UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS SITE CONTROL DIVISION

Remedial Planning/ Field Investigation Team (REM/FIT)

ZONE II

CONTRACT NO. 68-01-6692

CH2M HILL

Ecology & Environment

LOVE CANAL SEWERS AND CREEKS REMEDIAL ALTERNATIVES EVALUATION AND RISK ASSESSMENT

EPA 138.2L05.0

VOLUME I

March 28, 1985

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DIVISION OF SOLID AND
HAZARDOUS WASTE

SEE PG. 6-6 , 6-24
TABLES 6-1 → 6-3 COMPARE w/ BIDS

LOVE CANAL SEWERS AND CREEKS REMEDIAL ALTERNATIVES EVALUATION AND RISK ASSESSMENT

EPA 138.2L05.0

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WDR102/004

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Chapter 1
EXECUTIVE SUMMARY

INTRODUCTION

This report evaluates several remedial alternatives for the mitigation of contamination found in the sanitary and storm sewers of the Love Canal Emergency Declaration Area (EDA), Black, Bergholtz and Cayuga Creeks, which border the EDA and the City of Niagra Falls, New York; and an area known as the 102nd Street Outfall, which is located in the Little Niagara River (see Figures 1-1 through 1-4 and Plates 1 and 2 in the rear). A previous report prepared by Malcolm Pirnie, Incorporated entitled Environmental Information Document (EID) "Site Investigations and Remedial Action Alternatives, Love Canal" and submitted to New York State Department of Environmental Conservation (DEC) in October 1983 serves as the starting point for this report. The Malcolm Pirnie EID documented an intensive sampling effort designed to characterize the contamination present in the sewers and creeks of the Love Canal area (first investigated by the Environmental Protection Agency [EPA] in 1978) and determine appropriate remedial actions. A summary of the contaminants and concentrations found by Malcolm Pirnie are shown in Tables 1-1 through 1-3. The report and the alternatives recommended by Malcolm Pirnie were accepted by DEC; however, EPA officials chose not to issue a Record of Decision documenting (and funding) the alternatives to be implemented without additional information in the form of cost evaluations, risk assessments, and technical evaluations of additional remediation measures. EPA tasked CH2M HILL under the existing REM/FIT Zone II contract to augment the information contained in the Malcolm Pirnie EID, especially regarding technical and risk assessment issues.

PROCEDURES

In order to issue a Record of Decision before the start of the 1985 construction season and because extensive analysis of other alternatives had been done, EPA designated specific alternatives for evaluation. At the direction of EPA, remedial action alternatives suggested by the DEC and concerned citizens were also evaluated. A complete listing of the alternatives evaluated is shown in Table 1-4.

These alternatives were subjected to an initial screening based on criteria specified in the National Contingency Plan. Those alternatives that were eliminated on this basis are shown in Table 1-5. Additional screening and evaluation of alternatives was conducted on the basis of the impacts associated with the remedial activities (Table 1-6). Costs were derived for the remaining alternatives (Table 1-7). A summary of the feasibility, costs, and public health and

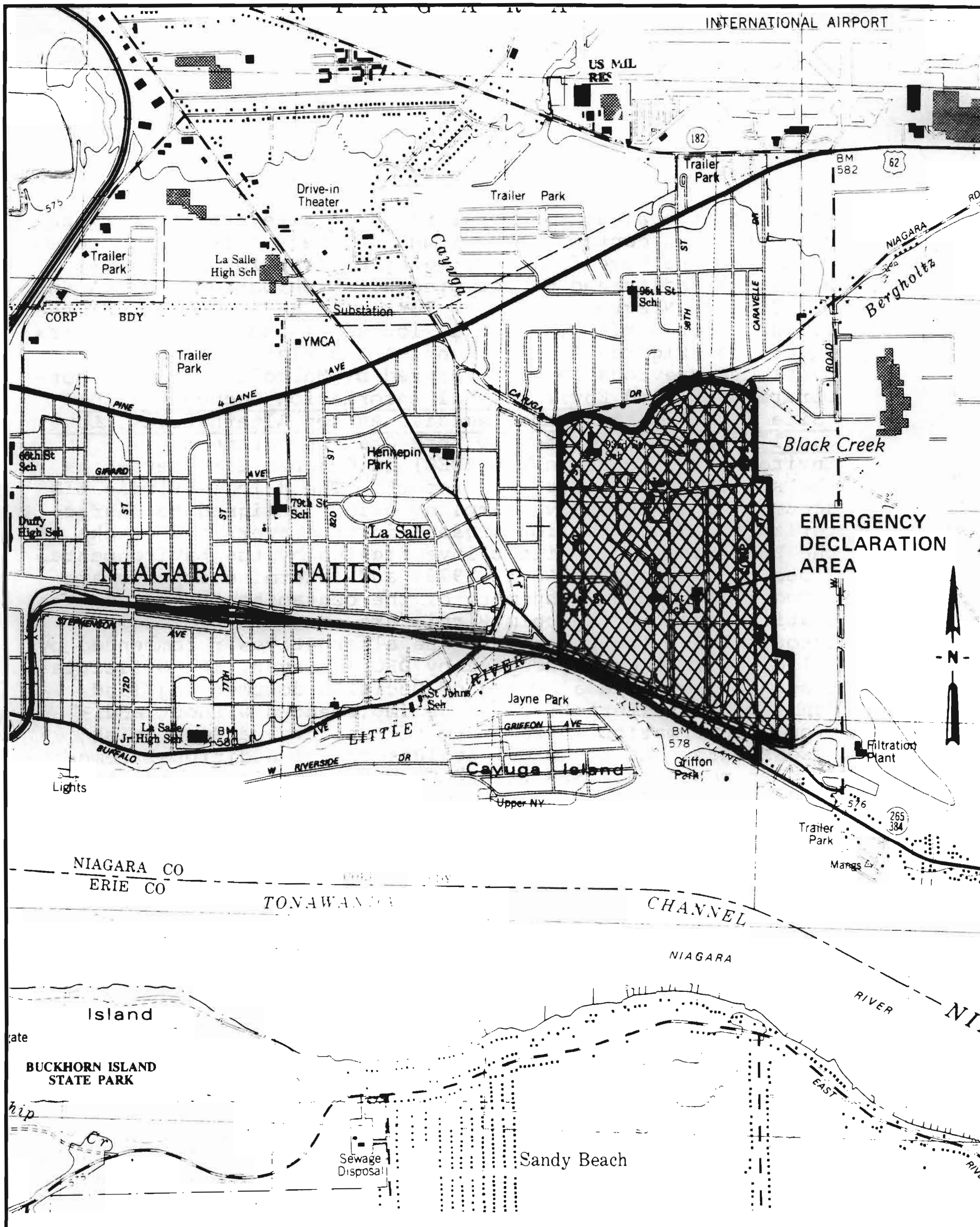

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Figure 1—1

Love Canal Area

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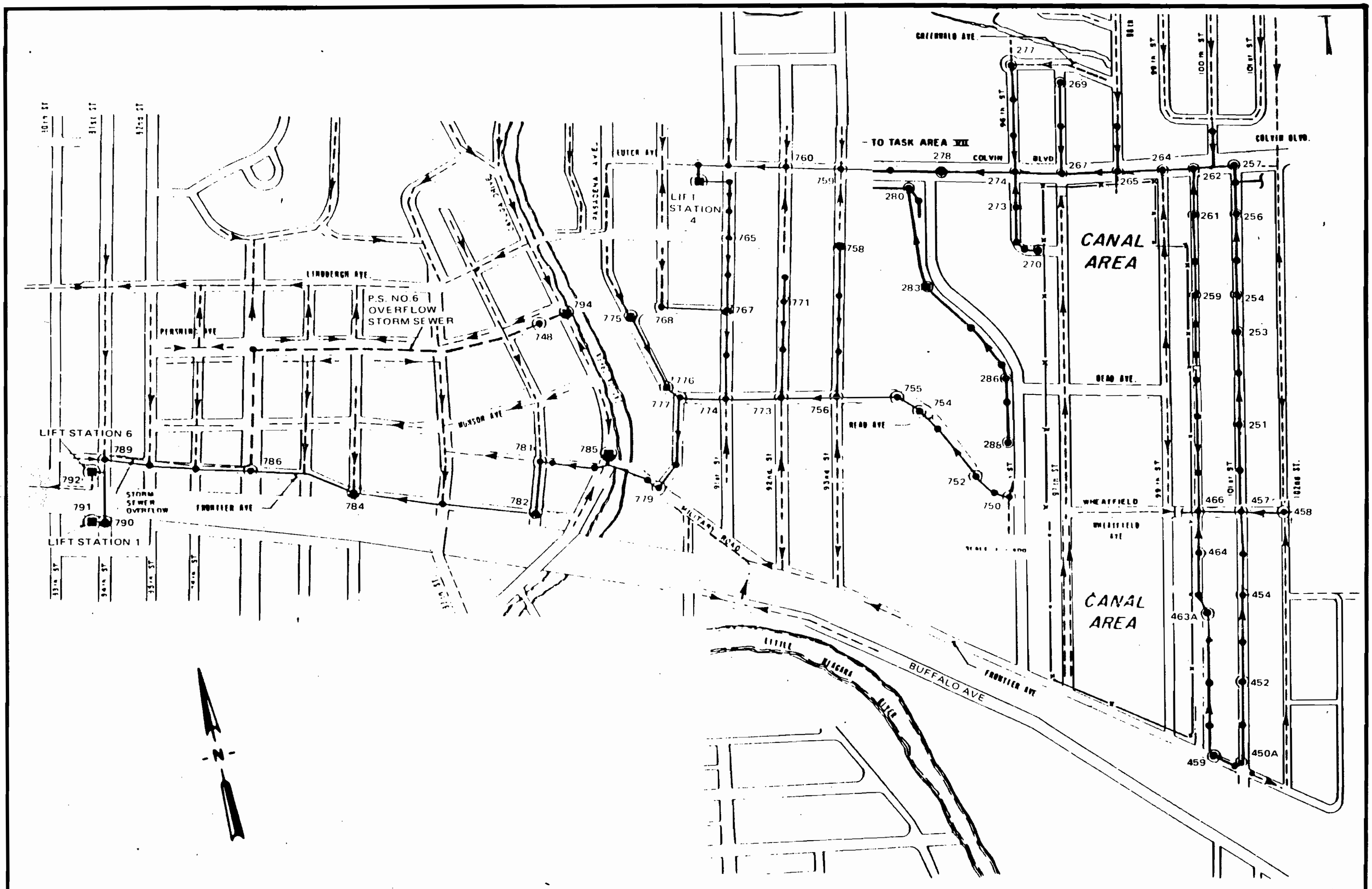

Figure 1–2
Sanitary Sewers of the Love Canal Area

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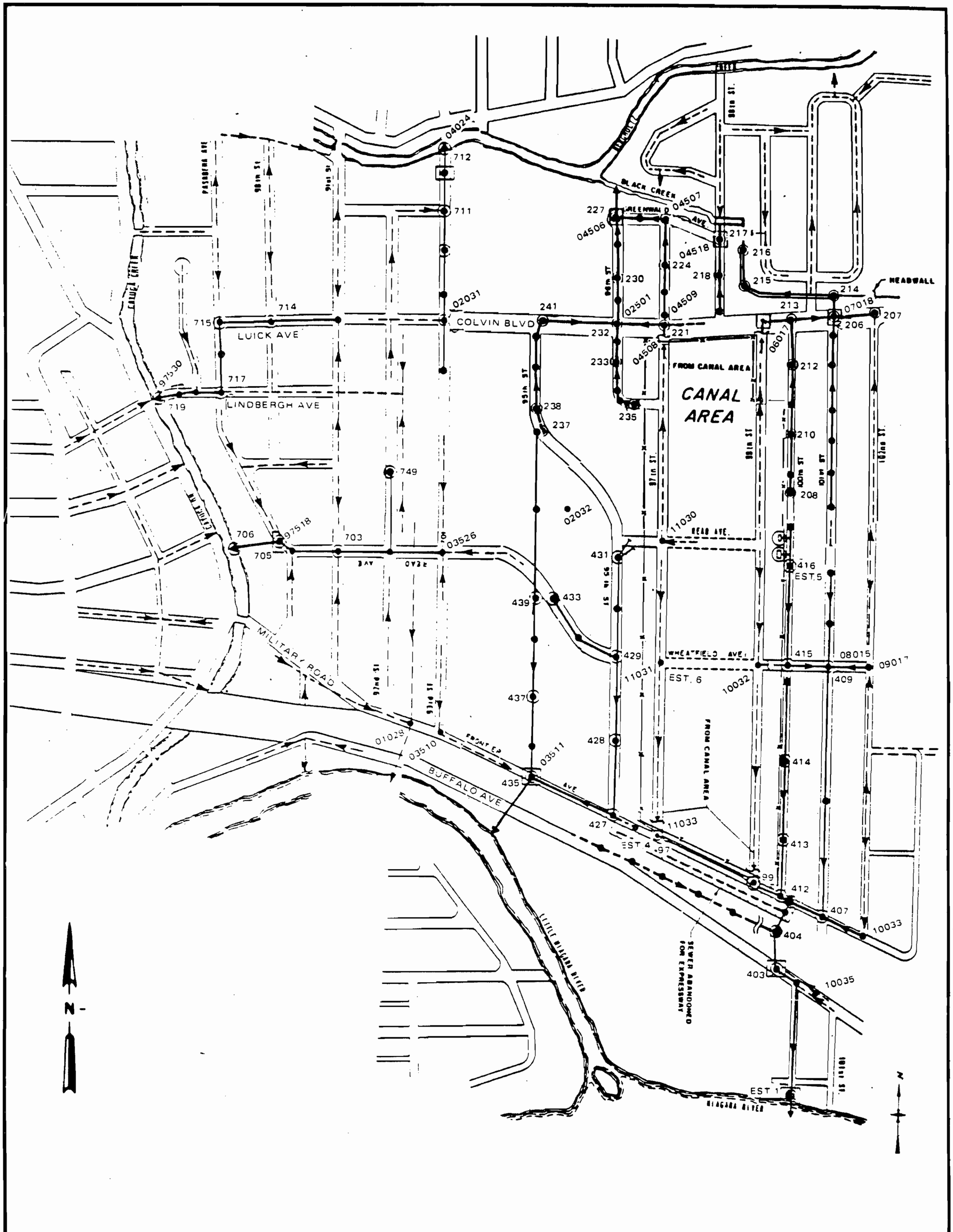

Figure 1—3

Storm Sewers of the Love Canal Area

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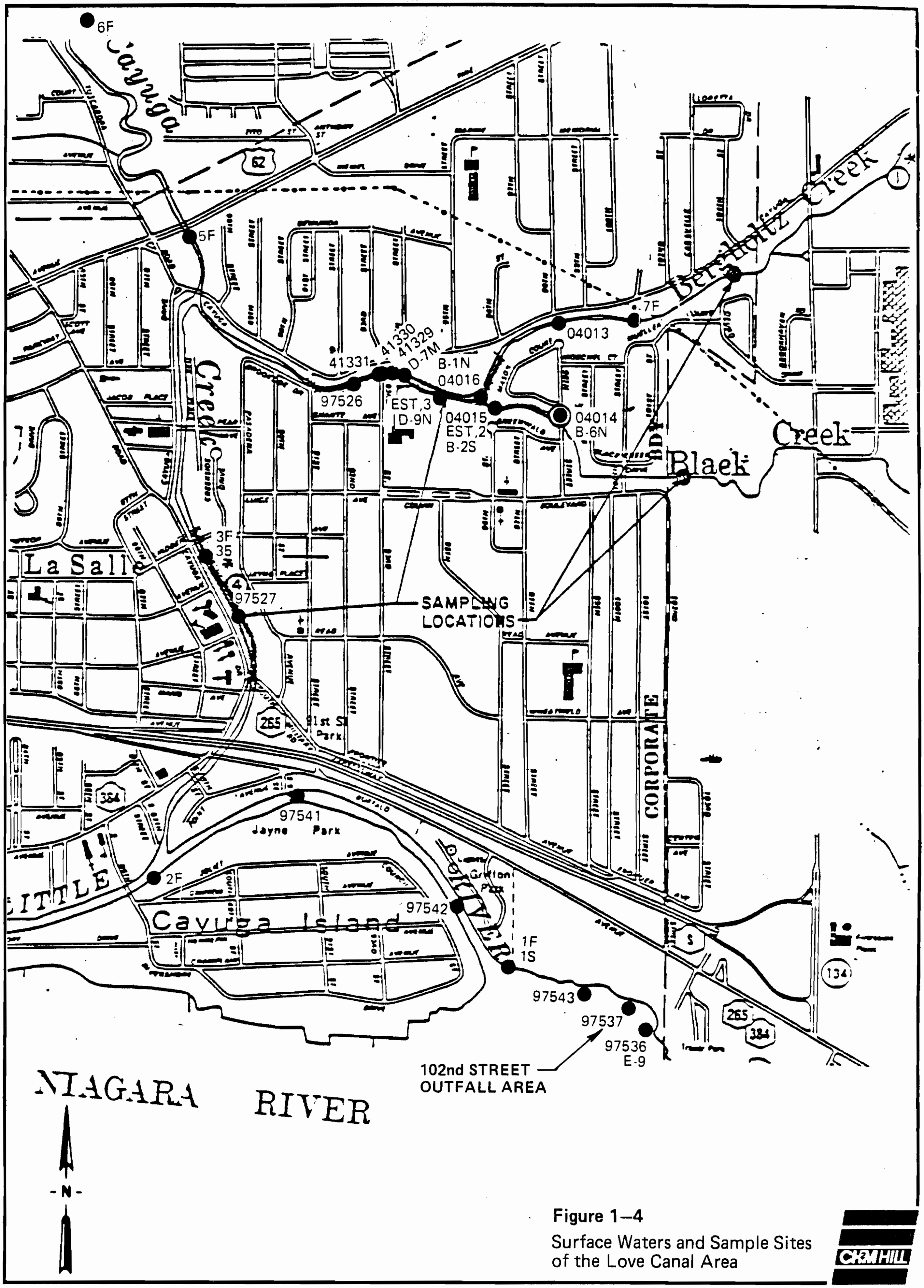

Figure 1–4
Surface Waters and Sample Sites of the Love Canal Area

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Table 1-1
CONCENTRATION RANGES IN INDIVIDUAL SANITARY SEWER SEDIMENT SAMPLES

Compound*	Range of Concentration (µg/kg)[1]	Sampling Location[2]
Chlorobenzene	ND - 78,000	457, 779
1,2-Dichlorobenzene	ND - 34,000	779, LS#6
1,3-Dichlorobenzene	ND - 52,000	265, 773,779, LS#4 LS#6
1,4-Dichlorobenzene	ND - 98,000	285, 457, 754, 755, 773 779, LS#9, LS#6
1,2,4-Trichlorobenzene	ND - 510,000	251, 262, 264, 265, 267, 457, 759, 773, 777, 779,786, LS#4, LS#6
Hexachlorobenzene	ND - 85,000	262, 265, 267, 457, 759,765, 777, 779 LS#4
Toluene	ND - 35,000	285,457,752,754,755,779
α - BHC	ND - 140,000	457, 777,779, LS#4
δ - BHC	ND - 130,000	457, 777, LS#4
γ - BHC	ND - 120,000	457, 777,779, LS#4
Fluoranthene	ND - 6,400	257, 277, 754, 768, LS#4
Benzoanthracene/Chrysene	ND - 4,600	LS#4
Anthracene/Phenanthrene	ND - 16,000	262, 754, 755, 779, LS#4, LS#6
Naphthalene	ND - 7,000	LS#6
Pyrene	ND - 5,200	277,754,768, LS#4 LS#6
Hexachlorobutadiene	ND - 76,000	262, 265, 457, 777, 779
1,1,1-Trichloroethane	ND - 2,500	457
Trichlorofluoromethane	ND - 3,300	457
Phenol	ND - 500	273
Dichlorophenol	ND - 63	
2,4,6-Trichlorophenol	ND - 560	777
2,3,7,8 - TCDD	ND - 30	264, 759, 765, 786

NOTE:

* - Methylene chloride, phthalate esters, and heavy metals were not included.
1 - All results reported on a wet weight basis.
2 - Manholes unless indicated otherwise.
ND - Not Detected
LS - Lift Station

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Table 1-2
CONCENTRATION RANGES IN INDIVIDUAL STORM SEWER SEDIMENT SAMPLES

Compound*	Range of Concentrations (μg/kg)[1]	Sampling Location[2]
Benzene	ND - 2,100	206
Ethylbenzene	ND - 2,200	221
Chlorobenzene	ND - 55,000	415, 715, 719, D.I.99
1,2-Dichlorobenzene	ND - 48,000	412, 719, D.I. 97. D.I.99
1,3-Dichlorobenzene	ND - 60,000	719, D.I.97
1,4-Dichlorobenzene	ND - 92,000	412, 715, 719, 750, D.I.97, D.I.99
1,2,4-Trichlorobenzene	ND - 130,000	221, 412, 714, 715, 719, D.I.97, D.I.99
Hexachlorobenzene	ND - 34,000	221, 412, 719, D.I.97
Toluene	ND - 280,000	221, 412, 415, 715, 719, D.I.99
Napththalene	ND - 11,000	412
2-Chloronaphthalene	ND - 46,000	412
Fluoranthene	ND - 6,800	415, 431, 712, D.I.97
1,2-Diphenylhydrazine	ND - 19,000	412
Anthracene/Phenanthrene	ND - 13,000	431, D.I.97, D.I.99
Pyrene	ND - 5,600	712, D.I. 97
Hexachlorobutadiene	ND - 43,000	719, D.I.97
α - BHC	ND - 11,000	412
β - BHC	ND - 6,800	D.I.97
2,3,6-Trichlorophenol	ND - 6,000	D.I.97
2,3,7,8 - TCDD	ND - 1.9	415, 712

NOTES:

* - Methylene chloride, phthalate esters, and heavy metals were not included.
1 - All results reported on a wet weight basis.
2 - Manholes, unless otherwise indicated.
ND - Not Detected
DI - Drop Inlet

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Table 1-3
CONCENTRATION RANGES IN INDIVIDUAL 102ND STREET
OUTFALL SEDIMENT SAMPLES

Compound[1]	Range of Concentrations (µg/kg)[2]	Location[3]
Carbon tetrachloride	ND - 2,300	E-13B
Chloroform	ND - 2,000	E-9C, G-14A, G-15C
Toluene	ND - 3,200	E-9A
Trichloroethylene	ND - 6,200	E-9A
Tetrachloroethylene	ND - 26,000	E-9A
Trichlorofluoromethane	ND - 2,500	E-14A
Chlorobenzene	ND - 9,100	E-7C, E-8C, E-9A, E-10C, E-11B, E-11C, E-12C, F-7A, F-7C, F-11C, G-7C, G-11C
1,2-Dichlorobenzene	ND - 36,000	E-7C, E-9A, E-9B, E-11B, E-11C, F-11C, G-6A
1,3-Dichlorobenzene	ND - 64,000	E-7C, E-9A, E-9B, E-11C, F-9A, G-6A
1,4-Dichlorobenzene	ND - 54,000	E-9A, E-9B, E-11B, E-11C, F-9A, F-11C, G-6A
1,2,4-Trichlorobenzene	ND - 300,000	E-8A, E-9A, E-9B, E-9C, F-9A, F-9B, G-6A, H-10A, K-21A
Hexachlorobenzene	ND - 52,000	E-9A, E-9B, E-9C, F-9A
Bis(2-chloroethyl)Ether	ND - 5,200	E-9A, F-9C, F-13A, F-13B, H-8C
α - BHC	ND - 48,000	E-4A, E-8A, E-9B, E-9C, F-8A, F-9A, F-9B, G-6A, G-9A, G-14B, K-6A, K-21A
β - BHC	ND - 49,000	E-8A, E-9A, E-9B, F-8A, F-9A, G-6A, K21A
γ - BHC	ND - 2,400	E-9B, G-6A
δ - BHC	ND - 260	E-9B
Chrysene	ND - 710	G-6A
Pyrene	ND - 540	G-6A
Phenanthrene	ND - 20,000	E-9A
Anthracene/Phenanthrene	ND - 200	E-9B
2,3,7,8 - TCDD	ND - 4	F-8

NOTE:

ND - Not Detected

1. Methylene chloride, phthalate esters, and inorganic compounds data were not included.
2. All results reported on a wet weight basis.
3. Refer to Figure 3-1 for locations. The last letter in the location designation indicates the depth of sample (i.e. A - 0-12", B - 12-24", C-24-36") below sediment surface.

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Table 1-4
REMEDIAL ALTERNATIVES

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
I. Sediment Removal or Remediation			
A. Sewers	X		X
1. No action	X		X
2. Plug and abandon sewers	X	-	
3. Clean contaminated sewer segments	X		X
a. Hydraulically clean	X		X
b. Mechanically clean and hydraulically flush lines	X		X
1) Use power rodding mechanical equipment	X		X
2) Use bucket cleaning mechanical equipment	X		X
4. Hydraulically and/or mechanically clean sewers and repair	X		X
a. Apply grout	X		X
b. Slip line sewer segments	X		X
5. Remove and replace contaminated sewer pipe and bedding material	X		X
B. Creeks			
1. No action	X		X
2. Delay remedial action until additional sampling is completed downstream as far as the confluence of Cayuga Creek and Little Niagara River		+	X
3. No remedial action downstream of the 93rd Steet School until sampling at the school is completed		+	X
4. Remediate Black Creek and Bergholtz Creek areas designated in 1983 EID (from 96th Street to point between 94th and 95th Streets)	X		X
5. Remediate the area in 4 above plus an additional 600 feet downstream to the 93rd Street storm sewer outfall		+	X
6. Remediate the area in 5 above plus an additional 2400 feet from the 93rd Street outfall to the confluence with Cayuga Creek		+	X

Table 1-4
REMEDIAL ALTERNATIVES
(Continued)

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
7. Remediate the area in 6 above plus the 6,300-foot section of Cayuga Creek from the Bergholtz Creek to the Little Niagara River		+	X
8. Institutional action only	X		X
a. Increase public awareness	X		X
b. Post signs	X		X
c. Fence the creeks	X		X
d. Ban fishing and water sports		+	X
9. Stabilize creek sediments	X		X
a. Place small stone on creek bed only	X	-	
b. Install filter fabric on creek and cover with stone	X		X
c. Place Black Creek within a culvert	X		X
d. Apply chemical or biological agents to make contaminants inert (the K-20 process)		+	X
10. Hydraulically clean Black Creek culverts and mechanically remove and dispose of sediments from creek bottom		+	X
a. Hydraulically dredge creek		+	X
b. Mechanically excavate creek		+	X
c. Mechanically excavate creek and construct sediment trap or tidal gate		+	X
C. 102nd Street Outfall			
1. No action	X		X
2. Stabilize sediments (long term)	X	-	
a. Solidify or destroy contaminants in place	X	-	
b. Bury sediments in place	X	-	
3. Repair tidal gate			
a. Repair tidal gate only		+	X
b. Repair tidal gate in conjunction with alternatives C.4, C.5, or C.6		+	X

Table 1-4
REMEDIAL ALTERNATIVES
(Continued)

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
4. Stabilize sediments (short term)	X		X
a. Cover deposits with filter fabric and stone fill	X		X
b. Construct earth/stone berm	X		X
c. Install sheet pile wall	X		X
d. Construct berm or wall and cover sediments with filter fabric and stone fill		+	X
5. Construct berm or wall and remove and dispose of sediments	X		X
a. Mechanically excavate using shore-based equipment	X		X
b. Mechanically excavate using a combination of shore-based and barge-mounted equipment	X		X
c. Use barge mounted clamshell dredge	X		X
d. Hydraulically dredge using barge-mounted equipment	X		X
6. Construct berm or wall and cap in-place		+	X
II. Transport and Dewatering of All Sediments, and Treatment of Fluids			
A. Transport sediments to dewatering facility	X		X
1. Convey sediments by pipe within a pipe (hydraulic cleaning or dredging)		+	X
2. Convey sediments by watertight trucks (mechanical excavation)		+	X
B. Dewater sediments	X		X
1. Erect passive or mechanical dewatering facilities	X		X
2. Dewater solids in interim storage facility		+	X
C. Treat fluids			
1. Treat fluids at modified Love Canal Leachate Treatment Plant	X		X
2. Erect separate fluid treatment facility		+	X
3. Discharge fluids to sanitary sewer for treatment at the Niagara Falls Wastewater Treatment Plant		+	X

Table 1-4
REMEDIAL ALTERNATIVES
(Continued)

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
III. Interim Storage			
A. Cut through new Canal cap liner, deposit sediments, and repair liner		+	X
B. Construct a separate, RCRA-grade* earthern bermed facility on top of the Love Canal cap		+	X
C. Construct a RCRA-grade* earthern bermed cell inside the fenced area of the cap, but off the Canal		+	X
D. Construct a concrete vault* (Times Beach design) located inside the fenced area of the cap, off the Canal		+	X
E. Convert the 93rd Street School building into an interim storage facility		+	X
F. Construct a RCRA-grade* earthern bermed cell on the 93rd Street School grounds		+	X
G. Construct a Times Beach concrete vault* on the 93rd Street School grounds		+	X
H. Construct a Times Beach concrete vault* at the LaSalle housing development following acquisition of that development		+	X
IV. Treatment During Interim Storage		+	X
A. Use K-20 process		+	X
B. Use Occidental Chemical system of microbial degradation		+	X
V. Treatment and Disposal			
A. "In-situ Neutralization"	X	-	
B. Land Disposal			
1. Onsite (excavate portion of clay cap, deposit sediments, and construct new cap; no further action).	X		X
2. Offsite at approved hazardous waste landfill	X		X

Table 1-4
REMEDIAL ALTERNATIVES
(Continued)

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
a. Send waste to local facility such as CECOS or SCA		+	X
b. Send waste to other facilities including U.S. Pollution Control, Inc.; Great Midwest Corporation; and the Environmental Conservation and Management Company		+	X
C. Incineration with Landfill Disposal of Ash			
1. Onsite	X		X
a. Construct fixed facility		+	X
b. Use a mobile incinerator		+	X
1) EPA mobile incinerator		+	X
2) ENSCO/Pyrotech Rotary Kiln		+	X
3) JM Huber advanced electric reactor		+	X
4) RoTech Cascading systems		+	X
5) Plasma Arc incinerator		+	X
2. Offsite			
a. Rollins facility, Deer Park, Texas		+	X
b. ENSCO facility, El Dorado, Arkansas		+	X
c. Chemical Waste Management facility, Chicago, Illinois		+	X
d. SCA Landfill facility, Niagara Falls, New York		+	X
D. Use of GeoTech Melt All system with landfill disposal of ash		+	X

*RCRA-grade storage facility (earthern berm or the Times Beach vault) will be double lined, with a leachate collection system, a leak detection system, a cap, and a contingency plan in case of failure. The facility would meet RCRA criteria in all aspects.

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Table 1-5
ELIMINATION OF SCREENED ALTERNATIVES

Alternative	Criteria for Elimination
I. Sediment Removal	
A. Sewers	
o. Mechanically clean and hydraulically flush lines	Costs/Exceeds Cost of Other Alternatives Without Greater Public Health Protection; and Engineering Practice/Limited Feasibility for Conditions
-- Use power rodding mechanical equipment	
-- Use bucket cleaning mechanical equipment	
B. Creeks	
o Delay remedial action until additional sampling is completed downstream as far as the confluence of Cayuga Creek and Little Niagara River	Effectiveness/Does Not Protect Public Health
o No remedial action downstream of the 93rd Street School until sampling at the school is completed	Effectiveness/Does Not Protect Public Health
o Remediate Black Creek and Bergholtz Creek areas designated in 1983 EID (from 96th Street to point between 94th and 95th Streets)	Effectiveness/Does Not Protect Public Health
o Remediate the area mentioned above plus an additional 600 feet downstream to the93rd Street storm sewer outfall	Effectiveness/Does Not Protect Public Health

Table 1-5
ELIMINATION OF SCREENED ALTERNATIVES
(continued)

Alternative	Criteria for Elimination
o Institutional action only by increasing public awareness, posting signs, fencing the creeks, banning fishing and watersports.	Effectiveness/Does Not Protect Environment, or Effectively Protect Public Health
o Stabilize creek sediments:	
-- Install filter fabric on creek bed and cover with small stone	Engineering Practices/Not a Reliable Remedial Measure
-- Apply chemical or biological agents to make contaminants inert (the K-20 process)	Engineering Practices/Not a Reliable Remedial Measure
-- Place Black Creek in culvert	Costs/Exceeds Cost of Other Alternative Without Greater Public Health Protection; and Engineering Practice/Limited Feasibility for Conditions
o Hydraulically clean Black Creek	Engineering Practices/Dredge Cannot be Used in Black Creek
III. Interim Storage	
o Convert the 93rd Street School building into an interim storage facility	Engineering Practices/Building Not Suitable for Use
o Construct a Times Beach concrete vault at the LaSalle housing development following acquisition of that development	Effectiveness/Possible Delays in Obtaining Property and Conducting Engineering Studies Do Not Contribute to Protection of Public Health

Table 1-5
ELIMINATION OF SCREENED ALTERNATIVES
(continued)

Alternative	Criteria for Elimination
IV. Treatment During Interim Storage	
o Use K-20 process	Engineering Practices/Not a Reliable Remedial Measure
o Use Occidental Chemical system of microbial degradation	Engineering Practices/Not a Feasible Remedial Measure
V. Disposal	
o Onsite (excavate portion of clay cap, deposit sediments, and construct new cap)	Engineering Practices/Insufficient Capacity
o Offsite at approved hazardous waste landfill:	
-- Send waste to local facility such as CECOS or SCA	Engineering Practices/Facilities Will Not Accept Wastes
-- Send waste to other facilities including U.S. Pollution Control, Inc.; Great Midwest Corporation; and the Environmental Conservation and Management Company	Engineering Practices/Facilities Will Not Accept Wastes

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Table 1-6
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
1. Sewers			
a. No action	None	None	Continued sediment migration to creeks and sewage treatment facility. Continued potential public exposure to contaminants. See Chapter 3.
b. Hydraulically clean and repair.	1. Run blower and plug sewer section.	Public contact minimized.	Potential for small amount of material to remain; minimized by TV inspection
	2. Set up cleaning jet at downstream, collection manhole.	Notice to residents of activity startup.	
	3. Perform cleaning operation (cleaning jet propels itself upstream and is then reeled back to collection manhole	Immediate cleanup if backup reported in house. Backflow to cleaned sewer. Immediate cleanup if backup segments blocked.	
	4. Manually or mechanically remove large debris (using shovels and buckets).	Sewer demand decreased by performing action during dry season.	
	5. Use suction equipment (submersible pump and vacuum nozzle or vacuum truck) to remove sediments.	Volatiles inside house minimized by opening windows.	
	6. Transport sediment/water to treatment/disposal facility.	Dust emissions minimal because of sediment water content.	
	7. Remove plugs from cleaned sewer section.	Machinery noise during daylight work hours.	
	8. Decon blower, jet cleaning equipment and truck, and tank truck.	Truck Traffic to dewatering facility.	
	9. Collect and treat decon wash water.	Potential for discharge of cleaning water minimized by sewer plugs.	
	10. TV inspection of cleaned segment.		
2. 102nd Street Outfall			
a. No action.	None.	None.	Continued sediment migration. Continued aquatic life exposure. Continued potential public exposure to sediments and contaminated fish. (See Chapter 3.)

Table 1-6
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
b. Mitigate backflow to sewer by repair to tidal gate.	1. Remove rocks and debris from in front of headwall.	One day of activity.	Mitigates potential backflow from outfall to storm sewer.
	2. Mobilize backhoe and portable generator to top of headwall.	Small disturbance of outfall sediment because any actions are at outfall.	Continued sediment migration in river.
	3. Lower tidal gate into position on face of headwall.	Negligible public exposure.	Continued aquatic life exposure.
	4. Bolt tidal gate flange to headwall.	Machinery noise at outfall during daylight work hours.	Continued potential public exposure to to sediments and contaminated fish. (See Chapter 3).
c. Immediate Stabilization			
1) Construct stone berm with timber sheeting.	1. Inspect intended berm location for large debris and remove debris as necessary (drill several borings along alignment).	Little or no worker or equipment contact with sediment, unless when driving wall, debris or rocks are hit. Then the wall will be pulled out, repositioned (or obstacle will be moved), and replaced. Some worker contact possible while repositioning sheeting.	Berm/sheeting will need to be maintained to insure continued effectiveness.
	2. Beginning at shore line, use front end loader and bulldozer to transport and place stone.		
	3. Use barge mounted pile driver to place timber sheeting (second barge may be necessary to guide sheeting).	Sediments disturbed and possibly entrained during construction.	
2) Construct steel pile wall.	1. Inspect wall location for debris, remove debris as necessary.	See 2(c)1, except sediment disturbance lessened.	See 2(c)1.
	2. Use barge-mounted drill rig to drill borings along wall alignment to determine depth of river bed and identify locations of any buried debris.		
	3. Use barge-mounted pile driver to construct wall starting at shoreline (2nd barge will need to be used to guide sheet piling).		

Table 1-6
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
d. Long-term remediation			
1) In-place containment (with 2(c)1 or 2.	1. Construct stone berm or wall (See 2(c) 1 or 2 above).	See 2(c)1.	See 2(c)1.
	2. Dewater, backfill contained area and cap it.	Haul trucks with fill.	None.
2) 2(c) 1 or 2 followed by removal using land based equipment	1. Construct stone berm or wall (See 2(c) 1 or 2 above).	Potential for splashing workers as sediments are transferred from clamshell to truck.	None.
	2. Remove rip-rap along shore line and build berms or mud mats as necessary.	Biota will be lost.	Biota community expected to reappear.
	3. Use shore-based drag line or clamshell on crawler crane to excavate sediments.	Truck traffic to dewatering facility.	
	4. Load excavated sediments into truck and transport sediments to dewatering/disposal facility.		
	5. Excavate stone berm placing stone in trucks--transport to disposal facility. Rebuild shore rip-rap to depth of excavation.		
	6. Decon dragline/clamshell, trucks, and/or other equipment.		
3. Black Creek			
a. No action.	None.	None.	Continued sediment migration. Continued potential public exposure. (See Chapter 3)

Table 1-6
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
b. Mechanically excavate	1. Construct access road along creek bank, clear, and grub. 2. Construct berms up and downstream and dewater between using pumps. 3. Use backhoe to excavate sediments and place them in a watertight truck. 4. Transport sediments to dewatering/disposal facilities. 5. Remove earth berms and dispose of at hazardous waste facility. 6. Decon excavating equipment and truck, etc.	Public contact minimized o Restricted access during activities. o Volatile emissions negligible because no volatiles detected in sediment. o Dust emissions minimal - Wet state of sediment - Cleanup of spills on banks o Sediment transport will be in leakproof trucks operating over short distance. Temporary haul roads. Machinery noise during daytime work hours. Creek biota will be lost.	Potential for small fraction of contaminated sediment to remain. Creek biota community expected to renew.
c. Construct tidal gate or sediment trap at confluence conjunction with 3.b. above.	1. Excavate approximately 18 inches in Black Creek (at confluence with Bergholtz Creek). 2. Mix and pour concrete to form tidal gate/sediment trap. 3. Continue with steps 6 and 7 above.	Negligible addition to 3.b.	Prevents backflow of Bergholtz Creek sediments to Black Creek if two creeks not cleaned concurrently or are cleaned by different methods.
4. <u>Bergholtz Creek & Beyond</u>			
a. No action.	None.	None.	Continued sediment migration. Continued aquatic life exposure. Continued potential public exposure to sediment and contaminated fish. See Chapter 3.
b. Mechanically excavate.	1. Construct temporary berm at mouth of Black Creek to use as stream crossing. 2. Follow steps 1-6 under 3.b. above, except use frontend loader and clamshells.	See 3.b. Numerous trips (more than 1,400) by haul truck to deposit sediments. Would block some streets at times. Noise and possible dust emissions.	Potential for small residential fraction of contaminated sediment to remain.

Table 1-6
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
c. Hydraulically excavate.	1. Construct temporary berm at mouth of Black Creek to use as stream crossing.	Potential contact reduced because of closed transport in pipes.	Creek biota community expected to renew.
	2. Construct berms up and down-stream and dewater between.	Potential pipeline leaks minimized by double walls.	Potential residual contamination; banks cannot be remedied using hydraulic dredge.
	3. Construct access road, clear, and grub.	Volatile emissions minimal because no volatiles detected in sediments. (91st Street and Colvin Boulevard)	Dewatering facility may be open for year(s) to allow sediments to dewater and stabilize.
	4. Manually remove large debris; reflood.	Bridges required where pipe crosses road.	
	5. Use mud cat to dredge sediments.	Machinery noise during work hours.	
	6. Dewater and inspect; reflood and redredge if necessary.		
	7. Remove earth berms and dispose of at hazardous waste facility.	Creek biota will be lost.	
	8. Transport sediment to disposal facility.	Pipelines (two; each is one mile long) must be in place throughout; pumps will run continually. Haul trucks will carry debris through streets.	
	9. Dewater dredge spoils and treat filtrate.		
	10. Decon mud cat, truck, dewatering pump, piping, etc.		
6. Sediment Dewatering			
a. Mechanically dewater.	1. Transport sediment in water tight truck or pipe sediment to dewatering facility.	Sediment compression may emit volatiles. Minimal dust emission because sediment still wet and is dropped into covered container.	Action is an intermediate stage of remedial action. Sediments are removed to Interim Storage (See #7). No long term impacts from action.
	2. Feed sediment onto vacuum filter and air press.		
	3. Remove filter cake and transport to disposal facility.		

Table 1-6
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
	4. Transport and treat filtrate, at LCTF, release to sewer system and NFWTP.		
b. Use interim storage	1. Construct temporary system for sewer sediment dewatering.	Splashing from hydraulically dredged sediments. Emissions possible.	Hydraulically dredged sediments may not solidify for over a year; cannot cap facility until then.
	2. Construct interim storage facility (48,000 cubic yards capacity for hydraulic dredge water recirculation) with major design modifications for hydraulic dredged sediments.		
	3. Pipe water/sediments by pipeline (3,000,000 gallons) or haul sediments to facility (1,400 truck trips).		Continual feed (3,000,000 gallons) to Love Canal leachate treatment facility from hydraulically dredged sediments.
	4. Collect liquid drained into underdrain/leachate collection system or taken off top. Recycle to creek in hydraulic dredging. Treat and dispose of water eventually.		Temporary feed (600,000 gallons) to Love Canal leachate treatment facility from mechanically excavated sediments; cap facility immediately.
	5. Choose disposal/treatment option from 8.		
7. Interim Storage			
a. Construct an earthen bermed facility.	1. Excavate soils and construct berms. If facility is to be within the cap, cut hole in existing HDPE liner.	Placement of material in the the facility could result in the release of contaminated materials that must be contained. Machinery would be involved, causing noise and dust. Haul trucks would bring material into area. Essentially same impacts as activities associated with capping Love Canal.	Aesthetics; if hydraulic dredging used, facility may not be capped for over a a year. Operation/maintenance needed for as long as 30 years. Can be capped immediately if mechanically excavated sediments disposed of.
	2. Fine grade base and install bottom liner. If facility is in cap, weld bottom liner to existing liner.		
	3. Compact clay layer and install leak detection system. Compact additional clay.		
	4. Fine grade and install second synthetic liner.		

Table 1-6
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
	5. Place granular material and piping for leachate collection system.		
	6. Deposit sediments and decon all contacted equipment.		
	7. Construct cover including installation of a synthetic liner. (May be some delay in covering if facility is used for dewatering).		
	8. Topsoil and seed cover.		
b. Construct a concrete structure (Times Beach vault)	1. Excavate soils and install synthetic membrane.	See 7a.	See 7a. Aesthetic impact different than 7a. since vault would be taller, but Only one-fifth as long. Vault can be capped sooner than 7a.
	2. Place drainage gravel and geotextile layers.		
	3. Pour 8" reinforced concrete and coat with polymeric asphalt.		
	4. Place drainage gravel and geotextiles to act as leachate collection system.		
	5. Similarly construct concrete sidewalls.		
	6. Follow steps 6-8 in 7.a., except no delay in covering.		
8. <u>Offsite Disposal</u>			
	1. Open storage facility, remove sediment.	Opening of storage facility and removal of sediments could generate dust, release volatiles. Will take several openings to remove material. Many trucks required to make 1,500 mile trip; possible accidents/incidents. Treatment/disposal should have no more than "normal" impacts at disposal sites.	Facility must be maintained or demolished once empty.

Table 1-6
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
	2. Load sediment on truck. 3. Transport to site & unload. 4. Treat or dispose. 5. Decon all equipment.		
9. Incineration			
a. Construct facility onsite.	1. Construct incinerator. 2. Open storage facility. 3. Transport dewatered sediment to incinerator. 4. Incinerate sediment. 5. Transport ash to secure landfill for disposal. 6. Decon equipment.	If operated within the regulations, emissions and incinerator operations should not pose a risk thresy to workers or residents. Materials must be prepared (ground up, dried). Handling and transport of sediment will release dust, volatiles, and will generate noise. Incinerator will generate noise, ash, and steam. Must have building to house it. Transport of ashcould result in spills. May require additional area to accommodate all of equipment. Cooling water must be treated.	Several years to build; at least one year of operation necessary; storage facility would essentially remain open entire period. Landfilling of residual may necessitate construction of new facility at Love Canal, or transport to offsite facility (See 8).
b. Use mobile incinerator	Same as 9.a. except step 6 would involve demobilization of incinerator equipment.	See 9.a.	Same as 9.a., except incinerator would be onsite from 1 to 29 years and mobilization would be much shorter.

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environmental concerns associated with a number of alternatives, including those alternatives to be considered by EPA, DEC and the public in arriving at a decision on remedial action, is contained in Table 1-8.

DATA VOIDS

Several alternatives presented for the decisionmaking process could not be completely evaluated with existing data. A limited sampling effort should be implemented to determine the following:

- The presence of dioxin in the banks of Black, Bergholtz and Cayuga Creeks;
- The presence of dioxin in the bottom sediments of Cayuga Creek; and
- The physical properties of the sediments in Black and Bergholtz Creeks and the sewers (settleability, filter leaf rests, load bearing capability, etc.).

This information would be most useful in the detailed design of the following:

- the extent of removal of contaminated material that should occur;
- the amount and nature of material to be removed; and
- the manner by which the material should be removed, dewatered, stored and disposed.

This sampling program can be initiated and completed prior to the anticipated beginning of any remedial action for the sewers (summer/fall 1985) or creeks (summer/fall 1986 or 1987). As the following discussion of decisions regarding alternatives will show, the information can be used to finalize several aspects of the remedial actions to be undertaken.

ALTERNATIVES FOR SELECTION

102ND STREET OUTFALL

Two immediate stabilization techniques can be used: a stone berm with timber sheeting OR a steel sheet wall. Either alternative can be used in the long-term remedial actions of containment inplace OR excavation and removal using land based equipment.

Table 1-7
SUMMARY OF ESTIMATED COSTS FOR FEASIBLE ALTERNATIVES

Alternative	Total Present Worth ($)[1]
Sewer Remediation and Repair	
1. No Action	--
2. Cleaning	1,348,000
3. Abandon in-place and replace with new line	7,080,000
102nd Street Outfall Remediation	
1. Immediate Stabilization	
- No Action	--
- Filter Fabric and Stone	207,000
- Berm with Timber Sheeting	509,000
- Steel Pile Wall	636,000
2. Long Term Remediation	
- No Action Subsequent to Berm or Wall	--
- In-Place Containment	598,000
- Removal Using Shore Based Equipment	350,000
Creek Remediation	
1. No Action	--
2. Hydraulic Dredging of Bergholtz Creek	
- 1983 EID limits only	700,000
- 1983 EID limits plus 1st incremental reach	798,000
- Above Plus 2nd Incremental Reach (PROBABLE AREA)	1,026,000
3. Mechanical Excavation--Land-Based Clamshell	
- 1983 EID limits	165,000
- 1983 EID limits plus 1st incremental reach	225,000
4. Mechanical Excavation--Tracked Front End Loader (and Clamshell as needed)	
- 1983 EID limits	184,000
- 1983 EID limits plus 1st incremental reach	248,000
- Above, Plus 2nd Incremental Reach (PROBABLE AREA)	1,178,000
- Black Creek only (PROBABLE AREA)	120,000
5. Additional Sampling Bergholtz and Cayuga Creeks and Banks	169,000
6. Fence Downstream Section of Bergholtz and Cayuga Creeks	161,000
On-Site Storage	
1. Above-Cap, Earthern Berm	
- Mechanical Excavation/5,000 cy	803,000
- Hydraulic Dredging/5,000 cy	829,000
- Hydraulic Dredging; 21,000 cy (Probable Volume)	1,131,000
- Hydraulic Dredging/135,000 cy	4,924,000

Table 1-7
SUMMARY OF ESTIMATED COSTS FOR FEASIBLE ALTERNATIVES
(Continued)

Alternative	Total Present Worth ($)[1]
2. Concrete Vault	
- Minimum Volume, 5,000 cy	509,000
- Probable Volume, 21,000 cy	1,135,350
- Maximum Volume, 135,000 cy	7,298,000
Transport of Sediment, Dewatering and Leachate Water Treatment	
1. Sewer Sediments Dewatering/Love Canal Leachate Treatment Plant	
- Mechanical Dewatering	391,000
- Clarification/Filtration/Mechanical Dewatering	683,000
- Temporary Steel Walls/Passive Dewatering	280,000
2. Transport and Dewatering of Mechanically Excavated or Hydraulically Dredged Creek Sediments Costs Are Contained in Creek Remediationand Interim Storage Costs.	12,900,000-18,060,000
Off-Site Incineration	
1. Rollins: 5,000 cy	7,900,000-9,400,000
2. Rollins: 21,000 cy	18,000,000-31,500,000
3. Rollins: 135,000 cy	206,900,000-247,400,000
On-Site Incineration	
1. EPA Mobile Incinerator: 5,000 cy	4,800,000-7,100,000
2. EPA Mobile Incinerator: 21,000 cy	15,600,000-42,000,000
3. EPA Mobile Incinerator: 135,000 cy	86,800,000-147,500,000
4. Huber AER: 5,000 cy	6,700,000-8,100,000
5. Huber AER: 21,000 cy	12,900,000-18,060,000
6. Huber AER: 135,000 cy	111,200,000-148,300,000
7. ENSCO Mobile Incinerator: 5,000 cy	5,400,000
8. ENSCO Mobile Incinerator: 21,000 cy	16,800,000
9. ENSCO Mobile Incinerator: 135,000 cy	91,300,000

[1] In 1984 dollars.

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Table 1-8
SUMMARY OF ALTERNATIVES AND CONCERNS

Location/ Remedial Action	A Status	B Estimated Cost (1,000's) Present Worth	C Technical Feasibility	D Public Health Concerns	E Anticipated Public Response	F Environmental Concerns	G Other
1. Sewers							
a) No Action	To be considered	--	Feasible	Unchanged exposure potential	Not acceptable	Continued contaminant migration	May not permit reinhabitation of EDA homes.
b) Hydraulic cleaning	To be considered	1,348	Feasible	Minimal potential exposure	Acceptable	Short-term remedial action impacts.	Must precede creek cleaning; dewatering technique decision must be made.
c) Abandon and replace with new lines	Eliminated (B,C,E,F,G)	7,080	Feasible	Reduced exposure potential	Not acceptable	Continued contaminant migration	May not permit reinhabitation of EDA homes.
2. 102nd Street Outfall							
a) No Action	To be considered	--	Feasible	Unchanged exposure potential	Not acceptable	Continued contaminant migration	Continued exposure potential in Niagara River and beyond.
b) Tidal gate repair	To be considered	1.5	Feasible	Unchanged exposure potential	Acceptable as interim measure	Continued contaminant migration	Reduces contaminant migration from river into storm sewer.
c) Immediate stabilization							
- Filter fabric and stone	Eliminated (D, E, F)	207	Feasible; See G	Reduced exposure potential	Not acceptable	Reduced contaminant migration	Cannot assess success without costly monitoring.
- Stone berm & sheeting	To be considered	509	Feasible	Reduced exposure potential	Acceptable as interim measure	Reduced contaminant migration	Adaptable to final remedial action.
- Steel wall	To be considered	636	Feasible	Reduced exposure potential	Acceptable as interim measure	Reduced contaminant migration	Adaptable to final remedial action.
d) Long-term remediation							
- No action after berm or wall	To be considered	See 2.c.	Feasible	Reduced exposure potential	Not acceptable	Reduced contaminant migration	Will fail eventually.
- Berm or wall and hydraulic dredging	Eliminated (B, C)	443	Not feasible	-	-	-	Insufficient water depth and area for dewatering.
- Berm or wall with shore based excavation	To be considered	350	Feasible	Minimal exposure potential	Acceptable	Short-term remedial impacts	Must be coordinated w/102nd St. Landfills remediation; storage facility must be built first.
- Berm or wall and in-place contaminant	To be considered	598	Feasible	Minimal exposure potential	Acceptable	Short-term remedial impacts	Must be coordinated w/102nd Street Landfills remediation.

Table 1-8
SUMMARY OF ALTERNATIVES AND CONCERNS
(Continued)

Location/ Remedial Action	A Status	B Estimated Cost (1,000's) Present Worth	C Technical Feasibility	D Public Health Concerns	E Anticipated Public Response	F Environmental Concerns	G Other
3. Creeks							
a) No Action	To be considered	--	Feasible	Unchanged exposure potential	Not acceptable	Continued contaminant migration	Would not permit rehabilitation of EDA homes.
b) Fencing/ordinances	To be considered	141	Feasible; See G	Unchanged exposure potential	Not acceptable as final solution	Continued contaminant migration	Limited reliability; may be undertaken in conjunction with other measures.
c) Stabilization							
- Filter fabric and stone	Eliminated (C)	--	Not feasible	-	-	-	Remedial area too large.
- Culverts	Eliminated (C)	--	Not feasible	-	-	-	Remedial area too large; would cause flooding.
d) Hydraulic dredging	To be considered	1,026	Feasible; see G	Minimal exposure potential	Acceptable	Short- and long-term remedial action impacts	Serious potential problems with dewatering; would delay closing of interim storage facility by year(s). Major impacts from pipelines during remediation; cannot use "Times Beach Vault" with this option; cannot clean banks with this option. See 4b below.
e) Mechanical excavation	To be considered	1,178	Feasible	Minimal exposure potential	Acceptable	Short-term remedial action impacts	Only feasible alternative for Black Creek or if creek banks need cleaning; major impacts from truck traffic (1,400 trips); block roads at times during remediation; would require some tree removal
4. Sediment Transport and Dewatering							
a) Transport							
- Trucks	To be considered	Costs included in 3d and 3e above	Feasible	Minimal exposure potential	Acceptable	Short-term remedial action impacts	Required for both hydraulic dredging and mechanical excavation, but latter requires 1,400 trips.

Table 1-8
SUMMARY OF ALTERNATIVES AND CONCERNS
(Continued)

Location/ Remedial Action	A Status	B Estimated Cost (1,000's) Present Worth	C Technical Feasibility	D Public Health Concerns	E Anticipated Public Response	F Environmental Concerns	G Other
- Pipeline	To be considered	Costs included in 3d above	Feasible	Minimal exposure potential	Acceptable	Short-term remedial action impacts	Two one-mile-long double pipelines required for hydraulic dredging; major impact on traffic; noise impact.
b) Dewatering							
- Mechanical	To be considered	391 (for minimal volume only; See G)	Feasible, See G	Minimal exposure potential	Acceptable	Short-term remedial action impacts	Costs calculated for 5,000 cy only; suitable for sewer sediments only; creek sediment volume too large.
- Use of interim storage facility (passive dewatering)	To be considered	For sewer sediments: 280	Feasible	Minimal exposure potential	Acceptable	Short-term remedial action impacts	Sewer sediments can be dewatered and temporarily stored in system similar to one previously used at Love Canal; system would be dismantled and dewatered sediments placed in interim storage facility when built.
		For mechanically excavated creek sediments: included in 5d below	Feasible	Minimal exposure potential	Acceptable	Short-term remedial action impacts	Interim secure storage facility of either design (see below) would dewater mechanically excavated sediments using leachate collection system. Interim secure storage facility must be built before remedial action begins.
		For hydraulically dredged creek sediments: included in 5c below (see G)	Feasible	Minimal exposure potential ? MORE EXPOSURE	Acceptable	Short- and long-term remedial action impacts	Interim secure storage facility must be built before remedial action begins. Major design changes needed to adapt system to use for dewatering hydraulically dredged material. Requi facility to be 2-5 times larger than for mechanically excavated sediments. May have serious difficulty in dewatering and stabilizing sediments; may require facility remain open for year(s). Hydraulic dredging option cannot be used without this type of dewatering facilit which also is to be used for wa recirculation to dredge.

Table 1-8
SUMMARY OF ALTERNATIVES AND CONCERNS
(Continued)

Location/ Remedial Action	A Status	B Estimated Cost (1,000's) Present Worth	C Technical Feasibility	D Public Health Concerns	E Anticipated Public Response	F Environmental Concerns	G Other
5. Interim Secure Storage Facility							
a) Below cap	Eliminated (C, D, E)	--	Not feasible (See G)	Increased exposure potential	Not acceptable	Short-term remedial action impacts	No volume available in cap below liner; would require excavation of more contaminated material. * DISAGREE
b) Earthen berm in cap	Eliminated (C, D, E)	--	Not feasible (See G)	Increased exposure potential	Not acceptable	Short-term remedial action impacts	Insufficient volume in cap; would require excavation of more contaminated material. * DISAGREE
c) Earthen berm inside Canal Fenceline or at 93rd Street School	To be considered	1,131	Feasible	Minimal exposure potential	Acceptable	Short-term remedial action impacts	Only feasible design (with modifications) for hydraulic dredging dewatering. May remain open for year(s).
d) Concrete vault inside Canal Fenceline or at 93rd St. School	To be considered	1,135	Feasible	Minimal exposure potential	Acceptable	Short-term remedial action impacts	Cannot be used to dewater hydraulically dredged sediments.
e) Concrete vault at LaSalle	Eliminated (C, E)	--	Not feasible (See G)	Minimal exposure potential	Not acceptable	Short-term remedial action impacts	Permitting would delay remediation for year(s).
6. Treatment/Disposal							
a) Offsite landfills	Eliminated (C)	--	Not feasible (See G)	--	--	--	No facilities able or willing to take sediments.
b) Offsite incineration (Rollins)	To be considered	31,500	Feasible	Minimal exposure potential	Acceptable (See G)	Short-term remedial action impacts	Impacts of lengthy truck transport difficult to determine.
c) Biological treatment	Eliminated (C)	--	Not feasible (See G)	--	--	--	Not demonstrated effective on dioxin in soils.
d) Chemical stabilization	Eliminated (C)	--	Not feasible (See G)	--	--	--	Not demonstrated effective on dioxin in soils.
e) Onsite incineration							
- Stationary	Eliminated (B)	(See G)	--	--	--	--	Cost effective only for 100,000 cy; 2-6 years to build and permit.
- EPA Mobile	To be considered	42,000	Feasible	Minimal exposure potential	Acceptable (See G)	Short- and long-term remedial action impacts	Several years to process waste.

Should be considered.

Table 1-8
SUMMARY OF ALTERNATIVES AND CONCERNS
(Continued)

Location/ Remedial Action	A Status	B Estimated Cost (1,000's) Present Worth	C Technical Feasibility	D Public Health Concerns	E Anticipated Public Response	F Environmental Concerns	G Other
- Huber AER	To be considered	18,060	Feasible (See G)	Minimal exposure potential	Acceptable (See G)	Short- and long-term remedial action impacts	No unit of sufficient size exists; not yet permitted for dioxins.
- ENSCO	To be considered	16,800	Feasible (See G)	Minimal exposure potential	Acceptable (See G)	Short- and long-term remedial action impacts	Not yet permitted to incinerate dioxins.
7. Bank and Cayuga Creek Sampling	To be considered	169	Highly Desirable	--	--	--	Needed for better determination of cleaning/dewatering options, and to determine size of storag facility.

NOTE:

1. This table is an extremely abbreviated summary of the material contained in this report and MUST BE EVALUATED ONLY IN CONJUNCTION WITH THE FULL REPORT. Not all alternatives that were evaluated are listed; not all technical, public health, monetary and environmental concerns are noted. A simplistic indicator (e.g., "Acceptable) is used in this table whereas full discussion in the report may occupy several pages.

2. Unless otherwise noted, alternatives pertain to remedial actions that are based on a total sediment volume of 280 cubic yards for the sanitary and storm sewers, and 20,000 cubic yards of sediment from the Black Creek culverts, Black Creek from the culverts to the confluence of Bergholtz Creek; Bergholtz Creek from 150 feet upstream of Black Creek to the confluence with Cayuga Creek; and various haul roads, berms for dewatering creeks, the drums onsite, etc.,

3. Column A indicates if the alternative is to be considered in the EPA/NYSDEC/public decisionmaking process. Letters in parentheses below the word "Eliminated" indicate the column pertaining to the reason for elimination.

4. Column B indicates the maximum estimated present worth (1984 dollars, 10 percent interest, 20 year time frame) of the alternative, unless otherwise indicated. See Chapters 6 and 8.

5. Column C indicates the technical feasibility of an alternative; see Chapters 5 and 6 and Appendix A.

6. Column D indicates the perceived public health concerns associated with the results of the alternative (i.e., how does the remedial action effect the public health when completed?) See Chapters 3, 5, 6, and 7 and Appendices B and C.

7. Column E indicates the perceived public response to the results of the alternative based on comments received at public meetings, through letters and phone calls, and through conversation with EPA and NYSDEC personnel. This is only an educated guess of the public response; and a complete responsiveness summary will be prepared following the scheduled public information meetings and workshops. See Chapters 2, 3, 5, 6, and 7 and Appendices A, B, and C.

8. Column F indicates an estimate of the environmental concerns associated with the implementation of the remedial action. See Chapters 3, 6, and 7 and Appendices B and C.

9. Column G contains comments and explanations.

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SEWERS

Hydraulic cleaning of the sewers seems most feasible. However, information is needed to determine the most effective dewatering technique: mechanical dewatering of sewer sediments followed by temporary storage in tanks OR using the leachate collection system of a temporary dewatering/ storage system.

Hydraulic cleaning of the culverts of Black Creek at the same time as the sewers offers certain cost and engineering advantages, but time and contractual constraints may prohibit that alternative.

CREEKS

Evaluation of the latest data on dioxin contamination in the creeks resulted in a determination that the total amount of sediment and other material to be removed and disposed of amounts to between 15,000 and 21,000 cubic yards, and would be generated by cleaning Black Creek from the 98th Street culverts to the confluence with Bergholtz Creek; Bergholtz Creek from 150 feet upstream of the confluence with Black Creek to the confluence of Cayuga Creek; and removing various haul roads, berms and other potentially contaminated materials associated with proposed remedial actions. The type of cleaning selected determines the total volume to be removed.

Two cleaning methods for the creeks remain for decision-making: mechanical cleaning using land based equipment OR hydraulic dredging. Both offer advantages and disadvantages; however, hydraulic dredging cannot be used to clean the creek banks if they are contaminated. Each method of cleaning determines the type of sediment transport and dewatering techniques that must be used.

Hydraulic dredging requires two long pipelines to transport sediment, and a specially designed earthen bermed interim secure storage facility for dredge water recirculation and sediment dewatering. Because of design and space constraints a concrete vault cannot be used with the hydraulic dredging option. The dewatering structure for hydraulic dredging must stay open (uncapped) for a year or longer. The focused sampling effort would yield information to more accurately evaluate the dewatering properties of the sediments.

AIR EMISSIONS A POSSIBLE PROBLEM

Mechanical excavation of sediments requires extensive use of trucks to transport sediments, which can be dewatered without modifying the design of either the earthen bermed or concrete vault interim secure storage facility.

Regardless of the dewatering method used, an interim secure storage facility must be built before the creeks are cleaned.

INTERIM SECURE STORAGE

Because the sediments can be removed more rapidly than they can be treated or disposed of, and because all treatment or disposal methods require preparation of the sediments (dewatering, sizing, etc.), all sediments must be stored. An interim secure storage facility meeting all RCRA guidelines is proposed. The type of design must be decided: earthen bermed OR concrete vault. The location must be decided: several places inside the Love Canal fenceline are suitable; the 93rd Street School grounds are also suitable. The concrete vault can be placed at several locations on the road beds within the Love Canal fenceline. The vault will be taller than an earthen bermed facility although it too can be bermed to blend with the landscape. The earthen bermed facility can only in one of three locations in the Love Canal fenced area. It will be 3 to 5 times as large as a concrete vault of the same capacity. It would be too large to fit within the fenceline without resting on top of the canal (undesirable) if designed to hold the maximum volume of sediment. If used to dewater the hydraulically dredged sediments, it may not be closed for at least one year.

DISPOSAL

Several options are available: offsite incineration at Rollins, which has a large transportation cost and undefinable community relations concerns associated with it or onsite incineration using the EPA mobile incinerator OR the Huber AER OR the ENSCO incinerator. Each of these methods have advantages and disadvantages associated with them. Following incineration of the sediment, the residue or ash must be disposed of in a RCRA permitted facility OR a special delisting process must be successfully completed to prove the ash is nonhazardous.

ENSCO

The remainder of this report contains information regarding the remedial alternatives discussed above.

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Chapter 2
INTRODUCTION

BACKGROUND

Between the years 1942 and 1952, Hooker Chemical and Plastics Corporation (now Occidental Chemical Corporation) disposed of over 21,000 tons of various chemicals into Love Canal. The solid and liquid wastes deposited into the Canal include acids, chlorides, mercaptans, phenols, toluenes, pesticides, chlorobenzenes, and sulfides.

In 1978, monitoring studies by the New York Department of Environmental Conservation (DEC), New York Department of Health (DOH), and United States Environmental Protection Agency (EPA) lead the DOH Commissioner to declare a state of emergency at Love Canal. President Carter also declared an environmental emergency at the Canal which enabled the federal government to provide financial assistance to the state for the initiation of remedial measures. Residents were moved from the area under an authorization by Congress which appropriated $20 million for the effort.

In October 1978, a series of remedial construction activities were started in the Canal Area. A leachate collection system was installed around the entire perimeter of the former canal in order to prevent continuing lateral migration of contaminants from the landfill. Additional trenches were dug from the main barrier drain trench towards the former canal and filled with sand and stone to hasten dewatering of the canal and to facilitate construction. A clay cap was also installed over portions of the landfill to minimize volatilization of contaminants, prevent human contact with hazardous wastes, prevent runoff of contaminated surface water, and to minimize the amount of precipitation infiltrating the landfill and thus reduce the generation of leachate. Leachate collection on the site is currently treated at a permanent activated carbon facility (the Love Canal Treatment Facility) which became operational at the end of 1979. In July and August of 1982, all Ring 1 and 2 houses within the fenced canal area were demolished. In February of 1983, work began on an expanded cap consisting of soil and synthetic materials. In June of 1983, the 99th Street School was also demolished to accommodate the final cap, which was completed in November, 1984.

In March and April 1980, EPA constructed a six-foot chain link fence as part of a removal action on both sides of Black Creek to deter human and animal contact with contamination spread from storm sewer drainage from the Canal.

In June 1980, EPA began an extensive environmental sampling program at the Canal which extended over the area designated as the Emergency Declaration Area (EDA). This study was completed in May 1982, and revealed a pattern of limited environmental contamination in the area immediately adjacent to the Canal, probably caused by "localized and highly selective migration of toxic substances from the former canal to the vicinity of certain Ring 1 houses." The EPA data also revealed that the contamination was present in storm sewer lines which originated near the former canal. No evidence of Love Canal-related contamination was found in storm sewers which were isolated from direct canal flow. Apart from these findings, the EPA monitoring data revealed no clear evidence of environmental contamination in the area encompassed by the emergency declaration order that was directly attributable to the migration of substances from Love Canal.

Based on the data collected during this study the Centers for Disease Control (CDC) stated that the areas adjacent to Love Canal are basically no less habitable than other areas within Niagara Falls, which could be characterized as industrial in nature. This statement was contingent upon the remediation of the pathways of contaminants from the site, i.e., the storm sewers and waterways they drain into.

In October 1981, the Love Canal appeared on the initial National Priorities List which made the site eligible for newly appropriated Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) monies.

In March, 1983, the sewers were severed at the Canal to deter future contaminant flow via these pathways. Cutoff walls were installed in the fall of 1983. While the contamination that currently exists in the sewers should not increase, these pollutants could eventually migrate from the sewers and end up in the creek and river sediments.

During the first three weeks of January 1983, field investigation was performed by Malcolm Pirnie, Inc. under contract to DEC. Nearly 1,000 samples were collected and analyzed. The contract between DEC and Malcolm Pirnie called for sampling only in specific locations. As a result, Bergholtz Creek downstream of the 93rd Street School grounds was not sampled. None of the creek banks were sampled. Cayuga Creek was only sampled in those areas where sewer outfalls from the Emergency Declaration Area were located, essentially from Military Road to Linbergh Avenue. Sediments at 102nd Street Outfall were only sampled to a depth of four feet.

Analyses of the samples were collected by Malcolm Pirnie were performed under a sequential, two-phase program. The first phase required the "screening" of a large representative population of samples from the five specific task areas under study. The screen had to be capable of detecting a wide variety of different chemicals at widely varying concentrations. The screening approach involved a solvent extraction of the sample followed by direct injection of the extract for GC/MS (gas chromatography/mass spectrometry) analysis. While other screening techniques were available, they were judged by Malcolm Pirnie to be not as informative as the extraction -- GC/MS analysis method ultimately used. The objective of the screening analysis phase was to provide Malcolm Pirnie with preliminary results which were used to select certain samples for a more costly, detailed quantitative analyses in the second phase of the analytical effort. The analytical effort of this phase was comprised of three parts: qualitative and quantitative analysis of organic compounds; quantitative analysis for 2,3,7,8-TCDD (Dioxin); and quantitative analysis for inorganics (toxic elemental metals). All analytical results for sediment samples were reported on a wet weight basis, rather than the dry weight basis used by EPA in the 1980 sampling. The dry weight method is considered to be more systematic because it eliminates the variability associated with different moisture contents in samples.

Contamination assessments were performed by Malcolm Pirnie based on the results of the January 1983 investigation. Alternatives to remediate the sewers and creeks were developed and evaluated. Various alternatives were recommended including: hydraulic cleaning of the sewers; the mechanical excavation of contaminated sediments within specific reaches of Black and Bergholtz Creeks; and the placement of a temporary earthen berm in the Niagara River to contain the contaminated sediments in the vicinity of the 102nd Street storm sewer outfall.

The Malcolm Pirnie Environmental Information Document (EID), entitled "Site Investigations and Remedial Action Alternatives Love Canal" (October 1983) was considered by EPA to be technically sound with the recommended alternatives being "intuitively" the most cost-effective. However, costs were only presented for those alternatives deemed feasible by Malcolm Pirnie. EPA determined that "to be consistent with the National Contingency plan, the accumulation of this data (on costs of the alternatives) will be necessary." Because of this, EPA chose not to issue a Record of Decision, which would delineate the proposed remedial measures for the sewers and creeks and serve as the basis for funding of these remedial measures. EPA also determined that while the EID "included a complete site and contamination assessment," an expanded and enhanced risk assessment of the remedial alternatives was necessary for inclusion in the final ROD. In August of 1984, EPA tasked CH2M HILL under the existing REM/FIT Zone II contract to re-evaluate the alternatives previously analyzed, restate the beneficial and adverse benefits of each, and provide cost estimates. CH2M HILL was also tasked with providing a risk assessment of the remedial alternatives.

The following major developments or new data submittals have occurred that could impact the recommendations contained in the Malcolm Pirnie EID:

- Sampling by the DEC in 1983 detected low levels of dioxin (i.e. sub-part-per-billion) in fish and sediment in Cayuga Creek in the vicinity of the Lindbergh Avenue 60-inch storm overflow, a known contaminant pathway from Love Canal. The limited sampling of Cayuga Creek performed by Malcolm Pirnie in 1983 identified no contamination along Cayuga Creek.

- Sampling in 1984 by DEC of Bergholtz Creek sediments downstream of the 93rd Street storm sewer outfall found significant levels of dioxin (i.e. 6.4-10.2 ppb). The Malcolm Pirnie 1983 sampling effort did not include this area.

- Further sampling of Bergholtz Creek by DEC in the summer of 1984 found dioxin at 11 ppb as far downstream as 90th Street near the confluence of Bergholtz and Cayuga Creeks.

- Preliminary results of the 1984 investigations of RCRA Research, Inc. of the 93rd Street School site found levels of dioxin in the subsurface soils and in the waters of Bergholtz Creek. Two of the subsurface soil samples, taken from fly ash layers located four to six feet below ground, averaged 1.63 ppb. Two water samples were found to contain dioxin at levels "near detection limits" of 0.001 ppb.

- Contact by DEC with local licensed hazardous waste landfill owners revealed a reluctance on their part "to handle and store dioxin-tainted, Love Canal wastes."

- There was considerable public controversy regarding the DEC's attempt in July 1984 to dispose of 425 55-gallon drums of contaminated sewer sediment removed from storm and sanitary sewers within Rings 1 and 2 by burying drums in the existing clay cap prior to placement of the synthetic membrane cover over the Canal.

- On November 8, 1984, President Reagan signed into law the Hazardous and Solid Waste Amendments of 1984. These amendments significantly altered the scope of the Resources Conservation and Recovery Act (RCRA) which governs the disposal of hazardous waste. Several disposal alternatives previously considered by Malcolm Pirnie because non-viable.

- On January 14, 1985, EPA amended the regulations under RCRA pertaining specifically to disposal of dioxin containing wastes.

OBJECTIVES

The objectives of this report are to further assess the components of the various alternatives developed during the 1983 Malcolm Pirnie EID (including onsite disposal); provide detailed cost estimates for each defined alternative; identify further study needs or data voids; generate qualitative risk assessments of the remedial alternatives; and prepare the public for the information meetings associated with the presentation of the results in the work elements defined above.

ORGANIZATION OF THIS REPORT

Chapter 3 provides a summary of information on the contaminants, pathways and receptors in the Love Canal Area, summarizes the toxicology of the "target chemicals" selected for evaluation, and summarizes the Risk Assessment of the No Action Alternative. Chapter 4 provides a description of how the remedial alternatives were selected, and lists all the alternatives that were evaluated. Chapter 5 discusses the screening out of certain alternatives. Chapter 6 discusses each of the remaining remedial alternatives and provides further screening. Chapter 7 presents a qualitative risk assessment of each of the remaining alternatives. Chapter 8 presents a summary of costs associated with these alternatives. Appendix A provides summaries of existing research in dioxin destruction technologies. Appendix B is a detailed discussion of Chapter 3 (the No Action Alternative Risk Assessment). Appendix C is a detailed discussion of the chemical and toxicological properties of the target chemicals.

USE OF THIS REPORT

This report, in keeping with EPA and NCP guidelines, does <u>not</u> contain recommendations for specific remedial activities or a combination of activities. The decision making authority is vested in the EPA and the DEC which reach a decision only after receiving input from the public. The benefits, adverse impacts and costs of each alternative must be weighed in arriving at the final remedial measures; this report attempts to provide the decision makers with that information. It should be noted that this report exceeds the bounds of NCP guidelines in certain respects. Normally, a large number of alternatives would have been screened out during the initial phase of the Feasibility Study so that only a limited number (usually three to five)of alternatives would be studied. However, the scope of work generated by EPA and the intensive public involvement in this study yielded many alternatives which were carried forward into the evaluation process. A Feasibility Study would also normally involve a preliminary Remedial Investigation (RI) designed to provide sufficient detailed information to support or eliminate alternatives on the basis of environmental and engineering data. If data gaps in the RI were identified during the Feasibility Study, then focused field investigations of limited scope could normally be undertaken to define the data needed. The Malcolm Pirnie EID was not intended to be a RI and additional field studies were not authorized for this Feasibility Study. Therefore, certain vital engineering data, such as the physical characteristics of the sediments in the sewers and creeks, or the ability of the road bed to support a "Times Beach" vault, must be obtained before an acceptable design can be developed.

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Chapter 3
SUMMARY OF THE HEALTH ASSESSMENT OF THE NO-ACTION ALTERNATIVE

INTRODUCTION

Under Section 104 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the EPA may undertake a response to cleanup environmental contamination (1) when there is a release of a hazardous substance or there is a substantial threat of such a release into the environment; or (2) when there is a release or substantial threat of a release into the environment of any pollutant or contaminant which may present an imminent and substantial danger to the public health or welfare.

Section 104(a)(1) of CERCLA authorizes removal or remedial action unless it is determined that such removal or remedial action will be done properly by the owner or operator of the vessel or facility from which the release or threat of release emanates, or by any other responsible party. If appropriate response actions are not being taken or executed properly, including in a timely manner, EPA may initiate proper action, terminate any improper actions; advise any known responsible party of these actions, and complete response activities.

It is important to note at this juncture that imminent does not mean immediate harm, rather it means an impending <u>risk</u> of harm. Similarly, endangerment means something less than <u>actual</u> harm. It is sufficient if the harm is <u>threatened</u>; no actual injury need ever occur.

In evaluating and selecting a response to uncontrolled releases of hazardous substances a major concern is adequate remediation and protection of the environment. The National Oil and Hazardous Substances Contingency Plan (NCP) requires, in Section 300.68(i)(2)(D):

> (D) An assessment of each alternative in terms of the extent to which it is expected to effectively mitigate and minimize damage to, and provide adequate protection of, public health, welfare, and the environment, relative to the other alternatives analyzed...

Section 300.68(i)(2)(E) requires:

> (E) An analysis of any adverse environmental impacts, methods for mitigating these impacts, and costs of mitigation.

EPA guidelines state that the following should be assessed in determining whether and what type of remedial and/or removal actions should be considered:

- o Population, environmental, and welfare concerns at risk;
- o Routes of exposure;
- o Amount, concentration, hazardous properties, environmental fate (e.g., ability to bio-accumulate, persistence, mobility, etc.), and form of the substance(s) present;
- o Hydrogeological factors (e.g., soil permeability, depth to saturated zone, hydrologic gradients, proximity to a drinking water aquifer, floodplains and wetlands proximity);
- o Climate (rainfall, etc.);
- o The extent to which the source can be adequately identified and characterized;
- o The likelihood of future releases if the substances remain onsite;
- o The extent to which natural or manmade barriers currently contain the substances and the adequacy of the barriers;
- o The extent to which the substances have migrated or are expected to migrate from the area of their original location or new location if relocated and whether future migration may pose a threat to public health; welfare, or the environment;
- o Extent to which contamination levels exceed applicable or relevant Federal or State public health or environmental standards, advisories and criteria and the extent to which there are applicable or relevant standards for the storage, treatment, or disposal of materials of the type present at the release; and
- o Contribution of the contamination to an air, land or water pollution problem.

This chapter summarizes the information available on the contaminant concentration and toxicology population (receptors), routes of exposure (pathways), and environmental fate of chemicals present in the Love Canal sewers and creeks. Appendices B and C provide a detailed discussion of these subjects.

TOXICOLOGY SUMMARY

Over 100 chemicals have been found in the sewers and creeks of the Love Canal area. These contaminants were found in the sanitary sewers, storm sewers, creeks and at the 102nd Street Outfall. Subsequent sampling by DEC and others has found contamination in areas not sampled by Malcolm Pirnie or EPA.

A complete evaluation of the chemical, physical and toxicological properties of the entire range of contaminants found in the Love Canal sewers and creeks is beyond the scope of this study. Based on the number of times found, and the chemicals' toxicology, a number of target chemicals were selected for evaluation of hazardous properties and environmental fate. A summary of the toxicological properties is presented below. Appendix C contains more detailed information on these target chemicals.

2,3,7,8-Tetrachloro-dibenzo-p-dioxin

TCDD has been shown to be extremely toxic in experimental animals and has teratogenic, mutagenic and carcinogenic effects. Sensitivity and target organs differ for various species. Chloracne and hyperkeratosis are distinctive symptoms of TCDD exposure in animals and humans. A number of reports suggest an association of soft tissue sarcomas and TCDD exposure in humans.

Hexachlorocyclohexane Isomers (HCH or BHC)

γ-BHC is stored in fat tissue of experimental animals, but is cleared from the system after cessation of exposure. Target organs include the brain, liver, and kidney. Chronic exposures may cause blood disorders. The α, β, and γ isomers of BHC have been demonstrated to induce cancer in experimental animals.

Chlorinated Benzenes

The main sites affected by acute exposure to high concentrations are the hepatic, renal and nervous systems. Lower levels of exposure to some of the chlorinated benzenes may have adverse effect on the nervous system. Hexachlorobenzene has been demonstrated to produce fetotoxicity in experimental animals. It has also been shown to be a animal carcinogen.

Toluene

The primary effect of exposure to humans is dysfunction of the central nervous system. Levels required to induce effects (100-300 ppm in air for short-term exposures) are substantially in excess of typical environmental levels. No evidence of mutagenicity, teratogenicity or carcinogenicity has been found in animal experimentation.

Arsenic

Mutagenic changes have been noted in animal cells following exposure to arsenic. Ingestion of arsenic contaminated water can result in changes in immune function, cardiovascular disorders, peripheral vascular disorders, and nerve degeneration in the peripheral nervous system. Arsenic exposure has been linked to cancer and reproductive effects in humans. Dermal exposure can lead to skin reddening and formation of skin eruptions.

Cadmium

Primary effects of chronic exposure to inhaled cadmium are pulmonary emphysema and renal tubular damage. Hypertension may be an early symptom of exposure. Recent evidence indicates inhaled cadmium acts to induce lung cancer.

Thallium

Thallium has been used for medicinal purposes, but can produce toxic effects when large doses (200 to 1,000 mg/kg body weight) are ingested. Effects of overexposure include neurological disorders, gastrointestinal disorders, hair loss, kidney damage, liver damage and death. Hair loss is a symptom of low dose exposure.

The toxicological profiles above are based on exposure to only one chemical, and synergistic and antagonistic effects are not considered. The state of toxicological knowledge is insufficient to describe the potential effects of multiple exposure to a variety of contaminants.

The contaminants may be grouped into two primary health effects categories, those that are known or suspected carcinogens and those that are not. TCDD, hexachlorobenzene, and the α, β, and γ isomers of BHC belong in the carcinogen group and the rest of the chlorinated benzenes, toluene, ingested cadmium, and thallium were evaluated as noncarcinogens. There are no data on ingested cadmium as an animal carcinogen, but there are data that it is carcinogenic when inhaled as a fume or injected.

Table 3-1 summarizes the various standards, criteria and recommendations on acceptable levels of contaminants in various environmental media.

IMPACT EVALUATION

In the following discussion, each of the contaminated areas (see Figures 3-1 through 3-5, Plates 1 and 2, and Appendix B) is summarized with respect to chemicals detected and the potential for human exposure. Some people may be exposed to more than one area (e.g., creek sediments and fish), and therefore their total exposure would be greater than that from any single area.

SANITARY AND STORM SEWERS

Tables 3-2 and 3-3 show the compounds and concentration ranges found during the January 1983 Malcolm Pirnie sampling program in the sanitary and storm manholes, respectively. While individual sediment samples contained organics within those ranges, many samples contained no detectable organics.

A comparison of the sampling data from samples collected in the storm sewers in 1980 by EPA-ORD and in 1983 by Malcolm Pirnie shows an apparent decrease in the concentration of TCDD, BHC isomers and hexachlorobenzene in the 2.5 year interval. This is consistent with an expected migration of sediments from water entrainment following the plugging of the sewer lines from the immediate Canal area to the EDA. The maximum reported and mean TCDD concentrations were 1.9 and 0.82 µg/kg, respectively in the Malcolm Pirnie data. From the EPA-ORD study, the maximum and mean concentrations were 650 and 49 µg/kg, respectively. The maximum reported and mean concentrations in the sanitary sewers were 30 and 3 µg/kg, respectively, from Malcolm Pirnie data. Nondetectable concentrations were reported by Malcolm Pirnie in 15 of 19 samples in the sanitary sewers and 10 of 12 in the storm sewers.

Although no one is exposed to sewer sediments on a regular basis, several potential exposure scenarios were examined, and they are summarized below.

- Sewer maintenance. Sewers do not receive regular maintenance. If maintenance is required on a typical sewer, standard practice would be to ventilate the sewers before entry and to use no special equipment, such as respirators. Higher level protection, however, would be used for entry into the EDA sewers in order to minimize worker exposure.

Table 3-1
HEALTH CRITERIA, GUIDELINES, AND STANDARDS FOR VARIOUS CONTAMINANTS

Contaminant	Drinking Water Standard (μg/l)	EPA Water Quality Criteria (μg/L): Drinking Water[b]	EPA Water Quality Criteria (μg/L): Fish and Drinking Water[c]	EPA Water Quality Criteria (μg/L): Freshwater Aquatic Life	Residential Soil Concentration (μg/kg)	Acceptable Daily Intake (mg/day)	Cancer Potency[d] (kg-day/mg)
2,3,7,8-TCDD		2.2×10^{-7} (f)	1.3×10^{-8} (e,f)		1[g]		156,000
α-BHC		0.013[f]	0.0092[f]	0.08 ave., 2.0 max.			11.12
β-BHC		0.023[f]	0.0163[f]				1.84
γ-BHC	4	0.026[f]	0.0186[f]				1.33
Chlorinated benzenes				250			
Chlorobenzene		20[b]				1	
Dichlorobenzenes				1,120 acute, 763 chronic			
1,2,4-Trichlorobenzene							
Hexachlorobenzene		0.021[f]	9.2×10^{-4} (f)				1.67
Toluene		15,000	14,300	17,500		30	
Arsenic	50	0.0025[f]	0.0022[f]	72 ave., 140 max.			15
Cadmium	10	1.2[f]	1[f]	$e^{(1.16 \ln(\text{hardness}) - 3.841)}$		0.17	
Thallium		18	13			0.037	

(a) EPA, 1980.
(b) For ingestion of 2 L per day.
(c) For ingestion of 2 L and 6.5 g of fish and shellfish per day.
(d) U.S. EPA, 1984d.
(e) U.S. EPA, 1984a.
(f) 10^{-6} excess lifetime cancer risk.
(g) Level of concern. Kimbrough, et al., 1983.

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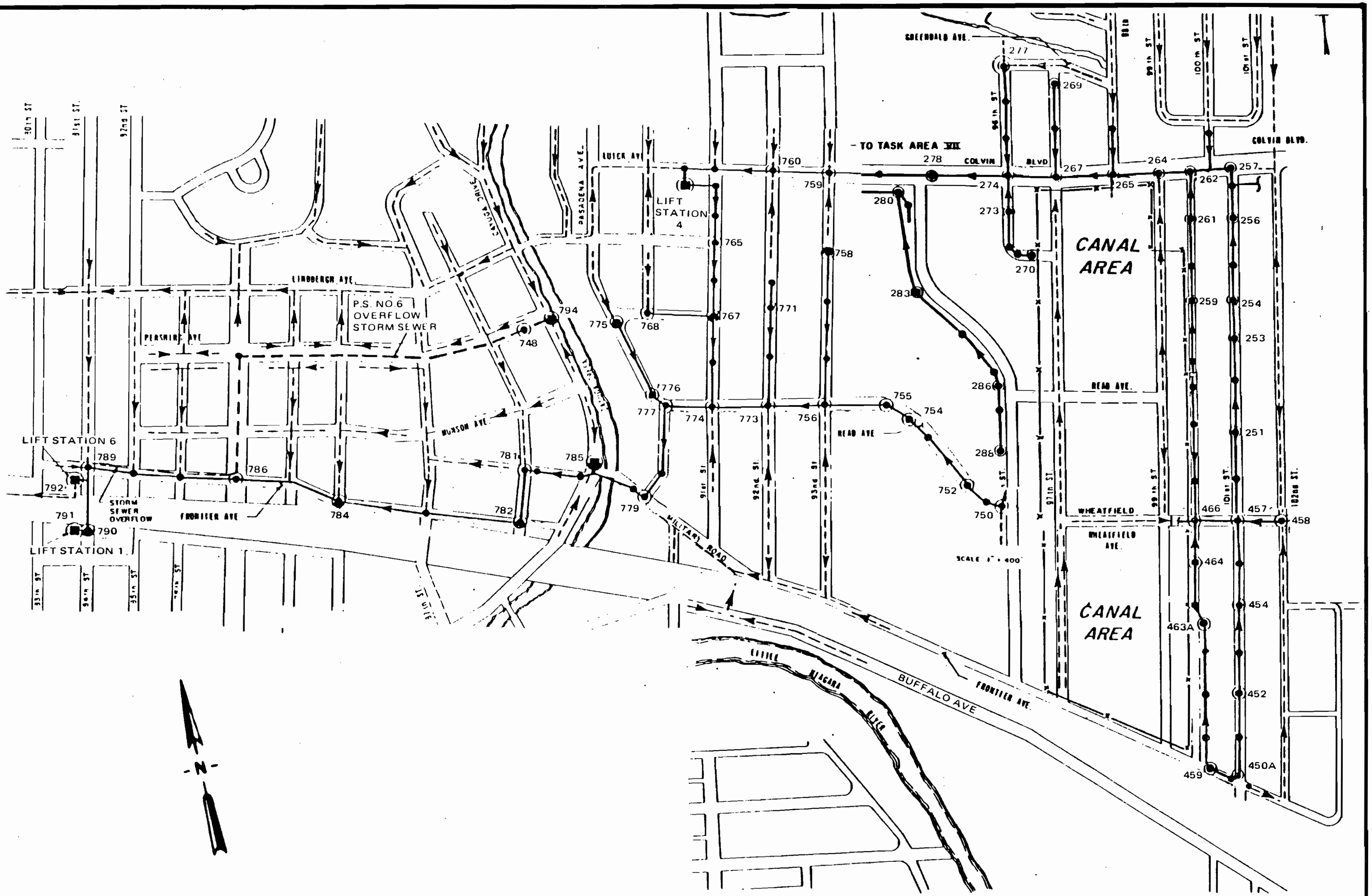

Figure 3–1
Sanitary Sewers of the
Love Canal Area

CH2M HILL

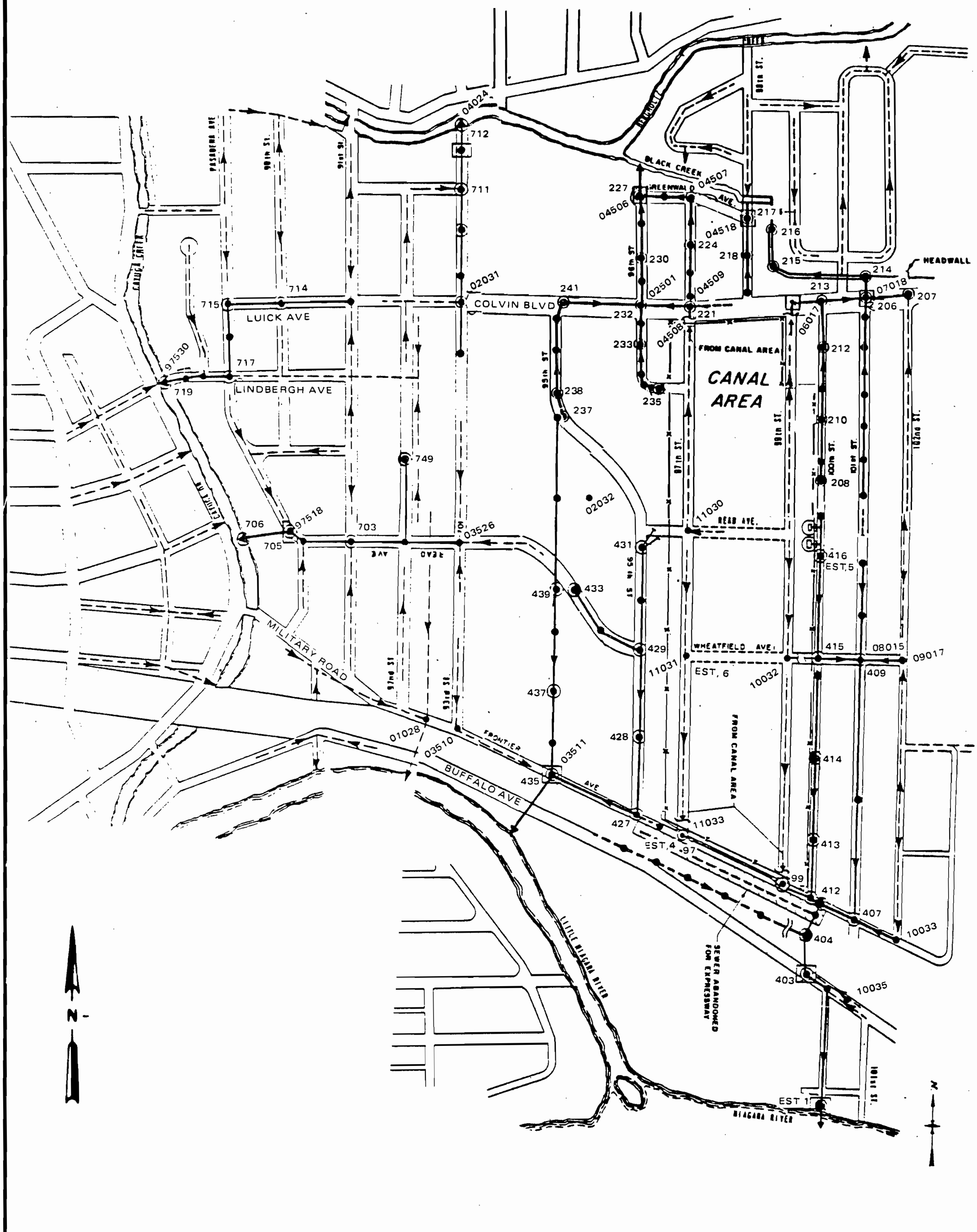

Figure 3–2
Storm Sewers of the Love Canal Area

CH2M HILL

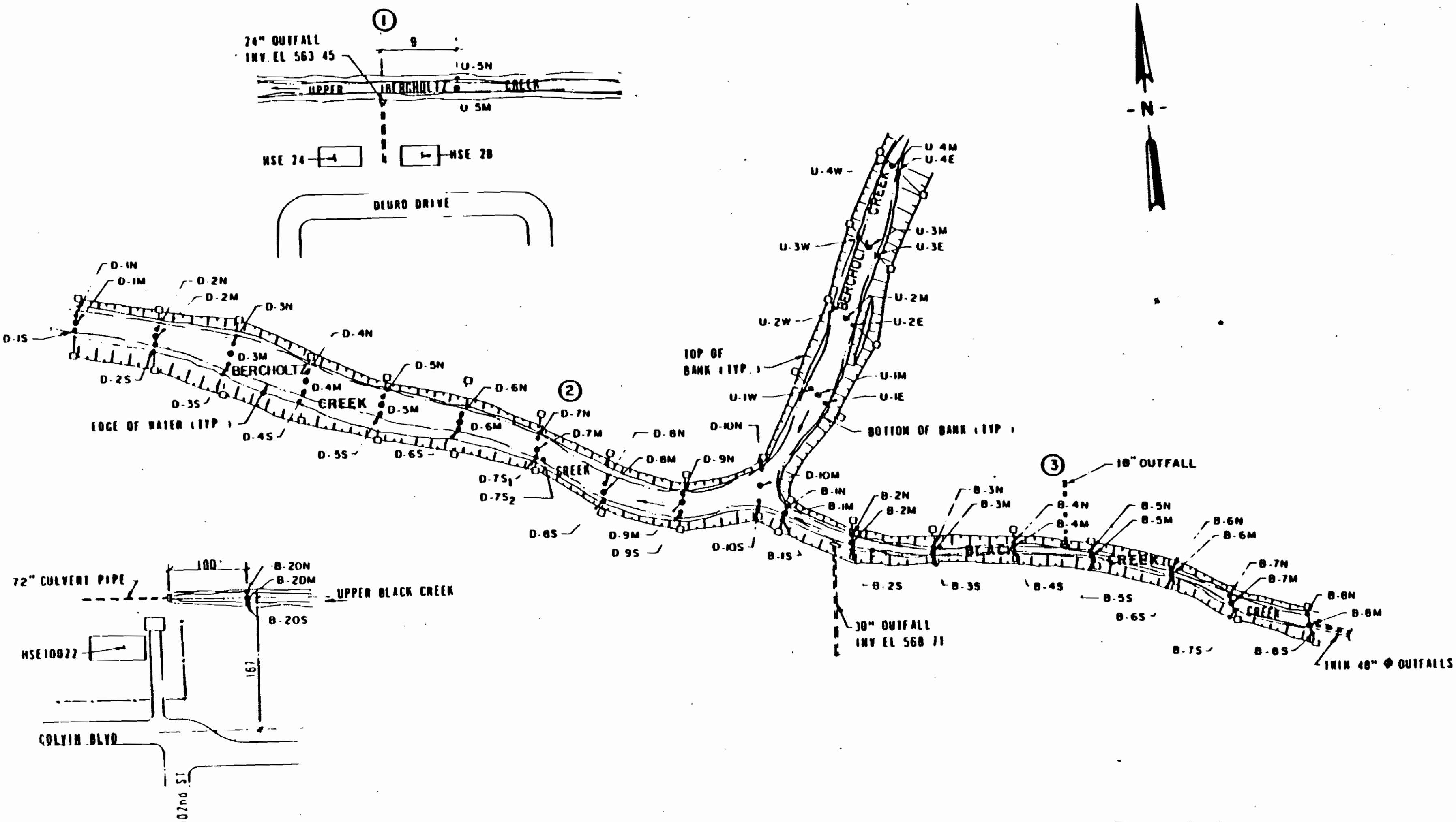

Figure 3–3
Surface Water Sample Sites
of the Love Canal Area
Black and Berholtz Creek

CH2M HILL

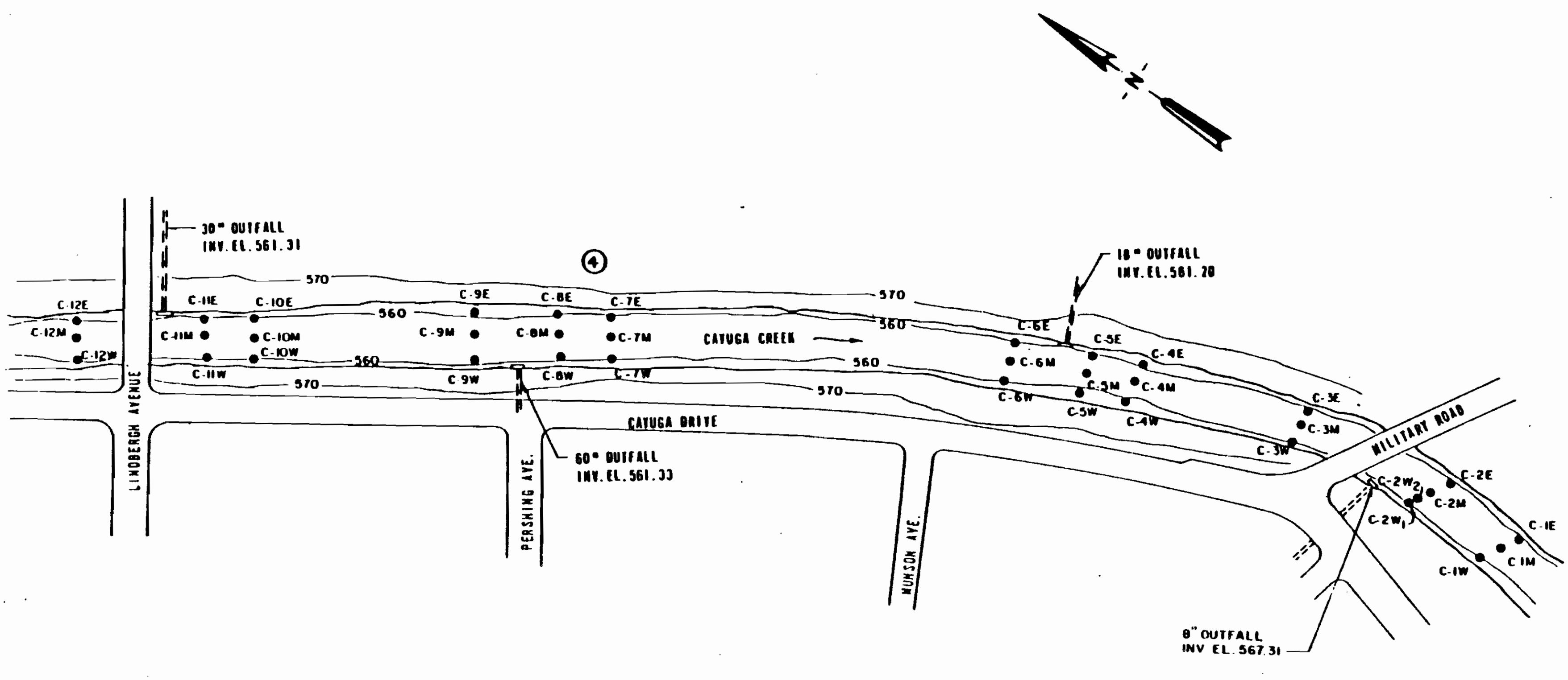

Figure 3–4
Surface Water Sample Sites of the Love Canal Area Cayuga Creek

CH2M HILL

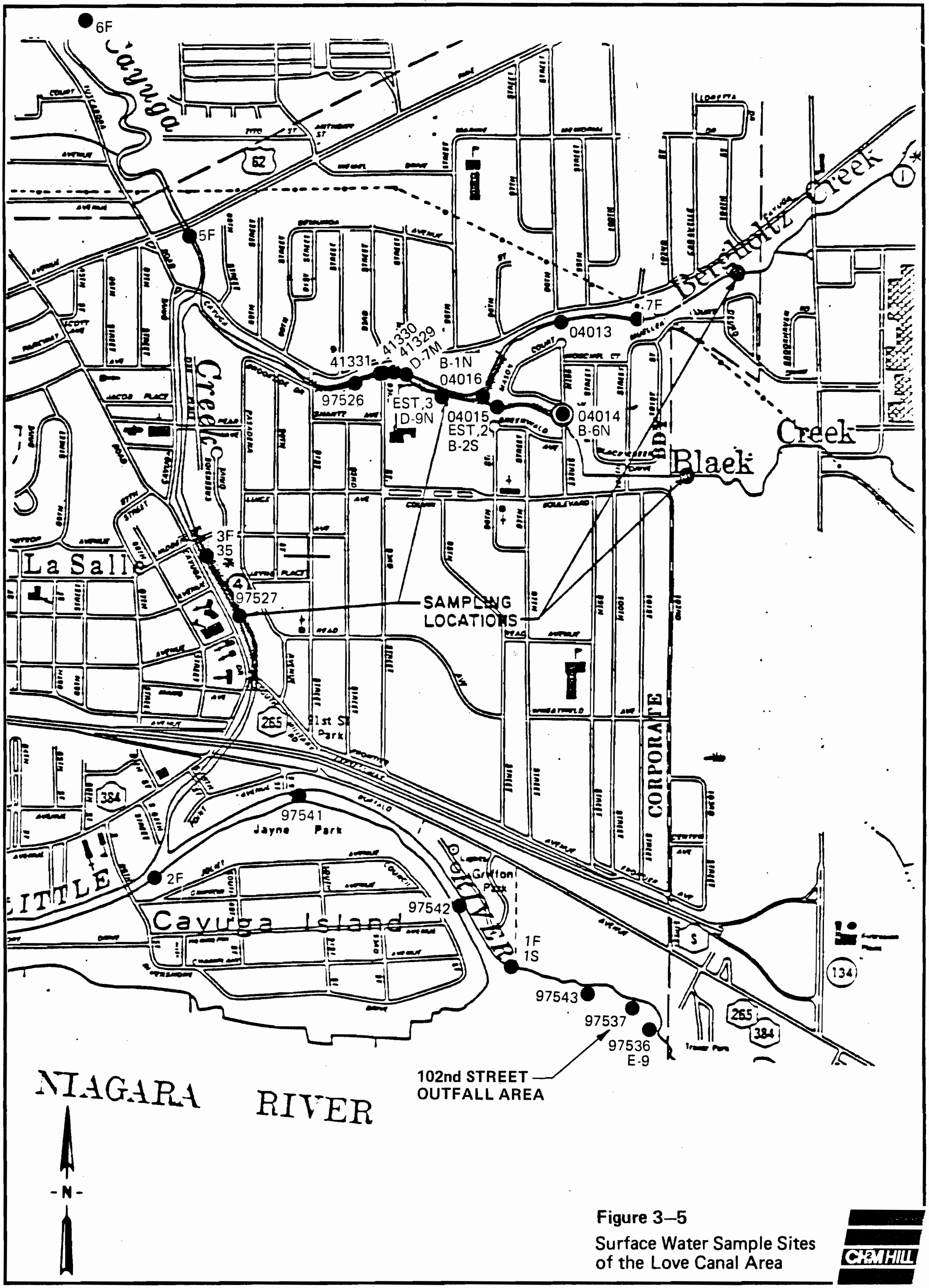

Figure 3–5
Surface Water Sample Sites of the Love Canal Area

Table 3-2
CONCENTRATION RANGES IN INDIVIDUAL SANITARY SEWER SEDIMENT SAMPLES

Compound*	Range of Concentration (μg/kg)[1]		Sampling Location[2]
Chlorobenzene	ND -	78,000	457, 779
1,2-Dichlorobenzene	ND -	34,000	779, LS#6
1,3-Dichlorobenzene	ND -	52,000	265, 773,779, LS#4 LS#6
1,4-Dichlorobenzene	ND -	98,000	285, 457, 754, 755, 773 779, LS#9, LS#6
1,2,4-Trichlorobenzene	ND -	510,000	251, 262, 264, 265, 267, 457, 759, 773, 777, 779,786, LS#4, LS#6
Hexachlorobenzene	ND -	85,000	262, 265, 267, 457, 759,765, 777, 779 LS#4
Toluene	ND -	35,000	285,457,752,754,755,779
α - BHC	ND -	140,000	457, 777,779, LS#4
δ - BHC	ND -	130,000	457, 777, LS#4
γ - BHC	ND -	120,000	457, 777,779, LS#4
Fluoranthene	ND -	6,400	257, 277, 754, 768, LS#4
Benzoanthracene/Chrysene	ND -	4,600	LS#4
Anthracene/Phenanthrene	ND -	16,000	262, 754, 755, 779, LS#4, LS#6
Naphthalene	ND -	7,000	LS#6
Pyrene	ND -	5,200	277,754,768, LS#4 LS#6
Hexachlorobutadiene	ND -	76,000	262, 265, 457, 777, 779
1,1,1-Trichloroethane	ND -	2,500	457
Trichlorofluoromethane	ND -	3,300	457
Phenol	ND -	500	273
Dichlorophenol	ND -	63	
2,4,6-Trichlorophenol	ND -	560	777
2,3,7,8 - TCDD	ND -	30	264, 759, 765, 786

NOTE:

* - Methylene chloride, phthalate esters, and heavy metals were not included.
1 - All results reported on a wet weight basis.
2 - Manholes unless indicated otherwise.
ND - Not Detected
LS - Lift Station

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Table 3-3
CONCENTRATION RANGES IN INDIVIDUAL STORM SEWER SEDIMENT SAMPLES

Compound*	Range of Concentrations (μg/kg)[1]	Sampling Location[2]
Benzene	ND - 2,100	206
Ethylbenzene	ND - 2,200	221
Chlorobenzene	ND - 55,000	415, 715, 719, D.I.99
1,2-Dichlorobenzene	ND - 48,000	412, 719, D.I. 97. D.I.99
1,3-Dichlorobenzene	ND - 60,000	719, D.I.97
1,4-Dichlorobenzene	ND - 92,000	412, 715, 719, 750, D.I.97, D.I.99
1,2,4-Trichlorobenzene	ND - 130,000	221, 412, 714, 715, 719, D.I.97, D.I.99
Hexachlorobenzene	ND - 34,000	221, 412, 719, D.I.97
Toluene	ND - 280,000	221, 412, 415, 715, 719, D.I.99
Napththalene	ND - 11,000	412
2-Chloronaphthalene	ND - 46,000	412
Fluoranthene	ND - 6,800	415, 431, 712, D.I.97
1,2-Diphenylhydrazine	ND - 19,000	412
Anthracene/Phenanthrene	ND - 13,000	431, D.I.97, D.I.99
Pyrene	ND - 5,600	712, D.I. 97
Hexachlorobutadiene	ND - 43,000	719, D.I.97
α - BHC	ND - 11,000	412
β - BHC	ND - 6,800	D.I.97
2,3,6-Trichlorophenol	ND - 6,000	D.I.97
2,3,7,8 - TCDD	ND - 1.9	415, 712

NOTES:

* - Methylene chloride, phthalate esters, and heavy metals were not included.
1 - All results reported on a wet weight basis.
2 - Manholes, unless otherwise indicated.
ND - Not Detected
DI - Drop Inlet

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- Inhalation of volatile organics by public. Volatile organics were detected in some samples in the sewers. Emissions through manholes, or the outfalls will be dispersed by winds and atmospheric turbulence. This will reduce the potential for the public to inhale volatile organics from the sewers.

- Surcharging of sediments to surface. Surcharging to within a few feet of the surface was observed in the manholes by Malcolm Pirnie. Surcharging of the sanitary sewers has been reported in the area of 91st, 92nd, 93rd Streets and Reading Avenue during periods of high rainfall, and of the storm sewers to the surface along 93rd Street. Chemical concentrations in material surcharged to the surface will become diluted as mixing with water and surface material occurs. The amount of deposited sediment will depend on local conditions. Human exposure will depend on the duration of the condition (e.g., surface washing by city services or rain, and chemical degradation will decrease concentrations), contact time, and the rates of soil ingestion, intestinal absorption, dermal absorption and inhalation of entrained soil. Most of these parameters have very uncertain values.

- Backflow of sanitary sewer sediments to basements. Backflow preventers were not installed in the EDA homes. Therefore, the potential exists that the sanitary sewer sediments may be discharged to the homes. If the discharge remains undetected, exposure to contaminated material may result.

- Exfiltration to groundwater. Exfiltration, or the leaking of sewer material from the pipe, may be enhanced in the EDA by the absence of drainage system to channel the groundwater away from the pipes. The shallow groundwater increases the potential release. The rate of exfiltration, if any, is unknown. Subsequent migration routes and consumptive uses are also not known. The potential for transport to surface is not known, although it should be noted that several of the target chemicals, including TCDD, are strongly adsorbed to soil and therefore would have limited migration with the groundwater.

INFILTRATION

CREEKS

The results of the January 1983 Malcolm Pirnie sampling program detected dioxin (2,3,7,8 TCDD) at five locations, with concentrations ranging from 1.2 to 45.8 μg/kg wet weight. 3-chloronapthalene was found at one of the same locations in Bergholtz and Black Creeks.

The organic contaminants were found in the upper foot of sediment. No detectable contaminants of suspected Love Canal origin were detected below the one-foot depth or at any of the other sampling locations in Bergholtz and Black Creeks. Concentrations in this same range have also been reported by EPA-ORD and NYDOH.

No volatile organics were detected by Malcolm Pirnie in the creek sediments or water, so inhalation is not a major exposure route for volatile organics. TCDD was detected, particularly near the confluence of Black and Bergholtz Creeks, at detected concentrations from 0.1 to 45.8 μg/kg. Nondetectable concentrations were reported in 13 of 15, 12 of 15, and all 13 samples in Black, Bergholtz and Cayuga Creeks, respectively.

Sediment transport with stream flow will tend to decrease the concentrations over time, but this possibility is reduced by the continued loading from the storm sewer outfalls. Potential human exposure may occur in two scenarios (potential fish ingestion is discussed later).

EXPOSURE TO SEDIMENTS

- Recreational activities. Exposure will occur during swimming, wading or other recreational use of the creeks. Access is limited along Black and Bergholtz Creeks because of fencing along the banks down to the 93rd Street School grounds. Although fences can be breached, the general effect is to reduce exposure. Access to Cayuga Creek is open, but the sediment here had the lowest concentrations. During recreational activities, water may be ingested or absorbed through the skin. The exposure factors and their uncertainty is much the same as discussed in the section on sewer surcharging. Ingestion of dried sediment along the creek banks is a potential additional exposure route.

- Migration to residential yards. A high rainfall rate and/or a high stage of the Niagara River could produce flooding of the creeks onto local residential yards. The qualitative nature of the human exposure potential is much the same as discussed for surcharged sewer sediments above.

FLOODING

102nd STREET OUTFALL

Love Canal related compounds were found in the Niagara River adjacent to the 102nd Street storm sewer outfall in a number of sediment samples. Table 3-4 shows the compounds and concentration ranges found in the outfall sediment. The samples taken in the proximity of the 102nd Street outfall had the highest contamination assessment levels.

The physical characteristics of the river bed from 0 to 3 feet consisted of fine silts, sand, and muck with miscellaneous debris such as logs, tires, drums, bottles, etc. A firm or impervious subbase such as clay was not encountered in the sampling area. None of the liquid samples taken during the January 1983 Malcolm Pirnie sampling program from this outfall area contained detectable levels of organics.

Maximum and mean TCDD concentrations at the 102nd Street storm sewer outfall, as reported by Malcolm Pirnie, are 3.3 and 0.4 µg/kg. Nondetectable concentrations were reported in 30 of 31 samples between rows F, J, 3 and 16 in the Malcolm Pirnie report.

Potential human exposure routes to the 102nd Street outfall sediments are much the same as in the discussion for the creek sediments.

Niagara River water (after treatment) is used for drinking water purposes. Concentrations of the target chemicals reported in the untreated water at the Niagara Falls water treatment plant were below the water criteria shown in Table 3-1.

FISH

Samples of spottail shiners and creek chubs collected by the New York Department of Environmental Conservation in 1984 in the creeks below Porter Road had reported TCDD concentrations from 6.8 to 127 ng/kg wet weight. Two of 7 samples exceeded 50 ng/kg and 3 of 7 exceeded 25 ng/kg. Concentrations of TCDD in sport fish in the Niagara River were most often reported as nondetects (detection limit 10 ng/kg) in 1980, but bass samples in 1981 were reported as nondetects (detection limit 1 ng/kg) to 30 ng/kg in the Lower Niagara River near Queenston. Sport fish captured in Lake Ontario had concentrations from nondetects (detection limit 10 ng/kg) to 19 ng/kg in 1980. These concentrations would be expected to decline as new fish mature if the creek and river concentrations decrease. Sediment migration downstream would be expected over time.

The consumption rate of fish caught in the creeks or near the 102nd Street outfall is not known, although anecdotal stories suggest summertime fishing.

Based on its evaluation of TCDD toxicity, the U.S. Food and Drum Administration (FDA) stated that fish containing more

Table 3-4
CONCENTRATION RANGES IN INDIVIDUAL 102ND STREET
OUTFALL SEDIMENT SAMPLES

Compound[1]	Range of Concentrations (μg/kg)[2]	Location[3]
Carbon tetrachloride	ND - 2,300	E-13B
Chloroform	ND - 2,000	E-9C, G-14A, G-15C
Toluene	ND - 3,200	E-9A
Trichloroethylene	ND - 6,200	E-9A
Tetrachloroethylene	ND - 26,000	E-9A
Trichlorofluoromethane	ND - 2,500	E-14A
Chlorobenzene	ND - 9,100	E-7C, E-8C, E-9A, E-10C, E-11B, E-11C, E-12C, F-7A, F-7C, F-11C, G-7C, G-11C
1,2-Dichlorobenzene	ND - 36,000	E-7C, E-9A, E-9B, E-11B, E-11C, F-11C, G-6A
1,3-Dichlorobenzene	ND - 64,000	E-7C, E-9A, E-9B, E-11C, F-9A, G-6A
1,4-Dichlorobenzene	ND - 54,000	E-9A, E-9B, E-11B, E-11C, F-9A, F-11C, G-6A
1,2,4-Trichlorobenzene	ND - 300,000	E-8A, E-9A, E-9B, E-9C, F-9A, F-9B, G-6A, H-10A, K-21A
Hexachlorobenzene	ND - 52,000	E-9A, E-9B, E-9C, F-9A
Bis(2-chloroethyl)Ether	ND - 5,200	E-9A, F-9C, F-13A, F-13B, H-8C
α - BHC	ND - 48,000	E-4A, E-8A, E-9B, E-9C, F-8A, F-9A, F-9B, G-6A, G-9A, G-14B, K-6A, K-21A
β - BHC	ND - 49,000	E-8A, E-9A, E-9B, F-8A, F-9A, G-6A, K21A
γ - BHC	ND - 2,400	E-9B, G-6A
δ - BHC	ND - 260	E-9B
Chrysene	ND - 710	G-6A
Pyrene	ND - 540	G-6A
Phenanthrene	ND - 20,000	E-9A
Anthracene/Phenanthrene	ND - 200	E-9B
2,3,7,8 - TCDD	ND - 4	F-8

NOTE:

ND - Not Detected

1. Methylene chloride, phthalate esters, and inorganic compounds data were not included.
2. All results reported on a wet weight basis.
3. Refer to Figure 3-1 for locations. The last letter in the location designation indicates the depth of sample (i.e. A - 0-12", B - 12-24", C-24-36") below sediment surface.

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than 50 ng/kg TCDD should not be consumed, and those containing between 25 and 50 ng/kg should not be consumed more than twice a month. The FDA did not provide any recommendations for consuming fish containing less than 25 ng/kg.

PREVIOUS HEALTH ASSESSMENT

In 1981, the U.S. Department of Health and Human Services (DHHS) obtained written opinions from eleven non-federal expert consultants on the health implications of the data obtained by the U.S. Environmental Protection Agency in its 1980 chemical testing at Love Canal. The consultants met for one day and were presented with a condensed form of the EPA monitoring data. The experts' opinions on the storm sewer and creek chemical concentrations were summarized as follows:

> "Consultants agree that levels of chemicals detected in storm sewers and in Area 11 (Canal itself and the first two rings of houses surrounding the Canal) exceed acceptable levels and represent a potential for increased health risk if remedial actions are not pursued and if human access is not controlled...."
>
> "Any judgment regarding the future habitability of the Love Canal area rests on two important requirements. The first reservation is that appropriate measures must be taken to clean up the obvious contamination of local storm sewers and their drainage tracts. Second, the security of Area 11 must be reevaluated to guarantee permanent containment of chemicals in the dump."

Although the U.S. Congress Office of Technology Assessment criticized the general conclusions of the 1982 EPA monitoring report and the DHHS statement on habitability, no criticisms were directed at the identified need to clean the storm sewers and drainage tracts. This need was restated by DHHS on July 13, 1982. The New York Department of Health has also supported this position.

Because the 1980 EPA sampling did not include the sanitary sewers, DHHS has not made any formal statements on the contamination there. DHHS has not formally reviewed the results of the 1983 Malcolm Pirnie investigation.

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Chapter 4
REMEDIAL ALTERNATIVES UNDER EVALUATION

BACKGROUND

The first step in planning a remedial approach for the Love Canal creeks and sewers, and the 102nd Street Outfall is to develop a list of feasible options. Necessary considerations for choosing alternatives include:

- Depth of contaminated sediment
- Degree of cleanliness required
- Extent of contamination
- Chemical and physical nature of contaminants
- Costs and availability of cleanup, treatment, and disposal equipment
- Feasibility of mobilizing required equipment
- Potential hazards to workers, the public, and the environment

EPA has issued guidelines stating that six broad categories of remedial measures are to be evaluated. These are as follows:

- Alternatives for treatment disposal at an offsite facility that meets RCRA standards.
- Onsite alternatives that meet applicable Federal public health or environmental standards (i.e., RCRA); however, RCRA and other permits are not required.
- Onsite alternatives that exceed applicable public health or environmental standards.
- Onsite alternatives that do not fully meet applicable public health or environmental standards, but would reduce the likelihood of present or future threat from the hazardous substances and which provide significant protection to public health, welfare, and the environment. This must include an alternative which most closely approaches the level of protection provided by the applicable or relevant standards.

- A no action alternative.

- Remedial measures suggested by the potential responsible party at the site.

These guidelines were issued as part of EPA's implementation of the National Oil and Hazardous Materials Contingency Plan (NCP). The report prepared by Malcolm Pirnie (1983 EID) did not meet the standards of the NCP, primarily because the NCP had not been fully promulgated when the study was started.

The alternatives that were evaluated as part of this study were not selected solely on the basis of the NCP categories, but were derived from the following sources:

- U.S. EPA Headquarters and Region II which specified certain of the Malcolm Pirnie alternatives as well as additional alternatives for evaluation;

- NYSDEC, which suggested certain remedial alternatives;

- The concerned citizens living within the EDA; and

- Citizen's groups from the Niagara Falls area.

Additionally, the results of previous studies conducted by CH2M HILL at Times Beach and other dioxin contaminated sites were examined to determine if feasible remedial alternatives from these sites could be applied to the Love Canal. Appendix A contains a detailed discussion of these treatment alternatives. Finally, certain vendors of cleanup or disposal technologies either provided written suggestions for, or presentations of, remedial alternatives that were evaluated.

ALTERNATIVES

Table 4-1 summarizes the different alternative actions that have been evaluated. The table provides a complete listing of the possible work elements involved in removal, dewatering and treatment or disposal of the sediments, and indicates which alternatives were proposed by the Malcolm Pirnie 1983 EID, and which were added or deleted by EPA, DEC, and the public.

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Table 4-1
REMEDIAL ALTERNATIVES

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
I. Sediment Removal or Remediation			
A. Sewers	X		X
1. No action	X		X
2. Plug and abandon sewers	X	-	
3. Clean contaminated sewer segments	X		X
a. Hydraulically clean	X		X
b. Mechanically clean and hydraulically flush lines	X		X
1) Use power rodding mechanical equipment	X		X
2) Use bucket cleaning mechanical equipment	X		X
4. Hydraulically and/or mechanically clean sewers and repair	X		X
a. Apply grout	X		X
b. Slip line sewer segments	X		X
5. Remove and replace contaminated sewer pipe and bedding material	X		X
B. Creeks			
1. No action	X		X
2. Delay remedial action until additional sampling is completed downstream as far as the confluence of Cayuga Creek and Little Niagara River		+	X
3. No remedial action downstream of the 93rd Steet School until sampling at the school is completed		+	X
4. Remediate Black Creek and Bergholtz Creek areas designated in 1983 EID (from 96th Street to point between 94th and 95th Streets)	X		X
5. Remediate the area in 4 above plus an additional 600 feet downstream to the 93rd Street storm sewer outfall		+	X
6. Remediate the area in 5 above plus an additional 2400 feet from the 93rd Street outfall to the confluence with Cayuga Creek		+	X

Table 4-1
REMEDIAL ALTERNATIVES
(Continued)

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
7. Remediate the area in 6 above plus the 6,300-foot section of Cayuga Creek from the Bergholtz Creek to the Little Niagara River		+	X
8. Institutional action only	X		X
a. Increase public awareness	X		X
b. Post signs	X		X
c. Fence the creeks	X		X
d. Ban fishing and water sports		+	X
9. Stabilize creek sediments	X		X
a. Place small stone on creek bed only	X	-	
b. Install filter fabric on creek and cover with stone	X		X
c. Place Black Creek within a culvert	X		X
d. Apply chemical or biological agents to make contaminants inert (the K-20 process)	X		X
10. Hydraulically clean Black Creek culverts and remove and dispose of sediments from creek bottom		+	X
a. Hydraulically dredge creek		+	X
b. Mechanically excavate creek		+	X
c. Mechanically excavate creek and construct sediment trap or tidal gate		+	X
C. Outfall			
1. No action	X		X
2. Stabilize sediments (long term)	X	-	
a. Solidify or destroy contaminants in place	X	-	
b. Bury sediments in place	X	-	
3. Repair tidal gate			
a. Repair tidal gate only		+	X
b. Repair tidal gate in conjunction with alternatives C.4 or C.5		+	X

Table 4-1
REMEDIAL ALTERNATIVES
(Continued)

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
4. Stabilize sediments (short term)	X		X
a. Cover deposits with filter fabric and stone fill	X		X
b. Construct earth/stone berm	X		X
c. Install sheet pile wall	X		X
d. Construct berm or wall and cover sediments with filter fabric and stone fill		+	X
5. Construct berm or wall and remove and dispose of sediments	X		X
a. Mechanically excavate using shore-based equipment	X		X
b. Mechanically excavate using a combination of shore-based and barge-mounted equipment	X		X
c. Use barge mounted clamshell dredge			
d. Hydraulically dredge using barge-mounted equipment	X		X
II. Transport and Dewatering of All Sediments, and Treatment of Fluids			
A. Transport sediments to dewatering facility	X		X
1. Convey sediments by pipe within a pipe (hydraulic cleaning or dredging)		+	X
2. Convey sediments by watertight trucks (mechanical excavation)		+	X
B. Dewater sediments	X		X
1. Erect passive or mechanical dewatering facilities	X		X
2. Dewater solids in interim storage facility		+	X
C. Treat fluids			
1. Treat fluids at modified Love Canal Leachate Treatment Plant	X		X
2. Erect separate fluid treatment facility		+	X
3. Discharge fluids to sanitary sewer for treatment at the Niagara Falls Wastewater Treatment Plant		+	X

Table 4-1
REMEDIAL ALTERNATIVES
(Continued)

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
III. Interim Storage			
A. Cut through new Canal cap liner, deposit sediments, and repair lines		+	X
B. Construct a separate, RCRA-grade* earthern bermed facility on top of the Love Canal cap		+	X
C. Construct a RCRA-grade* earthern bermed cell inside the fenced area of the cap, off the Canal		+	X
D. Construct a concrete vault (Times Beach design) located inside the fenced area of the cap, off the Canal		+	X
E. Convert the 93rd Street School building into an interim storage facility		+	X
F. Construct a RCRA-grade* earthern bermed cell on the 93rd Street School grounds		+	X
G. Construct a Times Beach concrete vault on the 93rd Street School grounds		+	X
H. Construct a Times Beach concrete vault at the LaSalle housing development following acquisition of that development		+	X
IV. Treatment During Interim Storage		+	X
A. Use K-20 process		+	X
B. Use Occidental Chemical system of microbial degradation		+	X
V. Treatment and Disposal			
A. "In-situ Neutralization"	X	-	
B. Land Disposal			
1. Onsite (excavate portion of clay cap, deposit sediments, and construct new cap)	X		X
2. Offsite at approved hazardous waste landfill	X		X

Table 4-1
REMEDIAL ALTERNATIVES
(Continued)

Alternative	Screened as Part of 1983 EID by Malcolm Pirnie	Added (+) or Deleted (-) as Result of Review by EPA, DEC, and Public	Evaluated in this Report
a. Send waste to local facility such as CECOS or SCA		+	X
b. Send waste to other facilities including U.S. Pollution Control, Inc.; Great Midwest Corporation; and the Environmental Conservation and Management Company		+	X
C. Incineration with Landfill Disposal of Ash			
1. Onsite	X		X
a. Construct fixed facility		+	X
b. Use a mobile incinerator		+	X
1) EPA mobile incinerator		+	X
2) ENSCO/Pyrotech Rotary Kiln		+	X
3) JM Huber advanced electric reactor		+	X
4) RoTech Cascading systems		+	X
5) Plasma Arc incinerator		+	X
2. Offsite			
a. Rollins facility, Deer Park, Texas		+	X
b. ENSCO facility, El Dorado, Arkansas		+	X
c. Chemical Waste Management facility, Chicago, Illinois		+	X
d. SCA Landfill facility, Niagara Falls, New York		+	X
D. Use of GeoTech Melt All system with landfill disposal of ash		+	X

*RCRA-grade storage facility will be double lined, with a leachate collection system, a leak detection system, a cap, and a contingency plan in case of failure.

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Chapter 5
INITIAL SCREENING OF ALTERNATIVES

INTRODUCTION

The EPA guidelines for implementation of CERCLA call for an initial screening of alternatives. Three broad criteria are to be used:

1. Cost. For each alternative, the cost of implementing the remedial action must be considered including operation and maintenance costs. An alternative that far exceeds the costs of other alternatives evaluated and that does not provide substantially greater public health or environmental protection, or technical reliability should usually be excluded from further consideration unless there is no other remedy which meets applicable or relevant Federal public health or environmental standards.

2. Acceptable Engineering Practices. Alternatives must be feasible for the location and conditions of the release, applicable to the problem, and represent a reliable means of addressing the problem.

3. Effectiveness. Those alternatives that do not effectively contribute to the protection of public health, welfare, and the environment should not be considered further. If an alternative has significant adverse effects, and very limited environmental benefits, it should also be excluded from further consideration.

Utilizing the criteria of acceptable engineering practices and effectiveness, a number of alternatives listed in Table 4-1 were eliminated from further consideration. For storm and sanitary sewers, mechanical cleaning was eliminated as an option because it is unnecessary for successful remediation. The survey of the sewers conducted by Malcolm Pirnie in 1983 revealed no evidence of root intrusion or heavy debris that would require the use of mechanical equipment.

For the creeks, delays in remediation or limiting remediation to specific segments of the creeks do not adequately protect public health. Sampling conducted by DEC in July 1984 revealed dioxin contamination of sediment as far downstream as the confluence of Bergholtz and Cayuga Creeks. Presently, several hundred feet of Bergholtz Creek between the existing fence and the site of contamination remain unfenced. As a result the contaminated sediments pose a potential threat to public health. In addition, delays in remediation would allow time for sediments to travel further downstream or, in the event of a severe storm, to be washed into yards along creek banks. Institutional steps to limit public access would not serve to eliminate the potential for exposure and would do nothing to prevent further contamination of downstream creek and river reaches.

No evidence this currently occurs

Several proposed remedial alternatives would also be unacceptable for the creeks. The placement of filter fabric and small stone on the creek bed would not eliminate the potential for contaminants to leach into water or subsoils. Also, the installation procedure would involve greater worker exposure to the contaminated sediments than would occur with other alternatives.

Stabilization of sediments using chemical (e.g., the K-20 process) or biological agents is also not a reliable remedial measure. Without extensive and expensive monitoring it would be difficult to determine if complete and long-lasting stabilization of contaminants has recurred.

Placing Black Creek in a culvert or hydraulically cleaning Black Creek are not appropriate. Installing a culvert would involve excavation of the creek bed in order to prepare a level surface. This excavation would result in the removal of most of the contaminated sediment thereby eliminating the need for the culvert. Hydraulic removal of sediment is infeasible due to problems in accessing the creek with hydraulic equipment.

Infeasible interim storage alternatives include converting the 93rd Street School to a storage facility and constructing a concrete vault at the LaSalle Development. The school building would require extensive structural enhancements including installation of leachate detection and collection systems to ensure it would be secure. Construction of a concrete vault at the LaSalle Development would require relocation of existing renters and demolition of several housing units. Both alternatives would involve lengthly permit and study processes which would delay sewer, creek, and outfall cleanup activities.

Treatment alternatives such as the K-20 process and microbial degradation applied during interim storage would not be reliable or practical. K-20 would inhibit the future treatment or destruction of the dioxin waste. The microbial degradation technique developed by Occidental Chemical is successful for most chlorinated organic compounds but is unproven for dioxin.

DISAGREE

Finally, two disposal options are not possible. Onsite disposal of the sediments in the clay cap is infeasible due to the lack of capacity. The volume of dewatered sediments removed from the creeks and sewers will exceed the space available within the cap. Second, offsite disposal at local or other facilities is not possible due to facility policy or design constraints which prevent their acceptance of the sediment wastes.

Table 5-1 lists the alternatives that were eliminated, and provides a summary of the reasons for elimination. Chapter 6 provides a more detailed evaluation of the remaining alternatives, and presents a cost analysis of all evaluated alternatives.

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Table 5-1
ELIMINATION OF SCREENEDD ALTERNATIVES

Alternative	Criteria for Elimination
I. Sediment Removal	
A. Sewers	
o. Mechanically clean and hydraulically flush lines	Costs/Exceeds Cost of Other Alternatives Without Greater Public Health Protection; and Engineering Practice/Limited Feasibility for Conditioning
-- Use power rodding mechanical equipment	
-- Use bucket cleaning mechanical equipment	
B. Creeks	
o Delay remedial action until additional sampling is completed downstream as far as the confluence of Cayuga Creek and Little Niagara River	Effectiveness/Does Not Protect Public Health
o No remedial action downstream of the 93rd Street School until sampling at the school is completed	Effectiveness/Does Not Protect Public Health
o Remediate Black Creek and Bergholtz Creek areas designated in 1983 EID (from 96th Street to point between 94th and 95th Streets)	Effectiveness/Does Not Protect Public Health
o Remediate the area in 4 above plus an additional 600 feet downstream to the 93rd Street storm sewer outfall	Effectiveness/Does Not Protect Public Health

Table 5-1
ELIMINATION OF SCREENED ALTERNATIVES
(continued)

Alternative	Criteria for Elimination
o Institutional action only by increasing public awareness, posting signs, fencing the creeks, banning fishing and watersports.	Effectiveness/Does not Protect Environment, or Effectively Protect Public Health
o Stabilize creek sediments:	
-- Install filter fabric on creek bed and cover with small stone	Engineering Practices/Not a Reliable Remedial Measure ?
-- Apply chemical or biological agents to make contaminants inert (the K-20 process)	Engineering Practices/Not a Reliable Remedial Measure
-- Place Black Creek in culvert	Costs/Exceeds Cost of Other Alternative Without Greater Public Health Protection; and Engineering Practice/Limited Feasibility for Conditioning
o Hydraulically clean Black Creek	Engineering Practices/Dredge Cannot be Used in Black Creek
III. Interim Storage	
o Convert the 93rd Street School building into an interim storage facility	Engineering Practices/Building Not Suitable for Use
o Construct a Times Beach concrete vault at the LaSalle housing development following acquisition of that development	Effectiveness/Possible Delays in Obtaining Property and Conducting Engineering Studies Do Not Contribute to Protection of Public Health

Table 5-1
ELIMINATION OF SCREENED ALTERNATIVES
(continued)

Alternative	Criteria for Elimination
IV. Treatment During Interim Storage	
o Use K-20 process	Engineering Practices/Not a Reliable Remedial Measure
o Use Occidental Chemical system of microbial degradation	Engineering Practices/Not a Feasible Remedial Measure
V. Disposal	
o Onsite (excavate portion of clay cap, deposit sediments, and construct new cap)	Engineering Practices/Insufficient Capacity DISAGREE
o Offsite at approved hazardous waste landfill:	
-- Send waste to local facility such as CECOS or SCA	Engineering Practices/Facilities Will Not Accept Wastes
-- Send waste to other facilities including U.S. Pollution Control, Inc.; Great Midwest Corporation; and the Environmental Conservation and Management Company	Engineering Practices/Facilities Will Not Accept Wastes

$$\frac{30{,}000 \text{ YD}^3}{1 \text{ ACRE}} = \frac{30{,}000 \times 27}{43560} \approx 22'$$

10 ACRE AREA WOULD BE RAISED ABOUT 2'

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Chapter 6
REMEDIAL ACTION ALTERNATIVES

SEWER REMEDIATION

SEDIMENT QUANTITIES

Sediment depths measured during the sampling by Malcolm Pirnie in 1983 ranged from 0-6 inches in the sanitary sewer manholes and 0-15 inches in the storm sewer manholes. However, most of the manholes contained very little sediments (0-2 inches). Of the 100 sanitary sewer manholes sampled, only 5 had sediment depths greater than two inches, while 52 had no measurable depth of sediment. Of the 100 storm sewer manholes sampled, only 16 contained sediment depths greater than 2 inches with 21 containing no measurable depth of sediment. Exact quantification of the amount of sewer sediments cannot be made because sediment depth could not be determined in the sewers between manholes (sewers were too small to enter) and may vary from the depths actually measured.

The amount of sediment that would be cleaned from the sanitary and storm sewers, if the recommendations from the Malcolm Pirnie EID are followed, is estimated to be 280 cubic yards, based on the following assumptions:

- 44,100 ft. sanitary sewer
- 10 inch average diameter--sanitary sewer
- 16,700 ft. storm sewer
- 24 inch average diameter--storm sewer
- 2,500 sq.ft. of lift station floors and walls to be cleaned
- 2 inch average depth of sediment in the sewers and lift station wet wells

These assumptions should result in a conservative estimate of quantities of contaminated sewer sediments.

PATHWAYS OF CONTAMINANT MIGRATION

This section briefly describes the contamination migration pathways presented in the Malcolm Pirnie EID to provide an understanding of the applicability of the various techniques to the Love Canal sewers.

- Sanitary Sewers--As shown on Plate 1, sediments containing the suspected Love Canal compounds were found in numerous sanitary sewer manholes to the limits of the study area. It was concluded by Malcolm Pirnie that most of the contamination in the sanitary sewers resulted from former direct connections to sewers in the Canal Area.

Primary migration pathways identified include the Wheatfield Avenue sanitary sewer which flowed via Wheatfield Avenue and 101st Street to Colvin Boulevard, and the 97th and 99th Street sanitary sewers which flowed into the Colvin Boulevard interceptor sewer. All flow in the Colvin Boulevard interceptor travels to the west to Lift Station No. 4 at Luick Avenue and 91st Street. These sources of contamination have since been blocked off and presumably have ceased to contribute contamination to the sanitary sewers.

Contamination was also found in sanitary sewers not directly downstream of the system formerly connected to the Canal Area sewer. The conclusion was made by Malcolm Pirnie that surcharging of sewers during peak flow periods and attendant flow reversal could have transported the sediments into these sewers from the main interceptors.

Sanitary sewers recommended for cleaning by Malcolm Pirnie where no contamination was found include sewers which are located between manholes where contamination was present (the assumption was made that the sediments may be transported up or downstream between the time of sampling and the time when they are actually cleaned) and sewers connected to main interceptors which have a high potential for surcharging. For sanitary sewers connected to the main interceptor, cleaning was recommended for one reach (i.e., to next upgradient manhole) either side of the interceptor.

- Storm Sewers--Contamination assessment of the storm sewer system is shown on Plate 2. Primary migration pathways identified are the 97th Street and 99th Street storm sewers, both of which flowed south to Frontier Avenue, then east on Frontier Avenue to manhole 406, then south to the 102nd Street outfall. The storm sewers on 97th and 99th Streets which flow to Black Creek via Colvin Boulevard and 96th Street and Colvin Boulevard and 101st Street, respectively, are also considered to be primary migration pathways. Storm sewers not directly connected to the Canal area could have received contamination from sanitary sewer lift station overflows or from portable pumps used to relieve the surcharged sanitary sewers.

Storm sewers recommended by Malcolm Pirnie for cleaning in the absence of evidence of contamination are those which receive overflows from sanitary sewer lift stations and those storm sewers tributary to creek outfalls where contamination has been documented.

METHODS

Several potential remedial alternatives for the sanitary and storm sewers were reviewed in the 1983 EID. These alternatives ranged from no action to the complete replacement of sewers. However, the remedial actions, as described in the following sections, are site specific.

Possible sewer cleaning methods include:

- mechanical
- hydraulic
- bucket dredging
- suction equipment

Possible sewer repair techniques include:

- pipe grouting
- pipe relining
- removal and replacement

Monitoring activities include:

- Periodic sampling/analysis of the sewer flows and sediments at strategic locations.

Investigative techniques useful in locating cross connections and assessing the degree of remediation required include:

- Television inspection of selected sanitary and storm sewers.

- Smoke testing.

With the exception of certain sewers, abandonment in place without replacement cannot be undertaken because the sanitary sewers are used both by the residents living throughout the area, and by the Love Canal Leachate Treatment Facility.

A detailed description and evaluation of all the above actions can be found in the 1983 EID.

CLEANING AS A REMEDIAL ALTERNATIVE

Of the four sewer cleaning alternatives presented, the mechanical methods (power rodding and bucket cleaning) are most effective in removing obstacles such as roots, stones, grease and sludges from sewers. Hydraulic flushing is most effective in cleaning sewers of loose or moderately accumulated sediments. Suction equipment is normally used to remove accumulated solids from manholes and to remove flush water and sediments from manholes in conjunction with the hydraulic flushing method.

Mechanical techniques have the advantage of removing heavy materials without using large quantities of water. However, there was no visible evidence of root intrusion or heavy sediment accumulation in a majority of the sewers. These techniques also do not remove all of the loosened debris from the system. Mechanical cleaning must also be followed by hydraulic flushing. For these reasons, mechanical cleaning can be screened as an alternative based on engineering acceptability.

The main advantage of hydraulic flushing is that essentially all the sediment is transported to a manhole and removed from the sewers. The hydraulic flush method generates large quantities of water (estimated at 7 gallons per foot of sewer for the light cleaning required here, and up to 20 gallons per foot may be required in the few sections with heavier sediment deposits). However, the sediments can be effectively removed from the water by dewatering techniques which are discussed elsewhere. The sediments must be transported to the dewatering facility, and the water removed from the sediments must be treated. These techniques are evaluated later in this report.

NOT TRUE or NOT A PROBLEM.

Due to the nature and degree of contamination found in the sewer sediments, the release of significant amounts of volatile organics during cleaning is not anticipated. The presence of volatile organics in the sewer sediments would be of concern because many of the homes served by contaminated sewers do not have traps in the house laterals to prevent gases from entering them from the sewers during cleaning. The potential for the release of sewer gases into adjacent houses can be mitigated by adequate venting through manholes during the cleaning operations and proper coordination with residents along the sewer lines.

The potential also exists for the exposure of residents to contaminated sewer sediments in the event that the sewers backflow into house basements during the cleaning operations. This, however, is not a likely occurrence and can be mitigated through full-time supervision of the cleaning operation, close coordination with area residents, and the use of spill contingency measures in the event of a backflow.

The most appropriate cleaning method is hydraulic flushing, in combination with flush water/sediment removal at various manholes using suction equipment. Some mechanical cleaning may be required in specific sewer sections with heavier sediment deposits, but this can not be easily determined until the actual cleaning is initiated. After the cleaning has been completed, television inspection can be made to verify that the sewer sediments were removed.

Repair Following Cleaning

The sewer repair alternatives are site specific and were not recommended by Malcolm Pirnie for the general repair of all the sanitary and storm sewers. Repairs would be done only where required for structural integrity. Two areas were identified by Malcolm Pirnie as requiring repair. There appears to be a structural collapse of approximately 300 feet of 10-inch pipe at a depth of approximately 10 feet of the sanitary sewer on Wheatfield Avenue (MH 457 to MH 458). There is a second 300-foot section of sanitary sewer on Read Avenue between MH 773 and MH 774 that appears to be either structurally damaged or blocked by root intrusion.

Grouting and relining of pipe is very site specific. The need to grout or reline cannot be determined until after the sewer cleaning has begun and television inspections of several sections of cleaned sewers are made.

Although Malcolm Pirnie recommended such activities in the EID, the repair of the sewer system may be an activity more adequately executed by the City of Niagara Falls, following the cleaning and inspection of the sewers. At the time of writing, DEC and the City are in negotiations regarding funding for repairs, coordination of cleaning and repair, and personnel protection measures for sewer repair crews.

Long-Term Monitoring Following Cleaning

Sewer monitoring (i.e. additional sampling and analysis) could be used in order to identify sections of pipe requiring either additional cleaning or to identify additional sources of contamination.

Inspection Techniques Following Cleaning

In addition to any general television inspection made after the sewers are cleaned, television inspection could be used to locate specific sources of infiltration (i.e. verify that sewers which have been blocked off in the past are not active pathways of contaminant migration), broken pipes, etc.

Specific locations recommended by Malcolm Pirnie for television inspection include:

- 1200 ft of sanitary sewer on 95th Street (MH 283-MH 288)
- 300 ft of sanitary sewer on Wheatfield Avenue (MH 457-MH 458)
- 1150 ft of sanitary sewer on Read Avenue (MH 750-MH 756)
- 950 ft of sanitary sewers entering MH 750 on 95th Street
- 300 ft of sanitary sewer on Read Avenue (MH 773-MH 774)
- 2200 ft of storm sewer on 95th St (MH 427-MH 431) and beneath the LaSalle Expressway (MH 404-MH 406)
- 750 ft. of storm sewer at 102nd Street landfill (MH 402-MH 401) to ensure that no major faults or extraneous connections exist in that stretch.

Have Jim [illegible] do this

Smoke testing could be used as necessary to determine sources and discharge points of pipes which may have acted as migration pathways. Smoke testing was recommended by Malcolm Pirnie for MH 277 (96th Street) and MH 265 (Colvin Blvd.)

The costs for television inspection were estimated at $1.50 per linear foot, and those for smoke testing were estimated at $500 per manhole.

In addition, after the sewer cleanup has been completed, solvent cloths will be used to take wipe samples in several manholes. The cloths will be analyzed for specific Love Canal related compounds to assure that contamination has been removed to an acceptable level.

Whose idea
was not done
what is an acceptable level?

ABANDONMENT AND REPLACEMENT AS A REMEDIAL ALTERNATIVE

Malcolm Pirnie recommended abandonment of approximately 900 feet of storm sewer located on Frontier Avenue immediately above the leachate collection system at Love Canal. Any exfiltration from this line would enter the leachate collection system; abandonment of the line eliminates this possibility. Two drop inlets (D.I. 97 and D.I. 99) would have to be blocked and the line plugged at MH 412 if

Bids @ $200K

abandonment is undertaken. Estimated cost for this work is $500.

Not true

With the exception of the above discussed sewer, abandonment in place without replacement cannot be undertaken because the sanitary sewers are used by the residents living throughout the area and the Love Canal Leachate Treatment Facility. Abandonment and removal of the contaminated sewers would result in additional contaminated material to be disposed of and offer no advantage over abandoning in-place and sealing off the sewers. Therefore only abandonment in-place and replacement with new sewers will be considered as a remedial alternative to cleaning the sewers.

The 1983 EID recommended cleaning 44,100 feet of sanitary sewers and 16,700 feet of storm sewers. To estimate the cost of replacing these sewers, it has been assumed that the average diameters of the sanitary sewer and storm sewer are 10-inch and 24-inch, respectively. The average installed replacement costs for 10-inch and 24-inch sewers are by Malcolm Pirnie estimated at $97 and $162 per foot, respectively. Total replacement costs for the sanitary and storm sewers are estimated to be $4,300,000 and $2,700,000, respectively. In addition, the existing manholes and sewers that are abandoned would have to be plugged with concrete at an estimated cost of $80,000. The costs to replace these sewers are high primarily due to the physical constraints of the area (i.e. numerous house laterals, road excavation, depth of excavation, etc.).

Since hydraulic cleaning of the sewers appears to be a viable remedial action, and sewer replacement costs are high, no further evaluation of the Love Canal area sewer abandonment and replacement remedial alternative has been done.

TIDAL GATE REPAIR AT 102ND STREET OUTFALL

To deter future surcharging through the storm sewers in the vicinity of 102nd Street and possible transport of contaminants from the 102nd Street storm sewer outfall, the currently inoperable tidal gate at the 102nd Street outfall should be replaced. The cost of replacement of this gate is estimated to be $1,500.

ADDITIONAL SAMPLING VERSUS CLEANING

The Malcolm Pirnie EID recommended additional sampling and analysis of sewer sediment at the following locations to further delineate possibly contaminated areas:

- Main interceptor sanitary sewer from Lift Station No. 6 to the intersection of 66th Street and John

Avenue. Samples would be obtained from 10 sanitary manholes and analyzed at an estimated cost of $34,800 (Malcolm Pirnie estimates).

- A 1,400 foot portion of Black Creek within culverts between the headwall at 102nd Street and the outlet at 98th Street. The creek is contained within 310 feet of 72-inch diameter culvert pipe and 1,090 feet of twin 48-inch diameter culverts in this area. The sediment in these pipes is possibly contaminated due to former direct connections to the storm sewers from the Canal Area. A total of 11 samples would be required in the Black Creek culverts. The Malcolm Pirnie estimated cost for the collection and analysis of these 11 samples is $36,000.

The estimated costs of cleaning the same reach of sanitary sewer as recommended for sampling above are shown in Table 6-1 and are based on the unit costs for sewer cleaning which were presented in the 1983 EID. The estimated cost to clean the 1,400 foot segment of Black Creek within the 48-inch diameter and 72-inch diameter culverts is also shown in Table 6-1.

These costs are based on the assumption that mechanical bucket cleaning would be followed by hydraulic cleaning to remove the estimated 4"-6" sediment depth. The costs of disposal of the liquid and sediments generated by cleaning of these additional sewers will have minimal impact on the cost associated with onsite water treatment and onsite storage. It is apparent that the cost to sample the sanitary sewers ($34,000) and the Black Creek culverts ($36,000) is lower than the cost to clean those same sewers ($67,000 sanitary)/($69,000 culverts). However, due to the high probability that contamination will be found and remediation will be necessary following the sampling and analysis, it is more cost-effective to forego the costs of additional sampling and proceed with the cleaning of the Black Creek Culverts and additional reaches of sanitary sewer.

NOT DONE

EQUIPMENT DECONTAMINATION AND ANALYTICAL COSTS

After sewer cleaning has been completed the equipment (i.e. trucks, pumps, etc.) will have to be decontaminated. The decontamination procedures would most likely include hydroblasting, steam cleaning, solvent wiping, and distilled water rinsing. Water resulting from the decontamination procedure will be captured for analysis or treatment. Solvent wipe cloths will be stored with the sewer sediments.

Table 6-1
ESTIMATED COSTS FOR CLEANING THE ADDITIONAL
SANITARY SEWERS AND THE BLACK CREEK CULVERTS

Sanitary Sewer	Amount	Units	Unit Cost	Capital Cost[1]
hydraulic flushing	4,750	L.F.	$9.00/L.F.	$42,800
transportation of cleaning residuals	33,250	gal	$0.20/gal	6,700
SUBTOTAL				$49,500
Engineering, Contingency, Legal, Administrative @ 35 percent				17,500
TOTAL				$67,000
BLACK CREEK CULVERTS				
mechanically clean	2,490	L.F.	$10.00/L.F.	$24,900
hydraulic flushing	2,490	L.F.	$9.00/L.F.	22,400
transportation of cleaning residuals	17,430	gal	$0.20/gal	3,500
SUBTOTAL				$50,800
Engineering, Contingency, Legal, Administrative @ 35 percent				18,200
TOTAL				$69,000[2]

NOTE:

1. All costs in 1984 Dollars.

2. These costs are based on the assumption that mechanical bucket cleaning would be followed by hydraulic cleaning to remove the estimated 4"-6" sediment depth. The costs of disposal of the liquid and sediments generated by cleaning of these additional sewers will have minimal impact on the cost associated with onsite water treatment and onsite storage.

L.F.--Linear Feet.

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When the decontamination procedure has been completed, wipe tests will be used to sample the equipment. These wipe cloths will then be analyzed for specific Love Canal related compounds to assure that no contamination remain on the equipment. The analyses will take approximately three (3) weeks during which time the equipment will remain impounded within the Love Canal facility.

SUMMARY OF SEWER REMEDIATION ALTERNATIVES

Table 6-2 shows the costs for the sewer remediation alternatives that were evaluated. The most cost-effective actions for the storm and sanitary sewers and associated costs are detailed in Table 6-3. The total cost for these actions is estimated to be $1,432,000.

All the known sewer connections to the Love Canal Area have reportedly been plugged or disconnected. However, subsequent to cleaning, TV inspection and smoke testing should be undertaken to determine if there are any unknown connections to be plugged that would eliminate contamination from entering the sewers. Hydraulic flushing should remove the contaminated sediments. A final TV inspection of the cleaned sewers will determine if the sediments have been removed. Installation of a new tidal gate on the headwall at the 102nd Street outfall will prevent backflow or contamination from the 102nd Street outfall from entering the storm sewer system. In addition, the additional length of sanitary sewer and the culvert in Black Creek should be cleaned without a sampling and analysis program to avoid a higher total cost through duplication of services and the possibility of continued exposure during the duration of the sampling program.

102ND STREET OUTFALL REMEDIATION

SEDIMENT QUANTITIES

Love Canal related compounds were found in the Niagara River adjacent to the 102nd Street storm sewer outfall in a number of sediment samples. The volume of contaminated sediments within the remedial action zone, as defined by Malcolm Pirnie in the 1983 EID and shown in Figure 6-1, was estimated to be 14,800 cubic yards. This assumes an excavation depth of 4 feet. The 4-foot depth was selected by Malcolm Pirnie. No data about contamination is available below 4-feet (the limits of the samples taken by Malcolm Pirnie), and contamination was found at the 3-foot depth. Additional sediments samples would be required to determine the maximum depth of contamination. For the purpose of estimating the remedial costs presented herein, it was assumed that the depth of excavation would be an average of 4-feet.

Table 6-2
SUMMARY OF ESTIMATED COSTS FOR SEWER REMEDIATION ALTERNATIVES

	Costs		
Alternatives	Capital	Annual Operation and Maintenance	Total Present Worth
1. Hydraulic cleaning[1]	$1,348,000	-	$1,348,000
3. Abandon in-place[2] and replace with new line	$7,080,000	-	$7,080,000

NOTES:

1. Cleaning costs are based on hydraulic flushing and television inspection of all the sewers. Short sections of sewers may require mechanical cleaning and/or removal and replacement. Costs include all sewers designated for cleaning in EID plus sanitary sewer from Lift Station #6 to 66th and John Streets plus Black Creek Culverts.

2. Includes 44,100 feet of 10-inch diameter sanitary sewer and 16,700 feet of 24-inch diameter storm sewer.

WDR99/005

Table 6-3
SUMMARY OF SEWER REMEDIATION AND REPAIR ACTIONS COSTS

Remedial Activity	Amount	Units	Unit Cost	Capital Cost[2]	
Hydraulic flushing - sanitary sewer[3]	52,750	L.F.	$9.00/L.F.	$475,000	
Hydraulic flushing - storm sewers[3]	22,890	L.F.	$9.00/L.F.	$206,000	
Hydraulic flushing - lift stations	3	each	$8000/ea	$ 24,000	
				subtotal	$705,000
TV Inspection - after sewer cleaning	75,640	L.F.	$1.50/L.F.	$113,500	
				subtotal	$113,500
Smoke Testing	2	manholes	$500/ea	$ 1,000	
Mechanical cleaning - sanitary sewer	300	L.F.	$10.00/L.F.	$ 3,000	
Mechancial cleaning - storm sewer	2490	L.F.	$10.00/L.F.	$ 24.900	
				subtotal	$ 28,900
Remove and replace - sanitary sewer[1]	600	L.F.	$100/L.F.	$ 60,500	$ 60,500
Transportation of cleaning residuals	481,500	gal	$0.20/gal	$ 96,300	$ 96,300
Replace Tidal Gate	1	ea	$1500/ea	$ 1,500	$ 1,500
Analytical Costs for Wipe Tests	10	ea	$1000/ea	$ 10,000	
Equipment Decontamination	5	ea	$9000/ea	$ 45,000	
				subtotal	$ 55,000
				SUBTOTAL	$1,060,700
Engineering, contingency, legal, Administrative @ 35%					$ 371,300
				TOTAL	$1,432,000

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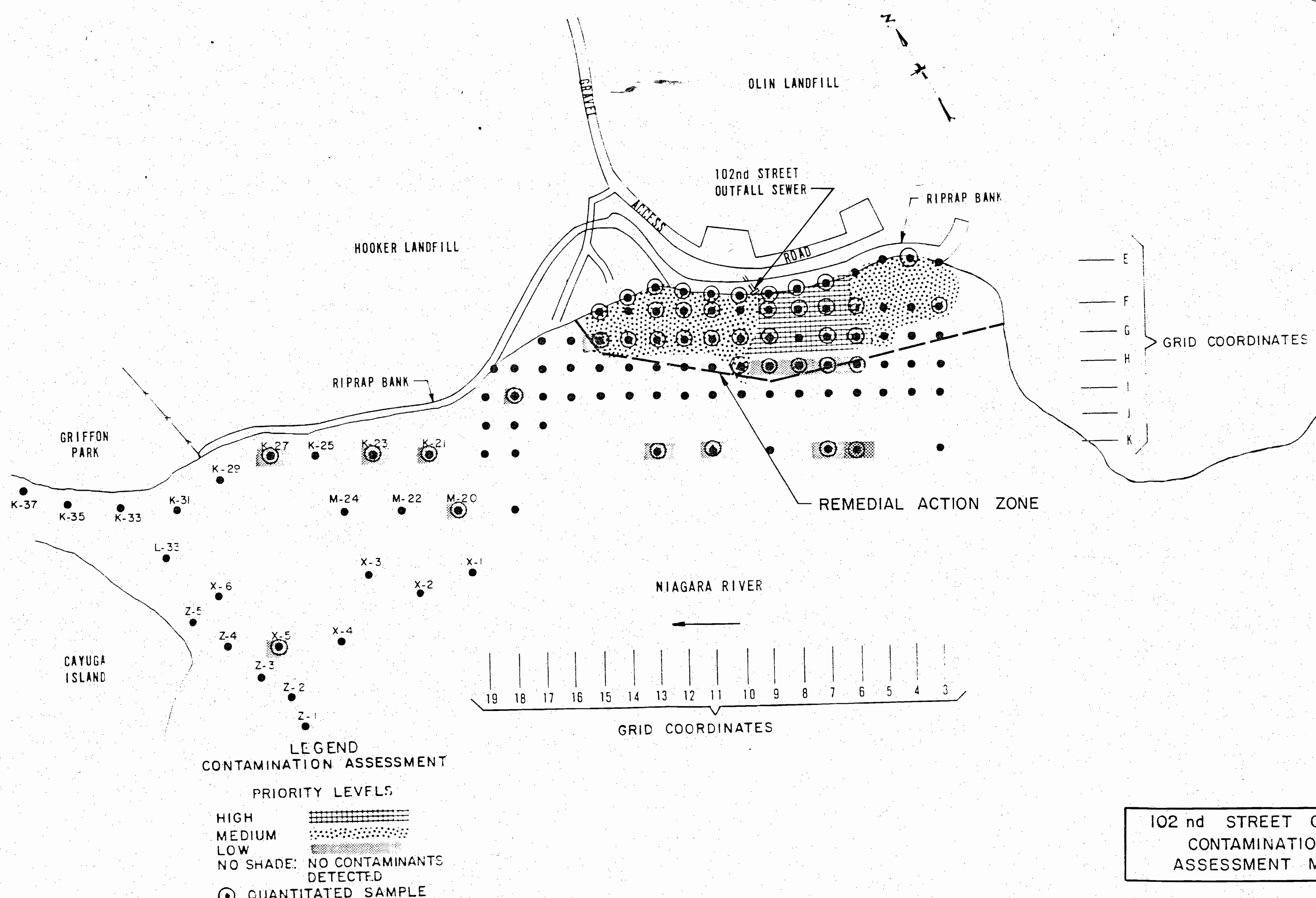
1. This assumes pipe on Wheatfield (MH 458 to MH 457) and balance lines Read Avenue (MH 774 to MH 773) and MH 412 are replaced. Costs may be borne by City of Niagara Falls.

2. All costs are in 1984 dollars

3. Includes additional sections (Black Creek culverts, and sewers to 66th Street and John) recommended for cleaning.

WDR99/006



102 nd STREET OUTFALL CONTAMINATION ASSESSMENT MAP

REEVALUATION OF IMMEDIATE STABILIZATION AND LONG-TERM REMEDIAL ALTERNATIVES

General

The contaminated sediment deposits at the 102nd Street Outfall are located adjacent to the Olin and Hooker 102nd Street landfills. Those landfills may still be contributing contaminants directly into the river or into the 102nd Street storm sewer which passes through the landfills and then into the outfall. Until such time that remedial activities at the two landfills have been completed, no permanent remediation of the outfall is considered advisable. However, there are immediate actions that can be taken in order to contain the contaminated sediments to prevent migration. In addition long-term remedial actions were evaluated.

Immediate stabilization alternatives considered in order to minimize the impact of the contaminated outfall sediments include the following:

- No action
- Temporary stabilization utilizing filter fabric and stone fill
- Temporary stabilization utilizing a berm, with or without timber sheeting
- Temporary stabilization utilizing steel sheet pile

Long-term remedial alternatives considered include the following:

- No action subsequent to temporary berm construction
- In-place containment
- Removal of the sediments and interim storage at Love Canal, or disposal at a permanent hazardous waste facility or by other means.

All the long-term remedial alternatives (except no action) require construction of either a stone berm with timber sheeting or a steel sheet pile wall during immediate stabilization.

Immediate Remedial Alternatives

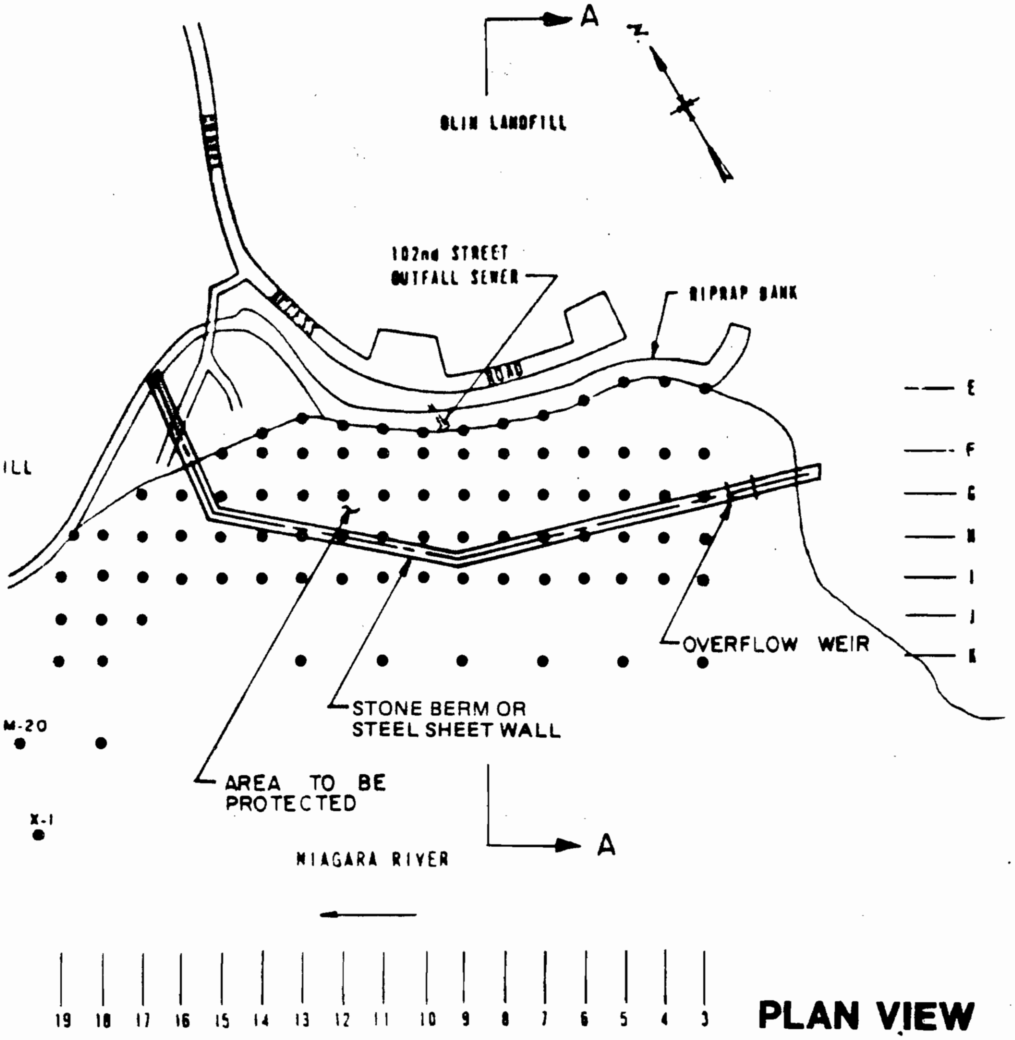
Immediate stabilization alternatives considered in the 1983 Malcolm Pirnie EID for temporary alleviation of the high priority action zone are discussed below.

- No Action--The no action alternative included in the 1983 EID referred to leaving the contaminated sediments in place and not performing any remedial measures to stabilize or remove sediments. The alternative also included a monitoring program to attempt to determine the rate of transport of contaminated sediments to downstream areas.

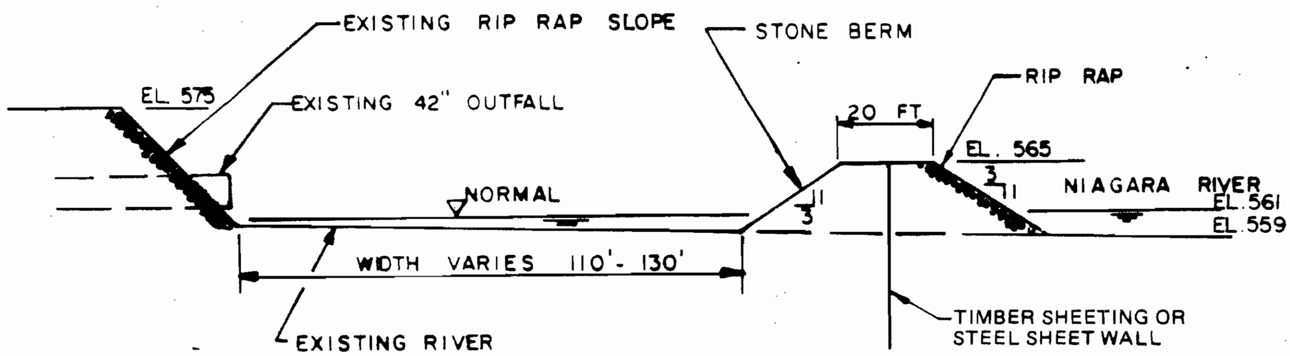
- Installation of Filter Fabric and Stone Fill--This alternative would involve placement of a filter fabric on the river bed to cover the area of contaminated sediment (Figure 6-1). Then a layer of stone approximately 18-inches deep would be put down to cover the fabric. Approximately 9,000 square yards of filter fabric and 4,500 cubic yards of stone fill would be required to cover the area.

  The only benefit of this alternative over the no action alternative is that after the fabric is installed, sediment transport into the Niagara River will be minimized. A major adverse impact of this alternative is that preparation of the area would require the removal and disposal of miscellaneous debris. Also, installation of the fabric would be difficult and would possibly have to be done manually. In addition, during the actual installation of the fabric, the sediments would be disturbed causing increased transport downstream. After the fabric is installed leaching of the contaminants into the water column or migration to greater sediment depths cannot be ruled out. Accordingly, further evaluation of this alternative was eliminated on the basis that human health and the environment are not adequately protected, and, as an engineering alternative, the filter fabric/small stone cannot be considered a reliable means of addressing the problem.

- Construction of a Berm--This alternative would involve construction of a temporary stone berm (Figure 6-2), approximately 900 feet in length, around the remedial action zone. Although the berm is likely to be permeable, an overflow weir would be constructed to assure that water entering the area from the 102nd Street outfall could



PLAN VIEW



CROSS SECTION A - A

NOTE: THIS FIGURE IS A REVISION OF FIGURE D.7-1 TAKEN FROM THE 1983 EID.

102nd STREET OUTFALL
BERM OR WALL

discharge into the Niagara River. The berm would provide a quiescent zone around the outfall to contain those sediments already there and settle out and contain those sediments entering the area.

An important benefit of the berm over the filter fabric alternative is that the contaminated sediment would be contained to a greater degree. Adverse impacts of this alternative include the possible downward migration of the contaminants and leaching of contaminants into the water column. During placement of the berm, resuspension and movement of the sediments could occur; however, the berm would be constructed in the area of low to no contamination.

If it was desired to make the berm impermeable to allow for the possibility of dewatering the area during any future remedial action and to contain any leached contaminants, then timber sheeting could be used. Since it is unlikely that the timber sheeting could be installed through stone berm, the sheeting would have to be installed during the initial construction of the berm. Therefore, a decision to retain the option to dewater the area in the future must be made prior to implementing this alternative.

- <u>Steel Sheet Pile</u>--In this alternative, a steel sheet pile wall could be installed instead of a berm. The steel sheet pile wall is more costly than the stone berm with timber sheeting, but offers the following advantages:

  - Existing debris and sediments would be disturbed to a lesser extent during installation, since the steel sheets would occupy a much smaller area than the berm.

  - The long-term remedial alternative options for dewatering, removal or in-place burial are preserved.

  - Installation of the steel sheets can proceed more rapidly than the berm and under any weather conditions.

Costs for Immediate Stabilization

Present worth, including capital and annual operating/maintenance costs, for the two immediate remedial alternatives are presented in Table 6-4. Operation and maintenance costs for the alternatives include annual inspection and

Table 6-4
ESTIMATED COSTS FOR IMMEDIATE
STABILIZATION AT 102nd STREET OUTFALL

Alternative	Costs		
	Capital	Annual Operational and Maintenance	Total Present Worth[1]
Berm[2]	492,000	2,000	509,000
Sheet Pile Wall	619,000	2,000	636,000

NOTES:

1. 1984 dollars. Present worth of capital and operation and maintenance costs were calculated for 20 years at 10% discount rate. No provisions were made to inflate future operating costs.

2. Includes timber sheeting.

WDR99/008

miscellaneous repairs. The capital costs for the stone berm with timber sheeting, and steel sheet pile alternatives include the costs associated with an exploratory soil boring program which would be required to determine the depth to bedrock and the type of soils beneath the 102nd Street Outfall.

The stone berm is considered the most cost-effective alternative. The estimated capital costs to construct the berm are $492,000 and are detailed in Table 6-5. Annual operating and maintenance costs are estimated to be $2,000. The stone berm could be constructed as described in the 1983 EID with the exception that shot rock or run of crusher stone would be used instead of the gravel fill material and timber sheeting would be installed. The berm would be constructed as shown on Figure 6-2.

However, the difference in present net worth between the two alternatives ($127,000) is well within the normal estimating bounds (-30 percent to +50 percent) for remedial alternatives. The two alternatives should therefore be considered essentially equal in costs, and the decision to implement the short term or immediate stabilization can be based on evaluation of other factors, such as adverse effects on the environment.

Long-Term Remedial Alternatives

Long term actions should be coordinated with the remediation of the two 102nd Street landfills. Three long-term remedial alternatives (no action following construction of a berm or wall, in-place containment, and removal and disposal) considered in the 1983 Malcolm Pirnie EID are discussed below.

- No action subsequent to construction of the berm or sheet wall--In this alternative, no further remediation would be required following the construction of the berm or sheet wall.

The major advantage of this alternative is that no additional cost would be required. The major disadvantage would be that the contaminated sediments remain at the outfall.

- In-Place Containment--In this alternative the 102nd Street storm sewer would be extended to discharge on the river side of the berm or wall. The height of the berm or wall would be increased from a top elevation of 565 ft. to 568 ft. Then the area between the berm or wall and the current shoreline would be backfilled with clean fill, capped with clay, covered with topsoil and seeded.

Table 6-5
ESTIMATED COST FOR TEMPORARY STONE BERM

Item	Quantity	Unit Cost	Total*
Stone Berm			
Exploratory Boring Program	Lump Sum	$14,000	$ 14,000
Shot Rock or Run of Crusher	10,900 cy	$20/cy	$218,000
Rip Rap	850 cy	$50/cy	42,500
Timber Sheeting	18,000 sq.ft.	$ 5/sq.ft.	90,000
Subtotal			$364,500
Engineering, Contingencies, and Legal (@ 35%)			127,500
TOTAL			$492,000

*1984 dollars.

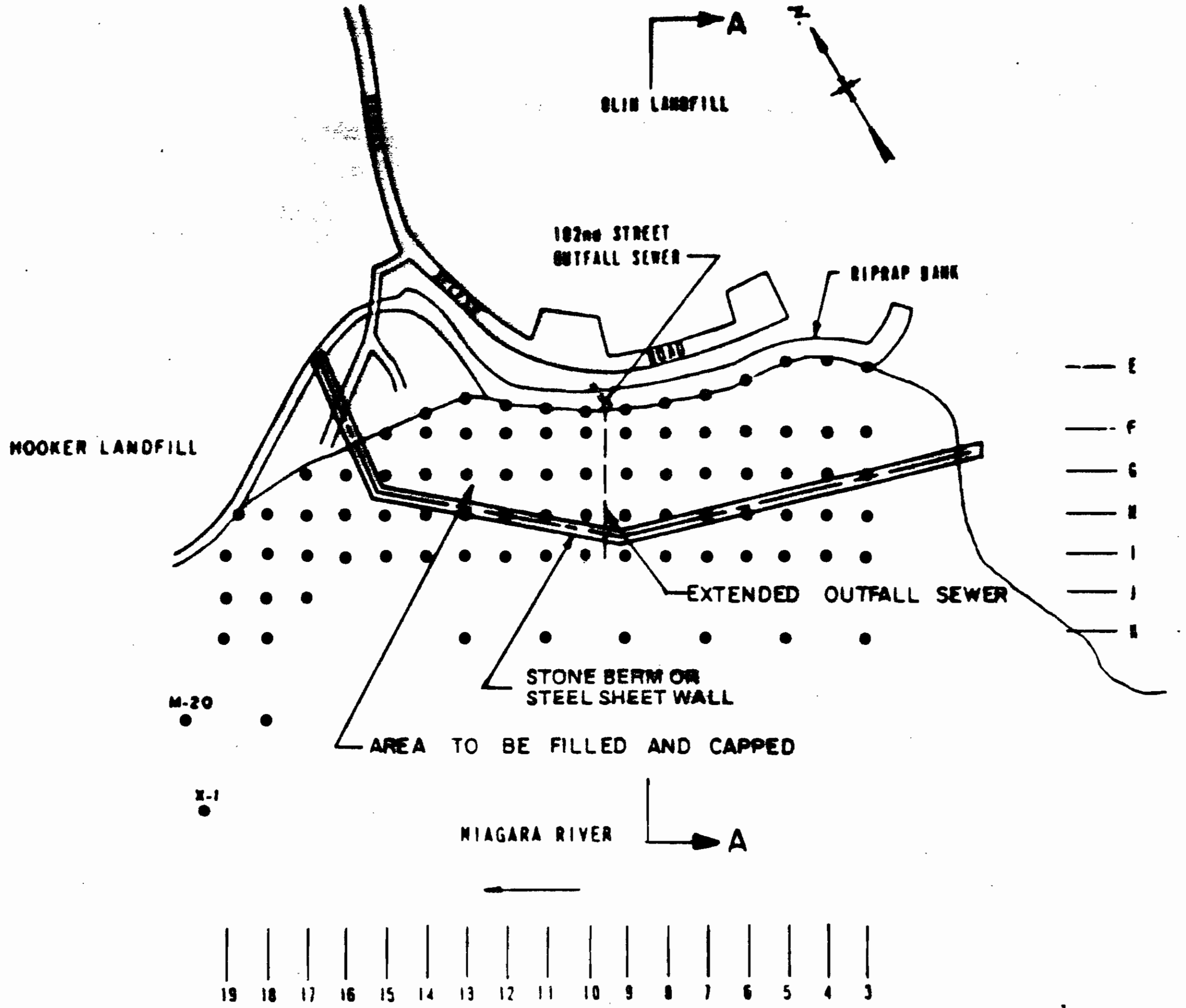
WDR99/009

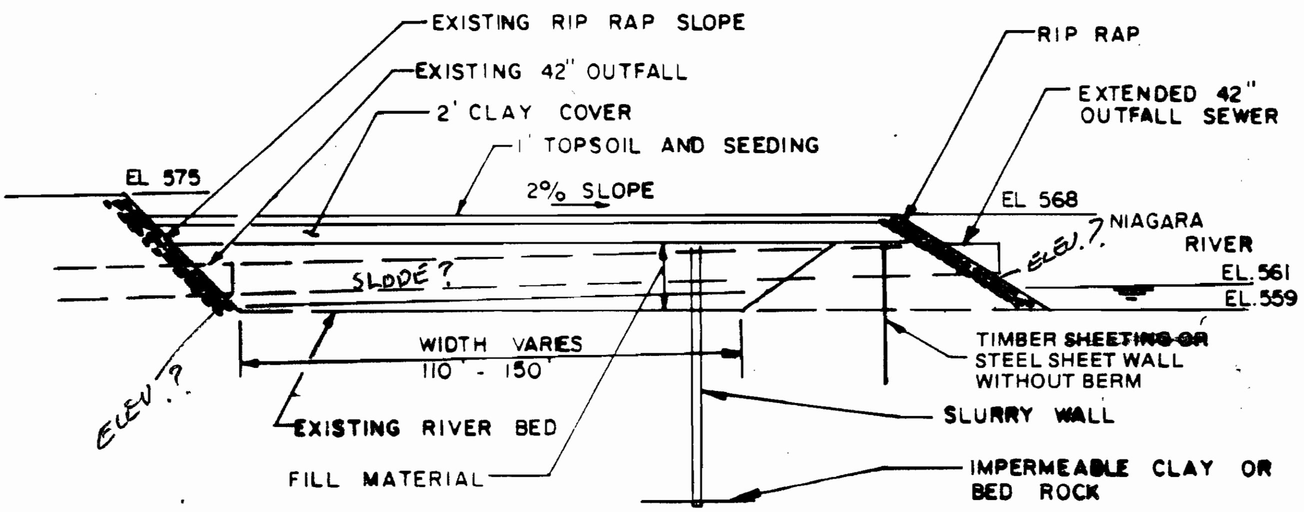
A clay slurry wall (approximately 20 feet deep) would also be constructed inside of the berm or wall through the fill to the river bedrock or impervious clay subbase. This slurry wall would prevent horizontal migration of any contaminants. The conceptual design of this alternative is shown in Figure 6-3.

With this alternative the sediments are likely to permanently remain in-place, unless a major flooding event disturbs the cover. The possibility of this occurrence can not be calculated at this time.

- Removal and Disposal--This alternative would require the excavation of approximately 4 feet of sediment in the outfall area shown on Figure 6-4. The sediments would then be either transported for disposal to an offsite facility or stored at an interim onsite facility at Love Canal. Excavation of sediments could be performed by mechanical excavation, or hydraulic dredging. Based on an assumed four-foot depth of excavation throughout the area shown on Figure 6-4, approximately 14,800 cubic yards of sediment would be removed. Excavation and dredging equipment and disposal alternatives are discussed individually below:

  - Land-Based Mechanical Excavation--The excavation of contaminated sediments near the shoreline would require construction of a berm with timber sheeting or the steel wall, during the immediate stabilization phase. Next, the area would be dewatered, and excavation would be accomplished through the use of clamshells, draglines or backhoes (described in the 1983 Malcolm Pirnie EID). However, the maximum reach of a clamshell is approximately 80 feet, a dragline 68 feet and a backhoe 30 feet. Since contaminated sediments extend approximately 150 feet offshore, provisions would have to be made for moving the equipment into the river. Since the bottom sediments will not support the weight of heavy equipment, a gravel haul road would have to be constructed in the river along the base of the existing rip-rap bank, and berms or mud mats used to allow equipment to reach the sediments farthest from shore. Water tight trucks would be loaded with the sediment, which would be hauled to an interim storage facility at Love Canal, or transported elsewhere for disposal. After the excavation is completed,



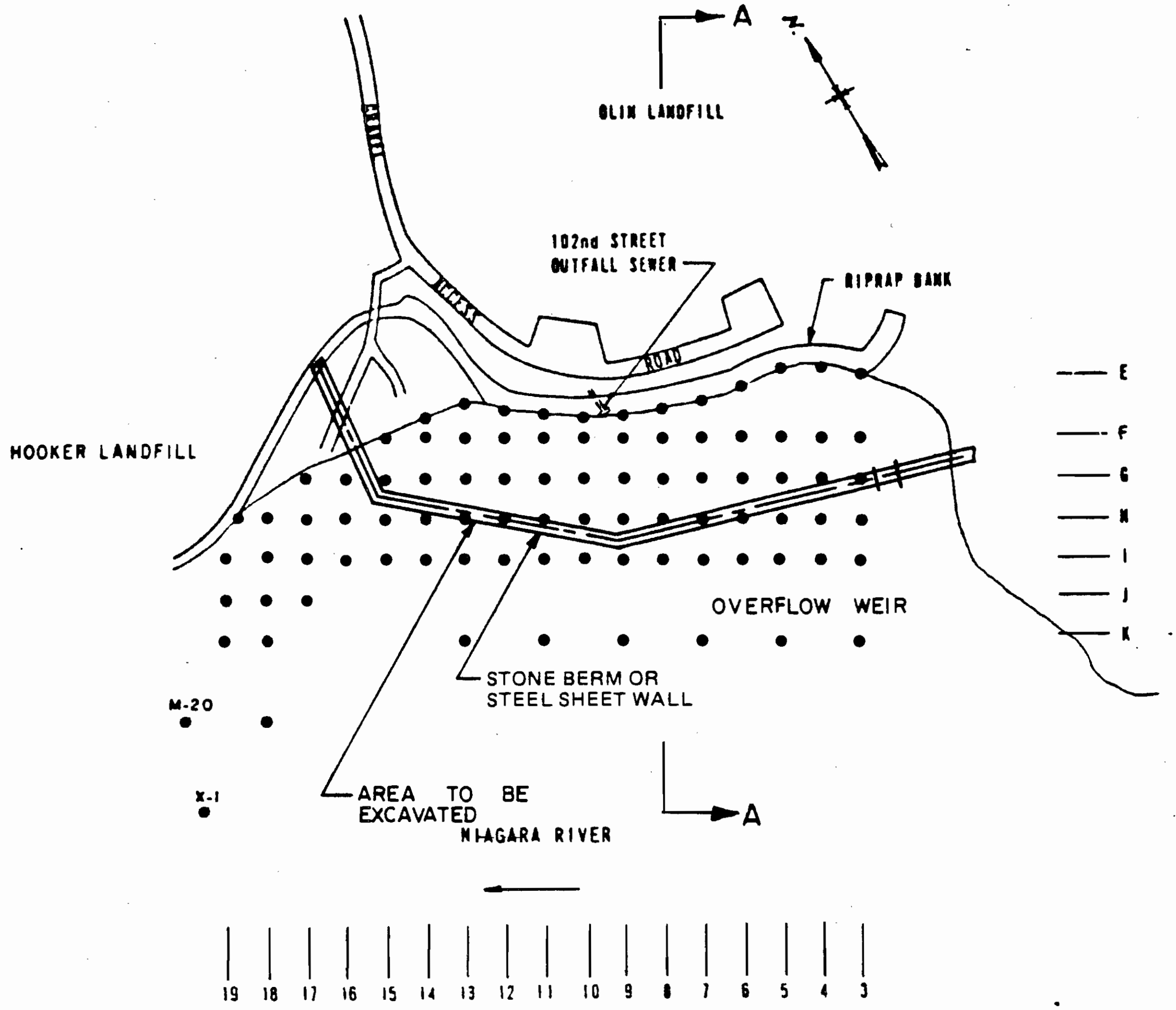


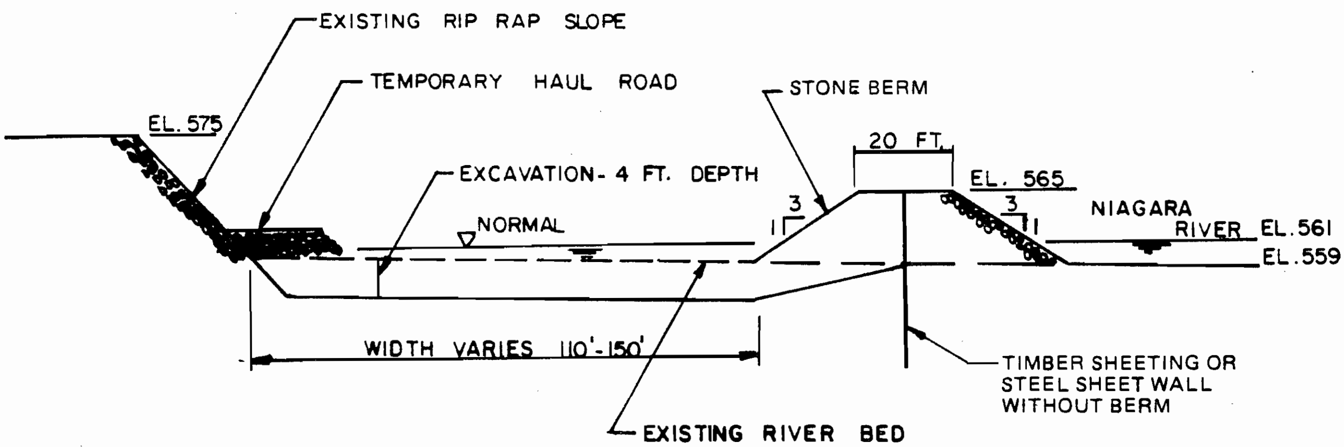
CROSS SECTION A-A

NOTE: THIS FIGURE IS A REVISION OF FIGURE D. 7-2 TAKEN FROM THE 1983 EID.

102nd STREET OUTFALL
PERMANENT IN-PLACE
CONTAINMENT ALTERNATIVE

FIGURE 6-4





CROSS SECTION A-A

NOTE: THIS FIGURE IS A REVISION OF FIGURE D.7-3 TAKEN FROM THE 1983 EID.

102nd STREET OUTFALL
EXCAVATION

all haul roads, berms, etc would have to be disposed with the excavated sediments.

- Mechanical Excavation Using Land-Based and Barge Mounted Equipment--This alternative is not considered necessary because the construction of the berm or sheet wall during the immediate remedial action would make barge mounted equipment unnecessary.

- Hydraulic Dredging--Either a Mud Cat dredge or a 12-inch diameter suction cutterhead dredge could be used for hydraulic dredging of the river sediments. The dredge would float on the water surface and vacuum up the sediments and then pump the sediment/water slurry at approximately 10 percent solids concentration through a pipeline. The pipeline (a double pipe would be used to contain any potential spills) would be laid directly on the ground along a suitable overland route to a Love Canal interim storage facility. At the storage facility the solids would be settled out of the water and the water returned via a second pipeline to the outfall area for reuse. Mechanical dewatering could also be used. Approximately 2,000 gallons per minute is the pumping rate used for a dredging operation.

Sites considered for the onsite dewatering and storage of excavated material included Love Canal and the 102nd Street landfill which is adjacent to the site. However, a preliminary evaluation of the 102nd Street Landfill indicated insufficient area to construct an above-grade storage facility for excavated outfall sediments and berms (approximately 26,500 cy). Additionally, specific information (i.e. soil conditions, land availability, etc.) with respect to the 102nd Street landfill area was not available. No further evaluation of the possible use of the 102nd Street Landfill was conducted.

The beneficial effect of the removal and disposal alternatives is the permanent removal of the sediments. Because of the berm or wall constructed around the outfall area, loss of sediments to the downstream reaches of the Niagara River during the excavation or dredging operation would be minimal. The hydraulic dredging operation, however, presents several adverse impacts in comparison to the mechanical excavation alternative, as follows:

- Hydraulic dredging may not be feasible due to the shallow (less than 24 inches) depth of the water in the work area.

- Hydraulic dredging would require construction of a dewatering facility, and would require treatment of the water removed with the sediment. Since the removal option should occur only after the 102nd Street Landfill is remediated, the dewatering and water treatment facility for this alternative may not be required until well after similar facilities required for the proposed remedial dredging of Bergholtz Creek have been dismantled. Therefore, the costs associated with dewatering the hydraulically dredged material could be significant.

- The hydraulic dredging generation would require removal of existing debris (rocks, tire, etc.) greater than six inches in any dimension from the bottom. Manual removal of these materials is currently the only feasible method, and could result in additional exposure to workers. The material would have to be trucked to a storage facility.

For these reasons, the hydraulic removal of sediments from the 102nd Street Outfall can be eliminated based on acceptable engineering practices, i.e., it may not be a feasible alternative.

Costs for Long-Term Remediation. Capital and operating and maintenance costs for the long-term remediation alternatives are presented in Table 6-6. Future actions (future capital expenditures) should be implemented only after resolution of the 102nd Street landfill litigation and remediation of that site. Capital costs which would be incurred in the future are presented in 1984 dollars. No present worth of that future capital expenditure was calculated because it is not known in which year the expenditure would be made.

Costs for permanent in-place containment include additional berm, rip rap, outfall extension, fill material, clay cover, topsoil and seeding. In addition, costs for a clay slurry wall and six monitoring wells were included. The operation and maintenance costs for the in-place containment alternatives would include maintenance of the rip-rap shoreline and cap and some long-term monitoring.

Costs for the excavation alternatives include estimated costs for the excavation and transportation to an onsite interim storage facility (i.e. Love Canal). Costs for the onsite interim storage at Love Canal of the sediments are

Table 6-6
ESTIMATED COSTS FOR LONG TERM
REMEDIATION AT 102ND STREET OUTFALL

Alternative	Costs	
	Future Capital[1]	Annual Operational and Maintenance
No Action Subsequent to Temporary Berm	-	-
In-Place Containment	598,000	-
Removal Shore Based Equipment	350,000	-

NOTES:

1. Capital and Operations/Maintenance costs in 1984 dollars.

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presented later. The sediment removal alternative presents costs using only the options of using shore-based equipment. Mechanical excavation costs were based only on the quantity of sediment to be removed. Since the excavation alternatives involve the removal of the contaminated sediment, no annual operating and maintenance costs are associated with that alternative.

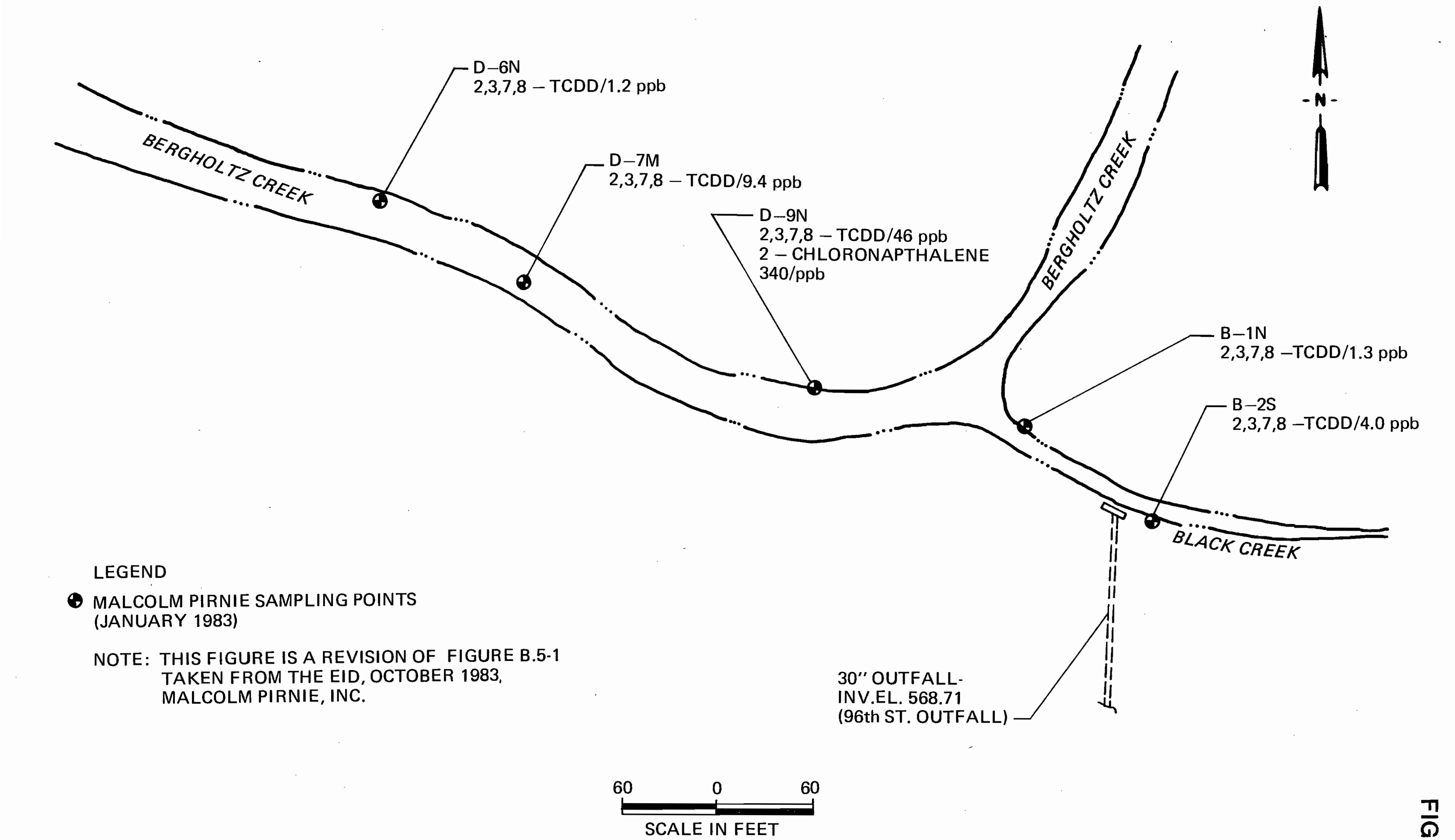
CREEK REMEDIATION

Additional Sampling of Cayuga Creek and the Creek Banks

Since the 1983 Malcolm Pirnie sampling program creek sediment samples taken by the DEC (April and July 1984) downstream of the 93rd Street outfall were found to contain dioxin. The DEC sampling results indicate that reaches of Bergholtz Creek downstream of the 93rd Street Outfall and possibly Cayuga Creek may require remediation. In addition, the 600-foot reach of Bergholtz Creek upstream of the 93rd Street outfall, to the EID limits, previously determined by Malcolm Pirnie to have no significant contamination, may now be contaminated by sediments either moving upstream during periods of backflow or downstream from the known contaminated reach. The DEC and Malcolm Pirnie sampling results are insufficient in scope to fully define the degree and extent of contamination throughout Bergholtz Creek, in Cayuga Creek or on the creek banks. In order to resolve the potential contamination question two alternatives are available:

- o Develop and implement an extensive sampling and analysis program followed by any necessary remedial actions.
- o Assume that remediation will be required in the first, second, and third incremental reaches of the creeks (see Figure 6-5) and implement removal of the sediments in the additional reaches during the currently recommended remediation project.

Contamination has been found at a number of separated areas in Bergholtz Creek. The remediation of just these "hot spots" is not technically feasible using either hydraulic dredging or mechanical excavation, nor is it acceptable from a public health protection aspect, since the "hot spots" may have migrated in the two years since sampling, and additional sampling would be necessary to confirm that the "hot spots" had been cleaned. The cleaning of the entire stretch of Bergholtz Creek is the more conservative approach. However, the volumes of sediment associated with Cayuga Creek and the difficulties associated with removing them are of such magnitude that a limited additional sampling program is necessary to arrive at the most feasible



BERGHOLTZ AND BLACK CREEKS
CONTAMINATION LOCATION POINTS

FIGURE 6–5

and cost-effective remedial alternative for mitigating the contamination that might be found there.

Consideration should also be given to sampling the embankments of Bergholtz and Black Creeks within the reaches designated for remediation to determine if significant amounts of contaminants were deposited on the embankments during flood conditions. From information collected from the U.S. Army Corps of Engineers, the 10-year flood level is approximately 9 feet in elevation above the creek bed for this reach of Bergholtz Creek and 10 feet in elevation above the creek bed during a 50-year storm event. Therefore, there is a possibility that if the creek sediments are contaminated, that they could become resuspended during a storm event and redeposited along the creek banks. The U.S. EPA performed sampling in the backyard of one resident located on the north side of the creeks between 94th and 95th streets in September, 1984. This area is low-lying with very gentle slopes to the creek. When the creek floods, the water can be expected to travel as far as 35 feet up the bank at this location. The results of this sampling did not indicate the presence of dioxin. Since this location is the most likely area to find significant dioxin contamination along the creek banks, there does not appear to be detected at other creek bank locations. However, additional samples should be collected for verification purposes. Sampling and analytical cost estimates for these limited sampling programs were prepared, based on the following assumptions:

- Sediment samples should be collected to a depth of less than 12 inches and analyzed for only 2,3,7,8-TCDD because, with the exception of one sample containing 2-chloronapthalene, no other organics of suspected Love Canal origin were detected by Malcolm Pirnie in excess of the screening criteria in the creek sediments. Only sediment samples would be taken because no significant contamination was detected in the creek water.

- Bank samples on both sides of Black and Bergholtz creeks can be taken simultaneously with the additional creek bed sediment samples taken in Cayuga Creek.

- Bank samples will be taken at two locations on each bank, at the existing tree line and approximately midway up to the top of the bank. Individual samples would be taken for each location on both north and south banks and retained for separate analysis if needed. The initial SCV would be of samples composited by location i.e., the two tree line samples would be composited. A positive indication of dioxin contamination would lead to analysis of each individual sample in the composite.

- Sediment samples will be collected in Cayuga Creek at 50-foot intervals from the confluence with Bergholtz Creek to the Little Niagara River at three locations across the bottom of the stream bed. The samples from one 50 foot interval will be composited for one analysis.

- Soil cores should be collected across the former connection between Cayuga and Bergholtz Creeks along the south side of Oak Island. In 1976 the Cayuga Creek Drive Bridge over Cayuga Creek was constructed. Debris from the bridge construction was used to fill the channel on the south side of Oak Island. The sediment which collected in the passage on the south side of Oak Island and/or the bend in Cayuga Creek could have been contaminated with Love Canal related sediments.

- Test borings should be conducted to a depth of ten feet (or refused) at approximately 300 foot intervals along the first and second incremental reaches to determine creek bed stability for use during mechanical excavation alternative.

- Physical characteristics of the sediment should be determined by testing for settleability, filter leaf test; hydrometer test (fives fraction); water content; and Atterberg limits.

Approximately 116 composite creek sediment samples would be collected at Cayuga Creek to the Niagara River. In the area of Bergholtz and Black Creeks, approximately 20 embankment samples would be taken.

The estimated costs for the additional sampling and analysis are as follows:

- Cayuga Creek to the Niagara River $93,600
- Embankment samples $28,000

In estimating the costs of the additional sampling and analysis, the assumption was made that each reach would be sampled at separate times requiring duplication of some tasks. These costs include worker decontamination facilities, labor for sampling and appurtenances, sampling equipment, preparation of the work and safety plans, preparation of sampling and analysis plans, and preparation of an engineering report.

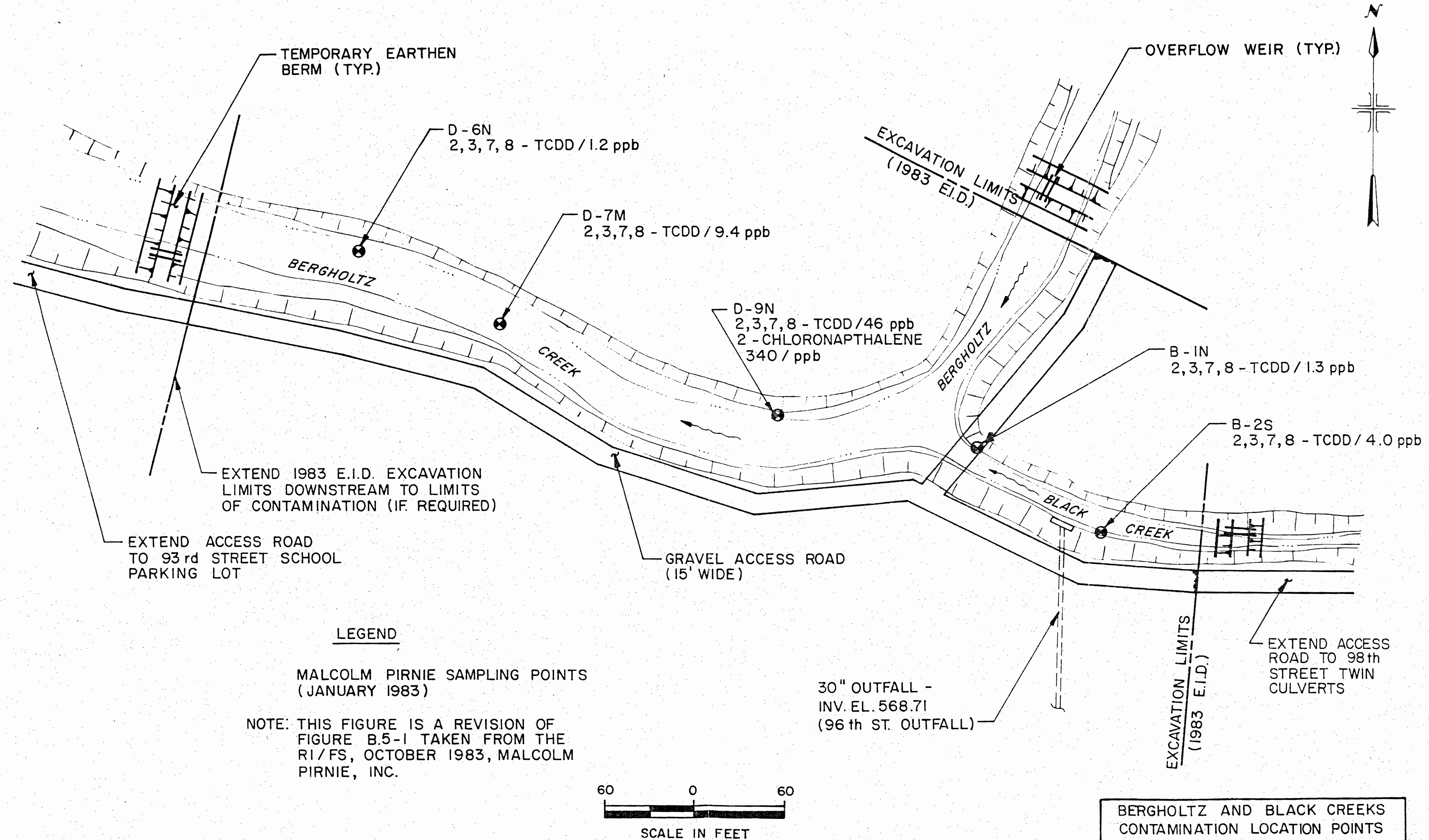
Although the potential exists that Love Canal-related contaminants may have been discharged to Cayuga Creek, insufficient data exists to verify and quantify its existence and extent. For this reason, and because it was specifically outside the scope of the current work plan, remediation methods and costs for Cayuga Creek were not determined. The sampling program recommended above would enable an estimate to be made of the type and cost of any remedial action necessary in Cayuga Creek or for the banks of Black and Bergholtz Creek. The timing of the sampling program can be such that no delay in the remedial activities in Black and Bergholtz Creek would be experienced. The sampling program results would also assist in finalizing the remedial activity planned for Bergholtz Creek, since only mechanical excavation could be used to excavate the banks.

SEDIMENT QUANTITIES

Based on the results of the creek sediment analyses a recommendation was made in the 1983 Malcolm Pirnie EID to excavate Bergholtz Creek extending from 500 feet downstream to 150 feet upstream of the confluence with Black Creek and to excavate a portion of Black Creek extending from Bergholtz Creek to a point 200 feet upstream. This area included all locations where dioxin was found by Malcolm Pirnie sampling effort as presented in Figure 6-5. For the purpose of estimating contaminated sediment quantities and remedial costs, it was assumed that the depth of excavation would be an average of 18-inches across the width of the creek bed. All contaminated sediments, debris and up to 6-inches of underlying dense silty clay would be removed. The actual sediment quantities removed during remediation are a function of the depth of excavation which may be limited by the method of excavation, and can only be determined during the remedial construction. Malcolm Pirnie did not estimate sediment quantities in 6-inch intervals to a depth of 4 feet because no contamination was detected during their sampling below the one-foot depth, and Malcolm Pirnie feels there is no justification for excavation to an average depth greater than 18-inches.

Approximately 1,800 cubic yards of sediment would be removed from the original limits of Black and Bergholtz Creek recommended for remediation in the 1983 EID as shown in Figure 6-6.

Due to the continued potential for contaminated sediment transport within the creeks and from the contaminated sewers to the creeks, and due to the potential existence of contamination in previously unsampled downstream reaches, or in the creek banks, the maximum quantities of sediment that may ultimately require excavation and disposal (see Table 6-7) were estimated for the following incremental



NOTE: THIS FIGURE IS A REVISION OF FIGURE B.5-1 TAKEN FROM THE RI/FS, OCTOBER 1983, MALCOLM PIRNIE, INC.

BERGHOLTZ AND BLACK CREEKS CONTAMINATION LOCATION POINTS AND REMEDIATION LIMITS

Table 6-7
ESTIMATED CONTAMINATED CREEK SEDIMENT QUANTITIES

Location[2]	Contaminated Sediment Quantities[1] (cubic yards)
Black and Bergholtz Creek (1983 EID limits)	1,800
Black Creek from EID limits to 98th Street twin culverts (part of 1st incremental reach)	300
Bergholtz Creek from EID limits to 93rd St. storm sewer outfall (part of 1st incremental reach)	1,670
Bergholtz Creek from 93rd St. to confluence with Cayuga Creek (2nd incremental reach)	11,250
Cayuga Creek from confluence with Bergholtz Creek to Little Niagara River (3rd incremental reach)	24,000
Creek Banks[3]	3,000

NOTE:

1. Assumes 18-inch average depth of excavation within creek bed.

2. See Figure 6-7 for locations.

3. Assumes the banks of Bergholtz and Black Creeks are excavated to a depth of six inches for a distance of approximately 30 feet away from the creek bed on the north bank, and about 22 feet away from the creek bed on the south bank.

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reaches of Black, Bergholtz and Cayuga Creeks (see Figure 6-7):

- First Incremental Reach--500 feet of Black Creek upstream of the reach designated for remediation in the 1983 Malcolm Pirnie EID to the 98th Street culverts and 600 feet of Bergholtz Creek downstream of the reach presently designated for remediation to the 93rd Street storm sewer outfall (1,970 cubic yards);

- Second Incremental Reach--2000 feet of Bergholtz Creek from the 93rd Street storm sewer outfall to the confluence with Cayuga Creek (11,250 cubic yards);

- Third Incremental Reach--6300 feet of Cayuga Creek from the confluence with Bergholtz Creek to the Little Niagara River (24,000 cubic yards).

- Creek Banks--Approximately 3100 feet along the north and south banks of Black and Bergholtz Creeks, with distances away from the creek bed varying between 22 and 30 feet.

As has been previously mentioned, the most recent sampling of Bergholtz Creek by DEC has revealed the presence of dioxin in one sample near the confluence of Bergholtz and Cayuga Creeks and in several samples taken between 90th and 93rd Streets. While the following discussion of remedial measures is oriented primarily toward those areas of the creeks that were demonstrated to be contaminated by the results of the Malcolm Pirnie sampling, the most effective remedial alternative would entail cleaning of the entire reach of Bergholtz Creek from above the confluence with Black Creek all the way to the confluence with Cayuga Creek. That area is encompassed by the original EID remedial limits and incremental reaches 1, and 2above.

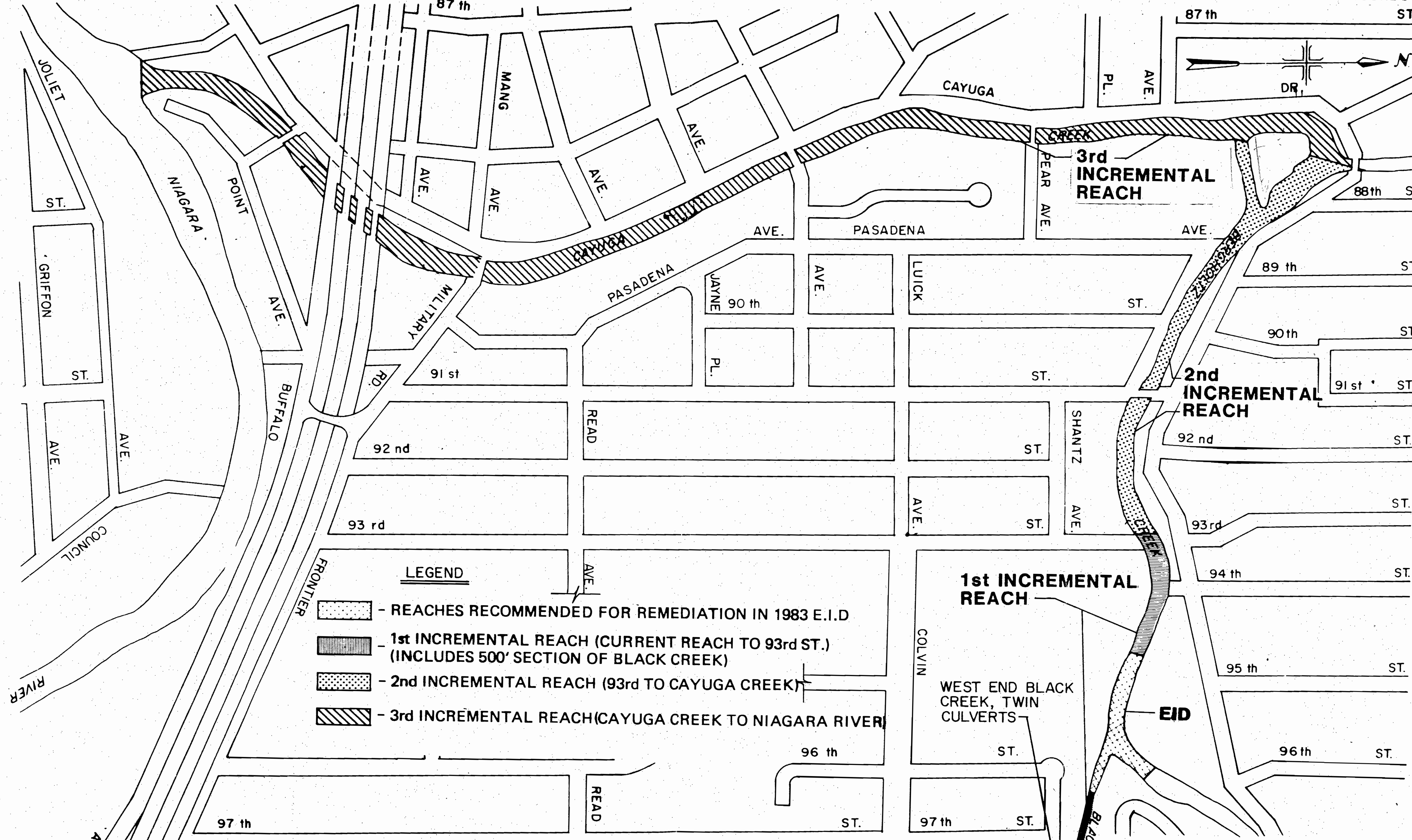
EVALUATION OF REMEDIAL CLEANUP ALTERNATIVES

Hydraulic Dredging

Hydraulic dredging cannot be universally applied to all the creek sections. Black Creek cannot be hydraulically dredged because of the physical constraints of the creek. In addition, if the banks along Bergholtz Creek are determined to require remediation they cannot be hydraulically dredged.

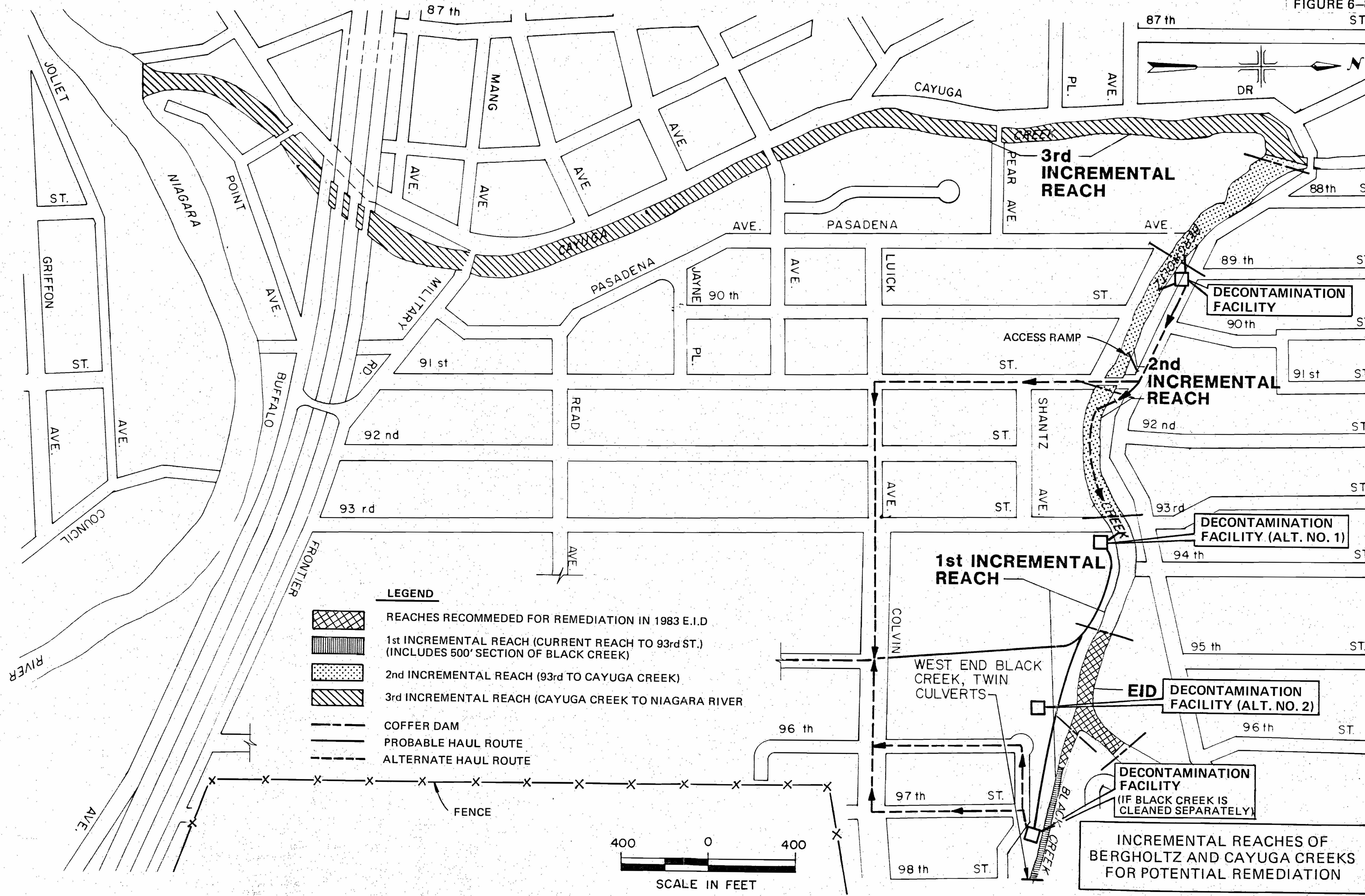
Hydraulic dredging of Bergholtz Creek could be accomplished using a 12-inch cutterhead suction dredge. Temporary berms would be placed in the creek to isolate a 500 foot section. The sediments in that section would be slurried with creek

FIGURE 6–7



INCREMENTAL REACHES OF BERGHOLTZ AND CAYUGA CREEKS FOR POTENTIAL REMEDIATION water as they are mechanically agitated by the cutterhead and then pumped at an approximate 10 percent solids concentration through a double pipeline to a dewatering facility at the Love Canal site. Because of the water usage rate, this alternative is probably limited to use with a nearby onsite dewatering facility. For this alternative, approximately 2,500 feet of 8-inch high density polyethylene pipe (HDPE) would be laid directly on the ground along a suitable overland route to the dewatering facility located within the canal site (see Figure 6-8). At the dewatering facility the solids would be settled out of the water and the water returned via a second 18-inch gravity HDPE pipeline parallel to the 8-inch pipeline to the creeks for reuse. The two HDPE pipelines would be encased in steel pipe to contain possible leakage from pipe joints. Temporary earthen berms, as shown in Figure 6-4, would be installed in the creek to provide adequate water depth to operate the dredge (i.e., a minimum of 24-inches), to minimize the quantity of water ultimately requiring treatment and to minimize the escape of suspended solids from the work area. The segment would be dewatered, and workers would enter the creek bed to remove debris larger than 6 inches in any dimension to avoid clogging the dredge pipe. The segment would be reflooded. One potential problem in attempting to flood the creeks to float the dredge is that there are two banks. These two areas are on the north bank between 94th and 96th streets and the south bank between 91st and 93rd streets. Flooding these areas would encompass a larger area and may begin the encroach on residential lawns. Consequently, in these two areas of Bergholtz Creek greater control would be required to confine the flooding within the creek bed, or short side (bank) containment berms would have to be erected on a temporary basis. Two passes of the dredge are likely to be required. The first pass would pick up the loose sediments while the second would actually cut down into the creek bed. The creek segments would be drained after two passages of the dredge for visual inspection to ensure the dredge had cleaned the appropriate areas. If contaminated sediments were still present, although temporary earthen berms will be placed in the creeks, the flow of the creeks will not be diverted around the work zone, but will be allowed to pool behind the berms. The berms will be constructed to allow storm events to pass over the upstream berm and through the work area to avoid flooding the upstream areas. The fact that storm water would pass through the work area is considered to be equivalent to the existing creek flow patterns. To minimize the potential for storm events, the creek cleaning would be scheduled during historical dry weather periods. The berms would be "leapfrogged" down the creek as the dredging progresses. The placement of berms and scheduling of the creek cleaning will be similar for the mechanical excavation alternatives, except that the section

FIGURE 6–8



INCREMENTAL REACHES OF BERGHOLTZ AND CAYUGA CREEKS FOR POTENTIAL REMEDIATION of creek to be cleaned would not be reflooded until excavation was complete.

Hydraulic dredging offers the primary advantage of minimal handling of sediments between the dredging site and the dewatering/containment site. It also reduces the potential for fugitive dust that could result from mechanical excavation and transport. Hydraulic dredging, however, necessitates construction of two pipelines that remain in place for the duration of the operation and building a dewatering facility not necessarily required by mechanical excavation. Additionally, the depth of removal of sediments cannot be precisely controlled. Finally, hydraulic dredging results in an extremely large volume of water (between 3 million and 23 million gallons) that must be transported, stored and treated. These difficulties were recognized in the 1983 Malcolm Pirnie EIF which stated ". . . hydraulic dredging of Black and Bergholtz Creeks has been effectively eliminated from consideration as a feasible alternative. The difficulties involved with siting and constructing a settling basin, rehandling of dredge solids, and treating the return water were deemed formidable obstacles to the selection of this alternative."

The factors affecting excavating efficiency of hydraulic dredging in shallow water bodies such as Bergholtz Creek are:

- Cutter lengths and design
- Cutter speed and swing speed
- Suction mouthpiece and suction velocities
- Elevation control
- Material characterization and stratification

Based upon the limited physical data available on Bergholtz Creek sediments, a hydraulic dredge appears to be capable of removing the sediments; however, production efficiencies may be substantially different than the assumed values used here in preparing preliminary cost estimates. Production capability would be hampered by excessive debris, much of which would have to be manually removed prior to dredging.

The dewatering facility required for the dredged sediments and treatment facilities required for the water removed with the sediments are described later. The creek sediments mostly consist of dense clays; however, slurrying the sediments during dredging will probably cause some consolidation (settling) problems as the sediments are dewatered. This could affect the reuse of the water in the creek segments by restricting the recirculation of water from the dewatering facility back to the creeks, and could delay closure of the interim secure storage facility which is be used as a dewatering facility. If consolidation/

stabilization is determined to be a problem, stabilizing agents such as flyash (available from local power plants) would be added to the sediments. Due to the poor settling characteristics of the fine clay and silt sediment, it is likely that coagulants such as alum and or polymer may be required to aid in the settling process. Laboratory testing will be required to determine appropriate chemicals, dosages, and settling/consolidation characteristics. The same laboratory tests can be used to determine if physical agents, such as fly ash, can be used. It must be noted that if coagulants are added to the sediment, the passive dewatering containment facility as described in the following sections may not work, since the coagulants would blind the filter fabric and sand layers over the leachate collection system. In that event, a separate dewatering would be necessary for hydraulic dredging to be used, or mechanical excavation would have to be used in its stead.

The minimum rental period for the dredge and appurtenances is one month. Therefore, the cost for hydraulic dredging is primarily a function of operating time and not volume of material removed.

Based on an assumed optimum operating rate of 50 cubic yards of material removed per hour, approximately 34 working hours are required to remove 1,700 cubic yards of sediments at 10 percent solids content. In addition to the minimum rental costs, some 40 percent of the total costs are associated with the 8-inch and 18-inch HDPE pipes. It was assumed that this pipe would have to be purchased and then either stored for future use or disposed of with the sediments at the end of the project. The outer steel pipes would be rented.

Hydraulic dredging costs for the 650-foot section of Bergholtz Creek specified in the 1983 Malcolm Pirnie EID, including decontamination procedures, are estimated to be approximately $700,000. The 8-inch and 18-inch HDPE pipes account for 40 percent of this cost. The present worth of this alternative is presented in Table 6-8.

Due to the minimum rental period and assumed short dredge time required for the reach of Bergholtz Creek recommended in the 1983 EID, hydraulic dredging of the first and second incremental reaches of Bergholtz Creek to the confluence with Cayuga Creek (as shown on Figure 6-7) would not significantly increase the project costs if done under the same contract. However, if those additional reaches, totaling approximately 3,000 feet in length, were dredged independently, the cost would nearly double. No operation and maintenance costs are anticipated in future years, since the removal of the sediments would negate the need for such operations.

Table 6-8
ESTIMATED COSTS OF CREEK REMEDIATION ALTERNATIVES

Alternatives	Costs[1] Capital	Annual Operating and Maintenance	Total Present Worth
1. No Action	-	-	-
2. Filter Fabric and Stone 1983 EID limits only	NOT TECHNICALLY FEASIBLE		
3. Hydraulic Dredging of Bergholtz Creek			
- 1983 EID limits only[2]	700,000	-	700,000
- 1st incremental reach only[3]	378,500	-	378,500
- 1983 EID limits plus 1st incremental reach[4]	798,000	-	798,000
- 1983 EID limits plus 1st and 2nd incremental reaches[4]	1,026,000	-	1,026,000
4. Mechanical Excavation Land-Based clamshell			
- 1983 EID limits	165,000	-	165,000
- 1st incremental reach[3] only	128,000	-	128,000
- 1983 EID limits plus 1st incremental reach	225,000	-	225,000
Tracked Front End Loader			
- 1983 EID limits only	184,000	-	184,000
- 1st incremental reach[3] only	144,000	-	144,000
- 1983 EID limits plus[5] 1st incremental reach	248,000	-	248,000
- 1983 EID limits plus 1st and 2nd incremental redress	1,178	-	1,178
- Black Creek only	120,000	-	120,000
5. Additional Sampling on[6] banks of Bergholtz and bed of Cayuga Creeks	169,000	-	169,000
6. Culverts			
- Culvert Bergholtz Creek	NOT TECHNICALLY FEASIBLE		
- Culvert Black Creek	NOT TECHNICALLY ACCEPTABLE		
7. Fence Downstream Sections of Bergholtz and Cayuga Creeks	145,000	2,000	161,000

NOTES:

1. Present worth is expressed in $1,000; based on 1984 dollars; assumes interest of 10 percent over 20 years.
2. Includes the reach of Black Creek from EID limit upstream to the 98th Street twin 48-inch culverts.
3. Location of incremental reaches shown on Figure 6-5.
4. Due to minimum rental period there is very little additional cost associated with the hydraulic dredging of the 1st incremental and/or 2nd incremental reaches under same contract with dredging original limits.
5. Black Creek - from confluence with Bergholtz upstream to 98th Street twin 48-inch culverts.
6. Assumes all sampling and analysis done under one program.

Additional lengths of the two pipelines (about a mile total) and booster stations would be needed to transfer the sediments and dredge water from the further downstream reaches of the creek back to a dewatering facility at the Love Canal. The total cost of hydraulically dredging Bergholtz Creek from above the confluence with Black Creek to the confluence with Cayuga Creek would be $1,026,000.

Mechanical Excavation

The simultaneous mechanical excavation of the EID and 1st incremental reach areas of both Bergholtz and Black Creeks can be done using either land-based clam shells or a combination of tracked front end loaders and land based clam shells. Preliminary indications are that mechanical excavation of the Bergholtz Creek 2nd Incremental reach (93rd Street to Cayuga Creek) could be done with a combination of front-end loaders and clam shells, or front-end loaders and trucks working on a haul road constructed in the creek bed. Cayuga Creek can not apparently be mechanically excavated by any means. Mechanical excavation is the only method that can be used to clean the creek banks.

Land-Based Equipment. Mechanical excavation of the 650-foot sections of Bergholtz Creek and Black Creek recommended in the 1983 EID could be done through the primary use of land-based clamshells. In addition, as previously discussed, the 500-foot section of Black Creek upstream of the 1983 EID limits to the 98th Street twin 48-inch culverts would be included in any remediation of Black Creek. Excavation of this section represents minimal sediment volume (see Table 6-7).

In order to dewater the creeks for excavation, temporary earthen berms would be constructed, as shown in Figure 6-6. The work zone would then be dewatered as much as practical to facilitate the excavation and minimize the potential of spillage due to watery sediments when loading trucks. Dewatering would also allow better control and monitoring of the excavation depth. Again, the berms would be constructed to allow the normal creek flow to pool behind the berms, and to pass storm flow without flooding the upstream areas.

Access to the creeks would be from a haul road (see Figure 6-6) constructed along the south bank from the 93rd Street school to a point about 700 feet upstream from Bergholtz Creek on Black Creek. A temporary stream crossing at the mouth of Black Creek would be needed to excavate Bergholtz Creek above the confluence. Clearing and grubbing would be needed in the creek channels and along the bank access points. Mechanical excavation using only the land-based clamshells would require essentially total removal of vegetation on the south banks of Bergholtz and Black Creeks.

The excavated sediments would be deposited in watertight trucks for transport off site or to an interim secure storage facility at Love Canal. Since the majority of creek sediments to be excavated are dense clay, no problems are anticipated with consolidation and stabilization of these sediments if the sediments are placed in a storage facility. If a problem were to occur, stabilizing agents such as flyash are readily available in the area. A decontamination station would be established in the 93rd Street School parking lot or in the field behind the 93rd Street School (as shown on Figure 6-8) for washing down the trucks and excavation equipment. While some dust and mud along the haul route (particularly in the vicinity of 93rd Street and the Canal Site) is unavoidable, it is considered controllable through the use of double lined and caulked (water tight) trucks and dust covers. The sediments are also anticipated to be moist; additional water could be applied for dust control after the trucks are loaded. Potential haul routes to the onsite interim storage facility are shown in Figure 6-8. Water from the decontamination station would be collected for treatment at the Love Canal Treatment Facility. After completion of each portion of the sediment excavation, the access road would be excavated and transported to the storage or disposal facility.

At completion of the sediment removal, the clam shells, trucks, and other equipment would undergo decontamination. This procedure is likely to include hydroblasting, steam cleaning, solvent wiping, and distilled water rinsing. All decontamination water would be collected and then treated at the Love Canal Treatment Facility. Any solvent cloths used to wipe down the equipment would be disposed of or stored with the sediments. After the decontamination procedure has been completed, several wipe cloth samples would be taken and analyzed for specific Love Canal related compounds to assure that no unacceptable contamination remained on the equipment. The analyses would take approximately 3 weeks, during which time the equipment would remain impounded within the Love Canal facility. If the analyses indicate no remaining contamination, the equipment would be released. However, if analysis indicates contamination, the decontamination procedure would be repeated.

The total project cost for land-based mechanical excavation using clam shells of the 650-foot section of Bergholtz Creek and 700-foot section of Black Creek is estimated to be $165,000. No operating and maintenance costs are anticipated in future years. The present worth of this alternative for the EID and 1st incremental reach areas is presented in Table 6-8. Because of the proximity of houses to the banks of Bergholtz Creek downstream of the 93rd Street bridge (2nd incremental reach), the use of only land-based clam shells is not technically feasible, and can be eliminated from consideration as an alternative.

Tracked Front-End Loader and Land-Based Equipment. If remediation is determined to be required in the second incremental reach in Bergholtz Creek, the use of tracked front-end loaders possibly in connection with a land-based clamshell becomes necessary due to the physical constraints of this section of creek. Again, temporary earthen berms would be constructed as shown in Figure 6-7 and the work site sequentially dewatered as described in previous sections. Temporary by-pass pumping may be necessary to ensure that the creek beds remain dewatered to maintain stability of the creek beds as haul road. Front-end loaders would then excavate and move the sediments to one or more stock pile locations within the creek beds. As the front-end loaders excavate and move contaminated sediments, haul roads within the creek beds could be constructed, if needed, by placing filter fabric and two feet of crushed stone on the clean creek bed. This would minimize dust from repeated passes of the front-end loader. The clamshell on the bank or a tracked front-end loader in the creek bed would then remove the sediments from the stockpile location and place them in watertight trucks. These trucks would then haul the sediments over the creek bed, haul roads, up the access ramps to the banks, be washed down at the decontamination stations, and travel any one of the designated haul routes to the onsite storage facility.

To remediate the areas between 98th and 93rd Streets either of the alternative decontamination stations identified on Figure 6-7 may be utilized. To remediate the creek beyond 93rd Street another decontamination station would have to be installed between Cayuga Drive and the bank of the creek across from 89th Street, since the haul trucks could not pass under the 91st Street bridge. A cofferdam would then be placed opposite this decontamination station in the creek bed so that the creek increment from 91st Street to 89th Street would be divided into two working sections. Trucks would enter or exit the creek bed for either section via the access ramps located adjacent to the decontamination facility. Existing trucks would be thoroughly cleaned of any creek sediments at the decontamination station before existing onto the street. It is necessary for the trucks to travel across 91st Street on the intersection Cayuga Drive because there is not enough clearance under the 91st Street bridge. Therefore trucks would travel a short distance on 91st Street/Cayuga Drive past the 91st Street bride and then re-enter the creek bed haul road via an access ramp. The trucks would then travel through the creek bed until 93rd Street where the trucks would exit the creek and follow the haul roads constructed to the onsite facility. The 93rd Street foot bridge would need to be demolished and replaced later to allow truck traffic through the creek beds. In order to minimize concern over any dust or sediment accumulated in the Streets due to truck traffic, a street sweeper would be utilized during the entire period of the creek cleaning operations.

The total project cost for the mechanical excavation alternative is estimated to be $1,178.000. No operating and maintenance costs are anticipated in future years.

The costs of the mechanical excavation alternative are comparable to the hydraulic dredging alternative. The primary attractions of the mechanical excavation approach include the following: (1) The size of the interim storage facility can be substantially reduced (by a factor of 3 to 5) from that required for hydraulic cleaning; (2) the interim storage facility may be capped immediately following completion of the creek cleaning; (3) the completeness of the creek cleaning can be more carefully controlled and (4) mechanical excavation is simpler, and therefore less likely to find; than hydraulic dredging.

The disadvantages with the mechanical excavation approach would be the difficulty in excavating the sediments, particularly the upper layer of loose sediments, if the area were not properly dewatered; and the potential instability of the creek beds to maintain a haul load. In order to better determine the stability of the creek bed sediments and hence their ability to maintain truck traffic, test borings could be performed along the creek beds. Ten borings would be sufficient.

Provided that the creek is kept properly dewatered and the sediments provide sufficient bearing capacity as determined by the test borings, the tracked front-end loader in combination with the clamshell is better able to control and monitor the excavation depth than a hydraulic dredge and disturbance to nearby residences and streets is minimized by using the creek beds as haul roads. As with all creek remediation alternative, personnel would be required to observe appropriate health and safety measures.

Mechanical Excavation of Black Creek. Black Creek can be cleaned only by mechanical excavation in the open creek bed downstream of the culverts at 98th Street. This excavation could be done simultaneously with the cleaning of Bergholtz Creek as discussed in the previous section, or at the same time the sewers are cleaned. This cleaning of Black Creek in conjunction with the sewers makes good engineering sense since the culverts of Black Creek must also be cleaned hydraulically. Combining the cleaning of the culverts and Black Creek itself would prevent the recontaminantion of the culverts by backflow. However, budgetary and time constraints must enter into the decision to combine the cleaning of Black Creek with the sewers.

If cleaning the 700-foot open section of Black Creek is done independently of Bergholtz Creek, excavation of approximately 400 cubic yards of sediment and decontamination procedures would be the same as those previously discussed. The access road would be constructed along the south bank of Black Creek and out to Greenwald Avenue. In addition, a concrete wall with a tidal gate would be installed in Black Creek near the confluence with Bergholtz Creek. This wall and gate would allow the water in Black Creek to continue to flow into Bergholtz Creek, but would prevent water in Bergholtz from backflowing into and possibly recontaminating Black Creek or the culverts.

Excavation of the 700-foot open section of Black Creek independently of the Bergholtz Creek cleanup is estimated to cost $120,000. A majority of these costs are associated with the mobilization/demobilization, decontamination station, and equipment decontamination procedures. The costs of this alternative are presented in Tables 6-8 and 6-9.

In-Place Stabilization

In-situ stabilization includes methods which secure contaminated sediments in place to prevent or minimize further transport of sediments downstream. In-situ stabilization methods discussed in the 1983 EID that might be applicable to Black and Bergholtz Creek sediments consist of the following:

- Placement of filter fabric and small stone
- Placing and culvert for the creek to flow through

These are discussed individually below.

Filter Fabric and Small Stone. In using this in-situ stabilization approach, the creek section would be dewatered, the filter fabric placed on the creek bed, and then approximately 8-inches of small stone placed on top of the filter fabric. Based on the 700-foot section of Black Creek and the 650-foot section of Bergholtz Creek approximately 45,000 square feet of filter fabric and 1100 cubic yards of small stone would be required to effectively cover the area. In order to place the fabric and stone, the creeks would be dewatered. Construction should be performed during periods of dry weather so that the potential for flooding the work site would be minimized.

While this approach should minimize or eliminate the transport of contaminated sediments into the downstream reaches,

Table 6-9
MECHANICAL EXCAVATION OF BLACK CREEK
WITH FRONT END LOADER/CLAMSHELL
COST BREAKDOWN

Item	Quantity	Unit Cost	Total
Mobilization/Demobilization	Lump Sum	10,000	$10,000
Clearing and Grubbing	Lump Sum	3,000	3,000
Access	400 cy	$12/cy	4,800
Dewatering with Berms	Lump Sum	5,000	5,000
Staging with Front End Loader	400 cy	$1.50/cy	600
Remove stockpiles with Clamshell	400 cy	$ 4/cy	1,600
Remove Temporary Berms	500 cy	$ 4/cy	2,000
Backfill	400 cy	$ 12/cy	4,800
Remove Access Road	400 cy	$ 4/cy	1,600
Washdown Station	Lump Sum	25,000	25,000
Transport Material	1300 cy	$ 4/cy	5,200
Concrete Wall and Tidal Gate	Lump Sum	4,000	4,000
Decontamination Procedure	Lump Sum	5,000	5,000
Down time for Equipment (1 month) 3 Trucks 1 Clamshell 1 Front endloader	Lump Sum	12,500	12,500
Analysis (Wipe Samples)	4	$ 1,000	4,000
		Subtotal	$89,100
Contingencies and Engineering (35%)			30,900
TOTAL ESTIMATED PROJECT COST			$120,000

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the sediments are not removed and therefore there is a potential, although minimal, for future sediment transport. Additionally, the alternative is not technically feasible for the entire length of Bergholtz Creek to Cayuga Creek or for the banks. No further consideration of this remedial alternative was undertaken.

Complete Culvert. Piping is not considered a feasible alternative for Bergholtz Creek. The dimension of the creek and the associated drainage area is too extensive to render piping to be practical and would increase the possibility of flooding in developed areas.

Black Creek could be completely piped through twin 43-inch by 68-inch elliptical culvert pipes as described in the 1983 EID. The complete piping approach would involve piping the entire 700-foot stretch from the confluence with Bergholtz Creek upstream to the existing twin 48-inch pipes.

The section of Black Creek to be piped would be dewatered (same dewatering method as for mechanical excavation). In order to prepare an even bearing surface and to allow the culvert pipe to be laid at an even grade, some sediment excavation from the creeks would have to be done. This excavation would most likely remove the majority of the contaminated sediments; therefore, these sediments would have to be placed in an offsite disposal facility or an onsite interim secure storage facility. After the pipes have been installed, clean soil would be back filled to cover the pipes or gabions could be installed over the pipes. The area could then be seeded. Because it appears that the contaminated sediments would have to be removed to permit installation of the pipe, the installation of a pipe and cover material would be an added cost (estimated at $207,000) to the mechanical excavation alternatives and have no additional benefit. This remedial alternative can be screened from further considerations.

Fence Remaining Sections of Bergholtz and Cayuga Creeks

At the present time, only the sections of creek near the confluence of Bergholtz and Black Creeks are enclosed by a fence. In order to prevent access to the remaining sections of the creeks, fences could be installed along the remaining downstream sections of Bergholtz and Cayuga Creeks. If the downstream reaches of these creeks were to be fenced, approximately 20,000 feet of fence would have to be installed at an estimated cost of $145,000. Annual maintenance costs are estimated to be $2,000. The present worth of this alternative is presented in Table 6-8. Institutional alternatives, such as increasing public awareness of the hazards associated with the creek, posting signs, or passing ordinances prohibiting fishing or water sports could be utilized in conjunction with the fencing to limit human contact with the creeks. The reliability of such institutional measures is dubious; furthermore, the contamination in the creeks would not be removed, and would continue to pose some degree of hazard to the populace near the creeks, and to the environment of the Niagara River and other downstream areas. This alternative is not acceptable as a final remedial measure on the basis of protecting human health or the environment, and can be removed from further consideration, unless it is carried out in conjunction with one of the removal options.

SUMMARY OF REMEDIAL ALTERNATIVES FOR THE CREEKS

The present worth of the alternatives evaluated are presented in Table 6-8. Mechanical excavation of Bergholtz and Black Creek using a combination of tracked front-end loaders with clamshell equipment would provide the following advantages:

- minimize clearing and grubbing of numerous mature trees along embankments of Black and Bergholtz Creeks.
- easily adaptable for excavation of creek banks if remediation is required.
- better control of depth and completeness of excavation.

Due to the above-listed advantages the most feasible cleaning alternative appears to be mechanical excavation of Bergholtz and Black creeks using front-end loaders with land-based equipment. The total excavation cost is estimated to be $1,178,000.

Some concern has been raised regarding the potential for recontamination of Bergholtz Creek by the 93rd Street School site. Although design of the cleanup of Bergholtz Creek could be undertaken immediately to expedite the remediation efforts, actual cleanup of Bergholtz Creek should not be undertaken until the currently ongoing remedial investigation of the 93rd Street School site is completed.

In order to further define the degree and extent of contamination in Cayuga Creek and develop remedial actions (if necessary), it is recommended that additional creek sediment samples be taken in Cayuga Creek from the confluence with Bergholtz Creek to the Niagara River. In addition, embankment samples within the 1983 EID limits and the first and second incremental reaches should be taken to determine if the banks of Bergholtz and Black Creeks need to be excavated. To minimize sampling costs, it is recommended that all the sampling be done under one project. The total sampling and analysis costs for all reaches recommended for sampling is estimated to be $169,000.

Remediation methods and costs have not been evaluated for those reaches of Cayuga Creek downstream of the confluence with Bergholtz Creek. No attempt should be made to apply unit costs to these reaches because such aspects as limited access to the creek, increased flow and greater depth may significantly increase the costs of remediation in these areas.

SEDIMENT TRANSPORT AND LEACHATE WATER TREATMENT

GENERAL

Sediment removal from the creeks and sewers will be accompanied by transport of these sediments to either an offsite disposal area, or to an interim storage facility at Love Canal. If the sediments are hydraulically dredged, a large volume of water (slurry carriage) will be generated. The sediments mechanically removed will contain "pore water." Unless the total volume of water and sediments is transported to an offsite disposal facility, water will be generated as the sediments undergo dewatering. Dewatering of the sediments is necessary to reduce the volume of material that must be stored in an interim storage facility and ultimately treated or disposed of. The estimated quantities of water resulting from the cleaning of the creeks and sewers are shown in Table 6-10. This water may require pretreatment prior to discharge to the City of Niagara Falls sanitary sewer system. The degree of pretreatment required would be dependent on the water quality, but at minimum could consist of solids removal followed by activated carbon treatment, presumably at the Love Canal Treatment Facility. The activated carbon treatment may be required because water collected during sediment dewatering would have been in contact with the contaminated sediments and may contain organic contaminants. Most of the Love Canal related organic compounds have a relatively high affinity for sediment particles and are not very water soluble; therefore, disportion of organics into the water column during creek and sewer cleaning is not anticipated. However, until sampling and analysis indicates no detectable organics, it will be assumed that this water must be applied to activated carbon beds. If analysis were to be made of the water prior to carbon treatment and no significant organics were detected, then this water could be discharged to the sanitary sewer, subject to approval by the DEC and the City. Any water applied to the activated carbon beds at the Love Canal Treatment Facility needs to be relatively free of solids to prevent plugging of the carbon beds. Thus, depending on the suspended solids

Table 6-10

SEWER AND CREEK CLEANING ESTIMATED WATER QUANTITIES REQUIRING TREATMENT

Location	Hydraulic (gallons)	Mechanical (gallons)
Sewers[1]	482,000	482,000[2]
Bergholtz & Black Creek, (as recommended in 1983 EID)	37,000[3]	37,000[3]
1st increment of Bergholtz Creek to 93rd Street	34,000[4]	34,000[4]
2nd increment of Bergholtz Creek to Cayuga Creek	114,000[5]	114,000[5]
Final volume in creek and transfer pipe requiring treatment	350,000	-
Ponded water in Dewatering Facility	2,650,000	-
TOTAL	3,667,000[8]	612,000

NOTES:

1. Estimated to require 7 gallons/ft. sewer cleaned.
2. Mechanical cleaning of the sewers has been eliminated as not technically sound. However, since hydraulic sewer cleaning would be performed even if the remainder of the mechanical remedial alternatives are implemented, the water quantity associated with hydraulic sewer cleaning should be evaluated for treatment under both types of alternatives.
3. Pore water is estimated to be 10% of the sediment volume.
4. Water associated with additional solids would add approximately 34,000 gallons (i.e., 10 percent of sediment volume).
5. Water associated with additional solids; would add approximately 114,000 gallons (i.e., 10 percent of sediment volume).
6. Assumes 500 foot segment of creek and 250 feet of pipe. The complete pipe length (one mile) would hold 106,000 gallons more.
7. Assumes a 16,000 cubic yard interim storage facility which would be used as a dewatering facility before closure. Two feet of water would be ponded on the facility when hydraulic dredging is complete (1,070 feet x 165 feet x 2 feet deep), leaving 2,650,000 gallons to be treated.
8. The assumption was made that hydraulic dredging water will be recycled thus greatly reducing the quantity of water ultimately treated. If recirculation is not possible, as much as 36,000,000 gallons of water would be required for dredging, and would have to be treated.

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concentration, the collected water may require additional solids removal.

SEDIMENT TRANSPORT

The methods used to transport the sewer and creek sediments to a dewatering facility prior to interim storage or treatment are dependent upon the sediment removal method. The three types of transport associated with the cleaning methods are as follows:

Sewer Cleaning (hydraulic)	Tank Trucks
Hydraulic Dredging of Creeks	Pipeline and Trucks
Mechanical Excavation of Creeks	Trucks

The sediments and hydraulic flush water that result from cleaning the sewers would be vacuumed into a tank truck for hauling to the dewatering facility. The tank trucks are watertight and no spills should result; however, leaks or splashes during loading and discharging of the load are possible. Volatile compounds would be disturbed during the flushing and vacuuming operation, possibly releasing vapors into the air. However, the amount of water used in the flushing operation would suppress the vapors to some degree, and a buffer zone around the tank truck as it was loading and unloading would ensure that volatile material could dissipate into the air without affect. The haul route of the truck from the manhole to the dewatering facility would be carefully laid out to minimize disruption of traffic, to reduce the amount of time spent in populated neighborhoods and to ensure that truck traffic would be at a minimum during times of peak traffic and outdoor activities. The trucks would be inspected for leaks at the beginning and end of each trip; the contractor would be required to have a contingency plan for cleaning up any spills or leaks. The public would be informed of the truck routes and travel schedule to minimize any conflicts, and would be asked to report any leaks or spills immediately. At least 70 trips (one per each day of cleaning) would be made.

The hydraulic dredging of the creeks would require two different pipelines and the use of haul trucks. In this option, access must be gained to the creeks for the construction of the berms used to isolate and dewater the 500 foot segments of the creeks. After the berms are built and the creek is dewatered, debris in the creeks (anything larger than six inches in any dimension) would be removed by workers who would enter the creek bed and haul out the material by hand. The debris would be hauled to the interim storage facility in trucks. The debris would be drummed before being hauled away. The truck beds would be double-lined in plastic, all joints (at the tailgate or truck bed) would be caulked, and layers of plastic would be placed over the load and weighted down. Routes for the truck could be established to minimize disruption of traffic. If the material is drummed, leakage or spillage would be of minimal concern. The amount of debris in the creek is expected to be minimal; about one truckload per 500 feet segment of creek (9 or 10 trips total) would be needed to haul off the debris.

The hydraulic dredging option would require two pipelines. One would be an 8-inch HDPE line (contained within a 12 inch steel line) to carry the dredge water and sediment load to the dewatering facility. The other line would be an 18-inch HDPE gravity flow line (within a 24 inch steel line) that carries water from the dewatering facility back to the creek segment being dredged. Returning this water to the dredging operation greatly reduces the amount of water that must be treated. The two pipelines must be in place for the duration of the dredging operation, and would be lengthened as the operation moves downstream toward Cayuga Creek. If the entire length of Bergholtz Creek is dredged, over one mile of each pipeline will be in use. Booster pumps powered by gasoline engines would be located at different points along the length of the dredge water/sediment pipeline (roughly every 1,500 feet). These pumps would run at all times during dredging operation. The lines would be inspected at different times during the work day for leaks; the contractor would be required to have a contingency plan and equipment for dealing with leaks and spills. The route of the pipelines would be either along the creek bank to a point near the dewatering facility, or along a street parallel to the creek. In either case, the pipelines would be encased in a "traffic bridge" at points where the pipelines crossed a road (91st Street, for example). The traffic bridges would be sized to accommodate the pipes (24-inch high or so) and to handle the biggest vehicle that would cross. Heavy vehicles would be routed around the areas where the pipelines cross streets.

The mechanical excavation would require a number of trucks to haul the sediments away from the creek to the interim secure storage facility. Haul roads would be constructed to different points on the creek bank for the trucks and clamshells to work from. The haul roads could be used by the front-end loaders to move from segment to segment of the creek. The clamshells could be stationed at the 91st Street Bridge to get sediments from several downstream segments; this would entail blocking access to the bridge for a number of days. Brookside Drive could also be used to gain access to the creek for the clamshells. Most probably, clam shells could be located at 93rd Street School, and trucks or front-end loaders could run up and down the creek bed to Cayuga Creek.

The trucks used to haul the sediments would be prepared as discussed above. Routes, time of day for trips and spill contingency plans will be decided upon before operations begin. It is anticipated that the sediments will be moist (about 50 percent water) so that dust control should not be a problem. A number of trips will be needed to carry the sediments; if trucks with a capacity of 13 cubic yards are used, about 1,400 trips would be needed to haul the entire 21,000 cubic yards of sediments from the length of Bergholtz Creek.

DEWATERING: GENERAL

The sediments removed from the sewers must be dewatered prior to storage in the interim secure storage facility or treatment. Two methods are available for use; either one can be implemented rapidly so that the sewer sediments can be removed during the 1985 construction season, dewatered, and deposited in the interim secure storage facility as soon as it is constructed. The sewers must be cleaned first to prevent recontamination of the creeks.

The sediments from the creeks will also require dewatering. However, the method used to clean the creeks--hydraulic dredging or mechanical excavation--will determine the amount of material to be dewatered, and the method to be used. Regardless of the removal or dewatering technique used for creek sediments, an interim secure storage facility must be built before creek remediation begins.

EXISTING LEACHATE TREATMENT SYSTEM CAPABILITIES

The Love Canal Treatment Facility has a batch operated activated carbon system with a capacity of approximately 150 gallons per minute. Love Canal leachate is pumped into a 30,000 gallon underground storage tank. From the underground tank, the leachate is pumped into a day tank and then into a clarifier. From the clarifier, the water is pumped through bag filters (to remove remaining particulate in excess of 50 microns) and then finally through the carbon beds.

Leachate generation varies throughout the year with the Spring months being the period of highest production. The installation of the synthetic liner over the cap on the Canal should reduce the quantity of leachate produced. At this time (September, 1984), the carbon beds are operated approximately 3 days per week during the spring and only one day per two weeks during the summer/fall. With a capacity of 150 gpm, the system could process approximately 63,000 gallons per 7-hour day. Provided that the creek and sewer cleaning is not done during periods of high leachate production, the treatment facility has sufficient spare capacity to treat the creek and sewer cleaning water. The existing Love Canal Treatment Plant has limited solids removal capabilities and the DEC has stated that only the carbon beds at the facility can be used. Therefore, all solids removal must be performed prior to transferring the water to the treatment plant. If the activated carbon beds at Love Canal were not available for use, rented carbon treatment facilities could be brought onsite at an estimated cost of $158,000.

Dewatering Techniques

Three methods of dewatering sediments were examined: mechanical dewatering, clarification/filtration, and use of the leachate collection system of an interim secure storage facility to dewater the sediments. As stated, the sewers must be cleaned first to avoid recontamination of the creeks. Since it is unlikely that the interim secure storage facility of 16,000 cubic yards capacity could be built in time to serve as a dewatering for the sewer sediments, a temporary dewatering/interim storage facility based on a system already used at Love Canal was also evaluated solely for the sewer sediments. The use of mechanical or clarification filtration systems on the volumes of sediments from the creeks would be dependent on regulating the cleaning operations to match the operating capacities of the systems, or building additional storage facilities and does not appear feasible. Regardless of the method chosen to dewater the creek sediments, the interim secure storage facility must be built first.

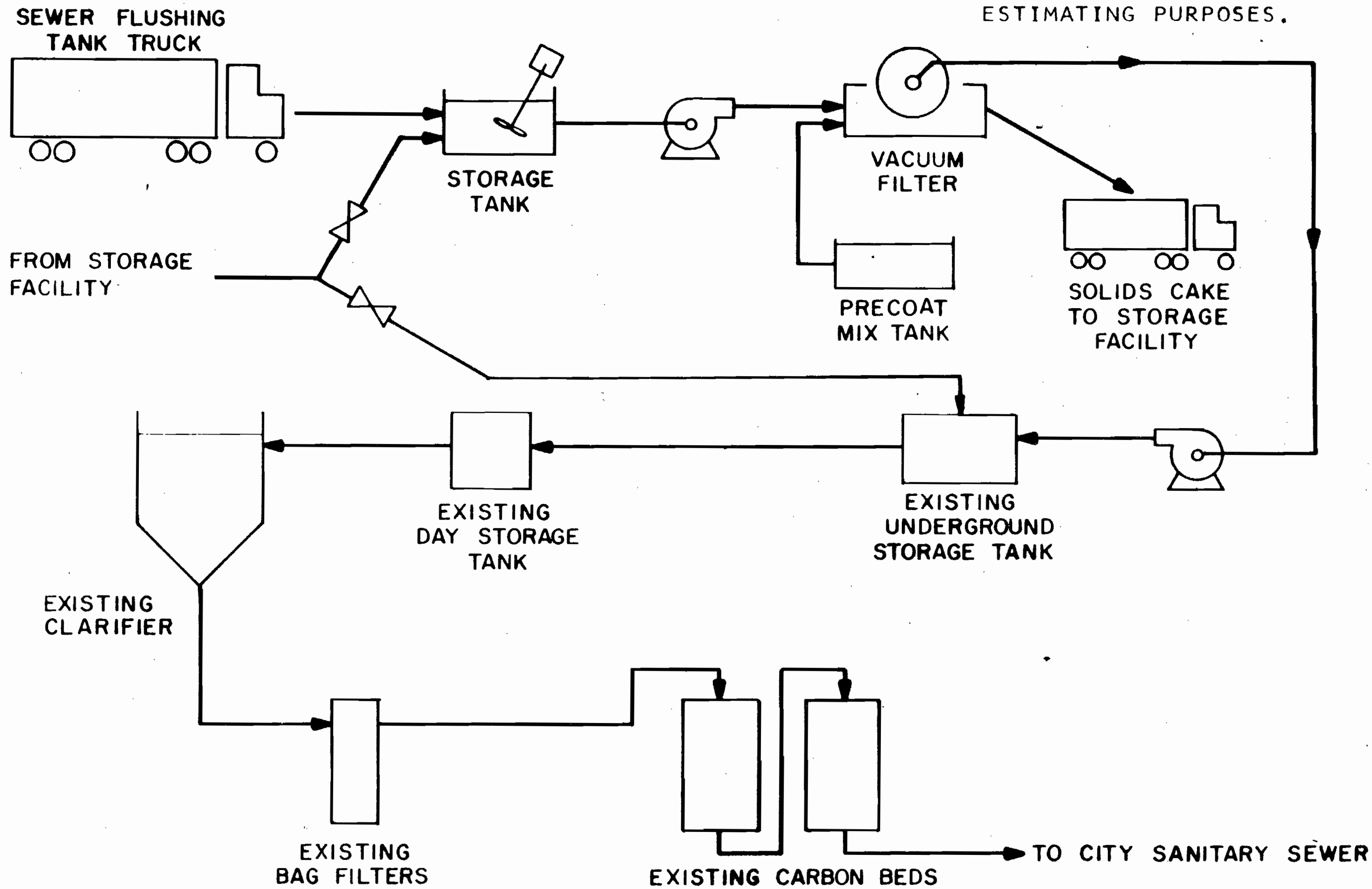
Temporary Steel Wall/Passive Dewatering. One method for dewatering the sewer sediments consists of a system much like the one originally used in the first sewer cleaning operation at Love Canal. In this system, an 80 ml HDPE liner would be placed within a bermed area to provide containment in the event of leaking. A sand layer with a leak detection system would be placed on the HDPE liner. Steel prefabricated walls would be erected around the leak detection system on the sand, and used to support a second HDPE liner that would be fitted over the walls and rest on the sand layer. Another layer of sand and a leachate collection system would be placed inside the walls on the liner, and covered with filter fabric, gravel or other suitable material. The water/sediment mixture from the sewer cleaning would be introduced into this system, and dewatered from below. An overflow weir would take ponded water from the top of the sediments into a second compartment of the system, which would hold this water until it could be filtered through a low pressure sand filter prior to being pumped to the Love Canal Treatment Facility. The system would measure (steel wall dimensions) about 100 feet long, 55 feet wide and 5 feet high. Its capacity would be 100,000 gallons, divided into 80,000 gallon and 20,000 gallon compartments, and would be sufficient for several days' storage of the water destined for the Love Canal Treatment Facility. This would prevent a halt in sewer cleaning if the treatment facility was working at capacity or shut down. This temporary sewer sediment dewatering facility would remain inplace within a floating cover until the sediments are dewatered and the interim secure storage facility is built. At that point, the inner liner, leachate collection system and dewatered sewer sediments would all be deposited in the interim secure storage facility for eventual disposal. The cost of this system is estimated at $289,000.

Mechanical Dewatering

Figure 6-9 shows a schematic of the mechanical dewatering process. For the purposes of providing a description of the process and developing a cost estimate, a vacuum filtration system has been used. The specific mechanical dewatering device to be used would be selected during the detailed design phase. The tank truck containing the sewer flushings for example, would unload into a temporary storage tank. Prior to filtering the water, a coating (precoat) of diatomaceous earth would be applied to the filter. The water/sediments would then be pumped (50 gpm) into the vacuum filter holding tank and filtered. As the filtering proceeds, the dewatered sediments and a layer of diatomaceous earth would be removed from the filter. After the thickness of the precoat has been reduced to a predetermined thickness, the remaining precoat/sediments are removed and the filter is recoated. Approximately 600 lbs of diatomaceous earth are required per ton of dried solids. The filtered water would be transferred to the existing underground storage tank at the Love Canal Treatment Facility for subsequent carbon treatment, while the filter cake (dewatered sediments) would be placed in suitable containers for onsite interim storage or transfer to an offsite disposal facility. This dewatering alternative offers the advantage of resulting in a relatively dry solids cake.

The mechanical dewatering process for the sewer sediments has been estimated to cost $391,000. A number of water tight containers (roll-off boxes, Baker tanks, etc.) would have to purchased, or leased and decontaminated, if onsite storage of the containers were required. In addition, suitable spill containment measures, such as a curbed concrete pad and adequate security measures would have to be installed for the container storage area. The containers (30 13-cy roll-off containers) and concrete pad are estimated to cost $300,000. The present worth of this alternative is presented in Table 6-11.

NOTE: VACUUM FILTER WAS USED IN PRELIMINARY DESIGN FOR DESCRIPTION AND COST ESTIMATING PURPOSES.



MECHANICAL DEWATERING/SOLIDS REMOVAL ALTERNATIVE

FIGURE 6-9

Table 6-11
ESTIMATED COSTS FOR DEWATERING/SOLIDS REMOVAL ALTERNATIVES

Item	Present Worth[1]
1. Steel Wall/Passive Dewatering	$289,000
2. Mechanical Dewatering	$391,000
3. Clarification/Filtration/ Mechanical Dewatering	$683,000

NOTES:

1. 1984 dollars. There are no long term operating costs associated with the dewatering/solids removal processes.

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The preliminary cost estimates for the treatment/dewatering equipment were based on processing the water at a flow rate of 50 gpm. This would allow treatment of each day's sewer cleaning in 2-3 hours. It has been estimated that approximately 1,000 feet of sewer can be cleaned each day. Therefore, approximately 70-75 work days would be required to pretreat the sewer flush water.

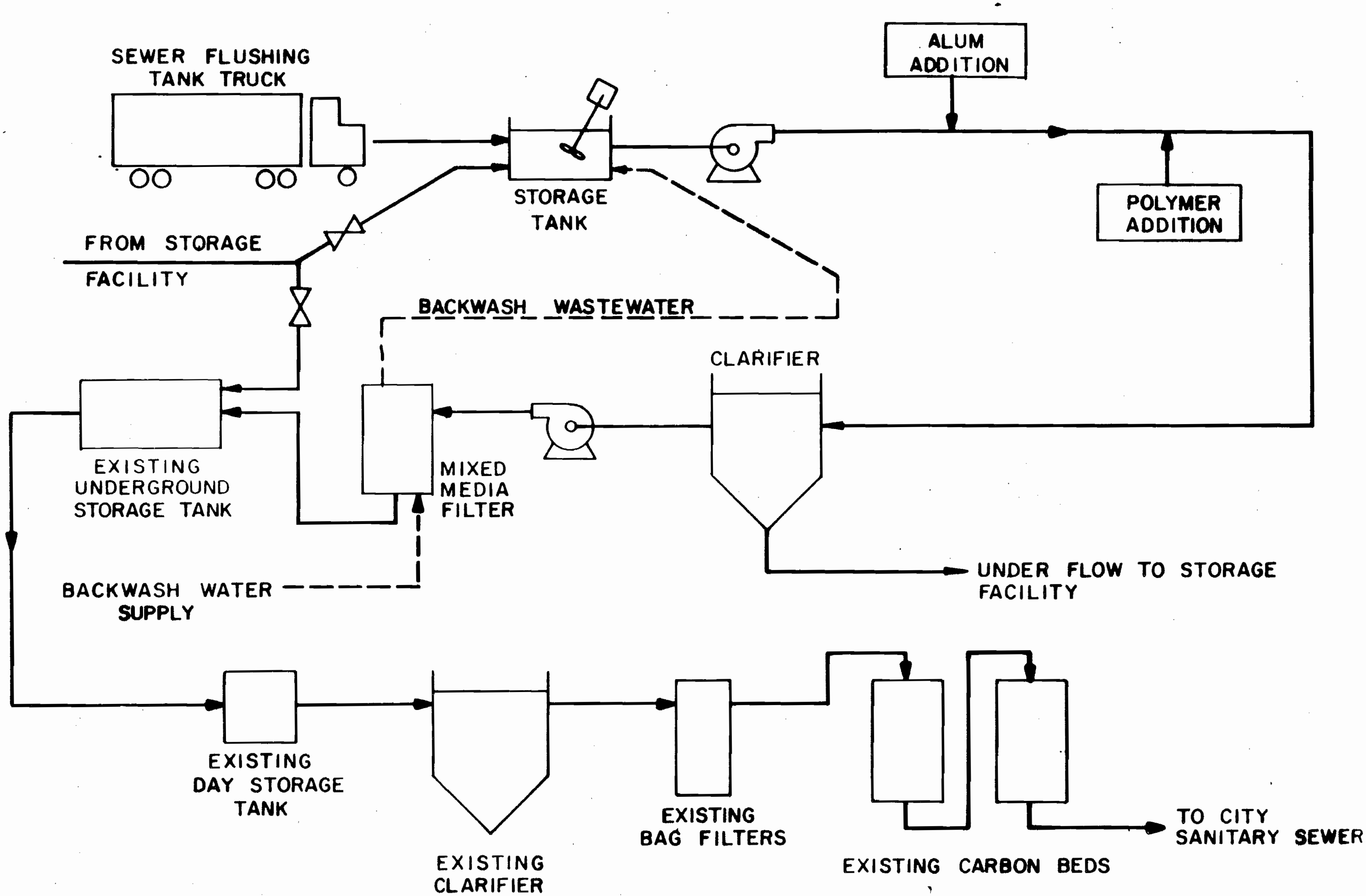
Clarification/Filtration

Figure 6-10 shows a preliminary schematic of a clarification/filtration process. The tank truck containing the sewer flushing would unload into a temporary storage tank. From the storage tank the water would be pumped (50 gpm) through a clarifier. The clarifier should settle out the bulk of the sediments. Flocculants (i.e. aluminum or iron salts and/or polymers) could be added upstream of the clarifier in order to promote settling. The underflow (settled sediments) slurry from the clarifier would have to be transferred to an additional dewatering process. The clarifier would be followed by a mixed media filter to remove the finer sediments not removed in the clarifier. The filtered water could then be transferred to the underground storage tank for subsequent application to the carbon beds. When sediment deposition in the filters requires the filters to be backwashed, the backwash water would be piped into the temporary storage tank for treatment in the clarifier.

It is important to note that clarification/filtration does not offer any advantage as a sediment dewatering alternative because the resulting solids slurry from the clarifier must undergo further dewatering or be repeatedly processed through the clarifier. Either process would only add to the cost. The clarification/filtration process is estimated to cost $292,000. The cost for an additional dewatering process would be similar to that for the previously discussed mechanical dewatering system. The present worth of these alternatives are presented in Table 6-11. The preliminary cost estimates for clarification/filtration equipment were based on a flow rate of 50 gpm, the same as for mechanical dewatering. The clarification/filtration dewatering alternative can be eliminated from further consideration.

Creek Sediment Dewatering

Because of the volumes of sediment involved, dewatering of the creek sediments would necessitate the use of the interim secure storage facility. The mechanically excavated sediments could be deposited directly into the interim secure storage facility, and the facility's leachate collection system would collect the pore water as the



CLARIFICATION/FILTRATION DEWATERING/SOLIDS REMOVAL ALTERNATIVE

FIGURE 6-1

sediments dewatered. This pore water would be treated and discharged. The mechanically excavated sediments could be deposited and dewatered in either the "Times Beach vault" type storage facility, or the earthen bermed storage facility.

The hydraulically dredged sediments will be difficult to dewater. In order to reduce the total volume of water associated with dredging, it has been assumed that the dredge water would be recycled. The Times Beach vault type of interim storage facility would not be well-suited for use in recycling the dredge water, or in dewatering the hydraulically dredge spoils. The earthen bermed type of interim secure storage facility could be designed to meet the requirements of the hydraulic dredging option. Basically, the use of the hydraulic dredge removal option requires a dewatering facility that has a capacity large enough for the sediments, pore water and settling agent; is designed to keep the sediments at a shallow depth (usually two feet or so) so that water can trickle down through the very fine materials to the leachate collection system; has the leachate collection system augmented with such devices as wick drains, curtain drains, french lateral drains or tube drains to speed the dewatering process; can be left open (uncapped) for a period of time (at least a year) while the sediments dewater and solidify enough to permit placement of a permanent cap; and has a system to collect ponded water from the sediments and return it to the dredge operation. These are major design features that could roadically alter the cost, the dimensions and even the feasibility of the interim secure storage features discussed in the following sections. It is imperative that suitable engineering soils data be obtained on the creek sediments before the decision is made to use the interim secure storage facility as a dewatering facility for hydraulically dredged sediments.

ONSITE INTERIM SECURE STORAGE

GENERAL

The 1983 EID eliminated onsite (viz. at the Love Canal site) sediment encapsulation/storage from the detailed evaluation of alternatives based on discussions with DEC personnel which indicated that the need to erect onsite dewatering facilities and the limited capacity of the Love Canal leachate collection system made onsite, in-cap encapsulation/storage unfeasible. However, a detailed investigation in this report of a onsite interim secure sediment storage facility revealed it to be a technically feasible alternative. Storage is necessary since treatment and disposal techniques currently available could not match the rate at which the sediments can be removed. Also, the sediments must be prepared for disposal or treatment by dewatering. Disposal or treatment of the stored material must follow, however.

Four onsite interim secure storage methods were evaluated in detail as follows:

- Storage in a totally segregated earthern berm containment cell (with its own leachate collection and leak detection systems) situated on top of the recently installed (October 1984) synthetic membrane liner, either on top of Love Canal or beside the canal within the fence line. A similar cell can be built at other locations in the Love Canal area.

- In-cap storage in a totally segregated containment cell (with its own leachate collection and leak detection systems) situated partially beneath the recently installed synthetic membrane clay cap on top of the canal.

- Concrete storage facility (with its own leachate and leak detection systems) at various locations.

It was assumed that the containment cell would be designed and constructed in accordance with Part 264 of the Resource Conservation and Recovery Act (RCRA) and Title 6, Part 360 of New York Compilation of Rules and Regulations. The facility would be designed both to meet the standards required of a permanent storage facility, and to permit easy removal of the contaminated material for future treatment or offsite disposal. A brief discussion of the storage methods is presented in the following sections.

Table 6-12 shows the range of estimated volumes of contaminated sediment to be removed from the sewers, creeks, and the Niagara River near the 102nd Street storm sewer outfall that might be stored in an interim secure storage facility.

ABOVE-CAP STORAGE

General

Above-cap storage in an interim secure earthen bermed or concrete vault facility was evaluated for the minimum, maximum and probable estimated sediment volumes associated with the clean-up of sewers, creeks, and the 102nd Street outfall area, and the approximately 650 drums now stored at the site. Facility requirements for both mechanical and hydraulic sediment excavation were determined for the minimum and probable sediment volume (i.e. 5,000 and 18,000-21,000 cubic yards).

Table 6-12
ESTIMATED SEDIMENT VOLUMES

Location		Sediment Removal Depths	Contaminated Sediment (cy)
A.	Sewers [1]	2 inches	280
B.	102nd Street Outfall[2]	4 foot	23,000
C.	Black and Bergholtz Creeks designated for remediation in EID	18 inches 4 feet	1,800 4,780
D.	Increment from recommended downstream reach in Bergholtz Creek to 93rd Street storm sewer overflow	18 inches 4 feet	1,670 4,450
E.	Increment on Bergholtz Creek from 93rd Street to confluence with Cayuga Creek	18 inches 4 feet	11,250 30,000
F.	Increment from Cayuga Creek and Bergholtz Creek confluence to Niagra River	18 inches 4 feet	24,000 64,000
G.	Bergholtz Creek Banks	6 inches	3,000

Minimum Sediment Removal[3,4]	3,000-5,000
Maximum Sediment Removal[5]	135,000
PROBABLE SEDIMENT REMOVAL[6,7,8]	16,000-18,000

NOTES:

1. Basis:
   - o 44,100 ft. sanitary sewer
   - o 10 inch average diameter - sanitary sewer
   - o 16,700 ft. storm sewer
   - o 24 inch average diameter - storm sewer
   - o 2,500 sq.ft. of lift station floors & walls
   - o 2 inch avg. depth of sediment in sewers and lift station wet wells
2. 102nd Street outfall should not be cleaned until remediation of 102nd Street landfill was completed. The 1983 Malcolm Pirnie samping effort detected contamination throughout the entire four feet depth sampled. However, Malcolm Pirnie made no attempt to sample below that depth.
3. Includes sewer cleaning, dredging of EID limits 18 inch depth, and volume associated with access roads and creek berms and the approximately 650 existing drums now stored at Love Canal.
4. The 3,500 cubic yard volume assumes hydraulic dredging. The 5000 cubic yard volume assumes mechanical excavation. The difference in volume is associated with the access roads necessary for mechanical excavation.
5. Includes maximum sediment volume for all locations and volume associated with access roads and creek berms, and the approximately 650 existing drums now stored at Love Canal.
6. Includes volumes associated with locations A, C, D, E, and the 650 drums.
7. The 16,000 cubic yard volume assumes hydraulic dredging. The 18,000 cubic yard volume assumes mechanical excavation. The difference in volume is associated with the access roads necessary for mechanical excavation.
8. In estimating total volumes of material to be removed, the amount of water associated with each alternative must be considered, as follows:
   Hydraulic Dredging 3,667,000 gallons
   Mechanical Excavation 612,000 gallons

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Description of Above-Cap Alternatives

Plate 3 shows a cross-section and location plan for the 18,000-21,000 cubic yard above-cap earthen berm storage alternative. The design for the volumes generated by other cleanup alternatives would be similar. However, the maximum volume (135,000 cy) facility would be much larger and would cover the majority of the southern section of the Love Canal site, including the Canal itself. Since it is extremely desirable not to put any additional weight on the Canal, the earthern bermed facility cannot be used for storage of the maximum volume of material. The facility dimensions for each of the alternatives are summarized on Table 6-13.

The following design parameters were established to size and cost the various above-cap earthen-berm interim secure storage alternatives:

- Topsoil currently in-place over the existing cap liner would be removed and stored onsite for cap construction.

- Installation of a synthetic membrane liner on the bottom of the facility. For cost estimating purposes, we have assumed that a 40 mil. high density polyethylene (HDPE) liner will be utilized. However, RCRA regulations require that a compatibility test using actual creek and sewer sediment leachate must be performed during detailed design to determine if HDPE is suitable for use as a liner for the storage facility.

- Installation of both leak detection and leachate collection systems separated by a synthetic membrane liner. Sand will be utilized as the initial layer of the leachate collection system to facilitate sediment dewatering. A particle size distribution analysis of the sediment will be performed as part of the detailed design in order to properly size the sand and prevent blinding of filter fabric and the leachate collection system.

- Design of the berms to include between 0.5 and 1.5 feet of freeboard, depending upon the size of the facility and the method of creek cleaning.

- Design of the berms for the hydraulic facilities to include a minimum of 2.0 feet of ponding depth. This assumes that the sediment would be deposited at an even depth over the entire facility. During actual operation, if this facility is to be used as a dewatering facility for the hydraulic sewer cleaning, or the hydraulic creek cleaning, the

Table 6-13
PRELIMINARY FACILITY DIMENSIONS[1]
ABOVE-CAP STORAGE, EARTHERN BERM

Above-Cap Alternative	Inner Dimensions[3] (Feet)	Outer Dimensions[4] (Feet)	Berm Height[2] (Feet)	Preliminary Location
Mechanical Excavation - 5,000 cy	210 X 550	275 X 675	8.5	In the southeast section of the Love Canal site approximately 600' north of Frontier Avenue
Hydraulic Dredging - 5,000 cy	215 X 550	280 X 675	9.0	As Above.
Mechanical Excavation - 18,000 cy	165 X 780	260 X 930	10.0	As Above.
Hydraulic Dredging - 16,000 cy	165 X 1070	260 X 1250	12.0	In the southeast section of the Love Canal site approximately 50' north of Frontier Avenue
Hydraulic Dredging - 135,000 cy	360 X 1500	580 X 1720	15.0	Centered in section of the Love Canal site south of the Leachate Treatment Plant

NOTES: (1) All Dimensions approximate
(2) Berm heights taken from center of berm
(3) Bottom inside of berms (base)
(4) Bottom outside of berms (base)

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majority of the sediment will be deposited at the inlet end of the facility.

- Placement of a synthetic membrane liner along the inside and outside faces of the berms.
- Placement of drainage fabric along the inside face of the berm underneath the synthetic membrane liner to facilitate leak detection.
- Cap construction identical to the recently installed synthetic membrane liner system.

Operation

Mechanical Excavation. The following description briefly outlines a preliminary operating procedure for the facility. The mechanically excavated creek sediments would be trucked to the site in water-tight trucks and unloaded into the storage facility. A small bulldozer would probably be used inside the facility to facilitate the placement and compaction of the sediments. This bulldozer would be decontaminated at the end of the project. The sewer flush water/sediments would be trucked in tanker trucks to the site for onsite separation of the water and sediments. The dry filter cake or sediment slurry (depending on the solids separation process used) would then be transferred to the storage facility. The sediment slurry would then undergo further passive dewatering. Since the sediments would not be a source of wind-blown litter, have no food value which would attract vermin or birds, and are not a fire hazard, daily cover will not be necessary, but could be used to reduce any odors from decaying leaves, etc.

The leachate collection/drainage system, as shown on Plate 3, acts as a solids drying bed as the water accompanying the solids or rainwater filters down through the sand, the filter fabric and into the collection/drainage system. Since the system is above-grade and double-lined, ground water would not enter the facility. The leachate underdrain system will be used for:

- additional dewatering of the sewer sediments if a sediment slurry from the clarification/filtration dewatering operation is transferred to the storage facility
- removal of small volumes of pore water accompanying creek sediments
- removal of precipitation that falls into the facility prior to closure.

Water which enters the leachate collection system will flow to two sumps located within the berms of the facility. The water would then be pumped from the sumps into a haul truck for treatment at the existing Love Canal leachate treatment system. Upon closure, the sediment will essentially be enclosed in an impermeable synthetic membrane topped by a soil, clay, and grass cover, thereby virtually eliminating rainwater infiltration. It is anticipated that only negligible quantities of leachate from the mechanically excavated sediments will be generated after closure.

Once the facility is closed, the following routine maintenance will be necessary:

- Routine checks of the leak detection system to insure the integrity of the synthetic membranes and to insure that the leachate collection system is working properly.

- Periodic leachate removal and treatment, if necessary.

- Maintenance of the surface of the berms and cap to insure the integrity of the facility.

Hydraulic Dredging. Operation of the facility will be somewhat different if hydraulic dredging is used to remove the creek sediments. From the creek the dredge would pump via pipeline the sediment slurry to the southern end of the storage facility. While the dredging is in progress, the storage facility would be used as a large settling basin. The settled water would flow over a floating weir or into a standpipe(s) located at the northern end of the onsite storage facility and flow by gravity back to the dredging area for reuse. The weir/stand pipe will be periodically adjusted to maintain a minimum of 1 foot of water over the deposited sediments. No water would be pumped from the underdrain system during the dredging.

If the sewer sediments are placed in the storage facility prior to the creek sediments, a small portion of the storage facility could be partitioned from the remainder of the facility for dewatering of the sewer sediments. This area will be completely covered prior to initiation of dredging activities in order to insure that none of the contaminated sewer sediments can be resuspended and recycled back to the creek(s).

When the hydraulic dredging has been completed water ponded on top of the facility (estimated to be about two feet deep), would be pumped into the treatment system if it is sufficiently free of suspended solids. Otherwise, this water would have to undergo mechanical dewatering/solids removal treatment prior to being spread on the carbon beds. The leachate collection system could then be utilized to further dewater the sediment as discussed above. This option could be used only if the sediments are spread sufficiently thin enough to allow dewatering to proceed, and if the sediments or coagulants added to the sediments do not blind the sand and filter fabric layers located above the leachate collection system. Another alternative would be to stabilize the hydraulically dredged sediments with flyash, which would bind up the pore water and dredge water. Upon closure of the facility, leachate generation would diminish with time. Closure may be delayed for a year(s) while the hydraulically dredged sediments stabilize.

The routine maintenance requirements outlined previously would also be required for these onsite storage facilities.

Security. Assuming minimum (5,000 cubic yards) sediment disposal, the onsite interim storage facility will be operated approximately five months. If maximum (135,000 cubic yards, hydraulically dredged) sediment disposal occurs, the facility would be open in excess of a year. Since Love Canal is already fenced for security and safety purposes, placement of additional fencing around the onsite encapsulation/storage facility is not considered necessary. However, if vandalism or safety becomes a concern, additional security measures (viz. lighting, security guards, additional fencing) will be taken.

Costs

The construction and maintenance costs associated with the above-cap storage facilities are presented in Tables 6-14 through 6-18. Present worth is calculated based on a 10 percent discount rate over a 20-year period. Table 6-17 presents the estimated costs associated with a 21,000 cubic yard (mechanical excavation) earthern berm facility which assumes that the Bergholtz Creek banks would also be cleaned to a depth of six inches. The cost of the facility without the volume associated with the creek banks (i.e., 3,000 cubic yards) would be approximately $1,000,000. No attempts were made to optimize the size of the various storage facilities; therefore, these costs should be considered preliminary because changing the facility layout may have a significant impact on the total construction cost. Size optimization would be performed during detailed design.

Table 6-14
MECHANICAL EXCAVATION - 5,000 CUBIC YARDS
ABOVE-CAP SECURE STORAGE (EARTHERN BERM)
ESTIMATED COSTS

CONSTRUCTION

Item	Quantity	Unit Cost ($)	Total Cost($)
SITE PREPARATION			
Topsoil Removal	2,150 cy	2.50	5,375
		SUBTOTAL	5,375
BOTTOM CONSTRUCTION			
Clay	4,300 cy	9.00	38,700
Synthetic Membrane Liner (40 mil. HDPE)	231,000 sf	0.50	115,500
Bank Run Gravel	2,150 cy	9.50	20,425
Bank Sand	6,425 cy	8.50	54,615
Filter Fabric	231,000 sf	0.06	13,860
4" PVC Pipe (Schedule 40)	1,200 lf	18.00	21,600
Lined Concrete Sumps (2)	2 each	5,000.00	10,000
Manhole Extensions (3)	3 each	1,500.00	4,500
		SUBTOTAL	279,200
BERM CONSTRUCTION			
Fill	9,600 cy	7.00	67,200
Silty-Sand	1,250 cy	9.00	11,250
Clay	525 cy	9.00	4,725
Synthetic Membrane Liner (40 MIL. HDPE)	56,475 sf	0.50	28,240
Topsoil	625 cy	10.00	6,250
Drainage Fabric	13,875 sf	0.06	835
		SUBTOTAL	118,500
CAP CONSTRUCTION			
Silty-Sand	9,000 cy	9.00	81,000
Synthetic Membrane Liner (40 MIL HDPE)	162,000 sf	0.50	81,000
Topsoil (Purchase, Place and Compact)	850 cy	10.00	8,500
Topsoil (Place and Compact)	2,150 cy	4.00	8,600
		SUBTOTAL	179,100
		TOTAL	582,175
ENGINEERING, LEGAL AND CONTINGENCIES (@35%)			203,825
		TOTAL	786,000
MAINTENANCE COSTS ($2,000/yr)		PRESENT WORTH	17,000
TOTAL PROJECT			$803,000

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Table 6-15
HYDRAULIC DREDGING - 5,000 CUBIC YARDS
ABOVE-CAP SECURE STORAGE (EARTHERN BERM)
ESTIMATED COSTS

CONSTRUCTION

Item	Quantity	Unit Cost ($)	Total Cost($)
SITE PREPARATION			
Topsoil Removal	2,150 cy	2.50	5,375
		SUBTOTAL	5,375
BOTTOM CONSTRUCTION			
Clay	4,500 cy	9.00	40,500
Synthetic Membrane Liner (40 mil. HDPE)	242,000 sf	0.50	121,000
Bank Run Gravel	2,250 cy	9.50	21,375
Bank Sand	6,725 cy	8.50	57,165
Filter Fabric	242,000 sf	0.06	14,520
Floating Weir/Stand Pipe (1)	1 each	1,000.00	1,000
4" PVC Pipe (Schedule 40)	1,200 LF	18.00	21,600
Lined Concrete Sumps (2)	2 each	5,000.00	10,000
Manhole Extensions (3)	3 each	1,500.00	4,500
		SUBTOTAL	291,660
BERM CONSTRUCTION			
Fill	10,200 cy	7.00	71,400
Silty Sand	1,350 cy	9.00	12,150
Clay	500 cy	9.00	4,500
Synthetic Membrane Liner (40 MIL. HDPE)	59,075 sf	0.50	29,540
Topsoil	675 cy	10.00	6,750
Drainage Fabric	12,925 sf	0.06	775
		SUBTOTAL	125,115
CAP CONSTRUCTION			
Silty-Sand	9,000 cy	9.00	81,000
Synthetic Membrane Liner (40 MIL HDPE)	162,000 sf	0.50	81,000
Topsoil (Purchase, Place and Compact)	850 cy	10.00	8,500
Topsoil (Place and Compact)	2,150 cy	4.00	8,600
		SUBTOTAL	179,100
		TOTAL	601,250
ENGINEERING, LEGAL AND CONTINGENCIES (@35%)			210,750
		TOTAL	812,000
MAINTENANCE COSTS ($2,000/yr)		PRESENT WORTH	17,000
TOTAL PROJECT			$829,000

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Table 6-16
HYDRAULIC DREDGING - 16,000 CUBIC YARD FACILITY
ABOVE-CAP SECURE STORAGE (EARTHERN BERM)
ESTIMATED COSTS

CONSTRUCTION

Item	Quantity	Unit Cost ($)	Total Cost($)
SITE PREPARATION			
Topsoil Removal	3,075 cy	2.50	7,690
		SUBTOTAL	7,690
BOTTOM CONSTRUCTION			
Clay	6,150 cy	9.00	55,350
Synthetic Membrane Liner (40 mil. HDPE)	331,700 sf	0.50	165,850
Bank Run Gravel	3,075 cy	9.50	29,215
Bank Sand	9,225 cy	8.50	78,415
Filter Fabric	331,700 sf	0.06	19,900
Floating Weir/Stand Pipe (4)	1 each	1,000.00	1,000
4" PVC Pipe (Schedule 40)	2,300 LF	18.00	41,400
Lined Concrete Sumps (2)	2 each	1,000.00	20,000
		SUBTOTAL	411,130
BERM CONSTRUCTION			
Fill	33,300 cy	7.00	233,100
Silty-Sand	4,275 cy	9.00	38,475
Clay	1,985 cy	9.00	17,865
Synthetic Membrane Liner (40 MIL. HDPE)	66,000 sf	0.50	33,000
Topsoil	2,150 cy	10.00	21,500
Drainage Fabric	53,600 sf	0.06	3,215
		SUBTOTAL	347,155
CAP CONSTRUCTION			
Silty-Sand	39,075 cy	9.00	123,075
Synthetic Membrane Liner (40 MIL HDPE)	703,300 sf	0.50	123,000
Topsoil (Purchase, Place and Compact)	3,025 cy	10.00	15,000
Topsoil (Place and Compact)	10,000 cy	4.00	12,300
		SUBTOTAL	273,375
		TOTAL	1,039,350
ENGINEERING, LEGAL AND CONTINGENCIES (@35%)			363,650
		TOTAL	1,403,000
MAINTENANCE COSTS ($2,000/yr)		PRESENT WORTH	17,000
TOTAL PROJECT			$1,420,000

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Table 6-17
MECHANICAL EXCAVATION - 21,000 CUBIC YARD FACILITY
ABOVE CAP SECURE STORAGE (EARTHEN BERM)
ESTIMATED COSTS

Construction

Item	Quantity	Unit Cost ($)	Total Cost ($)
Site Preparation	2800 cy	2.50	7,000
			Subtotal 7,000
Bottom Construction			
Clay	5575 cy	9.00	50,175
Synthetic Membrane Liner (40 mil. HOPE)	300,300 sf	0.50	150,150
Bank Run Gravel	2800 cy	9.50	26,600
Bank Sand	8,350 cy	8.50	70,975
Filter Fabric	300,300 sf	0.06	18,000
4" PVC pipe (schedule 40)	1850 lf	18.00	33,300
Lined Concrete Sumps (2)	2 each	1000.00	2,000
			Subtotal 351,200
Berm Construction			
Fill	16,900 cy	7.00	118,300
Silty-Sand	2,600 cy	9.00	23,400
Clay	1,250 cy	9.00	11,250
Synthetic Membrane Liner (40 mil. HOPE)	108,500 sf	0.50	54,250
Topsoil	1,300 cy	10.00	13,000
Drainage Fabric	33,550 sf	0.06	2,025
			Subtotal 222,225
Cap Construction			
Silty Sand	12,250 cy	9.00	110,250
Synthetic Membrane Liner (40 mil. HOPE)	220,400 sf	0.50	110,200
Topsoil (Purchase, Place Compact)	1300 cy	10.00	13,000
Topsoil (Place and Compact)	2800 cy	4.00	11,200
			Subtotal 244,650
			TOTAL 825,075
Engineering, Legal and Contingencies (@ 35%)			288,925
			TOTAL 1,114,000
Maintenance Costs ($2000/yr)			Present Worth 17,000
TOTAL PROJECT			1,131,000

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Table 6-18
HYDRAULIC DREDGING - 135,000 CUBIC YARDS
ABOVE-CAP SECURE STORAGE (EARTHERN BERM)
ESTIMATED COSTS

CONSTRUCTION

Item	Quantity	Unit Cost ($)	Total Cost($)
SITE PREPARATION			
Topsoil Removal	10,000 cy	2.50	25,000
		SUBTOTAL	25,000
BOTTOM CONSTRUCTION			
Clay	20,000 cy	9.00	180,000
Synthetic Membrane Liner (40 mil. HDPE)	1,110,000 sf	0.50	555,000
Bank Run Gravel	10,000 cy	9.50	95,000
Bank Sand	30,000 cy	8.50	255,000
Filter Fabric	1,110,000 sf	0.06	66,600
Floating Weir/Stand Pipe (4)	4 each	1,000.00	4,000
4" PVC Pipe (Schedule 40)	4,480 LF	18.00	80,640
Lined Concrete Sumps (2)	2 each	20,000.00	40,000
Manhole Extensions (15)	15 each	5,000.00	75,000
		SUBTOTAL	1,351,240
BERM CONSTRUCTION			
Fill	136,200 cy	7.00	953,400
Silty-Sand	17,000 cy	12.00	204,000
Clay	4,475 cy	9.00	40,275
Synthetic Membrane Liner (40 MIL. HDPE)	446,000 sf	0.50	223,000
Topsoil	5,675 cy	10.00	56,750
Drainage Fabric	120,900 sf	0.06	7,255
		SUBTOTAL	1,484,680
CAP CONSTRUCTION			
Silty-Sand	39,075 cy	9.00	351,675
Synthetic Membrane Liner (40 MIL HDPE)	703,300 sf	0.50	351,650
Topsoil (Purchase, Place and Compact)	3,025 cy	10.00	30,250
Topsoil (Place and Compact)	10,000 cy	4.00	40,000
		SUBTOTAL	773,575
		TOTAL	3,634,495
ENGINEERING, LEGAL AND CONTINGENCIES (@35%)			1,272,505
		TOTAL	4,907,000
MAINTENANCE COSTS ($2,000/yr)		PRESENT WORTH	17,000
TOTAL PROJECT			$4,924,000

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IN-CAP STORAGE

General

In-cap storage was evaluated for the minimum sediment volume only. An in-cap facility for the 16,000 cubic yard or maximum sediment volume (i.e., 135,000 cubic yards) was not considered technically feasible. There is not adequate room for these amounts of material, and the effect of the weight of material on the Canal contents can not be fully evaluated. On the basis of engineering practices, the in-cap storage of these amounts of material can be eliminated. The size of such facilities would also require the excavation of potentially contaminated materials (viz. outside the limits of the original clay cap). Since these potentially contaminated materials would have to be placed back into the facility, there would be no volume gain associated with and no economic incentive to perform the excavation. Facility costs would also escalate due to the special precautions associated with excavation of potentially contaminated materials.

Description of In-Cap Alternatives

Facility requirements were determined for both mechanical and hydraulic excavation of the minimum sediment volume (i.e. 5,000 cubic yards) and the approximately 650 existing drums now stored at the site. The specific facility dimensions for the two alternatives are summarized in Table 6-19. The following design parameters were established to size and cost the in-cap storage alternatives:

- Excavation of the recently installed synthetic membrane liner system including 1 foot of the original clay cap. This material would be stored on site for use in construction of the facility(s).

- Installation of a synthetic membrane liner on the bottom of the facility. For cost estimating purposes, we have assumed that a 40 mil. high density polyethylene liner (HDPE) will be utilized. However, RCRA regulations require that a compatibility test using actual creek and sewer sediment leachate must be performed during detailed design to determine if HDPE is suitable for use as a liner for the storage facility.

- Installation of leak detection and leachate collection systems separated by a synthetic membrane liner. Sand will be utilized as the initial layer of the leachate collection system to

Table 6-19
PRELIMINARY FACILITY DIMENSIONS[1]
IN-CAP SECURE STORAGE (EARTHERN BERM)
5,000 CUBIC YARDS ONLY

In-Cap Alternative	Inner Dimensions (Feet)	Outer Dimensions (Feet)	Berm Height[2] (Feet)	Preliminary Location[3]
Mechanical Excavation - 5,000 cy	200 X 280	315 X 395	6.5	Centered in southern section of the Love Canal site approx - imately 600' north of Frontier Avenue
Hydraulic Dredging - 5,000 cy	200 X 280	330 X 410	8.0	Centered in southern section of the Love Canal site approx-imately 600' north of Frontier Avenue

NOTES:
(1) All dimensions approximate
(2) Berm heights taken from center of berm
(3) Any volumes greater than 5,000 cy could not be accomodated by in-cap storage.

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facilitate sediment dewatering and solids removal from the leachate. A particle size distribution analysis of the sediment will be performed as part of the detailed design in order to properly size the sand and prevent blinding of the filter fabric and leachate collection system.

- o Design of the berms to include a minimum of 1.5 feet of freeboard.

- o Design of the berms for the hydraulic facility to include a minimum of 2.0 feet of ponding depth. This assumes that the sediment would be deposited at an even depth over the entire facility. During actual operation, the majority of the hydraulically dredged sediments and dredge water would be deposited at the inlet end of the facility.

- o Placement of a synthetic membrane liner along the inside and outside faces of the berms.

- o Placement of drainage fabric along the inside face of the berms underneath the synthetic membrane liner to facilitate leak detection.

- o Cap construction identical to the recently installed synthetic membrane liner system.

Operation

Operation of these facilities would be identical to the above-cap earthern berm alternatives.

Costs

The construction and maintenance costs associated with the in-cap storage facilities are presented in Table 6-20 and 6-21. Present worth is calculated based on a 10 percent discount rate over a 20-year period. No attempts were made to optimize the size of the various storage facilities; therefore, these costs should be considered preliminary because changing the facility layouts may have a significant impact on the total construction cost. Size optimization would be performed during detailed design.

ENVIRONMENTAL IMPACTS

An evaluation of the environmental impacts of above-cap versus in-cap storage indicates the following:

- o Both storage methods are technically-sound alternatives designed to mitigate any potential

Table 6-20
HYDRAULIC DREDGING - 5,000 CUBIC YARDS
IN-CAP SECURE STORAGE (EARTHERN BERM)
ESTIMATED COSTS

CONSTRUCTION

Item	Quantity	Unit Cost ($)	Total Cost($)
SITE PREPARATION			
Topsoil Removal	1,050 cy	2.50	2,625
Silty-Sand Removal	3,125 cy	2.50	7,815
Synthetic Membrane Liner Removal (40 Mil. HDPE)	4 Manday	250.00	1,000
Clay Removal	2,100 cy	2.50	5,250
		SUBTOTAL	16,690
BOTTOM CONSTRUCTION			
Clay (Purchase, Place & Compact)	250 cy	9.00	2,250
Clay (Place and Compact)	2,100 cy	4.00	8,400
Synthetic Membrane Liner (40 mil. HDPE)	112,000 sf	0.50	56,000
Bank Run Gravel	2,100 cy	9.00	18,900
Bank Sand	3,125 cy	8.50	26,565
Filter Fabric	112,000 sf	0.06	6,720
Floating Weir/Stand Pipe (1)	1 each	1,000.00	1,000
4" PVC Pipe (Schedule 40)	2,200 LF	18.00	39,600
Lined Concrete Sumps (2)	2 each	5,000.00	10,000
Manhole Extensions (6)	6 each	1,500.00	9,000
		SUBTOTAL	178,435
BERM CONSTRUCTION			
Fill	11,000 cy	7.00	77,000
Clay (Purchase, Place & Compact)	600 cy	9.00	5,400
Synthetic Membrane Liner (40 MIL. HDPE)	59,000 SF	0.50	29,500
Topsoil	700 cy	10.00	7,000
Silty-Sand	2,100 cy	9.00	18,900
Drainage Fabric	16,300 SF	0.06	980
		SUBTOTAL	138,780
CAP CONSTRUCTION			
Synthetic Membrane Liner (40 MIL HDPE)	87,200 sf	0.50	43,600
Silty-Sand (Purchase, Place and compact)	1,725 cy	9.00	15,525
Silty-Sand (Place & Compact)	3,125 cy	4.00	12,500
Filter Fabric	87,200 SF	0.06	5,235
Topsoil (Purchase, Place and compact)	500 cy	10.00	5,000
Topsoil (place and compact)	1,050 cy	4.00	4,200
		SUBTOTAL	86,060
		TOTAL	$419,965

Table 6-20
HYDRAULIC DREDGING - 5,000 CUBIC YARDS
IN-CAP SECURE STORAGE (EARTHERN BERM)
ESTIMATED COSTS
(Continued)

CONSTRUCTION

Item	Quantity	Unit Cost ($)	Total Cost($)
ENGINEERING, LEGAL AND CONTINGENCIES (@35%)			147,035
		TOTAL	567,000
MAINTENANCE COSTS ($2,000/yr)		PRESENT WORTH	17,000
TOTAL PROJECT			$584,000

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Table 6-21
MECHANICAL EXCAVATION - 5,000 CUBIC YARDS
IN-CAP SECURE STORAGE (EARTHERN BERM)
ESTIMATED COSTS

CONSTRUCTION

Item	Quantity	Unit Cost ($)	Total Cost($)
SITE PREPARATION			
Topsoil Removal	1,050 cy	2.50	2,625
Silty-Sand Removal	3,125 cy	2.50	7,815
Synthetic Membrane Liner Removal (40 Mil. HDPE)	4 Manday	250.00	1,000
Clay Removal	2,100 cy	2.50	5,250
		SUBTOTAL	16,690
BOTTOM CONSTRUCTION			
Clay (Purchase, Place & Compact)	250 cy	9.00	2,250
Clay (Place and Compact	2,100 cy	4.00	8,400
Synthetic Membrane Liner (40 Mil HDPE)	112,000 SF	0.50	56,000
Bank Run Gravel	2,100 cy	9.00	18,900
Bank Sand	3,125 cy	8.50	26,565
Filter Fabric	112,000 sf	0.06	6,720
4" PVC Pipe (Schedule 40)	2,200 LF	18.00	39,600
Lined Concrete Sumps (2)	2 each	5,000	10,000
Manhole Extensions (6)	6 each	1,500	9,000
		SUBTOTAL	177,435
BERM CONSTRUCTION			
Fill	6,700 cy	7.00	46,900
Clay (Purchase,Place & Compact)	500 cy	9.00	4,500
Synthetic Membrane Liner (40 MIL. HDPE)	57,300 sf	0.50	28,650
Topsoil	750 cy	10.00	7,500
Silty-Sand	2225 cy	9.00	20,025
Drainage Fabric	12,550 sf	0.06	755
		SUBTOTAL	108,330
CAP CONSTRUCTION			
Synthetic Membrane Liner (40 MIL HDPE)	83,700 sf	0.50	41,850
Silty-Sand (Purchase, Place & Compact)	1,525 cy	9.00	13,725
Silty-sand (Place & Compact)	3,125 cy	4.00	12,500
Filter Fabric	83,700 SF	0.06	5,025
Topsoil (Purchase, Place and compact)	500 cy	10.00	5,000
Topsoil (place and compact)	1050 cy	4.00	4,200
		SUBTOTAL	82,300
		TOTAL	$384,755

Table 6-21
MECHANICAL EXCAVATION - 5,000 CUBIC YARDS
IN-CAP SECURE STORAGE (EARTHERN BERM)
ESTIMATED COSTS
(Continued)

CONSTRUCTION

Item	Quantity	Unit Cost ($)	Total Cost($)
ENGINEERING, LEGAL AND CONTINGENCIES (@35%) 135,245			
		TOTAL	520,000
MAINTENANCE COSTS ($2,000/yr)		PRESENT WORTH	17,000
TOTAL PROJECT		$537,000	

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adverse environmental impacts. In addition, the Love Canal related sediments are being stored where they originated.

- In-cap storage would require disturbance of the recently completed synthetic membrane liner system. The potential for contamination leaks to occur during this period are minimal because the original clay will not be completely removed. However, above-cap storage does not present this potential problem.

- An in-cap facility <u>must</u> be located at the center of the Love Canal site within the boundaries of the original clay cap. The above-cap facility can be situated anywhere on the recently installed synthetic membrane liner throughout the fenced area at Love Canal. Therefore, it can be located so as to minimize the aesthetic impacts of the facility and to take advantage of the optimal foundation conditions.

- In-cap storage cannot accommodate the most probable volumes of sediment to be stored.

DISPOSAL BENEATH EXISTING CAP

The possibility of cutting through the existing synthetic membrane liner and placing the sewer and creek sediments beneath the existing cap was examined at the request of the potential responsible party. However, since any soils excavated from beneath the cap would be considered contaminated and would have to be placed back into the facility, there would be no volume gain and therefore, no capacity beneath the cap to dispose of the contaminated creek and sewer sediments. In addition, excavation beneath the cap would present the potential for release of hazardous substances and would require special precautions.

ON-SITE STORAGE AT 93RD STREET SCHOOL SITE

The 93rd Street School Site was also considered as a location for the onsite interim secure storage facility. A preliminary evaluation of the site indicated sufficient area to construct an above-grade storage facility for the contaminated creek and sewer sediments. Assuming similar design criteria, the costs associated with this onsite storage facility would be expected to be similar to those developed for onsite storage at the Love Canal site. However, specific information (i.e. soil conditions, land availability, etc) with respect to the 93rd Street School Site was not available. A detailed feasibility study would be required to accurately assess this alternative.

In addition, the possibility of utilizing the 93rd Street School Building to store the contaminated creek and sewer sediments was raised during a recent public meeting. Due to the anticipated high costs associated with structurally modifying the 93rd Street School Building, construction of a new concrete ("Time Beach" design) vault would be expected to be a more cost-effective alternative. However, evaluation of this alternative would require performance of a detailed feasibility study (i.e. structural integrity, volume available, modifications required, etc.).

CONCRETE INTERIM SECURE STORAGE FACILITY ("TIMES BEACH VAULT")

Three sizes of concrete storage facility were evaluated; all sizes are of similar design. The sizes are:

- 5,000 cy; sewers and Black and Bergholtz Creeks to the EID limits;
- 18,000-21,000 cy; sewers, Black and Bergholtz Creek to the EID and first and second incremental reach limits; drums, haul roads, and access ramps;
- 135,000 cy; sewers, Black, Bergholtz, and Cayuga Creeks.

Figure 6-11 shows a cross section of an interim secure concrete storage facility. The proposed design is discussed below.

Base Layers Below the Contamination

Various materials would be placed below the contaminated material to drain moisture out of the containment and keep groundwater from it. An impervious synthetic liner would be placed above the prepared base. The liner could be constructed of materials such as hypalon, PVC, or HDPE, and would be protected by layers of geotextile fabric on each side. Above this liner, a leak detection system of perforated PVC, HDPE, or ABS pipe would be embedded in a graded rock drain. The leak detection system would be divided into zones, each with a separate drain pipe running to a leak detection sump. With this pipe system, any leaks could be easily located for repair. While this system should collect very little water, any water it did collect would be drained by gravity to a leak detection sump and pumped to the leachate treatment system.

The drainage collection system would be above the leak detection system and the concrete floor. The system would be constructed of perforated PVC, HDPE, or ABS pipe embedded in a graded rock drain. The system would be drained by

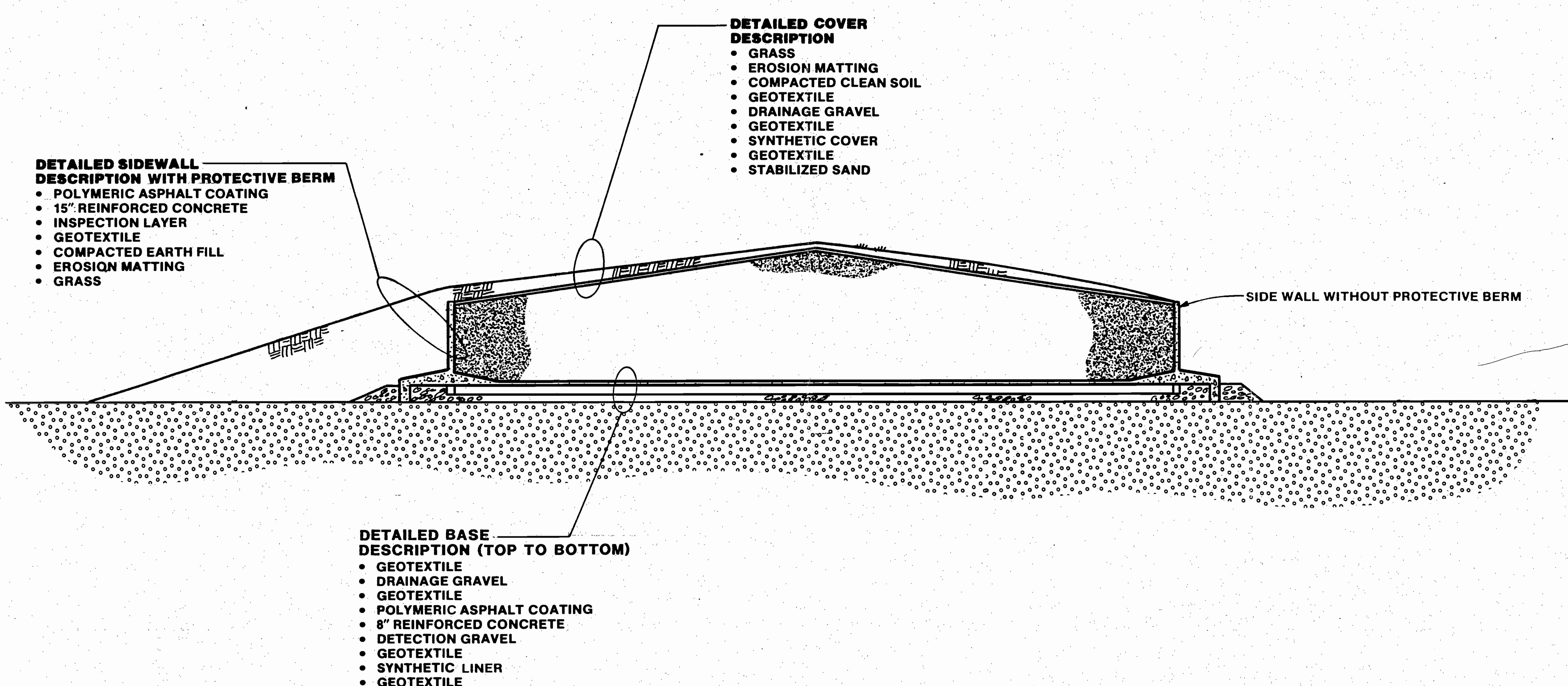

Figure 6–11
Cross-Section
Concrete Storage Vault, Shown
with and without Aesthetic Sidewall

gravity to the drainage collection sump and pumped to the leachate treatment system. A layer of geotextile fabric would cover the drainage collection layer, separating it from the contaminated material and preventing clogging.

Cover

The concrete interim containment facility, when closed, would be covered with an impermeable cover. The cover would prevent water percolation, promote drainage, minimize erosion, accommodate settling, and minimize maintenance.

The cover system would consist of nine layers. The layers (from the contaminated material up) would be stabilized sand, geotextile fabric, an impervious synthetic cover, geotextile fabric, drainage layer, geotextile fabric, compacted clean soils, erosion matting, and a vegetative cover (planted grass). The cover would be formed in to a dome. The final slope of the cover over the containment facility would be no greater than 10 percent and no less than 5 percent.

The stabilized sand layer would be directly over the contaminated material and would be a minimum of 6 inches thick when compacted to 90 percent of maximum ASTM D698 dry density. Maximum particle size would be 1/4-inch diameter with less than 10 percent passing U.S. #200 sieve. A geotextile fabric covering the sand layer would have a minimum thickness of 110 mils.

Next, synthetic membrane placed over the geotextile fabric would be either hypalon (chlorosulfonated polyethylene) or CPE (chlorinated polyethylene) material with a minimum thickness of 36 mil (±10 percent).

The cover would have vents penetrating the synthetic membrane to relieve gas that might be generated from organic decomposition. These vents and the membrane would be bonded together.

A 12-inch layer of clean imported granular drainage material on top of a geotextile layer would be placed over the synthetic cover. The granular material would conform to the requirements of less than 1-1/2-inch coarse aggregate for concrete.

The drainage layer would be covered with a final 110-mil geotextile layer, separating it from a layer of clean soil. A minimum of 18 inches of clean soil would cover this topmost geotextile layer. The soil would be applied and compacted in 6-inch lifts, as would the 18-inch layer of imported topsoil. The compacted topsoil would have a minimum thickness of 18 inches. The topsoil would then be entirely covered with erosion matting and hydroseeded. The uncontaminated surface runoff from the entire mound would be collected in surface trenches and drain away by gravity.

After the cover is in place, an earthen berm may be placed on the outside of the concrete walls and planted with grass to blend the storage facility into the surroundings. Figure 6-12 shows how this optional berm would look.

Dewatering of Sewer and Stream Sediment

The concrete storage facility could be designed to allow the contaminated material to be dewatered in it. The water will be collected and sent to the existing Love Canal leachate treatment system. Several major design modifications (drain curtains overflow outlet with scum baffles, etc.) would be needed to dewater the hydraulically dredged sediments; accordingly, this type of facility should not be considered for use as a dewatering facility for the hydraulically dredged sediments.

Location

Figure 6-11 shows several potential locations for a concrete storage facility and show the comparative sizes of the earthern berm and concrete vaults. The facility cannot be located over the homes which are buried in the Love Canal area because of uncertain settlement problems. It is also desirable to not place a concrete structure on the cap covering the canal because of uncertain settlement and potential slippage caused by the HDPE liner in the cap. The concrete storage facility can be located almost anywhere on the roadbed of 97th or 99th Street in the Canal area or on the 93rd Street School property. If located on the 93rd Street School property a new leachate treatment facility would have to be constructed or a leak protected pipeline would have to run to the existing leachate treatment facility at the Canal. As stated earlier, a feasibility study is required to accurately assess this alternative. Because the concrete vault is so much smaller than a earthern berm facility of equal capacity the vaults could be placed at an optional location within the Canal fenceline. Additionally, if Cayuga Creek is to be remedied at some future date, additional concrete vaults could be built on the Canal site to accommodate the total of 135,000 cubic yards. If earthern bermed facilities were to be used additional areas off the Canal site would be required.

Aesthetics

A concrete storage facility located at Love Canal or the 93rd Street School will be easily seen and rise 20 to 25 feet above the ground. To make the facility blend into

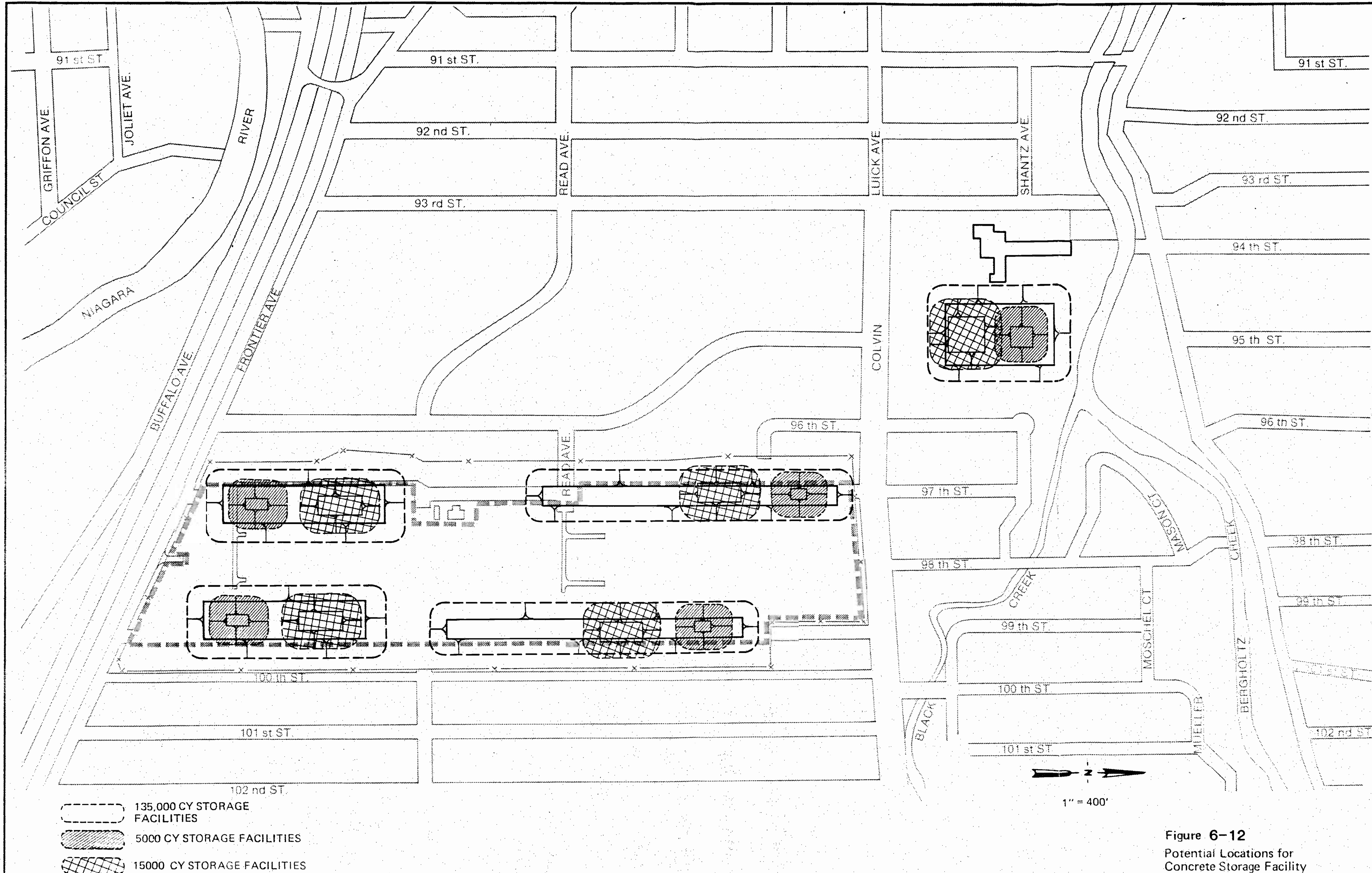

Figure 6–12
Potential Locations for Concrete Storage Facility

the surroundings a berm with a 4 to 1 slope can be placed around it and planted with grass. This can easily be done with a facility located on the 93rd Street School property, but on Love Canal it is very difficult due to space constraints. Figures 6-11 and 6-12 show a berm.

Cost of Concrete Storage Facility

Table 6-22 presents costs for the three sizes of concrete storage facility evaluated. These costs are presented with and without the cost for an earthen berm to improve aesthetics.

OFFSITE DISPOSAL

The new regulations for disposal of dioxin-contaminated material (Federal Register January 14, 1985) allow disposal in fully permitted hazardous waste landfills providing certain conditions are met. The major condition is compliance with a waste management plan that has been approved by EPA. The waste management plan must consider the following factors:

- The volume, physical, and chemical characteristics of the wastes, including their potential to migrate through the soil or to volatilize or escape into the atmosphere.
- The alternative properties of underlying and surrounding soils or other materials.
- The mobilizing properties of other materials codisposed with these wastes.
- The effectiveness of additional treatment, design, or monitoring requirements.

The regulations also allow for storage and disposal of these wastes at some interim status facilities such as enclosed waste piles, tanks, and containers.

Several facilities which have submitted permit applications have already received their RCRA Part B Permits; others may receive them in 1985. New York State Department of Environmental Conservation conducted initial investigations of disposal facilities that may qualify to dispose of Love Canal sediments. EPA also conducted an investigation of parties interested in accepting dioxin contaminated materials for disposal.

Table 6-22
CONCRETE STORAGE FACILITY
ESTIMATED COSTS

	Minimum Volume 5000 cy	Probable Volume 18,000 cy	Maximum Volume 135,000 cy
Site Preparation	2,040	7,344	30,900
Containment Base	116,600	419,916	1,732,000
Containment Sidewalls	137,000	264,036	1,719,000
Cover Construction	36,000	129,600	644,000
Contingency, Engineering, Administration	131,200	175,984	1,811,000
Total without Berms.	422,840	996,880	6,836,900
Berms	86,100	138,470	1,461,000
Total with Berms.	508,940	1,135,350	7,297,900

NOTE: The concrete storage facility for the probable volume of sediments would measure about 100 feet wide and 280 feet long if placed on the Love Canal site, and about 180 feet by 180 feet if placed on the 93rd Street School grounds. The cost of building on the 93rd Street School grounds would be about 4 percent less than building on the Love Canal site.

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PRELIMINARY INVESTIGATION--STATE OF NEW YORK

The DEC has been in contact with two likely commercial hazardous waste disposal facilities.

CECOS International has expressed an interest in taking the contaminated sediments or residue from treatment. CECOS has accepted small quantities of low concentration dioxin waste in the past. They are presently reviewing waste characteristic information, and will discuss with DEC and EPA Region II the possibility of accepting the contaminated sediments at the same time in the future. CECOS review has been in progress since July; no reply is forthcoming.

Chemical Waste Management has stated they are not interested in landfilling any dioxin waste at this time.

MARKETPLACE STUDY--U.S. EPA

The marketplace study was initiated to investigate commercial alternatives to the proposed Interim Central Storage Facility for the storage of dioxin contaminated material from six priority sites in Missouri. An informational advertisement was published in the May 30 1984 Commerce Business Daily (CBD) requesting responses from interested parties. The request said:

> CBD INFORMATION ANNOUNCEMENT
> PRIORITY DIOXIN SITES
>
> The Kansas City District Corps of Engineers is requesting information FOR IDENTIFICATION ONLY of interested parties to provide storage/land disposal of soil and large debris contaminated with 2,3,7,8 TCDD (dioxin) located at various sites in St. Louis, Franklin, and Jefferson Counties in Missouri. The aggregate quantity of this material is estimated to be between 25,000 and 50,000 cubic yards. It is presently planned that this material be stored in an Interim Central Storage Facility to be constructed at Times Beach, Missouri. The purpose of this announcement is to determine if equally viable, similarly cost effective alternate storage/land disposal facilities are available and willing to accept this material. A formal solicitation is anticipated to be issued on or about 1 Aug 1984 with contract award anticipated on or about 15 Jan 1985. All responding parties will be placed on the mailing list to receive the formal solicitation. At a minimum, the formal solicitation will require a fully implementable plan for the storage/land disposal of the material. The transportation phase may also be included or may be handled separately. All actions under the plan are to be completed no later than the 1985 construction season. All transportation and disposal activities must comply with applicable federal solid and hazardous waste regulatory criteria and the technical standards of 40CFR261-265 and other pertinent federal, state, and local waste regulations for disposal

of dioxin contaminated materials. Note: Storage/land disposal must be consistent with proposed EPA regulations for dioxin contaminated wastes under RCRA and be in compliance with the final regulations when promulgated.

Interested parties should furnish the following information to the address listed below:

Name of Firm(s)
Location and Description of Disposal Facility
Major Information Pertinent to Regulatory Compliance/Permitting Status--Include for information only:
- Status of RCRA Part B Permit
- Status of TSCA Permit
- Date and results of last RCRA and TSCA inspections
- Status of State permits
- Information concerning State dioxin waste regulations

Brief summary of firm's history and qualifications including regulatory compliance if applicable
Interest in Transportation Phase--IMPORTANT: All respondents must be capable of providing Storage/Land Disposal, Interest in transportation is optional.

Response to this inquiry must be received 15 days from the date of THIS issue. THIS IS NOT A REQUEST FOR PROPOSAL; THIS IS A REQUEST FOR INFORMATION ONLY.

Questions of a technical nature should be addressed to Ms. Janet Wade (816) 374-5332, and those of an administrative nature to Suzi Anderson (815) 374-5542.

U.S. Army Engineer District, Kansas City
700 Federal Building, 601 E. 12th Street
ATTN: MRKPS-K (Anderson)
Kansas City, MO 64106"

Of the five formal written responses and numerous telephone inquiries, three were determined by EPA to be suitable for further consideration in the marketplace study and were evaluated for Love Canal sediment disposal for this report.

<u>U.S. Pollution Control, Inc. (U.S. PCI)</u>

U.S. PCI operates two secure landfills in extremely remote areas--one near Wynoka, Oklahoma and one near Salt Lake City, Utah. In the past, they have refused to accept any dioxin containing waste, but due to the low concentrations of some dioxin containing materials and the volumes to be disposed of, they have considered changing current policies in order to accept low level dioxin contaminated wastes as a long term goal. Future policies will depend in part on developments in Oklahoma and Utah state regulations.

Great Midwest Corporation

The Great Midwest Corporation response presented an approach wherein underground mines were to be used for storage after the dioxin contaminated material is solidified with flyash. This is a new venture and thus no definitive location, direct hazardous waste operating experience, or compliance history is available. Also, the facility would have to be identified, purchased, technically characterized, designed, and permitted prior to construction.

The October 1984 reauthorization of the RCRA law has a provision which bans the disposal of hazardous wastes in any salt dome, salt-bed formation, underground mine or cave. The provision does allow for such disposal if EPA issues standards and, for a specific facility, finds no environmental threat and issues a permit. Given this additional constraint it is doubtful that this venture will continue. If it does proceed, several years will be required to identify and permit a facility after EPA issues standards. No additional information is available.

Environmental Conservation and Management Company (ECMC)

The ECMC submittal proposed to store dioxin-contaminated material at a landfill-type facility they planned to build and permit on Lewis Road in St. Louis County, Missouri. The proposed facility was across the Meramec River from Times Beach. Following a subsurface investigation of their proposed site and meetings with EPA, Missouri Department of Natural Resources, and the Missouri Division of Geology and Land Survey ECMC decided not to pursue development and permitting of the facility at this time.

INCINERATION

For hazardous waste destruction, incineration is becoming increasingly common, particularly when the waste is liquid or has significant heat value. Solubilized TCDD destruction by incineration has been shown to be feasible in offshore tests burning liquid Agent Orange. More recently, wastes containing large fractions of noncombustible solids have also been treated by incineration, most notably electrical capacitors and some soils contaminated with PCBs.

EPA finalized dioxin regulations on January 14, 1985. The regulations require 99.9999 percent (six 9s) destruction removal efficiency (DRE). The regulations allow for interim status incinerators to incinerate dioxin waste if approved by EPA and if a successful test burn has been conducted on something more difficult to incinerate than dioxin. Fully permitted incinerators (those with RCRA Part B permits) must follow similar guidelines. Once incinerated, the soil is still a hazardous waste; therefore, it still must be disposed of in a hazardous waste landfill unless it is delisted by EPA. Delisting requirements are waste and incinerator specific.

There are, to date, five commercial hazardous waste incineration facilities in the United States that have U.S. EPA Toxic Substances Control Act permits for the commercial incineration of PCB contaminated waste. Operators of two of these facilities have expressed a willingness to consider accepting TCDD wastes as a long-term goal. The principal constraints have been public resistance to transport of the waste material, undefined threshold concentration, and inadequate material handling capacity.

PERMITTED INCINERATORS

Of the five commercial hazardous waste incineration facilities permitted to burn PCBs, two only burn liquids and were, therefore, not considered further. The remaining three include Rollins in Deer Park, Texas; ENSCO in El Dorado, Arkansas; and Chemical Waste Management Inc. (formerly SCA) in Chicago, Illinois. ENSCO policy does not allow incineration of dioxin contaminated materials. The remaining two facilities have indicated an interest in accepting the dioxin contaminated materials, and Rollins has submitted tentative cost estimates and scheduling requirements for the destruction of Love Canal dioxin contaminated sediments. These two facilities are discussed in the following sections.

Rollins

Rollins currently operates three commercial hazardous waste incineration facilities. Their locations are Deer Park, Texas; Logan, New Jersey; and Baton Rouge, Louisiana. Although all three are of similar design and operate in the same mode (i.e. same kiln temperature and retention times), only the Deer Park facility is permitted to burn PCBs. Public hearings are currently underway for a PCB test burn which is due to begin at the Baton Rouge facility during the spring of 1985. Rollins operators expect permit approval for PCB incineration at Baton Rouge sometime in early 1986.

Rollins' facilities appear to be capable of handling the Love Canal stream/sewer sediments. A test burn conducted at the Deer Park facility demonstrated a DRE of six 9's with PCBs. Although this does not demonstrate that dioxin will be destroyed with the same efficiency it does demonstrate that the incinerator is capable of destroying hazardous chlorinated organic compounds. Rollins' facilities are also fully equipped with air pollution control systems which consist of a packed scrubber and a jet particulate scrubber; solids handling capability for feeding drums, and onsite landfills for residue disposal. Rollins has submitted their RCRA Part B permit application for their landfill at Deer Park.

Rollins management personnel have stated they could have the Deer Park facility available by July 1985 for the proposed incineration of Love Canal stream/sewer sediments. The incinerator likely will not require any capital improvements before accepting the sediments, and the facility landfill has sufficient capacity to accommodate residual ash since it will probably still be listed as a hazardous waste. If all the material is incinerated at one location, the incineration phase of the remedial action could be completed in one to three years for 135,000 cubic yards of material, provided the facility is 100 percent available for incineration of Love Canal material.

At the present time it is virtually impossible to make an accurate treatment estimate due to the changing regulations. Rollins' tentative estimate for incineration and residual ash disposal is $1200 to $1,500 per cubic yard of material. Cost for treatment of 5,000 to 135,000 cubic yards of material could range between $6 million and $202 million. Cost for incinerating 18,000 cubic yards could range from $23 to $28 million. In addition to the expense of incineration and disposal are costs for trial burns, permitting, dewatering, sediment preparation, monitoring, transportation, and decontamination of facilities.

The currently available facility in Deer Park, Texas is approximately 1500 highway miles from Buffalo, New York. At an average truck transportation cost of $3.50 per loaded mile, assuming that each of the gasketed, water tight vehicles carry approximately 17 cubic yards, the transportation cost could range from $1.5 million to $42 million for 5,000 to 135,000 cubic yards of material. The transportation costs for 15,000 cubic yards would be about $4.6 million.

If the burn could begin before regulations change, permitting costs may be decreased, and trial burn costs would be comparable to daily operating costs. Total cost of this remedial alternative could range between $5.5 million to $244 million.

Table 6-23 presents the costs for treatment at the Rollins' facility.

Table 6-23
OFFSITE INCINERATION COSTS
ROLLINS
(Cost in Thousands)

	Cost Per C.Y.	5,000 C.Y.	15,000 C.Y.***	135,000 C.Y.
Solids Handling & Size Reduction*	LS	300	420	2,910
Transportation				
DOT Permitting	LS	20	20	20
Loading		60	180	1,460
Hauling (1,500 Miles)	300	1,500	4,500	40,500
Incineration, Air Pollution Control Residue Disposal*	1,200-1,500*	6,000-7,500	18,000-22,500	162,000-202,500
TOTAL (in millions)		$7.9-9.4	23.1-27.6	206.9-247.4
COST PER C.Y.	$1,580-1,880	1,540-1,840	1,530-1,830	

*Cost provided by Rollins
***The costs associated with incineration of 18,000 cy, which includes the creek banks, will be approximately $28 to $34 million.

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Chemical Waste Management, Inc.

Chemical Waste Management, formerly SCA, operates a commercial incineration facility in Chicago IL. Although the facility is permitted to burn PCBs, the Region V EPA requires "waste stream by waste stream" approval and has not granted approval of dioxin incineration. Before Chemical Waste Management could consider accepting the Love Canal stream/sewer sediments, they would need to give public notice, supply a detailed waste characteristic summary for EPA review, and conduct a trial burn of the sediments. However, Chemical Waste Management has recently indicated that they are not willing to accept any dioxin contaminated waste from Love Canal at any corporate facility at this time.

Chemical Waste Management is considering building a hazardous waste incinerator at its Model City, New York facility. The incinerator will be designed for both solid and liquid hazardous materials and will be approximately half the size of their Chicago facility. Presently, they are conducting a marketing study and once completed will be submitting the necessary permit applications. Once the permits are approved, Chemical Waste Management anticipates that the incinerator could be constructed in about 2 years. Depending on how long it takes to get permit approvals, it will be 3 to 5 years before this is an operable facility.

ONSITE INCINERATION

For incinerating only 5000 cubic yards of contaminated material at Love Canal, building an incineration facility onsite would not be feasible. Transporting a mobile incinerator to the site, however, could be a viable alternative. On the other hand, because the size, and therefore the capacity, of a mobile incinerator is limited for transportation purposes, volumes on the order of 100,000 cubic yards could take more than 20 years to burn in the small units. For 100,000 cubic yards of material or more, a stationary but temporary facility built on site would be more suitable. The sediment volume must be accurately estimated before a comparison can be made between these two options.

MOBILE INCINERATORS

Mobile incinerators are available, but their availability is limited. Existing mobile incinerators capable of handling the Love Canal stream/sewer sediments include a facility operated by Pyrotech--an ENSCO subsidiary, and the EPA mobile unit. J.M. Huber Corporation is developing an advanced electric reactor (AER) which has destroyed dioxin by pyrolysis in a test at Times Beach, Missouri.

EPA Mobile Incineration System

The EPA mobile incinerator consists of major incineration and air pollution control equipment, combustion and stack gas monitoring equipment and ancillary equipment all mounted on four heavy duty trailers. Each of the trailers require construction of a concrete pad and some type of shelter. The overall plan area of the four trailers when assembled in operating configuration is 7 feet by 139 feet. The overall capacity is 15 million Btu/hr. Additional equipment required for operation which is not included with the four trailers includes wastewater treatment, decontamination facilities, feed preparation, and fuel, sediment, residue, and spare part storage. This additional equipment occupies another 10 to 12 trailers and the overall size of the incineration complex can be as much as 2 to 4 acres.

The EPA mobile incinerator is currently undergoing testing in Verona, Missouri, where it is scheduled to run a trial burn of dioxin contaminated materials. The trial burn is began in February of 1985 at the Denney farm site near Verona MO, and was expected to take 2 weeks to complete. After only a few hours of the trial burn, the incinerator malfunctioned and was shutdown for repairs. The trial burn is due to resume soon. After the trial burn, the incinerator will be shut down for approximately 5 weeks while analytical testing is done. After the testing is completed, the incinerator will be used for approximately 2 additional months to complete the cleanup of the Denney Farm site and several other sites in southwest Missouri.

A 50-foot by 200-foot building was constructed to house the incineration trailers. Support equipment is stored outside. After completion of the planned work in Missouri, one to 2 months would be required for transportation to Love Canal, setup, startup, and shakedown. Acquiring permits for incineration at Love Canal would take at least 3 months provided there are no complications. On an optimistic schedule, onsite treatment with the EPA incinerator could begin in September of 1985. However, approval of the Denney Farm site test burn required six months of negotiations between EPA officials and the state of Missouri. A more realistic schedule would place a treatment starting date sometime in early 1986. Other demands on the incinerator, such as the suggested use of the incinerator to cleanup material from several Missouri sites could delay this date further.

The EPA mobile incinerator design appears technically capable of treating dioxin contaminated waste and the testing in Missouri should verify this. Test burns of liquid PCBs demonstrated a DRE of six 9's. The solids handling capability of the system has been tested and refined. The facility is also equipped with air pollution control and stack gas monitoring systems. Incineration residue would have to be properly disposed of either onsite or in a secure landfill offsite.

Initial estimates indicate the capacity of the EPA incinerator is about 22 cubic yards per 24 hour day for material containing 50 percent moisture. Assuming the incinerator operates 200 days per year, completion of the remedial action would take between 14 months for 5000 cubic yards and 29 years for 135,000 cubic yards.

EPA estimates the incineration costs will range between $1,000 to $1,500 per cubic yard. The unit has a capacity of 22 cubic yards per day. Total incineration costs would range between $8.3 million to $258 million for 5,000 to 135,000 cubic yards of sediments. The cost for 18,000 yards would range from $19 to $37 million. Additional costs include those for site preparation, sediment dewatering, size reduction, sediment and residue storage, and residue disposal. The cost for residue disposal would likely be comparable to the cost of offsite disposal of the stream/sewer sediments before incineration. Table 6-24 presents the costs for the EPA mobile incinerator.

J.M. Huber Corporation

J. M. Huber Corporation has developed a process based on the Advanced Electric Reactor (AER) in which dioxin and other organics are destroyed by pyrolysis. The process consists of a solids preparation and feed system, the electric reactor, two post-reactor zones, and air pollution control equipment. Preliminary designs of the process also include solids size reduction (to particles of -10 mesh or smaller) and drying equipment (10 percent maximum moisture). The facility would cover a 100 ft. by 100 ft. area and reach about 100 feet high. Feed and residue storage are not included in that size estimate.

Huber currently maintains two AERs in Borger, Texas--one 3" diameter core, 1/2 pound/minute unit and one 12" diameter core, 50 pounds/minute unit. Dioxin tests have been conducted by Huber with both reactors at the Borger facility and with the 3" reactor in Times Beach. At Times Beach, treatment residues from materials containing 80 ppb dioxin had dioxin concentrations below a detection limit of 0.1 ppb. Huber has also conducted tests for PCB destruction all of which yielded DREs of at least six 9's.

If enough applications are identified to utilize the system at capacity for at least five years, Huber management personnel claim a 15,000 to 20,000 cubic yard per year

Table 6-24
ONSITE MOBILE INCINERATION COSTS
U.S. EPA MOBILE INCINERATOR
(Cost in Thousands)

	Cost ($1,000)*		
	5,000 C.Y.	15,000 C.Y.	135,000 C.Y.
Mobilization/ Demobilization	700	700	700
Permitting/Trial Burn	350	350	350
Storage	365	530	530
Solids Handling/ Preparation	325	325	325
Incineration (1,000 - 1,500/ C.Y.)	5,000-7,500	75,000-22,500	135,000-202,500
Residue Disposal	2,000	6,000	54,000
TOTAL (in millions)	8,340-10,840	15,400 - 30,400	190,900-258,400
TOTAL COST PER C.Y.	1,670-2,170	1,030-2,030	1,410-1,910

*The cost for incineration of 18,000 cubic yards would range from $19
$37 million dollars.

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transportable unit (24" diameter core) could be completed and available by early 1986.

Transportation and setup of the facility would take about one month. Assuming the permitting process for an AER and a rotary kiln are equivalent, treatment of the sediments by pyrolysis could begin in the second quarter of 1986 at the earliest. At a capacity of 15,000 to 20,000 cubic yards per year, treatment could be completed in four months (5000 cy) to seven years (135,000 cy).

Huber has made a preliminary estimate of $400 to $675 per cubic yard of material for treatment of the contaminated sediments. Cost for treatment of 5000 to 135,000 cubic yards of material would range between $2.0 million and $91.1 million. Cost for treatment of 18,000 cy would range from $18 to $22 million. Table 6-25 presents the costs for the AER.

ENSCO/Pyrotech

Pyrotech's mobile incinerator will occupy a 200ft x 200ft area. The facility consists of six trailers on which the incineration and air pollution control equipment is mounted. A fully equipped analytical laboratory and control room are operated in a separate 40ft van. The incineration equipment includes a rotary kiln which operates between 1800 to 2000 degrees Fahrenheit and an afterburner which operates between 2200 to 2600 degrees Fahrenheit. Air pollution control equipment includes a packed scrubber and a jet particulate scrubber. Overall capacity of the incinerator is estimated at about 43 cubic yards per 24 hour day.

The mobile, solid feed incinerator is not yet permitted to burn hazardous wastes. However, Pyrotech is currently preparing a permit application for the incineration of dioxin materials for a private company in Arkansas. State regulatory authorities have made a commitment to issue a trial burn permit to Pyrotech within nine months (summer or fall, 1985). Within 30 days of the completion of the trial burn, Pyrotech expects to be issued a permit to incinerate the dioxin material provided the trial burn is successful.

ENSCO operates a fixed incinerator in El Dorado Arkansas that is permitted to burn PCBs. ENSCO's incinerator has demonstrated a DRE of six 9's on PCBs. Since the mobile incinerator is similar in design and operation to the ENSCO incinerator, Pyrotech expects the trial burn to be successful.

The mobile incinerator is currently preparing to burn non-hazardous waste in Hillsborough County, Florida. Pyrotech plans to complete operations in Hillsborough County by June

Table 6-25
ONSITE MOBILE INCINERATION COSTS
HUBER CORPORATION
(15,000 cy/yr unit)

	Cost Per C.Y.	5,000 C.Y.	15,000 C.Y.*	135,000 C.Y.
Mobilization/De-mobilization	LS	840	840	840
Permitting/Trial Burn	LS	385	385	385
Storage	LS	320	780	780
Solids Handling/ Preparation	LS	1,160	1,160	1,160
Incineration (Pyrolysis)	400-675	2,000-3,375	6,000-10,125	54,000-91,125
Residue Disposal	400	2,000	6,000	54,000
TOTAL (in millions)		\$6.7-8.1	\$15.2-19.3	\$111.2-148.3
TOTAL COST PER C.Y.		\$1,340-1,620	\$1,010-1,290	\$820-1,100

*The costs for 18,000 cy would range from \$18.2 to \$23.2 million.

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1985. They also plan to complete construction of a second solids incinerator in the spring of 1985. Transportation to Love Canal, set-up, startup and shake down would take at least a month. Pyrotech expects permitting and test burns to take about two months although the state of Arkansas will require at least nine months. Provided there are no delays, the earliest Pyrotech could be prepared to begin incineration with one facility at Love Canal is late 1985. However, ENSCO prefers to schedule burns at least a year in advance and will likely have other commitments scheduled.

With a capacity of 43 cubic yards per day, Pyrotech should complete Love Canal sediment incineration between 7 months for 5000 cubic yards and 16 years for 135,000 cubic yards of material. This process could be speeded up if the second incinerator were available.

Pyrotech has submitted an initial incineration cost estimate of $320 per cubic yard of material. Permitting, test burns, and site preparation for one facility are included in the estimate. Treatment of 5,000 to 135,000 cubic yards of sediments would cost between $1.6 million to $43 million. Cost for treatment of 15,000 cubic yards would be $12 million. Additional costs include sediment dewatering, size reduction, sediment and residue storage, residue delisting or disposal, and possibly permitting and preparation for a second facility. Table 6-26 presents the cost estimate for the Pyrotech Mobile Incinerator.

Stationary Onsite Incineration

Construction of an incineration facility onsite, which would be feasible for quantities of 100,000 cubic yards or more, would take 2 to 4 years. Required activities include permitting, design, site preparation, construction, start-up, and shakedown.

Cost for incineration alone would be about $220 per cubic yard or between $1.1 million and 29.7 million for 5,000 to 135,000 cubic yards of material. Additional costs would include site preparation, sediment handling and dewatering, residue disposal, facility design and construction, permitting and trial burns, and fuel, sediment, and residue storage. Table 6-27 presents a cost estimate for incineration of 100,000 cubic yards of material.

Cascading Rotary Incineration System

Rotech Inc. (formerly Redco) had developed a cascading rotary incinerator which rotates at 10 to 20 revolutions per minute (rpm). Conventional rotary kiln incinerators normally operate at 1 to 3 rpm. The faster rotation produces a cascading motion of the solids in the reactor.

Table 6-26
ONSITE MOBIL INCINERATION COSTS
ENSCO/PYROTECH
(8,600 cy/year unit)

	Cost Per C.Y.	5,000 C.Y.	15,000 C.Y.	135,000 C.Y.
Mobilization/ Demobilization	LS	700*	700*	700*
Permitting/Trial Burn	LS	350*	350*	350*
Storage	LS	365	530	530
Solids Handling/ Preparation	LS	525	525	525
Incineration	261*	1,305	3,915	35,235
Residue Disposal	400	2,000	6,000	54,000
TOTAL (in millions)		$5.4	$12.0	$91.3
COST PER C.Y.		$1,080	$800	$680

*Costs provided by vendor; costs for 18,000 cy estimated at $14.4 million.

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Table 6-27
ONSITE FIXED INCINERATION COSTS
(Based on 100,000 cy facility)

General (Mobilization/Demobilization)	$ 4,151,000
Site Preparation	1,535,000
Storage	
Base	719,000
Sidewall	347,000
Material Compaction	1,886,000
Incineration/Air Pollution Control	
Solids Handling	2,911,000
Sediment Incineration	3,219,000
Scrubber Blowdown Treatment	2,920,000
Test Burn	850,000
Treatment and Monitoring	2,743,000
Operation & Maintenance	12,676,000
Restoration	396,000
Residue Disposal	40,000,000
TOTAL	$74,353,000
COST PER CUBIC YARD	$ 744/C.Y.

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This motion is said to improve the solids gas contact resulting in maximized heat transfer and improved combustion kinetics. The system operates in a countercurrent mode which provides for air preheating and solids reheating by counter current flow within combustion gases. In the Rotech System Combustion takes place between 1,200 and 1,500°F.

Currently, a small pilot unit is operational and has been tested on a number of wastes. Test data is not yet available but DRE's are expected to be comparable to or better than conventional rotary kilns. Costs are also expected to be competitive with conventional incineration.

INNOVATIVE TECHNOLOGIES/INSTITUTIONAL ALTERNATIVES

Appendix A of this report briefly summarizes some of the many technologies which are being developed and applied to the treatment and stabilization of hazardous wastes. However, only a small amount of the laboratory research and development work to date is directly applicable to the TCDD levels found in the Love Canal sewers and creeks; i.e., little research has focused specifically on removal or destruction of TCDD bound to sediment.

Recently, there has been a significant amount of research conducted on treatment methods for dioxin-contaminated materials. Some of the research which is most applicable to the Love Canal sewer and stream sediment is discussed below.

TIMES BEACH, MISSOURI, DIOXIN RESEARCH FACILITY

The Missouri Department of Natural Resources has made plots of dioxin-contaminated soil in Times Beach available for research. Most of the projects that are underway at Times Beach are not expected to yield any firm results for at least a year. The major projects are:

- Biological degradation research is being conducted by PPM Inc. Their approach is to test microorganisms that have been acclimated to PCB-containing materials.

- Dechlorination with an organo-sodium reagent is being tested by PPM Inc. The company has been using the compound for 3 years to destroy PCBs in oil. PPM has modified the reagent for use in soil and plans to test it at Times Beach this spring.

- EPA's Office of Research and Development is testing ultraviolet photolysis enhanced with polyethylene glycol and dechlorination with alkali polyethylene glycolate.

- o Monsanto has studied the transport mechanism of dioxin in soil and has concluded that dioxin moves to the surface where it is destroyed by sunlight in a matter of hours. They are testing their theory in test plots at Times Beach.

- o Agro K of Minneapolis, Minnesota, is investigating the use of an enzyme additive to enhance natural biodegradation. They believe that their enzyme will make the dioxin available for natural biological oxidation properties.

- o Research Manufacturing Consultation Corporation, in conjunction with Agro K, have been testing the compound hydrazine hydrate as a means of degrading dioxin in the soil. Initial tests with this compound yielded no significant reduction in dioxin concentration, more extensive testing is planned.

- o Huber Corporation tested their Advanced Electric Reactor (AER) on Times Beach soil in November 1984. The test was done on 70 pounds of soil contaminated with 80 ppb dioxin. The AER successfully reduced the dioxin levels to below one ppb.

EPA MOBILE INCINERATOR

EPA has moved their mobile incinerator to the Denney Farm site in southwest Missouri for a series of test burns and eventual cleanup of several small sites. The incinerator is scheduled to finish its initial test burn on dioxin-contaminated soil in February or March, 1985. After the test burn period, the incinerator will be shut down for 5 weeks while analytical work is completed. If the analytical testing verifies that the test burn was successful then the incinerator will operate an additional 2 months to clean up the Denney Farm site and several other small sites in the area.

INCINERATION TESTING BASEL, SWITZERLAND

In November, 1984, 10 kilograms of dioxin contaminated wastes from Seveso, Italy, were test burned in Basel, Switzerland. The incinerator was a rotary kiln operating at 1500°C followed by a holding chamber operating at 1200°C. Total burn time was 2.8 seconds. The results from the test indicate a DRE of 99.9999 percent.

BIOLOGICAL DEGRADATION RESEARCH, OCCIDENTAL CHEMICAL

Occidental Chemical has been conducting research in the biological degradation of chlorinated organic compounds for approximately 4 years. They have conducted research with naturally occurring organisms which were obtained from the Hyde Park Landfill and they have used genetic engineering techniques to develop organisms with selected characteristics. Thus far they have achieved good success with most compounds but have not yet been able to degrade TCDD.

EPA RESEARCH

EPA is conducting research in the sorption/desorption of TCDD in contaminated soils using a variety of solvent systems.

EPA is also researching in situ stabilization/fixation techniques for dioxin-contaminated material using additives such as Portland cement and alphatic materials.

CHEMICAL STABILIZATION, LOPAT ENTERPRISE, INC. K-20

Lopat Enterprises, Inc. manufactures a chemical stabilizing agent, K-20. In laboratory tests K-20 has been demonstrated to stabilize PCBs, pesticides, and other chemical compounds in various matrixes such as concrete, and soil. If applied to the Love Canal sewer and creek sediment it is believed that K-20 agent would stabilize the dioxin contamination. This stabilization of the material does not remove the dioxin; it merely inhibits the analytical test (or other physical/chemical process) from removing the dioxin. It is unlikely that the K-20 process could be applied directly to the creek sediments in place, because although the dioxin would be stabilized there would still need to be control of the sediments.

The most likely application for K-20 for the sewer and stream sediment would be to use it in conjunction with storage. However, this should only be considered for permanent storage and disposal options since the use of the K-20 stabilizer will likely inhibit future treatment or destruction of the dioxin waste.

PLASMA ARC TECHNOLOGY

DEC, in conjunction with Pyrolysis Systems, Incorporated of Welland, Ontario, Canada, has been investigating the use of plasma arc technology to destroy dioxin contaminated liquids associated with the Love Canal Leachate Treatment Facility. The technology of plasma arc destruction is discussed in Appendix A. To date, the Canadian unit has successfully destroyed non-toxic materials, with tests involving a "Love Canal Surrogate" scheduled to begin at the test site at the Royal Military College. The four year old design has been extensively reworked to accommodate additional fail safe mechanisms, and air emissions control. A prototype of this unit achieved 99.9999 percent DRE for an askerel (PCB) solution. It is anticipated that the unit will finish tests by the spring of 1985, and move to Love Canal shortly afterwards. Since the permitting process in Canada parallels that of New York, it is anticipated that permit application process will be expedited. The plasma arc unit is currently designed to burn only liquids, and is scheduled to dispose of Love Canal Treatment Facilities leachate collection system materials for some time. Before the unit could be used to dispose of the sewer and creek sediments, a change in the feed mechanism and additional testing would be necessary. The use of the plasma arc incinerator for sediment destruction would appear to be some time away.

GEOTECH MELT-ALL SYSTEM

The Geotech Development Corporation, in conjunction with Wizard Method of Niagara Falls, has formed a company called Chemical Vitrification, Inc. The Melt-All system uses a submerged electrode continual melt process by which the waste material is melted and converted into an inert glass-like material, pellets or a spin fiber material. The system produces temperatures from 2200-6200°F, which, it is claimed, can be precisely adjusted. The waste material, when prepared to an ideal condition of one gram size without bridging and less than fifty percent moisture, is feed from a hopper to gravity feed tubes located between the three electrodes of the system. The electrodes and feed tubes are located in an enclosed cauldron, which can have a slight negative pressure applied so that any gases given off by the melting process are drawn off for treatment. An electric current is applied to the three electrodes; as current from the electrodes passes through the waste it melts and forms a pool above an orifice on the cauldrom bottom. The temperature of this melt pool can be regulated by moving the electrodes closer together or farther away from each other. The waste material slumps into the melt pool until, under ideal operating conditions, the pool is large enough to form a "two hour reservoir" over the orifice. The two hour reservoir is based on the flow rate of the molten waste through the orifice, which can be regulated. A normal flow or pour rate for the models now in planning would be 1,000 pounds of molten material per hour. As the molten material emerges from the orifice, it can be collected as blocks, pelletized, or spun into fibers, depending on the characteristics of the original material and the treatment accorded it. Previous melts with fly ash have yielded totally inert material that can be used as a growth medium for plants, material that absorbs 500 times its weight in liquid and can be used in oil spill cleanup, and material that can be molded into inert heat resistant jet airplane parts.

The contents of the cauldron are at different temperatures away from the melt pool; these temperatures are sometimes sufficient to drive off volatile substances from the waste. These gases can be captured in a wet or dry baghouse, or in carbon absorption units. The residues from the air scrubbing can be reintroduced into the cauldron, if desired, or landfilled.

The system has several "fail-safe" design features. The melt can be maintained with three, two or one electrodes, so that failure of any one or two electrodes is not a major problem. Electrodes are routinely replaced with a melt in progress. If necessary, the melt can be halted by freezing the orifice with liquid nitrogen or water, depending on the melt temperature. The melt pool can be maintained with the orifice frozen, or allowed to cool down and solidify, and started up again later.

The system has been used extensively in France and Czechoslovakia; tests are underway in the United States. The company claims the system can be used to "destroy fly ash, expended filter cake, contaminated soil, mine tailings, contaminated filter media, sewage sludge, high acid and petroleum sludges and residue of incinerated toxic liquid waste."

The company has a pilot plant in operation in Pennsylvania. This unit measures 8½ feet wide by 24 feet long by 24 feet high, and is housed in simple Butler building. The unit uses electricity (400 kVA, 200 amps, 480 volts) and water (250 gpm non-contact cooling water).

The pilot plant reaches a temperature of 5200°F, and has pour rates of 25-300 pounds per hour. Units have been designed with a pour rate of 8,000 pounds per hour. The pilot plant cost approximately $3 million to construct; it is transportable, and can be erected and "shook down" in four days. While the system has never been tested on dioxin contaminated soil, several tests of fly ash, tailings and sludge have yielded volume reductions of 90 percent. A test on soil from an undisclosed location, alledgedly supplied by Hooker Chemical Company, resulted in a 40 to 1 volume reduction. Since the Melt-All System is innovative technology, it is improbable that EPA would permit delisting of the residue or melt, which would enable the material to be disposed of in a sanitary landfill. (The other incineration devices face the same problems). The advantage of the Geotech Melt-All system lies in the volume reduction, since most incineration techniques result in volume expansion. A volume reduction of 40 to 1 would permit the disposal of an original volume of 1,500 cubic yards into a 375 cubic yard facility.

Additional information has not been forthcoming from Geotech regarding costs. An estimate of $30 per ton (.3 kw of electricity per pound poured at $1.92/kw hour) was given, but cannot be verified.

The Geotech pilot plant, with a stated capacity of 250 pounds poured per hour, could dispose of 5,000 cubic yards of sediments in an estimated 12.5 years, assuming a linear relationship between pounds poured and pounds processed. The largest plant under design (8,000 pounds/hr.) could dispose of 5,000 cubic yards in roughly five months.

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Chapter 7
IMPACT ASSESSMENT OF REMEDIAL ALTERNATIVES

Operations with heavy equipment have several typical impacts: generation of dust and fumes, noise, destruction of local vegetation during the movement of large vehicles, etc. In this sense, the potential remedial activities for the sewers, creeks and 102nd Street outfall are no different than any other major construction actions. The significant difference is that the potential remedial activities require the handling, processing and disposal of contaminated material. Extra precautions to mitigate exposures to the public and workers during the operations are therefore required.

The remedial activities for the sewers, creeks, and outfall will consist of removal of contaminated material, transport, dewatering, and disposal. Cleanup of each area will be conducted over a construction season (April to October).

Basically, the materials will be removed by various methods and transported over distances of up to a mile to the processing area, where water may be removed from the sediments. Dewatering may also occur in the onsite interim secure storage facility. The next action would involve a short distance transport to the onsite interim storage since the sediments can be removed much faster than they can be treated or disposed of. Following a period of storage while the disposal option is determined, the storage facility would be opened, and the sediments removed as scheduled for disposal. The disposal options available presently are basically onsite or offsite incineration.

In the following sections, potential public health and safety concerns will be discussed, followed by discussions of the potential mitigation measures and worker health and safety issues.

REMOVAL ACTIVITIES

During the average work day for sewer sediment removal, approximately 1,000 feet of sewer will be cleaned. The major concerns for public exposure during sewer sediment removal and mitigation measures are:

- Sanitary sewer backup to homes. Volatile organics were detected in the sewer sediments. These gases may migrate under pressure to homes, and sediment may be flushed back to the homes. Residents will be given notice prior to sewer flushing in this area; the Contractor will have a cleanup contingency plan and equipment available.

- Exposure to storm and sanitary sediments. Public access to the work area will be restricted and good worker safety practices, such as minimizing splashing during the operations, will help minimize public contact. Sediments removed from the sewers will be extremely wet, ranging from 50 to 200 percent water, depending on the excavation method. Therefore, there is a very low probability that the non-volatile contaminants will be dispersed by the wind. Exposure to volatiles will be minimized by the open air conditions of the activity, ensuring the immediate reduction of the concentrations of volatiles in the air. The odor threshold for some of the organics is low, so it is possible that a chemical odor will be detected during the operation.

- Exposure to sediments being transported to the dewatering facility. As part of the operations safety protocol, inspections of the transport vehicles will be conducted daily to ensure they are leakproof, and that safety equipment (e.g., brakes) are operating correctly. Routes and driving times will be coordinated to minimize impacts.

The major public safety and health concerns during the creek sediments excavation include:

- Exposure to Sediments. Exposure will be minimized by restricting access during remedial activities and transporting sediments through the area in decontaminated leakproof trucks or pipelines. Spills and leaks would be cleaned up rapidly.

- Emissions. Removal of sediments would be conducted under open-air conditions ensuring quick reduction in chemical concentrations. The wet state of sediments would prevent dust problems during excavation, although there may be some problems with contaminated dust due to vehicle traffic on creek access roads. Dust control would be accomplished by water spraying the road surfaces.

- Noise. Some machinery and truck noise will exist during daytime working hours.

At the 102nd Street outfall, the present remedial objective is sediment migration control, not sediment removal. The excavation of sediments is expected to be considered only after remediation of the 102nd Street landfills (Olin and Hooker).

The major safety and health concerns at the outfall are related to worker exposure to sediments during construction of stone berm and/or sheet piling. Due to the distance between the outfall and residences the public exposure concerns are limited to noise and spillage during sediment transport operations.

DEWATERING ACTIVITIES

The impacts associated with the dewatering of the sediments has been discussed at length in Chapter 6. Impacts associated with the dewatering of mechanically excavated creek sediments is expected to be minimal; the sediments are hauled to and placed in the interim secure storage facility, and the relatively minor amounts of pore water are captured in the leachate collection system for disposal.

The sewer sediments can be dewatered in a temporary facility by mechanical or passive dewatering. The impacts include possible release of volatiles; dust emission from the mechanical filter press/dewatering; noise associated with moving the dewatered sediment to the interim secure storage facility as discussed previously.

The impacts associated with dewatering the hydraulically dredged sediments are many. The conceptual plan calls for two pipelines up to a mile long, one running from the creek to the dewatering facility and carrying creek sediments and water, and the other running from the dewatering facility back to the creek to the dredging operation. The reuse of water reduces the total amount of dredge water that must be treated from an estimated 23,000,000 gallons to 2,300,000 gallons. One of the pipelines will have gasoline powered pumps about every 1,500 feet; these pumps will run at all times during the operation. The pipelines (the biggest will be 24 inches or so in diameter) are actually pipes within a pipe; spills should be minimized.

The interim secure storage facility would require major design modifications so that the hydraulically dredged creek sediments can be dewatered. The pipeline would pump about 50 gpm into the facility; splashing and emissions could be controlled. If the sediments do not settle out and dewater rapidly, the facility must remain uncapped for year(s), although a temporary cover would limit contact or emissions.

ACTIVITIES

TRANSPORT OF SEDIMENTS

Public access during the loading of material following mechanical dewatering will be restricted, minimizing the potential for immediate contact. The dewatered material will contain about 10 percent moisture. Loading and offloading of contaminated material onto trucks will generate some dust emissions.

Covered trucks will be used to transport the material to the interim secure storage area. The trucks will be cleaned after loading to remove any surface contamination before leaving the site.

The transport of sediments to dewatering/temporary storage will require more than 70 truckloads for the sewers; about 9 or 10 truckloads will be needed for debris removed prior to hydraulic dredging; and over 1,300 truckloads for mechanical excavation. When moving to the interim storage facility, transportation distance and the potential for accidents (and possible public exposure) will be minimized by route and time of day constraints. Additional discussion of transportation impacts are provided in Chapter 6.

INTERIM ONSITE STORAGE

The sediments can be removed much more rapidly than they can be treated or disposed of; they must be stored for some period of time. Exposures during onsite storage could occur due to spillage during placement sediments in the storage facility or release of contaminants to the environment during the storage period. Since public areas to the storage area will be restricted, exposures due to spills and associated spill cleanup activities be a concern primarily for workers. Public exposure may occur in the form of dust blown sediment; however, dust problems will be controlled by spraying sediments.

Contaminant release to the environment during storage will be prevented mainly through the design of the facility. The facility will be double lined. Cover, leachate collection, and leak detection systems will meet all RCRA requirements. If the facility is located inside the Love Canal fence, the existing drain system and perimeter groundwater wells will provide additional monitoring and protection. If the facility is located at the 93rd Street School, a new monitoring well system, and security measures will be installed.

Aesthetics is another public impact to be considered. During storage the facility will appear as an elevated rectangular mound. If a Times Beach concrete vault is used, the appearance may be softened by constructing berms abutting the sidewalls. Following the storage period, the facility may be removed and the area returned to its original state. Complete descriptions of the interim storage alternatives are provided in Chapter 6.

INCINERATION (ONSITE)

Incineration onsite, using either a stationary facility (for 100,000 cubic yards or more) or mobile incinerator, has impacts associated with the following:

- o Opening the storage facility and removing and preparing the materials. The impacts associated with these activities have been discussed above.

- o Incineration. The incineration of materials generates heat, ash, steam, contact cooling water and air emissions. The ash, air emissions and cooling water must be controlled. Ash and the residuals from air emission control will be considered, in all likelihood, as hazardous waste, and must be treated or disposed.

- o Ash Disposal. Since incineration usually expands the volume of soil, the disposal of the soil residue will be a major undertaking. The ash can be landfilled (offsite facilities may be willing to accept the ash following incineration) or ocean dumped (this would require special permitting) or subjected to a treatment process that is not currently viable, but may be by the time a stationary facility is built, permitted and burns the material (4 to 6 years), or a mobile incinerator finishes the incineration (1 to 29 years).

- o Dismantling of the Facility. The mobile incinerator would be decontaminated and dismantled, generating solutions or materials for disposal. A stationary facility would be dismantled, necessitating disposal in a sanitary landfill.

Other impacts associated with incineration onsite include those of mobilizing or constructing the incinerator (heavy machinery, noise, dust, traffic) and the aesthetics associated with the building or temporary housing of the incinerator and the operation of the unit (steam releases, etc.).

OFFSITE DISPOSAL

Offsite disposal includes any method of treatment or disposal that occurs away from the Love Canal area, such as offsite incineration or landfilling. The major activities involved in offsite disposal include opening the interim storage facility; removal of sediments and loading of trucks; transport to the disposal area; unloading; storage and preparation of the materials; processing the material by incineration, burial etc.; and maintenance of the processed material (burial of ash, etc.). Impacts directly associated with the Love Canal area would be emissions and releases from opening the interim storage facility, loading trucks (and any processing of the material for loading) and the movement of trucks through the streets. Operational limitations (time of day, dust suppression, dust covers, monitoring wind direction and speed, monitoring emissions) can be used to limit impacts during the opening/loading/ initial movement stages. It is difficult to determine the impacts of leaving the facility essentially open and having several thousand trucks drive through the streets over a period of time (one to several years). It is equally difficult to estimate the impacts of these trucks during a 1,500 mile trip to an offsite disposal facility. In addition to dust emissions (which can be controlled to some degree), the possibility of accident or incident exists. The very real possibility exists that negative community feelings would necessitate delays enroute or rerouting of trucks, lengthening the trip.

Activities at the disposal site should have minimal impacts, since the facility will be fully permitted and inspected under RCRA, TSCA, etc. The long term impacts there would probably be the same as impacts currently existing at those facilities. Long term impacts at Love Canal would include maintaining or demolishing the interim storage facility.

WORKER HEALTH AND SAFETY

Potential worker exposure exists at almost every step of the remedial activities. Each time the sediments are moved, potential exposure via dermal contact, inhalation and ingestion exists. These potential exposures will be mitigated by the use of personal protective gear (e.g., air purifying respirators, coveralls, gloves, etc.) and instruction on safe work practices (e.g., no eating, drinking or smoking in the work area).

SUMMARY

Table 7-1 summarizes the potential public and environmental consequences that could result from specific alternatives and the exposure mitigation measures. Impacts associated with the no-action alternative were discussed in Chapter 3.

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Table 7-1
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
1. Sewers			
a. No action	None	None	Continued sediment migration to creeks and sewage treatment facility. Continued potential public exposure to contaminants. See Chapter 3.
b. Hydraulically clean and repair.	1. Run blower and plug sewer section.	Public contact minimized.	Potential for small amount of material to remain; minimized by TV inspection
	2. Set up cleaning jet at downstream, collection manhole.	Notice to residents of activity startup.	
	3. Perform cleaning operation (cleaning jet propels itself upstream and is then reeled back to collection manhole	Immediate cleanup if backup reported in house. Backflow to cleaned sewer. Immediate cleanup if backup segments blocked.	
	4. Manually or mechanically remove large debris (using shovels and buckets).	Sewer demand decreased by performing action during dry season.	
	5. Use suction equipment (submersible pump and vacuum nozzle or vacuum truck) to remove sediments.	Volatiles inside house minimized by opening windows.	
	6. Transport sediment/water to treatment/disposal facility.	Dust emissions minimal because of sediment water content.	
	7. Remove plugs from cleaned sewer section.	Machinery noise during daylight work hours.	
	8. Decon blower, jet cleaning equipment and truck, and tank truck.	Truck Traffic to dewatering facility.	
	9. Collect and treat decon wash water.	Potential for discharge of cleaning water minimized by sewer plugs.	
	10. TV inspection of cleaned segment.		
2. 102nd Street Outfall			
a. No action.	None.	None.	Continued sediment migration. Continued aquatic life exposure. Continued potential public exposure to sediments and contaminated fish. (See Chapter 3.)

Table 7-1
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
b. Mitigate backflow to sewer by repair to tidal gate.	1. Remove rocks and debris from in front of headwall.	One day of activity.	Mitigates potential backflow from outfall to storm sewer.
	2. Mobilize backhoe and portable generator to top of headwall.	Small disturbance of outfall sediment because any actions are at outfall.	Continued sediment migration in river.
	3. Lower tidal gate into position on face of headwall.	Negligible public exposure.	Continued aquatic life exposure.
	4. Bolt tidal gate flange to headwall.	Machinery noise at outfall during daylight work hours.	Continued potential public exposure to to sediments and contaminated fish. (See Chapter 3).
c. Immediate Stabilization			
1) Construct stone berm with timber sheeting.	1. Inspect intended berm location for large debris and remove debris as necessary (drill several borings along alignment).	Little or no worker or equipment contact with sediment, unless when driving wall, debris or rocks are hit. Then the wall will be pulled out, repositioned (or obstacle will be moved), and replaced. Some worker contact possible while repositioning sheeting.	Berm/sheeting will need to be maintained to insure continued effectiveness.
	2. Beginning at shore line, use front end loader and bulldozer to transport and place stone.		
	3. Use barge mounted pile driver to place timber sheeting (second barge may be necessary to guide sheeting).	Sediments disturbed and possibly entrained during construction.	
2) Construct steel pile wall.	1. Inspect wall location for debris, remove debris as necessary.	See 2(c)1, except sediment disturbance lessened.	See 2(c)1.
	2. Use barge-mounted drill rig to drill borings along wall alignment to determine depth of river bed and identify locations of any buried debris.		
	3. Use barge-mounted pile driver to construct wall starting at shoreline (2nd barge will need to be used to guide sheet piling).		

Table 7-1
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
d. Long-term remediation			
1) In-place containment (with 2(c)1 or 2.	1. Construct stone berm or wall (See 2(c) 1 or 2 above).	See 2(c)1.	See 2(c)1.
	2. Dewater, backfill contained area and cap it.	Haul trucks with fill.	None.
2) 2(c) 1 or 2 followed by removal using land based equipment	1. Construct stone berm or wall (See 2(c) 1 or 2 above).	Potential for splashing workers as sediments are transferred from clamshell to truck.	None.
	2. Remove rip-rap along shore line and build berms or mud mats as necessary.	Biota will be lost.	Biota community expected to reappear.
	3. Use shore-based drag line or clamshell on crawler crane to excavate sediments.	Truck traffic to dewatering facility.	
	4. Load excavated sediments into truck and transport sediments to dewatering/disposal facility.		
	5. Excavate stone berm placing stone in trucks--transport to disposal facility. Rebuild shore rip-rap to depth of excavation.		
	6. Decon dragline/clamshell, trucks, and/or other equipment.		
3. <u>Black Creek</u>			
a. No action.	None.	None.	Continued sediment migration. Continued potential public exposure. (See Chapter 3)

Table 7-1
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
c. Hydraulically excavate.	1. Construct temporary berm at mouth of Black Creek to use as stream crossing.	Potential contact reduced because of closed transport in pipes.	Creek biota community expected to renew.
	2. Construct berms up and down-stream and dewater between.	Potential pipeline leaks minimized by double walls.	Potential residual contamination; banks cannot be remedied using hydraulic dredge.
	3. Construct access road, clear, and grub.	Volatile emissions minimal because no volatiles detected in sediments. (91st Street and Colvin Boulevard)	Dewatering facility may be open for year(s) to allow sediments to dewater and stabilize.
	4. Manually remove large debris; reflood.	Bridges required where pipe crosses road.	
	5. Use mud cat to dredge sediments.	Machinery noise during work hours.	
	6. Dewater and inspect; reflood and redredge if necessary.		
	7. Remove earth berms and dispose of at hazardous waste facility.	Creek biota will be lost.	
	8. Transport sediment to disposal facility.	Pipelines (two; each is one mile long) must be in place throughout; pumps will run continually. Haul trucks will carry debris through streets.	
	9. Dewater dredge spoils and treat filtrate.		
	10. Decon mud cat, truck, dewatering pump, piping, etc.		
6. <u>Sediment Dewatering</u>			
a. Mechanically dewater.	1. Transport sediment in water tight truck or pipe sediment to dewatering facility.	Sediment compression may emit volatiles. Minimal dust emission because sediment still wet and is dropped into covered container.	Action is an intermediate stage of remedial action. Sediments are removed to Interim Storage (See #7). No long term impacts from action.
	2. Feed sediment onto vacuum filter and air press.		
	3. Remove filter cake and transport to disposal facility.		

Table 7-1
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
b. Mechanically excavate	1. Construct access road along creek bank, clear, and grub.	Public contact minimized o Restricted access during activities. o Volatile emissions negligible because no volatiles detected in sediment. o Dust emissions minimal - Wet state of sediment - Cleanup of spills on banks o Sediment transport will be in leakproof trucks operating over short distance.	Potential for small fraction of contaminated sediment to remain. Creek biota community expected to renew.
	2. Construct berms up and downstream and dewater between using pumps.		
	3. Use backhoe to excavate sediments and place them in a watertight truck.		
	4. Transport sediments to dewatering/disposal facilities.		
	5. Remove earth berms and dispose of at hazardous waste facility.	Temporary haul roads.	
	6. Decon excavating equipment and truck, etc.	Machinery noise during daytime work hours. Creek biota will be lost.	
c. Construct tidal gate or sediment trap at confluence conjunction with 3.b. above.	1. Excavate approximately 18 inches in Black Creek (at confluence with Bergholtz Creek).	Negligible addition to 3.b.	Prevents backflow of Bergholtz Creek sediments to Black Creek if two creeks not cleaned concurrently or are cleaned by different methods.
	2. Mix and pour concrete to form tidal gate/sediment trap.		
	3. Continue with steps 6 and 7 above.		
4. Bergholtz Creek & Beyond			
a. No action.	None.	None.	Continued sediment migration. Continued aquatic life exposure. Continued potential public exposure to sediment and contaminated fish. See Chapter 3.
b. Mechanically excavate.	1. Construct temporary berm at mouth of Black Creek to use as stream crossing.	See 3.b. Numerous trips (more than 1,400) by haul truck to deposit sediments. Would block some streets at times. Noise and possible dust emissions.	Potential for small residential fraction of contaminated sediment to remain.
	2. Follow steps 1-6 under 3.b. above, except use frontend loader and clamshells.		

Table 7-1
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
	4. Transport and treat filtrate, at LCTF, release to sewer system and NFWTP.		
b. Use interim storage	1. Construct temporary system for sewer sediment dewatering.	Splashing from hydraulically dredged sediments. Emissions possible.	Hydraulically dredged sediments may not solidify for over a year; cannot cap facility until then.
	2. Construct interim storage facility (48,000 cubic yards capacity for hydraulic dredge water recirculation) with major design modifications for hydraulic dredged sediments.		
	3. Pipe water/sediments by pipeline (3,000,000 gallons) or haul sediments to facility (1,400 truck trips).		Continual feed (3,000,000 gallons) to Love Canal leachate treatment facility from hydraulically dredged sediments.
	4. Collect liquid drained into underdrain/leachate collection system or taken off top. Recycle to creek in hydraulic dredging. Treat and dispose of water eventually.		Temporary feed (600,000 gallons) to Love Canal leachate treatment facility from mechanically excavated sediments; cap facility immediately.
	5. Choose disposal/treatment option from 8.		
7. <u>Interim Storage</u>			
a. Construct an earthen bermed facility.	1. Excavate soils and construct berms. If facility is to be within the cap, cut hole in existing HDPE liner.	Placement of material in the facility could result in the release of contaminated materials that must be contained. Machinery would be involved, causing noise and dust. Haul trucks would bring material into area. Essentially same impacts as activities associated with capping Love Canal.	Aesthetics; if hydraulic dredging used, facility may not be capped for over a year. Operation/maintenance needed for as long as 30 years. Can be capped immediately if mechanically excavated sediments disposed of.
	2. Fine grade base and install bottom liner. If facility is in cap, weld bottom liner to existing liner.		
	3. Compact clay layer and install leak detection system. Compact additional clay.		
	4. Fine grade and install second synthetic liner.		

Table 7-1
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
	5. Place granular material and piping for leachate collection system.		
	6. Deposit sediments and decon all contacted equipment.		
	7. Construct cover including installation of a synthetic liner. (May be some delay in covering if facility is used for dewatering).		
	8. Topsoil and seed cover.		
b. Construct a concrete structure (Times Beach vault)	1. Excavate soils and install synthetic membrane.	See 7a.	See 7a. Aesthetic impact different than 7a. since vault would be taller, but Only one-fifth as long. Vault can be capped sooner than 7a.
	2. Place drainage gravel and geotextile layers.		
	3. Pour 8" reinforced concrete and coat with polymeric asphalt.		
	4. Place drainage gravel and geotextiles to act as leachate collection system.		
	5. Similarly construct concrete sidewalls.		
	6. Follow steps 6-8 in 7.a., except no delay in covering.		
8. Offsite Disposal			
	1. Open storage facility, remove sediment.	Opening of storage facility and removal of sediments could generate dust, release volatiles. Will take several openings to remove material. Many trucks required to make 1,500 mile trip; possible accidents/incidents. Treatment/disposal should have no more than "normal" impacts at disposal sites.	Facility must be maintained or demolished once empty.

Table 7-1
IMPACTS ASSOCIATED WITH
LOVE CANAL REMEDIAL ALTERNATIVES
(Continued)

Alternative	Steps in Operation	IMPACTS: Remedial Action Phase	IMPACTS: Long-Term
	2. Load sediment on truck. 3. Transport to site & unload. 4. Treat or dispose. 5. Decon all equipment.		
9. Incineration			
a. Construct facility onsite.	1. Construct incinerator. 2. Open storage facility. 3. Transport dewatered sediment to incinerator. 4. Incinerate sediment. 5. Transport ash to secure landfill for disposal. 6. Decon equipment.	If operated within the regulations, emissions and incinerator operations should not pose a risk thresy to workers or residents. Materials must be prepared (ground up, dried). Handling and transport of sediment will release dust, volatiles, and will generate noise. Incinerator will generate noise, ash, and steam. Must have building to house it. Transport of ashcould result in spills. May require additional area to accommodate all of equipment. Cooling water must be treated.	Several years to build; at least one year of operation necessary; storage facility would essentially remain open entire period. Landfilling of residual may necessitate construction of new facility at Love Canal, or transport to offsite facility (See 8).
b. Use mobile incinerator	Same as 9.a. except step 6 would involve demobilization of incinerator equipment.	See 9.a.	Same as 9.a., except incinerator would be onsite from 1 to 29 years and mobilization would be much shorter.

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Chapter 8
SUMMARY OF COSTS

Cost estimates for the evaluated alternatives which are feasible to implement were presented in Chapter 6. The costs are summarized in this section along with the major assumptions associated with each alternative.

ESTIMATED COSTS

The National Contingency Plan requires that comparative cost estimates be developed for remedial action alternatives. The estimates presented in this section include currently identified direct and indirect costs associated with each alternative. Changes in the description, sediment volume, site conditions, work scope, facility siting, criteria, or contingencies for an alternative will correspondingly affect the estimated costs. Without a careful consideration of all these fundamental cost determinants, these estimates should not be inferred to be representative for any other site.

APPROACH

The total cost of a remedial action includes all perceived capital and operating costs associated with that alternative. Direct costs such as personnel protection, onsite construction, transport, storage, and treatment costs are included. Indirect costs are also a major part of a remedial action cost, and include items such as decontamination stations, perimeter fencing, additional sediment testing, community relations, groundwater monitoring, pilot testing, and permitting costs.

Because this feasibility study is conceptual and because available data are limited, a contingency and administrative allowance will also be included. This includes a limited allowance for normal process refinement, unknown site conditions, engineering, administrative costs, and other contingencies normally included. Allowances for inflation, additional material volume, and abnormal technical difficulties will not be accounted for in the contingency.

GENERAL ASSUMPTIONS

Major assumptions which affect the cost of an alternative which were not mentioned in Chapter 6 are listed below.

1. Destruction alternatives will be applied to all sediment with TCDD concentrations exceeding one ppb.

2. Major equipment components will be preassembled in modules offsite to minimize onsite activities during construction and demobilization.

3. An on-stream time of 4,800 hr/yr was assumed for processing the contaminated sediment through treatment processes. This assumes a working schedule of 24 hours a day for 200 days, with the remaining time spent in maintenance, repair or inspection of the system. An equally realistic on-stream time of 2000 hr/year can be used.

4. A minimum of Level C (protective clothing and air purifying respirators) personnel protection will be required for all onsite activities associated with handling or processing, with the exception of vehicle operators working entirely in enclosed vehicle cabs. These workers will be required to use a minimum of Level D (work uniform with safety shoes, hard hats, etc.) protective gear. The use of Levels C and D personnel protective gear will reduce worker efficiency, shorten summer work periods, and include other health and safety requirements. For Level C, these effects have been reported to increase labor requirements by at least three times over standard conditions. Decontamination trailers, truck wash stations, and site safety officers will also have to be present for all onsite activities.

5. Extensive community relations efforts will be required for all alternatives, especially in coordinating the laying of pipeline, haulroads, etc.

6. Onsite security will be provided during all construction, excavation, and treatment activities. The force will consist of two guards during the day and one guard on each of the offshifts.

7. Leachate and wastewater treatment from storage facilities and mobile incinerator operation onsite will be provided by existing leachate treatment facility at Love Canal. At a minimum, a new clarifier will be added to the leachate treatment facility to remove solids.

SPECIFIC ASSUMPTIONS FOR REMEDIAL ALTERNATIVES

The following assumptions are listed under the alternative to which they primarily apply. Many also apply to other alternatives but to a lesser degree. See the previous section for further descriptions of each alternative.

OFFSITE INCINERATION

- The solids dewatering and size reduction equipment will be completely decontaminated and dismantled at the completion of the dredging and solids preparation activities. The equipment will be sold for a reasonable salvage value. If not sold, the equipment will be retained for use by EPA or DEC on other sites.

- Level C gear will be worn by workers involved in dredging, analytical, preparation, and loading activities. Level D gear will be worn by workers involved in construction, hauling, restoration, and dismantling.

- Incineration residue will be disposed of at the onsite secure interim storage facility if offsite disposal cannot be achieved through delisting or by use of a commercial facility.

ONSITE INCINERATION

- Onsite construction of a stationary facility, excavation, incineration, demobilization, and restoration will take more than 8 years. Excavation, construction, and restoration will be performed during the construction season of April through October. Incineration will take place year-round.

- Sampling and analytical activities will include year-round perimeter air monitoring during the incineration phase of the project, sediment sampling and TCDD analysis of areas being dredged, TCDD analysis of incinerated material, and TCDD analysis of leachate generated by the interim secure storage facility.

- Incinerated sediments will be restored onsite or disposed of in a secure landfill offsite.

- The incineration facilities will be completely decontaminated and dismantled at the completion of excavation and incineration activities. The stationary incinerator will be sold for a reasonable salvage value.

- Access roads will not have to be significantly upgraded.

- Level C gear will be worn by workers involved in excavation, analytical, and incineration activities. Level D gear will be worn by workers involved in construction, restoration, and dismantling activities.

- A storage facility will be constructed to contain material to be incinerated.

COST SUMMARY

The costs presented on the following table are comparative order-of-magnitude estimates, which are defined by the American Association of Cost Engineers as follows:

> Order-of-Magnitude Estimate: This is an approximate estimate made without detailed engineering data. Examples include: an estimate from cost capacity curves, an estimate using scale-up or scale-down factors, and an approximate ratio estimate. It is normally expected that an estimate of this type would be accurate within +50 percent or -30 percent.

These estimates have been prepared for use in project evaluation and implementation from the information available at the time. The final costs of the selected remedial action will depend on actual labor and material costs, competitive market conditions, final scope, levels of personnel protection and decontamination, implementation schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented here.

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Table 8-1
SUMMARY OF ESTIMATED COSTS FOR FEASIBLE ALTERNATIVES

Alternative	Total Present[1] Worth ($)
Sewer Remediation and Repair	
1. No Action	--
2. Cleaning	1,348,000
3. Abandon in-place and replace with new line	7,080,000
102nd Street Outfall Remediation	
1. Immediate Stabilization	
- No Action	--
- Filter Fabric and Stone	207,000
- Berm with Timber Sheeting	509,000
- Steel Pile Wall	636,000
2. Long Term Remediation	
- No Action Subsequent to Berm or Wall	--
- In-Place Containment	598,000
- Removal Using Shore Based Equipment	350,000
Creek Remediation	
1. No Action	--
2. Hydraulic Dredging of Bergholtz Creek	
- 1983 EID limits only	700,000
- 1983 EID limits plus 1st incremental reach	798,000
- Above Plus 2nd Incremental Reach (PROBABLE AREA)	1,026,000
3. Mechanical Excavation--Land-Based Clamshell	
- 1983 EID limits	165,000
- 1983 EID limits plus 1st incremental reach	225,000
4. Mechanical Excavation--Tracked Front End Loader (and Clamshell as needed)	
- 1983 EID limits	184,000
- 1983 EID limits plus 1st incremental reach	248,000
- Above, Plus 2nd Incremental Reach (PROBABLE AREA)	1,178,000
- Black Creek only (PROBABLE AREA)	120,000
5. Additional Sampling Bergholtz and Cayuga Creeks and Banks	169,000
6. Fence Downstream Section of Bergholtz and Cayuga Creeks	161,000
On-Site Storage	
1. Above-Cap, Earthern Berm	
- Mechanical Excavation/5,000 cy	803,000
- Hydraulic Dredging/5,000 cy	829,000
- Hydraulic Dredging; 21,000 cy (Probable Volume)	1,131,000
- Hydraulic Dredging/135,000 cy	4,924,000

Table 8-1
SUMMARY OF ESTIMATED COSTS FOR FEASIBLE ALTERNATIVES
(Continued)

Alternative	Total Present Worth ($)[1]
2. Concrete Vault	
- Minimum Volume, 5,000 cy	509,000
- Probable Volume, 21,000 cy	1,135,350
- Maximum Volume, 135,000 cy	7,298,000
Transport of Sediment, Dewatering and Leachate Water Treatment	
1. Sewer Sediments Dewatering/Love Canal Leachate Treatment Plant	
- Mechanical Dewatering	391,000
- Clarification/Filtration/Mechanical Dewatering	683,000
- Temporary Steel Walls/Passive Dewatering	280,000
2. Transport and Dewatering of Mechanically Excavated or Hydraulically Dredged Creek Sediments Costs Are Contained in Creek Remediationand Interim Storage Costs.	12,900,000-18,060,000
Off-Site Incineration	
1. Rollins: 5,000 cy	7,900,000-9,400,000
2. Rollins: 21,000 cy	18,000,000-31,500,000
3. Rollins: 135,000 cy	206,900,000-247,400,000
On-Site Incineration	
1. EPA Mobile Incinerator: 5,000 cy	4,800,000-7,100,000
2. EPA Mobile Incinerator: 21,000 cy	15,600,000-42,000,000
3. EPA Mobile Incinerator: 135,000 cy	86,800,000-147,500,000
4. Huber AER: 5,000 cy	6,700,000-8,100,000
5. Huber AER: 21,000 cy	12,900,000-18,060,000
6. Huber AER: 135,000 cy	111,200,000-148,300,000
7. ENSCO Mobile Incinerator: 5,000 cy	5,400,000
8. ENSCO Mobile Incinerator: 21,000 cy	16,800,000
9. ENSCO Mobile Incinerator: 135,000 cy	91,300,000

[1] In 1984 dollars.

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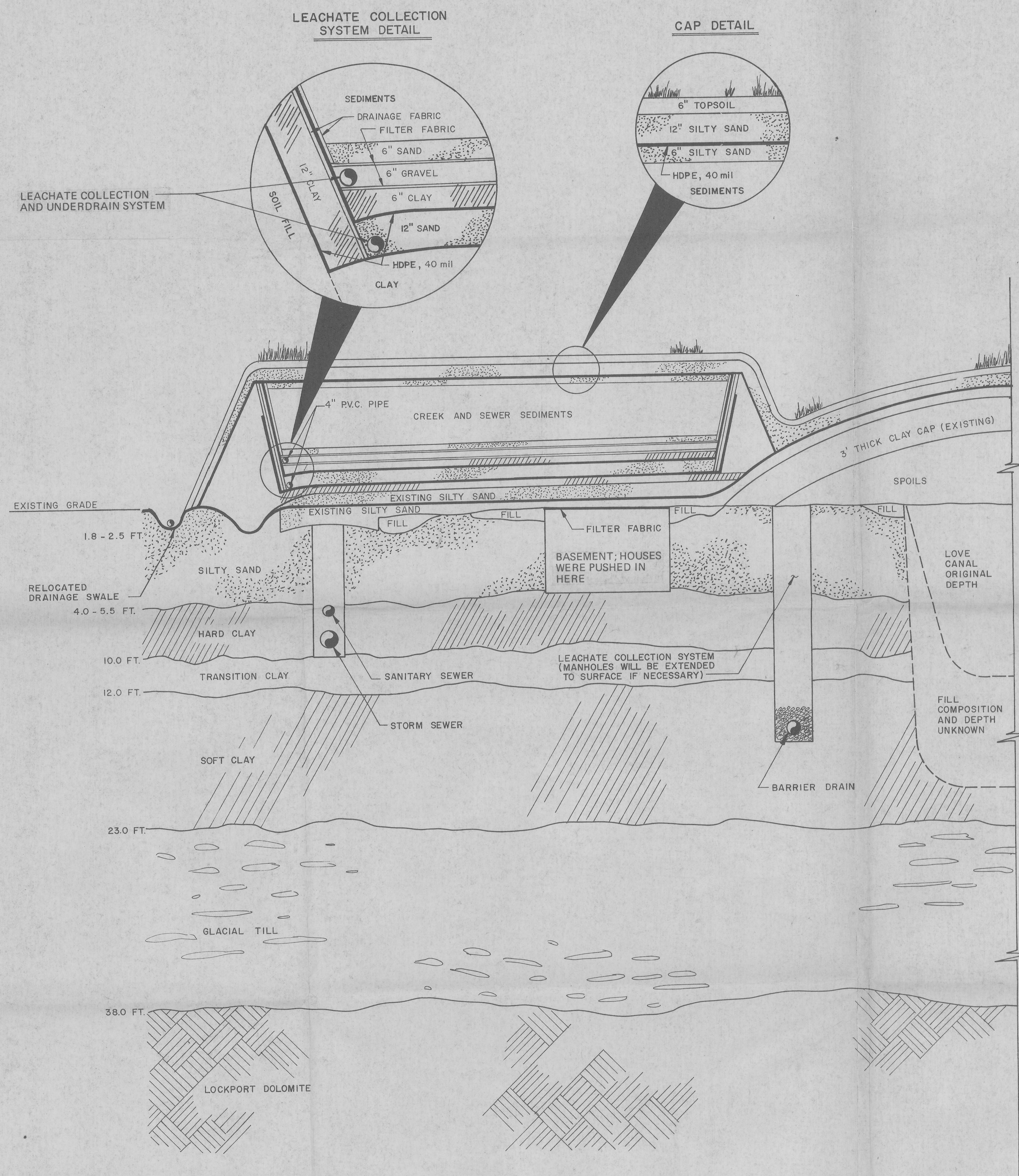
1987 - 2859300

ASCE 45 - 6.75 % x Const Cost = 193002

2500000 (2859300) 3000000

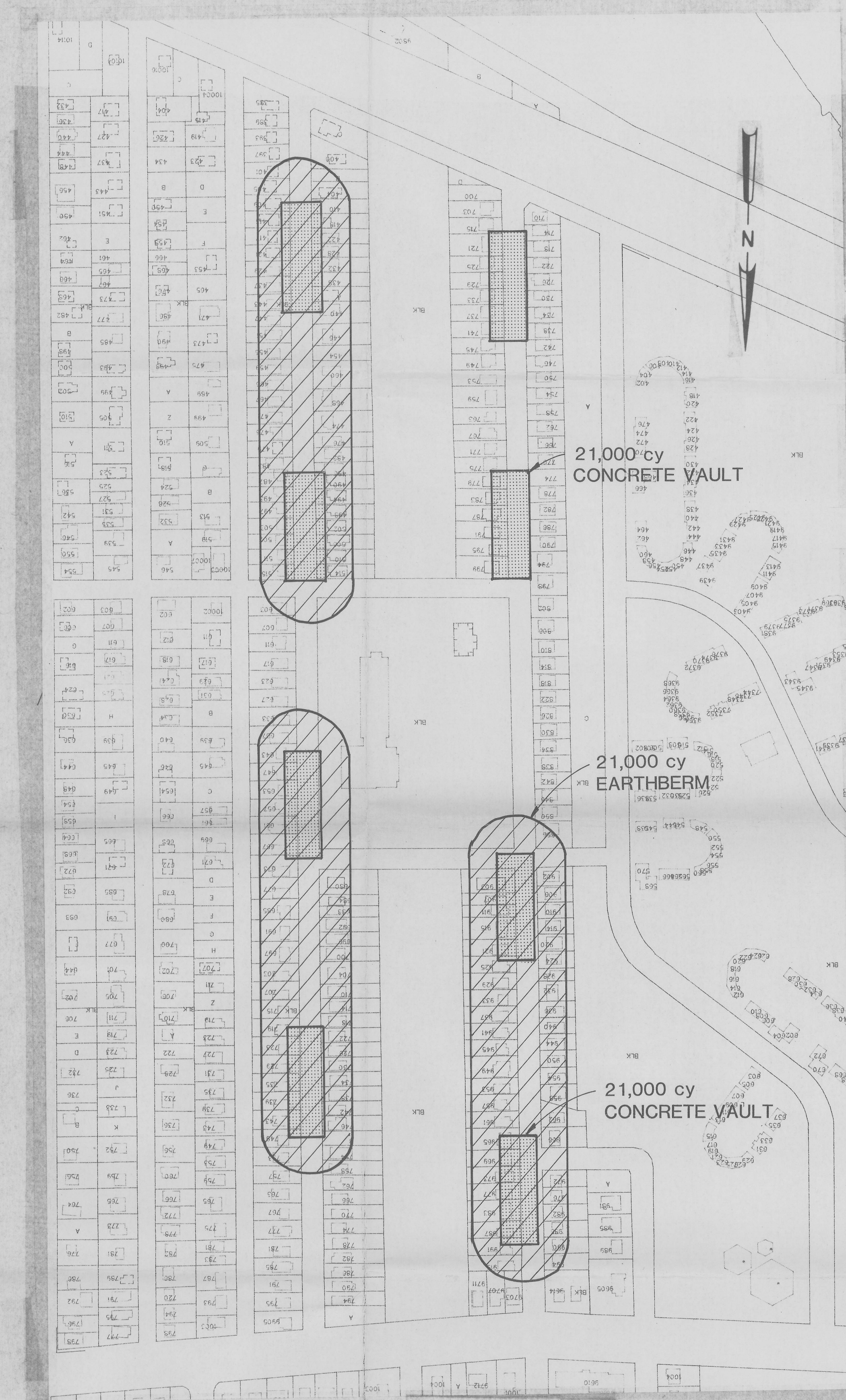
12.26 15.8

11.70 14.6



NOTE: ALL DEPTHS ARE APPROXIMATE AND VARY.

LEGEND
HPDE – HIGH DENSITY POLYETHYLENE
P.V.C. – POLYVINYL CHLORIDE



CONCEPTUAL LOCATION PLAN

PLATE 3

LOVE CANAL SEWER AND CREEK
REMEDIAL ALTERNATIVES EVALUATION

ABOVE /CAP EARTHERN BERM STORAGE

CONCEPTUAL SITE PLAN

NOT TO SCALE