d]	LT 25	73[d]	LT 0.2	62	3200
- total (CAMO)	LT 5	600	20[d]	30	380[d]	LT 0.2	91	2150
MW7 - dissolved	LT 5	600	31[d]	LT 25	6	LT 0.2	178	4900
- total (Versar)	16	NA	24[d]	20	72[d]	LT 0.2	180	4910
FAR (EAST) FILL								
Upgradient								
MW9 - dissolved	LT 5	100	LT 5	LT 25	LT 5	LT 0.2	LT 25	10
- total (Versar)	LT 10	NA	LT 10	5.3	52[d]	LT 0.2	LT 15	28
Downgradient								
MW11 - dissolved	LT 5	180	LT 5	LT 25	LT 5	LT 0.2	LT25	33
- total (CAMO)	LT 5	520	LT 5	95[d]	14	0.3	110	170

NOTE: All analyses by CAMO unless otherwise noted as Versar, the NYSDEC contract laboratory.

LT - Less than.
NA - Not analyzed.
NS - No standard.

[a]There is no groundwater standard for total chromium. The standard for hexavalent chromium is 50 ug/l.
[b]No standard; tabulated value is NYCRR Part 703 limit for discharge to groundwater.
[c]Suspected reporting error in detection limit.
[d]Exceeds standard.

TABLE A-3

SUMMARY OF NYSDEC RESULTS FOR ADDITIONAL PARAMETERS

November 1986

STANDARD OR LOCATION		CONCENTRATION (ug/l)				
	Be	Cu	Ag	Sb	Se	Tl
GROUNDWATER STANDARD	3	1000	50	3	20	4
MAIN (NORTH) FILL Downgradient: MW5	LT 2	25	LT 3	LT 10[a]	42[b]	LT 10[a]
BACK (SOUTH) FILL Downgradient: MW7	5.2[b]	126	LT 3	LT 10[a]	LT 5	LT 10[a]
FAR (EAST) FILL Upgradient: MW9	LT 2	5.6	LT 3	LT 10[a]	LT 5	LT 10[a]

NOTE: All analyses conducted on unfiltered samples by Versar, the NYSDEC contract laboratory.

LT - Less than.

[a]Detection limit greater than standard.
[b]Exceeds standard.

TABLE A-4

SUMMARY OF RESULTS FOR SURFACE WATER SAMPLES

November 1986

LOCATION	HARDNESS[a]	CONCENTRATION (ug/l)							
		Ba	Cd	Cr	Hg	Zn	Ni	As	Pb
S1 Start of flow									
Standard	NS	NS	LT 1	140	0.2	25	180	360	2
Sample (T)	4,600	80	LT 5	LT 25	LT 0.2	45	LT 25	LT 5	LT 5
S2 Inlet to pond									
Standard	NS	NS	LT 1	210	0.2	37	260	360	3
Sample (T)	7,500	80	LT 5	LT 25	LT 0.2	45	LT 25	LT 5	LT 5
S3 Pond outlet									
Standard	NS	NS	LT 1	210	0.2	37	260	360	3
Sample (T)	7,500	80	LT 5	LT 25	LT 0.2	40	LT 25	LT 5	LT 5
S4 Below fill									
Standard	NS	NS	LT 1	350	0.2	63	420	360	7
Sample (T)	14,100	80	LT 5	LT 25	LT 0.2	160	LT 25	LT 5	16
Sample (F)	-	80	LT 5	LT 25	0.2	55	LT 25	LT 5	14
S5 Mouth									
Standard	NS	NS	LT 1	630	0.2	120	720	360	17
Sample (T)	29,100	100	LT 5	LT 25	LT 0.2	48	LT 25	LT 5	21

NS - No standard.
LT - Less than.
T - Total metals.
F - Filtered (dissolved) metals.

[a]Hardness is from July 1987 sampling.

TABLE A-5

SUMMARY OF RESULTS FOR SEEPS

November 1986

STANDARD OR LOCATION	CONCENTRATION (ug/l)							
	As	Ba	Cd	Cr	Pb	Hg	Ni	Zn
STANDARD	No Applicable Standards							
MAIN (NORTH) FILL								
MF1 (T)	LT 5	400	18	LT 25	70	LT 0.2	53	1500
MF1 (F)	LT 5	350	17	LT 25	33	LT 0.2	50	1550
MF2 (T)	LT 5	80	LT 5	LT 25	29	LT 0.2	34	1050
MF3 (T)	LT 5	100	LT 5	LT 25	235	LT 0.2	LT 25	235
FAR (EAST) FILL								
FF1 (T)	LT 5	50	LT 5	LT 25	LT 5	LT 0.2	LT 25	50
BACK (SOUTH) FILL								
BF1	LT 5	530	16	LT 25	30	LT 0.2	97	7200
BF2	LT 5	180	29	LT 25	15	LT 0.2	161	5800
BF3	LT 5	80	LT 5	LT 25	5	LT 0.2	LT 25	118

LT - Less than.

TABLE A-6

SUMMARY OF RESULTS FOR GROUNDWATER SAMPLES

July 1987

STANDARD OR LOCATION		CONCENTRATION (ug/l) Cd	Cr	Pb	Zn	Be	Se[a]	pH (S.U.)	CONDUCTIVITY (umhos/cm)	TURBIDITY (NTU)
GROUNDWATER STANDARD		10	50	25	5000	NS	20	6.5–8.5	NS	NS
MAIN FILL										
Upradient:	MW1	LT 5	LT 30	LT 5	NA	LT 1	LT 5	5.8	74	85
	MW2	LT 5	LT 30	LT 5	NA	LT 1	195[b]	6.7	454	140
Downgradient:	MW3	9	LT 30	LT 5	NA	LT 1	8	5.4	1165	86
	MW4	LT 5	LT 30	LT 5	90	LT 1	11	6.0	1195	120
	MW5	LT 5	LT 30	LT 5	NA	1	58[b]	6.0	643	49
BACK FILL										
Upgradient:	MW8	LT 5	LT 30	LT 5	20	LT 1	LT 5	7.2	572	35
Downgradient:	MW6	13[b]	30	53[b]	2390	6	10	4.6	385	90
	MW7	54[b]	LT 30	29[b]	10300[b]	10	8	4.3	1063	28
FAR FILL										
Upgradient:	MW9	LT 5	LT 30	5	NA	LT 1	LT 5	6.5	77	62
Downgradient:	MW10	LT 5	LT 30	LT 5	NA	LT 1	645[b]	6.2	251	225
	MW11	LT 5	LT 30	5	NA	LT 1	415[b]	6.7	340	260
SUPPLY WELL	PW1	LT 5	LT 30	LT 5	NA	LT 1	LT 5	7.1	198	4

NOTE: All analyses conducted on filtered samples.

LT - Less than.
NA - Not tested.
NS - No standard.

[a]Suspect results; see discussion on selenium.
[b]Exceeds standard.

TABLE A-7

COMPARISON OF RESULTS FOR FILTERED AND UNFILTERED GROUNDWATER SAMPLES

July 1987

STANDARD OR LOCATION	CONCENTRATION (ug/l) Cd	Cr[a]	Pb	Zn	Be	Se[b]
GROUNDWATER STANDARD	10	NS	25	5000	NS	20
MAIN (NORTH) FILL						
Downgradient:						
MW4 - dissolved	LT 5	LT 30	LT 5	90	LT 1	11
- total (CAMO)	LT 5	LT 30	26[c]	90	1	5
MW5 - dissolved	LT 5	LT 30	LT 5	NT	1	58[c]
- total (Versar)	5	11	16	95	1	50[c]
BACK (SOUTH) FILL						
Upgradient:						
MW8 - dissolved	LT 5	LT 30	LT 5	20	LT 1	LT 5
- total (CAMO)	LT 5	LT 30	16	20	LT 1	LT 5
Downgradient:						
MW6 - dissolved	13[a]	30	53[c]	2390	6	10
- total (Versar)	16[a]	43	202[c]	2780	6	LT 5
MW7 - dissolved	54[c]	LT 30	29[c]	10300[c]	10	8
- total (CAMO)	58[c]	LT 30	37[c]	10500[c]	20	LT 5
FAR (EAST) FILL						
Downgradient:						
MW11 - dissolved	LT 5	LT 30	5	NT	LT 1	415[c]
- total (CAMO)	LT 5	LT 30	20	NT	1	645[c]
- total (Versar)	5	48	25	151	2	6

NOTE: All analyses by CAMO unless otherwise noted as Versar, the NYSDEC contract laboratory.

LT - Less than.
NA - Not analyzed.

[a]There is no groundwater standard for total chromium. The standard for hexavalent chromium is 50 ug/l.
[b]Suspect results; see discussion on selenium.
[c]Exceeds standard.

TABLE A-8

SUMMARY OF NYSDEC RESULTS FOR ADDITIONAL PARAMETERS

July 1987

CONCENTRATION (ug/l)	STANDARD	LOCATION (ALL DOWNGRADIENT) MW5 MAIN FILL	MW6 BACK FILL	MW11 FAR FILL
Al	2000[a]	6240[b]	24000[b]	25000[b]
Sb	NS	32	62	72
As	25	LT 10	14	LT 10
Ba	1000	138	430	330
Ca	NS	28000	21000	6090
Co	NS	13	56	25
Cu	1000	38	181	54
Fe	300	11000[b]	33000[b]	46000[b]
Hg	2	LT 0.2	LT 0.2	LT 0.2
Mn	300	2800[b]	17020[b]	1801[b]
Mg	NS	17000	18000	18000
Ni	2000[a]	22	107	49
K	NS	17000	5940	37000
Ag	50	6	6	6
Na	NS	29000	16000	19000
Tl	NS	LT 10	LT 10	LT 10
V	NS	6	21	18

NOTE: All analyses conducted on unfiltered samples by Versar, the NYSDEC contract latoratory.

NS - No standard.

[a]No standard; tabulated value is NYCRR Part 703 limit for discharge to groundwater.
[b]Exceeds standard.

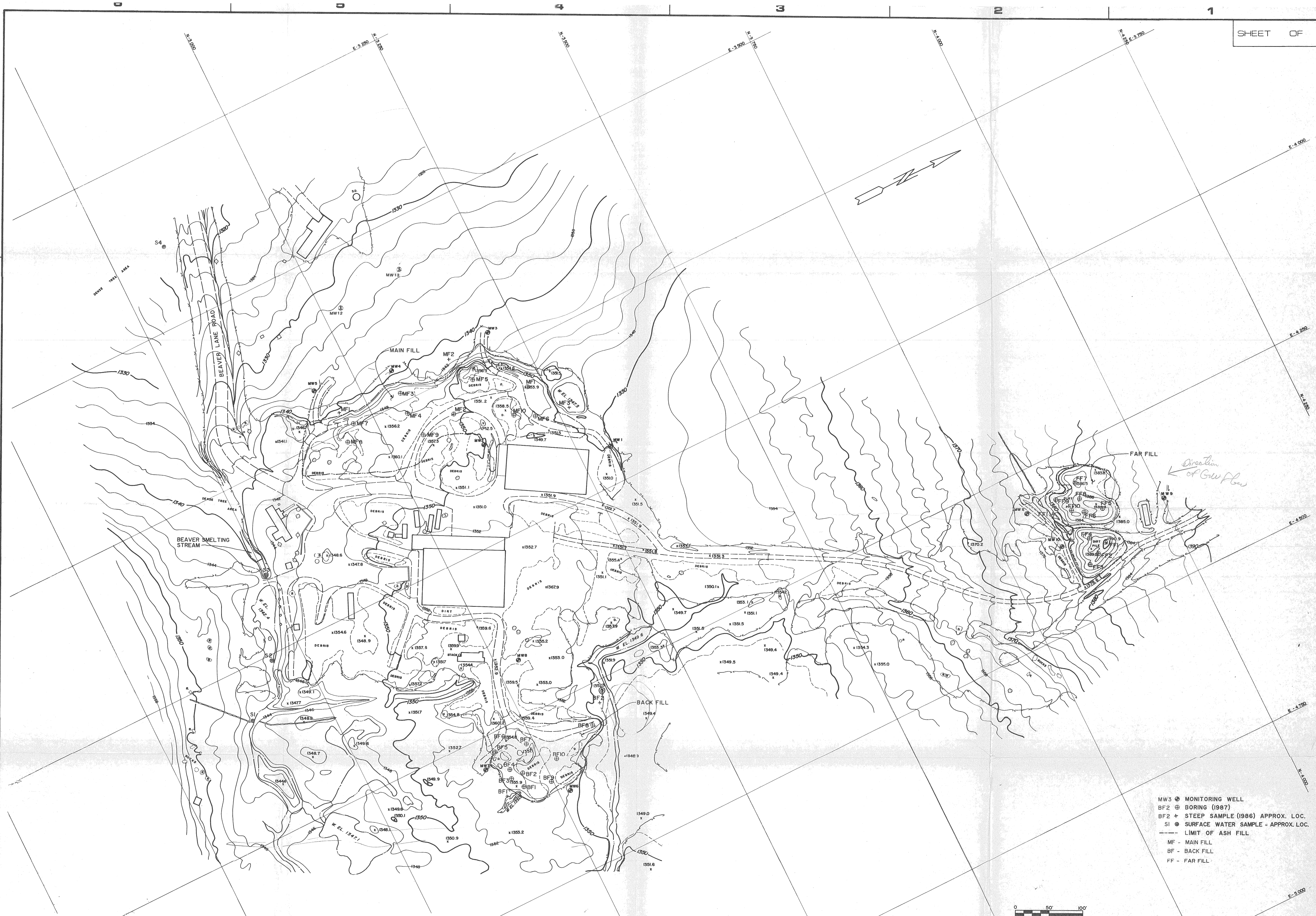
TABLE A-9

SUMMARY OF RESULTS FOR SURFACE WATER SAMPLES

July 1987

LOCATION			HARDNESS	Cd	Pb	Zn
			CONCENTRATION (ug/l)			
Beaver Smelting Stream						
S-1	Start of flow:	Sample	4600	6	18	30
		Standard	NS	LT 1	2	25
S-2	Inlet to pond:	Sample	7500	LT 5	9	30
		Standard	NS	LT 1	3	37
S-3	Pond outlet:	Sample	7500	LT 5	15	30
		Standard	NS	LT 1	3	37
S-4	Below fill:	Sample	14100	7	126	70
		Standard	NS	LT 1	7	63
S-8	Halfway to mouth:	Sample	25700	LT 5	115	120
		Standard	NS	LT 1	15	104
S-5	Mouth:	Sample	29100	LT 5	58	90
		Standard	NS	LT 1	17	120
Neversink River						
S-6	Upstream:	Sample	9600	LT 5	LT 5	LT 10
		Standard	NS	LT 1	LT 1	30
S-7	Downstream:	Sample	7500	LT 5	LT 5	LT 10
		Standard	NS	LT 1	LT 1	30

NS - No standard.
LT - Less than.



NO.	ZONE	REVISIONS	DATE	BY	APP'D.
1	C5	ADDED MW12, MW13	8/89	PET	

DESIGNED ______ DATE ______
DRAWN ______ DATE ______
CHECKED ______ DATE ______
APPROVED ______ DATE ______

______ DATE ______

Lawler, Matusky & Skelly Engineers

Environmental Science & Engineering Consultants

One Blue Hill Plaza
Pearl River, New York 10965

WHITEMAN OSTERMAN & HANNA
CONTRACT 2
BEAVER SMELTING AND REFINING CORP.
BEAVER LANE
WOODBOURNE, SULLIVAN COUNTY, NEW YORK
SITE REMEDIATION

EXISTING SITE PLAN

SCALE 1" = 50' CONTOUR INTERVAL 2'

DATE 9/2/88

DWG. NO. 1