

2021 Hazardous Waste Scanning Project

File Form Naming Convention.

(File_Type).(Program).(Site_Number).(YYYY-MM-DD).(File_Name).pdf

Note 1: Each category is separated by a period "."

Note 2: Each word within category is separated by an underscore "_"

Specific File Naming Convention Label:

RepsA.HW.932020.1982-04-01.Env-Info.pdf

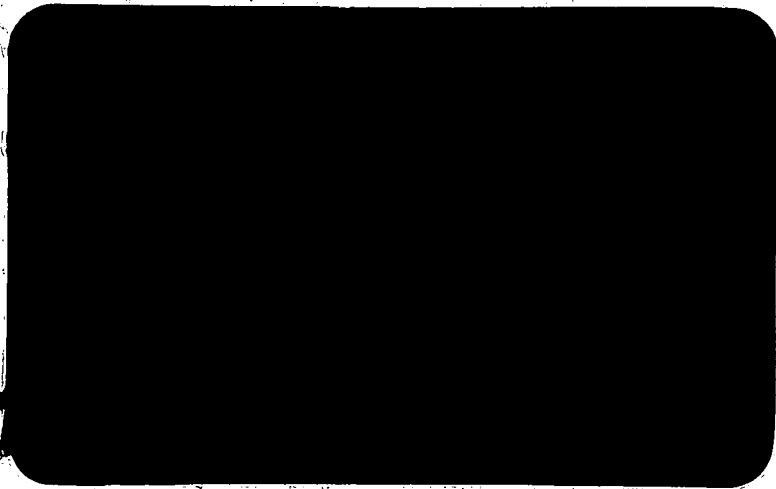
N09.40

IMMEDIATE
REMEDIAL
ACTION—
UNCONTROLLED HAZARDOUS
WASTE DISPOSAL SITES

Zone 1

CAMP DRESSER & MCKEE INC.
CH2M HILL

CONESTOGA-ROVERS & ASSOCIATES LIMITED
HALEY & ALDRICH, INC.
HARPER-OWES
ENTEKO
ARTHUR D. LITTLE, INC.



For additional information about EPA's "Immediate Remedial Action Program", contact Program Coordinator, Gary A. Dunbar at Camp Dresser & McKee Inc., 617 742-5151.

PRELIMINARY DRAFT REPORT

LOVE CANAL
REMEDIAL ACTION PROGRAM

ENVIRONMENTAL
INFORMATION DOCUMENT



April 1982

Project No. W54923.B3

LOVE CANAL PROJECT 1 ACTIVITY SCHEDULE

<u>Activity</u>	<u>Date (week of)</u>
Release of EPA Report	4/19
Release of EID	5/3
Public Meeting in Niagara Falls	5/17
Advertise for Bids	5/24
Receive Bids	6/21
Evaluate/Award Bids	7/19
Contractor Mobilize/Begin	8/2
First Phase Complete	11/15
Second Phase Begin	April, 1983
Second Phase Complete	August, 1983

Note: This schedule assumes that the EPA Report release will not delay Project 1. Times shown are estimates that are subject to considerable change dependent upon each sequential step. Construction time estimates can be more accurately projected when the design has been completed.

PRELIMINARY DRAFT REPORT

**LOVE CANAL
REMEDIAL ACTION PROGRAM**

**ENVIRONMENTAL
INFORMATION DOCUMENT**



October 1981

Project No. W54923.B3



CONTENTS

	<u>Page</u>
List of Tables	iv
List of Figures	v
Summary	S - 1
1.0 Introduction	1 - 1
2.0 Project Objectives	2 - 1
3.0 Description of Preliminary Alternatives	3 - 1
3.1 Alternative One - No Additional Action	3 - 1
3.2 Utility Cut-Off Containment	3 - 2
3.3 Partial Slurry Wall Containment	3 - 9
3.4 Complete Slurry Wall Containment	3 - 10
4.0 Cost of Preliminary Alternatives	4 - 1
4.1 No Additional Action Alternative	4 - 1
4.2 Utility Cut-Off Containment	4 - 2
4.3 Partial Slurry Wall Containment	4 - 2
4.4 Complete Slurry Wall Containment	4 - 2
4.5 Cost Considerations	4 - 2
5.0 Evaluation of Preliminary Alternatives	5 - 1
5.1 Performance Criteria	5 - 1
6.0 Detailed Development of Selected Alternative	6 - 1
6.1 Leachate Collection Rates	6 - 3
6.2 Need for Monitor Wells	6 - 7
6.3 Estimated Cost of Selected Alternatives	6 - 7
6.4 Health and Safety Considerations	6 - 8
6.5 Coordination with NYSDOT Contract	6 - 9
6.6 Environmental Considerations	6 - 11
 APPENDIX	
A Document Summary	A - 1
B Health and Safety Plan	B - 1

TABLES

		<u>Page</u>
3 - 1	Cutoff Wall Design Data	3 - 3
4 - 1	Alternative 1 - No Additional Action	4 - 3
4 - 2	Alternative 2 - Utility Cutoff Con- tainment	4 - 4
4 - 3	Alternative 3 - Partial Slurry Wall Containment	4 - 6
4 - 4	Alternative 4 - Complete Slurry Wall Containment	4 - 8
4 - 5	Summary of Life Cycle Costs	4 - 10
5 - 1	Performance Criteria Evaluation	5 - 2

FIGURES

3 - 1	Alternative 2 - Typical Connection of Existing Storm Inlets for Offsite Conveyance of Runoff	3 - 4
3 - 2	Alternative 2 - Proposed Modifications to Existing Stormwater Catch Basins	3 - 5
3 - 3	Love Canal Facilities After House Demolition	3 - 6
3 - 4	Alternative 2 - Utility Cutoff Con- tainment	3 - 7
3 - 5	Alternative 3 - Partial Slurry Wall Containment	3 - 8
3 - 6	Alternative 4 - Complete Slurry Wall Containment	3 - 11
6 - 1	Selected Plan	6 - 4
6 - 2	Selected Plan - Typical Cross Section	6 - 5



SUMMARY

Numerous investigations have been conducted during the past few years to document the effects upon the surrounding area of past hazardous waste disposal practices at Love Canal. This report was authorized to evaluate alternative plans for the first of a number of planned remedial actions at the site, and to develop in detail, a conceptual plan to be selected by the United States Environmental Protection Agency and New York State Department of Environmental Conservation.

Several preliminary plans were evaluated, as follows:

- o One No-Additional-Action Plan, providing for continued operation of the existing leachate collection system and treatment facilities at an average flow rate of about 8 gallons per minute.
- o Three variations of a plan to expand the existing leachate collection system using components of the storm and sanitary sewers and drains around the houses. This would increase the treatment plant average flow rate to between 11 and 28 gallons per minute. By increasing the interception of contaminated groundwater, this plan would reduce the movement of groundwater away from the site. These alternatives were eliminated based on preliminary evaluation and also on the announcement of plans to demolish all houses within the fence.
- o Three plans to partially contain the site within a slurry wall extending from ground surface to a clay formation of reduced permeability at a depth of up to 14 feet, plus expansion of the existing clay cap to cover most of the area within the slurry wall. This approach could reduce treatment plant flow rates to about 3 gallons per minute.

Preliminary cost analyses indicated that life cycle costs for the containment plans are substantially lower than for the other plans due to lower operation, maintenance, and replacement costs. Health and safety considerations, environmental effects, and several other criteria also favored implementation of a containment plan.

Subsequently, a plan was selected for detailed development and evaluation, reflecting a containment concept with a treatment plant flow rate averaging about 3 gallons per minute. The selected plan includes surrounding the entire site with a slurry wall and covering essentially all of the

site with a clay cap, graded to promote increased surface runoff from the site. Existing utility lines crossing the site boundary will be cut off and plugged. Most existing monitor wells will be maintained, and new water and wastewater lines will be provided to serve the leachate treatment plant. Provisions will be made for continued utility service to the school. The existing storm and sanitary sewers may be cleaned within the site to remove contaminated deposits before these lines are plugged. Also, the slurry wall may be constructed using a vibrated beam method or using an excavated trench, backfilled with slurry.

These activities have been coordinated with the planned NYSDOT demolition contract to reduce redundant activity and improve the total project effectiveness. The work described in Chapter 6 of this report is planned to begin in the fall of 1982 with a two phase construction period ending in the summer of 1983.



1.0--INTRODUCTION

CH2M HILL was authorized by the United States Environmental Protection Agency (USEPA) and the New York State Department of Environmental Conservation (NYSDEC) to complete the first of a number of potential projects designed to contain and/or remove contamination directly attributable to past waste disposal practices at Love Canal. This first project considered only the problems within the fenced area. A number of projects relating to the solution of problems outside the fence are planned. Project 1 includes preparation of bidding documents for implementation of the remedial action program at the Love Canal site, and also includes preparation of this Environmental Information Document (EID). The purpose of the EID is to develop and evaluate alternatives for remedial action within the fenced compound area directly surrounding the canal. One alternative, selected by NYSDEC and USEPA for further evaluation, is developed in detail.

Considerable study has been conducted at Love Canal over the last several years. The selection and design of the planned action described in this report is based on data collected in the prior studies and made available to the consultants, as summarized in Appendix A.

The remedial action project has been significantly altered by decisions made in recent months. Homes in Rings 1 and 2 are now planned for demolition in early summer 1982 and the initiation of construction described in this report is not planned until early fall. These decisions have eliminated the need to consider several of the alternatives developed in the initial draft of this report. The development of the selected alternative has taken into account information made available to the consultants by March 1, 1982.



2.0--PROJECT OBJECTIVES

CH2M HILL's Draft Work Plan, dated September 29, 1981, expressed a need to restate the project objectives to assure a clearer understanding of NYSDEC's Work Directive. This was accomplished at a meeting between CH2M HILL, USEPA, and NYSDEC in Washington, D.C., on October 13, 1981. The restated objectives are to be accomplished using existing data and can be completed within the initially required time frame. The restated objectives, although not significantly different from the initial objectives, allow a clearer comparison between the various alternatives being considered for Project 1.

Project 1, therefore, is designed to accomplish the following objectives:

1. To prevent the movement of significant contaminants off-site through the storm and sanitary sewers, roads, and other utility systems.
2. To isolate the transport of surface runoff from the site and increase the volume of runoff.
3. To improve the collection of contaminants in the shallow groundwater by collecting subsurface flow into the leachate collection and treatment system.
4. To reduce the flow of shallow groundwater from the site.

The Environmental Information Document addresses each of the alternative plans in terms of their ability to meet these project objectives as well as other performance criteria described in Section 5.



3.0--DESCRIPTION OF PRELIMINARY ALTERNATIVES

A meeting was held on October 13, 1981, with representatives from EPA and NYSDEC. As a result of this meeting, five principal alternatives were selected for preliminary evaluation, one of which had two variations that were considered. The decision to demolish homes in Rings 1 and 2 eliminated two of these alternatives from further consideration. However, these two alternatives had been tentatively rejected on both an economic and technical basis, prior to this decision. In the following section, each of the remaining alternatives is described in sufficient detail to support subsequent evaluation and economic analysis.

3.0--ALTERNATIVE ONE--NO ADDITIONAL ACTION

As implied by the name, this alternative entails no additional measures within the fenced area to contain or control contamination directly attributable to Love Canal. The present leachate collection and treatment system would continue in operation. Storm and sanitary sewer flows would continue to leave the area except where these sewers are currently plugged. No further measures would be implemented to expand the leachate collection system, and no sewer cleaning and rehabilitation would be conducted. This alternative does not preclude additional measures outside the fenced area that are beyond the scope of this project. It is assumed that leachate flow to the existing onsite treatment plant would probably increase as a result of the changed area percolation characteristics following home demolition.

The present leachate treatment plant is designed for maximum flows of 200 gallons per minute (gpm). During the period January 1980 to February 1981, flows averaged 8.3 gpm (12,016 gallons per day, gpd). The peak day flow was 48 gpm, declining to 41 gpm for the peak 3-day flow occurring in February 1981. Since the high flows generated during the initial operation of the temporary leachate collection and treatment facilities in late 1979, average monthly leachate flows have ranged from 204,200 gallons to 664,800 gallons.

In addition to the treatment plant flow averaging 8.3 gpm, an additional unknown flow leaves the site in the storm and sanitary sewers, resulting from infiltration to these sewer systems. An attempt has not been made to quantify this flow, however the additional flow is probably in the range of 2 to 7 gpm, based on calculations from infiltration flows in the Niagara Falls area. The total flow leaving the site under present conditions is estimated at 10 to 15 gpm.

3.2--UTILITY CUT-OFF CONTAINMENT

Previous investigations have concluded that the lateral movement of contaminants from Love Canal occurs primarily along paths of least hydraulic resistance such as sewer lines and pipe trenches. There is little evidence of lateral movement through area soils of low permeability. Trenches excavated and backfilled during utility pipeline construction may provide preferential pathways through which contaminated material may move, particularly considering that backfill materials are not well documented. For this reason, it is desirable to construct a slurry trench or slurry wall at each point along the fence line where a road or utility line crossing is known to exist to reduce the potential for off-site migration of contaminants.

Review of available records regarding utility line location indicates that utilities are located within roadway rights-of-way. Seven roadways pass through the fence line, with right-of-way widths ranging from 50 to 65 feet. Consequently about 420 feet of slurry trench or slurry wall will be required. Depth of the cutoff wall at each location should extend at least one foot below the lowest sewer line invert elevation indicated from available drawings, or one foot below the top of the soft clay formation found throughout the area, whichever is deeper. The top of soft clay is below the bottom of vertical desiccation cracks in overlying hard clays in these lacustrine deposits. About 6 feet of hard clay will need to be penetrated. Table 3-1 shows the approximate total depths at each roadway cutoff wall site. The cutoff wall could be either a vibrated beam slurry wall or an excavated trench backfilled with soil and bentonite slurry.

The onsite existing utilities will be abandoned as the cut-off slurry walls are constructed. The storm and sanitary sewers will be plugged at selected manholes to reduce horizontal movement within the fenced area. The plans and specifications will include a separate bid item to power rod (where necessary) and "dry" bucket clean these sewers to remove sediment and contaminated material. The material removed would be taken to a secure landfill using RCRA procedures for manifesting and transporting. The decision to clean the sewers will be made based on information available at the time bids are received.

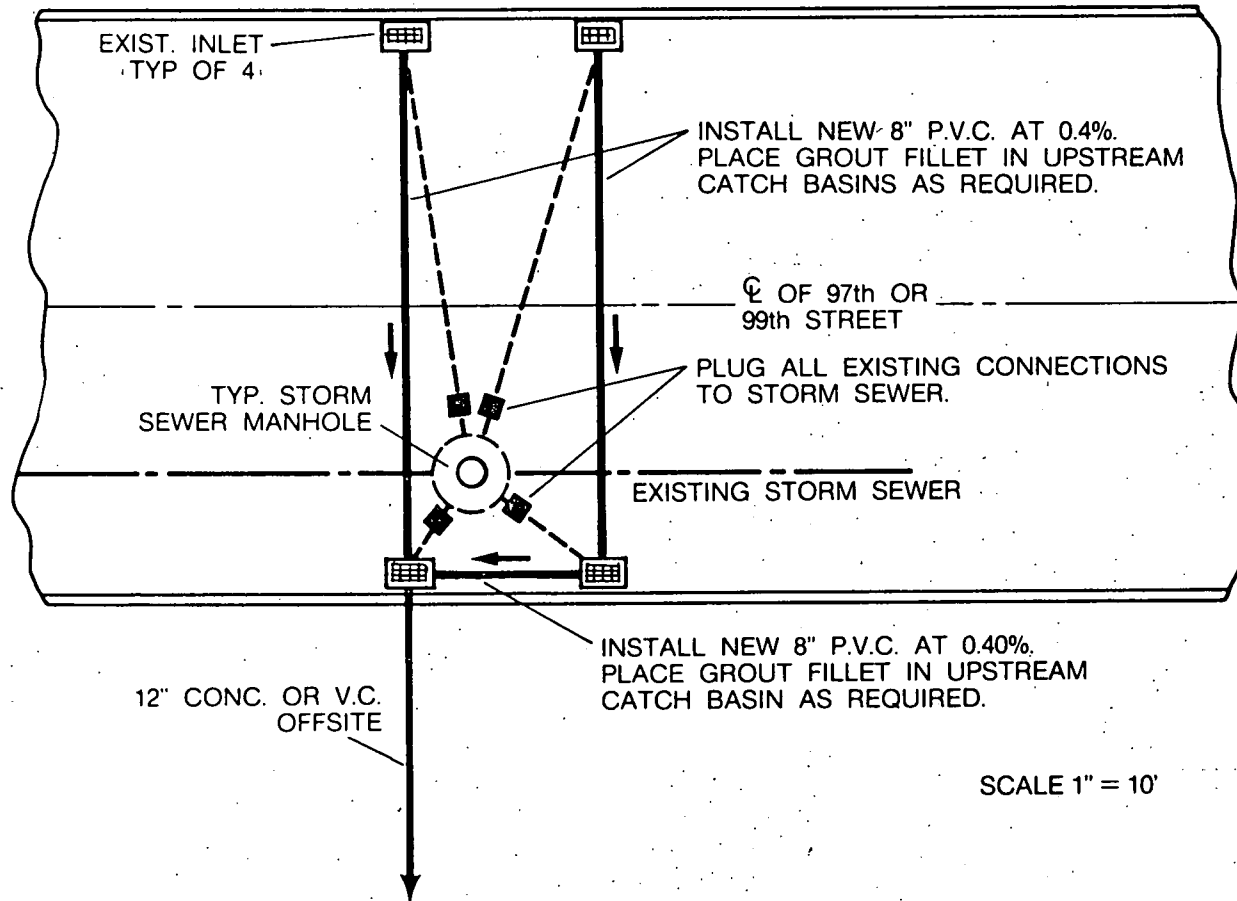
New storm drainage facilities would be constructed across lot lines to avoid homes or demolished foundations tying into existing off-site storm sewers. Using multiple inlets at the low points along with a 12-inch storm sewer would

Table 3-1

CUTOFF WALL DESIGN DATA

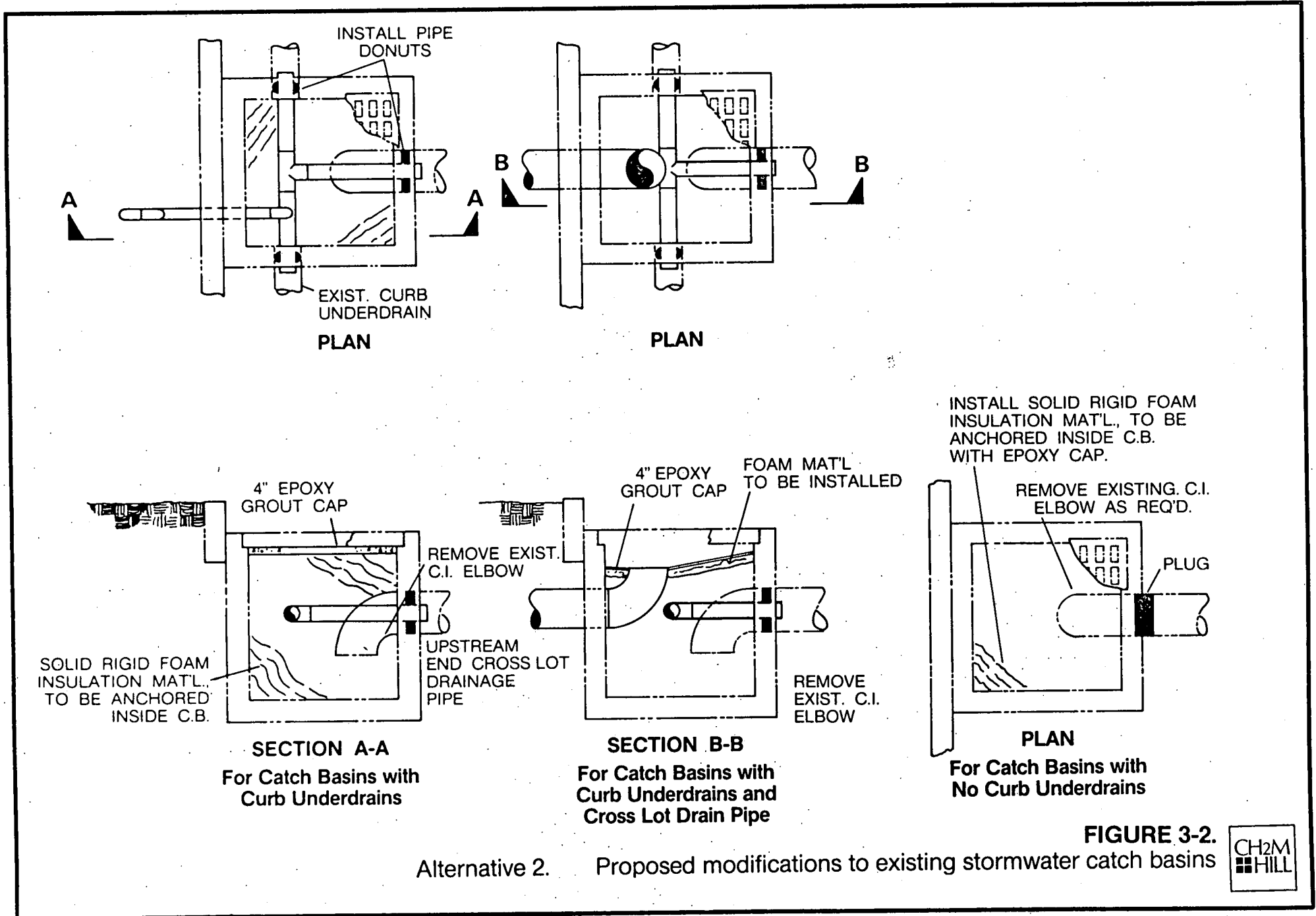
Location	Street Elevation (ft msl)	Minimum Sewer Invert Elevation		Depth to Soft Clay	Min. Cutoff Wall Depth (ft)
		Description	Elevation		
97th Street at Colvin Blvd.	571.5	10" Sanit.	558±	10.0	14
97th Street at 96th Avenue	573.8	6" Water	569.8	12.0	12
97th Street at Frontier	574.2	21" Storm	564.7	10.5	11
99th Street at Colvin	572.6	10" Sanit.	562.7	13.0	13
Wheatfield near 100th Street	572.7	10" Sanit.	561±	10.5	13
99th Street at Frontier	574.0	21" Storm	564.6	10.5	11
97th Street at Read Avenue	572.4	No Utilities	--	13.5	14

Note: Actual depth will be determined during construction.



Alternative 2. — Typical connection of existing storm inlets for offsite conveyance of runoff.





Alternative 2.

Proposed modifications to existing stormwater catch basins



FIGURE 3-2.

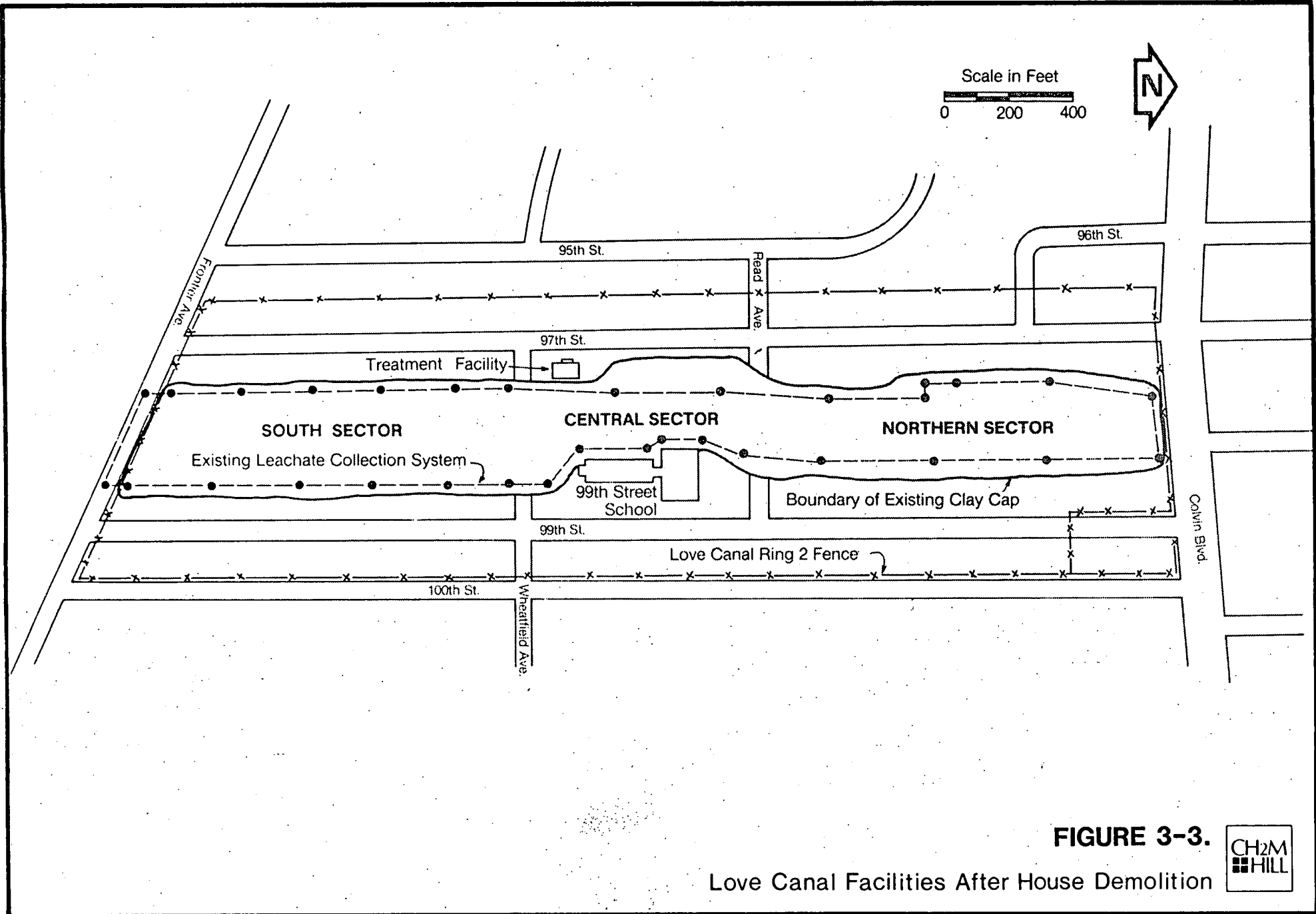


FIGURE 3-3.

Love Canal Facilities After House Demolition



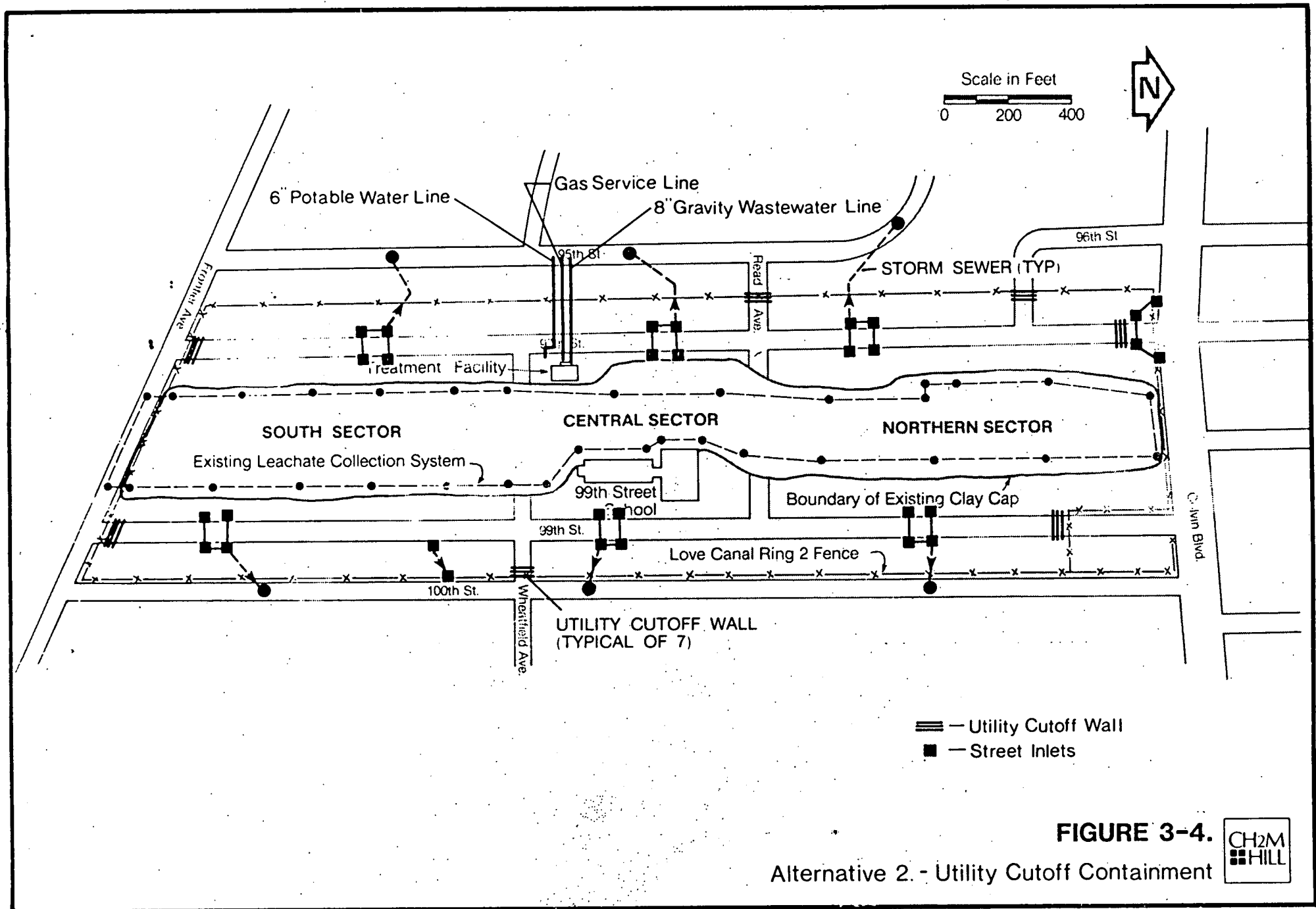
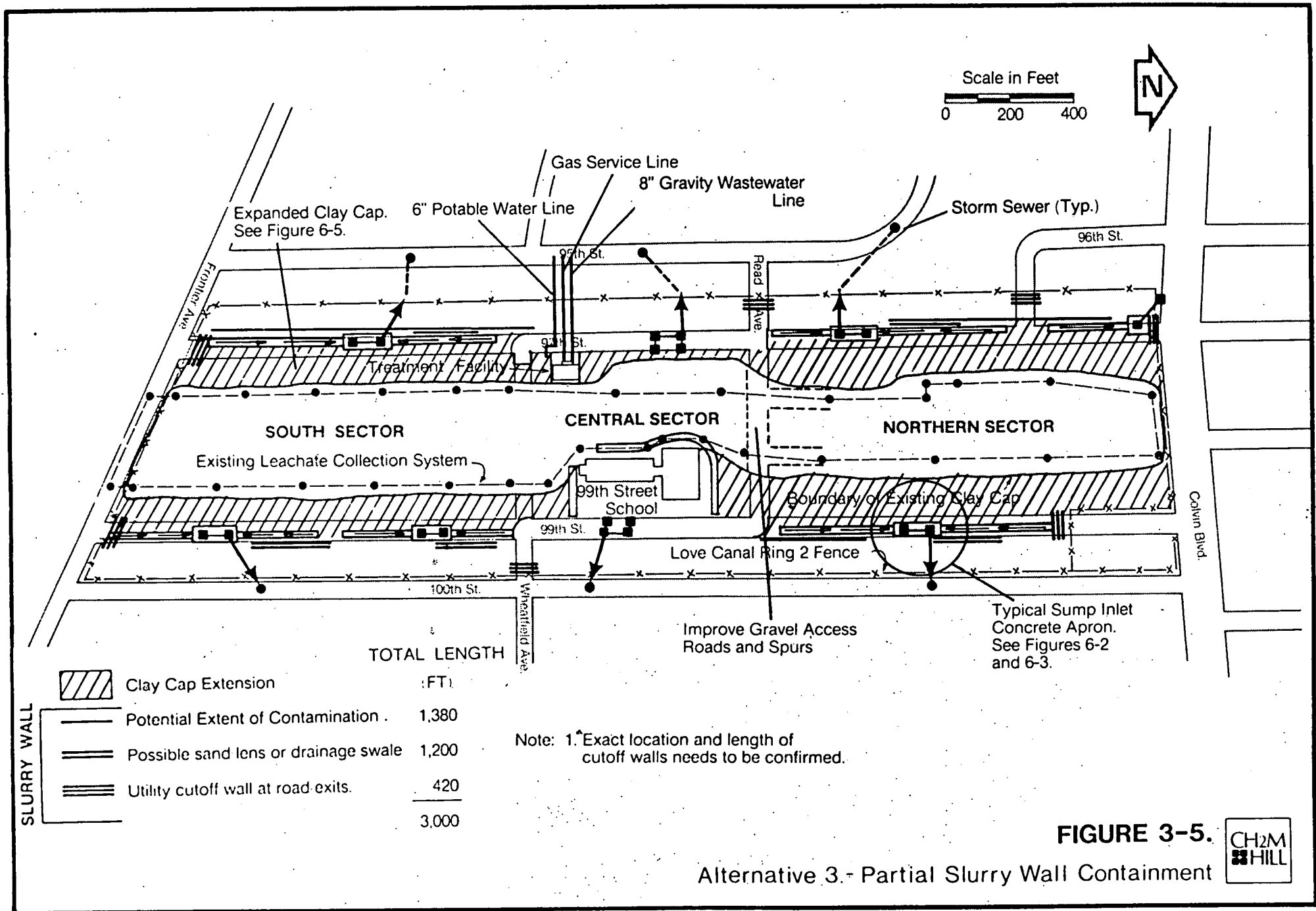


FIGURE 3-4. CH₂M HILL
 Alternative 2 - Utility Cutoff Containment



reduce ponding and provide positive drainage from the site, but would not provide the degree of drainage normally associated with regular catch basin spacing in residential areas.

For preliminary design purposes it is assumed that existing catch basins located at 7 low points along 97th and 99th Streets would be converted to collect runoff and convey it off-site as shown on Figure 3-1. These catch basins would be modified as shown on Figure 3-2 to collect stormwater from both sides of the street and to prevent flows from entering the existing storm sewer system. Figure 3-3 illustrates the site following house demolition and Figure 3-4 details the construction planned in Alternative 2. The action described in the alternative would have little impact upon the site water balance, compared to Alternative 1.

3.3--PARTIAL SLURRY WALL CONTAINMENT

The intent of Alternative 3.3 is to contain the site to a significant degree, to reduce subsurface infiltration both vertically and laterally, and to reduce flows through the leachate collection and treatment system, thereby reducing operating costs.

This would be achieved by implementing all elements of Alternative 3.2. Additionally, slurry walls would be constructed at locations where subsurface movement of water may occur along a preferential natural route such as a sand lens or drainage swale, as identified from previous soil borings and geophysical surveys. The slurry walls would also be constructed at points where contamination has potentially migrated towards 97th and 99th Streets, some of which overlap with sand lenses and drainage swales. About 3,000 lineal feet of cutoff walls would be required, to depths up to about 14 feet, including the 420 lineal feet at road exits from the site. Exact locations and lengths need to be confirmed if this approach is selected. All slurry wall locations would be along the east side of 99th Street and along the west side of 97th Street. Figure 3-5 shows the proposed location of these cutoff walls, which would also be located at all points where utilities and roads leave the fenced area, as in Alternative 3.2.

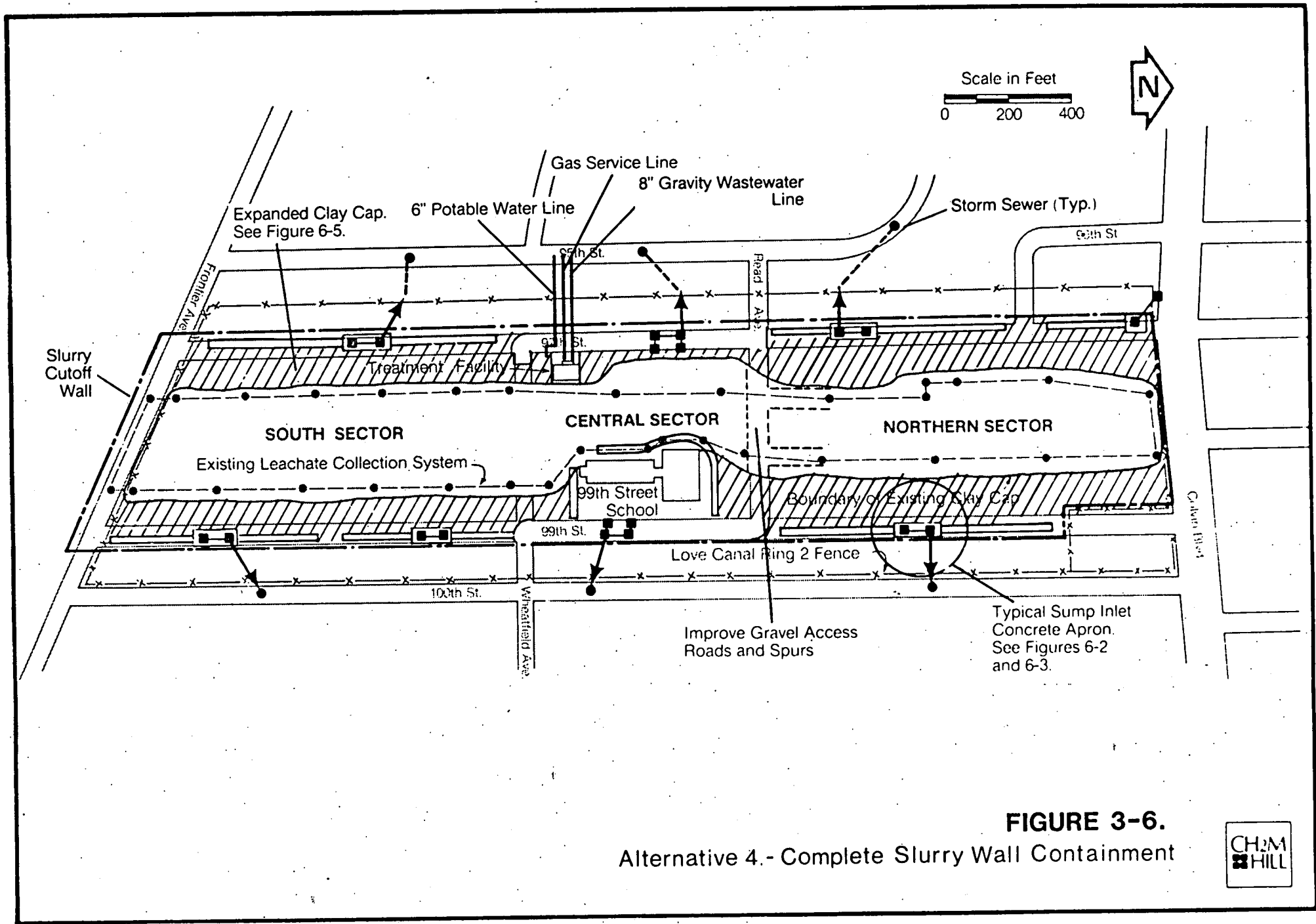
An important element of Alternative 3.3 would be expansion of the clay cap over the entire area within the cutoff walls, to reduce vertical recharge of the shallow soil system. Vertical permeability of the clay cap should be on the order of 10^{-7} cm/sec or less to significantly reduce recharge. The existing clay cap would be extended to the outer edge of 97th and 99th Streets over the demolished Ring

1 homes. The streets within the fenced area not necessary to maintain the school or treatment plant will be covered with the expanded clay cap. Several alternative designs are available that accomplish the objectives of the expanded cap system. Selection of the system for detailed design will be made on the basis of effectiveness and life cycle cost. For cost estimate purposes, a bentonite treatment system with a minimum depth of 12" and slope of 2% from street to the existing cap has been selected. Six inches of top soil and grass system are also included. The system designed will be sufficient to reduce formation of vertical desiccation cracks.

Following completion of the cutoff walls and the expanded clay cap, the hydraulic gradient for subsurface movement of water will be toward the canal from all directions, through the natural soils. Recharge that would occur through the cap or along higher permeability routes such as drainage swales, sand lenses or utility trenches would be reduced. Due to the low permeability of the shallow soils, the rate of inflow to the site will be very low. Discharge from the site will occur through continued operation of the existing leachate collection and treatment system. However, within a period of a few years, an equilibrium will be established between inflow and outflow at the site, with groundwater levels controlled by the barrier drain and by a hydraulic gradient to the drain from the edge of the clay cap in areas where the cutoff wall is absent. Estimated equilibrium flow rate is within a range of 3 to 5 gallons per minute (gpm) with the range reflecting natural variations of soil permeability that may be anticipated. This compares with present treatment plant capacity of 200 gpm, and present average flow rates of 8.3 gpm in the barrier drain plus an unknown flow rate resulting from infiltration to the storm and sanitary sewers, previously estimated at 2 to 7 gpm. Water levels within the contained area should drop. Although no significant hydraulic connection is believed to exist between the bedrock and the water table, if it does exist, the flow may be upward into the leachate collection system since water levels would be higher in the bedrock than in the water table aquifer. Should this occur, the barrier drains should be operated at a higher level, reducing the upward movement.

3.4--COMPLETE SLURRY WALL CONTAINMENT

Alternative 3.4 is similar to Alternative 3.3 in all aspects except the slurry wall completely encircles the site as shown in Figure 3-6. The anticipated water balance is estimated at 3 gpm.



Scale in Feet
 0 200 400

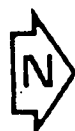


FIGURE 3-6.

Alternative 4.- Complete Slurry Wall Containment





4.0--COST OF PRELIMINARY ALTERNATIVES

The cost estimates which have been prepared for the evaluation of preliminary alternatives are "order of magnitude estimates." This is an approximate estimate made without detailed engineering data. Examples include: an estimate from cost-capacity curves, an estimate using scaleup and scaledown factors, and an approximate ratio estimate.

These estimates of costs have been prepared by CH2M HILL through experience and judgement in applying available cost data. However, it is recognized that CH2M HILL has no control over costs of labor and materials, or over competitive bidding procedures and market conditions. The actual project costs may vary from the included preliminary cost estimates.

The unusually long life cycle of this particular project (100-200 years or possibly longer) makes the economic analysis of alternatives somewhat subjective. Normal economic analyses of present worth which utilize generally accepted discount rates should not be applied to life cycles which exceed 40-50 years. This is due to the uncertainty of potential economic conditions so far into the future.

Thus, for the present worth analysis of alternatives considered for Love Canal, it is assumed that the future rate of inflation equals the discount rate and that the time value of money is zero rather than the generally accepted 2-½ to 3 percent. This offers a subjective comparison of alternatives which should be meaningful since the economic analysis assumptions are applied equally to all alternatives being considered. Alternatives that have higher operation and maintenance costs are slightly favored by this assumption.

None of the cost estimates for the preliminary alternatives include an allowance for a monitoring program, which would be an essential element of long-term site management. Since monitoring would be relatively common to all alternatives, its omission in the economic analysis should not affect the relative cost-effectiveness of alternatives.

4.1--NO ADDITIONAL ACTION ALTERNATIVE

The no-additional-action alternative does not imply that there are no costs associated with it. The existing leachate collection and treatment system must be operated to help prevent potential surface exposure of leachate on the canal site.

Table 4-1 summarizes the annual operating, equipment replacement, and life cycle costs of this alternative. The present worth of this operation and maintenance cost-intensive alternative for 50 years and 100 years is \$13.77 million and \$71.11 million, respectively.

4.2--UTILITY CUT-OFF CONTAINMENT

As this option has no significant impact on the site water balance, the long-term operation and maintenance costs remain essentially the same. Itemization of costs associated with this option are summarized in Table 4-2.

4.3--PARTIAL SLURRY WALL CONTAINMENT

The capital cost of this alternative is considerably higher than the cost for the second alternative; however, there is a significant cost benefit over a period of time due to lower O&M costs resulting from significantly reduced flows to the treatment plant. Present worth over a 100 year period is approximately 10 percent less than Alternative 2. Table 4-3 summarizes the costs associated with this containment alternative.

4.4--COMPLETE SLURRY WALL CONTAINMENT

This alternative shares similar operation and maintenance cost advantages as the partial slurry wall alternative previously discussed. Although the capital cost is slightly higher, the life cycle cost is lower than any of the alternatives considered. Table 4-4 summarizes the costs associated with this alternative.

Life cycle costs for all alternatives under consideration are summarized in Table 4-5.

4.5--COST CONSIDERATIONS

Aside from any future improvement in technology that may enable these wastes to be rendered innocuous, we doubt that continued leachate collection over a period of many years will reduce contaminants in the leachate from the Love Canal area to harmless concentrations. Consequently, continued operation of treatment facilities will probably be necessary. Due to the high operating cost of this facility, efforts

Table 4-1
 ALTERNATIVE 1--NO ADDITIONAL ACTION

Action Summary: Continue operating the existing leachate collection system as is. Estimated leachate flow is 8.3 gpm.

CAPITAL COST--(1981 Dollars): None

ANNUAL OPERATING COST

Item	\$/year
Gas Utility	\$ 14,000
Electric Utility	8,500
Water/Sewer Charges	2,000
Irrigation/Mowing of Cap	7,500
Building/Equipment Maintenance	10,000
Telephone	2,500
Activated Carbon Replacement (5-6 changes/yr @ \$10 ^k /change)	55,000
Activated Carbon Disposal @ \$10 ^k /load	55,000
Labor (3 full-time; 8 hrs/day; 5 days/wk)	80,000
Supervision/Administration	20,000
Total Annual Operating Cost	\$254,500

REPLACEMENT COST

Item	\$
Pump Motors/Misc. @ Pump Stations (\$10 ^k /station every 10 years)	\$ 60,000 every 10 years
Replace Major Equipment @ WWTP Every 20 Years (100 gpm capacity)	\$ 400,000 every 20 years
Replacement Treatment Plant Bldg. Every 50 Years (Smaller Bldg.)	\$ 400,000 every 50 years
Replace Leachate Collection System Every 50 Years	\$4,750,000 every 50 years

LIFE CYCLE COST

Cost Item	Present Worth in 1981 Dollars (1 x 10 ⁶)			
	1 Year	50 Years	100 Years	200 Years
Capital	--	--	--	--
Annual O&M	0.25	12.73	25.46	50.92
Replacement*	--	1.04	7.29	20.19
Total	0.25	13.77	32.75	71.11

*Utilities not included

Table 4.2
ALTERNATIVE 2
UTILITY CUTOFF CONTAINMENT

Action Summary: Plug all sewer lines at site exits and 3 internal points. Slurry cutoff wall at utility exits. Paving and catchbasin modifications to provide street drainage. New water and wastewater lines to treatment plant. Utility service to school. Estimated leachate flow is 8.3 gpm.

CAPITAL COST---(1981 Dollars):

Item	No. Units	\$/Unit	Amount
Plug sewer lines	19	\$500.00	\$ 9,500
420 ft. slurry wall @ 7 sites			81,000
Catchbasin modifications, piping and paved ditches	--	--	254,000
Clean storm and sanitary sewers	--	--	47,000
New 6" water line	295 lf	41.00	12,100
New 8" wastewater line, including manholes	669 lf	65.00	43,500
Utility services to school	--	--	<u>23,700</u>
Total Construction Cost			\$470,800
Engineering Services During Construction (SDC), Administration, Contingencies (25%)			117,700
Health and Safety (5%)			<u>23,540</u>
Total Capital Cost			\$612,040

ANNUAL OPERATING COST

Item	\$/year
Gas Utility	\$ 14,000
Electric Utility	8,500
Water/Sewer Charges	2,000
Irrigation/Mowing of Cap	7,500
Building/Equipment Maintenance	10,000
Telephone	2,500
Activated Carbon Replacement (5-6 changes/yr @ \$10 ^k /change)	55,000
Activated Carbon Disposal @ \$10 ^k /load	55,000
Labor (3 full-time; 8 hrs/day; 5 days/wk)	80,000
Supervision/Administration	<u>20,000</u>
Total Annual Operating Cost	\$254,500

Table 4-2 Continued
 Alternative 2
 UTILITY CUTOFF CONTAINMENT

REPLACEMENT COST

<u>Item</u>	<u>\$</u>
Pump Motors/Misc. @ Pump Stations (\$10 ^k /station every 10 years)	\$ 60,000 every 10 years
Replace Major Equipment @ WWTP Every 20 Years (100 gpm capacity)	\$ 400,000 every 20 years
Replacement Treatment Plant Bldg. Every 50 Years (Smaller Bldg.)	\$ 400,000 every 50 years
Replace Leachate Collection System Every 50 Years	\$4,750,000 every 50 years

LIFE CYCLE COST

<u>Cost Item</u>	<u>Present Worth in 1981 Dollars (1 x 10⁶)</u>			
	<u>1 Year</u>	<u>50 Years</u>	<u>100 Years</u>	<u>200 Years</u>
Capital	0.61	0.61	0.61	0.61
Annual O&M	0.25	12.73	25.46	50.92
Replacement	--	<u>1.04</u>	<u>7.29</u>	<u>20.19</u>
Total	0.86	14.38	33.36	71.72

Table 4.3
ALTERNATIVE 3
PARTIAL SLURRY WALL CONTAINMENT

Action Summary: Plug all sewer lines at site exits and 3 internal points. Slurry cutoff wall at selected areas. Clay cap extended to 97th and 99th Streets. Paving and catchbasin modifications to provide street drainage. New water and wastewater lines to treatment plant. Utility service to school. Estimated leachate flow is 5 gpm.

CAPITAL COST--(1981 Dollars):

<u>Item</u>	<u>No. Units</u>	<u>\$/Unit</u>	<u>Amount</u>
Plug sewer lines	19	\$500.00	\$ 9,500
420' Slurry wall @ 7 util. exits			81,000
2700' slurry wall @ selected locations	37,800	7.00	264,000
Graded earthfill cap at 2% slope	24,000 cy	10.00	240,000
6" topsoil	17,000 cy	10.00	170,000
Seeding and mulching	--	--	40,000
Bentonite treatment, 2 lb/sf	887,500 sf	0.30	266,250
Catchbasin modifications, piping, and paved ditches	--	--	254,000
Clean storm and sanitary sewers	--	--	47,000
Street paving, gravel access roads, and curb replacement	--	--	43,850
New 6" water line	295 lf	41.00	12,100
New 8" wastewater line, including manholes	669 lf	65.00	43,500
Telephone and power line relocation, Frontier Avenue	--	--	39,300
Utility services to school	--	--	<u>23,700</u>
Total Construction Cost			\$1,534,200
Engineering Services During Construction (SDC), Administration, Contingencies (25%)			383,550
Health and Safety (5%)			<u>76,710</u>
Total Capital Cost			\$1,994,460

Table 4.3 Continued

ANNUAL OPERATING COST--(1981 Dollars)

<u>Item</u>	<u>\$/year</u>
Gas Utility	\$ 14,000
Electric Utility	5,300
Water/Sewer Charges	1,300
Irrigation/Mowing of Cap	15,000
Building/Equipment Maintenance	10,000
Telephone	2,500
Activated Carbon Replacement (4-5 changes/yr @ \$10 ^k /change)	45,000
Activated Carbon Disposal @ \$10 ^k /load	45,000
Labor (2 full-time; 8 hrs/day; 5 days/wk)	53,600
Supervision/Administration	<u>10,000</u>
 Total Annual Operating Cost	 \$201,700

REPLACEMENT COST

<u>Item</u>	<u>\$</u>
Pump Motors/Misc. @ Pump Stations (\$10 ^k /station every 10 years)	\$ 60,000 every 10 years
Replace Major Equipment @ WWTP Every 20 Years (50 gpm capacity)	\$ 275,000 every 20 years
Replacement Treatment Plant Bldg. Every 50 Years (Smaller than existing)	\$ 200,000 every 50 years
Replace Leachate Collection System Every 50 Years	\$4,750,000 every 50 years
Rejuvenation of Clay Cap Every 20 years	\$ 395,000 every 20 years

LIFE CYCLE COST

<u>Cost Item</u>	<u>Present Worth in 1981 Dollars (1 x 10⁶)</u>			
	<u>1 Year</u>	<u>50 Years</u>	<u>100 Years</u>	<u>200 Years</u>
Capital	1.99	1.99	1.99	1.99
Annual O&M	.20	10.09	20.17	40.34
Replacement*	<u>--</u>	<u>0.79</u>	<u>8.17</u>	<u>22.02</u>
 Total	 2.19	 12.87	 30.33	 64.35

*Utility replacement not included.

Table 4.4
ALTERNATIVE 4
COMPLETE SLURRY WALL CONTAINMENT

Action Summary: Plug all sewer lines at site exits and 3 internal points. Slurry cutoff wall around entire site. Clay cap extended to 97th and 99th Streets. Paving and catchbasin modifications to provide street drainage. New water and wastewater lines to treatment plant. Utility service to school. Estimated leachate flow is 3 gpm.

CAPITAL COST--(1981 Dollars):

<u>Item</u>	<u>No. Units</u>	<u>\$/Unit</u>	<u>Amount</u>
Plug sewer lines	19	\$500.00	\$ 9,500
Slurry wall around entire site	110,000 sf	7.00	770,000
Graded earthfill cap at 2% slope	24,000 cy	10.00	240,000
6" topsoil	17,000 cy	10.00	170,000
Seeding and mulching	--	--	40,000
Bentonite treatment, 2 lb/sf	887,500 sf	0.30	266,250
Catchbasin modifications, piping, and paved ditches	--	--	254,000
Clean storm and sanitary sewers	--	--	47,000
Street paving, gravel access roads, and curb replacement	--	--	43,850
New 6" water line	295 lf	41.00	12,100
New 8" wastewater line, including manholes	669 lf	65.00	43,500
Telephone and power line relocation, Frontier Avenue	--	--	39,300
Utility services to school	--	--	<u>23,700</u>
Total Construction Cost			\$1,959,200
Engineering Services During Construction (SDC), Administration, Contingencies (25%)			489,800
Health and Safety (5%)			<u>98,000</u>
Total Capital Cost			\$2,547,000

Table 4-4 Continued

ANNUAL OPERATING COST--(1981 Dollars)

Item	\$/year
Gas Utility	\$ 14,000
Electric Utility	3,150
Water/Sewer Charges	750
Irrigation/Mowing of Cap	15,000
Building/Equipment Maintenance	10,000
Telephone	2,500
Activated Carbon Replacement (2-3 changes/yr @ \$10 ^k /change)	25,000
Activated Carbon Disposal @ \$10 ^k /load	25,000
Labor (1 full-time; 8 hrs/day; 5 days/wk and one part time)	35,000
Supervision/Administration	10,000
Total Annual Operating Cost	\$140,400

REPLACEMENT COST

Item	\$
Pump Motors/Misc. @ Pump Stations (\$10 ^k /station every 10 years)	\$ 60,000 every 10 years
Replace Major Equipment @ WWTP Every 20 Years (25 gpm capacity)	\$ 200,000 every 20 years
Replacement Treatment Plant Bldg. Every 50 Years (smaller than existing building)	\$ 200,000 every 50 years
Replace Leachate Collection System Every 50 Years	\$4,750,000 every 50 years
Rejuvenation of Clay Cap Every 20 Years	\$ 395,000 every 20 years

LIFE CYCLE COST

Cost Item	Present Worth in 1981 Dollars (1 x 10 ⁶)				
	1 Year	25 Years	50 Years	100 Years	200 Years
Capital	2.55	2.55	2.55	2.55	2.55
Annual O&M	.14	3.51	7.02	14.04	28.08
Replacement	--	0.72	1.49	7.87	21.35
Total	2.69	6.78	11.06	24.46	51.98

Table 4-5
 SUMMARY OF LIFE CYCLE COSTS
 Present Worth in 1981 Dollars (1×10^6)

<u>Alternative</u>	<u>1 Year</u>	<u>50 Years</u>	<u>100 Years</u>	<u>200 Years</u>
1				
Cap	--	--	--	--
O&M	0.25	12.73	25.46	50.92
Replace	--	1.04	7.29	20.19
Total	0.25	13.77	32.75	71.11
2				
Cap	0.61	0.61	0.61	0.61
O&M	0.25	12.73	25.46	50.92
Replace	--	1.04	7.29	20.19
Total	0.86	14.38	33.36	71.72
3				
Cap	1.99	1.99	1.99	1.99
O&M	0.20	10.09	20.17	40.34
Replace	--	0.79	8.17	22.02
Total	2.19	12.87	30.33	64.35
4				
Cap	2.55	2.55	2.55	2.55
O&M	0.14	7.02	14.04	28.08
Replace	--	1.49	1.49	21.35
Total	2.69	11.06	18.08	51.98

NOTE: Alternative 1 -- No additional action
 Alternative 2 -- Utility cut-off containment
 Alternative 3 -- Partial slurry wall containment
 Alternative 4 -- Complete slurry wall containment

should be directed to reducing treatment flow rates while containing migration of wastes away from the site. Alternative Nos. 3 or 4, or a combination of each, appear desirable to achieve this goal and have the lowest life cycle costs of all the alternatives. If the time value of money were to be accounted for in a more sophisticated economic analysis, these two alternatives would be even more desirable due to the relatively high operating cost components of the other alternatives.



5.0--EVALUATION OF PRELIMINARY ALTERNATIVES

5.1--PERFORMANCE CRITERIA

Several performance criteria have been established, with which to evaluate each of the preliminary alternatives. A ranking of alternatives is shown in Table 5-1 for each performance criterion. No attempt has been made to assign weights to each of the criteria due to the varying perspectives of the numerous individuals concerned about the remedial action program at Love Canal. Furthermore, the ranking should be considered approximate since some of the alternatives are similar in rank associated with certain performance criteria. A brief discussion of the performance criteria follows.

Costs:

Initial, annual operation and maintenance, and life cycle. The life cycle costs assume that the inflation and interest rates cancel out, such that the present worth of initial and annual cost is equal to their sum.

Environmental Impact:

"Short-term": during period of construction; "long-term": everything thereafter.

Health and Safety:

"Construction site": potential effect upon workers within the fenced compound. "Community": effect upon outside areas during construction.

Technical Reliability:

Reliability based upon past proven performance of system components in comparable situations.

System Reliability:

Reliability of the physical components of each alternative, considering their potential for failure under conditions of extended service. Sump pumps and treatment facilities are less reliable than pipelines, which in turn are less reliable than clay caps or cutoff walls.

Community Acceptance:

Self-evident.

Table 5-1

PERFORMANCE CRITERIA EVALUATION

Criterion	Rank ^{1, 2, 3}			
	Alt 1	Alt 2	Alt 3	Alt 4
Initial Cost	1	2	3	4
O&M Cost	3	3	2	1
Life Cycle Cost	3	4	2	1
Long-Term Environmental Impact	4	3	2	1
Short-Term Environmental Impact	1	2	3	4
Construction Site Health & Safety	1	2	3	4
Community Health & Safety	4	3	2	1
Technical Reliability	1	2	2	2
System Reliability	4	3	2	1
Community Acceptance	4	3	2	1
Construction Duration	1	2	3	3
Achieve Objectives	4	3	2	1
Meet Project Bid Date	1	2	2	2

¹ Ranking ranges from "1" = best to "4" = worst. Equal rankings denoted by equal low numbers

² Alternative 1 = No additional action
 Alternative 2 = Utility cut-off containment
 Alternative 3 = Partial slurry wall containment
 Alternative 4 = Complete slurry wall containment

³ No weighting factors have been applied to performance criteria.

Construction Acceptance:

Short construction period considered more desirable than long construction period.

Achieve Objectives:

Ability to meet the objectives for this project discussed in Section 2.

Meet Project Bid Date:

Likelihood that September, 1982 bid date can be achieved.



6.0--DETAILED DEVELOPMENT OF SELECTED ALTERNATIVE

A preliminary draft of the Environmental Information Document was submitted to USEPA and NYSDEC during October 1981. Subsequently a modified version of Alternative 4, Complete Slurry Wall Containment, was selected by these agencies for detailed development. Elements of the selected alternative are as follows:

- o A continuous slurry wall will be constructed to depths ranging from 10 to 14 feet around the entire canal site. On 97th and 99th Streets, it will be constructed about 15 feet outside the curb line on the side of the road furthest from the canal. On the north end it will be constructed just inside the fenceline along Colvin Boulevard. On the south end, it will be constructed within the Frontier Avenue right-of-way south of the road.
- o Subject to approval by the City of Niagara Falls, 97th and 99th Streets will be abandoned south of Wheatfield Avenue and north of Read Avenue. NYSDEC will coordinate approval activities with the City.
- o An expanded clay cap will cover the site, extending from the existing clay cap to the outside edges (furthest from the cap) of the abandoned portions of 97th and 99th Streets. Around the school and the leachate treatment plant, ground surface will be contoured to ensure adequate drainage from these structures. The expanded cap will be graded to a minimum 2 percent slope from the existing cap to the roads. Grading the site will increase runoff from the presently flat terrain, thereby reducing infiltration. The 15-foot strip between the slurry wall and the street, and the ground surface between the school and the treatment plant and the street will not be provided with a clay cap.
- o Water, gas, sanitary, and storm sewers entering and leaving the site will be cut off and plugged.
- o A new 6-inch potable water line will connect the leachate treatment plant to the existing water system on 95th Street to the west of the plant. A new 8-inch effluent line will connect the plant sanitary facilities to the off-site wastewater collection system on 95th Street. This line will parallel the new 6-inch water line.

- o Runoff from the site will be collected at 8 locations. Two of these will be located between Wheatfield and Read Avenues on 97th and 99th Streets. The remaining 6 locations will collect drainage from the expanded clay cap.
- o Specified existing monitor wells will be maintained while some wells, to be designated, will be plugged.
- o Telephone utility lines along Frontier Avenue may have to be relocated to facilitate slurry wall construction.
- o The storm and sanitary sewers may be cleaned to remove deposits.
- o After site activities are completed, 97th and 99th Streets between Wheatfield and Read Avenues will be repaired and sealed to restore the surface and to reduce infiltration of water through the pavement surface.
- o It is assumed that the pending NYSDOT contract will include the following elements:
 - Demolish both Ring 1 and Ring 2 homes.
 - Provide clay cap on demolished homesites within the fenced area.
 - Remove all unnecessary utility poles and sidewalks within the fenced area. All pavements and slabs in the Ring 2 area and in roadside portions of Ring 1 will be removed. Trees will be saved where possible, to be designated during construction.
 - Provide new utility service to the existing wastewater treatment plant and school.

The continuous slurry wall will be either a vibrated beam slurry wall or a trench backfilled with slurry. Only one company in the United States is licensed to construct slurry walls using the vibrating beam method. The trench offers the advantages of greater width to resist hydraulic and chemical stresses; construction using readily available conventional equipment and procedures; greater ease in severing and plugging utility lines; and greater flexibility to adjust trench depth during construction to excavate only to the depth required to tie-in with the soft clay layer. The conventional slurry trench would also offer the opportunity to perform a continuous geotechnical investigation around the entire site. A significant disadvantage of the

trench method is that it requires excavation and handling of potentially contaminated material, with associated expensive health and safety considerations. Contaminated material would be placed along the toe of the existing clay cap, thereby reducing fill requirements compared with the vibrating beam slurry wall method. The slurry wall will be located within the 60-ft road right-of-way, which includes 15 feet to either side of the curb line.

It may prove to be desirable to delete some portions of the wall in areas where the likelihood of contamination movement is small. This decision can be made following demolition of the houses and receipt of contractor bids for the work described in this report. This would represent a modification of the selected plan. If this occurs, flow rate at the leachate treatment plant may be expected to be less than the present flow rate, but slightly greater than that expected for the selected plan.

As discussed in Chapter 3, several alternatives for expanding the clay cap system are being considered. The final choice for design will consider effectiveness in reducing vertical groundwater movement, maintenance cost, capital cost, reliability, as well as other technical considerations.

Previous investigations have confirmed the existence of deposits of contaminated material in the sewer system. Since the sewer lines are to be plugged at selected locations and will not be incorporated into an expanded leachate collection system, prior cleaning of the lines may not significantly reduce the potential for offsite movement of contaminants and may not add to satisfactory performance of the selected plan. However, cleaning of the lines will immediately remove much of the existing deposits. The decision to clean the sewers will be made after the house demolition has been completed and bids for this work have been received.

Sewer system plugging will be completed as described for preliminary alternatives in Section 5. Figures 6-1 and 6-2 show the components of the selected alternative.

6.1--LEACHATE COLLECTION RATES

The selected plan should reduce the long-term operating cost of the Love Canal site, most of which is attributable to operation of the leachate treatment plant. By plugging the utility lines, expanding the clay cap and constructing a slurry wall around the site, the principal paths of recharge to the site will be sealed. Secondary paths of infiltration

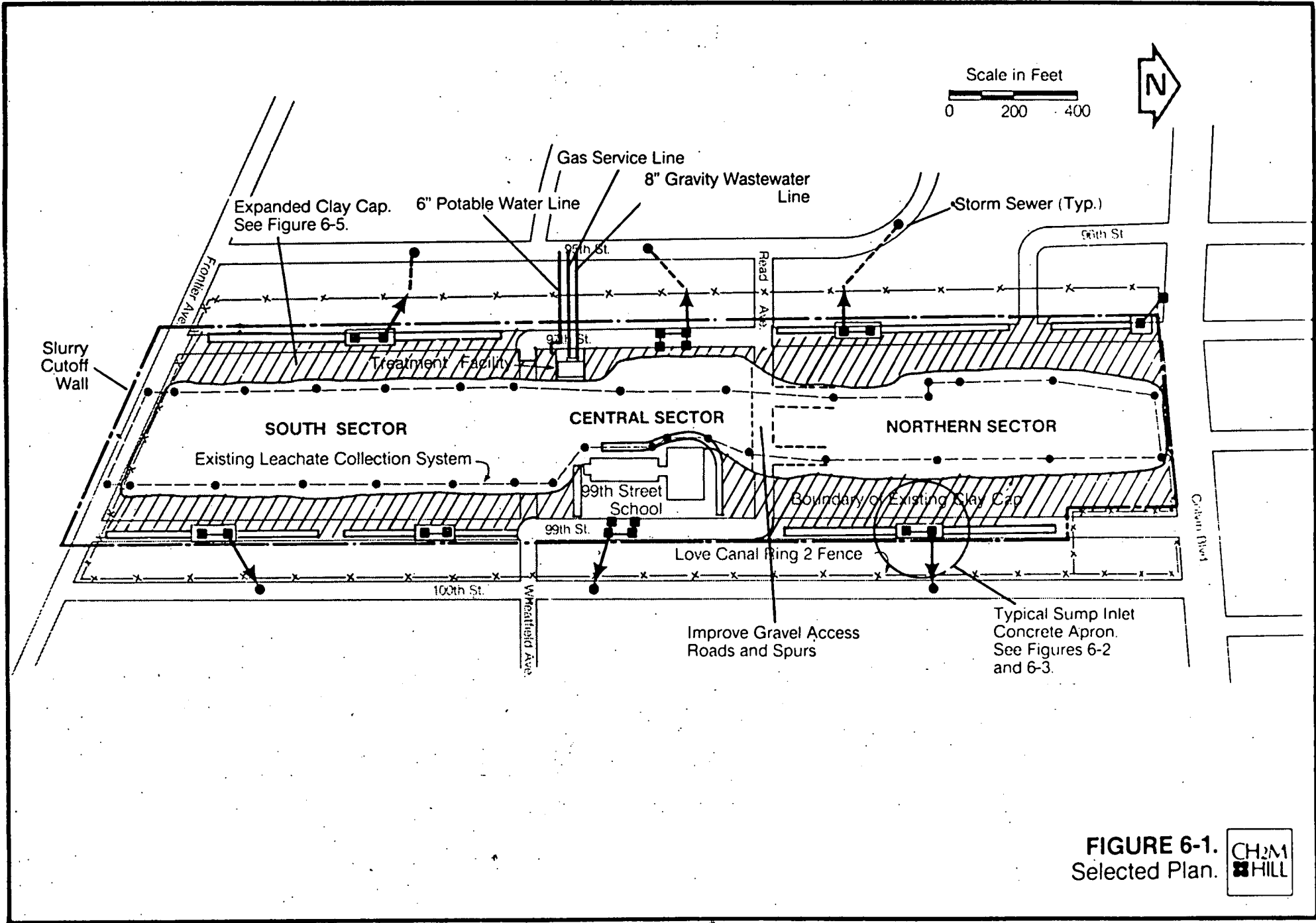


FIGURE 6-1.
Selected Plan.



ELEVATION (ft. msl)

APPROX. LOCATION: 650' SOUTH OF COLVIN BLVD.

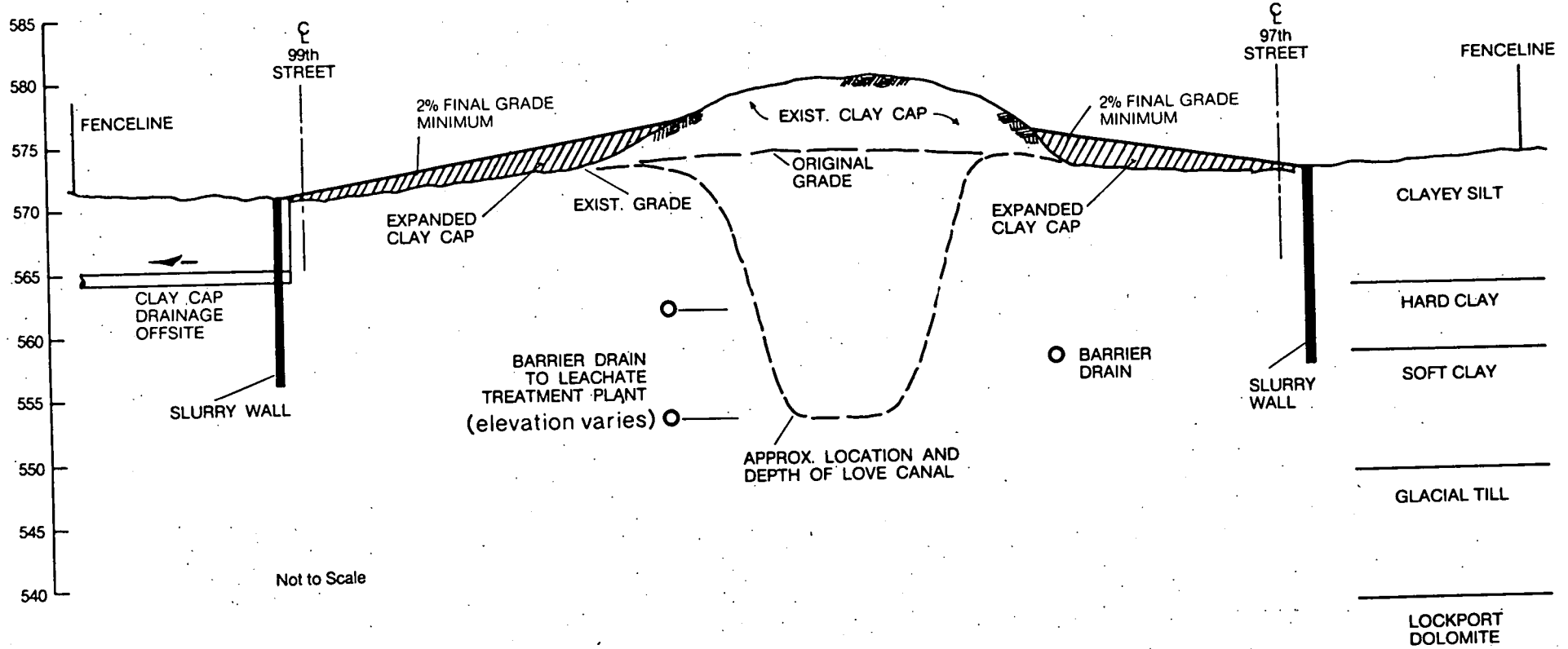


FIGURE 6-2.
Selected plan—Typical cross section.



include seepage through desiccation cracks in the existing clay cap; seepage through the roadway, recharge through small areas adjacent to the streets, the school, and the treatment plant that will remain unsealed; and the remote possibility of upward movement of water from the Lockport dolomite formation beneath the canal. A small amount of flow will also occur through and under the slurry wall because of the head differential across the wall. All of these secondary paths of recharge are expected to be at low flow rates.

We anticipate that once construction is complete, flow rates to the leachate treatment plant will gradually decline to a long-term equilibrium approaching about 3 gallons per minute (gpm). This compares with present leachate collection rates averaging 8.3 gpm, plus some dewatering of the area caused by infiltration to the existing storm and sanitary sewers. The time required to reach the equilibrium flow rate is probably on the order of about 5 years, within a reasonable range of 3 to 10 years.

This estimate of long-term equilibrium flow rate is a best estimate with available data, recognizing that several uncertainties exist with regard to average physical properties of soils at the site; existing flow rates in the storm and sanitary sewers, natural water balance at the site, effect of planned irrigation practices on the clay cap, and the short duration of available treatment plant flow records. It is difficult to judge the reduction in flow that may result from a particular remedial action program when the baseline total flows entering and leaving the site are uncertain.

At the equilibrium flow rate, water levels within various parts of the site will be controlled by water levels within the barrier drain, which currently range from 552- to 562-foot msl. Levels will tend to drop slowly toward the minimum elevation of 552 feet unless balanced by recharge.

Normal annual fluctuation of artesian water levels in the underlying Lockport dolomite probably ranges seasonally from about 564 to 567 feet. In the water table prior to construction of the barrier drain, water levels probably ranged seasonally from 562 to 570 feet. Consequently the average difference in water level between the two zones has been very small, with possible seasonal reversal of head differential. With the selected plan, an increase in head differential will occur, with the artesian water level up to 15 feet higher than the water table. This differential will occur throughout most of the site while currently it occurs only at the barrier drain. The water elevation in the barrier drain should be managed to control the head differential to reduce the possibility of upward flow of water.

While no evidence is available suggesting an existing hydraulic connection between the zones, it is remotely possible that an areawide increase in head differential could induce increased upward flow of water from the Lockport dolomite into the canal, along a path of least resistance through the glacial till and clay deposits.

6.2--NEED FOR MONITOR WELLS

If equilibrium flow rates do not level off at the expected rate, one possible source would be upward seepage into the canal, which would cause a local depression in the water levels of artesian aquifer monitor wells. Careful planning and early implementation of a monitor program of aquifer water levels is an important part of the Love Canal remedial action program. If such monitoring indicates that upward seepage is occurring, this water source can be easily reduced or eliminated by adjusting the operating control levels in the barrier drain to maintain higher water levels within the site.

A trend of slightly increasing leachate collection rates may possibly begin after several years, reflecting the need for maintenance of the slurry wall or clay cap. Careful monitoring of flows and water levels in monitor wells will enable maintenance at selected locations where the need arises and when flows begin to exceed anticipated operating rates.

The monitoring well design and plan for monitoring is critical to the success of proper operation and maintenance of the proposed alternative. This task must be completed and plans developed for early implementation prior to or in conjunction with completion of the proposed construction. Collection of base line data before construction is completed would be advantageous.

6.3--ESTIMATED COST OF SELECTED ALTERNATIVES

Life cycle costs, expressed in 1981 dollars, total \$24,460,000 over a period of 100 years. Life cycle costs reflect the assumption that major equipment is replaced at a design capacity of 25 gpm instead of the current 200 gpm capacity, and that the treatment plant building is replaced with a smaller building.

As discussed in Section 5, these are "order-of-magnitude" costs expressed in 1981 dollars.

Direct comparison between the cost of the selected alternative and the costs of preliminary Alternatives 1 through 4 is not

totally valid since the selected alternative reflects several refinements in conceptual design that are not included in the preliminary alternatives.

6.4--HEALTH AND SAFETY CONSIDERATIONS

Appendix B contains the construction health and safety plan that has been developed for implementation of the selected alternative. Special attention was given to community concerns for the health and safety aspects of the preliminary alternatives and the selected alternative.

The selected alternative represents a low-level risk to the community and the contractor employees. The contractor bid package includes specific minimum health and safety requirements to ensure both worker and community protection.

Since the onsite sewers are physically isolated from the rest of the municipal system, the selected alternative should eliminate community concerns regarding the continued spread of contaminants offsite through the sewer systems. It should generally contribute to the overall public health of the area by containing the hazardous waste from exposure by direct contact, air, or seepage.

As discussed previously, the sewers may be cleaned. Previous studies by O.H. Materials, Inc. have demonstrated that bucket cleaning of the sewers does not release detectable amounts of organic vapors to the atmosphere. The residents' concerns related to "steam cleaning" of the sewers should not be a problem with this alternative. A closed environmental system will not be needed for bucket cleaning activities.

Removal of sediment from the sewers would reduce the risk of anyone having accidental contact with contaminants. Sediment removal and plugging the sewers at the site boundaries also eliminates the need for concern regarding slow release of contaminants from sediments. The use of slurry cut-off walls through utility trenches gives an additional margin of safety by preventing any future offsite migration of contamination in trench materials.

All materials removed from the sewers would be drummed and disposed of at a New York State-approved landfill. The transportation and disposal of sealed containers of sediment should not pose any significant risk to the community.

All contractor equipment and vehicles entering the site will be cleaned with cold water prior to leaving the site. Rinse water will be collected in the leachate collection system

and treated at the existing treatment plant. All vehicles leaving the site will be checked by the safety officer to ensure community protection.

Security of the site will be furnished by the contractor to preclude the accidental injury of unauthorized personnel entering the site. The New York State onsite coordinator and contractor safety officer will require that appropriate coordination is accomplished and resources are available to safely handle any emergency that would impact the community.

The contractor employed to accomplish the project will be required to meet stringent health and safety requirements for both protection of onsite workers and the surrounding community. The contractor's health and safety plan will meet the State and EPA criteria for protection of all parties. The contract specifications will require the contractor to provide all onsite employees with appropriate medical examinations, training, and protective equipment to ensure their health and safety.

Both New York State and the EPA policies dictate that any unknown hazard be treated as a worst-case until proven safe. Therefore, the contractor will be required to monitor the air at the job site for contaminant release and see that appropriate protective action is taken for workers and the community. Previous O.H. Materials, Inc. monitoring indicates that contaminant exposures during construction will be very low, if detectable. Procedures to reduce dust problems during construction will be undertaken and work discontinued if the levels exceed preset limits.

As pointed out in the introduction to this report, this project is the first of a number of projects planned under Superfund. This project addresses only the area within the fence and is dependent upon the design, construction and long-term operation of monitoring wells.

6.5--COORDINATION WITH NYSDOT CONTRACT

The NYSDOT contract for the demolition of Ring 1 and 2 homes is scheduled for implementation during the spring and summer of 1982. Estimated construction time for the NYSDEC contract is 6 months. Thus, it is probable that the NYSDOT and NYSDEC contractors may be working on the site at the same time. In recognition of potential coordination problems, several work sessions have been held involving NYSDOT, NYSDEC, and CH2M HILL to develop an implementation program which would maximize cost-effectiveness and safety and minimize potential coordination problems. The following elements were addressed during this coordination meeting:

- o The limits of each contractor's scope of work will be clearly defined in the respective contract documents.
- o Prior to bid, each contractor will be made aware that another contractor may be onsite at the same time and their combined efforts need to be coordinated in the best interests of NYSDOT and NYSDEC.
- o The NYSDOT work will be performed in compliance with an implementation schedule. The site will be divided into three (3) work zones. The first zone is located in the southwestern end of the site (home numbers 856-710 and 703-799); the second zone is immediately north of the first (903-9621 and 903-9711); and the third zone is the eastern half of the site (794-680, 603-9905, 400-514, and 385-515). The NYSDOT contractor will direct his efforts in order to complete work in each zone respectively, within a given period of time. Thus, each zone will be vacated by the NYSDOT contractor at predetermined times to facilitate access and control by the NYSDEC contractor.
- o The work described in this report will be completed in two construction seasons. All utility work is planned to be completed in 1982 with the cap expansion and slurry wall planned for completion in the summer of 1983.
- o The NYSDOT contractor will be responsible for the following:
 - Removing unnecessary utility poles and lines (coordinated with Niagara Power Co.).
 - Disconnecting of unnecessary gas mains and services on the site (coordinated with National Fuel Co.).
 - Disconnecting of unnecessary water and sewer services (coordinated with the City of Niagara Falls).
 - Providing new electric and gas service to the leachate collection and treatment facilities and the school (coordinated with NYSDEC and the utility companies).
 - Protecting and salvaging large trees on site.

- Protecting monitoring wells as designated by NYSDEC.
- Mapping the location of buried basement, garage, and pavement slabs.
- Marking approximate location of house services (water, gas, sanitary sewer, and storm sewer) at curb line.

A contingency plan will be developed through a joint effort of NYSDOT, NYSDEC, and CH2M HILL for the disposal of excess demolition rubble if it becomes necessary. It is the intention of NYSDOT to require the contractor to place all rubble within the basements if at all possible.

6.6-- ENVIRONMENTAL CONSIDERATIONS

Numerous investigations have been conducted at Love Canal to document the environmental effects of past waste disposal practices in the area, including the lateral and vertical extent of contaminant migration as well as community health and safety impacts. Appendix A contains a list of reports and other sources of information that were available for this investigation. Although it was not an objective of this study to define the extent of the affected environment, the preliminary and selected alternatives reflect an assumption that contamination directly attributable to past waste disposal practices at Love Canal is confined to within the existing fenceline, with the possible exception of movement slightly outside the fenceline along Frontier Avenue. This assumption seems generally consistent with the findings of previous reports made available to us. Further documentation of the affected environment as to geology, soils, vegetation, hydrology, land use and other environmental criteria is not reproduced herein since it has been covered in great detail in other reports listed in Appendix A. Environmental consequences of the selected alternative are addressed briefly in Section 5. In general, the selected alternative has the most favorable long-term environmental impact of all the alternatives considered. In terms of energy use, the selected alternative is clearly favorable since it minimizes long-term operational costs, a substantial portion of which are energy-intensive. While long-term land use in this area is yet to be confirmed, the selected alternative is consistent with continued residential land use in areas outside the fenceline. Within the fenceline, the plant provides a safe environment in which contaminated materials are effectively encapsulated in clay. The potential for lateral or vertical movement of contaminated leach-

ate will be controlled by the leachate collection system such that no contaminated flow will leave the encapsulated area. The selected alternative should effectively preclude the release of air emissions at contaminant levels harmful to the environment.

No valuable and depletable natural resources would be committed by implementation of the selected plan. With the possible exception of bentonite, maximum use of locally available materials is reflected in this plan.

Environmental consequences during the construction period of about one year should be controlled effectively by implementation of the health and safety plan discussed previously in Section 6.3. Before, during, and after construction, monitoring will be necessary to document the effects of the remedial action program and to confirm that objectives of this program are being achieved.

D R A F T

Appendix B
HEALTH AND SAFETY PLAN
(To be Included in Construction Documents, Special Conditions)

ARTICLE 26 HEALTH AND SAFETY PLAN

DEFINITIONS

The following definitions, in addition to those contained in the General Conditions and elsewhere in the Supplementary Conditions, shall apply to the work of this Contract.

1. Onsite Personnel: Onsite Personnel include the Owner, Contractor, Subcontractors and State and Federal Representatives.
2. Visitor: Visitors are all others, except the Onsite Personnel.
3. Safety Officer: The Safety Officer is the Contractor's employee so designated, and will be primarily responsible for the implementation and enforcement of the Health and Safety Plan. The Safety Officer shall have a minimum of two (2) years working experience in the chemical industry and/or chemical waste disposal industry or shall be registered industrial hygienist with two (2) years related experience. The Safety Officer shall have a sound working knowledge of State and Federal occupational safety and health regulations and formal educational training in occupational safety and health.
4. Custodian: The Custodian is the Contractor's employee responsible for keeping all safety equipment and project facilities clean, properly equipped, and maintained.
5. Security Officer: The Security Officer is the Contractor's employee responsible for maintaining the security of the Site.
6. On-Scene Coordinator (OSC): Any person assigned such responsibility and authority by the State of New York who has responsibility for day-to-day field surveillance duties.

7. Remedial Action: Remedial action includes all labor, materials, and other items that are shown, described or implied in the Contract Document, and includes all extra and additional work and material that may be ordered by the Owner.
8. Hazardous Work Area (Dirty Area): Any portion of the Site inside the Transition Area.
9. Monitoring: Monitoring indicates the use of direct reading field instrumentation to provide information regarding the levels of gases, vapors, and particulates which are being generated during remedial action. Monitoring will (shall) be conducted to evaluate both employee exposures to toxic materials as well as the off-site migration of airborne contaminants.
10. Physician: The Physician is an occupational physician who has specialized training in occupational medicine.
11. Chemist: The chemist shall have a bachelor degree in chemistry and demonstrated experience in the collection and analysis of hazardous waste samples.

Health and Safety Plan - General

These Specifications shall be observed during all phases of site investigation and construction. The Contractor shall develop a health and safety plan which meets the minimum requirements of this Section and the detail equipment specifications in Section 01016.

The safety and health of the public and onsite personnel and the protection of the environment shall take precedence over cost and schedule considerations for all project work. Either the New York State OSC or the Safety Officer shall make decisions regarding when work will be stopped for health or safety reasons. The OSC shall make decisions when conflicting opinions exist.

The Occupational Safety and Health Administration (OSHA) standards and regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 C.F.R. 1910 and 1926) provide the basic safety and health program for the project. Specifications in this section are in addition to OSHA regulations. The Safety Officer or the State Safety Coordinator may require procedures in addition to those required by OSHA or those contained herein.

The Contractor and his Safety Officer shall be responsible for the implementation of all safety and health measures herein, to include the provision of equipment, materials, personnel, facilities, maintenance, operations, services, and supervision necessary for implementation.

Should any item or aspect vital to personnel or public health or safety at this site be inadvertently omitted from this plan, and be within the Contractor's claimed area of competence, such that it should have been an obvious omission to the Contractor, then such item or vital aspect shall be deemed a contractual responsibility.

Should any unforeseen or site peculiar safety related factor, hazard, or condition become evident during the performance of work at this site, it shall be the Contractor's responsibility to suspend work immediately on site, move workers off the site and notify the on-scene coordinator in writing as quickly as possible, for resolution. Work shall not commence until the particular factor causing the concern has been resolved.

Should the Contractor seek relief from or substitution for, any portion or provision of the Health and Safety Plan, such relief or substitution shall be requested of the OSC in writing, and if approved, be authorized in writing. Interpretation of the provisions of this Section shall be the exclusive prerogative of the State OSC.

Consistent disregard for the provision of these Health and Safety specifications shall be deemed just and sufficient cause for termination of Contract or any subcontract without compromise or prejudice to the rights of the government or state.

Work Zones

The Contractor shall establish work zones with the approval of the State OSC.

Hazardous Work Area (Zone). This area shall include an area 50 feet in all directions from all open trenches and any areas where environmental monitoring has shown a potential hazard to workers. This area shall be barricaded, fenced, or roped off and marked. The level of personnel protective equipment required in this area is to be determined by the Safety Officer or OSC after monitoring and on-site inspection. No onsite personnel shall be allowed to be in a hazardous work area alone.

Neutral Zone. This is a buffer zone between the hazardous work area and the support area. This shall not be less than 50 feet wide adjacent to the hazardous work zone. Equipment decontamination stations and emergency equipment such as SCBA, emergency showers and eye lavages shall be located in this area. Drinking stations and portable toilets may be located in this area or the support area.

Support Zone. This is the remainder of the site. Change and shower rooms, lunch and break areas, and operations, storage and maintenance facilities shall be separate and located in this area. Eating, smoking, and chewing are permitted in this area.

Laundry facilities for reuseable work clothing and towels shall be located in the support zone. No work clothing or towels shall be allowed offsite.

Training

Contractor shall be required to certify that all contractor and subcontractor personnel assigned to or regularly entering the site for the purpose of performing or supervising work, for health, safety, security, or administrative purposes, for maintenance, or any other site-related function, have received safety training provided by or for the Contractor. Such training must consist of at least 16 hours of practical and theoretical instruction covering: chemical health hazards, physical health hazards, personal hygiene, safety equipment and procedure, and protective respiratory equipment and usage.

Contractor shall provide and require that all previously trained contractors, subcontractor or service personnel assigned to or entering the site complete one hands-on refresher training session of at least two (2) hours to guarantee that all such personnel are capable of and familiar with the use of safety, health, respiratory and protective equipment and with the safety and security procedures required for this site.

Contractor shall ensure that female employees, with child bearing capability, are informed of the potential hazards of toxic chemicals to the unborn child and the risks associated with working onsite.

Contractor Shall be responsible for, and guarantee that personnel not successfully completing the required training do not and are not permitted to regularly enter the site to perform work.

Exceptions to the above shall be made only by the OSC for authorized visitors.

Medical Surveillance

The Contractor shall utilize the services of a physician to provide the minimum medical examinations and surveillance specified herein. The name of the physician and evidence of examination of all onsite personnel shall be provided to the State or New York Department of Health (DOH) prior to personnel working onsite.

All onsite personnel involved in this project shall be provided with medical surveillance prior to onset of work, immediately at the conclusion of project, and at any time there is suspected excessive exposure to substances that would be medically detectable.

Medical surveillance is the physician's responsibility but shall meet the requirements of OSHA Standard 29 C.F.R. 1910.134 for all personnel. The physical examination shall emphasize skin, renal, and hepatic systems, reproductive, immunological, neurological, and hemological systems, and include tests for liver and kidney function, a complete blood count and urinalysis.

The ability of onsite personnel to wear respiratory protection shall be guaranteed by the Contractor. Cardiorespiratory system examination and pulmonary function testing are minimum requirements.

The Contractor shall maintain records of all medical surveillance employees and make those records available to DOH upon request by appropriate officials.

Security

Site security shall be provided and maintained by the Contractor on a continuous basis, 24 hours per day, 7 days per week throughout the period of Contract, including holidays. In addition to maintaining the existing security fence, the Contractor shall provide a security officer and personnel to control access to site and patrol the site.

Security identification, specific to the site, shall be provided by the Contractor for all onsite personnel entering the site. The Contractor shall be responsible for and guarantee that such identification shall be worn by each individual, visible at all times, while the individual is on the site.

Vehicular access to the site, other than to designated parking areas, shall be restricted to authorized vehicles only.

Use of site-designated parking areas shall be restricted to vehicles of government, contractor, subcontractor, and service personnel assigned to the site and actually on duty, but may also be used on a short-term basis for visitors. Visitor parking may be so designated at the option of the OSC.

Personal vehicles shall not be authorized to enter the site.

The Contractor shall be responsible for maintaining a log of security incidents and visitor access granted.

The Contractor shall require all personnel having access to the site to sign-in and sign-out, and shall keep a record of all site access.

All approved visitors to the site shall be briefed on safety and security, provided with temporary identification and safety equipment, and escorted throughout their visit.

Site visitors shall not be permitted to enter active hazardous work areas.

Site areas shall be posted, "Warning, Hazardous Work Area, Do Not Enter Unless Authorized; and fenced (snow fences adequate) or barricaded.

Temporary lighting shall be provided adequate to ensure effective night surveillance.

Communications

The Contractor shall provide hardline telephone communication at the site field office.

Emergency number, such as police, sheriff, fire ambulance, hospital, NYS, DEC, US EPA, applicable to this site shall be prominently posted near the telephone.

The Contractor shall provide a PA system, fixed, hand-held, or mobile, adequate to cover the site.

Two-way radio communication provided by the Contractor shall be available linking the command office to each active work location.

Emergency and First Aid Requirements

The Contractor shall, prior to the beginning of work, cooperate with State and local authorities and civic leaders in the formulation of contingency plans to safeguard resident populations, livestock, property, and other assets from any reasonable probable deleterious effects associated with or resulting from remedial work at this site.

The Contractor shall diligently act and so direct and perform the work at this site as to minimize or, if possible, eliminate the risk of an emergency impacting the local environment or population.

In the event of any emergency associated with or resulting from work at this site, the Contractor shall without delay: cease work activity on the site; take diligent action to remove or otherwise minimize the cause of the emergency; render full assistance to local authorities to remedy any impact on local residents or property; alert the OSC; and institute whatever measures might be necessary to prevent any repetition of the conditions or actions leading to or resulting in the emergency.

No onsite personnel shall be allowed to be in a hazardous work area (zone) alone. In the event one is overcome, his "buddy" shall immediately seek help. Each hazardous work area shall be provided with an OSC-approved, immediately adjacent, emergency eye wash and shower. This unit may be portable.

At least one "industrial" first aid kit shall be Contractor provided and maintained fully stocked at a manned location such as the Contractor's office. Should active work areas be so isolated or separated as to make one first aid location impractical, then first aid stations shall be established as required in close proximity to the work, but not inside a hazardous work area.

First aid kit locations shall be provided with adequate water and other supplies necessary to cleanse and decontaminate burns, wounds, or lesions.

The Contractor shall have at least one certified First Aid Technician onsite at all times. This person may perform other duties, but must be immediately available to render first aid when needed.

Each active work location shall be provided by the Contractor with at least one 20-pound dry chemical fire extinguisher. Fire extinguishers of this size and type shall also be Contractor provided at the Contractor's office, state office, and at any other site locations where the OSC determines that flammable materials present a fire risk.

The Contractor shall plan to provide emergency protection to the public and to personnel assigned to the site and shall meet with the state personnel, local police, civic leaders, and hospital and ambulance staffs to ensure that the risks associated with the remedial work to be performed at this site are known and understood.

A minimum of ten (10) MSHA/NIOSH approved pressure demand, self-contained breathing apparatus (SCBA) shall be provided and located as follows: eight in contractor office, two in state office. Onsite personnel will be trained to use SCBA.

Personal Safety and Related Equipment

The Contractor shall provide all onsite personnel with appropriate personal safety equipment and protective clothing. The Contractor will ensure that all safety equipment and protective clothing is kept clean and well-maintained. Detail specifications for quantities and types of equipment are in Section 01016.

As a minimum, the Contractor shall furnish for onsite personnel:

1. Work clothing as dictated by weather.
2. Disposable outerwear such as coveralls, gloves, hardhat liners, and foot coverings.
3. Hardhats.
4. Full face organic vapor, acid gas, particulate filtering respirators.
5. Safety shoes and boots.
6. Rubber overshoes.

All prescription eyeglasses in use on the site shall be safety glasses. No contact lenses shall be allowed onsite.

All disposable or reusable gloves worn on the site shall be OSC-approved. Inner gloves, if used, shall be disposable cotton. Welding gloves or other special gloves, if used in a hazardous work area, must be worn outside elastomer gloves, must be suitably stored onsite and must not be removed from the site during the remedial work unless disposed of as provided under section titled "Contaminant Control."

Footwear used onsite shall be steel-toed safety shoes or boots, with chemical resistant soles, and shall be worn covered by rubber overshoes when entering or working in a hazardous work area. Rubber overshoes shall be decontaminated daily and discarded if the inside is wetted with chemicals.

Respiratory equipment utilization and equipment onsite shall conform to OSHA 1910.134 requirements, and specifically as regards maintenance, inspection, fit testing, and usage.

Contractor, subcontractor, and service personnel unable to pass a fit test as a result of facial hair or facial configuration shall not enter or work in a hazardous work area that requires respiratory protection. Facial hair must be fully contained to ensure proper seal.

All personnel shall wear an approved hardhat while onsite. Exception may be taken to this provision for personnel working indoors on clerical or administrative tasks, or off duty, in first aid, field office, lunch area or other such location, but shall not be excepted in any active field work area.

Any personal protective equipment contaminated by a hazardous or suspected hazardous material will be decontaminated onsite. The Safety Officer is responsible for ensuring all personal protective equipment is decontaminated before being reissued.

Each full-face organic vapor canister respirator shall be individually assigned and not interchanged between workers without cleaning and sanitizing. Canisters and filters will be changed daily or when organic vapors are detected by wearer.

Personal Hygiene

The Contractor shall be responsible for, and ensure that all contractor, subcontractor, and service personnel performing or supervising remedial work within a hazardous work area, or exposed or subject to exposure to hazardous chemical vapors, liquids, or contaminated solids, observe and adhere to the personal hygiene-related provisions of this Section.

Contractor, subcontractor, and service personnel found to be consistently disregarding the personal hygiene-related provisions of this plan shall, at the request of the OSC or his delegated OSR, be barred from the site. This shall not be construed as relieving the Contractor from responsibility for enforcement.

The Contractor shall provide:

1. Suitable disposable outerwear, gloves, hardhat liners, and footwear on a daily basis for the use of employees and visitors.
2. Contained storage and disposal for used disposable outerwear.
3. Shower facilities for employees.

4. Hand washing facilities.
5. A facility for changing into and out of work clothing. Work clothing should be stored separate from street clothing.
6. A lunch and/or break room.
7. A smoking area.

Contractor, subcontractor, and service personnel shall wear disposable outerwear, gloves, and outer footwear at all times whenever entering or working in a hazardous work area.

Used disposable outerwear shall not be reused, and when removed, shall be placed inside disposal containers provided for the purpose.

Smoking and chewing shall be prohibited except in a designated contractor-provided smoking area.

Eating and drinking shall be prohibited except in a designated contractor-provided lunch or break area.

Contractor, subcontractor, and service personnel shall be required to thoroughly cleanse their hands before entering the smoking or lunch areas.

Soiled disposable outerwear shall be removed prior to entering the lunch area, and prior to cleansing hands.

All personnel working in a hazardous work area shall be required to shower and change to fresh clothing after each working period or shift, prior to leaving the site.

Air Monitoring

During the progress of active remedial work, the Contractor shall monitor the quality of the air in and around each active work location. Sampling shall be conducted on a regular periodic basis, and additionally as required by special or work-related conditions.

Instruments required, and Contractor provided, for air monitoring shall include: an explosimeter, an organic vapor photoionizer, and an organic vapor analyzer.

Air monitoring equipment shall be operated by personnel trained in the use of the specific equipment provided.

The Contractor shall maintain a log of the location, time, type, and value of each reading and/or sampling. Copies of daily log sheets shall be included with the daily report to the OSC.

Should the organic vapor level in any active working location exceed 300 ppm for any single reading, or 100 ppm for any two successive readings, or should the explosimeter indicate over 25 percent of the lower explosive limit on any single reading, then that work location shall be shut down and evacuated upwind. Work shall not resume at such a work location until a full survey shall indicate that explosimeter vapor readings have subsided to a safe level.

Following a work location shut down, explosimeter and organic vapor sampling shall be continuous until the Contractor feels confident that the cause of the shut down has disappeared, at which time normal periodic sampling may be resumed.

A wind direction and speed indicator shall be emplaced by the Contractor at each active work location. The air monitoring log shall include wind direction and velocity information for each reading.

Each of the Contractor's air monitoring teams shall consist of two (2) employees working on the "buddy system", and except for emergency functions, such as firefighting or first aid, shall be devoted full time to air monitoring unless otherwise determined by the OSC.

The Contractor, by continuous downwind air sampling shall ensure that air leaving the active work locations does not pose a hazard to residents or other persons downwind from the site.

Dust Control

During remedial action, the Contractor shall implement, monitor and enforce a dust control program to minimize the generation and off site transportation of fugitive emissions.

All roadways, designated work areas and other possible sources of dust generation shall be thoroughly treated (wetted, covered, sealed) to minimize dust generation.

Respirable dust monitors shall be utilized to monitor the levels of dust generation. Departures from general background shall be reported to the OSC who shall initiate the appropriate action including work stoppage to reduce dust emissions to an acceptable level.

Contaminant Control

Vehicles and equipment working in, being operated in, or otherwise coming in contact with known or suspected toxic or hazardous materials shall be decontaminated in a designated decontamination area prior to leaving the site.

Decontamination of vehicles and equipment shall consist, at a minimum, of a pressure spray cold water wash. Should oily or sticky contaminants present on the site make simple washing ineffective, the Contractor shall decontaminate by a method previously agreed upon with and approved by the OSC.

Wash waters and solids shall be disposed to the onsite waste treatment plant and all such wastes shall be treated as potentially hazardous.

Personnel engaged in vehicle decontamination shall be protective equipment to include appropriate disposable clothing and respirator.

The decontamination area shall be considered a hazardous work area.

Materials known or suspected to be contaminated with toxic chemicals, or to be toxic or hazardous shall not be left exposed to the elements during the progress of remedial work. Excavated material shall be covered or shielded from rain and wind to minimize dispersal of particulates and vapors.

Containers of contaminated waste, toxic liquids or solids, or other hazardous substances shall not be left uncovered or otherwise configured to continuously expose the contents.

Unless previously agreed upon with the OSC, hazardous materials unearthed, excavated, or otherwise derived from a hazardous work area shall not be removed from that area. Exception from this provision is hereby made for samples required by the scope of remedial work, by local authorities, by the State, or by the Federal Government.

All materials removed from sewers will be drummed and transported to New York State-approved disposal sites. Contaminated clothing, used respirator cartridges and other disposable items will be put into containers for transport to the same disposal site.

Any excavated material not used as backfill material will be disposed of as a hazardous material in a New York State-approved site.

All streets in the site shall be cleaned by the Contractor in such a manner as to prevent surface contamination from leaving the site.

During dry periods, dust suppression techniques, such as continuous wetting of work areas (including roadways) and equipment shall be employed.

All drums which are to be disposed at a New York State-approved disposal site must have the moisture content of its contents indicated on the drum.

Trenching and Work in Trenches

In addition to OSHA requirements in 29 C.F.R. 1926, the following minimum procedures will be followed:

At least one (1) three thousand (3,000) cubic feet per minute (FPM) air mover shall be used to provide ventilation while workmen are in trenches.

Contractor personnel shall monitor air while workmen are in trenches.

Manholes, Wet Wells, and Other Confined Spaces

All confined spaces will be ventilated for an adequate time prior to entry with at least one (1) 3,000 cfm air mover.

Contractor personnel shall monitor air for oxygen (minimum 19.5 percent), combustible gas, and organic vapors prior to workmen entering confined space. Safety Officer will determine the need for respiratory protective devices based upon monitoring results.

Contractor shall provide emergency escape type respiratory protection devices to all workmen working in confined spaces.

SAFETY REGULATIONS

(To Be Posted For Onsite Personnel)

Our main safety emphasis is on preventing contact with soil, clay, and water. Towards this end, the following rules have been established.

REGULATIONS

1. Eating, smoking and chewing on the site is PROHIBITED except in specifically designated areas.
2. All personnel on the site must wear either new gloves of clean cotton inner gloves. These are disposable and new inner gloves should be used every day.
3. If you get wet to the skin, you must wash the affected area immediately. If clothes in touch with the skin are wet, these must be changed.
4. You must wash your hands before eating, drinking, or smoking.
5. Observe regulations on washing and removing boots before entering the dressing room or a clean area and showering before going home.

RECOMMENDATIONS

1. Do not smoke with dirty hands; better yet, do not smoke.
2. Check for any personal habit which could get soil or water into your body.

Examples, including licking food off your fingers, wiping your face or nose with a dirty hand or running a dirty hand through your hair.

Check that any regularly worn clothing is clean. Examples include dirty watchbands, neck chains, and a dirty liner on your safety helmet.

Safety practices with poisonous chemicals can be summed up in a few words:

Do Not Breathe in Chemical Odors and Do Not Touch the Water and Soil.

If you do get dirty or wet, clean up as soon as possible.

SAFETY REMINDER FOR TOXIC CHEMICALS
(Post for Onsite Personnel)

Chemicals cannot cause health or toxic problems unless you breathe them, eat them, or put them on your skin.

CHEMICAL GASES

The main problem is in the trenches, manholes, and other confined spaces.

1. Always have air mover operational when working in confined spaces. This is your best protection.
2. Wear your respirator in confined spaces.
3. Change respirator canister if you cannot breathe easily or if the odor comes through the respirator.

CHEMICALS IN SOIL, CLAY, AND WATER

Do not let chemicals get into your mouth, nose, or stay on your skin.

Use common sense personal hygiene.

1. Do not eat or chew on the site.
2. No smoking except in smoking area.
3. Wear protective clothing.
4. Glove liners must be clean.
5. Wash your hands whenever practical. Wash before eating, drinking, or smoking.
6. Do not carry chemicals home to your family. (For example, on clothing, mud in the car, dirty hands).