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Occidental Chemical Corporation

Olin

Feasibility Study

Final Report

102nd Street Landfill Site
Niagara Falls, New York

Volume II & Appendices

July 1990

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ENVIRONMENTAL
CONSULTANTS

OCCIDENTAL CHEMICAL CORPORATION

OLIN CORPORATION

FEASIBILITY STUDY

FINAL REPORT

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VOLUME II - TEXT & APPENDICES

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SIRRINE ENVIRONMENTAL CONSULTANTS
GREENVILLE, SOUTH CAROLINA

7.0 DETAILED ANALYSIS OF ALTERNATIVES

Detailed analysis of alternatives is required by the NCP (40 CFR 300.430(e)(9)). Analysis is divided among Operable Units One, Two and Three, although a coordinated remedial action would require elements of each.

7.1 EVALUATION CRITERIA

The NCP requirements are reflected in the interim final document Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (OSWER Dir. 9335.3-01, October 1988). Nine evaluation criteria are presented that "have proven to be important for selecting among remedial alternatives". These criteria provide the basis for evaluating alternatives and subsequent selection of a remedy. The criteria are:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility or volume of waste
- Short-term effectiveness
- Implementability
- Present worth capital and operating costs
- State acceptance
- Community acceptance

All potential remedial alternatives will be evaluated according to the above criteria, except for State acceptance and community acceptance, which are evaluated separately. Short descriptions of these criteria are given below.

1) Overall protection of human health and the environment. A remedial alternative must adequately eliminate, reduce or control all current or potential risks through identified

pathways at a site to be considered for selection. Short-term risks during implementation of an alternative must be within acceptable levels.

2) Compliance with ARARs. Considers action-specific, location-specific and chemical-specific ARARs. CERCLA § 121(d)(4) provides five waivers for ARARs for remediations not financed by the Fund. Potential location-specific and chemical-specific ARARs for the Site are presented in Section 4.

3) Long-term effectiveness and permanence. Considers the residual risk following implementation of the alternative, adequacy of process controls, need for replacement of materials during design life.

4) Reduction of toxicity, mobility and volume. Considers type of process, volumes of waste involved, degree of reduction, degree of irreversibility, type/volume of residuals remaining.

5) Short-term effectiveness. Considers factors relevant to implementation of the remedial action, including protection of the community, protection of on-site workers, potential environmental impacts (e.g., air emissions), time required to achieve the remedy.

6) Implementability. Considers ability to construct, reliability of technology, ease of installing additional remedial actions (if required), monitoring considerations, and any regulatory requirements.

7) Present worth costs (capital and operational). Capital cost factors include:
   - Mobilization
   - Site development
   - Equipment purchase and rental
   - Engineering and construction management

- Material costs
- Excavation
- Health and safety
- Legal fees and insurance
- Contingency

Operational and maintenance costs reflect the following:

- Equipment repair and replacement
- Labor
- Purchased service costs
- Utilities
- Monitoring and analysis costs
- Disposal costs
- Administrative functions
- Contingency
- Review of remedy every 5 years, as required by SARA.

8) State acceptance. Assesses State concerns. As part of a cooperative agreement with the USEPA, State acceptance will be incorporated into the FS as part of the document review process.

9) Community acceptance. Assesses community concerns. Public comments will be made on the Final Feasibility Study and incorporated into the responsiveness summary of the Record of Decision. Where appropriate, anticipated public concerns based on existing remedial activities in the Niagara Falls area and at similar remedial actions elsewhere are included in the Feasibility Study.

Accuracy of the present worth costs is +50/-30 percent, per EPA guidance. The feasibility level cost estimates given with each alternative have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented herein.

A discount rate of 5 percent is used and inflation is taken to be 0 percent. A sensitivity analysis will be used when sufficient uncertainty exists regarding the design, implementation, operation or effective life of an alternative.

Costs for long-term groundwater monitoring on a biannual basis (estimated) and review of Site remedy every five years are given with each Operable Unit One alternative. These elements will be required for any remedial action that is selected where residuals remain at the Site. Present worth costs for these items are based on 30 years of operation, the maximum time allowed by EPA guidance. This approach provides conservative estimates of cost.

Schedule estimates are based on projected availability of materials and labor and may have to be updated at the time of remediation. Construction schedules are based on good weather, the ability to create and receive adequate and authorized access, and the availability of required utilities. All time estimates assume that the selected Remedial Design, including construction drawings, have been approved and all negotiations with contractors have been concluded.

7.2 OPERABLE UNIT ONE

Operable Unit One is comprised of landfill residuals, off-site soils, shallow groundwater and NAPL, as described in Section 6.1. Retained alternatives are described in Table 7.1. Potential remedial alternatives involving limited action, capping or incineration for the landfill residuals have multiple options regarding off-site soils, groundwater and NAPL. To clarify the analysis, remediation of the landfill residuals will be discussed only at the first reference within an alternative. Evaluations of other options within an alternative will reference the initial discussion for common elements of analysis.

7.2.1 Alternative OU1-1 - No Action

This alternative represents no action for the wastes now disposed at the Site ("landfill residuals"), off-site soils, groundwater and NAPL. No remedial action measures would be implemented and Site conditions would remain similar to those at the time of this study. Human health and environmental risks for the site would essentially be the same as those identified in the baseline risk assessments (Section 3). Long-term monitoring of groundwater conditions would be required for an appropriate period. The no action alternative is required by the NCP, to establish a baseline for evaluation of remedial alternatives.

Overall Protection of Human Health and the Environment

The landfill area is covered with approximately one foot of clean soil, vegetated, and surrounded along all sides of land access by a security fence. Accordingly, the baseline risk assessment determined that landfill residuals do not represent direct a human exposure pathway unless disturbed during any future construction or remedial action. The clean soil cover and absence of extensive burrowing animal populations indicates that landfill residuals also do not pose a significant environmental exposure pathway. The bulkhead limits erosion and potential environmental impacts. The Site is currently ranked 901 out of 989 on the National Priorities List (NPL) (55 FR 9688).

All Site groundwater discharges to the Niagara River and currently is not used as a source of drinking water. The availability of municipal water supplies indicates that future uses of groundwater for drinking or other purposes is unlikely. Potential risks from groundwater discharge through ingestion of municipal drinking water, exposure during swimming, and fish consumption were found to be significant by EPA's baseline risk assessment under a "reasonable maximum" exposure scenario. A significant human health risk is defined as a one in one million incremental increase in the chance of getting cancer. Environmental exposure to groundwater is through discharge to the Niagara River. EPA's baseline risk assessment determined that there is possible environmental risk to aquatic and benthic organisms in the embayment. OCC and Olin ("The Companies"), in a separate baseline risk assessment, used average EPA values for recreational use of the embayment and fish consumption and found no significant human health or environmental risks associated with groundwater and surface water pathways.

No pathway for direct human or environmental exposure to NAPL exists. However, NAPL is a source of chemicals in groundwater and may indirectly present risks to human health.

EPA's baseline risk assessment determined that risks due to off-site soils and perimeter soils are significant. Perimeter soils at sampling locations IJ-2 and JK-2 exceed the Center for Disease Control (CDC) guidance level for dioxin in residential soils, although no off-site soils exceed the CDC level for dioxin. Except for the dioxin above CDC levels, the Companies' baseline risk assessment found no significant human health or environmental risks associated with off-site or perimeter soils, based on a casual contact exposure scenario.

All future references to baseline Site risks for Operable Unit One will refer to the findings of EPA's risk assessment. The Companies' risk assessment is available for review as part of the Administrative Record.

Because of the human health and environmental risks posed by off-site soils, perimeter soils, and groundwater at the 102nd Street Site, the no action alternative cannot be considered protective of human health and the environment based on existing Site conditions and anticipated exposure pathways.

Potential future activities in the landfill are not covered under the baseline risk assessments and must be evaluated separately. The approximately one foot of clean cover over the landfill limits human contact and the potential for airborne emissions. Disturbance of landfill residuals would increase potential exposure to the surrounding populations and the environment. Institutional controls will be necessary to limit construction or other potentially intrusive activities at the Site.

Compliance with ARARs

Potential chemical-specific and location-specific ARARs are presented in Section 4. Because no remedial actions are included in this alternative, there are no action-specific ARARs.

No ARARs for potential remediation levels in soils were identified. A potential advisory is the general CDC guidance level for dioxin, which is exceeded in two limited areas of the perimeter soils.

Groundwater beneath the Site is considered Class GA (best use as a source of potable water) under the State classification system and Class II B (potentially available for drinking water, agriculture or other beneficial use) under EPA's Groundwater Classification Guidelines. Standards that are potentially ARAR for Class GA groundwater are:

- Maximum Contaminant Levels (MCLs) under the Safe Drinking Water Act (40 CFR 141.11);
- 6 NYCRR Section 703.5, NYSDEC Quality Standards for Groundwater;
- 10 NYCRR Subpart 5-1, NYSDOH MCLs;
- 10 NYCRR Part 170, NYSDOH Potential Sources of Water Supply.

EPA generally considers MCLs to be the most appropriate remediation level for Class II B groundwater. Based on this preliminary evaluation of ARARs, Site groundwater exceeds potential remediation levels and the no action alternative would not satisfy groundwater ARARs without a waiver (CERCLA Part 121(d)(4)).

The lowland area at the Site is not affected by the no action alternative. No endangered species or areas of significant historical importance were identified at the Site. The no action alternative therefore does not violate any location-specific ARARs.

Long-term Effectiveness and Permanence

The magnitude of residual risks at the Site would remain unchanged under the no action alternative. The existing security fence and vegetative cover limit current exposure to landfill residuals through direct contact or airborne emissions. Current inspections of the fence and grounds keeping efforts must be maintained to limit potential risk in the future.

Buried materials in the landfill are primarily construction debris, fly ash and other inorganic residuals. These materials are inert and should pose no potential for risk, as evidenced by the landfill's stability since operation has ceased. Organics deposited in the landfill are generally non-volatile and resistant to biodegradation, greatly limiting the potential for generation of emissions. The only potential risks for long-term stability are chlorate residuals and elemental phosphorus. Chlorate residuals were deposited in dilute form and pose the greatest potential risk when agitated. Surrounded by primarily inert and compacted materials, chlorate residuals should present no long-term risks. Elemental phosphorus is only a risk when exposed to air and Site quantities are currently stable beneath the water table. Groundwater level at the landfill shoreline is controlled through a transient response by the level of the Niagara River, which can temporarily fluctuate over two feet at the Site during withdrawal of water downstream for power generation (CRA/WCC, 1990). Natural factors affecting river level can also influence the Site groundwater level. Groundwater fluctuations in the fill and alluvium due to these river changes are less than 0.2 feet. The approximately 10 feet of compacted fill material above the phosphorus should provide an effective insulation of air during any transient drops in the water table, however, and the risk from buried phosphorus is considered minimal. There have been no observed problems with the phosphorus since closure of the site over 20 years ago. Landfill residuals are therefore considered stable and no long-term risks are anticipated under current conditions. The bulkhead limits shoreline erosion and retains residuals within the landfill, minimizing any potential environmental impacts.

Potential future concerns associated with buried landfill materials would result from erosion of the cover or excavation and subsequent exposure. Maintenance of surface vegetation would limit the potential for erosion. The security fence deters unauthorized access and intentional damage to the cover. Institutional controls would be required to limit future uses of the landfill that might disturb the cover or the bulkhead.

Periodic monitoring of Site groundwater would be required to evaluate the potential for risks in the future. Institutional controls may be necessary to prevent any future use of groundwater influenced by Site activities, although the availability of a municipal water supply indicates that potential groundwater uses are unlikely.

Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of the no action alternative every five years would be required by SARA. Conditions at the Site are not anticipated to change significantly over a five year period.

Reduction of Toxicity, Mobility or Volume

This alternative would not significantly reduce the toxicity, mobility or volume of Site residuals. A slight level of remediation may occur through natural processes such as biodegradation, adsorption and chelation. Site-related chemicals would remain in the groundwater and have the potential to leach into the Niagara River under this alternative.

Short-term Effectiveness

This alternative presents no additional risks to the community, on-site workers or the environment due to implementation. The no action alternative can be implemented immediately. Since no remedial actions are included, there is no schedule of completion.

Implementability

The no action alternative can be readily implemented. With regular maintenance, the existing fence and ground cover provide an effective deterrent to potential human exposure. The bulkhead will maintain the structural integrity of the landfill and control potential risks to the environment. Regular Site maintenance would be required.

Groundwater discharge is the sole migration pathway and this can be readily monitored using the existing observation wells. The no action alternative would not hinder the implementation of any remedial actions in the future.

The no action alternative would require strict institutional controls to govern future use of the Site. The adequacy of these controls to protect human health and the environment should be evaluated periodically to maintain their effectiveness.

Cost

Since the existing well portfolio is adequate for monitoring purposes, there are no construction costs associated with this alternative. Operating costs include periodic sampling of select monitoring wells, chemical analyses, reporting and review of the Site every five years. Sampling is assumed to be a biannual event focused on indicator parameters. Maintenance costs include grounds keeping and inspection and repair of the fence.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$ 0
Present Worth O&M Costs -	$1,380,000
Total Present Worth Costs -	$1,380,000

Community Acceptance

The community may be reluctant to accept no remedial activities at the Site. The no action alternative would not create aesthetic concerns or have a potential for significant fugitive emissions.

7.2.2 Alternative OU1-2 Options - Limited Action

One potential risk to human health associated with the Site is due to the perimeter surficial soils that exceed the CDC guidance level for dioxin in residential areas. These soils are localized at sampling locations IJ-2 and JK-2 and their volume is approximately 300 cubic yards. Actual risks associated with these soils are currently mitigated because they have been covered with clean gravel. The remedial assessment of landfill residuals under Alternative OU1-2 is focused on the given perimeter soils.

Off-site soils and the remaining perimeter soils are within CDC dioxin levels, but nonetheless were found to pose significant potential risks in EPA's baseline risk assessment through exposure to other Site-related chemicals. Remedial options under this alternative include no action and remediation with the targeted perimeter soils. Remedial options for groundwater under this alternative include no action and extraction in conjunction with a cutoff slurry wall. The cutoff wall would follow the shoreline and control groundwater intrusion from the river. Groundwater extraction would be followed by appropriate treatment.

NAPL remediation is problematic because recovery rates cannot be estimated with any certainty. While the nature and extent of NAPL in the landfill has been documented, the ability to selectively extract NAPL from the landfill is questionable due to its existence within the fill and alluvium and potential lack of accumulated depth at the clay/till confining layer. The absence of confined pools of NAPL could make productive recovery difficult. Further complicating NAPL collection is the strong sorption of free product organics to finely divided alluvial solids. The tortuous path of fluid flow within the porous alluvial materials at the Site indicates that diffusional mass transfer processes might control NAPL release rather than bulk flow, limiting the volume of NAPL that could be recovered. Recovery of dense NAPL has generally not been very effective (Mackay and Cherry, 1989). For these reasons, NAPL would be controlled by the groundwater recovery/cut-off wall system under Alternative OU1-2. No selective recovery of NAPL is considered under this alternative, although separation of incidentally collected NAPL from the recovered groundwater may be possible.

7.2.2.1 Alternative OU1-2A - Perimeter Soils Above CDC Dioxin Limit in On-site Secure Cell

This alternative would involve upgrading the existing security fence around the landfill as necessary and consolidating all perimeter soils with dioxin levels above the CDC guidance level in a secure cell on the Site. No remedial actions would be implemented for off-site soils, the remaining perimeter soils, groundwater or NAPL. Long-term monitoring of groundwater conditions may be required for an appropriate period.

The secure cell would isolate soils from human exposure and remove the most significant potential risk to human health due to surficial soils. The remainder of Site surficial soils present less risk to human health and the environment.

Construction of the secure cell would conform to RCRA and New York State technical requirements for hazardous waste treatment, storage and disposal facilities. State regulations allow alternative design and operating practices for secure land burial facilities when a demonstration shows that there will be no migration of hazardous constituents (6 NYCRR Section 373-2.14). The perimeter soils to be consolidated in the secure cell contain dioxin ($\leq$5.2 ug/kg) and mercury ($\leq$2.4 mg/kg) as the primary hazardous constituents. The limited mobility of these compounds indicate a non-significant migration potential. For purposes of the Feasibility Study, design of the secure cell would consist of a compacted sub-base, synthetic lower liner, synthetic cap, and a vegetated cover with drainage and be equivalent to the existing spoils cells on the site. Construction of the cell would be above grade to avoid any landfill residuals. Actual design specifications would be determined during Remedial Design, should this alternative be selected.

The sub-base and underlying liner would be constructed at an appropriate distance from the property boundary and above the 500 year flood plain. The liner would be tested to verify that construction complies with design specifications. Perimeter soils would then be excavated from the two sampling locations and consolidated in the secure cell. Dust control and other precautions would be used as necessary to safeguard the community and workers. A synthetic liner and the vegetated cover would then be placed over the cell. Site access is sufficient for the given tasks without additional construction.

The security fence would be repaired as necessary to prevent unauthorized access. Double strand barbed wire fencing and warning signs would be upgraded as necessary along the fence. Portions of the landfill security fence would have to be removed during excavation of the perimeter soils and replaced following application of clean backfill.

Periodic inspection of the secure cell and fence would be required to assess their integrity. Periodic monitoring would be required to assess groundwater conditions.

Protection of Human Health and the Environment

This alternative addresses the most significant source of risk to human health identified in EPA's baseline risk assessment under current conditions due to perimeter soils. Enclosure of the given perimeter soils within a secure cell would preclude potential exposure and hence risk to human health. Excavation of the soils could be achieved safely and with a minimum of dust generation. The proximity of the perimeter soils to the secure cell indicates that transportation would not generate significant risks to the community.

Since the secure cell is the only difference between this alternative and no action, the remaining considerations regarding protectiveness of human health and the environment are as described in Section 7.2.1. This assessment is based on current conditions and institutional controls would be necessary to limit potential activities at the Site in the future.

Compliance with ARARs

No ARARs for potential remediation levels in soils were identified. Consolidation of the given perimeter soils in a secure cell would satisfy the CDC guidance level for dioxin.

The perimeter soils are not a RCRA waste and consolidation within a unit does not trigger RCRA landfill requirements (EPA, August 1988). RCRA is therefore not applicable for this remedial action. The characteristics of the residuals and requirements of the secure cell indicate that RCRA construction requirements may be relevant and appropriate. Federal construction requirements are contained in 40 CFR 264 Subpart N. State requirements are contained in 6 NYCRR Section 373-2.14. No permits are required since this is a CERCLA action taking place entirely on-site, although substantive aspects of ARARs must be followed. The Health and Safety Plan governing all remedial activities must conform to 29 CFR 1910.120.

Potential groundwater and location-specific ARARs are as discussed in Section 7.2.1.

Long-Term Effectiveness and Permanence

The secure cell would satisfy the remedial objective of providing long-term prevention of human exposure to the perimeter soils above CDC guidance levels for dioxin. The lesser risks associated with chemicals in the off-site and remaining perimeter soils would not be reduced under this alternative.

The synthetic materials used in construction of the cell can be expected to provide an extended and durable service life. The impermeable nature of the cell would deny infiltration and prevent leaching. Chemical concentrations in the perimeter soils are such that no compatibility concerns are anticipated. The low mobility of dioxin and mercury in soils would limit any potential for migration should the secure cell fail. With proper maintenance, the secure cell can provide indefinite control of the given perimeter soils. Periodic inspections would be required to check for erosion, settling and condition of the drainage system. Long-term operation and maintenance should be uncomplicated and no major replacement activities are anticipated. The upgraded fence would help maintain the integrity of the secure cell by limiting unauthorized access.

Remaining risks at the Site are as discussed under Alternative OU1-1 (Section 7.2.1). Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are not anticipated to change dramatically over any given five year period.

Reduction of Toxicity, Mobility, or Volume

The toxicity and volume of residuals within the given perimeter soils would not be changed under this alternative. The potential toxic effects of the residuals would be reduced, however, since there would be no human or environmental exposure routes. The mobility of the chemicals in the perimeter soils, already low, would be decreased further in the secure cell.

The evaluation of other media in Operable Unit One under this criterion is as discussed in Section 7.2.1.

Short-term Effectiveness

The limited depth, volume, construction period, and concentrations of chemicals in the given perimeter soils indicate that potential risks to the community or workers during remedial activities are minimal. Potential risks would be limited through dust control and deliberate excavation techniques. Removal of the security fence adjacent to the excavation would be a temporary measure. Provisional measures would be taken to continue the deterrence of unauthorized access. Excavated soils would be transported in lined and covered trucks to minimize potential releases. Transportation would not expose the surrounding community since all movement would be within the landfill boundaries. Protection of workers would be provided by adherence to the remedial health and safety plan.

This alternative may require coordination with the City of Niagara Falls regarding traffic flow and underground utilities. Implementation of this alternative should require approximately one month after selection of a contractor and securing City approval.

Implementability

This alternative involves standard excavation and construction techniques that have been successfully employed at numerous hazardous waste sites. Excavation activities would have to be coordinated with the City of Niagara Falls and the local utility companies. A satisfactory number of qualified contractors and material suppliers exist and there should be no shortage of qualified bidders. Labor requirements in the Niagara Falls area may impact the schedule and cost of this alternative.

Cost

Construction costs associated with this alternative include mobilization, excavation, creation of the secure cell, backfill and upgrading the security fence. Operating costs include maintenance of the cell, periodic sampling of select monitoring wells, chemical analyses, reporting and review of the Site remedy every five years. Sampling is assumed to be a biannual event focused on indicator parameters. Maintenance costs include facility inspections and grounds keeping.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$420,000
Present Worth O&M Costs -	$1,380,000
Total Present Worth Costs -	$1,800,000

Community Acceptance

Removal of this potential risk to human health at the Site should be acceptable to the community. The low potential for exposures associated with this alternative would enhance community acceptance.

7.2.2.2 Alternative OU1-2B - Move Select Perimeter Soils to Secure Cell, Groundwater Cutoff Wall, Extraction, and Treatment

This alternative adds groundwater remediation to Alternative OU1-2A. A cutoff slurry wall along the shoreline would be required to control intrusion from the river and allow effective extraction of Site groundwater. Perimeter soils above the CDC guidance level would be consolidated within a secure cell on the Site and the security fence would be upgraded as necessary. No remedial actions would be implemented for off-site soils, the remaining perimeter soils, groundwater or NAPL. Long-term monitoring of groundwater conditions would be required for an appropriate period.

Extraction and treatment of Site groundwater would address potential Federal and State ARARs on groundwater chemical levels. The secure cell would isolate soils from human exposure and remove the most significant potential risk to human health due to surficial soils. The remainder of Site surficial soils present less risk to human health and the environment.

Placement of the cutoff wall would contain all NAPL within the saturated zone. The RI determined that migration of NAPL was essentially limited to the Site. For purposes of the FS, the cutoff wall would be constructed approximately 20 feet outside of the existing bulkhead and keyed into the clay/till confining layer, as shown in Figure 7.1. Actual placement of the cutoff wall would be established through the placement of geotechnical borings in the river. Borings would extend to the clay/till layer to define the extent of NAPL and to characterize the geology in the area of construction. The slurry wall would be constructed outside the extent of NAPL.

Permeability of the clay and till formations beneath the Site are less than $1X10^{-7}$ cm/sec. Length of the cutoff wall would be approximately 1700 feet. Depth to the confining layer along the shoreline varies from approximately 20 to 35 feet. An extra two to five feet should be allowed in construction of the slurry wall for keying into the confining layer and any surface preparation. For evaluating the implementability and cost criteria, it will be assumed that the depth of the cutoff wall would be 40 feet throughout the entire length. Width of the cutoff wall would be approximately three feet.

Construction of the cutoff wall outside of the bulkhead would avoid buried landfill debris. The only potential site-related chemicals encountered would be associated with seeps and sediments. Sediment excavation would be coordinated with the selected alternative for Operable Unit Two. Placement of the cutoff wall outside of the existing bulkhead would require construction of a new bulkhead. A cofferdam would be constructed outside of the shoreline and a rip-rap bulkhead placed along the new river's edge. Water inside of the cofferdam would be pumped out into the river. Clean fill would be placed in the dewatered area between the bulkheads and in the lowland area and compacted. Construction of the slurry wall would proceed through the compacted fill and extend to the confining layer. Structural stability of the compacted fill would be maintained by the new bulkhead along the shoreline. Site access would be upgraded where necessary with the construction of crushed gravel roads along the shoreline.

Unless the storm sewer is rerouted (Alternative OU3-3, Section 7.4.4), it must be extended through the slurry wall. Special considerations would be required during construction of the new bulkhead and cutoff wall. A temporary wet well would be required for the collection of storm flow. The wet well could be constructed at an upstream manhole or at the outfall. Collected water would be pumped directly to the river. Bulkhead and slurry wall construction would proceed as indicated. Once construction was completed, a hole would be placed in the slurry wall and bulkhead for extension of the storm sewer. The wet well would then be removed and final sewer connections completed. Extension of the storm sewer would have to occur during a dry (no flow) period.

The cutoff wall would have chemical compatibility with the chlorinated organic and inorganic (brine) residuals found in the landfill. Compatibility verification would be required as part of the Remedial Design should a slurry wall be specified as part of the Site Remedial Action. Compatibility testing using Site leachate might take 6 months or longer, depending on design requirements. For purposes of the Feasibility Study, a soil-bentonite-polymer construction will be assumed because of its compatibility with high salts content and halogenated organics. Periodic quality control testing would be required to evaluate the properties of the backfill/bentonite mixture. Cement might have to be added to the slurry wall mixture to maintain structural integrity. Actual construction materials would be determined during Remedial Design.

The backfill/bentonite slurry may be mixed using a bulldozer along the trench line or by using a dedicated mixing platform located on a pad. Construction methods would be resolved during Remedial Design.

Excess materials would be generated during construction of the cutoff wall due to swelling of the bentonite ("fluffing"). Materials generated from "fluffing" would be spread along the trench. Construction of the cutoff wall would need to include the possibility of working under Level C personal protective equipment. Excavation and mixing procedures would occur under wet conditions and minimize potential emissions. Monitoring of the ambient air would be required.

For purposes of the Feasibility Study, groundwater recovery would be through extraction wells. The RI estimated that approximately 15,600 gallons per day of groundwater in the fill and alluvium leave the Site, or approximately 11 gallons per minute (gpm). To be conservative, the extraction rate for the Feasibility Study is assumed to be 25 gpm. Drawdown due to groundwater recovery operations would be limited, to prevent possible lowering of the water table beneath the phosphorus. Any recovery of NAPL would be through incidental collection with the groundwater.

Off-site groundwater is that in Griffon Park and along the eastern boundary of the landfill. Site-specific indicator (SSI) compounds were below the survey levels in all monitoring wells within Griffon Park. Only one off-site well to the east of the landfill contained SSI above survey levels. Benzene and phenol exceed New York groundwater criteria in monitoring well MW-14. The groundwater extraction system in this alternative would address the region near MW-14.

Groundwater transmission lines would be placed below grade and excavation would avoid landfill residuals where possible. Lines would be heat traced and insulated to prevent freezing if placement was not below the frost line.

Potential groundwater treatment requirements were evaluated in Section 4. Based on representative concentrations in Site groundwater and anticipated discharge requirements, the following classes of compounds potentially require treatment:

- Volatile organics (e.g., benzene, dichloroethylene)
- Semi-volatile organics (e.g., trichlorobenzenes, tetrachlorobenzenes)
- Metals (e.g., arsenic, mercury).

Potential treatment alternatives for these compounds were presented in Section 6.3.1.3. As discussed, the actual treatment processes required for groundwater discharge would be determined during Remedial Design. For purposes of the Feasibility Study, groundwater treatment would include the following elements:

- Pretreatment (concentration equalization, neutralization, air stripping)
- Inorganic treatment (filtration, precipitation/flocculation)
- Organic treatment (carbon adsorption).

Discharge options for treated groundwater include release to the Niagara River under an SPDES permit, to an on-site subsurface infiltration gallery, and to the City of Niagara Falls Publicly Owned Treatment Works (POTW). Treatment requirements for these options cannot be determined without an official permit application. For evaluation purposes, treated groundwater is assumed to be discharged to the City of Niagara Falls municipal sewer system under a pretreatment agreement. No sewer connections are currently available at the Site and a connecting line would have to be constructed. The nearest connection is a 12-inch line on Buffalo Avenue near 93rd Street, about 1500 feet west of the Site. Actual methods for the treatment and discharge of groundwater would be determined in the Remedial Design, should groundwater remediation be selected.

Construction requirements and evaluation under the detailed analysis criteria for the secure cell were presented in Section 7.2.2.1.

Protection of Human Health and the Environment

This alternative would control groundwater discharge to the Niagara River, the only exposure route of chemicals in groundwater from the Site. EPA's baseline risk assessment determined that embayment concentrations due to Site discharge pose a significant risk to human health and the environment. There are no current or anticipated users of Site groundwater. This alternative would reduce the quantities of chemicals leaving the Site.

Construction of this alternative would not be expected to produce significant risks to the community or remedial workers. Potential exposures can be controlled through proper excavation and construction techniques and adherence to the remedial health and safety plan.

Compliance with ARARs

Site groundwater exceeds the potential Federal and State ARARs identified in Section 4. This alternative would effect remediation of the groundwater and address these ARARs. As defined, the Site includes the nearshore sediments of Operable Unit Two. Construction of the cutoff wall would occur entirely on Site and would not require any permits, per CERCLA §121(e). All construction activities in the Niagara River would be closely coordinated with the U.S. Army Corps of Engineers (USACE) and would meet the substantive requirements of the regulations authorizing the permits.

Potential action-specific ARARs associated with the extraction, treatment and discharge of Site groundwater are presented in Table 7.2. Air stripper emissions would require Best Available Control Technology (BACT) under 6 NYCRR Part 212. Vapor-phase carbon adsorption would likely satisfy BACT requirements. Potential actions involving off-site transport include the treatment/disposal of sludge associated with metals removal and carbon regeneration/disposal. The sludge and carbon would require manifesting and have to be taken to a RCRA-permitted facility if they were considered hazardous. EPA's off-site policy for CERCLA remedial efforts would require that the facility have no outstanding violations of its permit. Treated groundwater would not be subject to potential RCRA requirements since the domestic sewage exclusion (RCRA Subtitle C) states that non-domestic wastes are not considered hazardous when discharged to sewers containing domestic waste that is treated at a POTW. The POTW would also not be subject to RCRA requirements due to this discharge.

Potential ARARs associated with the given perimeter soils and construction of the secure cell are as given under Alternative OU1-2A (Section 7.2.2.1).

Long-term Effectiveness and Permanence

Extraction wells would achieve removal of groundwater for subsequent treatment. Groundwater recovery via extraction wells and submersible pumps is a proven technology that has a high degree of reliability. Maintenance consists of periodic inspection of the wells, pumps and control units. Chemical compatibility verification would be required for all wetted parts.

The retained technologies all have a proven capability of effectively and reliably removing chemicals from wastewater and groundwater. Elevated inorganic concentrations in the groundwater may create fouling in the treatment processes but this potential can be reduced through chemical precipitation of the influent, if necessary. The effectiveness of air stripping and carbon adsorption as removal mechanisms is primarily a function of a chemical's Henry's Law constant (Hc) and octanol-water partitioning coefficient (Kow), respectively. Based on the known values for Site chemicals, air stripping is expected to be an effective pretreatment process for a portion of the groundwater chemistry. The remaining organics would be removed through carbon adsorption. A preliminary assessment of biodegradability indicates that a portion of the anticipated influent is amenable to biological reduction. While the effectiveness must be verified through treatability testing, the low operating and maintenance requirements suggest fixed film biodegradation would be a possible pretreatment step.

Effluent from the groundwater treatment system would satisfy all discharge requirements and would not adversely impact the selected receiving system. Periodic inspection, maintenance and effluent sampling would be required. Sludge from filtration or precipitation processes would be generated on a continual basis and have to be stored on-site prior to proper disposal. Sludge that was hazardous by characteristic would be sent to a RCRA-permitted facility. Spent carbon would also be stored on-site prior to regeneration or incineration. These treatment residuals may be considered hazardous and require special handling and storage procedures. A "sacrificial" bed might be required at the head of carbon treatment if the extracted groundwater contains dioxins. Highly adsorbable compounds, such as dioxins, would be preferentially adsorbed in a lead column. This would allow carbon in the trailing columns to be handled by off-site facilities.

Having completed compatibility verification, long-term stability of the slurry wall should be good. Performance testing would be performed during installation and limited monitoring would be performed following construction. Extraction of groundwater would reduce the level of chemical exposure to the cutoff wall and further limit potential compatibility concerns. The clay/till layer would form a stable, low permeability region to key the slurry wall into and provide effective long-term containment of Site groundwater. Effective erosion control along the shoreline would be required to maintain the integrity of the cutoff wall.

Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are expected to improve due to groundwater extraction and the cutoff wall.

Reduction of Toxicity, Mobility, or Volume

Groundwater extraction would reduce the volume of chemicals at the Site while the subsequent treatment would reduce the toxicity of groundwater prior to discharge. The cutoff wall would limit the mobility of chemicals in the groundwater and of NAPL and allow more effective extraction.

Fixed film biodegradation would destroy biodegradable Site chemicals. The remaining treatment process, such as precipitation and carbon adsorption, would transfer chemicals to another media pending final disposal. Thermal regeneration of activated carbon would effect destruction of adsorbed chemicals. Should spent carbon contain dioxins, an option would be to take the carbon to the OCC facility in Niagara Falls for storage prior to incineration (if available). Sludge from inorganic treatment may require further treatment prior to disposal.

Short-term Effectiveness

Installation of extraction wells would pose no health risks to the community. On-site workers can be protected from potential risks through adherence to the remedial health and safety plan. Well cuttings would be securely stored on-site within the existing spoils cells. Construction of the groundwater treatment facility would pose no risks to the community or workers.

Potential risks during construction of the cutoff wall would be from dust generation and excavation of subsurface materials. Construction of the slurry wall outside of the bulkhead would minimize the potential for contact with landfill residuals. Excess materials generated during construction of the cutoff wall should contain little, if any, site-related chemicals and not present significant health risks. A health and safety plan, including ambient air monitoring, would be implemented to cover all aspects of remediation.

Compatibility testing of slurry wall mixtures may take 6 months or longer, depending on performance specifications.

Construction time for the cutoff wall would be approximately two months barring unforeseen difficulties. No work can be performed on the cutoff wall during freezing conditions. Installation of the extraction wells would take approximately one to two months and could occur simultaneously with slurry wall construction. Installation of the groundwater treatment system and construction of a connecting line to the municipal sewer would require approximately three months and would occur after the completion of other remedial activities.

Limitations on the time to reach ARARs in the groundwater include the effectiveness of the extraction system and the potential of non-collected NAPL and other landfill residuals to act as continuing sources of chemicals in the groundwater. Since no active source control measures are included in this alternative, groundwater remedial activities are assumed for costing and design purposes to last 30 years, the maximum period allowed under EPA guidance (EPA, September 1985).

Implementability

Construction of the slurry wall into the river should pose no significant difficulties. Creation of a new bulkhead would rely on conventional technologies and be straightforward. Dewatering of the intervening water between the pre-existing and new bulkheads would require high capacity, low head pumps and no treatment, since the river water is merely being re-routed. Placement and compaction of fill in the dewatered area can be advanced from the pre-existing bulkhead. Construction of the slurry wall into this dewatered area would be easier than behind the pre-existing bulkhead since there would be no potential for encountering Site waste materials.

Continued discharge of the sewer during construction of the slurry wall would occur through use of a temporary wet well. Dismantling of the wet well and extension of the storm sewer would have to be done in a period without precipitation.

Numerous monitoring wells have been constructed in the landfill area and no difficulties are anticipated in construction of the extraction wells. Distribution lines to the groundwater treatment system would be below grade and heat traced to prevent potential freezing where placed above the frost line.

Potential groundwater treatment processes for the anticipated flow rates have no special installation requirements and the combined treatment system should be readily constructed. The processes would have to be housed in a heated structure to provide effective performance year round. Footings for the supporting slab would have to be below the frost line to limit heaving during freezing periods. The required excavation may encounter Site residuals, which would be placed in the secure cell. Improved access may be required to allow removal of waste sludges and spent carbon. RCRA-permitted facilities would have to be identified for disposal of inorganic sludges and regeneration or disposal of spent carbon. Construction of the connecting line to the sewer would have to consider existing underground utilities and be coordinated with the City of Niagara Falls. Health and safety precautions would have to be followed in areas of landfill residuals.

Discharge to the City POTW would require development of a pretreatment agreement, since the Site would be a new source to the sewer. The City of Niagara Falls is currently under a Consent Order and all discharge applications require review by EPA and the NYSDEC as well as the City. Preliminary discussions with the City indicate the review process could take up to two years. Review of an SPDES permit application for discharge to the river could require a similar period. Permitting the discharge of treated groundwater would be a significant lead item for implementation of alternatives involving groundwater remediation. Design of the treatment system could not be finalized until the permit was approved and discharge requirements were defined.

Compatibility verification would be required to establish the correct slurry mixtures. Monitoring well data and historical disposal records could be used to estimate realistic worst case exposures for the cutoff wall. The estimated maximum required depth of 40 feet is readily achievable with standard construction equipment. The clay/till base and alluvium deposits are stable and defined media for the construction of a slurry trench. Water from the Niagara River and the municipal supply has an average hardness of 120 mg/l (as $CaCO_3$) and is suitable without pretreatment for use in the slurry. Future construction would not be hindered by the cutoff wall, should additional remedial measures be required. Slurry walls have been constructed at a number of sites in New York with good success.

Cost

Construction costs associated with this alternative include mobilization; extraction wells and the groundwater distribution system; the groundwater treatment system; discharge line to the sewer; material, labor and equipment for the cutoff wall; upgrading the Site roads; and those given with Alternative OU1-2A. Operating costs include power and maintenance for the extraction wells; labor, chemicals, power and sampling for the treatment system; inspections of the cutoff wall; and those given with Alternative OU1-2A. Sampling is assumed to be a biannual event focused on indicator parameters. Maintenance costs include facility inspections and grounds keeping.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$4,800,000
Present Worth O&M Costs -	$4,820,000
Total Present Worth Costs -	$9,620,000

Community Acceptance

This alternative should not generate any significant risks to the community. Construction operations would be unobtrusive and not cause any aesthetic concerns.

7.2.2.3 Alternative OU1-2C - Incinerate Perimeter Soils at OCC, Groundwater Cutoff Wall, Extraction, and Treatment

This alternative is identical to Alternative OU1-2B except that perimeter soils with dioxin above the CDC guidance level would be incinerated at the scheduled OCC rotary kiln incinerator. Soils would be stored in the OCC Centralized Storage Facility (CSF) at the Niagara Falls facility prior to incineration. Permit applications have been submitted for the incinerator and construction is tentatively scheduled for 1992. Groundwater and NAPL at the Site would be controlled by a cutoff wall along the shoreline and a pump-and-treat system. No remedial actions would be implemented for off-site soils, the remaining perimeter soils, or the landfill materials.

The CSF is operating under an approved RCRA Part B permit. Soils from the 102nd Street Site are included in the permit.

The given perimeter soils would be excavated as described under Alternative OU1-2A. Excavated soils would then be placed inside double lined synthetic (polyethylene/woven polypropylene) bags prior to transportation. The bags are a requirement of the Part B permit. Soils must be adjusted to a minimum pH of 10 using lime to control biological activity prior to placement in the bags. Full bags would be loaded into lined roll-offs and transported to the CSF for storage. Distance from the Site to the CSF along Buffalo Avenue is approximately 4 miles. Bags would be placed into the incinerator intact. Clean backfill would be placed in the excavation and covered with crushed stone. Excavation and transportation of perimeter soils would have to be coordinated with the City of Niagara Falls.

Construction requirements and evaluation under the detailed analysis criteria for the groundwater remediation system and cutoff wall are presented with Alternative OU1-2B in Section 7.2.2.2.

Protection of Human Health and the Environment

The protectiveness of this alternative is equivalent to that of Alternative OU1-2B, since the same media are addressed. This alternative would eliminate potential exposure to perimeter soils above CDC guidance levels and control groundwater discharge to the Niagara River, the only exposure route of chemicals from the Site. EPA's baseline risk assessment determined that the perimeter soils and Site discharge to the river pose significant risks to human health and the environment. This alternative would reduce the quantities of chemicals at and leaving the Site.

Construction of this alternative is not expected to produce significant exposures to the community or remedial workers. Potential exposures can be controlled through proper excavation and construction techniques and adherence to the remedial health and safety plan. Potential risks due to transportation are considered slight because of the low chemical concentrations, the short distance involved, and the protective enclosure provided by the bags. Operation of the incinerator would be to Federal and State emission requirements and therefore protective of human health and the environment. Potential emission rates would be estimated from soils analyses and expected removal efficiencies.

Compliance with ARARs

Shipping of the soils to the CSF would have to comply with New York State manifesting requirements (6 NYCRR Section 373-2). Transportation would comply with State and Federal requirements (49 CFR Parts 171-173). Storage of the soils would be according to the existing RCRA Part B permit. Operation of the incinerator would be according to the applicable RCRA operating permit.

ARAR considerations for the secure cell and groundwater extraction, treatment and discharge are presented under Alternative OU1-2B.

Long-term Effectiveness and Permanence

The incinerator would achieve a 99.9999 percent destruction and removal efficiency (DRE) for dioxins. Incineration is considered by EPA to be the best demonstrated available technology (BDAT) for organics in soils. Potential risks due to the incinerator ash should be negligible because of the initial mercury levels ($\leq$2.4 mg/kg). While there are no remaining sources of risk to human health or the environment, five-year reviews of this alternative would be required since waste residuals would be left at the Site.

Reduction of Toxicity, Mobility, or Volume

Incineration would address the greatest potential concern associated with the given perimeter soils by the essentially complete and irreversible destruction of dioxins. The resulting ash should pose no health risks. The volume of chemical residuals at the Site would also be reduced through groundwater extraction and treatment.

Short-term Effectiveness

The limited depth, volume and concentrations of chemicals in the given perimeter soils indicate that potential risks to the community or workers during remedial activities are minimal. Potential risks would be limited through dust control and deliberate excavation techniques. Excavated soils would be transported and stored in double-lined bags to minimize potential releases. Transportation would not expose the community to significant risk because of the sealed bags and the short distance involved. Protection of workers would be provided by adherence to the remedial health and safety plan.

Operation of the incinerator with the given perimeter soils is not expected to produce any significant risks to the community or workers. The bags would prevent any incidental exposure prior to incineration. Emissions from the incinerator would pose no risk since the DRE for dioxin would be achieved. Any mercury emissions generated from the soil should be controlled by the emissions control system.

This alternative might require coordination with the City of Niagara Falls regarding traffic flow and underground utilities. Excavation, transportation and storage of the soils should require approximately one month after selection of a contractor and securing City approval. Construction of the incinerator is tentatively scheduled for 1992.

Implementability

The CSF is a fully permitted and operating facility. Handling of the dry, shallow perimeter soils would be straightforward and there are no anticipated concerns regarding implementation. Incineration is a proven technology for low level dioxins in homogeneous soils and the required DRE should be readily achieved. Potential administrative concerns with this alternative include approval of the construction and operating permits for the incinerator. Potential technical concerns include start up of the incinerator and successful completion of a trial burn. While an operating date for the incinerator is uncertain at this time, placement in double-lined bags within a secure RCRA-approved area is a reliable storage method for the soils pending actual startup.

Cost

Construction costs associated with this alternative include mobilization, excavation, placement of soils in the bags, transportation, incineration and backfilling. Operating costs include soil storage fees and review of the Site remedy every five years. Maintenance costs include inspections of the storage facility.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$4,690,000
Present Worth O&M Costs -	$4,820,000
Total Present Worth Costs -	$9,510,000

Community Acceptance

Sediments containing dioxins from Black and Bergholtz Creeks have been transported along Buffalo Avenue to Occidental's Niagara facility without significant public comment. Construction of the OCC incinerator has been encouraged by the Niagara Falls City Council. This alternative should present no significant health risks or aesthetic concerns.

7.2.2.4 Alternative OU1-2D - Move Perimeter and Off-Site Soils to Secure Cell, Groundwater Cutoff Wall, Extraction, and Treatment

This alternative is an extension of Alternative OU1-2B in that all off-site and perimeter soils above organic SSI survey levels would be consolidated into a secure cell located on the landfill. Surficial soils would be scraped from around the existing structures and transported to the landfill. Excavated areas would be covered with clean fill and there should be no damage to the off-site structures. The security fence along the eastern, northern and portions of the western property line would have to be removed during excavation and replaced following placement of the clean backfill. Construction of the secure cell would be as described in Section 7.2.2.1. Groundwater and NAPL would be controlled with a groundwater remediation system used in conjunction with a cutoff wall. No direct remedial actions would be applied to the central landfill area.

The areal extent of off-site and perimeter soils to be consolidated within the secure cell is shown in Figure 7.2. For excavation to a depth of one foot, the total volume of these soils is approximately 5800 cubic yards.

Certain off-site and perimeter soils under this alternative are on private property. Access rights would have to be granted prior to excavation of these soils. Off-site soils are located north of Buffalo Avenue. Properties in this area are zoned C-1 (retail business). All but two of the buildings within the off-site soils are owned by the Love Canal Area Revitalization Agency. The only building within the off-site soils exceeding survey levels is the property at 9802 Buffalo Avenue. A substantial portion of this property is pavement, which would have to be removed during excavation. An occupied residence exists at 9818 Buffalo Avenue, in an area with no SSI above survey levels. Excavation along sampling vectors Q, R and S may infringe upon private properties to the east of the Site. These properties are zoned R-2 (one- and two-family residential). A building is immediately east of sampling location R-100, which has a total organic SSI concentration of 0.2 mg/kg.

Protection of Human Health and the Environment

Protectiveness of this alternative with respect to the perimeter soils above the CDC guidance level is as discussed under Alternative OU1-2A. Chemical concentrations in the off-site soils and remaining perimeter soils pose lower risks than the soils above the CDC guidance level. These risks were still determined to be significant in EPA's baseline risk assessment. Removal of these soils would increase the existing protectiveness of human health. Protectiveness of this alternative with respect to control of Site groundwater and NAPL is as discussed under Alternative OU1-2B (Section 7.2.2.2).

Compliance with ARARs

There are no ARARs governing the off-site and additional perimeter soils addressed under this alternative. Compliance with ARARs is as discussed under Alternative OU1-2B (Section 7.2.2.2).

Long-term Effectiveness and Permanence

The limited mobility of chemicals in the additional soils addressed under this alternative indicates that consolidation in a secure cell would provide reliable long-term isolation from human and environmental exposure. Enlarging the size of the cell would not compromise its integrity or longevity. The evaluation of other remedial activities under this alternative is as described with Alternative OU1-2B (Section 7.2.2.2).

Long-term monitoring would be required to evaluate future conditions and institutional controls would be necessary to limit future activities at the Site. Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are anticipated to improve due to groundwater extraction and the cutoff wall.

Reduction of Toxicity, Mobility, or Volume

The mobilities of chemicals in the additional soils are low. Enclosure in a secure cell would reduce the limited mobility of site-related chemicals. Evaluation under this criteria for remaining aspects of this alternative are as described under Alternative OU1-2B (Section 7.2.2.2).

Short-term Effectiveness

Risks associated with excavation are considered minimal. Potential risks can be limited through dust control, deliberate excavation procedures, and adherence to the remedial health and safety plan. Pavement and other aggregate materials may require sizing prior to inclusion in the secure cell. Excavation activities along Buffalo Avenue must consider underground utilities and possible traffic interruptions. Remedial activities would be coordinated with the City of Niagara Falls and local utility companies.

Removal of the security fence would occur in sections during excavation. Provisional security measures would deter unauthorized access during excavation.

Implementation of this alternative cannot occur until negotiations with any potentially impacted property owners are concluded. Construction of the secure cell should take approximately two months. Excavation of the off-site and perimeter soils, fence repair and backfilling should take approximately two months.

Implementability

Technical feasibility considerations regarding excavation and construction of the secure cell are addressed under Alternative OU1-2A and regarding groundwater remediation and the cutoff wall under Alternative OU1-2B. A potential limitation towards implementation of this alternative is the negotiation of access to or purchase of adjacent properties. Excavation north of Buffalo Avenue and to the east of the landfill would occur on property that is privately and publicly owned. The time and cost of these negotiations, if required, cannot be accurately predicted. Nine properties along the north side of Buffalo Avenue have been purchased by the Love Canal Area Revitalization Agency and this might facilitate access requirements.

Creation of the enlarged (from Alternative OU1-2A) secure cell poses no additional constraints and there is adequate space on the landfill for its construction. Activities required for this alternative rely on standard equipment and materials. There should be no shortage of qualified bidders or suppliers.

Implementability considerations for groundwater remediation and the cutoff wall are as discussed under Alternative OU1-2B (Section 7.2.2.2).

Cost

Construction costs associated with remediating the off-site and perimeter soils include mobilization, purchase of off-site properties, excavation, creation of the secure cell, backfill and upgrading the security fence. Operating costs include maintenance of the cell, periodic sampling of select monitoring wells, chemical analyses, reporting and review of the Site remedy every five years. Maintenance costs include facility inspections and grounds keeping. Additional construction and operating costs for groundwater and NAPL control are described with Alternative OU1-2B.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$5,040,000
Present Worth O&M Costs -	$4,820,000
Total Present Worth Costs -	$9,860,000

Community Acceptance

Public perception may dictate a preference for the removal and isolation of the perimeter and off-site soils. Access to adjacent private and public properties would be required.

7.2.2.5 Alternative OU1-2E - Stabilize Perimeter and Off-Site Soils, Groundwater Cutoff Wall, Extraction, and Treatment

This alternative involves consolidation and on-site stabilization of all off-site and perimeter soils above organic SSI survey levels. Volume of these soils is approximately 5800 cubic yards. Groundwater and NAPL would be controlled with a groundwater remediation system used in conjunction with a cutoff wall. No direct remedial actions would be applied to the subsurface residuals in the central landfill area.

Excavation of soils would be as described under Alternative OU1-2D. The security fence along the eastern, northern and portions of the western property line would have to be removed during excavation and replaced following placement of clean backfill.

Treatability testing would be required to verify the stabilization process parameters. Testing objectives include the optimal type and dosage of reagent(s), strength requirements, volume increase and monofill leachability (EP Tox, TCLP).

Excavated soils would be staged on the landfill under controlled conditions. The staging area would be lined and potential airborne releases would be monitored. Dust control would be practiced. Soils would be screened to remove large aggregate materials unsuitable for stabilization. These materials could be stored for insertion in the stabilized monofill. Perimeter soils east of the landfill are known to contain large rocks and similar debris.

Screened soils would be fed by a conveyor system to a pug mill for processing. Stabilization reagents would be metered in at the ratios determined during treatability testing.

Stabilized soils would be stored on a synthetic liner prior to final disposal. Periodic sampling of the stabilized soils would be performed to evaluate compliance with the performance requirements.

Treatment of the excavated soils and replacement may constitute disposal as defined by RCRA. Disposal requirements under RCRA may then be applicable for the stabilized soils. Exact disposal requirements are uncertain at this time. New York State has the jurisdiction to administer RCRA at the Site and allows alternative designs for secure land burial facilities when a case for no migration can be demonstrated. Stabilization of the soils would reduce the limited mobility of chemicals in the soils and no migration is anticipated. For purposes of the Feasibility Study, a secure cell as described under Alternative OU1-2D would be specified for on-site disposal of the stabilized soils. Actual requirements would be determined during Remedial Design, should this alternative be selected for Remedial Action.

Utilities required for the stabilization process include water, fuel (for the process equipment), and electricity. Water and fuel can be supplied from portable storage tanks. Storage tanks would be required for the fixation chemicals. Additional site access may be required.

Construction requirements for the cutoff wall and groundwater remediation system are as described under Alternative OU1-2B (Section 7.2.2.2).

<u>Protection of Human Health and the Environment</u>

Stabilization would not appreciably increase the protectiveness from that provided in Alternative OU1-2D since the soil chemicals already have a limited mobility and in Alternative OU1-2D would be enclosed in an impermeable cell and isolated from human exposure. Therefore, the protectiveness of this alternative is as described under Alternative OU1-2D (Section 7.2.2.4).

Compliance with ARARs

There are no promulgated remediation levels governing the off-site and additional perimeter soils addressed under this alternative. Potential action-specific ARARs relate to excavation followed by on-site treatment and resultant triggering of RCRA disposal requirements. New York State alternative design allowances have been used in the Feasibility Study for construction of a secure cell to hold stabilized materials. Actual requirements would be determined in Remedial Design. Since all remedial activities would take place entirely on-site, no RCRA permits would be required.

Off-site and perimeter soils are not listed RCRA wastes. The Extraction Procedure Toxicity Test may be required to verify that the stabilized soils are not characteristic hazardous wastes and that land disposal restrictions are not ARAR.

Compliance with ARARs for groundwater remediation and construction of a cutoff wall are as discussed under Alternative OU1-2B (Section 7.2.2.2).

Long-term Effectiveness and Permanence

Stabilization is a proven treatment method for soils containing low mobility organics and metals like those in the perimeter and off-site soils (EPA, June 1989). The long-term stability and resistance to leaching of the resulting monofill would be enhanced slightly by enclosure in a secure cell. The long-term effectiveness of stabilization can be estimated during the Remedial Design phase.

Remaining risks at the Site are associated with buried landfill materials, as discussed under Alternative OU1-2A (Section 7.2.2.1). Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are anticipated to improve due to groundwater extraction and the cutoff wall.

Reduction of Toxicity, Mobility, or Volume

Stabilization of the soils would reduce the limited mobility of site-related chemicals. Binding chemicals within the monofill would reduce their availability and hence their toxic effects. A volume increase would occur due to addition of the stabilizing reagents. Remaining considerations are as discussed under Alternative OU1-2D (Section 7.2.2.4).

Short-term Effectiveness

Potential risks to the community and on-site workers would be through airborne emissions during excavation and stabilization. Dust control and deliberate soil removal techniques would limit emissions during excavation. Dust control and limited agitation would limit potential exposures during stabilization. In both cases, the limited concentrations and low volatility of chemicals in the soils indicate a limited risk potential during remediation. The remedial health and safety plan would be followed throughout all activities.

All process equipment would be decontaminated before leaving the site. The stabilization compounds are non-hazardous and do not represent a risk to the community or workers.

Remedial activities cannot proceed without access privileges to adjacent private property. The time necessary to obtain access cannot be determined with any certainty. Excavation and stabilization of the off-site and perimeter soils would take approximately two months. Schedule for the remaining activities in this alternative are as described under Alternative OU1-2B (Section 7.2.2.2). Total implementation time for this alternative would be approximately six months.

Implementability

Use of common excavation and materials processing equipment indicates that process reliability should be acceptable. The reagent blend must be checked regularly to verify that adequate stabilization of chemicals is achieved. Stabilization has been implemented successfully at numerous waste sites. Stabilization would complicate any future remedial actions on the soils due to the rigidity of the resulting monolith.

Monitoring of the stabilized soils would be difficult due to their location in the secure cell. The impermeable nature of the cell and the limited mobility of the soil chemicals indicate that monitoring requirements are minimal.

A potential impediment to implementation of this alternative is securing access to the adjacent private properties. Implementability considerations for construction of the groundwater remediation system and the cutoff wall are as discussed under Alternative OU1-2B (Section 7.2.2.2).

Cost

Construction costs associated with this alternative include mobilization, excavation, rental of process equipment, stabilization reagents, creation of a secure cell, backfill and upgrading the security fence. Operating costs include maintenance of the cell, periodic sampling of select monitoring wells, chemical analyses, reporting and review of the Site remedy every five years. Maintenance costs include facility inspections and grounds keeping. Additional construction and operating costs for groundwater and NAPL control are described with Alternative OU1-2B.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$5,830,000
Present Worth O&M Costs -	$4,820,000
Total Present Worth Costs -	$10,700,000

Community Acceptance

Stabilization poses no significant risks to the surrounding community. Access to adjacent private and public properties would be required.

7.2.3 Alternative OU1-3 Options - Cap Landfill and Perimeter Soils

The common element within this set of alternatives is capping of the landfill and all perimeter soils. Capping would serve a dual purpose for the buried landfill residuals. A cap would deny potential human exposures in the future and limit infiltration through the landfill. Limiting infiltration would significantly reduce the potential for transport of chemicals in the landfill to the groundwater and reduce the groundwater extraction rates necessary to control migration. The majority of site-related chemicals are not particularly mobile and capping would further impede their potential movement. This collection of alternatives addresses the potential risk to human health associated with the localized perimeter soils above the CDC guidance level for dioxins in residential areas.

The landfill is currently covered with topsoil and well vegetated. A fairly dense growth of trees exists in the northwest and north central areas of the Site. Topographical relief is minimal.

Construction of a cap involves the use of heavy earth moving and grading equipment. Existing access may have to be improved for optimal use of this equipment. The landfill area requires clearing of trees and large brush. Vegetation and stumps would be grubbed below the surface to prevent regrowth. Care would have to be taken to avoid exposing any buried landfill debris. Groundwater observation wells not needed for long-term monitoring would be abandoned following the procedures used in the RI. The Site security fence would be replaced as part of construction activities.

Area of the cap would be approximately 24 acres, as defined in Figure 7.3. Fill would be imported to the Site and compacted to form a sloped base for the cap. The cap would be constructed of a single layer synthetic liner over the compacted sub-base. A multi-layer cap including compacted clay, as specified under RCRA, is not felt to be appropriate for the Site. The quantities of compactable clay necessary for construction might not be readily available locally due to restrictions on soils removal by the various townships. Shipping the required quantities to the Site would greatly increase costs without increasing the effectiveness of the remedy. The long-term reliability of synthetic liners is well established (Gundle, 1990) and a redundant barrier should not be necessary. Single synthetic liners have been approved to cap landfills at other CERCLA sites (Sirrine, 1988). Further discussion on the appropriate design for a Site cap is presented under the Compliance with ARARs criteria for Alternative OU1-3A. For purposes of the Feasibility Study, the Site cap would consist of a compacted sub-base of common and select fill, geotextile cushion, 60-mil high-density polyethylene (HDPE) liner, drainage net, filter fabric, soil cover and vegetation. A typical cross-section is presented in Figure 7.4. Permeability of the cap would be approximately 1 x 10^{-13} cm/s (Gundle, 1990). Actual design and materials of construction would be determined in the Remedial Design phase, should this alternative be selected for implementation.

The lowland area would be filled to establish a uniform elevation across the landfill. A bulkhead would be constructed along the southern exposure of the filled area for erosion protection. A drainage culvert would be constructed along the west side and the existing swale on the east side would be improved to control surface water runoff. A storm sewer line along the south side of Buffalo Avenue would be necessary to handle runoff along the northern edge of the cap. Underground utilities in this area might have to be relocated to the north side of Buffalo Avenue.

Materials within the landfill primarily include construction debris, fly ash, and inorganic residuals (lime sludge, brine sludge and gypsum). These materials should be well interlocked and consolidated. Substantial settling of the landfill is not anticipated. Organic materials in the landfill are not generally volatile or amenable to biodegradation. Organics found as dense NAPL would not be available for biodegradation since they are not in solution.

Options for off-site soils under this set of alternatives include no action and consolidation under the cap. Groundwater control options are extraction/treatment in conjunction with a cutoff slurry wall and with a circumferential slurry wall. NAPL remedial options include no action, control within the slurry walls, and selective extraction followed by incineration at the OCC liquid injection incinerator. Every alternative includes long-term groundwater monitoring.

7.2.3.1 Alternative OU1-3A - No Further Action

This alternative involves consolidation of perimeter soils within the fenced landfill area and construction of a cap. No direct remedial actions would be conducted for off-site soils, groundwater or NAPL.

Excavation and movement of the perimeter soils would be as described under Alternative OU1-2D (Section 7.2.2.4). Perimeter soils would be kept in a staging area and covered daily prior to inclusion beneath the cap to limit the potential for air-borne emissions. Construction of the cap would be as described above.

Protection of Human Health and the Environment

The greatest potential risks to human health associated with perimeter and off-site soils at the Site are posed by perimeter soils exceeding the CDC guidance level. Capping of these soils would prevent any incidental human exposure. Capping of the landfill would also preclude potential future exposures to buried residuals. This would reduce, but not eliminate, the reliance on institutional controls to control future Site activities. This alternative would not address risks posed by off-site soils.

The majority of buried landfill materials are above the water table. Placing a cap above these residuals would significantly reduce their leaching potential through infiltration. A cap would also control any chemical migration through surface runoff, although this potential is considered slight due to the existing vegetated cover. A reduced leaching potential would translate into lower chemical loadings into the Niagara River, hence lower risks. However, landfill materials and NAPL beneath the water table would continue to contribute chemicals to the river.

Compliance with ARARs

Design of the Site cap would have to consider potential RCRA requirements. Disposal of wastes was discontinued in 1970, prior to November 19, 1980 (the effective date of RCRA). Consolidation of waste materials within a unit and capping in place does not trigger RCRA disposal requirements (EPA, 1988). RCRA treatment and disposal requirements are therefore not applicable. While RCRA design requirements are directed at discrete, isolated units of defined disposal and were not meant to govern remedial activities at large dispersed areas located along a river's edge, such as the 22-acre Site, they are considered relevant and appropriate since they address areas of waste disposal. The cap design would comply with RCRA performance standards. For purposes of the FS, the single synthetic liner design would meet an equivalent standard of performance to RCRA (40 CRF 264.310) and New York State landfill closure criteria (6 NYCRR 373-2.14(g)), as follows:

- i) provide long-term minimization of migration of liquids
- ii) function with minimum maintenance
- iii) promote drainage and minimize erosion or abrasion of the cover
- iv) accommodate settling and subsidence to maintain cover integrity
- v) have a permeability less than that of natural subsoils.

Actual design requirements would be specified during Remedial Design.

This alternative would permanently eliminate the 0.6 acre lowland area. If this alternative is selected, a wetlands assessment would be performed to determine whether this area qualifies as a wetland. If it does, an equivalently sized wetland must be established elsewhere, or a variance obtained otherwise. All construction activities would take place above the 100-year flood plain. The Health and Safety Plan governing all remedial activities must conform to 29 CFR 1910.120.

Capping the Site would result in a fenced, sloped area overlying a synthetic liner, which would discourage future uses. Deed restrictions would represent a secondary control measure and would be included in the implementation of this alternative to prevent uses of the Site that could reduce the effectiveness of remedial measures.

Potential groundwater and location-specific ARARs are as discussed in Section 7.2.1. Potential ARAR considerations associated with remaining elements of this alternative are as described under Alternative OU1-2B (Section 7.2.2.2).

<u>Long-term Effectiveness and Permanence</u>
Implementation of this alternative would address existing and anticipated potential risks to human health through isolation of the perimeter soils and buried residuals. Potential risks remaining at the Site (under current conditions) would be associated with chemical loadings to the Niagara River. Chemical loadings following construction of a cap would be less than current loadings.

Leakage due to permeation of synthetic membrane liners is not significant in comparison to flow through holes created during construction or installation (Bonaparte, 1989). Use of a 60 mil liner would limit the potential for pin holes to be formed during manufacturing. Vacuum testing of seams in the field would provide excellent quality assurance and control the only other potentially significant avenue of cap leakage.

Long-term stability of the cap should be excellent with regular inspections and maintenance. The landfill materials are primarily inert and minimal settling or generation of gases is anticipated. Synthetic liners can accommodate slight settling due to their resiliency. Periodic inspections would be required to check for erosion, settling and conditions of the drainage system. Deterioration of cap integrity must be identified and corrected quickly to maintain effectiveness. The integrity of the fence must also be maintained to deter unauthorized access. An established inspection and maintenance schedule would be implemented following construction and continued for as long as chemical residuals remained at the Site. Regular care of the cap system would preserve its effectiveness indefinitely.

Caps have been constructed at numerous CERCLA sites with excellent results. Proper construction and regular maintenance would allow a perpetual operating life. Future replacement, if required, should be straightforward since the earthwork has already been completed and would isolate residuals during construction. Potential risks are considered minimal should elements of the cap require repair or replacement.

Evaluating the effectiveness of this alternative could be performed through periodic groundwater monitoring. Test vents might be required to estimate gas generation potential within the landfill. This potential is considered slight based on the materials in the landfill.

Since landfill residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Inspection and maintenance records for the cap would be reviewed at this time. Conditions at the Site are anticipated to improve with placement of the cap.

Reduction of Toxicity, Mobility, or Volume

The mobility and potential exposure of chemicals above the water table would be greatly reduced under this alternative. The mobility of chemicals below the water table would not change significantly. There would be no reduction in toxicity or volume of site-related chemicals. Risks due to residuals remaining at the Site would be minimal.

Short-term Effectiveness

Grubbing and grading of the Site would be necessary for construction of the cap. Dust control would be exercised to minimize the potential release of air-borne particulates. Earth working operations should not impact buried residuals and the only potential for exposure to Site-related chemicals due to remedial activities would be those in the perimeter soils. These soils would be kept in a staging area and covered daily prior to inclusion beneath the cap to limit potential exposures. Worker safety can be controlled through adherence to the remedial Health and Safety Plan.

Work along Buffalo Avenue might impact traffic flow and underground utilities. Remedial activities would have to be coordinated with the City of Niagara Falls and utility companies.

Construction of the cap could not begin until all materials are available and rerouting of utilities and traffic has been coordinated. Implementation time would depend on the number of crews involved but should be approximately 6 months. This schedule assumes standard production rates and compliance with all inspections of performance requirements and workmanship. Adverse climatic conditions could hinder construction performance and delay the schedule. Construction should be scheduled to allow vegetation immediately after final grading.

Implementability

Construction of a cap is a straightforward operation that has been accomplished at numerous waste sites. Clearing of the Site and establishment of access for heavy machinery should pose no difficulties. Care would be taken during removal of vegetation to minimize exposure to any buried residuals. Construction considerations at the 102nd Street Site include compaction of the underlying landfill residuals, availability of earthen construction materials, and surface drainage. Subsidence of landfill residuals beneath the cap following construction could deform and limit the effectiveness of the cap. This potential is reduced since the materials in the landfill are generally inert and should maintain a structural rigidity following compaction. Caps have been successfully implemented at other CERCLA landfills.

Local use restrictions would limit the availability of cap-quality clay and this would not be used as a redundant layer. The availability of common and select fill material should be adequate but procurement and transportation may limit construction activities. Covering the entire area of waste disposal would position the cap immediately adjacent to Buffalo Avenue. Drainage along this northern edge of the cap would require construction of a below grade storm sewer on the south side of Buffalo Avenue. Existing underground utilities would have to be re-routed. A drainage system would also have to be constructed along the western edge and the existing swale on the eastern edge would have to be improved. The drainage system would collect only rainwater, which could be discharged directly to the river. Cover design would have to consider possible freezing in the drainage system during winter.

Liner installation would have to be scheduled for suitable climatic conditions. Seams may be welded under freezing conditions but not during periods of precipitation. Final construction should allow for vegetation during the growing season.

Construction of the cap might cause temporary interruptions of traffic and utility service. Hauling the required quantities of materials to the Site may impact traffic patterns and cause road wear. A staging area would be required outside of the area to be capped.

Lead time for the HDPE liner and geotextile materials is approximately one month and competitive sources should be available. Identification of the common and select fill sources would be the single greatest lead item. Cap construction is a common remedial measure and there should be a number of qualified bidders. Labor requirements in the Niagara Falls area may impact the schedule and cost of this alternative.

Cost

Construction costs associated with this alternative include mobilization, excavation, grubbing, grading, earth work, materials, labor and health monitoring. Operating costs include maintenance of the cap, periodic sampling of select monitoring wells, chemical analyses, reporting and review of the Site remedy every five years. Sampling is assumed to be a biannual event focused on indicator parameters. Maintenance costs include facility inspections and grounds keeping.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$7,960,000
Present Worth O&M Costs -	$1,590,000
Total Present Worth Costs -	$9,550,000

Community Acceptance

Construction of the cap might cause temporary interruptions of traffic and utility service. Hauling the required quantities of materials to the Site may impact traffic patterns and road wear. These might be potential concerns to the surrounding community and the City of Niagara Falls. Construction activities would not cause any significant health risks or aesthetic concerns.

7.2.3.2 Alternative OU1-3B - Cutoff Wall, Groundwater Extraction and Treatment

This alternative is an extension of Alternative OU1-3A in that groundwater extraction and treatment in conjunction with a cutoff wall would be added. Groundwater, NAPL and residuals below the water table would be controlled. Capping would limit leaching of residuals above the water table and accelerate remedial efforts in the groundwater. No remedial actions would be applied to off-site soils.

Construction of the cutoff wall and groundwater extraction, treatment and discharge systems would be as described under Alternative OU1-2B (Section 7.2.2.2). Excavation of the perimeter soils and construction of the cap would be as described under Alternative OU1-3A (Section 7.2.3.1). Layout of the cap and cutoff wall are shown in Figure 7.5. Extension of the cap to the cutoff wall would add about one acre, making the total capped area under this alternative approximately 25 acres.

Construction of the slurry wall would precede that of the cap. Following compaction of fill material within the new bulkhead, the cutoff wall would be constructed. Layers of the cap would then be installed to the alignment of the cutoff wall. The HDPE liner would be keyed into the slurry wall to form an impermeable seal over the Site. A typical section of the cap and cutoff wall system is shown in Figure 7.6.

Groundwater extraction wells would be installed within the cutoff wall. Piping to the treatment system would be insulated and heat-traced for year round operation where installed above the frost line. The treatment facility would be located on a reinforced section of the cap or immediately adjacent to the cap. Access would be provided for maintenance of the extraction and piping systems.

Assessment under the evaluation criteria for the cap and for groundwater control are as discussed under Alternative OU1-3A (Section 7.2.3.1) and Alternative OU1-2B (Section 7.2.2.2), respectively. Summaries of the assessments are given below.

Protection of Human Health and the Environment

The cap would isolate Site materials and perimeter soils that currently and potentially pose a significant risk to human health. The cutoff wall and groundwater control system would essentially eliminate discharge to the river and would thus reduce the risks to human health and the environment associated with this pathway. Construction of this alternative would not be expected to produce significant risks to the community or remedial workers. This alternative would be protective of human health and the environment.

Compliance with ARARs

There are no identified ARARs for soil remediation. Alternative 3B would achieve groundwater ARARs outside of the slurry wall, which is the point of potential exposure, at the time of implementation. While the limited groundwater recovery rates would require a prolonged remediation period, both groundwater and NAPL would be contained by the slurry wall, thereby effectively eliminating possible routes of exposure. Potential chemical- and location-specific ARARs are presented in Section 7.2.1. Potential ARARs associated with groundwater control are presented in Table 7.2.

Long-term Effectiveness and Permanence

The cap and cutoff wall would be expected to have a high degree of reliability, as discussed previously. Long-term maintenance of the cap and groundwater control system would be required. The required maintenance presents no technical concerns. Effectiveness of this alternative can be assessed through periodic groundwater monitoring. Should elements of this alternative need replacement, doing so would pose no significant risk to human health or the environment.

The limited gradient generated by the groundwater recovery system would not significantly lower the water table. The potential for exposing phosphorus to the air would be minimal.

Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are anticipated to improve due to placement of the cap and groundwater extraction.

Reduction of Toxicity, Mobility, or Volume

Mobility and availability of landfill residuals above the water table would be greatly reduced under this alternative. The volume and toxicity of Site groundwater chemicals (and potentially NAPL) would not be significantly reduced through treatment. Sludge and spent carbon from treatment might contain hazardous constituents and handling would comply with Federal and State transportation and disposal requirements.

Short-term Effectiveness

Effective dust control and deliberate excavation techniques would limit any potential risks to the community and remedial workers. A health and safety plan, including ambient air monitoring, would be implemented to cover all aspects of remediation.

Implementation time for this alternative would be approximately 10 months. Construction of the cutoff wall, installation of the groundwater remediation system, and capping would occur sequentially. Potential lead items are identification of fill sources and coordination with local authorities. Groundwater ARARs outside of the slurry wall would be met when the complete remedy is in place. The potential for NAPL to impact groundwater and the stringent levels established by the potential ARARs indicates that groundwater extraction and treatment would not be sufficient to achieve ARARs for on-site groundwater in the short-term.

Implementability

Installation of the extraction wells prior to final cap construction would avoid the need to drive heavy equipment over the cap. Groundwater distribution lines would be run below grade along the access road to allow ready inspection and maintenance. Lines would be insulated and heat-traced to avoid freezing where placement was above the frost line.

Construction of the cap and slurry wall would have to be coordinated. The slurry wall cannot be installed under freezing conditions and the cap seams cannot be welded during periods of precipitation. Final construction of the cap should allow for vegetation during the growing season.

Construction of the sewer connection would require coordination with the City of Niagara Falls and utility companies. Permitting the discharge could take up to two years. Final design of the treatment system could not be performed until discharge requirements were established.

Cost

Construction costs associated with this alternative include mobilization, excavation, capping, the cutoff wall, installation of the extraction system, the treatment system and installation of a sewer connection line. Operating costs include maintenance of the cap, operation of the extraction and treatment system, sewer charges, periodic sampling of select monitoring wells, chemical analyses, reporting and review of the Site remedy every five years. Sampling is assumed to be a biannual event focused on indicator parameters. Maintenance costs include facility inspections and grounds keeping.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$12,600,000
Present Worth O&M Costs -	$5,030,000
Total Present Worth Costs -	$17,600,000

Community Acceptance

This alternative should not create any significant health risks or aesthetic concerns. Potential human health and environmental risks are addressed using construction methods that should not impact the lifestyle of the community.

7.2.3.3 Alternative OU1-3C - Circumferential Wall, Groundwater Extraction and Treatment

This alternative is identical to Alternative OU1-3B except that a slurry wall is constructed to enclose the entire landfill. This circumferential wall would limit groundwater migration through the Site and, in conjunction with a cap, provide competent containment of buried landfill residuals. Groundwater extraction would be at a flow rate sufficient to maintain a lower hydraulic head within the circumferential wall than outside. This inward gradient would limit the potential for leakage of chemicals through the slurry wall. This alternative would involve no remedial actions for off-site soils. NAPL would be controlled through the circumferential wall and groundwater extraction.

Length of the circumferential wall would be approximately 4800 feet. Depth to the confining clay/till layer along the Site varies from approximately 10 to 35 feet. An extra five feet should be allowed in construction of the slurry wall for keying into the confining layer and any surface preparation. Average depths to a confining layer are generally less around the remainder of the Site than along the shoreline. For evaluating the implementability and cost criteria, it will be assumed that the depth of the cutoff wall would average 30 feet along the perimeter of the landfill. Width of the circumferential wall would be approximately three feet. Layout of the cap and circumferential wall system is shown in Figure 7.7.

Construction of the circumferential wall would be as described under Alternative OU1-2B (Section 7.2.2.2). Installation of the slurry wall along the non-river sides of the landfill would be considerably easier since a supporting base would not have to be constructed. Griffon Park was used as a municipal landfill and the potential exists that waste disposal may have occurred along the eastern boundary as well. Soil borings conducted along the northern, eastern, and western boundaries of the 102nd Street landfill encountered native materials and domestic trash. Exposure to chemical residuals during construction of the circumferential wall is not anticipated. Continuous monitoring of ambient air would be used to assess personal protective equipment requirements. Uncovered landfill residuals would be taken to a secure area prior to consolidation beneath the cap.

Any buried materials that are encountered should be unreactive and well compacted. The interlocked nature of buried landfill debris can typically support construction of a slurry trench. Should sloughing become significant, a base of clean soils can be placed at the top of the trench to allow initiation of the slurry wall. The possibility of encountering buried residuals would increase potential personal protective equipment requirements.

Groundwater extraction within the circumferential wall would maintain an inward gradient in the groundwater. An inward groundwater gradient would limit the potential of leakage through the slurry wall.

The outward migration of chemicals in the groundwater would be largely eliminated through the combined effects of three engineered remedial measures. First, the landfill cap, with a hydraulic conductivity of approximately 1×10^{-13} cm/sec, would substantially reduce the volume of recharge to the landfill area through precipitation and site run-on. Secondly, the circumferential slurry walls, with a hydraulic conductivity of approximately 1×10^{-7} cm/sec, would dramatically reduce the rate of lateral flow through the fill material of the landfill. Thirdly, a drainage control trench constructed inside the slurry wall would control the groundwater gradient by inducing an inward flow. Review of site hydrologic conditions and preliminary modeling efforts indicate that gradient control would be required along the south (riverside) and west sides of the landfill and possibly along the east side. For purposes of the FS, drainage would be installed along the east, west and south sides of the landfill. Actual drainage requirements would be determined during Remedial Design, should this alternative be selected. This measure would essentially eliminate groundwater flow from the landfill toward the south and west.

An evaluation of the potential infiltration through the cap and groundwater flow through the slurry wall was conducted to estimate the groundwater extraction rate necessary to maintain a sufficient gradient. Assumptions and calculations for the extraction estimate are presented in Appendix D. Based on these estimates, a total volume of approximately 2500 gallons per day would have to be extracted along the south and west sides of the landfill for gradient control. The best method for distributed removal of this limited volume across the Site would be through an interception trench. Construction of this trench would be within the fill material between the slurry wall and the pre-existing bulkhead and inside the slurry wall along the eastern and western boundaries. Length of the trench would be approximately 3000 feet, as shown in Figure 7.7. A typical section is shown in Figure 7.8.

Depth of the trench would be slightly below the seasonal low water table. The induced drawdown would maintain an inward gradient but would not lower the water table substantially. Buried phosphorus would not be exposed to the atmosphere.

Groundwater collected in the trench would be pumped to the surface and held in an on-site storage tank. Volume of the tank would be approximately 20,000 gallons, equivalent to a week's production. The inside of the tank would be coated for corrosion protection. The base of the tank would be heated and the walls insulated to prevent freezing. Construction of the storage tank would either be on a fortified section of the cap or on adjacent property. Truck access would be required for hauling of collected groundwater, which would limit placement options for the tank.

Collected groundwater could be taken to the Love Canal treatment facility, the Olin wastewater treatment facility in Niagara Falls, or the OCC wastewater treatment facility in Niagara Falls, depending on the influent characteristics and discharge requirements. For purposes of the FS, collected groundwater would be taken by 4,000 gallon tanker truck to the permitted OCC wastewater treatment facility in Niagara Falls for treatment and discharge. The actual treatment facility would be determined during Remedial Design. The limited volume of groundwater generated with the circumferential wall alternative does not warrant construction of a dedicated treatment facility.

The only occurrence of SSI above detection limits in perimeter groundwater was in MW-14, along the eastern boundary of the landfill. Benzene and phenol in this well exceed New York groundwater criteria. The circumferential wall would enclose MW-14 and the underlying groundwater.

Protection of Human Health and the Environment

The cap would isolate Site materials and perimeter soils that currently and potentially pose a significant risk to human health, however, this alternative does not address the risks currently posed by off-site soils. The circumferential wall and groundwater control system would essentially eliminate discharge to the river, thus mitigating the risks to human health and the environment from this pathway. Construction of this alternative would not be expected to produce significant risks to the community or remedial workers.

Compliance with ARARs

There are no identified ARARs for soil remediation. Groundwater ARARs are as for Alternative 3B. Construction of the storage tank would conform to State design criteria for storage facilities (6 NYCRR 373-2.10). Transportation to the OCC facility would comply with Department of Transportation and New York State requirements. Discharge of the treated groundwater would have to comply with the existing POTW pretreatment agreement or SPDES permit. Potential chemical- and location-specific ARARs are presented in Section 7.2.1. Potential ARARs associated with groundwater control are presented in Table 7.2.

Long-term Effectiveness and Permanence

The cap and circumferential wall would be expected to have a high degree of reliability. The cap would be isolated from chemical residuals by the underlying compacted soils while the chemical compatibility of the slurry wall would be verified through performance testing. Long-term maintenance of the cap and groundwater control system would be required. The required maintenance presents no technical concerns. Regular maintenance of the cap and slurry wall system would preserve its effectiveness indefinitely and effect a permanent remedy. Effectiveness of this alternative can be assessed through periodic groundwater monitoring. Groundwater monitoring would include analyses for selected SSI parameters, to assess the efficacy of containment and the quality of off-site conditions, and water level measurements, to verify that an inward gradient exists across the circumferential wall. Placement of monitoring wells would be determined in the Remedial Design. Should elements of this alternative need replacement, doing so would pose no significant risk to human health or the environment.

Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are anticipated to improve due to the cap, circumferential wall and groundwater extraction.

Reduction of Toxicity, Mobility, or Volume

The mobility and availability of all landfill residuals would be greatly reduced under this alternative. The volume and toxicity of recovered Site groundwater (and potentially NAPL) would be significantly reduced through treatment. Residuals from treatment might contain hazardous constituents and handling would comply with Federal and State transportation and disposal requirements.

Short-term Effectiveness

Potential for risk would exist during excavation of landfill residuals for construction of the circumferential wall. All such materials would be staged in a secure area prior to inclusion under the cap. Effective dust control and deliberate excavation techniques would limit any potential risks to the community and remedial workers. Regular health and safety monitoring would be required.

Implementation time for this alternative would be approximately 12 months. Construction of the circumferential wall, installation of the groundwater remediation system, and capping would occur sequentially. Potential lead items are identification of fill sources and coordination with local authorities. As with Alternative 3B, Alternative 3C would achieve groundwater ARARs outside of the slurry wall at the time of implementation. The limited groundwater recovery rates preclude short-term remediation of Site groundwater. However, both groundwater and NAPL would be contained by the slurry wall, thereby effectively eliminating potential routes of exposure. Gradient control would be required for the life of the circumferential wall to prevent leakage. A 30 year lifetime, the maximum allowed for costing, is assumed for this alternative.

Implementability

Installation of the interception trench and circumferential wall prior to cap construction would avoid the need to drive heavy equipment over the cap. Groundwater distribution lines would be run below grade along the access road to allow ready inspection and maintenance. Lines would be insulated and heat-traced to avoid freezing where located above the frost line.

Construction of the circumferential wall within the compacted fill inside the new bulkhead should pose no difficulties, although cement might be added to the admixture for structural support. Construction of the circumferential wall along the non-river borders of the Site might contact buried non-Site residuals. Landfill debris should have sufficient structural integrity to allow construction of the slurry wall. Depth to a confining layer along these sides is less than along the river, facilitating construction of the wall. The slurry wall would have to allow for an extension of the storm sewer, unless the sewer was re-routed (see Operable Unit 3, Section 7.4).

Cost

Construction costs associated with this alternative include mobilization, excavation, capping, the circumferential wall, installation of the extraction system, the groundwater storage system and installation of a sewer connection line. Operating costs include maintenance of the cap, operation of the extraction and treatment system, transportation charges, periodic sampling of select monitoring wells, chemical analyses, reporting and review of the Site remedy every five years. Sampling is assumed to be a biannual event focused on indicator parameters. Maintenance costs include facility inspections and grounds keeping.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$12,100,000
Present Worth O&M Costs -	$4,540,000
Total Present Worth Costs -	$16,600,000

Community Acceptance

This alternative should not create any significant health risks or aesthetic concerns. All potential human health and environmental risks are addressed in an unobtrusive manner.

7.2.3.4 Alternative OU1-3D - Off-Site Soils under Cap; Circumferential Wall, Groundwater Extraction and Treatment

This alternative is an extension of Alternative OU1-3C in that off-site soils above the organic SSI survey levels would be consolidated under the cap. Construction procedures are as described below:

Off-site excavation - Alternative OU1-2D (Section 7.2.2.4)
Capping - Alternative OU1-3A (Section 7.2.3.1)
Circumferential wall - Alternative OU1-3C (Section 7.2.3.3)
Groundwater extraction/treatment - Alternative OU1-3C (Section 7.2.3.3).
Cap/circumferential wall placement - Figure 7.7

Excavation of off-site materials would be performed simultaneously with construction of the cap. Transportation of off-site materials to the landfill would be in lined and coveredtrailers.

Protection of Human Health and the Environment

The cap would isolate Site materials, including perimeter and off-site soils, that currently and potentially pose a significant risk to human health. The circumferential wall and groundwater control system would essentially eliminate discharge to the river, thereby mitigating the risks to human health and the environment attributable to this pathway. Construction of this alternative would not be expected to produce significant risks to the community or remedial workers. This alternative would be protective of human health and the environment.

Compliance with ARARs

There are no identified ARARs for soil remediation. Groundwater ARARs are as described for Alternative 3B (Section 7.2.3.3). Potential chemical- and location-specific ARARs are presented in Section 7.2.1. Potential ARARs associated with groundwater control are presented in Table 7.2.

Long-term Effectiveness and Permanence

The cap and circumferential wall would be expected to have a high degree of reliability, as discussed for Alternative OU1-3C. Long-term maintenance of the cap and groundwater control system would be required. The required maintenance presents no technical concerns. Effectiveness of this alternative can be assessed through periodic groundwater monitoring. Should elements of this alternative need replacement, doing so would pose no significant risk to human health or the environment.

Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are anticipated to improve due to the cap, circumferential wall, and groundwater extraction.

Reduction of Toxicity, Mobility, or Volume

The mobility and availability of all landfill residuals would be greatly reduced under this alternative. The already low mobility of off-site chemicals indicates that their limited mobility would not be significantly reduced by inclusion under a cap. The volume and toxicity of recovered Site groundwater (and potentially NAPL) would be significantly reduced through treatment. Residuals from groundwater treatment might contain hazardous constituents and handling would comply with Federal and State transportation and disposal requirements.

Short-term Effectiveness

Construction of the circumferential slurry wall would be outside of all buried Site residuals. Any off-site buried materials that are encountered during excavation that must be removed for construction of the circumferential wall would be staged in a secure area prior to inclusion under the cap. The potential risks associated with any off-site materials is considered minimal. Effective dust control and deliberate excavation techniques would limit any potential risks to the community and remedial workers. A health and safety plan, including ambient air monitoring, would be implemented to cover all aspects of remediation.

Implementation of this alternative cannot occur until negotiations with any potentially impacted property owners are concluded. Excavation activities along Buffalo Avenue must consider underground utilities and possible traffic interruptions. Remedial activities would be coordinated with the City of Niagara Falls.

Implementation time for this alternative would be approximately 12 months. Construction of the circumferential wall, installation of the groundwater recovery system, and capping would occur sequentially. Construction time for the cap would be a function of the number of crews and weather conditions. Potential lead items are identification of fill sources and coordination with local authorities. Time to reach ARARs for groundwater is as for Alternative 3C.

Implementability

Installation of the interception trench and circumferential wall prior to cap construction would avoid the need to drive heavy equipment over the cap. Groundwater distribution lines would be run below grade along the access road to allow ready inspection and maintenance. Lines would be insulated and heat-traced to avoid freezing where located above the frost line.

Construction of the circumferential wall along the non-river borders of the Site might contact buried non-Site residuals. Landfill debris should have sufficient structural integrity to allow construction of the slurry wall. Depth to a confining layer along these sides is less than along the river, facilitating construction of the wall. The slurry wall would have to allow for an extension of the storm sewer, unless the sewer was re-routed (see operable Unit 3, Section 7.4). Off-site debris may require additional compaction prior to inclusion beneath the cap, although the limited volume of materials is practically insignificant in relation to the 25 acre cap.

A potential limitation towards implementation of this alternative is the negotiation of access to adjacent properties. Excavation north of Buffalo Avenue and to the east of the landfill would occur on property that is privately and publicly owned. The time and cost of these negotiations, if required, cannot be predicted.

Cost

Construction costs associated with this alternative include mobilization, access to off-site properties, excavation, the cap, the circumferential slurry wall, installation of the extraction system, the groundwater storage system and installation of a sewer connection line. Operating costs include maintenance of the cap, operation of the extraction and treatment system, sewer charges, periodic sampling of select monitoring wells, chemical analyses, reporting and review of the Site remedy every five years. Sampling is assumed to be a biannual event focused on indicator parameters. Maintenance costs include facility inspections and grounds keeping.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$12,200,000
Present Worth O&M Costs -	$4,540,000
Total Present Worth Costs -	$16,700,000

Community Acceptance

This alternative should not create any significant health risks or aesthetic concerns. Rerouting of traffic and utilities might cause temporary inconveniences. Access to adjacent private properties would be required. Potential human health and environmental risks are addressed in an unobtrusive manner.

7.2.3.5 Alternative OU1-3E - Off-Site Soils under Cap; Cutoff Wall, Groundwater Extraction and Treatment; NAPL Extraction and Incineration (OCC)

This alternative is an extension of Alternative OU1-3B (Section 7.2.3.2) in that off-site soils would be consolidated beneath the cap and NAPL would be selectively extracted. Recovered NAPL would be stored on-site prior to incineration in the liquid injection incinerator at OCC's Niagara Falls facility. Construction procedures for previously described elements of this alternative are as given below:

Off-site excavation - Alternative OU1-2D (Section 7.2.2.4)
General capping - Alternative OU1-3A (Section 7.2.3.1)
Capping of off-site materials - Alternative OU1-3D (Section 7.2.3.4)
Cutoff wall - Alternative OU1-2B (Section 7.2.2.2)
Groundwater extraction/treatment - Alternative OU1-3B (Section 7.2.3.2).
Cap/cutoff wall placement - Figure 7.5

NAPL extraction wells would be located in areas of concentrated NAPL identified in the Remedial Investigation. Placement of these wells would be through the cap. Wells would be installed following construction of the sub-base. Subsequent cap layers would be built around the wells and sealed to avoid becoming conduits for infiltration. Access paths would be required for inspection and maintenance of the NAPL wells. Collected NAPL would be pumped to a central collection tank. NAPL in the tank would periodically be pumped to a truck for transportation to the OCC incinerator. Groundwater would be pumped to the on-site treatment system prior to discharge.

The effectiveness of NAPL recovery cannot be estimated accurately at this time because of distribution within the fill and alluvial hydrogeological regimes at the Site, the potential for NAPL to remain in the interstitial spaces of aquifer materials and the emerging state of dense NAPL recovery technologies. Funicular saturation and residual dense NAPL left at the end of pumping could be on the order of tens of percents or more of the initial quantity (Smith and Sykes, 1988). The extent of NAPL would be confirmed through geotechnical borings conducted at the start of remedial activities. The defined locations of recoverable NAPL would allow effective placement of dedicated extraction wells. Creosote, a DNAPL, has been recovered at rates of approximately 80 percent from dedicated wells (Mr. John Harrison, personnel communication). Extraction of Site NAPL would remove a significant source of chemicals to the groundwater.

Assessment of this alternative under the evaluation criteria would be as discussed with the alternatives listed above except for NAPL extraction. The evaluation here focuses on differences attributable to the selective removal of NAPL from the Site.

Protection of Human Health and the Environment

The only potential direct exposure route for NAPL is through discharge to the Niagara River. The cutoff wall and groundwater extraction system would control this discharge independently of selective NAPL recovery. Protection of human health and the environment is the same for this alternative as for Alternative 3B.

Compliance with ARARs

Groundwater ARARs outside of the slurry wall would be achieved at the time of implementation. Selective extraction of NAPL, if successful, could accelerate the achievement of on-site groundwater ARARs. The NAPL storage tank would have to be constructed and monitored to comply with New York State design criteria (6 NYCRR Section 373.2-10). Transportation to the OCC incinerator would comply with Department of Transportation and New York State (6 NYCRR Part 372) requirements. NAPL incineration would have to comply with the RCRA permit for the incinerator.

Long-term Effectiveness and Permanence

The long-term stability and impermeability of the cap and circumferential wall system would be verified through structural, chemical compatibility and permeability testing prior to construction. Regular maintenance of the system would preserve its integrity indefinitely.

NAPL collection efficiencies cannot be determined precisely at this time. High removal efficiencies may be complicated due to its presence vertically through the fill and alluvium, and the physical properties of dense NAPL. The presence of the clay/till confining layer and the cutoff wall would restrict NAPL movement and generate conditions conducive to dedicated NAPL extraction. A significant quantity of NAPL should be extracted after the completion of recovery efforts. Incineration of the NAPL would be a permanent remedy for recovered NAPL. Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are anticipated to improve due to the cap, cut-off wall, and extraction of NAPL and groundwater.

Reduction of Toxicity, Mobility, or Volume

Selective recovery of NAPL would reduce the volume of landfill residuals at the Site. Removal of NAPL would diminish a significant source of chemicals in Site groundwater. An indeterminate amount of NAPL would remain that could not be recovered. Incineration would permanently reduce the volume and toxicity of NAPL chemicals.

Short-term Effectiveness

Monitoring wells have been placed safely in the approximate locations where NAPL recovery might occur and no installation risks are anticipated. Transportation of the NAPL to the OCC incinerator would be approximately four miles along Buffalo Avenue. Use of chemically compatible equipment, deliberate loading procedures and prudent driving methods would limit the potential for any risks to the community.

Design life for NAPL collection cannot be accurately estimated. A remedial period of 10 years is assumed based on the estimated extent of NAPL.

Implementability

Construction of the NAPL extraction wells should be readily achieved. Recovery equipment for dense NAPL is in the developmental stage and data from full-scale applications is emerging. A number of manufacturers offer product-only recovery pumps for dense NAPL. NAPL has been recovered effectively at OCC's Taft Louisiana Plant using extraction wells. Piping and storage systems would have to be insulated and heat-traced to allow year round operation where constructed above the frost line.

Cost

Construction costs associated with this alternative include mobilization, installation of the wells, piping and the storage tank. Operating costs include energy costs, transportation, NAPL analyses and incineration.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$13,700,000
Present Worth O&M Costs -	$7,620,000
Total Present Worth Costs -	$21,300,000

Community Acceptance

This alternative should pose no health risks or aesthetic concerns to the community.

7.2.3.6 Operable Unit OU1-3F - Off-Site Soils under Cap; Circumferential Wall, Groundwater Extraction and Treatment; NAPL Extraction and Incineration (OCC)

This alternative is a modification of Alternative OU1-3E in that the slurry wall would encompass the entire landfill (circumferential wall). Off-site soils would be consolidated beneath the cap. Groundwater would be collected by an interception trench to maintain an inward gradient within the slurry wall. NAPL would be selectively extracted and destroyed at the liquid injection incinerator at OCC's Niagara Falls facility. Construction procedures for previously described elements of this alternative are as given below:

Off-site excavation - Alternative OU1-2D (Section 7.2.2.4)
General capping - Alternative OU1-3A (Section 7.2.3.1)
Capping of off-site materials - Alternative OU1-3D (Section 7.2.3.4)
Circumferential wall - Alternative OU1-3C (Section 7.2.3.3)
Groundwater extraction/treatment - Alternative OU1-3C (Section 7.2.3.3)
NAPL extraction/incineration - Alternative OU1-3E (Section 7.2.3.5).
Cap/circumferential wall placement - Figure 7.7

Assessment of this alternative under the evaluation criteria would be as discussed with the alternatives listed above except for the combination of a circumferential slurry wall with NAPL extraction. The evaluation here focuses on differences attributable to the cumulative effects of isolating Site residuals within an impermeable enclosure and the selective removal of NAPL.

Protection of Human Health and the Environment

Creation of a competent enclosure about the Site would deny all potential exposure routes to the community and the environment. All Site-related residuals would be effectively controlled within a monitored setting. The perimeter soils along the eastern boundary of the Site would be contained within the circumferential wall, and other perimeter and off-site soils would be placed beneath the cap.

Implementation of this alternative would involve a minimal amount of excavation into Site residuals. The absence of intrusive actions would minimize the potential for fugitive emission releases to the community and potential exposure of reactive materials (chlorates, phosphorus) within the landfill.

Compliance with ARARs

Achievement of groundwater and action-specific ARARs for this alternative is as discussed for Alternative 3E (Section 7.2.3.5).

Long-term Effectiveness and Permanence

The long-term stability and impermeability of the circumferential wall would be verified through structural, chemical compatibility and permeability testing prior to construction. Selective extraction of NAPL would reduce the potential for direct contact between NAPL and the slurry wall. Gradient control within the circumferential wall might improve the effectiveness of NAPL recovery by minimizing lateral movement within the saturated zone. Incineration of NAPL is a permanent remedy for recovered NAPL.

Isolating Site residuals within the regularly maintained enclosure of the cap and circumferential wall would provide effective denial of potential exposure routes for human health and the environment. Synthetic membrane caps and soil-bentonite slurry walls both have a demonstrated history of providing durable barriers to liquid movement. Unified cap/slurry wall systems have been applied successfully at a number of hazardous waste remediations.

The limited volume of extracted groundwater necessary to maintain the effectiveness of this alternative allows use of an interception trench, which would involve lower maintenance and replacement requirements than would well point extraction with a cutoff wall. Transportation of extracted groundwater to an existing treatment facility that is continuously manned would offer more reliable remediation than an on-site system. Construction and operation of the NAPL and groundwater storage facilities would be to New York State requirements and should allow reliable and effective service.

Reduction of Toxicity, Mobility or Volume

The interconnected cap and circumferential wall system would effectively reduce the mobility of Site residuals. The volume of chemicals in recovered groundwater and NAPL would be permanently reduced through extraction and treatment or destruction. Any groundwater or NAPL that is not recovered would be effectively controlled by the circumferential wall, thereby controlling the potential toxic effects of Site residuals.

Short-term Effectiveness

Potential risks to the community during implementation of this alternative are minimal. Construction of the circumferential slurry wall would be outside of all buried Site residuals. Any off-site buried materials that are encountered during excavation that must be removed for construction of the circumferential wall would be staged in a secure area prior to inclusion under the cap. The potential risks associated with any off-site materials is considered minimal. Effective dust control and deliberate excavation techniques would limit any potential risks to the community and remedial workers. Construction of the slurry wall would be conducted under wet conditions, which would minimize the potential for fugitive emissions. A health and safety plan, including ambient air monitoring, would be implemented to cover all aspects of remediation.

Transportation of groundwater and NAPL to the OCC treatment facilities would be approximately four miles along Buffalo Avenue. Use of chemically compatible equipment, deliberate loading procedures and prudent driving methods would limit the potential for any risks to the community.

Operating life for the cap and slurry wall would be indefinite with regular inspections and maintenance. For costing purposes in the FS, the maximum allowable period of 30 years has been used. Design life for NAPL collection cannot be accurately estimated at this time. A remedial period of 10 years is assumed for NAPL recovery.

Implementation time for this alternative would be approximately 12 months. Disposal of extracted groundwater at an operating facility could reduce permitting requirements and facilitate implementation of this alternative.

Implementability

Construction of the cap, circumferential wall, interception trench and NAPL recovery system are as discussed previously and no significant difficulties are anticipated. Construction of the circumferential wall and cap along Buffalo Avenue might require rerouting of traffic and relocation of underground utilities. Implementation of this alternative would require coordination with the City of Niagara Falls and the appropriate utility companies. There are no anticipated constraints regarding the availability of materials or qualified contractors.

The effectiveness of the remedy can be verified through groundwater monitoring and periodic inspections of the cap. If necessary, repairs to the cap could be readily implemented due to this structured design and use of rapidly exchangeable materials. Any defects in permeability or structural integrity of the slurry wall could be addressed through in situ pressure grouting. Should there be a temporary decrease in effectiveness of the cap or slurry wall, corrective actions necessary to mitigate any chemical releases would be undertaken.

Cost

Construction and operating costs associated with this alternative are as described previously. The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs -	$13,200,000
Present Worth O&M Costs -	$7,140,000
Total Present Worth Costs -	$20,300,000

Community Acceptance

This alternative should pose no health risks or aesthetic concerns to the community. Temporary interruptions of utilities and traffic patterns might be required.

7.2.4 Alternative OU1-5 Options - Incinerate NAPL Areas, Cap Site

The central theme of this set of alternatives is on-site incineration of off-site soils, perimeter soils and the concentrated organic areas in the landfill indicated by the identified extent of NAPL. Incineration is capable of destroying all organic SSI compounds found in soils and debris and would be a permanent remedy for these residuals. Inorganic materials, such as heavy metals, would not be destroyed and would partition to the ash or to the stack emissions. Destruction of the majority of organic SSI residuals at the Site would provide the most permanent remedy for the Site, albeit the most technically difficult to accomplish.

The areal extent of materials to be excavated, as indicated by the most likely extent of NAPL, is approximately 5.7 acres. The average fill thickness in the area of potential excavation is approximately 10 feet. The average depth to groundwater in this area is approximately 8 feet. For the Feasibility Study, it is assumed that 20 percent of the excavated materials would be collected from below the water table and are therefore under saturated conditions. No dewatering would be conducted under Alternative 5A. Fill materials above the water table are assumed to be at 20 percent moisture, while those below the water table are at approximately 50 percent moisture. The materials to be excavated under this option include:

- Unsaturated fill materials (73,600 cubic yards)
- Saturated fill materials (18,500 cubic yards)
- Perimeter soils (3,400 cubic yards)
- Off-site soils (2,300 cubic yards).

Total volume of materials to be excavated is approximately 98,000 cubic yards. Removal of the surficial perimeter and off-site soils would present no technical difficulties. The following discussion will address the implementation requirements for excavation of the fill materials.

Excavation stability is a function of the cohesion, grain size distribution, and water content of the resident materials. The fill consists of a loose heterogeneous deposit of unconsolidated materials with no significant cohesive component. The fill materials are therefore cohesionless and have a low angle of repose. Standard geotechnical design dictates an excavation slope of 2(H) to 1(V) or less be used for open cuts of Site fill materials (Sowers, 1979). For a 10 foot depth, an excavation into the fill would require a minimum lateral offset of 20 feet. A buffer zone of 20 feet would be provided at the bottom of the cut for separation of excavation and replacement activities. Excavation profiles and dimensions for this option are shown in Figure 7.10. The given angle of repose might be low for fill materials containing inorganic sludges due to their tendency to flow, especially if saturated. This would render slopes unstable in the excavations and might require slopes as flat as 4(H) to 1(V) for safety and stability. Flatter slopes would increase the lateral offsets, and therefore the trench widths, shown in Figure 7.10.

The excavation depicted in Figure 7.10 would proceed as a moving trench along one front. After construction of the initial trench, further excavation would proceed along one face of the long axis of the trench. As materials were removed from the leading face, processed materials (incinerator ash) would be placed into the excavation on the opposite and adjacent faces over materials to be left in place. Materials to be excavated in the subsequent pass would be left uncovered. This process is depicted in Figure 7.11.

The anticipated excavation lines for the Site are shown in Figure 7.12. The lead trench would be constructed at the edge of organic deposition. Subsequent excavations would be conducted parallel to the long axis of the lead trench. Fill materials would be removed in three foot lifts into the organic deposition areas. The need to maintain the leading lateral face open for excavation would create a significant surficial area for fugitive vapor and dust emissions. These fugitive emissions would arise due to excavation and loading of materials, wind erosion, and ash replacement (although ash replacement emissions will be virtually free of organic contaminants). EPA has estimated that fugitive dust emissions from the excavation activities would total approximately 6,840 kg. The potential carcinogenic risk to adult downwind populations due to fugitive dust and vapor emissions during excavation of the contaminated fill has been estimated by EPA to be 1.1×10^{-6}. Estimated ambient air concentrations at the Site property line would exceed NYSDEC Ambient Guideline Concentrations for HCCH.

Wind breaks and wetting of the exposed face with water or foaming agents would help minimize the potential for fugitive emissions. As the prevailing wind direction is from the southwest, any Site emissions would likely travel towards residences and commercial facilities north of Buffalo Avenue. The effectiveness of wind breaks would be limited by the lateral extent of the open excavations. Excavation line A-A in Figure 6.6 has its major axis parallel to the prevailing wind direction and could not be well shielded by a wind break. Inflatable domes have been used to control fugitive emissions from open excavations with limited success. Domes at the nearby Model City, NY secure landfill and at a Superfund site in Galveston, TX have collapsed during operations. The high winds and snowfall at the Site would make an inflatable dome infeasible. Watering provides only temporary control and a chemical foam would be required for adequate dust suppression. Selection of the foaming agent would involve assessment of potential impacts on groundwater and incinerator operation.

Excavation of the Site fill and maintenance of stable slopes would be difficult due to the distinct non-homogeneity of materials, their unconsolidated nature, and the presence of potentially reactive and hazardous materials. Materials known or reported to have been placed in the landfill include:

- inorganic sludges (brine, lime)
- fly ash
- gypsum
- phosphorus and inorganic derivatives
- reactive compounds (chlorites, chlorates, perchlorates)
- construction debris (concrete, piping)
- chlorinated organics
- brine sludges containing mercury

Considerations during the excavation of these materials are summarized in Table 7.8. Excavation of certain inorganic sludges, such as hypophosphite mud and "black cake", would be complicated by their limited cohesiveness and tendency to flow from an excavating bucket or shell during removal. Gypsum and brine sludge set up under moist conditions and form cementitious agglomerations that would have to be broken prior to removal.

Some of the elemental phosphorus disposed on the Site was reported buried within the area of NAPL presence (Figure 7.12). Elemental phosphorus is highly reactive in the presence of oxygen. Exposed phosphorus would have a high potential for fugitive emissions. Risks associated with these emissions would be increased due of their proximity to organic chemicals. The proximity of on-site workers to reactive compounds would present the greatest risk to human health, however. Excavation would avoid this area to prevent exposure of phosphorus to air. Although the areas of phosphorus disposal are fairly well documented, the possibility of encountering unidentified phosphorus burial areas during excavation cannot be discounted.

Chlorate residuals (chlorites, chlorates, perchlorates) represent another chemical concern during excavation due to their reactivity. OCC and Olin disposed of these compounds in their landfill areas and chlorate residuals are anticipated during excavation. Chlorate compounds become explosive upon agitation. The stability of chlorate residuals during excavation and materials handling after years of burial is questionable.

Drum excavation would require special handling techniques. The integrity of drums that have been buried for a number of years in contact with various chemicals is questionable. Large excavating equipment tend to shear drums rather than expose them. Rupturing of drums during excavation would create a strong potential for fugitive emissions. Released chemicals would be difficult to control or recover. Intensive manual operations would therefore be required for the extrication of drums from the landfill.

Excavation in the NAPL areas assumes an average penetration of two feet into saturated materials. The uncohesiveness of saturated materials complicates excavation and would preclude the use of a power shovel or front end loader without dewatering. Other options would involve placing personnel within the open excavation, which would be undesirable on a human health basis due to the physical hazards associated with heavy equipment operating in an unshored excavation. A dragline could remove saturated materials but would have difficulty maintaining the required excavation profile. Draglines are imprecise and non-selective excavators, and even experienced operators not encumbered by Level B PPE find it difficult to maintain desired excavation boundaries and slopes.

The preferred excavation equipment would either be a backhoe or a clam shell. Set up, operation and excavation control would be better achieved with a backhoe. The 35-foot reach required in Figure 6.4 is achievable by large backhoes. A large backhoe could easily maintain the estimated incinerator throughput of 10 tons per hour and would be the preferred excavation method for Option 1. Special handling would still be required for large pieces of construction debris. For example, large pieces of reinforced concrete might exceed the capability of a backhoe and require use of a crane.

Even with materials removal being conducted from outside of the excavation, potential emissions levels would dictate the use of Level B personal protective equipment (PPE; self-contained breathing apparatus, chemical-resistant clothing) at a minimum. Fill materials would vary in composition and concentration as an excavation proceeded across the landfill. Continuous monitoring would be required to assess worker protection needs. The need for manual handling of contaminated debris will increase personal protection requirements. Working at Level B generally results in a 50 percent reduction in productivity as compared to equivalent tasks where no protection is required (Level D).

The final consideration regarding excavation is the inclement weather typical in the Niagara Falls area from November through March. Average daily temperatures are below 40°F throughout this period and the average annual snowfall is 93 inches (NOAA, 1980). The average wind speed is 12 mph from the southwest. The prevailing wind direction at the Site would be off of the river and gusts of 30-40 mph are common. These conditions would hamper remedial activities, especially excavation, and reduce productivity.

A number of incinerator vendors representing rotary kiln and circulating bed combustor (CBC) designs were contacted for technical approach and preliminary cost estimates. Vendors representing infrared-type (Shirco) designs were specifically excluded because of difficulties with feeding materials to the incinerator and in achieving required destruction and removal efficiencies (DRE) at the Peak Oil (FL) NPL Site. The feed conveyor of infrared units provides substantially less agitation of aggregate materials than would other incinerator designs. While modifications have been made to this design by others (OHM, IT), the infrared design would likely be less capable than rotary kiln or CBC units for the heterogeneous materials at the 102nd Street Site. Vendors representing both rotary kiln and infrared designs specified rotary kiln for potential application at the Site.

The rotary kiln design has apparent benefits over a CBC unit for potential application with the types and compositions of Site landfill residuals. Materials must be sized to approximately two inches in diameter for use in a CBC system because of fluidization requirements. A rotary kiln has more tolerant requirements and can accept a wider variety of materials. Sodium concentrations of approximately ten percent can cause agglomeration of the bed media in CBC units (OES, 1989). While exact concentrations in the landfill are unknown, significant quantities of sodium chlorite residuals, sodium hypophosphite mud and brine sludge are known to be among the landfill chemical inventory (CRA/WCC, 1990) and a potential risk of agglomeration exists. For these reasons, evaluation of on-site incineration is based on use of a rotary kiln. Actual incinerator design would be determined during Remedial Design, should one of the Alternative OU1-5 options be selected.

Excavation of buried Site residuals would be difficult due to the heterogeneity of materials, the elevation of the water table, and the chemicals within the landfill. Anticipated difficulties and potential considerations associated with excavation were presented in Section 6.4.1. Major factors affecting excavation at the Site include:

- uncohesive fill materials require shallow excavation slopes (large trench widths)
- extreme difficulty of visually classifying heterogeneous chemical residuals within an obscured landfill
- potential for exposure of fugitive emissions to down wind populations
- potentially reactive materials (chlorates, phosphorus) in the fill
- irregular shapes and sizes of construction debris requiring special excavation equipment and manual handling

- Level B protection required due to chemical residuals, resulting in loss of productivity
- drums of chemicals which would tend to shear during excavation
- inclement weather which would hamper activities and reduce productivity.

Operation of an on-site incinerator would require the coordinated operation of several technically demanding activities following excavation, from materials preparation through ash replacement. Descriptions of these processes and site-specific operational requirements are presented below.

Materials handling requirements prior to on-site incineration at the 102nd Street Site would be complex because of the:

- variety of materials within the landfill
- uncertainty regarding the composition, location and integrity of fill materials
- presence of potentially reactive and toxic materials
- restrictions on blending and segregation options due to incremental excavation of the site.

Materials known or reported to have been placed in the landfill include:

- inorganic sludges (brine, lime)
- fly ash
- gypsum (calcium sulfate)
- phosphorus and inorganic phosphorus derivatives
- potentially reactive compounds (chlorites, chlorates, perchlorates)
- construction debris (concrete, piping)
- chlorinated organics
- brine sludges containing mercury.

The specific distribution and composition of these materials across the Site is unknown. The available materials for blending and segregation will be limited to the fill contents of the leading face of excavation and the effectiveness of visual classification. Limitations on the visual identification of a variety of unmarked, mixed and obscured chemical residuals will be most pronounced for chlorate compounds (chlorites, chlorates, perchlorates). These compounds are potentially reactive (explosive) upon agitation and contact with organic materials. Chlorate compounds must be excluded where possible from the general materials handling process train.

Based on these factors, the materials handling system would have to be within an enclosed structure and include a full complement of sorting, shredding and feed equipment that was chemical and shock resistant. A typical materials handling system based on the processing of relatively uniform soils and sludges would probably be incapable of preparing a workable incineration feed stock. A specially designed system would have to be constructed at the Site to handle the variety of materials known to be in the landfill.

The 102nd Street landfill was a general disposal grounds for chemical production, demolition, process equipment and general debris from Occidental and Olin for a period of approximately 25 years. Available disposal records are incomplete and the possibility exists that unidentified materials may be encountered which require special handling beyond the capabilities of the proposed system. System components and flow trains are therefore conceptual at this point and would be altered during remediation if unanticipated materials cannot be adequately handled. Process modifications required during remediation would require temporary shut-down of the incinerator and prolong the duration of activities.

SITING

The processing and incineration of excavated materials would involve several steps based upon the characteristics (physical and chemical) of the waste materials. These system elements would include a roll-off storage area, preparation and handling building, tank farm, incinerator, air pollution control system, ash handling and storage, and support utilities. The total required area is approximately eight acres.

Placement of the incineration system would be based on siting restrictions, areal requirements, and a maximum possible off-set from down wind populations. Figure 2.5 shows the areas of phosphorus burial and the proposed areas of excavation. The incinerator system would require the placement of pilings for support and additional subsurface work. Siting above phosphorus disposal areas is therefore not feasible. The incinerator could also not be placed within areas to be excavated. Available siting areas would be the southeast, northeast, north central and northwest portions of the Site. None of these areas contains enough contiguous space for the eight acres necessary for the incineration system. The only area with sufficient space would be the continuation of the northwest corner of the Site into Griffon Park. The prevailing wind direction is from the southwest. The incinerator would be placed as far from Buffalo Avenue as possible to limit downwash impacts from the incinerator. The proposed layout for the incineration system is shown in Figure 7.9. Building descriptions are provided below and summarized in Table 7.3.

EXCAVATED MATERIAL STORAGE AREA

After excavation, material would be placed in a lined roll-off container, covered with a tarp, and transported to the storage area. A road system would be created for ready handling of the loaded, roll-offs from the excavation to the pre-processing storage area. Loaded volume of roll-offs would be limited to 10 cubic yards to facilitate transport across the Site. The storage area would be sloped to prevent run-off and to facilitate removal of any accumulated precipitation or other liquid. The excavation process is expected to generate approximately 3,000 cubic yards, or 300 roll-offs, at a time. This volume would be split between raw material storage and ash storage. The excavation storage area is conceptually sized to accommodate 150 roll-offs (in three rows of 50). This design enables each roll-off to be readily accessible. A reinforced slab would be required for storage and movement of the loaded roll-offs. Material storage would conform to RCRA requirements.

PREPARATION AND HANDLING BUILDING

The variety of materials that are known to be present in the landfill will require a broad array of material handling and pretreatment equipment. The materials that would be encountered include soils, sludges, liquids, and construction debris. The following pretreatment operations would be required at a minimum: unloading/sorting, cutting, crushing, water treatment, shredder/crusher/classifier, and mixing/staging/feed equipment.

All materials preparation would be conducted within an enclosed building. All emissions within the building would be vented to a scrubbing system prior to atmospheric release. Material would be moved from the roll-off storage area to this building prior to incineration. Material would be sorted in the unloading area and then moved to the appropriate treatment area. Any large metal pieces (I-beams, tanks, etc.) would be hand cleaned or cut into pieces small enough to be fed to the incinerator (using shears, torches, saws, etc.) Following field preparation, large pieces of concrete (construction debris, the storm sewer, etc.) would be sent to the crushing room to be broken up using "headache balls" or hydraulic rams. Pumpable sludges would be pumped to the water treatment area for dewatering using a filter press. Filtrate removed from the sludges along with water generated in the truck wash, collected in the containment areas or from the incinerator scrubber would be treated before discharge to the Niagara Falls POTW. Solid materials such as soils, aggregate chemicals and small debris would be transferred to the shredder/crusher/classifier area. Any pieces larger than 2" x 2" would be fed to the shredder and continually reclassified until small enough to be fed to the incinerator. A portion of the materials would be contained in drums and metal containers. Containerized materials would be extracted into a hydropulper and then pumped for pretreatment and destruction in the incinerator by liquid injection or sized for solids feed. A crusher would be used for any intact drums which might be excavated. Solids from the hydropulper and the crushed containers would be fed to the shredder and through the classifier.

WASTE FEED SYSTEMS

After preparation, materials would be transported to a sorting area prior to incineration. Materials would be fed to the incinerator using a screw conveyor, ram feeder, or an injection feeder depending on their consistency and bulk. While the great majority of Site residuals would be inert, excavations would include pockets of concentrated organic and inorganic residuals. The dispersed nature of disposal at the Site and the limitations of visual classification would limit blending capability. With the exception of drummed chemicals, no specific waste segregation is anticipated. A uniform feedstock would not be achievable and the incinerator would operate under a range of organic and inorganic feed concentrations. Feed variability could hamper steady-state operation of the incinerator and could cause attainment of destruction and removal efficiencies (DREs) and air pollution control efficiencies to be impaired.

Each of the feed delivery systems can require extensive maintenance because materials cannot be processed properly. Examples include:

- chlorate residuals, which are potentially explosive upon shock or friction, especially when mixed with combustible materials (Sax, 1984)
- gravel or scrap can cause abrasion of a screw conveyor
- fine, sandy soils in a ram feeder that create spillage
- shredded plastic liners from roll-offs that become entangled in screws, pulleys, and belts.
- wire, cloth, and plastic debris from the shredder that can jam conveyors, screws, and feeders.
- sticks, rocks, and other wastes entrained in sludges that can cause wear in cavity pumps.

Excavation and materials handling activities at the 102nd Street landfill would generate all of the above materials.

Materials handling maintenance would be appreciable. Any repairs or servicing would have to be performed under Level B protection, increasing maintenance requirements and system down time. While incineration would generally be the rate limiting step, the disparate composition of fill materials and attendant handling requirements could make materials preparation the critical process during remediation.

INCINERATOR PLACEMENT

Approximate weight of the loaded incinerator would be 100 tons. The Griffon Park landfill would not have sufficient compressive strength or consolidation to support this localized loading. Pilings would have to be driven into the clay/till layer to provide adequate support.

ASH CONTROL

After incineration, ash would be conveyed from the kiln and cooled with a water quench. The direct water quench of hot (1600°F) ash causes steam formation and ash entrainment which is sent to the air pollution control system. Temperature of the quenched ash would be approximately 300°F. Ash would then be fed to roll-offs in the temporary storage area adjacent to the incinerator prior to transport to long-term storage. Ash would also be stored in covered roll-offs prior to replacement in the landfill. No significant volume reduction through incineration is anticipated since the majority of fill materials are inert. Storage space would be given for 1500 cubic yards of ash (150 roll-offs).

Ash would be replaced in the landfill to close open excavations. As the residue of incineration of dioxin-containing wastes, ash would be an F028 listed waste. The ash could also be considered hazardous by characteristic (TCLP) based on metals content. Final disposal of the ash would depend on whether the ash could be delisted. Should the ash be considered hazardous, direct replacement would probably not be allowed and other options would have to be evaluated. Off-site RCRA-permitted landfills have historically refused to accept Site materials because of the presence of dioxin. The sheer volume of materials would approach the capacity of most landfills and exclude other generators from disposal. Landfill acceptance of Site ash at the expense of industries or other facilities is unlikely. The final option for disposal of hazardous ash would be in double-lined cells at the Site, if possible. New York State siting criteria (6 NYCRR 373-2.14) require that:

- no waste shall be closer than 10 feet to an aquifer or bedrock
- facilities shall be located at an elevation not less than five feet above a flood plain unless provisions have been made to prevent the encroachment of flood waters
- the required horizontal separation between deposited hazardous waste and any surface waters shall be determined for each secure landburial facility by reference to soil attenuation characteristics, drainage and natural or man-made barriers.

The first criterion would prohibit creation while the other criteria would heavily discourage creation of a secure landfill at the Site. A waiver from New York State siting criteria would be required for creation of a secure landfill. With a waiver, the secure landfill would conform to RCRA requirements and include an impermeable cover. Should ash fail the Toxicity Characteristic Leachate Procedure test due to metals, the ash might have to be stabilized prior to placement in the RCRA cells. Because of the uncertainty of ultimate ash characteristics, three ash disposal options exist for each of the Alternative OU1-5 options:

- direct replacement on-site followed by capping
- off-site landfilling at a RCRA facility
- replacement on-site into RCRA cells following stabilization.

The ash composition would vary as the fill contents. Continual analyses would be required and different disposal methods may be required for portions of the ash.

AUXILIARY FACILITIES

Auxiliary facilities for support of incineration operations include:

- tank farm
- generator building
- boiler room
- fire water storage tank
- truck wash
- water treatment
- first aid station with ambulance
- decontamination area
- worker change room
- parking lot.

Summary descriptions of these facilities are presented in Table 7.3.

ADDITIONAL ASH STORAGE

Additional ash storage would be provided to hold the ash until it could be redeposited in the landfill. Delisting of the ash would be required prior to redepositing it. The total ash storage areas would hold approximately 150 roll-offs, or 1500 cubic yards of ash. This volume would be generated in approximately 190-320 hours of incinerator operation. This period would be sufficient for ash analysis. Ash that exceeded organic disposal levels would be reprocessed. Ash that exceeded metals disposal levels could be stabilized prior to replacement in the landfill.

INCINERATION

Incineration of fill materials would be accomplished in a rotary kiln. Typical operating conditions and process descriptions are provided in Table 7.4. The given values represent average steady-state operating conditions based on typical transportable rotary kilns. Actual operating conditions would be based on the composition of feed materials determined during excavation and emissions control requirements determined as part of the trial burn.

Incinerator throughput for unsaturated materials would be approximately 10 tons per hour. Materials excavated from below the water table would contain a residual moisture content that must be vaporized in the kiln before treatment can be effected. The additional heat input required for water vaporization would reduce incinerator throughput by approximately 30 percent for the same fuel consumption, increasing the time for remediation.

The percentage of time the incinerator is operating at full capacity, or service factor, for transportable rotary kilns is typically 65 to 80 percent. The following conditions at the Site would place the service factor towards the lower value:

- formation of slags and cake deposits within the kiln
- deterioration of kiln refractory by inorganics
- carryover of particulate matter to the secondary combustion chamber
- formation of agglomerated materials that require reprocessing
- variations in the organic and inorganic composition of the feedstock
- materials handling capacity.

Solids temperatures within the kiln would approach 1600°F (870°C). Compounds with melting points below this temperature would become molten and form slag if present in sufficient quantities. Melting points for inorganic materials reportedly disposed of at the Site are presented in Table 7.5. Inorganic compounds form eutectic mixtures with sodium that have lower melting points than the parent compound. The extensive presence of sodium in fill materials (brine sludge, hypophosphite mud) would increase the potential for slag formation in a kiln. The variable composition of sodium compounds in the landfill would make slag formation difficult to anticipate. Slag can re-solidify and form uneven cake formation because of differential heating within the kiln. Cake deposits become insulating barriers for heat and propagate. Cake build-up can form circular "doughnuts" along the circumference of a kiln or dams at the kiln exit. Either of these formations would impede solids movement through the kiln. Uneven cake formation results in an unbalancing of the kiln and excessive wear on the rotary drive mechanism and kiln supports. Significant cake formations must be removed by hand or broken off using a shotgun. Either method requires downtime of the incinerator and results in a reduced service factor.

Sodium salts penetrate refractory materials when hot. When the kiln becomes cooler (during shut-downs for maintenance or because of process fluctuations), the salts will expand and cause flaking of the refractory. This gradual destruction process would require periodic replacement of the refractory material. The volume of sodium salts in the fill would make refractory deterioration a significant maintenance potential.

Rotary kilns are known for carryover of particulate matter from the kiln to the secondary combustion chamber (SCC). The higher operating temperatures in the SCC cause melting of the particulates and subsequent cake formation along the chamber walls through cooling. This cake must be removed to maintain proper air flow (residence time) and temperatures. Rotary kiln carryover is a function of the amount of fine particulate matter and is generally in the range of 7 to 10 percent. The fly ash deposited at the Site and the native clayey soils are fine materials and would have high carryover rates, thereby increasing maintenance requirements for the SCC.

Soils with a high moisture and clay content, such as native and saturated soils, can agglomerate into clumps. This agglomeration potential would be enhanced by the binding action of gypsum, which was deposited at the Site. The rotating action of the kiln can form clumps of three to four feet in diameter that would restrict the movement of other materials. Spherical formations may roll through the kiln before complete combustion can be achieved. Agglomerations can also form an insulating barrier for interior materials that prevents adequate thermal penetration. These materials would then have to be reprocessed, decreasing actual throughput rates.

Blending of the incinerator feedstock would be limited by the materials available from the currently excavated portion of the Site and the ability to visually classify unidentified and obscured fill materials. Disposal of organic and inorganic residuals likely occurred during batches or through some segregation of the landfill. Even if aggregate materials other than intact drums could be visually segregated by chemical content, the current excavation face could be almost exclusively comprised of organic or inorganic materials. The incinerator feedstock would therefore have periods high in organic composition relative to average fill conditions as well as fluctuations to the inorganic extreme. Such variations in feedstock composition will require close control over incinerator operating parameters such as kiln temperature and the efficiency of the air pollution control system (APCS). While rotary kilns can tolerate some fluctuations in feedstock, optimal performance is achieved by basing operating conditions on a uniform input. The anticipated feedstock variations would require conservative operating conditions (lower throughput, higher temperatures, higher scrubber water flow) to maintain DREs and allowable emission rates. Sustained periods of extreme feedstock composition could require readjustment of incinerator operating conditions to handle slag formation (inorganics) or maintain DREs (organics). Feed rates would be decreased during system adjustments and the service factor would be reduced.

Materials preparation and handling considerations were discussed previously. Downtime in the materials handling area would translate to downtime in the incinerator (since there would be no feedstock) and a lowering of the service factor.

Operating factors affecting the incinerator service factor are summarized in Table 7.6. Based on these considerations, a service factor of 70 percent is anticipated for a rotary kiln incinerator at the Site. Continuous operation of an incinerator requires a synergetic interaction, from materials handling through the APCS. The chemical and morphological variations in Site fill could make any portion of the process train rate limiting and reduce the estimated service factor.

Feedstock following preparation will be sized to a diameter of two inches or less. This size should allow adequate thermal penetration for most materials to be treated. Ash containing organics above treatment levels would have to be reprocessed.

Mercury from chlorine cell production is present in the Olin brine sludge at concentrations estimated to be on the order of 50 mg/kg. Disposal of mercury in the Occidental property is not documented but mercury has been detected in subsurface soil samples. Arsenic and cadmium were found in the ground water and their presence in the fill is inferred. Each of these metals would partition to the flue gases (EPA, 1989a). The presence of organochlorines, such as a HCCH and HCB, would increase the distribution of metals in the flue gas as a vapor phase (EPA, 1988) through the formation of metallic chlorides. Recovery of vapor-phase metals would be difficult. For example, mercury recovery by a Venturi scrubber, the most common APCS on transportable kilns, is approximately 40 percent (EPA, 1989b). Additional APCS measures would be required to reduce Site metals emissions from the stack. Assessments of risk from hazardous waste incineration emissions have found that metals generate the highest excess lifetime cancer risks (ASME, 1988), however EPA's assessment of mercury releases during incineration indicates that Site levels would not cause significant health risks.

Other emissions considerations include control of HCl and particulate matter. Site organics are generally chlorinated (HCCH, HCB, TCB) and would cause HCl formation during their incineration. Caustic or lime would be added to the Venturi scrubber for HCl removal. Particulate removal efficiency is a function of the particle size distribution, with smaller particles (0.3 - 2 μm) being removed less efficiently. Entrained clays and fly ash would be within this range and therefore difficult to remove. Conservative operation of the incinerator because of the heterogeneous feedstock would require high excess oxygen (air) levels, which would enhance entrainment. The impacts of particulate entrainment on the APCS system could significantly reduce on-stream availability of the entire incineration system.

Venturi scrubbers require a significant quantity of wastewater. Typical liquid to gas ratios are 10-15 gallons per 1000 acf, resulting in an estimated usage rate of approximately 500 gallons per minute for the Site incinerator (including evaporative losses). The scrubber system would operate with no wastewater discharge, if possible, by using all blowdown water to cool the incinerator ash. The acceptability of this operation would depend on the levels of mercury and other potentially hazardous compounds in the scrubber water. If excess blowdown results or if scrubber water is unacceptable for direct cooling, a mobile wastewater treatment system would be used that is capable of meeting pretreatment (POTW) or SPDES limits. Residuals generated from treatment of the scrubber water would have to be disposed of according to RCRA requirements.

A trial burn would be required unless the incinerator vendor could show demonstrated achievement of the required DREs and emission limits on similar chemicals and residual materials. For purposes of the FS, it is assumed that a trial burn would be required prior to remediation. The trial burn would be conducted according to New York State requirements. Following development, the plan would be submitted to the State for review and approval. After approval, the trial burn would be conducted and the results prepared and submitted to the State for concurrence. Estimated time for the trial burn process would be approximately one to two years. A permit would also have to be obtained for discharge of the scrubber water during this time. Public notice and public meetings, if required, are not included in this estimate. Stand-by time would have to be paid to the incineration contractor while the trial burn results were being reviewed.

The trial burn would be complicated by the heterogeneity and potential risks associated with Site residuals. Formation of a representative feedstock would be difficult due to the variety of materials and chemicals placed in the landfill. A substantial trenching program would be required to identify representative sampling locations for creating a composite feedstock. This level of excavation would require monitoring, staging and safety requirements equivalent to full remediation to be protective of the community. This will expand the scope of the trial burn plan, increasing the preparation and review process. Overall time for the trial burn process would therefore most likely be on the order of two years, as shown in Table 7.7

Incinerator ash would be considered hazardous until it was delisted. New York does not handle delisting petitions and defers to EPA. The review time for delisting applications is approximately two years. The ash would have to be stored as a hazardous waste during the delisting process and under current regulations it might not be possible to replace the ash in the excavation. Ash that was replaced in the excavation would contain metals from the scrubber water quench and be a source of fugitive emissions.

Incineration would address approximately 5.8 to 7.6 acres of the landfill under the range of Alternative 5 options. The remaining 14.5 to 16.3 acres of landfill would still contain residuals that could potentially impact Site groundwater or become an exposure pathway in the future. These areas would therefore be capped under this alternative. Incinerator ash or replacement fill would be redeposited in the excavated areas and capped as well, creating a cap over the Site identical to that described under Alternative OU1-3B (Section 7.2.3.2). Volume reduction of landfill materials following incineration is expected to be slight and substantial quantities of additional fill material are not anticipated if the ash can be replaced on-site.

The possibility of replacing ash on-site is not guaranteed, pending the results of the delisting application. Accordingly, a sensitivity analysis must be applied to the cost estimates for incineration based on ash disposal. Costs are given for Alternatives OU1-5A and OU1-5B for replacement of ash on-site, for placement at a RCRA-permitted land disposal facility, and for placement in RCRA cells on-site following stabilization. Additional costs for off-site landfilling include transportation, disposal charges, and replacement fill. Landfill space for the 98,400 cubic yards of ash may not be readily available. The ash might be banned from land disposal if it was considered to be an F028 waste (from incineration of F020 wastes).

Assuming that the ash is acceptable for landfilling and that adequate landfill capacity is available, the hauling of ash should be limited by the incinerator throughput and there would be no significant effect on the implementation schedule.

The incinerator would be located approximately 400 feet from Cayuga Island. The sound intensity 3 feet from a rotary kiln incinerator is approximately 107 dB (OCC, 1989). Without any absorbing features between the Site and Cayuga Island, noise attenuation would be solely in proportion to the inverse of the distance squared. Based on this relationship, the sound intensity at Cayuga Island would be approximately 65 dB (Appendix E). This is equal to the Niagara Falls noise ordinance for residential areas. The average noise level in a normal suburban residential area is 43 dB, however (Community Noise Control, undated). In addition, EPA typically applies a day-night level correction (L_{DN}) of 10 dB to account for lower background levels and an increased consciousness of noise at night. The difference between incinerator noise on Cayuga Island and the normal evening level there would be approximately 32 dB. The decibel scale is logarithmic and this difference would be equivalent to an increase in apparent noise level of approximately 1500 times. While the incinerator noise level might not exceed City standards, there would be a significant increase in night time noise level for the residents of Cayuga Island.

7.2.4.1 Alternative OU1-5A - Includes Cutoff Wall, Groundwater Extraction and Treatment

Excavation and incineration under this alternative would be as described above. Construction of the groundwater extraction/treatment system and the cutoff wall would be as described under Alternative OU1-2B (Section 7.2.2.2). Residual NAPL outside the extent of excavation would be controlled through groundwater extraction and the cutoff wall.

Protection of Human Health and the Environment

This alternative would increase the protectiveness of human health and the environment, but probably by no more than a cap/slurry wall combination. EPA's baseline risk assessments found that buried landfill materials present no significant direct risks under baseline conditions, however the indirect risks associated with groundwater migration from the Site are significant and would be reduced by this alternative. Site residuals outside the excavated areas would remain intact. The cap would isolate all Site materials that currently and potentially pose a significant risk to human health. Incineration of the top ten feet of fill and NAPL would remove these sources of organic compounds to the groundwater but NAPL in the alluvium would remain. The cutoff wall and groundwater control system would essentially eliminate discharge to the river, controlling any remaining sources of chemical loadings.

Open excavation and staging areas present potential sources of fugitive emissions. Uncovering any remaining elemental phosphorus during excavation would present an immediate concern to remedial workers and a potential risk to the community through the generation of fugitive emissions. Other chemicals of concern are chlorinated organics and heavy metals. Toxicological properties of these compounds are presented in Section 3.2.5. The prevailing wind direction in the Buffalo/Niagara Falls area is from the southwest and south (NOAA, 1980), towards Buffalo Avenue from the Site. While pedestrian and vehicular traffic along Buffalo Avenue is generally light, the LaSalle Expressway is extensively travelled. Residences along the eastern boundary of the Site and on Cayuga Island could be exposed to airborne releases during shifts in the wind.

The age of construction debris in the landfill is consistent with the use of asbestos as an insulating material. Uncovered asbestos represents a potential health risk to the community through fugitive emissions and to remedial workers.

The variety of chemicals in the landfill and their range in concentrations would present a distinctly non-uniform feedstock to an incinerator. This increases the potential for air emission excursions and community exposures since control devices are less effective under varying chemical loadings.

Compliance with ARARs

The excavation and treatment (incineration) of waste residuals would trigger Federal RCRA requirements, as specified in 40 CFR 264, Subpart O. State requirements are essentially the same except that metals emissions would require a risk assessment. Destruction and removal efficiencies (DRE) for principal organic hazardous constituents (POHCs) would be 99.99 percent. The requirement for 99.9999 percent DRE for dioxins and furans would be relevant and appropriate based on the treatment technology and the chemicals involved. A trial burn would be conducted within the requirements of 40 CFR 270.62. Incinerator ash would be considered hazardous until it was delisted (40 CFR 260.22).

Obtaining approval for the operation of an incinerator at the Site would be a dual process involving the NYSDEC Divisions of Air Resources and Hazardous Substance Regulation. The Air Resources regulation 6 NYCRR Part 212, General Process Emission Sources, might require that a control system remove 99 percent of the chloride emissions if after evaluation by the State those emissions are considered to be significant. Particulate emissions would be rated on their potential to impact maximally exposed individuals. Emissions from the incineration of Site residuals, which contain dioxins and heavy metals, would likely receive an A rating. The A rating would require a particulate removal rate of 99 percent or subject the incinerator to a Best Available Control Technology (BACT) analysis. The proposed incinerator scrubber would likely be considered BACT.

The incinerator would also have to comply with the Hazardous Substance Regulation requirements under 6 NYCRR Section 373.2-15. These requirements include a 99 percent removal of chloride emissions that would subordinate the Part 212 requirements. Particulate emissions would be limited to 0.08 gr/dscf at 7 percent oxygen. The stricter of the Air Resources and Hazardous Substance Regulations requirements would govern operation of the incinerator.

Conservative air emission levels would likely be applied, especially for heavy metals, and the feasibility of an incinerator meeting all air toxic limitations cannot be fully addressed without a trial burn. The possibility exists that as waste residuals are partitioned to the stack and analyzed, certain compounds may exceed acceptable emission limits. The temperatures necessary to achieve the required DREs create a strong potential for the volatilization of toxic metals such as mercury. The variety of materials in the landfill indicates that composition of the feedstock would vary and the emissions controls system would be exposed to a range of loadings. Control systems are less effective with varying inputs and the ability to meet the anticipated strict emission standards would be lessened. The heterogeneity of the landfill materials would also complicate the preparation of a representative feedstock for a trial burn.

National Emission Standards for Hazardous Air Pollutants (NESHAPS) place requirements on specific sources of arsenic and mercury. Hazardous waste incinerators are not among the regulated sources, however, and NESHAPS would not be an ARAR.

Discussions with incinerator vendors indicate that particulate emissions would be considerably less than 65 tons per year. The incinerator would not be classified as a major source for any regulated compound and would not be subject to Prevention of Significant Deterioration (PSD) requirements.

A health and safety plan, including ambient air monitoring, would be implemented to cover all aspects of remediation. The health and safety plan must conform to 29 CFR 1910.120. Potential groundwater and location-specific ARARs are as discussed in Section 7.2.1.

Long-term Effectiveness and Permanence

Incineration would be a permanent remedy for organics in excavated residuals. Inorganics, such as mercury and arsenic, would be emitted from the stack, collected in the emissions control system and returned to the ash, or remain in the ash. However, chemical residuals in areas not excavated (e.g., NAPL in the alluvium) and potential metals levels in the ash would reduce the effectiveness of this alternative. Potential risks associated with untreated residuals remaining after incineration are from discharge to the Niagara River and potential exposures to landfill materials in the future. The cutoff wall and groundwater extraction system would control discharge to the river. The cap would physically limit exposures to the unexcavated areas and the ash in the future and reduce the need for any institutional controls.

Incineration would not destroy metals and their presence in the landfill residuals limits the overall effectiveness of incineration. The high temperature and residence times necessary to achieve the DREs may cause volatilization of arsenic, cadmium and mercury and other volatile metals to the stack. Chlorinated organics would be a significant source for the creation of HCl.

Additional emission controls might be required to prevent releases above risk levels. Metals levels remaining in the ash might represent risks for disposal. These potential risks would be limited by the presence of the cap. Estimates of metal partitioning during incineration can best be conducted during the trial burn.

Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. These residuals would be controlled by the cap, cutoff wall and groundwater extraction system.

Reduction of Toxicity, Mobility, or Volume

Organic compounds in the excavated materials would be destroyed through incineration. The mobility of the remaining chemical residuals at the Site would be reduced through the denial of infiltration by the cap. A significant portion of Site residuals would remain at the end of incineration in the unexcavated areas and as NAPL in the alluvium. The landfill would still be capped following incineration. Capping would provide an effective, long-term limitation on the mobility of Site residuals.

Residuals remaining after treatment are incinerator ash and scrubber blowdown. The ash may still pose potential risks due to metals levels. Scrubber blowdown not used for ash quenching would require treatment prior to discharge.

Short-term Effectiveness

Potential risks during operation of the incinerator should be acceptable, since materials are contained from when they are sized until they exit in the ash conveyor. Metals emissions in the stack might be a potential source of human health risk to the community. The primary safety concerns would arise during the excavation and staging of landfill debris. Open excavations and piled residuals would be potential sources of fugitive emissions. Dust control and air monitoring would be required to limit potential exposures to the community. Incinerator ash and open excavations would be covered to limit fugitive emissions. The length of time required for remediation would expose excavated materials to a range of weather conditions. Excavation activities would be conducted within 50 feet of Buffalo Avenue, creating a limited buffer zone for the community. Worker health could be protected through adherence to the remedial health and safety plan.

The trial burn process would require approximately two years. Within this time, mobilization and set-up of the incinerator would require approximately 2 months. Optimal implementation time for excavation and incineration would be approximately 25 months at a nominal throughput of 10 tons per hour, an incinerator service factor of 70 percent, and 24 hour a day operation. Adverse climatic conditions, unanticipated landfill residuals, materials handling difficulties with the diverse feedstock and elevated moisture content would delay this schedule. Residuals excavated from the saturated zone would require a longer processing time and have lower incinerator throughput rates. While incineration should be the rate limiting step for this alternative, unanticipated conditions in the landfill could impact excavation and materials handling and therefore limit production rates. A more realistic implementation period would be on the order of 36 months. This schedule would also be dependent on the availability of a rotary kiln with sufficient throughput.

Construction of the cap and cutoff wall would require another 6-8 months. Construction of the groundwater extraction and treatment system would follow cap construction and require approximately four months. Total time for implementation of this alternative would be approximately 72 months.

Implementability

Excavation at the Site presents potential difficulties for implementation based on health and materials handling concerns. The variety of construction debris present would be difficult to extricate because of their size and irregular shapes. The stability of excavations through fill material and extending into the water table is questionable. The potential presence of elemental phosphorus (if any in the NAPL areas) would reduce the rate of excavation near the water table and could limit the number of potential contractors.

Open excavation and staging areas present potential sources of fugitive emissions. The proximity of the Site to pedestrian traffic, vehicular traffic, and residences would require intensive dust control and air monitoring to minimize health concerns in the community. Uncertainties exist regarding potential materials handling requirements due to the disparate nature of materials in the landfill. Construction debris, cement and inorganic sludges could create materials handling and preparation difficulties. Manual separation of materials unsuitable for incineration, such as I-beams and reinforcing rod, would be required. It is anticipated that these materials would not be free of or separate from chemical residuals. The intensity of worker exposure during excavation and materials handling would necessitate the use of Level B personal protective equipment (PPE). Higher levels of PPE result in lower productivity and this would limit excavation rates. Uncovered asbestos materials would present additional excavation and handling requirements to safeguard the safety of the community and remedial workers.

Chlorate residuals in the landfill are a special concern for incineration. While inert under present conditions, chlorate might become reactive through agitation or contact with organic compounds during materials preparation or during incineration.

A number of drummed chemical residuals were disposed in the landfill. Drums present additional materials handling concerns and must be handled separately. After as long as 35 years in the landfill, the integrity and stability of these drums is suspect.

Placement of the incinerator and peripheral equipment would be primarily on the former municipal landfill at Griffon Park. While compaction under the gradual, uniform load of a cap should not be significant, it is questionable whether the low compressive strength of the landfill materials could support the localized load of an incinerator and its associated equipment. Pilings or other supports may have to be constructed for the incinerator. The pilings would most likely have to be of end bearing construction and extend to the clay/till layer to achieve adequate support. Boring activities in the clay/till layer could form a conduit for groundwater transport to the previously unimpacted bedrock aquifer. Operation of the incinerator and storage of hazardous waste (incinerator ash) for an extended period might be a concern for the property owner, the City of Niagara Falls, and impact implementation.

Ultimate disposal of the ash is uncertain. Direct replacement at the Site might be possible if the ash was delisted. Should any or all of the ash not be delisted, disposed would have to be in a RCRA-approved facility. Off-site facilities could be reluctant to accept former dioxin-containing wastes and could have capacity limitations for the volume of Site ash. Construction of a RCRA-equivalent landfill at the Site would be the final option but would require a waiver from State siting criteria. Metals levels in the ash could require stabilization to pass the TCLP criteria for Subtitle C disposal.

Winter conditions in the Niagara Falls area would limit production and increase operating costs. The preferred fuel for an incinerator is natural gas and an auxiliary gas line would be required. If the existing supply is not sufficient, fuel oil could be used as auxiliary fuels at an increase in cost. High quality fuel oil would be necessary to limit sulfur emissions.

Cost

Construction costs associated with this alternative include mobilization, excavation, staging, health and safety, fuel, equipment, materials handling and sizing, incineration, labor, ash handling, and demobilization. Operating costs include air monitoring and analyses of the feedstock and ash. Costs for capping, the cutoff wall and groundwater extraction, treatment and discharge are as described under Alternative OU1-3B (Section 7.2.3.2).

The detailed cost estimate for this alternative is presented in Appendix C. A sensitivity analysis was conducted using ash disposal as the cost variable. Costs were estimated for direct replacement of the ash at the Site, off-site disposal at a RCRA-approved facility, and placement in on-site RCRA cells following stabilization. A summary of the estimated costs is given below:

	Direct Replacement of Ash On-Site	Stabilization of Ash, On-Site RCRA Cells	Off-site Landfilling of Ash
Total Construction Costs	$72,000,000	$ 90,300,000	$112,000,000
Present Worth O & M Costs	$ 5,030,000	$ 5,030,000	$ 5,030,000
Total Present Worth Costs	$77,100,000	$ 95,300,000	$117,000,000

Community Acceptance

Potential health risks to the community would be through potential emissions from the stack and fugitive emissions from excavation and staging operations. The possibility of exposing reactive materials such as phosphorus and chlorates among chlorinated organics and heavy metals might not be welcomed by the immediate community. Excavation and incineration operations might be aesthetically unfavorable to the community for an extended period. The significantly increased noise level on Cayuga Island caused by operation of the incinerator for two or more years would be a source of community concern. The City of Niagara Falls might object to operation of the incinerator on their property at Griffon Park.

7.2.4.2 Alternative OU1-5B - Includes Cutoff Wall, Groundwater Extraction and Treatment; NAPL Extraction and Incineration (OCC)

This alternative is a slight extension of Alternative OU1-5A (Section 7.2.4.1) in that selective NAPL collection would be conducted. While incineration would remove the bulk of identified organic residuals in the fill, selective NAPL extraction would address a portion of the remaining organic source materials in the alluvium. Collected NAPL would be stored on-site prior to incineration at the liquid injection incinerator at OCC's Niagara Falls facility. NAPL recovery and destruction would be as described under Alternative OU1-3E (Section 7.2.3.5). Additional elements of this alternative are as described below:

Off-site excavation - Alternative OU1-2D (Section 7.2.2.4)

General capping - Alternative OU1-3A (Section 7.2.3.1)

Capping of off-site materials - Alternative OU1-3D (Section 7.2.3.4)

Cutoff wall - Alternative OU1-2B (Section 7.2.2.2)

Groundwater extraction/treatment - Alternative OU1-3B (Section 7.2.3.2).

Incineration - Alternative OU1-5A (Section 7.2.4.1).

Assessment of this alternative under the evaluation criteria would be as discussed with the alternatives listed above. The evaluation here summarizes those assessments and focuses on differences between this alternative and Alternative OU1-5A attributable to the selective removal of NAPL from the Site.

Protection of Human Health and the Environment

The only potential exposure route for NAPL under current conditions is through discharge to the Niagara River. The cutoff wall and groundwater extraction system would control this discharge independently of selective NAPL recovery. Discharge to the river under current conditions does not pose a significant threat to human health or the environment.

Compliance with ARARs

If successful at recovering all NAPL in the alluvium, Alternative OU1-5B would address groundwater ARARs. Selective extraction of NAPL would accelerate the achievement of ARARs. The storage tank would have to be constructed to comply with waste storage requirements. Transportation to the OCC incinerator would comply with Department of Transportation (49 CFR Parts 171-173) and New York State requirements (6 NYCRR Parts 364 and 372).

Long-term Effectiveness and Permanence

NAPL collection efficiencies cannot be determined precisely at this time. High removal efficiencies may be complicated due to site-specific conditions and the physical properties of dense NAPL, as discussed in Section 7.2.3.5. The presence of the clay/till confining layer and the cutoff wall would restrict NAPL movement and generate conditions conducive to dedicated NAPL extraction. A significant quantity of NAPL should be extracted at the completion of recovery efforts, however, some NAPL will remain. Incineration of NAPL is a permanent remedy. Since waste residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. Conditions at the Site are anticipated to improve following incineration with placement of the cap, cutoff wall, and groundwater extraction system.

Reduction of Toxicity, Mobility, or Volume

Selective recovery of NAPL would reduce the volume of landfill residuals at the Site to an extent greater than that achieved under Alternative 5A. Incineration would permanently reduce the volume and toxicity of recovered NAPL. NAPL recovery would address a significant source of organic chemicals remaining after incineration. Even after selective extraction, an indeterminate amount of NAPL would remain that could not be recovered. The remaining NAPL would gradually dissolve into the groundwater. The mobility and volume of dissolved NAPL would be reduced through the groundwater extraction and treatment system.

Short-term Effectiveness

Monitoring wells have been constructed in the approximate locations of anticipated NAPL recovery and no installation risks are anticipated. Transportation of NAPL to the OCC incinerator would require approximately four miles along Buffalo Avenue. Use of chemically compatible equipment, deliberate loading procedures and prudent driving methods would limit the potential for any risks to the community.

Design life for NAPL collection cannot be accurately estimated. A period of 10 years is assumed.

Implementability

Construction of the NAPL extraction wells should be readily achieved. Recovery equipment for dense NAPL is in the developmental stage and data from full-scale applications is evolving. NAPL has been recovered effectively at OCC's Taft Louisiana Plant using extraction wells. Piping and storage systems would have to be insulated and heat-traced to allow year round operation.

Cost

Additional construction costs associated with this alternative beyond those of Alternative OU1-5A include mobilization, installation of the NAPL recovery wells, piping and the storage tank. Operating costs include energy, transportation, NAPL analyses and incineration.

The detailed cost estimate for this alternative is presented in Appendix C. A sensitivity analysis was conducted using ash disposal as the cost variable. Costs were estimated for direct replacement of the ash at the Site, off-site disposal at a RCRA-approved facility, and placement in on-site RCRA cells following stabilization. A summary of the estimated costs is given below:

	On-site Replacement of Ash	Stabilization of Ash, On-Site RCRA Cells	Off-site Landfilling of Ash
Total Construction Costs	$72,800,000	$ 91,100,000	$113,000,000
Present Worth O & M Costs	$ 7,620,000	$ 7,620,000	$ 7,620,000
Total Present Worth Costs	$80,400,000	$ 98,700,000	$121,000,000

Community Acceptance

This alternative should pose no additional health risks or aesthetic concerns to the community compared with Alternative OU1-5A.

7.2.4.3 Alternative OU1-5C - Incineration of Site Materials in Organic Areas to Clay/Till Layer; Includes Circumferential Wall, Groundwater Extraction and Treatment

This alternative is an extension of Alternative OU1-5A (Section 7.2.4.1) in that Site materials within the organic areas would be excavated to the clay/till layer and incinerated on-site. The Site would have to be dewatered to allow excavation below the water table. The dewatering would remove some of the recoverable NAPL while the remaining NAPL would be excavated and incinerated. No supplemental NAPL recovery would be required.

Chemical residuals such as metals and phosphorus would remain in the areas not excavated. The Site would therefore be capped following incineration. Site groundwater would be controlled by the circumferential slurry wall and dewatering system which would be required for excavation below the water table and would be left in place. Additional elements of this alternative are as described previously:

Off-site excavation - Alternative OU1-2D (Section 7.2.2.4)
Excavation of fill - Alternative OU1-5A (Section 7.2.4.1)
On-site incineration - Alternative OU1-5A
General capping - Alternative OU1-3A (Section 7.2.3.1)
Capping of off-site materials - Alternative OU1-3D (Section 7.2.3.4)
Circumferential wall - Alternative OU1-3C (Section 7.2.3.3)
Groundwater extraction/treatment - Alternative OU1-3C (Section 7.2.3.3)
NAPL extraction/incineration - Alternative OU1-3E (Section 7.2.3.5)
Cap placement - Figure 7.7

Assessment of this alternative under the evaluation criteria would be discussed with the alternatives listed above. The evaluation here summarizes those assessments and focuses on differences between this alternative and Alternative OU1-5A attributable to excavation below the water table to the clay/till layer.

Excavation would involve removal of the alluvial materials below the water table down to the clay/till interface. The purpose for increasing the vertical extent of excavation would be to remove residual NAPL. The volume of additional materials to be excavated under this option can be estimated from the geologic cross-sections given in the RI (Figures 3.7 to 3.9) by calculating the distance from two feet below the water table (excavation terminus for Option 1) to the clay/till layer. This additional depth varies from approximately 11 feet along the eastern Olin property boundary to 25 feet in the central portion of the Occidental property. The lateral extent of excavation would be extended from that for Alternatives 5A and 5B to account for elevated groundwater chemical levels in the alluvium potentially attributable to the presence of concentrated organic source areas. The volume of additional materials in the area of excavation is approximately 300,000 cubic yards. Combined with the fill volume from Option 1, the total volume of materials to be excavated and incinerated is approximately 400,000 cubic yards.

Excavation below the water table is a difficult process that would be complicated by the adjacent Niagara River. The alluvial materials extend for 13 to 27 feet below the water table and would have to be dewatered before they could be excavated. Dewatering would allow the construction of more stable excavation fronts and help ensure that Site residuals are removed rather than sloughing under saturated conditions in the excavation. There are three potential methods for controlling the limits and stability of the excavation and minimizing flow from the Niagara River and groundwater into the excavation during dewatering:

1) Construct shoring within a cell
2) Drive sheet pilings
3) Construct a slurry wall.

The objective is to create a low permeability barrier that is keyed into the clay/till layer (to prevent recharge). The entire fill zone cannot be benched to the water table nor is it desirable to have workers operate within an exposed cut in the fill. Each of the operations would therefore have to begin at the current land surface and subsequent excavation would proceed through the fill and alluvial materials in one step.

The fill and alluvial materials are uncohesive and unconsolidated. For stability in uncohesive materials, shoring must be supported through tie-backs anchored to a competent formation. No such formation is accessible from the area of proposed excavation and shoring is therefore infeasible. Sheet piles would be very difficult, if not infeasible, to drive through the approximately 10 feet of heterogeneous fill materials and then into the clay/till approximately 30 feet below the surface. The installed piles would be difficult to align and the resulting water leakage under 20 or more feet of head would likely be considerable. Sheet piles are typically kept dewatered from outside of the enclosure but this would be impossible due to the river's recharge. Sheet piles are therefore infeasible.

The only feasible method for dewatering and controlling groundwater flow in the area of excavation would be to construct a slurry wall keyed into the clay/till. Construction of the slurry wall in the proximity of the area of proposed excavation would involve construction into the Site fill. Fill materials in the area of excavation contain large aggregates, construction debris, brine sludges, phosphorus, and chlorate residuals. The large aggregates and construction debris would make construction of a stable, uniform trench difficult. Salt content of the brine sludges would impair setting of the slurry mixture and could reduce the resultant wall permeability. Phosphorus and chlorate residuals could become reactive upon agitation or excavation. For these reasons, the slurry wall would have to be constructed outside of the fill and follow the perimeter of the Site.

Construction of the slurry wall would be as described for Alternative OU1-3C (Section 7.2.3.3). The procedures are as follows:

1) Construct coffer dam in embayment. Pre-consolidation of sediments would be required to provide stable base for construction.
2) Construct slurry wall through coffer dam and around landfill, keyed into the clay/till layer
3) Pump water inside coffer dam into river
4) Install interception trench on top of clay/till layer inside coffer dam plus extraction wells along periphery of landfill
5) Extract groundwater, treat and discharge to the river. Continuous pumping would be required to maintain the dewatered state
6) Begin excavation of landfill.

The cofferdam would have to be placed far enough from shore so that any NAPL beneath the river could be excavated while maintaining sufficient lateral support for the slurry wall against the hydrostatic pressure of the Niagara River. For purposes of the FS, the lateral extent of NAPL from the shoreline is assumed to be less than 20 feet outside of the existing bulkhead. The clay/till layer is up to 25 feet below the river's bottom at this distance. The saturated alluvial sands would be uncohesive and an excavation slope of no greater than 2(H) to 1(V) could be maintained. The minimum distance from shore for placement of the slurry wall would be 20 feet (NAPL) plus 50 feet (two times the excavation depth) plus 30 feet (the interior bottom width of the coffer dam), for a total of 100 feet.

Excavation profiles and dimensions for activities to the clay/till layer are shown in Figure 7.13. The maximum allowable excavation slope for the uncohesive Site materials would be 2(H) to 1(V) and could be less for the dewatered alluvial sands. The anticipated excavation lines and cofferdam construction are presented in Figure 7.14. As indicated by the figure, an area of elemental phosphorus disposal occurs in the excavation zone. Excavation into elemental phosphorus is not advisable because of safety concerns and a portion of the NAPL area might not be excavated. A sectional view of excavation within the cofferdam is depicted in Figure 7.15.

The interception trench could not be constructed on top of saturated sediments and would have to be installed through the coffer dam. The interior of the coffer dam would be widened for lateral support against the river pressure, thereby allowing room for construction. The clay/till confining layer forms a trough in the center of the landfill (Figures 3.7 and 3.10 of the RI) and an interception trench alone could not dewater the landfill. The interception trench would remove the majority of groundwater beneath the Site but extraction wells would be required along the landfill perimeter and interior for more thorough dewatering.

The storativity of medium to coarse grained sands, such as those in the alluvium, is approximately 0.32 (Mercer, 1982). For an enclosed area of approximately 25 acres and an average saturated thickness of 20 feet, the total volume of groundwater to be extracted is approximately 52 million gallons. The extracted groundwater would contain organic SSI, metals, and NAPL. Based on the chemical loading estimates of the RI, the anticipated discharge. Pumping at an anticipated rate of one million gallons per day during initial dewatering would overload the nearest sewer line (12" diameter) and treated groundwater would have to be discharged to the river. Groundwater extraction and treatment would be required throughout the duration of excavation activities to control seepage and precipitation into the fill. The Niagara River would be approximately 25 feet above the clay/till layer and this head differential would provide a strong gradient for seepage. The Site infiltration rate of 10 inches per year would provide 6.5 million gallons of water per year alone. For purposes of the FS, it is assumed that long-term dewatering would involve removing 2 million gallons of groundwater per month to account for seepage.

A soil-bentonite slurry wall would be specified because of its low permeability. This type of slurry wall has little structural strength and the coffer dam would have to provide the restraining force against the hydrostatic pressure of the river. Minor discontinuities in construction would be inevitable along the 1500 foot length of slurry wall along the river. While these discontinuities would be negligible for a standard slurry wall where the hydrostatic head was equalized, the 25 foot head differential here would create a significant potential for velocity currents that could undermine the slurry wall and coffer dam. Maintenance of the slurry wall and coffer dam against the river's pressure for a period of approximately twelve years would be difficult. Failure of the slurry wall could result in the washout of landfill materials and subsequent release into the Niagara River. A double walled slurry wall with cement construction might be required for safety and stability. A bulkhead would be required to protect the coffer dam against wind, wave action, and ice.

Excavation near the coffer dam would have to be carefully coordinated and executed in short segments to reduce the potential for failure of the coffer dam. Each segment would have to be backfilled prior to proceeding to an adjacent segment. This would also be true of any portion of the Site where the combined thickness of the underlying glaciolacustrine clay and glacial till are not substantial. The upper portion of the dolomite bedrock is fractured and may be relatively permeable. The cross sections of the Site indicate that the interface between the bedrock and the glacial till is about 25 feet below the river level. Assuming the clay/till have a relatively low permeability, unit weight on the order of 100 pcf (pounds per cubic foot), and a minimum thickness of 8 feet, this yields a downward force of 800 psf resisting a hydrostatic uplift on the order of 1,560 psf, or a net uplift of about 760 psf. The cohesive strength of the clay/till should be sufficient to resist heaving in excavations of small areal extent, but this might not be the case for large excavations or extended time periods. The estimate of clay/till thickness is based on discrete borings. Intermediate sections could be thinner and therefore more susceptible to heaving. Breaching of the clay/till layer would result in loss of vertical containment of the Site and cessation of excavation below the water table, since dewatering could no longer be maintained.

Treatment of the extracted groundwater would include NAPL removal, carbon adsorption and metals removal. The groundwater extraction system would collect the recoverable NAPL, thereby lessening the need for incineration of the alluvial materials. Residual NAPL remaining after dewatering would be held within the alluvial materials and therefore be non-mobile.

After dewatering, excavation would proceed as described for removal of the fill. The dewatered alluvial materials would be uncohesive and require a maximum 2(V) to 1(H) excavation slope. The trench would be developed as shown in Figure 7.11 except that the exposed surface area for excavation line A-A (Figure 7.14) would be approximately 13,000 square feet. EPA has estimated that fugitive dust emissions from excavation activities line under average conditions would total approximately 15,150 pounds. The large surface area of the excavations and the multi-year duration of activities would exacerbate the limitations on control of fugitive emissions. The effectiveness of dust control would be hampered during periods of high winds. Open excavations would exist for the estimated twelve years of incineration activities.

Selection of feasible excavation equipment would be as described previously. Front end loaders and power shovels would experience difficulty operating on the dewatered alluvial materials, especially while loaded. A drag line could accommodate the excavation profile given in Figure 7.11. Other equipment options include a backhoe or a clam shell. The distance to the center of the excavation would be 70 feet, exceeding the reach of large backhoes. The remaining option would be a crane-mounted clam shell. A large crane with counter weights would be required to support a loaded boom length of about 175 feet. This boom length is necessary to provide a stable boom angle of 45° or greater. Landfill materials do not have sufficient compressive strength to support the direct load of such equipment. Mats or railroad ties would be placed to distribute the applied load. Variations in landfill contents would create differential settling and movement of a crane across the Site would require prior compaction testing. A combination of backhoe and clamshell would likely be required for the excavation to the clay/till layer.

Elemental phosphorus, as disposed at the Site, is highly reactive upon contact with oxygen. Dewatering would lower the Site water table below phosphorus disposal areas and increase the potential for exposure of phosphorus to air (under current conditions some of the phosphorus is already above the water table). The effectiveness of the existing earthen cover to isolate the phosphorus from air is probably adequate. Still, phosphorus disposal areas would have to be monitored during and after dewatering operations to assess subsurface conditions. Exact placement of the phosphorus is uncertain and excavations in the area would be inadvisable and not conducted.

Excavation and incineration of Site materials to the clay/till layer would require twelve years, not including mobilization, start up, the trial burn, unanticipated maintenance or shut downs, and decommissioning. Excavation and incineration activities would be a source of fugitive emissions and aesthetic concerns for the community throughout this period. Night-time noise levels on Cayuga Island would be approximately 1500 times ambient conditions (Appendix H). The proximity of these activities to Buffalo Avenue would likely be a detriment to revitalization efforts in the Love Canal area.

Excavation to the clay/till layer would also undermine the 100th Street storm sewer and render it inoperable. The reinforced concrete of the storm sewer would have to be crushed and sized for incineration. A lift station and replacement storm sewer would have to be constructed to control storm flow in the area.

Previous discussions and figures have been based on the optimal situation of a 2(H) to 1(V) maximum excavation slope. Should a flatter excavation profile be required, the following conditions would result:

- larger excavation equipment would be required to reach the interior of the excavation
- the surficial area of exposed chemical residuals would increase, creating a greater emissions potential and increasing the difficulty of dust control
- an increase in the offset of the slurry wall into the Niagara River.

All of these conditions would complicate excavation and decrease the implementability of this alternative.

A total of 400,000 cubic yards of ash would be generated through incineration of the additional materials. The ash would be considered an F028 waste and would have to be delisted for direct replacement. Metals levels could make the ash hazardous under the characteristic of toxicity, complicating the delisting process. Ash levels would have to conform to delisting levels established in the trial burn for direct replacement in the excavation. Ultimate disposal of the ash would have to conform to RCRA requirements if it could not be delisted. The given volume could exceed the capacity of local off-site permitted landfills and hazardous ash would have to be placed in RCRA-equivalent cells constructed on-site. Construction of a secure landfill might not be possible because of New York State siting requirements. For conceptual purposes of the FS, it is assumed that incinerator ash would be replaced directly in the excavation. A sensitivity analysis will be applied towards the anticipated ash handling options to assess the range of potential costs.

The slurry wall would be left in place and the dewatering system would be used for groundwater recovery and gradient control. The combined slurry wall and dewatering system would form a groundwater control system for metals in the incinerator ash and chemical residuals outside the area of excavation. Clean fill would be placed inside the coffer dam to allow grading of the Site for a cap. The dewatering system would be shut off to allow hydrostatic pressures to equalize across the slurry wall.

Incineration of NAPL areas to the clay/till layer would not provide final remediation of the Site. Any fill material not excavated would still require control as would the incinerator ash. Capping and groundwater control would be implemented after incineration. Capping would provide an effective, long-term limitation on the mobility of Site residuals and isolation of the Site from human exposure. Incineration to the clay/till layer is a more permanent remedy than alternatives involving capping and groundwater control alone, and would result in a greater reduction in Site residuals. However, the resulting reduction of human health and environmental risks would be similar for both approaches.

Protection of Human Health and the Environment

This alternative would increase the protectiveness of human health and the environment, possibly even more than combination (although with proper long-term maintenance and monitoring the cap/slurry wall should provide adequate human health and environmental protection). Incineration would remove the bulk of identified sources of organic compounds at the Site. Site residuals outside the excavated areas would remain intact. The cap would isolate all Site materials that currently or potentially could pose a significant risk to human health. The groundwater control system would essentially eliminate discharge to the river, controlling any remaining sources of chemical loadings.

Potential risks to the community and to on-site workers associated with excavation were presented under Alternative OU1-5A and are summarized below:

- fugitive emissions from static sources such as open excavations (dust, vapors) and replaced ash (dust)
- fugitive emissions from dynamic sources such as excavation and stock piling
- the potential for explosive or combustive conditions due to the presence of reactive materials such as chlorates within the excavation
- the potential presence of elemental phosphorus within the excavations
- creation of significant point sources of chemicals to the atmosphere should intact drums be sheared during excavation.

Dust control measures would be required to limit fugitive emissions. Factors that could reduce the effectiveness of control measures include:

- the area of the open excavation faces (approx. 13,00 square feet)
- the slope of the excavation faces (maximum of 2(H) to 1(V) and the resulting face length that must be controlled (approx. 60 to 70 feet)
- the uncohesiveness of the resident materials, which will cause sloughing and loss of surface controls such as wetting agents
- the high winds common at the Site (gusts of 30-40 mph are not uncommon)
- the limited buffer towards downwind areas (a minimum of 50 feet along Buffalo Avenue).

The Companies have estimated volatile emissions from the excavation sides, and particulate emissions from wind erosion, dynamic excavation activities, and equipment moving using EPA emission and air dispersion models (Sirrine, 1990). Air modeling was conducted on a screening level using estimates of maximum hourly volatile emissions and also assuming ambient wind conditions prevail which yield "worst case" air concentrations. Based on this conservative screening model, airborne emissions resulting from excavation at the Site would pose an estimated potential carcinogenic risk of 3.1 X 10^{-4} at the Site property line based on casual contact. Predicted property-line volatile concentrations of benzene and HCCH would exceed NYSDEC air toxics guideline values (Air Guide - 1), and predicted property-line airborne particulate concentrations would exceed National Ambient Air quality Standards.

EPA used more detailed emissions estimates, and site-specific weather data, to evaluate the potential risks to nearby residents which could result from fugitive emissions for Alternative 5C (Gradient Corporation, 1990). Based on EPA's evaluation, potential health risks to 101st Street and Cayuga Island residents would range from 7.9 x 10^{-7} (Cayuga Island--children) to 2.3 x 10^{-6} (101st Street--children). EPA's predicted HCCH-vapor concentrations at the property line would exceed NYSDEC guideline values for air toxics (Air Guide - 1)

Property line monitoring of airborne chemical and particulate concentrations would be required during remedial activities. It is anticipated that Level B personal protective equipment (self-contained air supply) would be required for on-site workers.

Compliance with ARARs

ARARs regarding incineration would be as described for Alternative OU1-5A. Following incineration, groundwater recovery and treatment would be conducted to attain ARARs in portions of the Site that exceed Federal or State requirements.

Long-term Effectiveness and Permanence

Incineration of the majority of organic chemical residuals is the most permanent of all remedial alternatives. Residuals remaining at the Site would include metals in the incinerator ash and chemicals outside the areas of excavation. The slurry wall and groundwater extraction system would control discharge to the river. The cap would physically limit exposures to the unexcavated areas and the ash in the future.

Incineration would not destroy metals and their presence in the landfill residuals limits the overall effectiveness of incineration. The high temperature and residence times necessary to achieve the DREs may cause volatilization of arsenic, cadmium and mercury and other volatile metals to the stack. A rigorous air pollution control system (APCS) would be required. Chlorinated organics would be a significant source for the creation of HCl and could reduce the metals removal efficiencies of the APCS.

Since chemical residuals would remain at the Site, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA. These residuals would be controlled by the cap, slurry wall and groundwater extraction system. Groundwater conditions would be evaluated through a long-term monitoring program.

Reduction of Toxicity, Mobility, or Volume

Organic compounds in the excavated materials would be destroyed through incineration and this alternative provides the greatest reduction of toxicity, mobility and volume of all the alternative considered. The mobility and potential toxic effects of the remaining chemical residuals at the Site would be reduced through the denial of infiltration by the cap. The mobility and volume of chemicals in groundwater would be permanently reduced through recovery and treatment.

Short-term Effectiveness

This alternative has the greatest potential for short-term impacts on the community and on-site workers because of the size and duration of excavation activities. The resultant potential for fugitive emissions and limitations on control measures represents the primary potential for fugitive emissions and limitations on control measures represents the primary concern for human health in the community. The combination of Site conditions and excavation requirements indicate that the potential for particulate and vapor emissions would be appreciable. While ambient air monitoring would be conducted at the property line, the size of open excavations (140' x 200', approx. 0.6 acres) dictates that available control measures might be inadequate during excursions. Anticipated situations of concern include periods of sustained wind gusts off of the river, combustive reactions caused through contact with chlorates, and shearing of drums of chemicals. Wind breaks and other dust and vapor suppression measures would be required, however the effectiveness could be impaired due to the length of the exposed front and the length along the prevailing wind direction of the excavations.

Dusting control through wetting or foam placement would be difficult because of the nature of the fill and alluvial materials and the size of the excavations. The uncohesive landfill materials would tend to slough and expose fresh chemical residuals. The aerial extent of the excavations and their slope length would inhibit complete coverage. Wind, cold weather and night-time operations would further complicate adequate dust control measures.

The vertical distribution of NAPL in the alluvium would present a significant emissions potential during excavation. The oblique excavation face would expose NAPL and other chemistry across a distributed area. The exposed area would be a source of volatile emissions through bulk diffusion into air currents. Airborne volatilization would be a dynamic process as the excavation face sloughs and fresh chemistry is exposed. While the chemicals in NAPL (trichlorobenzene, HCCH, dioxins) are not highly volatile, their toxicity via inhalation is significant. Compounds at the Site with high volatility and significant inhalation toxicity include benzene and trichloroethylene. These compounds would be readily volatilized from an open excavation face or sheared drum. Approximately 500 tons of benzene was disposed at the Site. Another issue is that clam shells cannot achieve tight seals and loss of some of the moist, sandy alluvial materials is likely. Any NAPL within the lost materials would become an additional source of fugitive emissions.

EPA evaluated potential volatile emissions from NAPL for the organic compounds at the Site which would most likely be of concern (HCCHs, PCBs, dioxin, benzene, HCB and tetrachlorobenzene) and found that they pose no unacceptable health risks to nearby residents.

Additional concerns for on-site workers would include:

- reactivity of chlorate residuals
- operating heavy equipment on uncohesive materials containing chemical residuals
- operating within the coffer dam.

Worker entry into the open hole would be minimized during excavation but would likely be required for drum removal and the extrication of bulk construction debris. Visual identification of covered and obscured chemical residuals would be extremely difficult. Worker entry would be required for ash replacement and compaction. A less hazardous but significant health consideration would be exposure to inclement weather. Winter conditions, especially the wind chill factor, would require thermal protection and reduce productivity.

The trial burn process would require approximately two years. Construction of the coffer dam and slurry wall would occur concurrently. Within this time, mobilization and set-up of the incinerator would require approximately 2 months. Optimal implementation time for excavation and incineration of the 400,000 cubic yards of material would be approximately 144 months based on a service factor of 70% and the following conditions:

	Unsaturated materials	Saturated materials
Volume	133,000 CY	267,000 CY
Density	1.25 tons/CY	1.5 tons/CY
Throughput	10 tons/hour	7 tons/hour
Time required	32 months	112 months

The service factor reflects the anticipated average, not extreme, climatic and remedial conditions. Adverse climatic conditions, unanticipated landfill residuals, materials handling difficulties with the diverse feedstock and elevated moisture content could delay this schedule. While incinerator throughput should be the rate limiting step for this alternative, unanticipated conditions in the landfill could impact excavation and materials handling and therefore limit production rates. This schedule would also be dependent on the availability of a rotary kiln with sufficient throughput.

Final compaction of the ash and demobilization of the incinerator would require two months. Construction of the cap and connection with the slurry wall would require another 6-8 months. The groundwater extraction and treatment system would be the former dewatering and treatment system. Total time for implementation of this alternative would be approximately 180 months (15 years).

Implementability

General considerations regarding excavation of the fill and incineration were presented in the evaluation of Alternative OU1-5A (Section 7.2.4.1).

Excavation beneath the water table represents a large increase in implementation requirements compared with excavation of unsaturated materials, both for construction and operations. Major considerations include the presence of the Niagara River, the size of the excavations, and the extended time period required for remediation. The Niagara River would provide a continual, high strength source of recharge to the Site that would have to be isolated for excavation to proceed. Sediments in the embayment would have to be consolidated through vibro-flotation (or equivalent method) to allow construction of the coffer dam and slurry wall. Construction of a 40 foot slurry wall along the 1500 foot length of the river's edge would invariable result in slight discontinuities of the wall. These discontinuities could become velocity channels after the Site was dewatered and a 25 foot head differential existed across the slurry wall. Any channels would be difficult to detect until significant breakthrough had occurred. An intensive inspection and maintenance schedule would be required to control the dam integrity and prevent washout.

Primary implementation concerns include the stability of open excavations, support of large excavating equipment, and control limitations on emissions from open excavations. The stability of large equipment along the edge of open excavations over heterogeneous fill and replaced ash would be a concern. Prior compaction and the placement of load bearing mats would be required, especially for the use of clam-shall cranes.

The hydrostatic head differential would act along the fractured bedrock along all sides of the slurry wall to create a heaving potential within open excavations. While the nominal thickness of the clay/till is 8 feet based on discrete borings, the effective thickness would be what remained after excavation. The purpose of excavating below the water table would be to collect NAPL, which accumulates along the clay/till layer. The clay/till would only be exposed at the center of the excavation and could only be reached by a clam-shell crane. Clam-shells are imprecise excavating equipment, especially at the lateral limit of movement, at the bottom of a 30 foot hole, and when the operator is wearing a full-face respirator as part of the Level B requirements. These geological and excavation factors would combine to create a significant potential for heaving. Heaving would rupture the clay/till hydrologic barrier and allow communication of Site chemicals to the bedrock aquifer. Water inflow would prevent repair of the rupture and cause flooding of the Site, thereby halting remedial activities.

Excavation below the water table would undermine the storm sewer and it would have to be dismantled. The storm sewer is constructed of 9 inch thick steel-reinforced concrete and is 624 feet long. The majority of demolition would be directed from the surface, but the reinforced sewer materials would likely require some manual removal. Roughly three quarters of the storm sewer passes through areas of NAPL presence and worker exposure is a concern. Level A personal protective equipment (PPE) (highest level of skin and respiratory protection) would likely be required. The demolition of large construction materials with heavy equipment in an excavation incurs the risk of physical injury. This risk would be increased by the awkward and restrictive movements afforded by level A PPE.

Weather in the Niagara Falls area can be inclement (snow, ice, cold) from October through March, or half the year. These conditions would impede remedial efforts and could prolong the duration of activities. Remedial workers would have to operate under Level A or B PPE, which causes a reduction in operations efficiency and could also extend the duration of activities.

Cost

Construction costs associated with this alternative beyond those for Alternative OU1-5A include the slurry wall, the cofferdam, the dewatering system, rerouting of the storm sewer, and additional excavation and incineration. Additional operating costs would include treatment of the groundwater from dewatering. Costs for capping, the cutoff wall and groundwater extraction, treatment and discharge are as described under Alternative OU1-3B (Section 7.2.3.2).

The detailed cost estimate for this alternative is presented in Appendix C. A sensitivity analysis was conducted using ash disposal as the cost variable. Costs were estimated for direct replacement of the ash at the Site, off-site disposal at a local RCRA-approved facility, and placement in on-site RCRA cells following stabilization. A summary of the estimated costs is given below:

	Direct Replacement of Ash On-Site	Stabilization of Ash, On-Site RCRA Cells	Off-Site Landfilling of Ash
Total Construction Costs	$288,000,000	$356,000,000	$448,000,000
Present Worth O&M Costs	$8,000,000	$8,000,000	$8,000,000
Total Present Worth Costs	$296,000,000	$364,000,000	$456,000,000

Community Acceptance

The excavation and incineration of heterogeneous landfill materials containing chemical residuals is uncommon for residential communities and is generally perceived as undesirable. Community concerns regarding on-site incineration are primarily related to health effects and aesthetic considerations. The expansive excavations required for material removal to the clay/till layer would provide a significant potential for fugitive emissions and afford a limited buffer zone for the community. Aesthetic concerns would be related to vehicular traffic, noise, and the incinerator profile. Noise sources include:

- vibro-flotation for consolidation of the sediments
- incinerator operation
- excavation equipment.

Night-time noise levels on Cayuga Island from incineration alone would be 1500 times ambient levels. Community opposition would likely be heightened by the duration of excavation and incineration activities, a period of approximately 12 years. The realistic estimate for total implementation of this alternative would be over 15 years.

7.3 OPERABLE UNIT TWO - River Sediments

Operable Unit Two consists of the sediments adjacent to the Site. Sediment volumes associated with remedial alternatives for this operable unit were described in Section 6.1.5. Selection of an alternative for this Operable Unit would be dependent on which alternative is selected for Operable Unit One, as the final disposition of the sediments will be in conjunction with the materials in Operable Unit One.

7.3.1 Alternative OU2-1: No Action

The no action alternative includes no remedial action measures and assumes that Site conditions would remain similar to what was present at the time of the Remedial Investigation (July, 1990). The NCP requires that the no action alternative be retained through detailed screening of alternatives as a baseline for comparison. For the Site, no action would include long-term monitoring of sediment conditions for an appropriate period.

Overall Protection of Human Health and the Environment

EPA's baseline Environmental Endangerment Assessment determined that estimated chemical concentrations in the embayment water pose potentially significant risk to survival or propagation of invertebrates or fish residing in, frequenting, or passing through the embayment, and to animals feeding on aquatic organisms in the embayment. A potentially significant risk was identified for infaunal organisms living in sediments in the embayment area. No significant human health risks were identified due to drinking water from the river; however, significant risks were identified due to eating fish from the embayment and swimming in the vicinity of the Site. The Companies' baseline Environmental Endangerment Assessment determined that the near-shore sediments posed potential risks to infaunal organisms but no significant risks to the remaining aquatic environment.

Compliance with ARARs

Because no remedial actions are included in this alternative, there are no action-specific ARARs. No ARARs for potential remediation of sediments were identified. However, the interstitial pore concentrations of several site-related organic chemicals currently exceed the New York State Ambient Water Quality Standards (AWQS) set by 6NYCRR Part 701 and 10NYCRR Part 5 for fresh waters. While not a direct standard, interstitial pore water concentrations exceeding State AWQS are "To-Be-Considered" guidance and will be used as a conservative estimate of sediments potentially requiring remediation. These criteria are applied only to the sediment interstitial pore waters.

Long-Term Effectiveness

This alternative will leave sediments containing Site-related chemicals above survey levels. However, these sediments extend no more than 300 feet from shore into the embayment.

Since waste residuals would remain in the riverbed, review of the effectiveness and protectiveness of the no action alternative every five years would be required by SARA. Condition of the sediments is not expected to change significantly over a five year period.

Reduction of Toxicity, Mobility, or Volume

There would be no reduction of waste toxicity, mobility, or volume under this alternative other than by natural mechanisms such as biodegradation.

Short-Term Effectiveness

There would be no health risks for remediation workers since there would be no construction activities. Potential risks to the community would be through leaching of chemicals from the sediments into the Niagara River. Potential environmental impacts include continued exposure to aquatic and benthic organisms and fish-eating wildlife.

The No Action alternative can be implemented immediately. Sediment monitoring would be conducted at appropriate time intervals.

Implementability

The No Action alternative requires no implementation other than long-term monitoring.

Cost

There are no capital costs associated with this alternative. The only operation and maintenance costs associated with this alternative would be the cost of the sediment monitoring. Sampling is estimated to be an annual event focused on site-specific indicator chemicals. Costs for the review of the Site remedy every five years are included with each of the alternatives for Operable Unit One. This cost is automatically factored into the total remediation costs because an alternative must be selected for Operable Unit One as part of the overall Site remedy.

A detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

Total Construction Costs	$0
Present Worth O & M Costs	$415,000
Total Present Worth Costs	$415,000

Community Acceptance

This alternative would leave Site-related chemicals in the riverbed. Therefore, the community might be reluctant to accept selection of the No Action alternative.

7.3.2 Alternative OU2-2A: Dewater/Dredge Areas of Elevated Chemical Concentrations, Spread on Site, Cap

This alternative would be selected in conjunction with one of the options of Alternative 3 for Operable Unit One. This alternative involves first installing cofferdams around each of the two areas of elevated chemical concentrations identified in Section 4.2.3.3, as shown in Figure 7.16, to control any sediment dispersion during the remediation activities. The cofferdams would be either a portable type made of a steel support frame covered by a flexible fabric membrane, a clay (berm) type, or a sheet pile type. The portable cofferdam would be the preferred type to use if suitable dewatering can be achieved and the sediments can support the equipment required for excavation. If there is a need for the cofferdam to be used as an access road for excavation equipment to reach the sediments, the clay type cofferdam would be used. If suitable dewatering of the enclosed area cannot be achieved using the portable or clay type, the sheet pile cofferdam would be selected. A temporary extension of the storm sewer would need to be added to transport any effluent through the enclosed area and into the river.

Once the cofferdams have been constructed, removal of the 4600 cubic yards of sediment enclosed by the cofferdams could be accomplished by hydraulic dredging or by dewatering followed by mechanical excavation (to a depth of two feet). If dewatering followed by mechanical excavation is used, surface water inside the cofferdams would first be pumped back into the river. Once the water has been removed from inside the cofferdams, the sediments could be excavated using conventional excavation equipment. Excavation could be done from the shore or, if necessary, heavy filter fabric covered with stone could be laid on the dewatered sediments to construct a temporary road for excavation equipment to reach the sediments. The excavated sediments would then be fed to a filter press for further dewatering if necessary. The portable type cofferdam would probably be suitable for use with this dredging method. However, if the sediments below the cofferdam are porous enough to allow leakage through to the area being dewatered, the sheet pile type would be required to achieve suitable dewatering of the enclosed area for mechanical excavation. The sheet pile cofferdam would create greater sediment dispersion during installation and removal than would the portable type and silt curtains might be required for sediment control.

The hydraulic dredging method would utilize a small portable dredge. The dredge would traverse the area by winching itself along cables attached at various locations within the area. Sediments would be transported to a staging area consisting of large storage tanks or storage ponds prior to dewatering. The sediments would then be dewatered using a belt filter press and conveyed to a stockpile area to await treatment along with the materials from Operable Unit One. The water removed would be pumped to a treatment system and treated for suspended solids and organics prior to final discharge to the river. For purposes of the FS, water treatment would consist of multi-media filtration followed by carbon adsorption.

Because hydraulic dredging uses water as a transport medium to convey the sediments, large quantities of water would require treatment using this method and a large area would be needed for storage tanks or storage ponds and dewatering equipment for processing. Another potential difficulty associated with this method is that debris larger than six inches, such as old tires, tree stumps, bottles, etc., would have to be removed prior to dredging. This removal would be done either manually or mechanically and would increase the materials handling and risk of exposure associated with this alternative. The portable type cofferdam would probably be suitable for use with this dredging method and would not require additional clay that would eventually require disposal.

For all sediment removal options, the cofferdam would be removed once all of the sediments have been removed. If a clay cofferdam is used, the clay from the cofferdam removal would then be spread over the landfill area along with the dewatered sediments prior to construction of a cap.

Overall Protection of Human Health and the Environment

This alternative addresses the sediment areas containing the highest concentrations of Site-related chemicals and thus the sources of highest risk. By removing those areas exceeding the sediment criteria derived from State AWQS, the significant risk to the environment associated with these areas would be eliminated.

Compliance with ARARs

There are no promulgated Federal or State quality standards for Site sediments. Sediment locations with chemical concentrations above survey levels that could exceed New York State AWQS in the interstitial pore waters (which represent "To-Be-Considered" (TBC) guidelines) waters were presented in Table 4.5. All of these sample locations are within the areas of excavation of this alternative except for location A-465 (which has been determined anomalous by the RI). These criteria are not a promulgated standard for sediment remediation but represent a conservative level of protectiveness for aquatic organisms.

As stated in the document CERCLA Compliance with Other Laws (EPA, 1988), "an area of generally dispersed waste containing an existing or new landfill unit could be viewed as a single large landfill". Since the contaminated sediments are considered to be a result of dispersion or migration of materials from the landfill, they are part of the same unit. Consolidation of sediments within the landfill would not trigger RCRA requirements.

Because this is a CERCLA action taking place entirely on-site, permits from the U.S. Army Corps of Engineers (USACE) and the New York Department of Environmental Conservation would not be required. However, remedial actions would need to meet the substantive requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. All construction activities in the Niagara River would be coordinated with the USACE.

Long-Term Effectiveness and Permanence

This alternative would leave sediments containing Site-related chemicals at levels of ≤ 1 mg/kg in the riverbed. Monitoring of the remaining sediments on a periodic basis would be required. Because waste residuals would remain at the Site, review of the effectiveness and protectiveness of the remedy every five years would also be required. Monitoring and maintenance of the cap is discussed in Alternative OU1-3A, Section 7.2.3.1.

Reduction of Toxicity, Mobility, or Volume

This alternative reduces the mobility of sediments containing the highest concentrations of Site-related chemicals by removing and placing them under a cap. The cap would essentially eliminate the potential for chemical migration from the sediments to the river water. This alternative also reduces exposure to benthic organisms living in the sediments.

This alternative addresses the sediment areas containing the highest concentrations of site-related chemicals. Upon completion of this alternative, site-related chemicals at concentrations of <1 mg/kg will remain in some of the sediments adjacent to the Site.

Short-Term Effectiveness

The only potential risk to the community to be addressed during remedial actions would be through sediment dispersion in the Niagara River. The cofferdam would be constructed outside the area of excavation to alleviate this risk. Any sediments that escape the control structures should be quickly attenuated by the flow of the river and not pose a significant risk. Potential risks to the workers on-site would include contact with the contaminants in the sediments removed during the remediation activities. This exposure would be minimized by using proper protective equipment and following the remedial health and safety plan. Vapor emissions from dewatering would be minimal because of the low concentrations and Henry's constants of the chemicals and their moist state.

Environmental impacts would include destruction of the existing benthic community and temporary disturbance of any fish and waterfowl in the area. Recolonization of the benthic community would be expected to occur naturally in the area once the cofferdam was removed and wildlife impact would be minimal.

The implementation time for this alternative would be approximately two to three weeks to construct the cofferdam, one month to dewater and excavate the enclosed area, and one month to dewater the excavated sediments and spread them across the Site for a total of approximately three months to complete the remediation.

Implementability

Technologies used for this alternative are all conventional and demonstrated. Implementation of this alternative would be relatively straightforward. The portable type cofferdam would be easier to install and remove than the clay cofferdam or the sheet piling. To install the portable cofferdam, the steel framework is assembled using bolted clamps and pinned connections along the perimeter of the area to be dewatered. The sections of fabric membrane are then assembled on shore and rolled and floated out into position on the assembled framework. After connection of the fabric, it is unrolled down the diagonal face of the framework and extended preset distance over the riverbed. A heavy chain sewn into the outer perimeter of the fabric is used to sink the sealing sheet to facilitate the dewatering. The water inside the structure can then be pumped over the structure to dewater the enclosed area.

The clay cofferdam could be constructed using earth moving equipment. The sheet piles would have to be driven from the shore as far as possible, and from a barge for the portions which cannot be reached from the shore. A potential difficulty with sheet piles is that they may drive contaminated sediments deeper into the riverbed. Installation and removal process of both sheet piles and clay type cofferdams could generate appreciable quantities of dispersed sediments. Since these activities would occur within the cleaner sediments outside of the areas of excavation, any resultant turbidity should not present significant risks. Silt curtains could be used as a sediment control measure.

A potential difficulty which could arise with the mechanical excavation of the sediments is that the structural integrity of the sediments is questionable for supporting excavation equipment. All of the sediments cannot be reached from the shore, so a clay type cofferdam may be required for the equipment to drive on to reach the sediments.

The hydraulic dredging process would result in approximately one million gallons of dredge material to be staged and dewatered. A staging/processing area consisting of storage tanks and filter presses would need to be set up on site for dewatering the dredged sediments prior to spreading them over the Site prior to capping.

Remedial activities in the river would not be done during freezing or windy conditions. Floating ice could damage any sediment controls set up and render them ineffective. Because technologies used are conventional, no difficulty is anticipated in acquiring the necessary equipment and personnel required for completing the remediation. Sediment remediation would be coordinated with construction of the cap.

Cost

Construction costs for this alternative include cofferdam construction, mobilization, staging, sediment removal, sediment dewatering, water treatment, cofferdam removal and demobilization. A sensitivity analysis was conducted using the sediment removal method and the type of cofferdam as the key variables. It is assumed that the portable type cofferdam would be used for the hydraulic dredging since dewatering of the enclosed area would not be required for this sediment removal method. It is assumed the sheet piles would be required (worst case) for use with the mechanical dredging if suitable dewatering of the enclosed area could not be achieved with one of the less expensive cofferdam types.

A detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated cost is given below:

	Mechanical Dredging/ Sheet Piles	Hydraulic Dredging/ Portable Cofferdam
Total Construction Costs	$1,390,000	$2,310,000
Present Worth O & M Costs	$415,000	$415,000
Total Present Worth Costs	$1,800,000	$2,730,000

Community Acceptance

This alternative would create a temporary disturbance in the river during implementation; however, completion time would be relatively short and upon completion, the area would be essentially returned to its present state. Although a limited amount of site-related chemicals will remain in the sediments, levels protective of the environment would be met and no significant risk to the community would remain.

7.3.3 Alternative OU2-2C: Dewater/Dredge Areas of Elevated Chemical Concentrations, Incinerate

This alternative is identical to Alternative OU2-2A, as discussed in Section 7.3.2, except that the 4600 cubic yards of dewatered sediments would be incinerated instead of being capped. The clay used to construct the cofferdam would be used as fill beneath the Site cap. This alternative would be selected in conjunction with one of the on-site incineration options of Alternative OU1-5 or the sediments could be taken to the Central Storage Facility (CSF) at OCC's Niagara Falls facility for eventual incineration in the proposed rotary kiln incinerator. Implementation requirements for on-site incineration were described in Section 7.2.4 and for incineration at OCC's Niagara Facility in Section 7.2.2.3. The Site would be capped under one of the Alternative OU1-3 options if the sediments were taken to the CSF.

Overall Protection of Human Health and the Environment

This alternative addresses the areas of sediment containing the highest concentrations of Site-related chemicals. The greatest risks associated with the sediments would be reduced by removing the areas of sediments exceeding the AWQS-derived criteria. Although some Site-related organics would remain, the risk associated with these sediments would be much lower.

Compliance with ARARs

As stated previously, no promulgated standards for sediment quality exist but State AWQS are TBC remediation guidelines. Sediment locations that could exceed AWQS in the interstitial pore water were presented in Table 4.5 and would be removed under this alternative. By removing these sediments, the remaining interstitial pore concentrations would be lowered to levels below the AWQS established by 6NYCRR Part 701 and 10NYCRR Part 5. The conservative remediation levels would therefore be met by this alternative.

Because this is a CERCLA action taking place entirely on-site, permits from the U.S. Army Corps of Engineers and the New York Department of Environmental Conservation would not be required. However, remedial actions would need to meet the substantive requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. All construction activities in the Niagara River would be coordinated with the USACE.

Excavation and treatment of the sediments would trigger RCRA requirements. Incineration ARARs are discussed under Alternative OU1-5A (Section 7.2.4.1).

Long-Term Effectiveness and Permanence

As with Alternative OU2-2A, sediments containing levels of Site-related chemicals less than 1 mg/kg would remain in the riverbed upon completion of this alternative. The organics in the excavated sediments would be destroyed during incineration. Long-term monitoring and a remedy review every five years would be required for those sediments remaining in the embayment. No long-term maintenance would be required for sediments under this alternative.

Reduction of Toxicity, Mobility, or Volume

This alternative would reduce the mobility of the contaminants by removing the sediments from the riverbed. The toxicity and volume of organic compounds would be permanently reduced to zero when the sediments are incinerated.

Sediments containing the highest levels of Site-related chemicals would be remediated in this alternative. Concentrations of Site-related chemicals less than 1 mg/kg would still be present in some of the remaining sediments.

Short-Term Effectiveness

Potential risks to the community during excavation of this alternative would be due to contaminated sediment dispersion during the dredging operation and air emissions during incineration. Sediment dispersion would be controlled via construction of a cofferdam around the area being remediated. Emission control equipment would be used to reduce risk due to incineration. Risks to workers would be due to contact with the sediments containing the highest levels of organics. This exposure would be minimized by using proper protective equipment and following the remedial health and safety plan.

As with Alternative OU2-2A, recolonization of the benthic community would be expected to occur naturally after completion of the activities. The fish and waterfowl in the area would also be temporarily disturbed.

Implementation time for this alternative would be the same as for Alternative 2A, approximately three months to construct the cofferdam, dredge the sediments, and dewater the sediments. The sediments would then be staged for incineration along with other Site residuals. Incineration time would be approximately one month for the dewatered sediments.

Implementability

This alternative would utilize conventional equipment and techniques for removing and dewatering sediments. Concerns associated with this alternative are the same as those discussed for Alternative OU2-2A, Section 7.3.2. Implementation concerns associated with incineration are discussed in Section 7.2.4.1, Alternative OU1-5A. The additional moisture in these sediments would limit the throughput in the incinerator and would increase the fuel costs for their treatment.

Cost

Construction costs for this alternative include cofferdam construction, mobilization, staging, sediment removal, sediment dewatering, cofferdam removal, demobilization, and incremental costs for incinerating the dewatered sediments and cofferdam material along with the materials from Operable Unit One. A sensitivity analysis was conducted using the sediment removal method and the type of cofferdam as the key variables. Again, it is assumed that the portable type cofferdam would be used for the hydraulic dredging and that the sheet piles would be required for use with the mechanical dredging.

A detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated cost is given below:

	Mechanical Dredging/ Sheet Piles	Hydraulic Dredging/ Portable Cofferdam
Total Construction Costs	$3,240,000	$4,070,000
Total O&M Costs	$ 415,000	$ 415,000
Present Worth Costs	$3,660,000	$4,480,000

Community Acceptance

This alternative is essentially the same as Alternative OU2-2A up to the point of final disposition of the sediments. Selection of incineration as a means of remediating the Site is discussed in Section 7.2.4.1.

7.3.4 Alternative OU2-4: Dredge the Full Extent of SSI Above Survey Levels, Dewatering Cell, Extend Cap Over Cell

For this alternative, a cofferdam would be constructed around the full extent of site-specific indicator (SSI) parameters above survey levels identified in Section 4, as shown in Figure 7.17. As with Alternative OU2-2, one of three different types of cofferdams could be constructed: a sheet pile cofferdam, a clay cofferdam, or a portable cofferdam made of a steel support frame covered by a flexible fabric membrane. All types would be capable of controlling sediment dispersion during dredging. Once the dredging is completed, the cofferdam would be removed. If a clay or sheet pile type cofferdam is used, removal would create some turbidity and sediment dispersion. The clay that is removed from the river could be used as part of the fill material needed for capping the dewatering cell. If the portable cofferdam is used, removal would create a small amount of turbidity, but disposal would not be necessary since these are rental items which can be reused following decontamination.

For the mechanical excavation method, once the cofferdam is in place, the enclosed area would be dewatered by pumping the water back into the river. Because the river water is essentially being rerouted, it is expected that no permits would be required for this process. After the area had been dewatered, a bulkhead similar to the existing bulkhead along the shoreline of the Site would be constructed across the lowland area and a portion of the embayment as shown in Figure 7.18. The 15,000 cubic yards of sediments located outside of this bulkhead and inside the cofferdam would then be excavated using mechanical methods, as discussed in Section 7.3.2. Sediments would be excavated to a depth of two feet, as discussed in Section 6.1.5. The excavated sediments would be placed inside the dewatering cell created inside the new bulkhead. Once all of the sediments inside the cofferdam have been placed in the dewatering cell, the sediments in the cell would be allowed to settle and the water above the sediments would be pumped out into a water treatment system to remove organics and/or suspended solids prior to discharging it back into the river.

If hydraulic dredging is used, first the cofferdam and bulkhead would simultaneously be constructed. The water inside the bulkhead would be pumped back into the river. The sediments inside the cofferdam and outside the bulkhead would be dredged and placed inside the bulkhead, creating a dewatering cell. The lowland area would also be used as part of the dewatering cell. Once this cell is filled up, the sediments would be allowed to settle, the water would be decanted off the top and pumped to a water treatment system, and the entire process would then be repeated until all of the sediments above organic SSI survey levels have been placed behind the bulkhead. The total volume of water to be treated in this process would be approximately 4.5 million gallons.

Once the water has been removed from the dewatering cell, approximately 8500 cubic yards of additional fill material would have to be added to fill the enclosed area prior to constructing a cap over the entire Site, including this cell. This would increase the size of the cap by approximately 1.8 acres over the original 25 acres. This alternative would have to be completed in conjunction with one of the options of Alternative 3 for Operable Unit One.

As part of this alternative, the storm sewer would need to be permanently extended through the enclosed area so that it could continue to empty into the river. The length of additional sewer would be approximately 150 feet.

Overall Protection of Human Health and the Environment

This alternative would address the entire extent of Site-related chemicals in the Niagara River sediments. The risk to the environment posed by Site-related chemicals in the embayment sediments would be removed with this alternative. Removal of additional sediments beyond those in the areas of chemical concentrations exceeding AWQS in the interstitial pore waters addressed in Alternative OU2-2 would not be significantly more protective of the environment. Execution of this alternative would permanently remove a portion of the existing aquatic habitat for benthic organisms, fish, and waterfowl and the small lowland area currently existing along the Site shore. However, this area is not of significant or unusual importance because of the limited area, and the benthic community is expected to repopulate naturally once the remedial work is completed. Extension of the shoreline out into the area where the river presently flows would permanently change the current river flow patterns and potentially effect downstream sedimentation and erosion patterns. However, these changes are not anticipated to be significant.

Compliance with ARARs

Removing the identified sediments from the river bottom would reduce the interstitial pore concentrations to levels below the criteria derived from 6NYCRR Part 701 and 10NYCRR Part 5. Since the entire volume of sediments containing SSI chemicals is addressed and contact of the chemicals with the river water is eliminated by the cap, this alternative would exceed the conservative remediation levels established by the AWQS.

This alternative would permanently eliminate the 0.6 acre lowland area. If this alternative is selected, a wetlands assessment would be performed to determine whether this area qualifies as a wetland. If it does, an equivalently sized wetland must be established elsewhere, or a variance obtained otherwise.

Consolidating the sediments into the cove adjacent to the landfill and including this area under the cap would not invoke RCRA requirements. Disposal/placement does not occur if wastes are consolidated in the same area or capped.

Because this is a CERCLA remediation and all activities are on-site, permits from the U.S. Army Corps of Engineers and the New York Department of Environmental Conservation would not be required. However, remedial actions would need to meet the substantive requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Construction activities in the Niagara River would be coordinated with the USACE.

Long-Term Effectiveness and Permanence

Sediments remaining in the river would present no significant risks after completion of this alternative. The entire volume of sediments containing SSI chemicals will be contained by a cap as described in Section 7.2.3. Placement of the cap over the sediments would eliminate exposure via direct contact and placement of a cutoff wall along the bulkhead would eliminate potential chemical migration from the sediments via groundwater migration. Therefore, no long-term monitoring of river sediments would be required. Potential long-term monitoring and operation and maintenance requirements for the cap and slurry wall are described in Section 7.2.3.1.

Reduction of Toxicity, Mobility, or Volume

This alternative would reduce the mobility of the chemicals by containing the sediments under a cap. The entire volume of sediments containing SSI above survey levels would be addressed by this alternative. The volume of sediment residuals would remain the same as a result of this alternative, but their mobility would be permanently reduced (with long-term maintenance) and their potential toxic effects would be essentially eliminated since there would be no remaining exposure pathways.

Short-Term Effectiveness

A potential risk to the community during implementation of these remedial actions would be sediment dispersion into the river. This would be limited by constructing a cofferdam around the entire volume of sediments containing SSI. Some turbidity during construction and removal of the cofferdam would result in a limited amount of sediment dispersion, but these sediments are outside the extent of SSI above survey levels and therefore would present no significant risks.

Risks to the workers during the remedial activities would be due to contact with contaminated sediments. This alternative would involve handling of a larger volume of contaminated sediments than would Alternative OU2-2, but the chemical concentration levels in these additional sediments would be lower. This risk would be minimized by proper use of personal protection equipment and adherence to the remedial health and safety plan.

Potential environmental impacts would include displacement of the existing benthic community and temporary disturbance of the fish and waterfowl which frequent this area. However, recolonization of the benthic community would be expected to occur naturally in the area remaining once the cofferdam was removed. The area covered by the cap would not be recoverable to benthic organisms but represents a limited portion of the river.

This alternative would take approximately six months to implement, not including the time to construct the cap or the cutoff wall discussed in Sections 7.2.3 and 7.2.2.2, respectively, for Operable Unit One. The additional time required for extending the cap and cutoff wall over that required for Operable Unit One would be approximately two months. Work would have to occur during months that the weather is favorable for construction in western New York.

Implementability

The basic technologies used for this alternative are conventional and demonstrated as discussed in Section 7.3.2. Construction of the cofferdam, either clay or portable, should be a relatively straightforward operation as would be the construction at the bulkhead. If a sheet pile cofferdam is required, a barge would be necessary for its installation and removal. If mechanical dredging is used, dewatering the enclosed area is a simple operation which could be done with centrifugal or air diaphragm pumps. One difficulty which could arise with this alternative is that the dewatered sediments may not have enough structural integrity to support the access road for the excavation equipment. If this problem arises, a portion of the excavation may be accomplished from the shore. The cofferdam could be fortified and the equipment could be driven on it to reach the remainder of the sediments.

If hydraulic dredging is used, large quantities of water will be generated as part of the dredging process. These waters would require treatment prior to returning them to the river because of the intimate contact with contaminated sediments during transport to the dewatering cell. The dewatering of this volume of water would require a large area for staging and processing and would also be costly.

Clean fill would be imported to bring the dewatering cell up to the level of the landfill. A cap conforming to the specifications presented under Alternative OU1-3A (Section 7.2.3.1) would then be extended over the cell area.

Cost

Construction costs for this alternative include mobilization, cofferdam construction, bulkhead construction, staging, sediment removal, sediment dewatering, water treatment, cofferdam removal, extending the storm sewer, filling the dewatering cell, and extending the cap from the landfill area over the dewatering cell. Operation and maintenance costs would be included with the costs for maintaining the cap given with Alternative OU1-3 options. A sensitivity analysis was conducted using the sediment removal method and the type of cofferdam as the key variables. It is assumed that the portable type cofferdam would be used for the hydraulic dredging and that the sheet piles would be required for use with the mechanical dredging.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

	Mechanical Dredging/ Sheet Piles	Hydraulic Dredging/ Portable
Cofferdam		
Total Construction Costs:	$4,620,000	$6,180,000
Total O&M Costs:	$0	$0
Total Present Worth Costs	$4,620,000	$6,180,000

Community Acceptance

This alternative would address the entire volume of sediments above survey levels. Upon completion of this alternative, the shoreline would be slightly modified. Construction will create a temporary disturbance during implementation, but no significant risks to the community would result. No significant opposition to this alternative is anticipated.

7.3.5 Alternative OU2-6A: Dredge the Full Extent of SSI Above Survey Levels, Dewatering Cell, Spread on Site, Cap

This alternative is the same as Alternative 4 except that a temporary berm would be constructed rather than a bulkhead and a temporary extension would be added to the storm sewer rather than a permanent one. A cofferdam would first be placed along the extent of organic site-specific indicator (SSI) parameters above survey levels. A temporary berm would then be constructed to create a dewatering cell as shown in Figure 7.18. Sediments between the berm and the cofferdam would then be excavated or dredged into the dewatering cell and dewatered. Then the entire dewatering cell, including the contaminated sediments upon which the excavated sediments were placed and the material used to construct the berm, would be excavated. These excavated sediments would then be spread across the Site and capped using one of the options of Alternative 3 for Operable Unit One. The volume of sediments to be excavated and spread across the Site would be approximately 20,500 cubic yards (Section 6.1.5) and the additional volume of berm residuals would be 7300 cubic yards, resulting in approximately 28,000 cubic yards of material to be spread across the Site.

Overall Protection of Human Health and the Environment

This alternative would address the entire volume of sediments containing SSI above survey levels. Removal of the sediments beyond the areas potentially exceeding AWQS in the interstitial pore waters addressed in Alternative OU2-2 would be slightly more protective of the environment. The environmental risk would be eliminated through removal of sediments above survey levels. Implementation of this alternative would displace the existing benthic community in a limited area, but complete recolonization of the benthic community by natural processes would be anticipated once the remedial actions are completed. By placing the contaminated sediments under the cap, all migration pathways for contaminants currently in the sediments would be controlled.

Compliance with ARARs

Removing the contaminated sediments from the river bottom would reduce the interstitial pore concentrations to levels below the criteria derived from 6NYCRR Part 701 and 10NYCRR Part 5. Since the entire volume of sediments containing SSI above survey levels would be removed from the river, chemical concentration levels in the pore waters would be negligible. As discussed earlier, CERCLA Compliance with Other Laws (EPA, 1988) states that "an area of generally dispersed waste containing an existing or new landfill unit could be viewed as a single large landfill." Since the chemicals in the sediment are considered to be the result of erosion or dispersion of the wastes deposited at the landfill, the sediments would be considered to be part of the same unit. Therefore, RCRA requirements would not be triggered by moving the sediments onto the landfill and capping it.

This alternative would permanently eliminate the 0.6 acre lowland area. If this alternative is selected, a wetlands assessment would be performed to determine whether this area qualifies as a wetland. If it does, an equivalently sized wetland must be established elsewhere, or a variance obtained otherwise.

Because this is a CERCLA action occurring totally on-site, permits from the U.S. Army Corps of Engineers and the New York Department of Environmental Conservation would not be required. However, remedial actions would need to meet the substantive requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Construction activities in the Niagara River would be coordinated with the USACE.

Long-Term Effectiveness and Permanence

Because the entire volume of sediments containing SSI chemicals above survey levels would be addressed and all potential migration pathways would be isolated with the construction of the cap (see Section 7.2.3 - Alternative OU1-3), this alternative provides long-term effectiveness greater than that provided by Alternative OU2-2. Long-term monitoring and operation and maintenance of the cap would be required as discussed in Section 7.2.3.

Reduction of Toxicity, Mobility, or Volume

This alternative would permanently reduce the mobility of the chemicals in the sediments by containing the sediments under the regularly maintained cap. The entire volume of sediments would be addressed by these remedial actions. The volume of contaminants would remain the same as a result of this alternative, but the potential toxic effects would be essentially eliminated because no exposure pathways would remain.

Short-Term Effectiveness

A potential risk to the community during implementation of this alternative would be sediment dispersion into the river. This risk would be minimized by constructing a cofferdam around the entire extent of the contaminated sediments. Turbidity caused by construction and removal of the cofferdam would result in some dispersion of sediments. However, the sediments in the area of the cofferdam contain minimal chemical levels. The anticipated remaining moisture content even after dewatering would minimize the likelihood of any fugitive emissions.

Risks to the workers during the remedial activities would be due to contact with the contaminated sediments. More handling of sediments is involved in this alternative than in Alternative OU2-4, therefore the potential risk would be higher. Proper use of personal protection equipment and adherence to the remedial health and safety plan would minimize this risk.

Potential environmental impacts would include displacement of the existing benthic community and temporary disturbance of any fish and waterfowl which frequent this area. However, upon completion of this alternative it is expected that natural processes would result in repopulation of the aquatic wildlife and waterfowl.

This alternative would take approximately six months to implement. Implementation would need to occur during the portion of the year when weather is favorable for outdoor construction in western New York, probably between April and October. Freezing temperature could cause handling problems with the sediments, floating ice could damage the cofferdam, and high winds could interfere with the effectiveness of the cofferdam.

Implementability

The technologies used for this alternative are all conventional and should present no problems when implemented. Construction of the cofferdam would be a straightforward operation whether the clay or portable type is used. The sheet pile cofferdam would probably require the use of a barge for installation and removal. One difficulty which may be encountered is that the sediments may not provide sufficient structural integrity to support equipment on the access road which will be constructed. If this is the case, some excavation can be accomplished from the shore, and the clay type cofferdam can be used to drive equipment on to reach the remaining sediments.

These remedial activities would not be carried out during freezing conditions. A diversion system would have to be set up to control runoff water from rain events as well as any infiltration running through the storm sewer away from the contained area. Excavation of the sediments in the dewatering cell is a conventional technology. Construction of the cap is discussed in Section 7.2.3, Alternative 3 for Operable Unit One.

Because the technologies are conventional, obtaining the necessary equipment and operators should not present any major problems.

Cost

Construction costs for this alternative include mobilization, cofferdam construction, berm construction, storm sewer extension, sediment removal, sediment dewatering, cofferdam removal, and staging for placement under the cap. Operation and maintenance costs are included to the costs for Operable Unit One Alternative 3. No additional monitoring (beyond that required for the cap/slurry wall monitoring and maintenance) would be required for this alternative. A sensitivity analysis was conducted using the sediment removal method and the type of cofferdam as the key variables. It is assumed that the portable type cofferdam would be used for the hydraulic dredging and that the sheet piles would be required for use with the mechanical dredging.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

	Mechanical Dredging/ Sheet Piles	Hydraulic Dredging/ Portable Cofferdam
Total Construction Costs	$3,600,000	$5,570,000
Total O&M Costs	$ 0	$ 0
Total Present Worth Costs	$3,600,000	$5,570,000

Community Acceptance

This alternative would remove all of the sediments containing Site-related chemicals above survey levels from the riverbed. Implementation would create a disturbance, but should take only a short period of time to complete. Once completed, the area would return naturally to its former condition with minimal loss of riparian habitat. Because environmentally protective levels would be met and little risk to the community would result from implementation of this alternative, community acceptance of this alternative is anticipated to be favorable.

7.3.6 Alternative OU2-6C: Dredge the Full Extent of SSI Above Survey Levels, Dewatering Cell, Incinerate

This alternative is identical to Alternative OU2-6A except for the final disposition of the dewatered sediments. The sediments in the cell would be excavated and placed in a temporary storage area prior to being incinerated with Site fill materials. The volume of additional material to be incinerated would be approximately 20,500 cubic yards. This alternative would be implemented in conjunction with one of the on-site incineration options of Alternative OU1-5. The volume of excavated sediments under this alternative would exceed the available space at the CSF. Incineration at OCC's Niagara Falls facility is therefore not considered under this alternative. The clay used for construction of the berm would be used during construction of the Site cap.

Overall Protection of Human Health and the Environment

This alternative would address the entire volume of SSI chemicals above survey levels in the sediments. The risk to the environment which these sediments currently pose would be eliminated. Implementation of this alternative would displace the existing benthic community, but complete recolonization would be expected to occur naturally once remedial actions are completed.

All sediments above survey levels calculated to exceed AWQS in the interstitial pore waters would be removed under Alternative OU2-2. This alternative would remove all sediments containing SSI above survey levels and be more protective of human health and the environment than would one of the Alternative OU2-2 options, although the significance of the risk reduction cannot be quantified. Risks associated with the incinerator would be the same as those discussed in Section 7.2.4.1.

Compliance with ARARs

There are no identified ARARs for Site sediments. Removing the identified sediments from the river bottom would reduce the interstitial pore concentrations to levels below the criteria derived from 6NYCRR Part 701 and 10NYCRR Part 5. Since the entire volume of sediments containing SSI above survey levels will be removed from the river, chemical concentration levels in the pore waters will be negligible.

Because this is a CERCLA action taking place entirely on-site, permits from the U.S. Army Corps of Engineers and the New York Department of Environmental Conservation would not be required. However, remedial actions would need to meet the substantive requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Construction activities in the Niagara River would be coordinated with the USACE.

As described in CERCLA Compliance with Other Laws Manual (EPA, 1988), "placing the waste into an incinerator and replacing it on land, even within the larger area of contamination, would trigger applicability of RCRA requirements for disposal/placement, because waste is being moved to different types of units." The results of RCRA being triggered are discussed in Section 7.2.4.

Long-Term Effectiveness and Permanence

The entire volume of sediments above SSI survey levels would be treated, eliminating all organic compounds by incineration and providing the greatest long-term effectiveness and permanence of the OU2 alternatives. No long term monitoring or operation and maintenance would be required for this alternative.

Reduction of Toxicity, Mobility, or Volume

The volume and toxicity of organic chemicals in the sediments would be eliminated through incineration. Mercury and other metals present would not be destroyed through incineration and would partition to the stack gases and/or the ash. Further treatment of the ash might be required if metals levels exceed TCLP standards.

Short-Term Effectiveness

Potential risks to the community during implementation of this alternative would be due to sediment dispersion into the river during the excavation or air emissions during the incineration. Risks due to the sediment dispersion would be minimized by constructing a cofferdam around the entire extent of the contaminated sediments. Turbidity caused by construction and removal of the cofferdam would result in some sediments being dispersed. Sediments in the area of the cofferdam contain little contamination and no significant risks are anticipated. The air emissions would be minimized by using pollution control devices as discussed in Section 7.2.4.

Risks to the workers during the remedial activities would be due to contact with the contaminated sediments. Extensive handling of sediments is involved in this alternative, therefore the risks would be higher than those for other alternatives. Proper use of personal protection equipment and adherence to the remedial health and safety plan would be essential.

Potential environmental impacts would include displacement of the existing benthic community and temporary disturbance of any fish and waterfowl which frequent this area. However, the area would be restored to its original state by natural processes upon completion of this alternative.

It would take approximately six months to construct the cofferdam and berm, dredge and dewater the sediments, excavate and size the dewatered sediments, and stage them for incineration. These dewatered sediments would be incinerated along with the residuals from Operable Unit One and would require approximately nine months to process. The dredging and dewatering would have to be done during the part of the year when weather conditions in western New York are favorable for this type of activity, probably during the period from April to October.

<u>Implementability</u>

Construction and removal of the cofferdam would be a straightforward operation whether the clay or portable type is used. Installation of a sheet pile cofferdam would require a barge. If the sediments do not provide sufficient structural integrity to support equipment on the access road to be constructed, most of the excavation could be accomplished from the shore. The cofferdam could be reinforced and used as a road for equipment to reach the remaining sediments. A potential drawback to using hydraulic dredging would be placing the sediments, suspended in water for transport, over areas which must eventually be excavated and incinerated. Adding moisture to these areas would increase the difficulty and cost of further processing the sediments in the incinerator. Sizing would need to be completed as part of the excavation process in preparation for incineration. Implementation of the incineration process is discussed in Section 7.2.4, Alternative 5 for Operable Unit One.

Cost

Construction costs for this alternative include mobilization, cofferdam construction, berm construction, stormwater extension sediment removal, sediment dewatering, cofferdam removal, berm removal, staging, and incremental costs for incinerating these materials along with those from Operable Unit One Alternative 5. Operation and maintenance costs would be included with those for Operable Unit One. No additional monitoring would be required for this alternative. A sensitivity analysis was conducted using the sediment removal method and the type of cofferdam as the key variables. It is assumed that the portable type cofferdam would be used for the hydraulic dredging and that the sheet piles would be required for use with the mechanical dredging.

A detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below:

	Mechanical Dredging/ Sheet Piles	Hydraulic Dredging/ Portable Cofferdam
Total Construction Costs	$11,800,000	$13,200,000
Total O&M Costs	$ 0	$ 0
Total Present Worth Costs	$11,800,000	$13,200,000

Community Acceptance

Use of incineration might generate community opposition due to perceived health risks and potential aesthetic concerns. No opposition to the sediment removal process is anticipated, as this process is the same as Alternative OU2-6A (See Section 7.3.5).

7.4 OPERABLE UNIT THREE - Storm Sewer

Operable Unit Three consists of the portion of the 100th Street storm sewer which crosses the Site. Selection of an alternative for this operable unit will also be impacted by the selection of an alternative for Operable Units One and Two. Remediation of the storm sewer would be done prior to remediation of the sediments in order to prevent possible recontamination of the sediments. Any requirements for a temporary or permanent extension of the storm sewer as a result of activities for the sediments are addressed as part of the alternatives for Operable Unit Two.

7.4.1 Alternative OU3-1: No Action

The no action alternative includes no remedial action measures and assumes that the storm sewer conditions would remain similar to what was observed during the Remedial Investigation. The NCP requires that the no action alternative be retained through detailed screening of alternatives as a baseline for comparison.

Overall Protection of Human Health and the Environment

The storm sewer is a migration pathway for groundwater to the Niagara River. Significant risk to human health related to this groundwater migration was identified in EPA's risk assessment, albeit the risks were approximately an order of magnitude less than those posed by direct groundwater discharge into the embayment. In addition, NAPL was found in the underlying sewer sediments, although it was not detected in the sewer aqueous (water) samples. Groundwater travelling through the storm sewer is a potential source of chemistry in the sediments adjacent to the outfall. Sediment chemical levels at the outfall pose a potential risk to organisms living in the sediments. Embayment concentrations resulting from the storm sewer discharge also present possible aquatic and environmental concerns. Therefore remediation of the storm sewer would be necessary based on EPA's risk assessments. The Companies' risk assessments determined that storm sewer discharge does not present significant risks to human health or the environment.

Compliance with ARARs

There are no ARARs which directly apply to this alternative. Chemical concentrations in the storm sewer infiltrate were measured in the RI (Section 6.2.4). The storm sewer loadings (at 4 gpm) would be attenuated by flow in the embayment (750 cfs) by more than 80,000 times and would not exceed New York State AWQS. No location-specific or action-specific ARARs for this alternative have been identified.

Long-Term Effectiveness and Permanence

There are no control requirements for this alternative and no maintenance is required. Long-term monitoring would include flow measurements and chemical analyses of any infiltration on a periodic basis.

Reduction of Toxicity, Mobility, or Volume

There would be no reduction of waste toxicity, mobility, or volume under this alternative.

Short-term Effectiveness

There would be no health risks for remediation workers since there would be no construction activities. Potential risks to the community and the environment would be through future migration of contaminated groundwater via the storm sewer to the Niagara River. The no action alternative can be implemented immediately.

Implementability

There are no concerns regarding implementation of the No Action alternative.

Costs

There are no construction costs associated with this alternative. Operating costs for long-term monitoring are based on annual sampling for indicator parameters. Costs for review of the Site remedy every five years are included with the alternatives for Operable Unit One. These required elements are automatically factored into the total remediation costs because alternatives for Operable Units One and Two must be selected as part of the overall Site remedy.

The detailed cost estimate for this alternative is presented in Appendix C. A summary of the estimated costs is given below.

Total Construction Costs	$0
Present Worth Operation and Maintenance Costs	$375,000
Total Present Worth Costs	$375,000

Community Acceptance

Because the storm sewer currently transports groundwater to the Niagara River, the community might object to the No Action alternative being selected.

7.4.2 Alternative OU3-2A: HDPE Slipliner

This option involves inserting a 36" I.D. HDPE pipe into the existing 42" I.D. storm sewer which crosses the Site. The HDPE pipe would be resistant to the chemicals present at the Site. Because of the difference in the surface friction coefficients between concrete and HDPE, the smaller diameter slipliner would be able to handle the same volume of flow as the existing pipe. The annular space between the two pipes could then be pressure grouted to prevent groundwater migration via this pathway. Another potential means of dealing with the remaining annular space would be to seal each end with a collar of grout or other low permeability material, leaving the annular space along the length of the pipe open. Even if groundwater were to infiltrate this space, it would be trapped there with no exit pathway through which to migrate. Because the storm sewer is laid on such a small grade, there would be a low head inside the area, and leakage potential would be slight. The grout material selected would be resistant to Site chemicals, including those present in the NAPL.

Prior to installing the pipe, the storm sewer would have to be cleaned and the sediments which have settled in the pipe would have to be removed. These sediments and those removed from the river bottom to facilitate installation of the liner pipe contain NAPL and would require proper treatment and disposal. This would be done in conjunction with the treatment or containment method selected for Operable Unit Two.

During preparation operations and installation of the slipliner, sediment controls would be necessary to prevent migration of the contaminants down the river. A bypass system would also need to be set up to handle effluent in case of a rain event during the cleaning/installation process. This system would also be used to handle any upstream infiltration which may be present. These operations would be done in conjunction with the remedial work for Operable Unit Two and utilize the sediment controls selected for use with those operations.

Overall Protection of Human Health and the Environment

Sliplining the storm sewer would preclude infiltration of contaminated groundwater into the pipe, thus removing the storm sewer as a pathway for contaminant groundwater to travel to the river. The possibility of groundwater migration along the exterior of the pipeline would remain, but data collected during the RI indicates this is not a preferential pathway for chemical migration. If the alternative selected for Operable Unit One includes a cutoff or circumferential wall, any groundwater migration would be contained before it reached the river. This alternative addresses the potential risk to the environment posed by the storm sewer.

Compliance with ARARs

The storm sewer is owned by the City of Niagara Falls. Prior to beginning any remedial activities, approval would need to be obtained from the Niagara Falls City Engineering Office and the City Sewer Division. A detailed proposal of the planned activities would need to be submitted to the City Engineering Office to obtain this approval.

No location-specific ARARs were identified for this alternative. Groundwater infiltration would be denied and storm sewer discharge to the embayment would be dependent on upstream sources.

Long-term Effectiveness and Performance

Groundwater containing SSI would remain on the Site after implementation of this alternative; however, the migration pathway through the storm sewer would be eliminated. Long-term monitoring of the sewer influent and effluent would be required; the remedy review required for the Site every five years could include inspection of the slipliner installation.

Periodic inspections and repair would be required for this alternative. The structural integrity of the existing pipe appears to be excellent and with the proper installation of the liner and grout the storm sewer should remain functional and free of infiltration. The slipliner material (HDPE) is compatible with Site chemicals.

Reduction of Toxicity, Mobility, and Volume

Installation of a slipliner into the storm sewer would reduce the mobility of the Site-related chemicals and would address the threats to human health and the environment due to the storm sewer. There would be a minor reduction in the volume of Site-related chemicals (e.g., NAPL) under this alternative, and the exposure would be reduced significantly since no preferential pathways would remain.

Short-Term Effectiveness

A potential safety risk to workers during installation of the slipliner would be due to exposure to the contaminated sediments at the storm sewer outfall. This risk could be minimized by following the remedial health and safety plan, including proper training and protective equipment. A potential risk to the community during implementation would be transport of contaminated sediments downstream. This risk could be minimized by proper installation of sediment controls, as discussed for Operable Unit Two. A cofferdam would be constructed which would enclose the area around the storm sewer outfall and contain any sediment dispersion.

Risks to the neighboring community would result from any dispersion of contaminated sediments which are mobilized during preparation and installation activities. Sediment migration would be minimized by sediment controls, such as a cofferdam, which would be established for operations for remediating Operable Unit Two.

Implementation time, including time for constructing sediment controls, would be approximately three months.

Implementability

Installation of hard pipe slipliners is a proven conventional technology. The proximity of this storm sewer to the Niagara River and to Buffalo Avenue, the presence of contaminated sediments in the storm sewer, and the length of the line would make this installation more difficult than usual. Installation of the slipliner from the north side of the Site would not be feasible because of space limitations.

If the slipliner is inserted from the south side of the Site, the pipe would have to be staged and welded on barges and floated to the storm sewer discharge point to be inserted. The sediments directly in front of the storm sewer would need to be excavated in order to facilitate the installation. These excavated sediments and the sediments removed from the storm sewer during the cleaning process would be staged to be treated along with the sediments in Operable Unit Two. Sediments in the storm sewer contain NAPL and would require special handling during removal.

Installation of the slipliner inside the storm sewer would require approximately one week following mobilization and materials preparation. Implementation would be scheduled for a low flow period, but as a protective measure a bypass system would be set up to divert flow away from the storm sewer, as necessary.

The annular space between the slipliner and storm sewer would be sealed to deny groundwater a potential pathway. The ends could be plugged by injecting grout approximately five feet into each end to form a complete seal or collar. The effectiveness of the plugging can be verified by visual inspection. Installation of grout in the annular space along the entire length of the storm sewer could be a difficult operation. Even distribution of grout around the liner along the entire length would be difficult to implement. Collars would be the preferred method for sealing the annular space.

Sediment controls would be set up in conjunction with work done on Operable Unit Two. Evaluating the effectiveness of this alternative can be done through regular monitoring of the storm sewer effluent.

Cost

Costs for this alternative include storm sewer preparation, materials and installation of the liner, and grouting the remaining annular space between the existing pipe and the liner. This cost does not include sediment controls; those costs are included as part of alternatives for Operable Unit Two. Long-term operation and maintenance costs would include periodic inspections and repairs.

The detailed cost estimate for this alternative is presented in Appendix C. The following is a summary of the costs associated with this alternative:

Total Construction Costs:	$535,000
Present Worth O&M Costs:	$ 69,600
Total Present Worth Costs:	$605,000

Community Acceptance

This alternative would eliminate groundwater migration via the storm sewer. Although installation of the liner would create a temporary disturbance, no opposition to this alternative is anticipated.

7.4.3 Alternative OU3-2B: Inversion Liner

This option involves installing a flexible, needled polyester felt tube which has been impregnated with a liquid thermosetting resin. It is installed by feeding the tube through a stand pipe, filling it with water, and using the hydrostatic pressure to force the tube through the length of the pipe. The tube is inserted with the resin impregnated side on the outside pressing against the walls of the existing pipe. The water in the tube is then heated to cure the resin, forming a "pipe-within-a-pipe". This lining has no joints or seams except at the ends.

As with the hard pipe slipliner, the existing storm sewer would have to be cleaned and prepared prior to installation. Sediments contain Site chemistry including NAPL and would need to be treated and disposed of properly, probably in conjunction with Operable Unit Two. The stalactites which currently exist at some of the joints would need to be removed. If a drag bucket or pig does not remove the stalactites, manual entry into the sewer line would be necessary to chip off the stalactites in order to prepare the pipe for insertion of the insituform liner. Any stalactites remaining in the pipe could puncture the liner or impede proper sealing of the liner to the pipe.

Depending on the amount of flow into the storm sewer upstream of the Site, a bypass system may be required to handle the flow during the installation of the inversion liner. Because this installation would require only a limited amount of time to complete, work could be scheduled during dry weather period so that effluent due to rain in the Love Canal area would not be a concern.

Overall Protection of Human Health and Environment

Sliplining the storm sewer using an inversion liner would eliminate infiltration of contaminated groundwater into the pipe, thus eliminating the storm sewer as a pathway for contaminated groundwater to travel to the River. The possibility of groundwater migration along the exterior of the pipeline would remain, but if the alternative chosen for Operable Unit One contains a cutoff or circumferential wall, it would halt this migration before it reached the river. Also, data collected during the RI indicates this is not a preferential pathway for chemical migration. This alternative would address the potential risk to the environment posed by the storm sewer.

Compliance with ARARs

The storm sewer is owned by the City of Niagara Falls. Prior to beginning these remedial activities, approval would need to be obtained from the Niagara Falls City Engineering Office and the City Sewer Division. A detailed proposal of the planned activities would need to be submitted to the City Engineering Office to obtain this approval.

No location-specific ARARs were identified for this alternative. Groundwater infiltration to the storm sewer would be denied and discharge to the embayment would satisfy AWQS.

Long-Term Effectiveness and Permanence

Contaminated groundwater would remain on the Site after implementation of this alternative; however, the storm sewer migration pathway would be eliminated. Periodic assessment of the liner integrity and any Site contribution to flow in the sewer would be required to verify the effectiveness of the remedy.

No long-term operation and maintenance would be required for this installation. The current structural integrity of the existing pipe appears to be excellent. Inversion liner materials such as vinyl esters are compatible with Site chemicals (Insituform, 1990). The lined pipe should remain functional and free of infiltration if the installation is done properly; inspections and repairs would ensure its long-term effectiveness.

Reduction of Toxicity, Mobility, or Volume

Installation of an inversion liner into the storm sewer would reduce the mobility of Site groundwater. There would be no reduction in toxicity or volume of chemical residuals under this alternative, although the volume entering the Niagara River would be reduced.

Short-Term Effectiveness

The greatest risks associated with this alternative would be to workers entering the storm sewer as part of the cleaning and preparation process if necessary to remove the stalactites. Sediments in the storm sewer contain NAPL and on-site workers would require the proper use of personal protective equipment, as dictated by the remedial health and safety plan. Potential dispersion of sediments downstream would be the only risk to the environment or the community; this risk could be minimized by constructing sediment controls prior to beginning with this work. Sediment controls would be established for remediation of the sediments in Operable Unit Two, which must be addressed as a part of the overall Site remediation.

Estimated time for constructing a cofferdam would be approximately one month and for pipe cleaning and preparation and installation of the inversion liner would be approximately two weeks.

Implementability

The inversion lining process is an accepted technology which has been used successfully for many industrial piping retrofits (Insituform, 1980). Compatibility with Site chemicals would have to be demonstrated before an inversion liner could be approved for use in the storm sewer, however.

Installation could be implemented via the manhole located adjacent to Buffalo Avenue. Traffic on Buffalo Avenue would probably need to be diverted, but rerouting would probably not be necessary. This would have to be coordinated with the City of Niagara Falls.

Construction of an inversion liner would require significantly more surface preparation than for a hard pipe slipliner. Because of the possibility of puncture to the liner tube, the stalactites present at the pipe joints must be removed prior to installation. Once the sewer has been pigged, the line could be televised to determine whether or not manual entry would be required to remove remaining stalactites inside the pipe for installation of the liner. If manual entry is required, the potential risk level associated with entry into a confined space extending over 300 feet would be significant. Sediments in the storm sewer would also be removed using a pig or drag bucket and would then need to be properly treated and disposed. Sediments in the storm sewer contain NAPL and would require special handling for removal. The liner will displace any water standing in the pipe during installation, and it will form around any sediments remaining in the pipe, thus entrapping them. The remaining volume of sediments after preparation of the storm sewer should be minimal. Sediment controls would need to be set up in the river prior to the cleaning and preparation processes in order to prevent possible sediment migration downstream.

A bypass system may be required, depending on the volume of storm water and infiltration into the storm sewer upstream of the Site. Infiltration in the portion of the storm sewer being remediated would be reduced by an excess amount of resin in the tube which would force its way into any cracks or broken joints. Therefore the infiltration would be reduced and should not interfere with the sealing process.

The oil fired boiler trucks used to heat the water for the curing process would cause noise for a period of 12-18 hours. Residents in the vicinity of the Site would need to be notified prior to the installation process.

Sediment controls would be set up in conjunction with work on Operable Unit Two. Evaluating the effectiveness of this alternative can be done through regular storm sewer effluent monitoring.

Cost

Costs for this alternative include cleaning and preparation of the existing pipe as well as materials and installation of the inversion liner. This cost does not include sediment controls required for the pipe cleaning process; those costs are included in the estimates for alternatives for Operable Unit Two. Long-term operation and maintenance costs include periodic inspections and repairs. The detailed cost estimate for this alternative is presented in Appendix C and summarized below:

Total Construction Costs:	$649,000
Present Worth O&M Costs:	$ 69,600
Total Present Worth Costs:	$718,000

Community Acceptance

This alternative would present minimal risks to the community during implementation and could be implemented in a short period of time. Temporary inconvenience to the community would result from the traffic diversion and the noise level during the installation process. However, no significant opposition from the community is anticipated.

7.4.4 Alternative OU3-3: Lift Well, Force Main

This alternative involves constructing a lift station on the north side of Buffalo Avenue and a force main along Buffalo Avenue and south to the Niagara River along a path east of the Site. The existing storm sewer would then be deactivated using one of two methods: a) plugging using a grouting material, or b) excavating.

Installation of a lift station and discharge system is a well established technology. The lift station pumping system would need to be capable of handling a peak flow of 20 MGD. The force main would need to have a 36 inch diameter in order to handle the flow. The lift station would be constructed north of Buffalo Avenue due to space limitations south of the road. The force main would run eastward along Buffalo Avenue. Flow would then be by gravity southward to the Niagara River along a path east of the property line. The exact route and length of force main would be determined during Remedial Design. The Belden Site, located east of the Olin property, is a listed hazardous waste site in the State of New York. This could make location of a suitable alternative route difficult. Underground utilities such as the gas line, water main, and telephone line could be impacted, depending on the route selected. There is also a drainage ditch which runs adjacent to the Site and drains into the river. The ditch limits the space available for routing the force main. An easement for the storm sewer might have to be obtained for the selected route.

For Option A, the existing storm sewer would be plugged completely full with grout. The grout selected would have to be resistant to Site-related chemicals. Grouting is a well established technology, but the length of the sewer and the level of contamination at the site could make installation difficult. As an option, the sewer ends could be plugged with chemical-resistant grout for a distance of approximately five feet. The effectiveness of plugging can be verified by a visual inspection.

For Option B, the existing storm sewer would be completely excavated. The volume of excavated materials would be approximately 500 cubic yards. Because of the contamination at the Site, Level B safety precautions would probably be required. The concrete sewer line would need to be broken up during excavation in preparation for its disposal. The soils and debris resulting from this excavation process would be remediated in conjunction with Operable Unit One (capped with the rest of the Site or incinerated). This debris would not be accepted at any commercial facilities because it would be considered to be dioxin-containing waste.

Overall Protection of Human Health and the Environment

The human health or environmental risk associated with the existing sewer is due to Site groundwater infiltrating and traveling to the river through the storm sewer and chemicals in sediments within the sewer or at the outfall. By deactivating the storm sewer, this migration pathway would be removed. If Option A is selected, the exterior of the storm sewer would remain as a minor pathway for groundwater migration, depending on the alternative selected for Operable Unit One.

A potential safety risk due to implementing Option A would be exposure to chemicals in sediments during the cleaning process either to workers by direct exposure to the contaminated sediments in the storm sewer or to the community via sediment dispersion caused by the cleaning. Proper personal protection equipment and sediment controls will minimize these risks.

The primary safety risk due to implementation of Option B would be due to exposure to fugitive emissions during the excavation process. The proximity of the storm sewer to Buffalo Avenue would enhance the potential of exposure for the community. Strict adherence to the remedial health and safety plan would reduce the risk to workers. Dust control measures would be necessary to minimize exposure to the community.

The installation of the lift well and force main might have the same risks as discussed for Option B due to the excavation procedures should buried residuals be encountered along the length of construction. Although the alternate route selected will not run through the 102nd Street landfill, it may run through other landfill areas, such as the Belden Site. The level or types of contamination in these areas is not known.

Compliance with ARARs

Prior to beginning these remedial activities, approval must be obtained from the Niagara Falls City Engineering Office and the City Sewer Division. A detailed proposal of the planned activities would need to be submitted to the City Engineering Office to obtain this approval. Because the alternate route would run through property in the City of Wheatfield, approval from their City officials would also be required.

No location-specific ARARs were identified for this alternative. Groundwater infiltration to the storm sewer would be denied and discharged to the embayment would satisfy AWQS.

Long-Term Effectiveness and Permanence

By circumventing the Site, the possibility of future infiltration from this Site is also avoided. If Option A is chosen, the outside of the storm sewer would remain as a minor migration pathway, depending on the alternative selected for Operable Unit One. If Option B is chosen, no migration pathways associated with the storm sewer would remain assuming the hydraulic conductivity of the backfill used to replace the storm sewer path is less than that of the surrounding fill.

Both options would require long-term operation and maintenance of the 20 MGD lift station. Large debris can be carried in the upstream 42-inch line and the lift station would become a collection point. The cyclic nature of operation between dry periods and storm flow would decrease the normal service life of the pumps. Both of these factors would increase maintenance requirements. Mechanical failure could result in storm water backing up the sewer and potentially causing flooding.

Reduction of Toxicity, Mobility, and Volume

Deactivating the storm sewer either by plugging it or by excavating it would reduce the mobility of contaminated groundwater by eliminating the infiltration as a migration pathway. The toxicity and volume of groundwater would not be changed by this alternative.

Short-Term Effectiveness

Excavation into soils potentially containing low levels of chemicals would be required for the construction of the lift well and force main. Effective dust control would be exercised to minimize the release of air-borne particulates. Workers would wear the appropriate personal protection equipment, as dictated by the remedial health and safety plan.

For Option A, there would be no risk to the community associated with grouting the sewer. Workers would wear the personal protection equipment prescribed by the remedial health and safety plan. For Option B, the excavation into the soils on Site would require strict dust control and proper personal protection equipment for workers.

No environmental impact is anticipated as a result of Option A. There is a potential for fugitive emissions with Option B. The implementation time would be approximately six months to install the lift well and force main, one month to grout the existing storm sewer, and six weeks to excavate the existing storm sewer under optimal conditions. Installation of the new force main would involve a jack and bore operation or cutting through the roadway, since the line would run under Buffalo Avenue. For the excavation option, the excavated storm sewer would have to be broken up and sized to be placed under the cap or into the incinerator. Therefore a contingency of one month should be added to Option A and two months to Option B, resulting in a total implementation time for Option A of eight months and for Option B, ten months.

Implementability

Installation of a lift well and force main is a proven conventional technology. The proximity of the installation to Buffalo Avenue would result in interruption of traffic during construction activities, which would have to be coordinated with the City of Niagara Falls. Since the lift well and a sizable portion of the force main would be installed in property not currently owned by the responsible parties, an easement for the installation would have to be established. The Belden Site, located east of the 102nd Street Site, is a New York State registered site currently classified as a Code 3 site. This could present a problem for identifying a suitable alternate route for the storm sewer. Also, the Niagara Falls/Wheatfield City line runs adjacent to the eastern property boundary, placing potential routes east of the Site in the City of Wheatfield. Since the storm sewer is owned by the City of Niagara Falls, this also could present a problem with selecting an alternate route.

Limited contamination may exist in some of the soils that would need to be excavated for this installation. The excavated soils would require proper disposal. Fugitive emissions would need to be controlled. Treatment along with Operable Unit One would be the most practical means of disposal.

For Option A, grouting the storm sewer is also a conventional technology. The storm sewer would have to be cleaned prior to installing the grout. This cleaning process would require sediment controls to prevent transport of sediments downstream during the process as discussed in Section 7.4.2.

For Option B, excavating the storm sewer would be a difficult process. Concerns regarding excavation in the fill were presented in Section 6.4.1. Soil borings next to the storm sewer found NAPL and other organic chemical residuals. Extensive precautions would be necessary to avoid exposure of workers and the community to fugitive emissions during excavation. Excavation would be required down to a level below the water table, complicating extraction of the storm sewer. The excavated materials, including the reinforced concrete pipe, would need to be broken up into smaller pieces to facilitate handling and would require proper disposal. Because the materials would be considered to be dioxin-containing wastes, they would not be accepted at any commercial facility. They would have to be treated along with the materials in Operable Unit One.

Cost

Costs for this alternative include materials and installation of a lift station with a peak 20 pumping system rated for a peak flow of 20 MGD and a 36" diameter force main. Costs for deactivating the existing line are also included; for option A, by grouting, and for option B, by excavating followed by proper disposal. The operation and maintenance costs include power usage and equipment maintenance and replacement.

The detailed cost estimate for this alternative is presented in Appendix C and summarized below:

Option A

Total Construction Costs:	$1,830,000
Present Worth O&M Costs:	$1,160,000
Total Present Worth Costs:	$2,990,000

Option B

Total Construction Costs:	$3,980,000
Present Worth O&M Costs:	$971,000
Total Present Worth Costs	$4,950,000

Community Acceptance

Construction of the new storm sewer would cause temporary interruptions in traffic and utility service. Excavation of the existing storm sewer might generate fugitive emissions and cause aesthetic concerns. Because the new storm sewer path would run through property not in the City of Niagara Falls, this alternative would probably meet with opposition from residents of Wheatfield since storm drainage from the Love Canal area runs through this storm sewer.

7.5 SUMMARY OF ALTERNATIVES

Selection of the most appropriate remedial measures for the 102nd Street Site requires comparison of the alternatives pursuant to the CERCLA evaluation criteria. As directed by the NCP (300.430(f)(1)(A)), Overall Protection of Human Health and the Environment is a threshold criterion that an alternative must meet to be eligible for selection. Compliance with ARARs is also a threshold criterion unless one of the five CERCLA waivers is invoked. The remaining criteria allow practical differentiation among the alternatives that satisfy these threshold criteria.

The evaluations of remedial action alternatives for Operable Units One, Two and Three, based on the baseline risk assessments and the detailed analysis of alternatives, are summarized below.

7.5.1 Operable Unit One - Landfill Area, Off-Site Soils, Groundwater, NAPL

Operable Unit One consists of fill materials, perimeter soils, off-site soils, groundwater, and non-aqueous phase liquids (NAPL). EPA's baseline human health risk assessment determined that the presently covered landfill does not represent a potential direct exposure route unless the cover is disturbed. Areas of off-site and perimeter soils, including a presently covered section of perimeter soils that exceeds the CDC guidance level for dioxin in residential areas, pose significant risks to human health, as evaluated under "maximum reasonable exposure" assumptions in EPA's baseline risk assessment. Groundwater at the Site presents a minimal health risk since the community draws its water supply from a separate municipal source. The future need to obtain water from the landfill is therefore virtually non-existent. EPA's baseline risk assessment determined that groundwater leaving the Site and entering the Niagara River represents a significant risk to human health and the environment based on "maximum reasonable exposure" assumptions. The Companies' baseline risk assessment, using exposures based on casual contact with soils and EPA average values for recreational use of the Niagara River and fish consumption, determined that Site groundwater, off-site soils, and perimeter soils below the CDC guidance level for dioxin did not pose significant risks.

Overall Protection of Human Health and the Environment

Perimeter and off-site soils presently pose potential risks to human health. Only those remedial alternatives which provide further isolation or treatment of these soils, limiting future potential human exposure, will be protective of human health. Similarly, only those remedial alternatives which contain and treat groundwater or which remove and treat the source of groundwater chemicals will be protective. The baseline risk assessments determined that buried landfill materials do not pose significant risks under current conditions.

In evaluating the Site and remedial alternatives, the EPA and the Companies separately evaluated potential risks to human health from fugitive emissions and occupational hazards that could occur during any remediation involving extensive excavation of the Site landfill. EPA concluded that the risks associated with fugitive emissions would not exceed acceptable risk levels. Excavation of surficial soils in the perimeter and off-site areas could be adequately controlled and would not generate significant risks.

Compliance with ARARs

Alternatives involving Site capping and the extraction and treatment of groundwater and non-aqueous phase liquids (NAPL) would achieve a reduction of the level of Site chemical levels. Meeting the stringent groundwater ARARs would require a considerable remediation period and is a long-term goal. No ARARs could be identified that govern soils remediation. With regard to remedial activities, discharge of treated groundwater off-site would require a City of Niagara Falls or an SPDES permit. If on-site incineration were selected, governmental approval and completion of a successful trial burn plan would be required. Ash from incineration would be considered hazardous until delisted, possibly delaying ultimate disposal and creating potential storage difficulties during the interim.

Long-Term Effectiveness and Permanence

The wastes now disposed at the Site (the "landfill residuals") are anticipated to be stable under current conditions. While there are potential concerns associated with excavation and subsequent agitation (chlorates) or exposure to air (phosphorus), residuals would present little, if any, risk if containment alternatives are implemented. Alternatives involving capping and a slurry wall (cutoff or circumferential) would effectively minimize the limited potential for off-site migration of residuals. The cap and slurry wall would be continuously maintained to preserve their effectiveness. Long-term maintenance of capping, slurry wall and groundwater/NAPL extraction alternatives would present no special difficulties. Incineration would be a permanent remedy for organics in excavated residuals. Inorganic materials and any residual organic materials not excavated would not be treated through incineration. The Site would still have to be capped following incineration. Since varying amounts of landfill residuals would remain at the Site under each of the alternatives under consideration, a review of the selected remedy every five years would be required.

Reduction of Toxicity, Mobility or Volume

Remedial alternatives involving a cap and slurry wall would permanently reduce the mobility and the toxicity effects of landfill residuals. Groundwater and NAPL recovery and treatment as part of these alternatives would further ensure the retention at the Site of the most mobile residuals. Significant reductions of organic residuals can only be achieved by directing remedial efforts towards NAPL recovery and its thermal destruction.

While incineration would provide a permanent remedy for organic compounds in the areas where excavation could be undertaken, inorganics and some organic materials would remain. Capping in conjunction with groundwater recovery would therefore continue to be required to permanently reduce the mobility of residuals remaining after excavation and incineration.

Short-Term Effectiveness and Impacts

Remedial options involving capping, slurry wall, and groundwater/NAPL extraction are less intrusive and present fewer significant concerns regarding protection of the community or workers during implementation than do more extensive excavation remedies. These remedies would effectively contain the Site and reduce environmental risk. Excavation could substantially impact the community and would require extensive protection of workers. Open excavations would be sources of fugitive emissions. The presence of reactive materials such as chlorates and phosphorus within the landfill would also be concerns that would need to be specially addressed during excavation. The sound intensity of an on-site incinerator would increase night-time noise levels at nearby Cayuga Island by 1500 times for a period of three to twelve years. Ash management would involve emissions control and disposal planning. However, EPA concluded that excavation/incineration activities would not pose significant community health risks.

Implementability

Capping, slurry wall and groundwater/NAPL extraction alternatives rely on proven technologies and can be readily implemented. These alternatives would not be subject to as many technical and schedule uncertainties associated with excavation and incineration of the heterogeneous materials within the landfill.

Implementation concerns associated with excavation are numerous. The disparate nature of materials would create materials handling difficulties because of the bulk, consistency and chemical nature of the residuals. In particular, the stability of excavations near the water table is questionable. The presence of reactive materials raises safety concerns and would extend the time required for excavation. Removed materials would have to be carefully sorted to avoid placing chlorate residuals within the incineration process train. Open excavations and staging areas would have to be carefully controlled and monitored to limit the release of fugitive emissions. The proximity of the Site to vehicular and pedestrian traffic and to residences along the eastern boundary and on Cayuga Island enhances the concern regarding potential airborne releases.

Preparation, approval and implementation of an incinerator trial burn plan would be an involved and lengthy process. Disposal of incinerator ash would be uncertain pending a petition for delisting and stockpiling of the ash would create logistical and aesthetic concerns.

Cost

Estimated implementation schedules and present worth costs for Operable Unit One alternatives are presented in Table 7.8.

Community Acceptance

Options involving capping, slurry wall, and groundwater/NAPL extraction have been utilized at other sites in Western New York and, when compared to extensive excavation, involve fewer construction activities and should present fewer logistical, aesthetic or health concerns to the community. Potential concerns associated with slurry wall and cap construction should be limited to temporary interruptions of traffic and utility service.

Community concerns regarding excavation and incineration could be more substantial. Fugitive emissions from excavations and ash piles as well as incinerator emissions would present potential concerns regarding human health, as could substantial changes in the ambient noise level. Aesthetic concerns could include noise, odors and the presence of an ash pile. Public concerns could be heightened by the limited buffer zone available between the Site and Buffalo Avenue and residences to the east and on Cayuga Island.

7.5.2 Operable Unit Two - Off-Shore Sediments

Operable Unit Two consists of the off-shore sediments. EPA's risk assessment concluded that chemical concentrations in the embayment water column pose significant risk to human health and the environment. EPA's baseline environmental endangerment assessment determined that sediment pore water concentrations also present environmental risks. The Companies' risk assessment identified a potentially significant risk for infaunal organisms living in the nearshore sediments but no significant risks to the remaining aquatic environment.

Overall Protection of Human Health and the Environment

Removal of sediments in the areas of elevated chemical concentrations above survey levels would satisfy ambient water quality standards and be protective of the environment. Removal of all sediments above SSI survey levels would be more protective of the environment.

Compliance with ARARs

No promulgated standards were identified for sediment remediation. Removal of the sediments within the areas of elevated chemical concentration would satisfy the conservative application of ambient water quality criteria to interstitial pore waters. Filling the 0.6 acre lowland area would require a wetlands assessment and possibly require establishing an equivalent habitat elsewhere.

Long-Term Effectiveness and Permanence

Long-term chemical migration control following removal of the sediments within the areas of elevated chemical concentration would be effective. Removal of a wider area of sediments out to the extent of SSI would result in a remedy of greater effectiveness. Incineration of sediments provides the greatest permanence since a cap/slurry wall must be maintained indefinitely.

Reduction of Toxicity, Mobility or Volume

Placement of off-site sediments beneath a cap would effectively reduce the mobility and toxic effects of sediment chemicals. Incineration would permanently reduce the toxicity and volume of sediment chemicals.

Short-Term Effectiveness

Dredging of sediments could create potential risks through sediment dispersion and disturbance of the benthic community. A cofferdam would control any dispersed sediments. Recolonization of the benthic community would occur naturally after removal of the cofferdam. Potential concerns regarding capping and incineration would be as described in Section 7.5.1.

Implementability

All of the dredging and cofferdam options considered for off-shore sediment remediation are conventional and demonstrated. Dewatered sediments would have an elevated moisture content and would require pre-incineration treatments or longer incinerator processing time. Other considerations regarding incineration are presented in Section 7.5.1.

Cost

Estimated implementation schedules and present worth costs for Operable Unit Two alternatives are presented in Table 7.9. Removal of sediments would occur prior to activities in Operable Unit One. The alternative schedules given for each operable unit are therefore cumulative.

Community Acceptance

The proposed remedial activities in the Niagara River during sediment removal, because of their temporary and short-term character, should have little, if any, impact on the community. Chemical levels within any suspended sediments would be below State AWQS since sediment controls would be outside the areas of remediation. Any turbidity from sediment activities would be quickly dispersed and attenuated within the Niagara River. As such, the community should not object to these activities. For the reasons stated in Section 7.5.1, incineration of the sediments might encounter opposition from the nearby community.

7.5.3 Operable Unit Three - 100th Street Storm Sewer

Operable Unit Three consists of the 100th Street storm sewer. Potential remedial alternatives for this storm sewer address infiltration of Site groundwater and its subsequent discharge to the Niagara River. EPA's risk assessment determined that embayment concentrations resulting from the storm sewer discharge present significant risk to human health and the environment. The discharge of groundwater through the sewer is a source of chemicals in the sediments at the sewer outfall. The Companies' risk assessment determined that the storm sewer discharge does not present significant risks to human health or the environment.

Overall Protection of Human Health and the Environment

Remediation of the storm sewer is necessary to protect human health and the environment, based on EPA's risk assessment. Sliplining, "insituform" (inversion) lining and rerouting of the storm sewer would preclude potential impacts to the sediments from groundwater discharge. Rerouting of the storm sewer includes the option of excavation into the landfill. Potential risks associated with excavation are summarized in Section 7.5.1.

Compliance with ARARs

No ARARs were identified for remediation of the storm sewer. Possible remedial activities involving the existing storm sewer would have to be submitted to the City of Niagara Falls and/or the Town of Wheatfield for approval.

Long-Term Effectiveness and Permanence

The slip liner and inversion liner would provide long and reliable service with minimal maintenance requirements and repairs, when necessary. If the sewer were rerouted, the lift station used for this purpose would require continual maintenance.

Reduction of Toxicity, Mobility or Volume

Sliplining, inversion lining and deactivating and rerouting the storm sewer would effectively reduce the mobility of Site groundwater through the storm sewer so long as they were maintained.

Short-Term Effectiveness

Installation of the slipliner or inversion liner could require extensive preparatory work near the storm sewer outfall. The storm sewer may have to be cleaned manually prior to installation of an inversion liner. Neither of the options should pose significant risks to the community or the environment, however some safety precautions are associated with confined space activities in the sewer.

In the case of rerouting the storm sewer, buried residuals east of the Site may be encountered during excavation. Removal of the existing storm sewer would be a potential source of fugitive emissions to the nearby community while grouting the sewer in place would not produce this risk.

Implementability

Installation of a slipliner, inversion liner or a lift station relies on conventional and demonstrated technologies. A temporary collection and diversion system might be required to collect storm flow during construction of the slipliner and the lift station. Rerouting of the storm sewer would require coordination with the City of Niagara Falls, the Town of Wheatfield and local utility companies.

Cost

Estimated implementation schedules and present worth costs for the Operable Unit Three alternatives are presented in Table 7.10. Remediation of the storm sewer might not occur coincidentally with activities in Operable Units One and Two. The alternative schedules given with each alternative should therefore be viewed as cumulative.

Community Acceptance

The temporary diversion associated with installation of the slipliner or inversion liner should not be a significant concern to the community. Disturbances would be of a longer duration for rerouting of the storm sewer. Community concerns regarding excavation are discussed in Section 7.5.1.

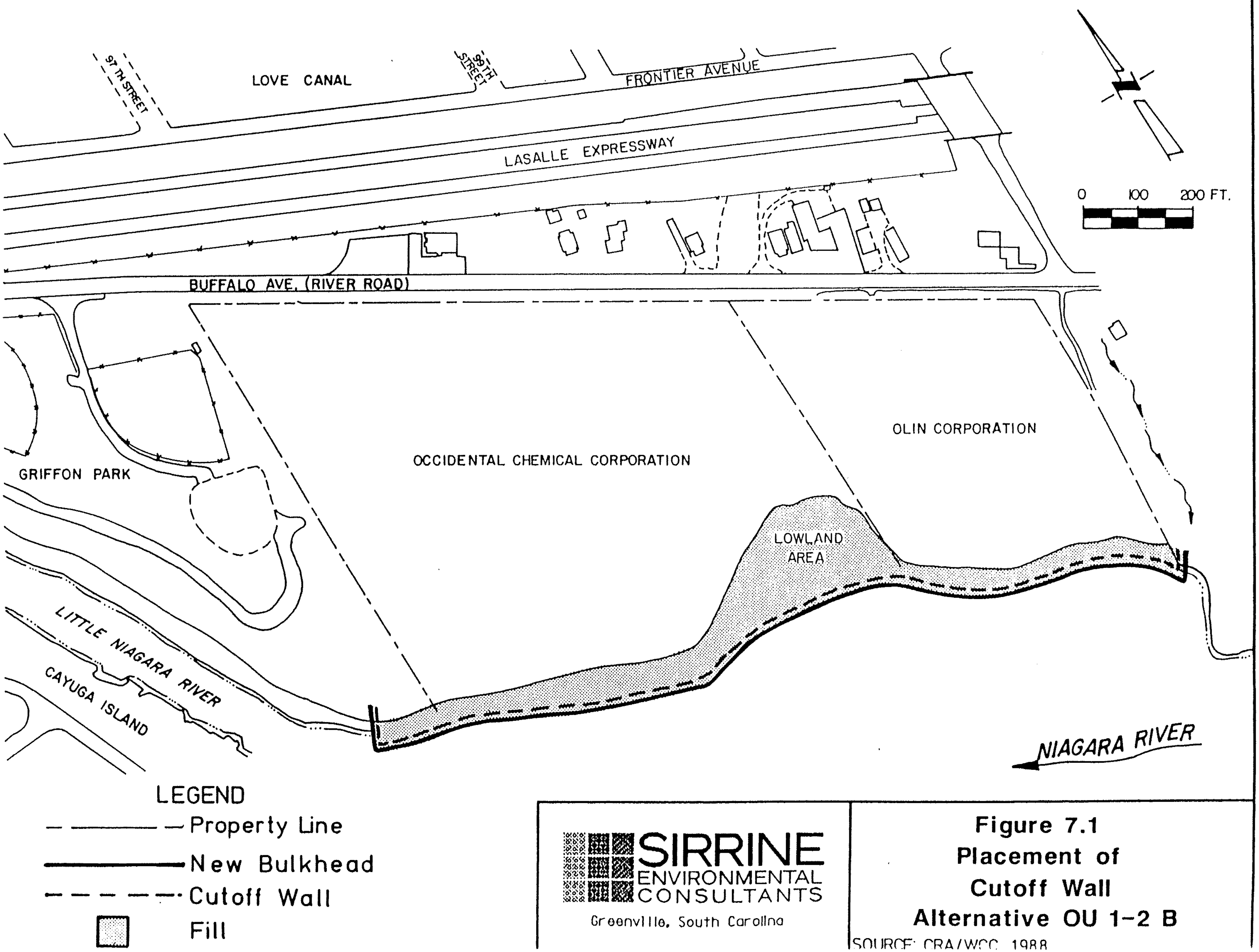

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Figure 7.1
Placement of Cutoff Wall Alternative OU 1-2 B

SOURCE: CRA/WCC 1988

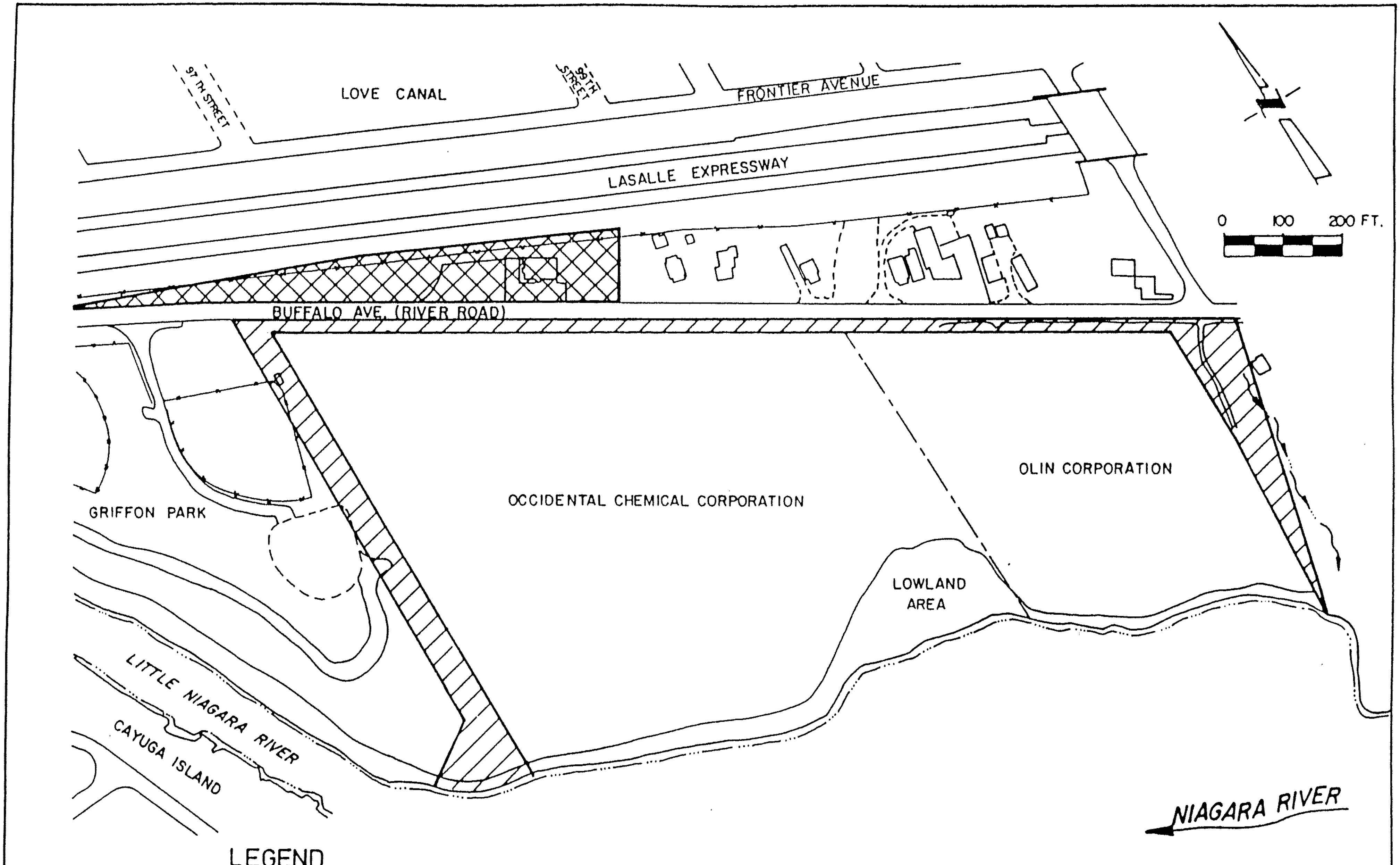

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Figure 7.2
Areal Extent of Off–Site and Perimeter Soils Above Organic SSI Survey Levels

SOURCE: CRA/WCC, 1988

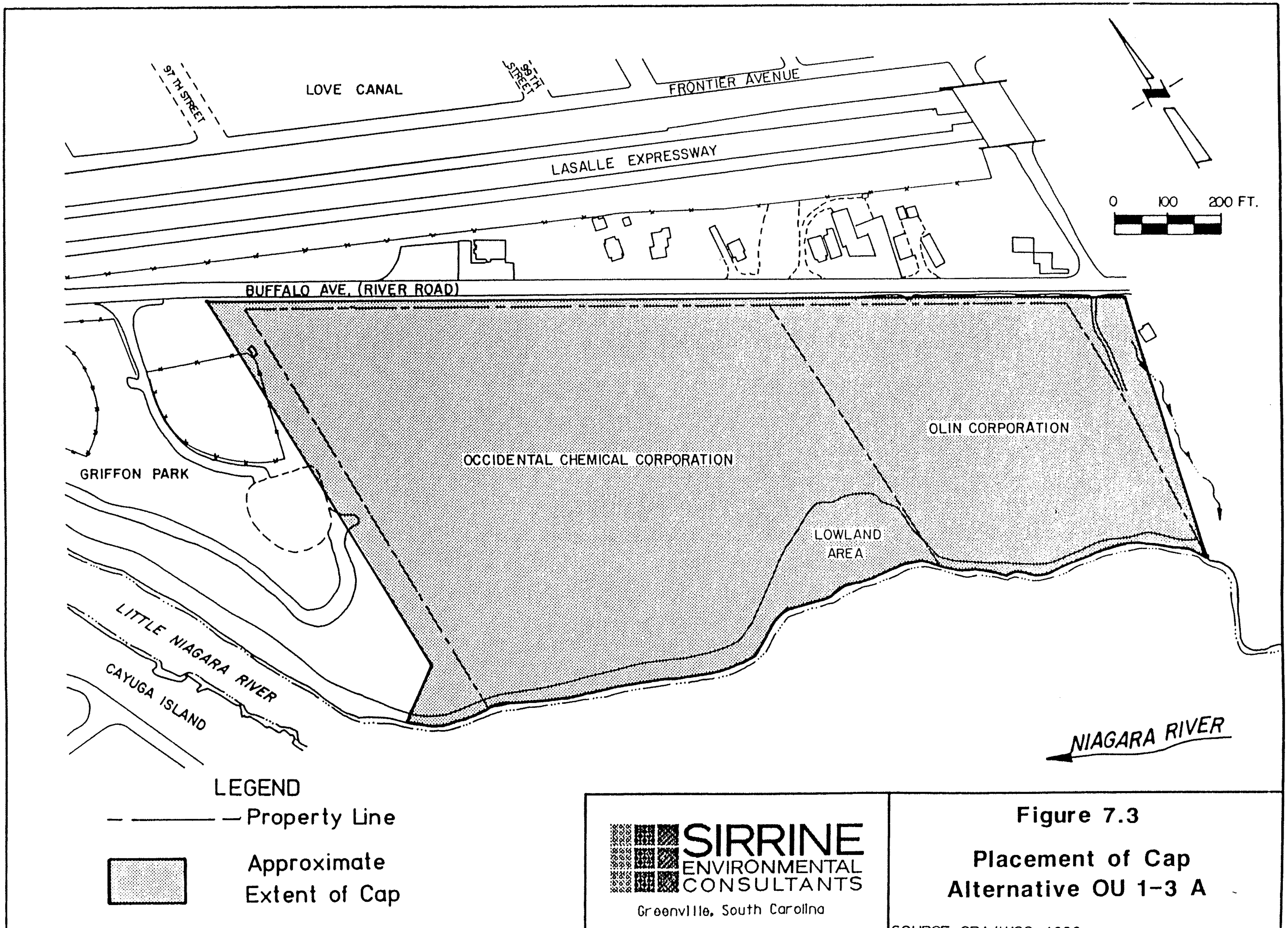

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Figure 7.3

Placement of Cap Alternative OU 1-3 A

SOURCE: CRA/WCC. 1988

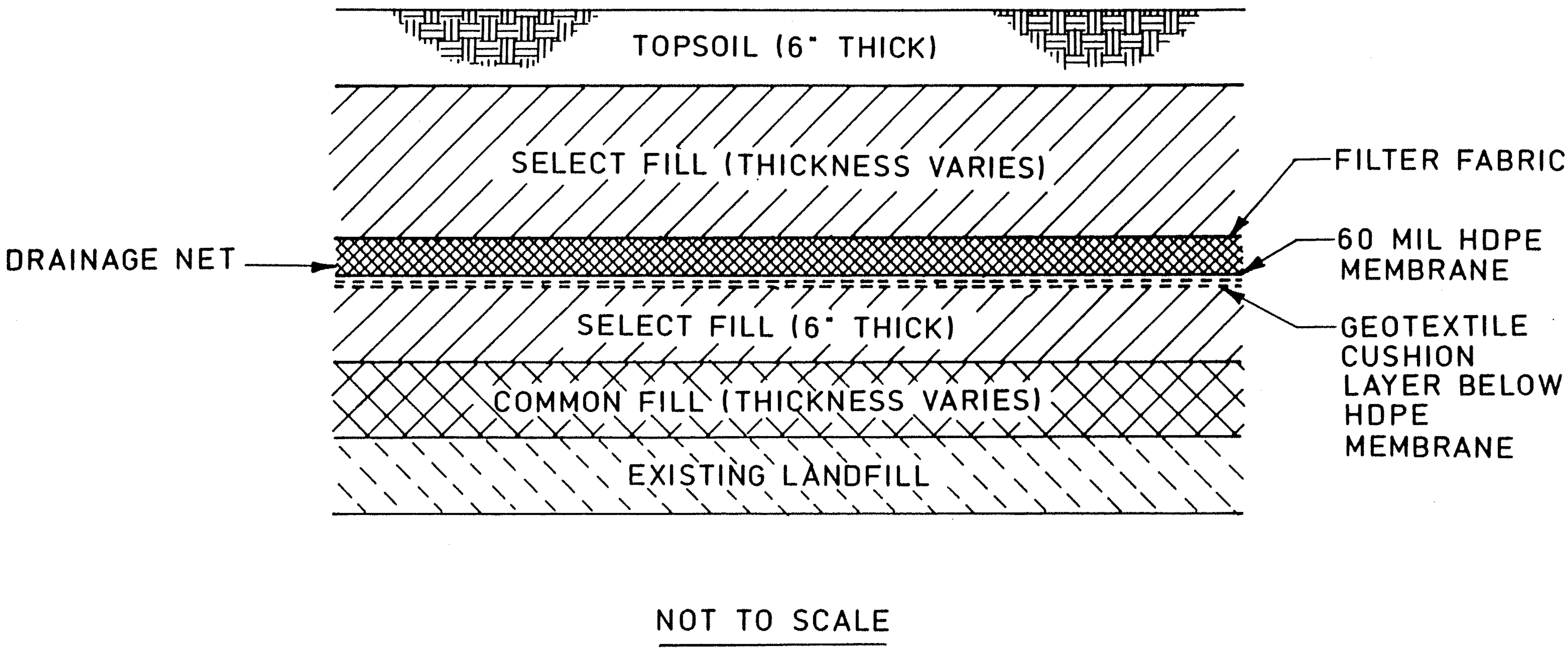

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Figure 7.4

Typical Cap Section Alternative 3 Options

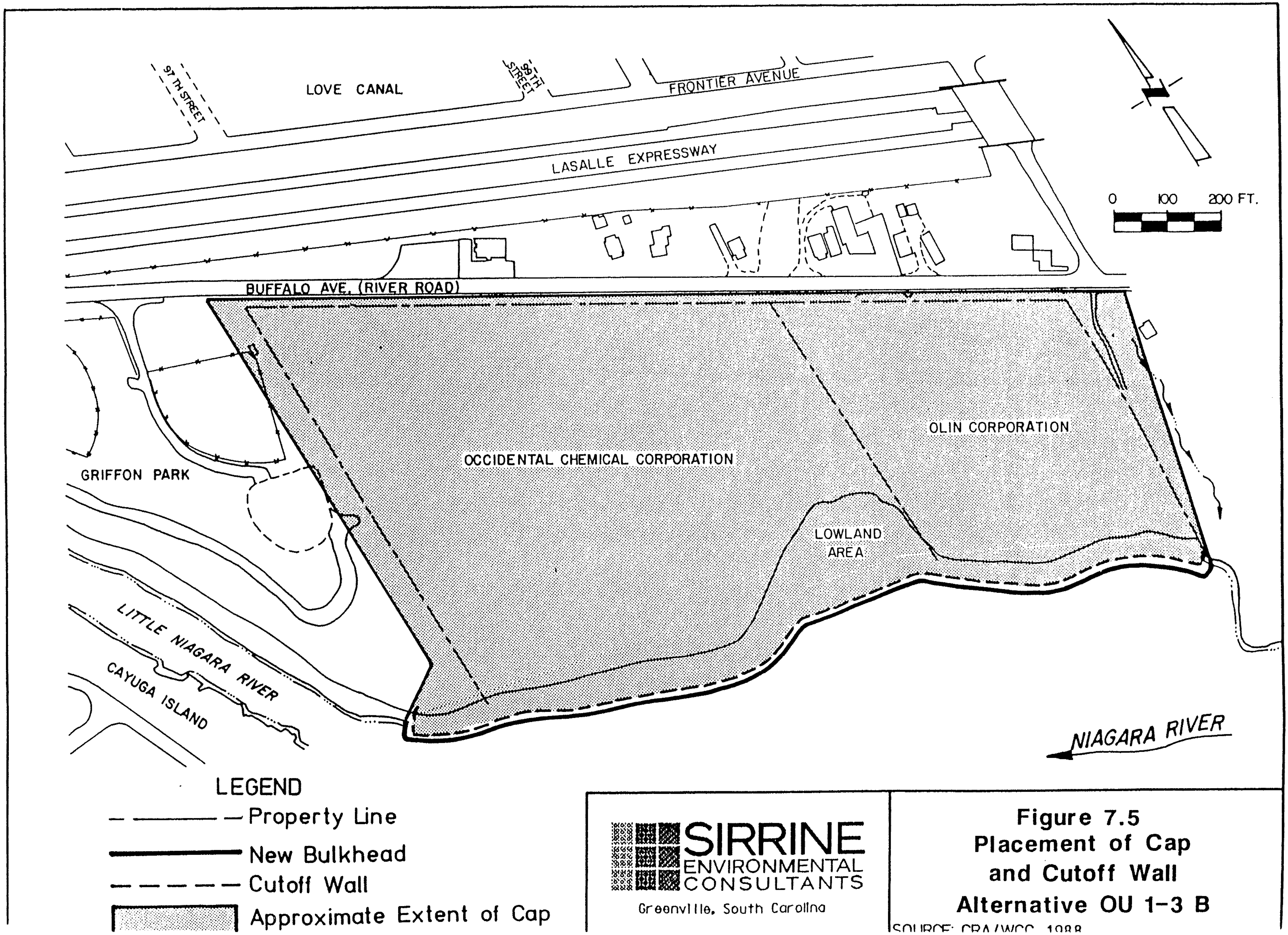

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Figure 7.5
Placement of Cap and Cutoff Wall
Alternative OU 1-3 B

SOURCE: CRA/WCC 1988

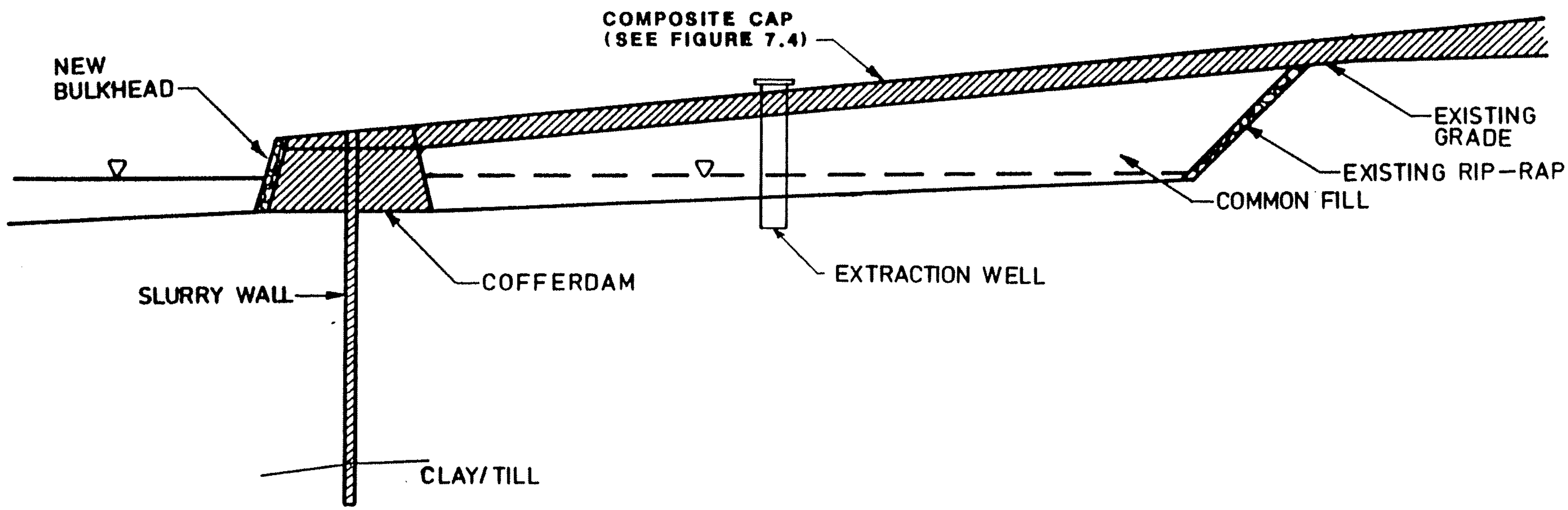

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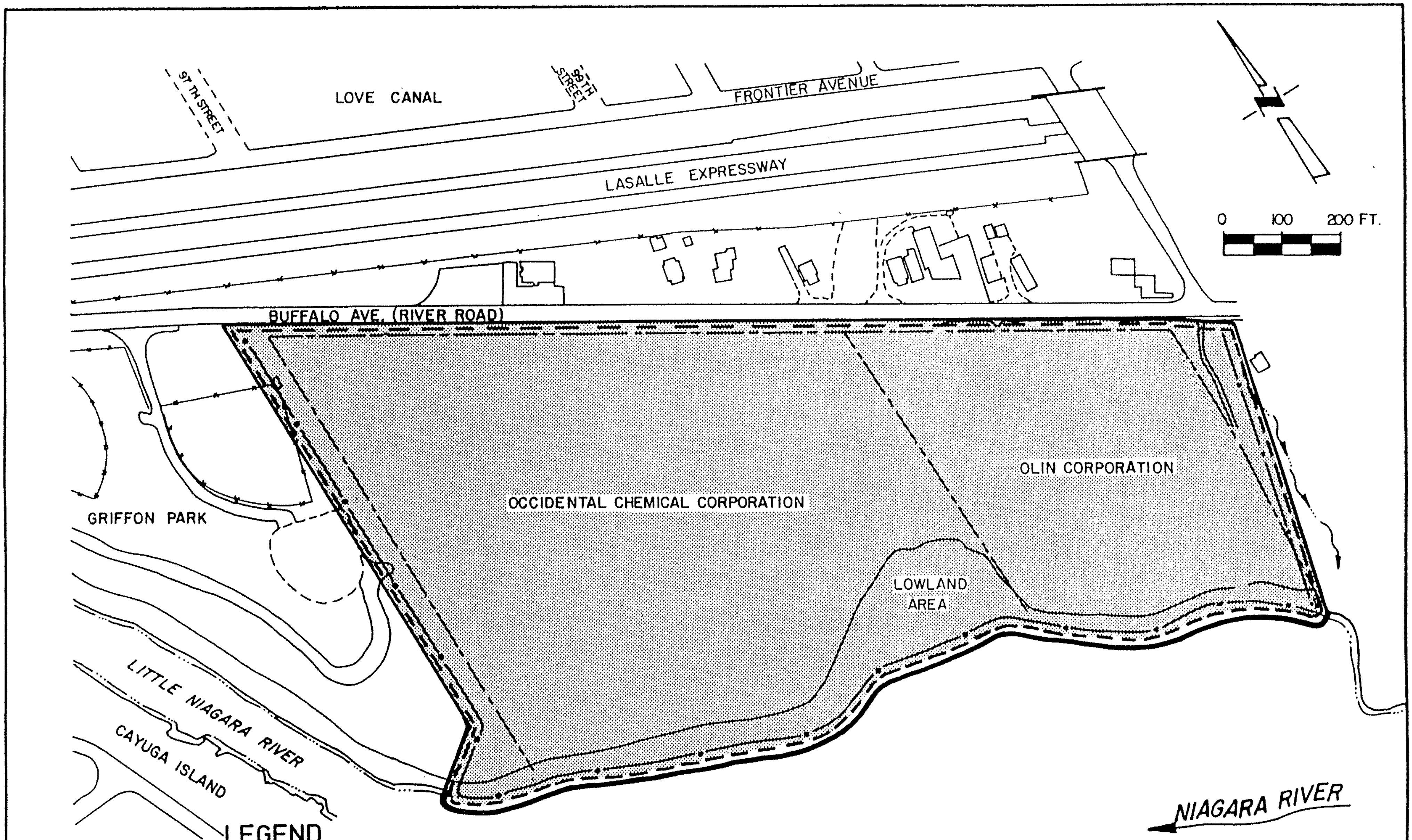
Figure 7.6

Typical Cutoff Wall/Cap Section



LEGEND

- Interception Trench
- Property Line
- New Bulkhead
- Circumferential Wall
- Approximate Extent of Cap

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Figure 7.7
Placement of Cap and Circumferential Wall Alternative OU 1-3 C

SOURCE: CRA/WCC 1988

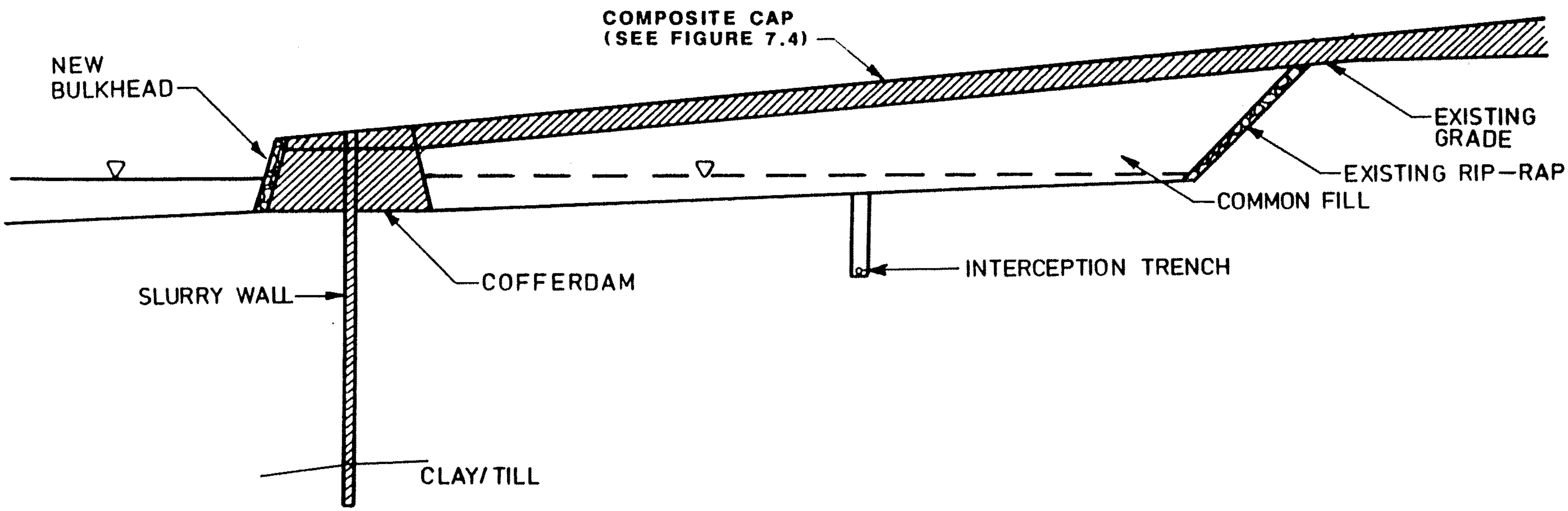

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Figure 7.8

Typical Circumferential Wall/Cap Section

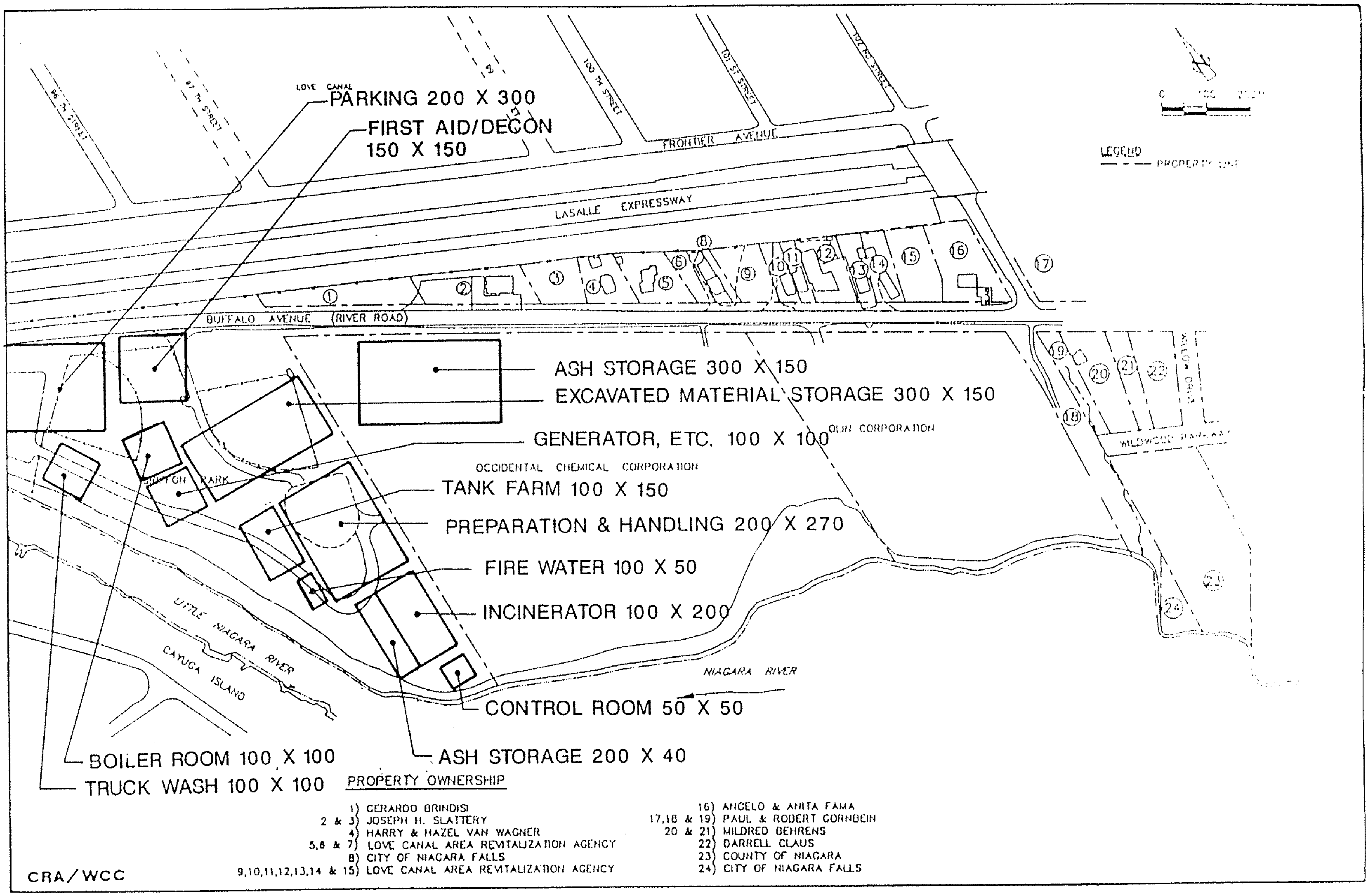

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FIGURE 7.9
TYPICAL LAYOUT FOR INCINERATION ALTERNATIVES

SOURCE: CRA/WCC, 1988

OPTION 1 - Excavate fill materials

Excavation slope: 2(H) to 1(V)
Depth of excavation: 10 feet (average)
Trench width (top): 60 feet
(bottom): 20 feet
Trench length: varies

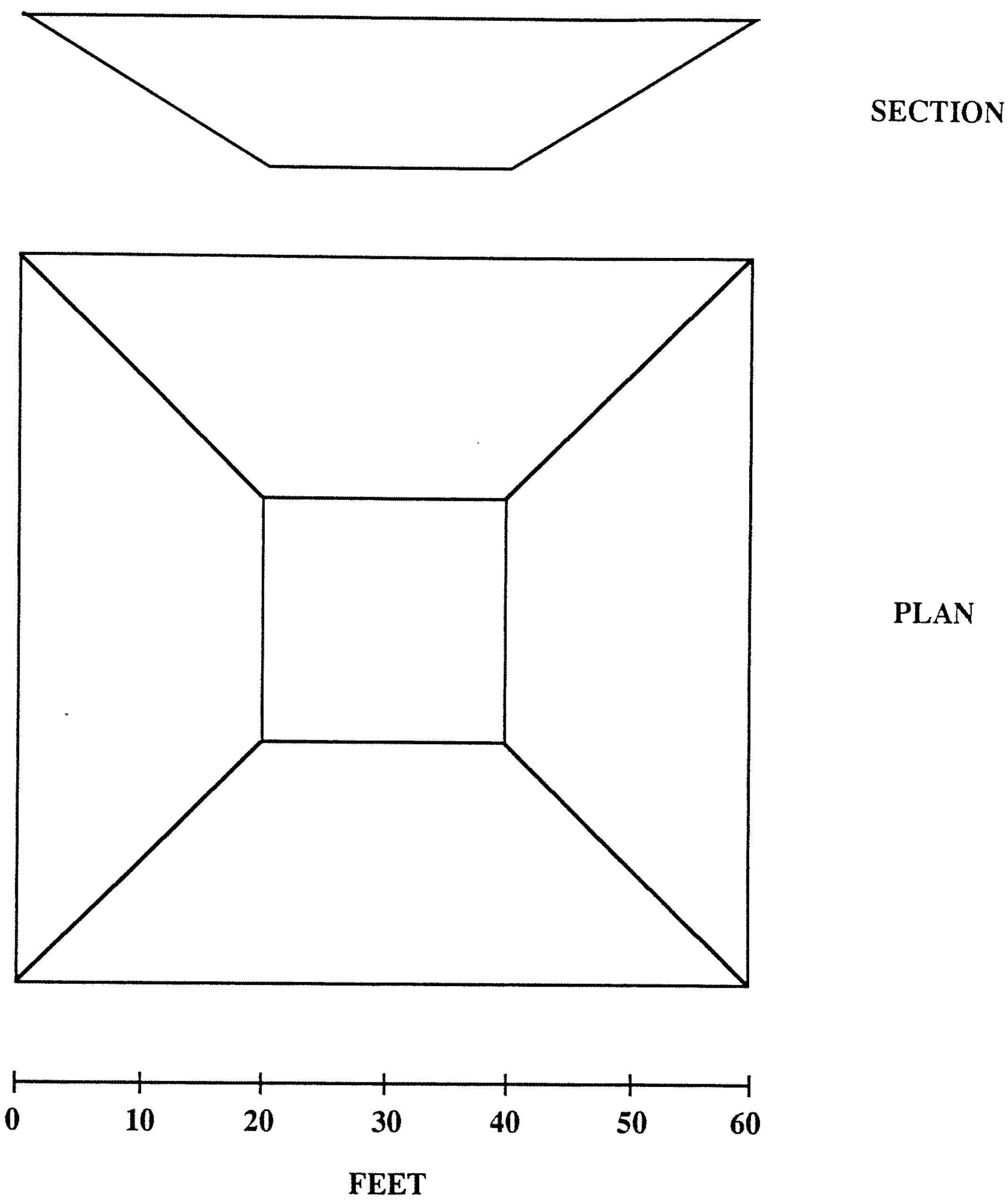

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FIGURE 7.10
EXCAVATION PROFILES,
FILL MATERIALS
102nd Street Site

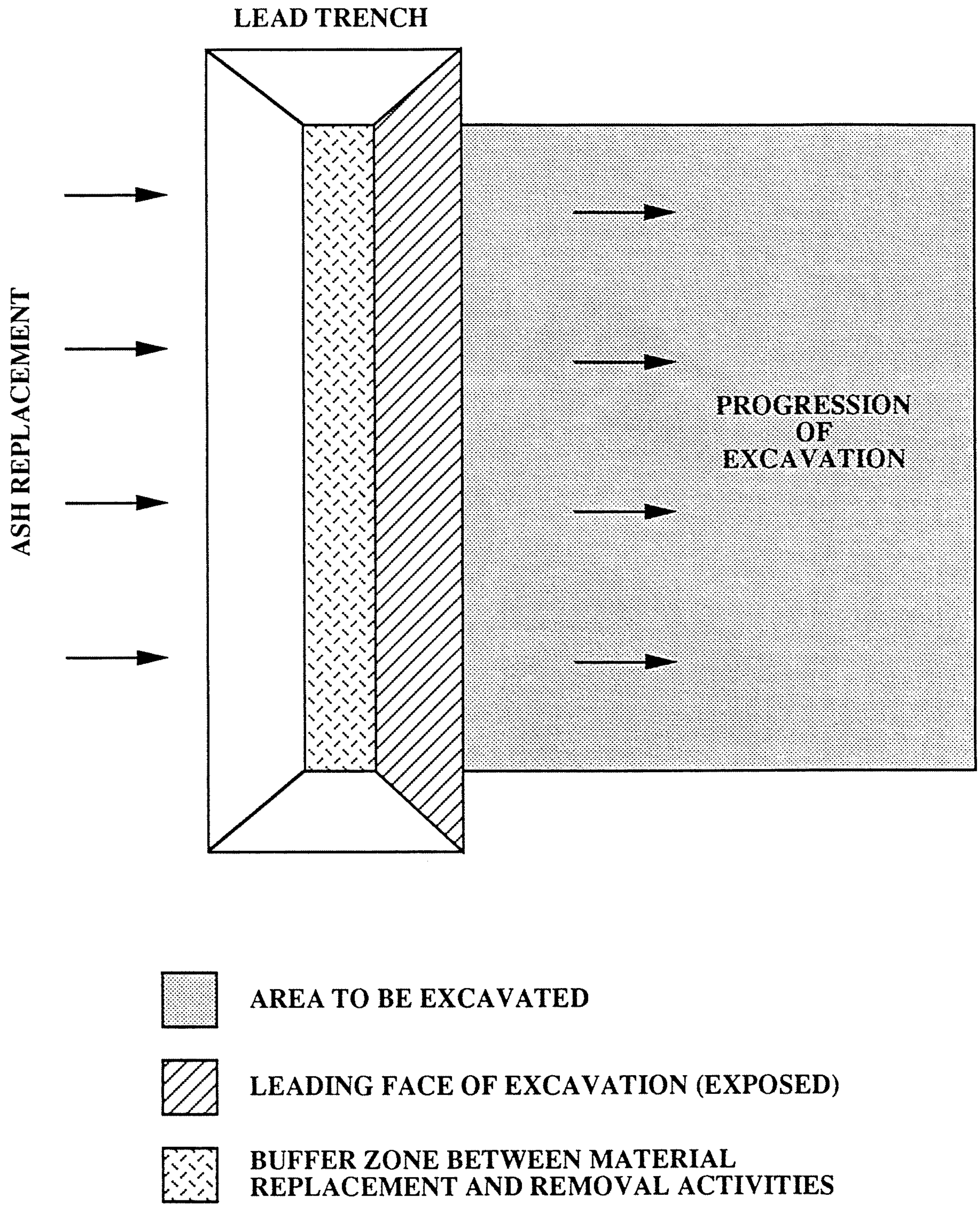

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FIGURE 7.11
EXCAVATION PROGRESSION
102nd Street Site

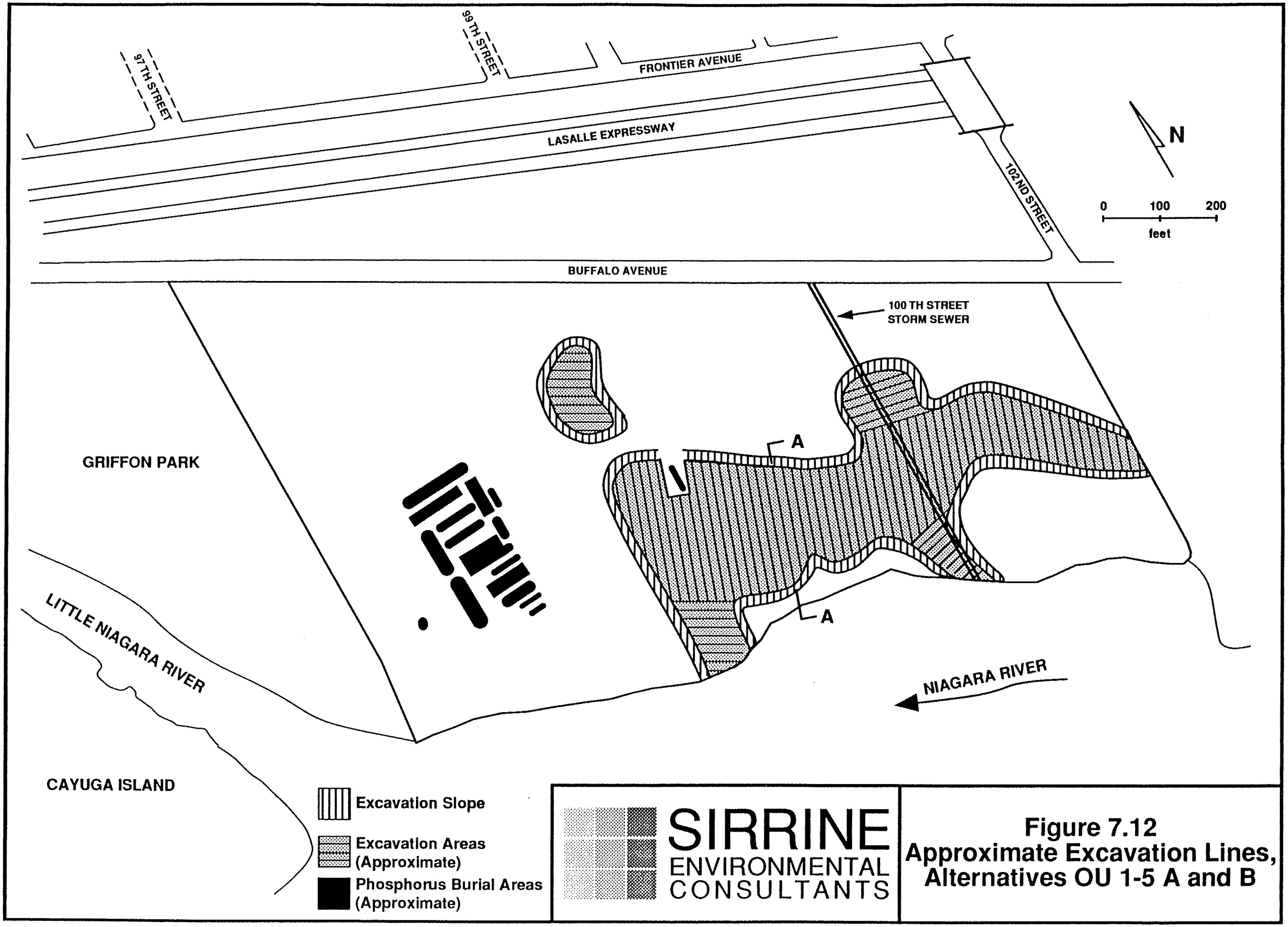

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Figure 7.12
Approximate Excavation Lines, Alternatives OU 1-5 A and B

OPTION 2 - Excavate to clay/till layer
Excavation slope: 2(H) to 1(V)
Depth of excavation: 30 feet (average)
Trench width (top): 140 feet
(bottom): 20 feet
Trench length: varies

DEWATERED ZONE

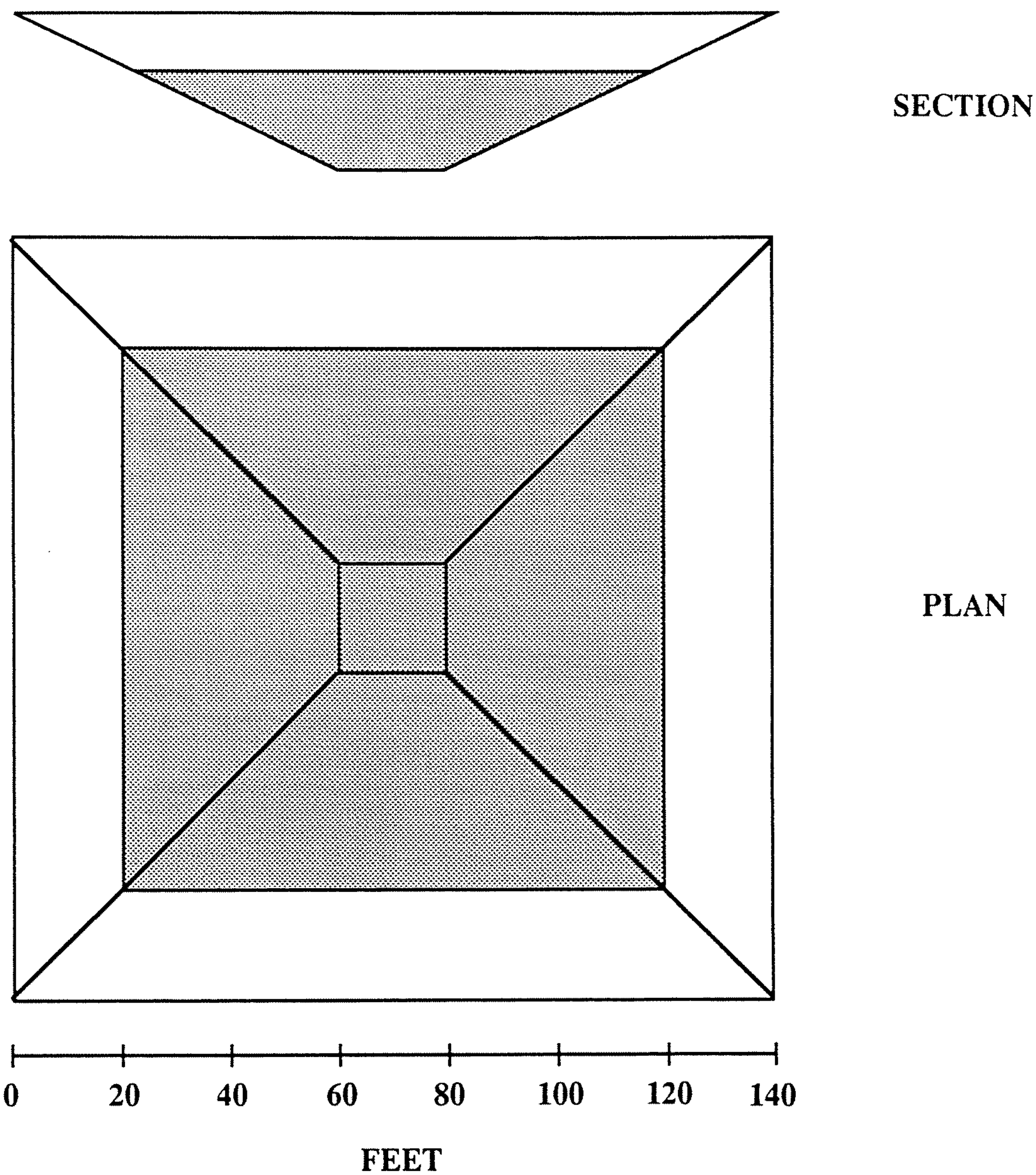

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FIGURE 7.13
EXCAVATION PROFILES, TO CLAY/TILL LAYER
102nd Street Site

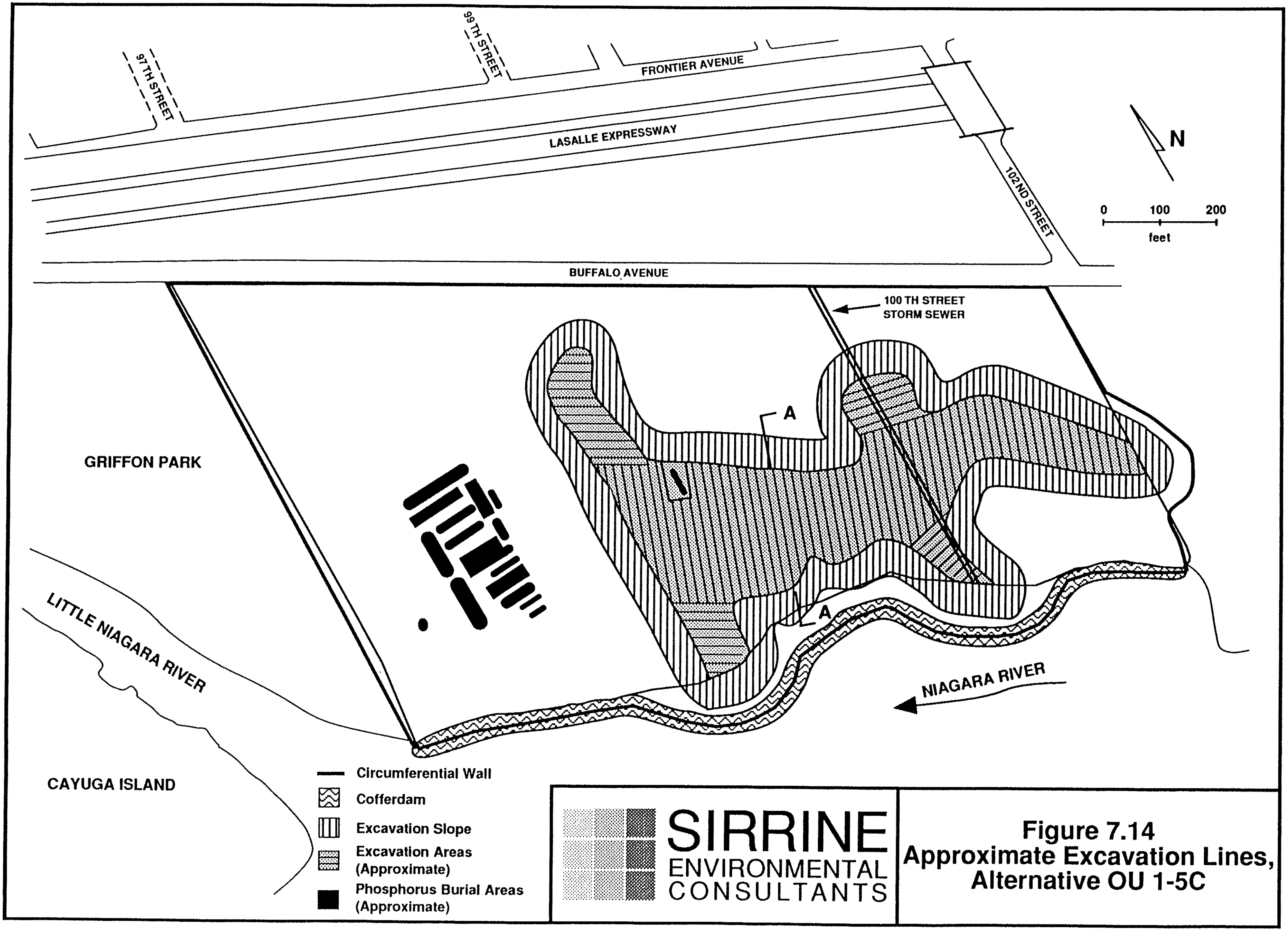

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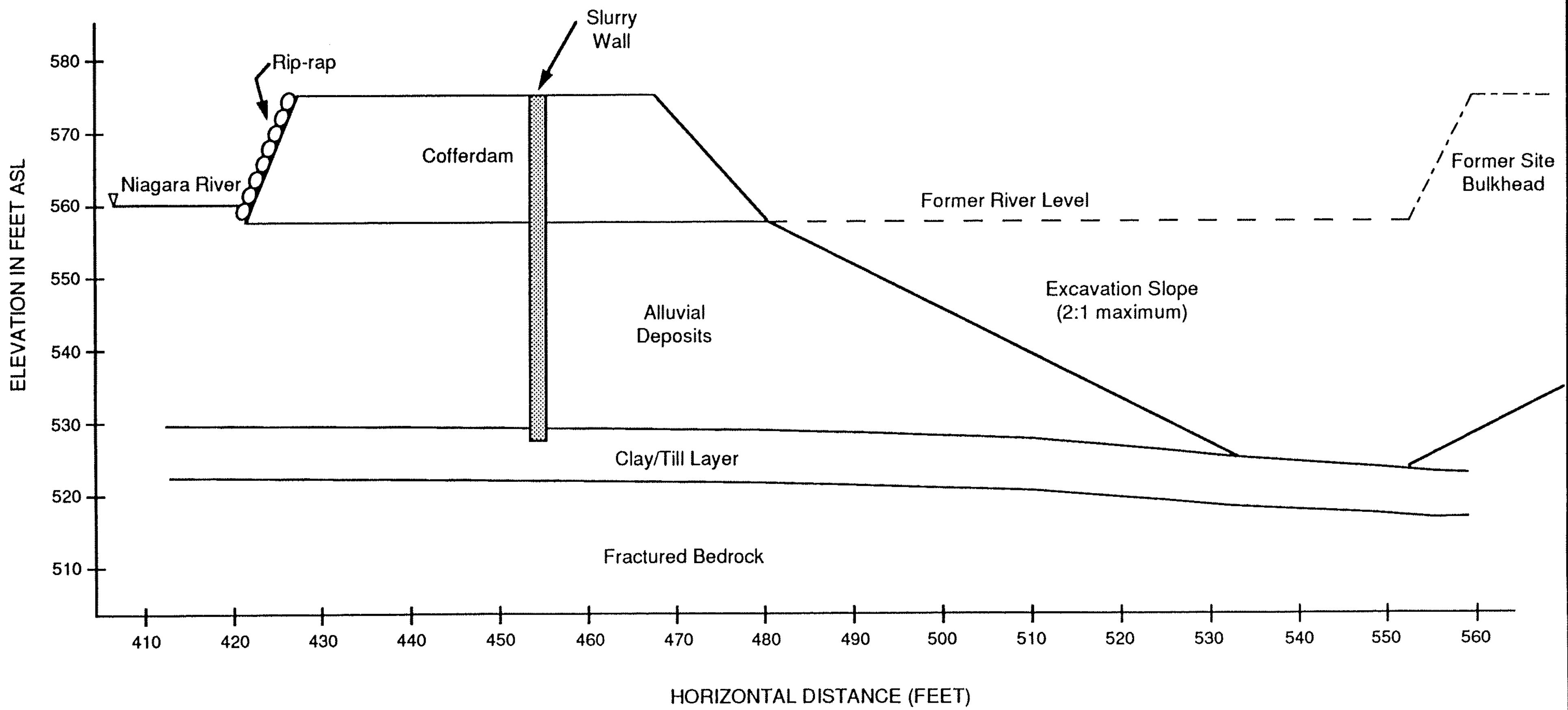
Figure 7.14
Approximate Excavation Lines, Alternative OU 1-5C



NOTE: Geological sections are approximate.

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Figure 7.15
Cofferdam For Excavation To Clay/Till Layer Alternative OU1-5C

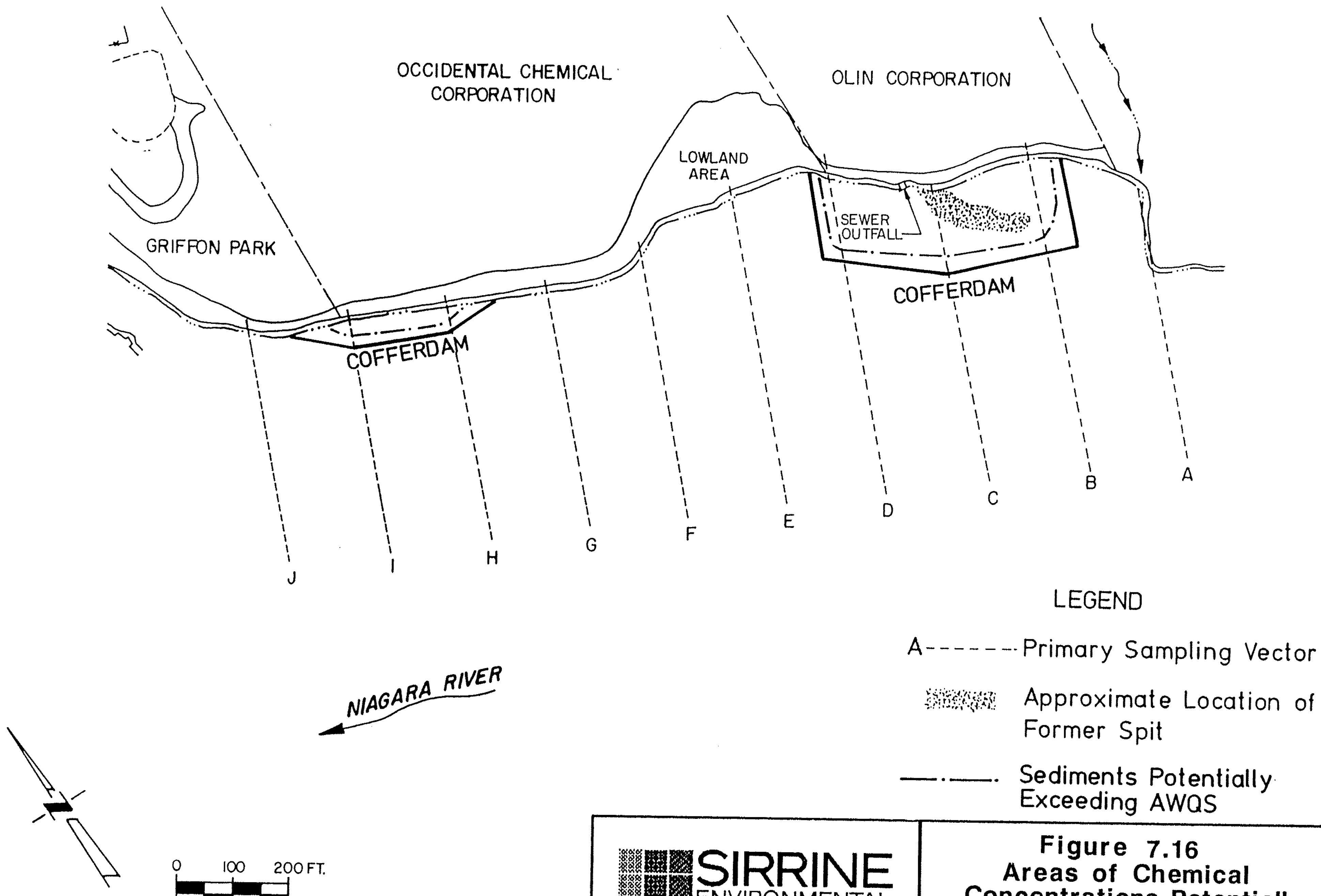

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Figure 7.16
Areas of Chemical Concentrations Potentially Exceeding AWQS
Alternative OU2-2 Options

SOURCE: CRA/WCC, 1988

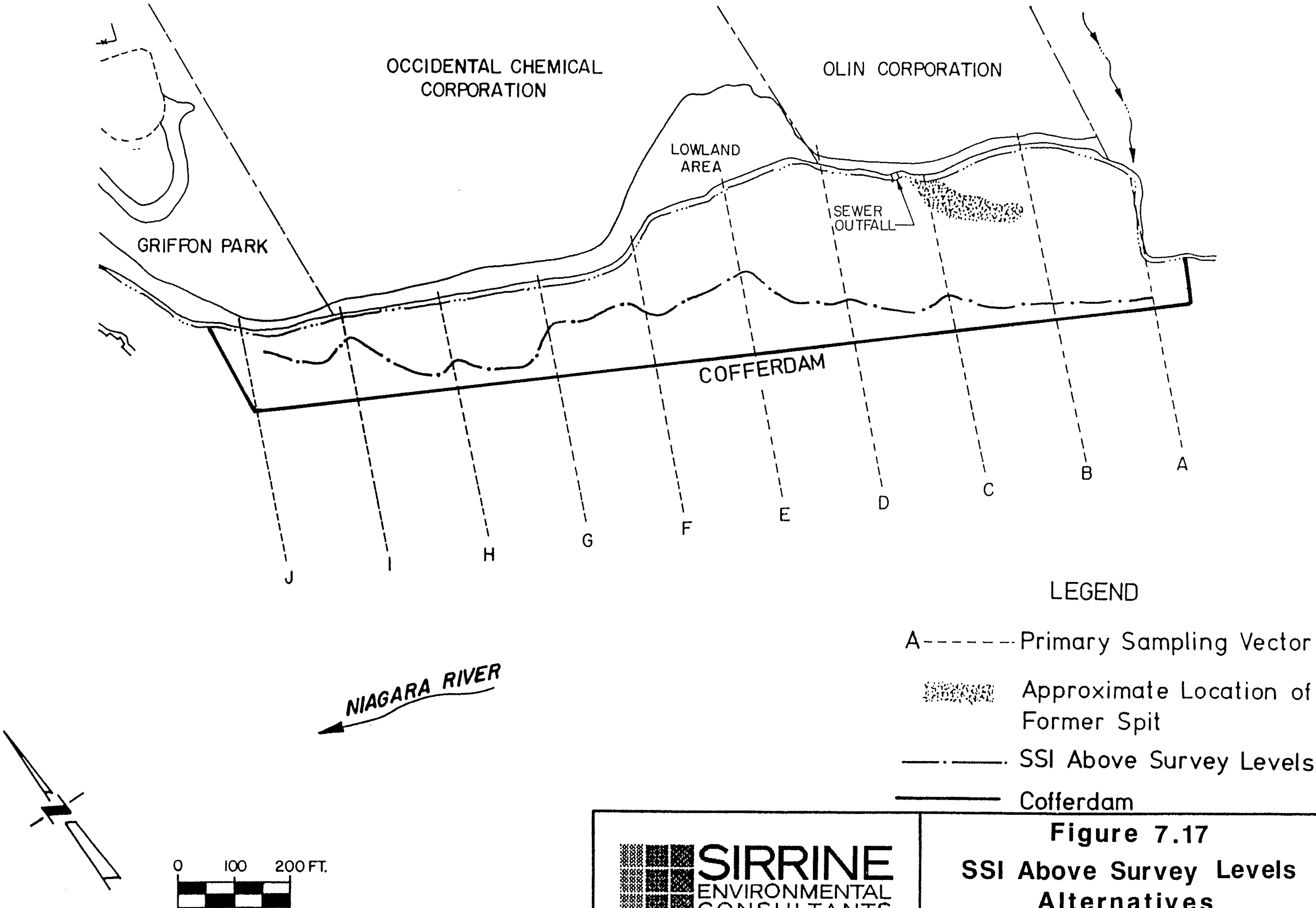

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Figure 7.17
SSI Above Survey Levels Alternatives
OU2-4 & OU2-6 Options

SOURCE: CRA/WCC, 1988

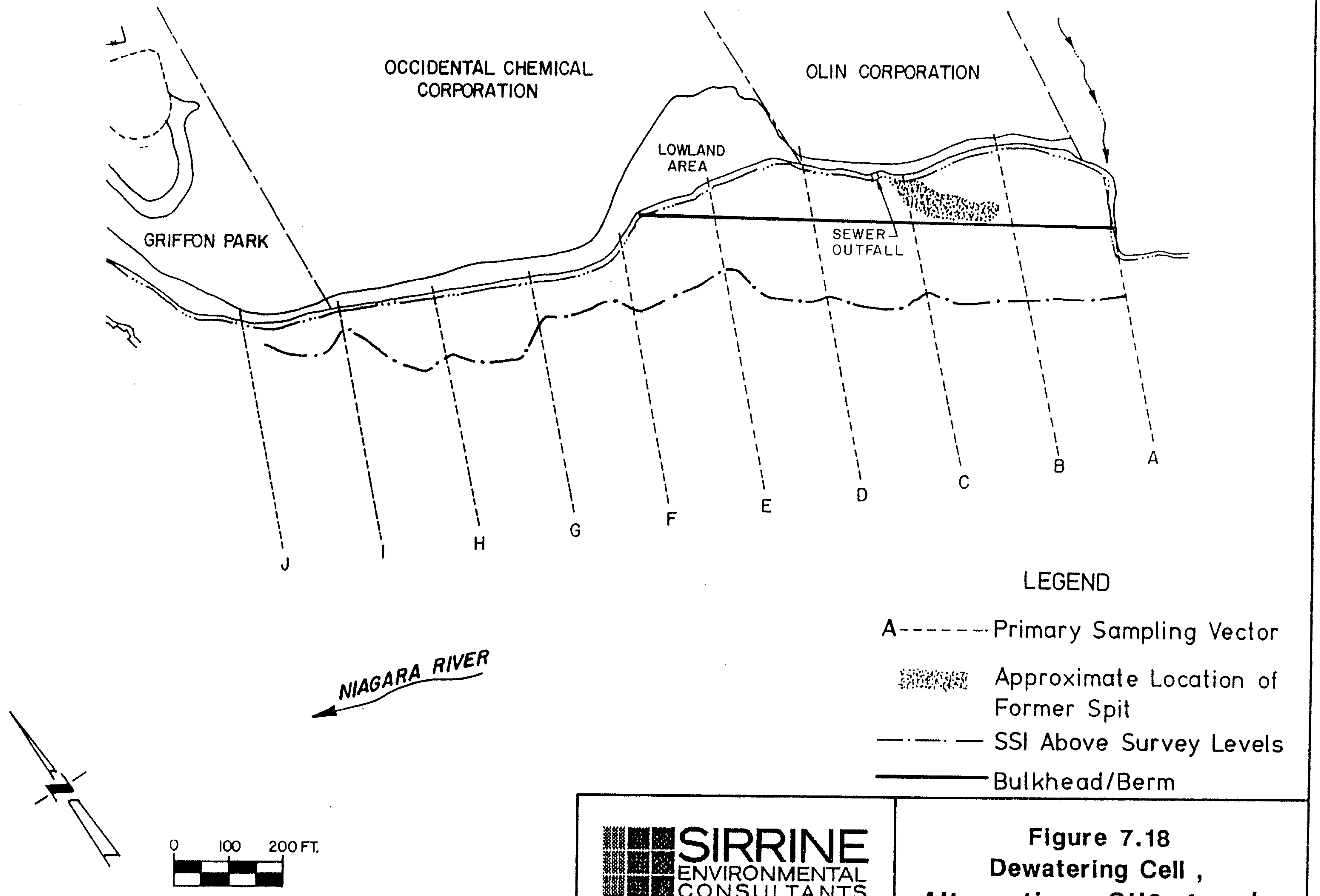

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Figure 7.18
Dewatering Cell, Alternatives OU2-4 and OU2-6 Options

SOURCE: CRA/WCC, 1988

TABLE 7.1

OPERABLE UNIT ONE (OU1) ALTERNATIVES

Alternative	Landfill	Perimeter Soils	Off-site Soils	Groundwater	NAPL
1	Existing fence, cover	Existing cover	No action	No action	No action
2 A	Upgrade fence, use existing cover	Secure cell	No action	No action	No action
2 B	Upgrade fence, use existing cover	Secure cell	No action	Cutoff wall recovery and treatment	Cutoff wall
2 C	Upgrade fence, use existing cover	Off-Site Incineration	No action	Cutoff wall, recovery and treatment	Cutoff wall
2 D	Upgrade fence, use existing cover	Secure cell	Secure cell	Cutoff wall, recovery and treatment	Cutoff wall
2 E	Upgrade fence, use existing cover	Stabilization	Stabilization	Cutoff wall, recovery and treatment	Cutoff wall
3 A	Capping	Capping	No action	No action	No action
3 B	Capping	Capping	No action	Cutoff wall, recovery and treatment	Cutoff wall
3 C	Capping	Capping	No action	Circumferential wall, recovery and treatment	Circum-ferential wall
3 D	Capping	Capping	Capping	Circumferential wall, recovery and treatment	Circum-ferential wall
3 E	Capping	Capping	Capping	Cutoff wall, recovery and treatment	Recovery and incineration
3 F	Capping	Capping	Capping	Circumferential wall, recovery and treatment	Recovery and incineration
5 A	Incineration and capping	Incineration	Incineration	Cutoff wall, recovery and treatment	Cutoff wall
5 B	Incineration and capping	Incineration	Incineration	Cutoff wall, recovery and treatment	Recovery and incineration
5 C	Incineration and capping	Incineration	Incineration	Circumferential wall, recovery and treatment	Excavation and incineration

TABLE 7.2

ACTION-SPECIFIC ARARS FOR GROUNDWATER REMEDIATION

ELEMENT	AREA	POTENTIAL ARARS
Extraction	Well Construction	None identified
Treatment	Air Stripping	Air Guide-1, Control of Toxic Ambient Air Contaminants (NYSDEC, 7/86)
		6 NYCRR Part 212 - Gaseous Process Emission Sources
	Inorganic sludges and spent carbon residuals	6 NYCRR Section 373-2 NYS Manifesting
		49 CFR Parts 171-173 (DOT)
		6 NYCRR Part 370 - General Hazardous Waste Requirements
		6 NYCRR Section 373-1 - Hazardous Waste Storage
		EPA Off-Site Policy - Any TSD facility receiving waste from a CERCLA site must be in full compliance with RCRA.
Discharge	Municipal POTW	City of Niagara Falls Permit
	Niagara River	SPDES Permit

TABLE 7.3

FUNCTIONS OF BUILDINGS/AREAS IN TYPICAL LAYOUT

Building/Area	Function
Excavated Material Storage	Contained area for storing roll-offs containing excavated materials
Preparation and Handling Building	Processing Areas include: • unloading/sorting • cutting • crushing • water treatment • shredder/crusher/classifier • mixing/staging • waste feed systems
Tank Farm	Fuel storage Liquid waste storage Nitrogen system Oxygen system
Incinerator	Includes secondary combustion chamber and air pollution control devices
Control Room	Control devices for Incinerator/APCD operation
Generator	Emergency generator, air compressor
Boiler Room	Boiler for heating buildings Ash sampling laboratory
Fire Water	Storage tank and pump for required fire protection
Truck Wash	Decontaminate trucks and rolloffs Wastewater treatment system
Ash Storage	Temporary and long-term ash storage
First Aid/Decon	First aid station (including ambulance) Worker change/decontamination area
Parking	Parking lot for approximately 150 workers

TABLE 7.4

TYPICAL ROTARY KILN OPERATING PARAMETERS

Throughput:	10 tons/hour (unsaturated materials) 7 tons/hour (saturated materials)
Service factor:	70%
Stack height:	60 feet
Stack velocity:	3,000 feet/minute
Stack flue gas flow rate:	40,000 acfm @ 190°F
Kiln temperature:	1,600°F
Secondary combustion chamber temperature:	2,200°F
Kiln solids residence time:	30 - 60 minutes
Secondary combustion chamber residence time:	2 seconds
Excess oxygen in stack gas:	10%
Air pollution control device:	Venturi scrubber
Stack emission temperature:	190°F
Particulate emissions:	0.08 gr/dscf
Ash temperature (following water quench):	300°F

TABLE 7.5

MELTING POINTS OF SITE RESIDUALS

Compound	Melting Point (°C)
NaCl	800
$NaClO_2$	200 (decomposes)
$NaClO_3$	248
$NaClO_4$	482 (with decomposition)
$CaCO_3$	825 (decomposes)
$Ca(OH)_2$	580 (loses water)
Hg	-39
$HgCl_2$	276 (melting point) 303 (boiling point)
$Ca(H_2PO_2)_2$	357 (boiling point)
Gypsum ($CaSO_4 \cdot 2H_2O$)	1450
Soil	1100 - 1400
Steel (carbon)	1200

Kiln Temperature ≈ 1600°F ≈ 870°C

TABLE 7.6

ROTARY KILN MAINTENANCE FACTORS

Item	Consideration
Inorganic residuals	Kiln temperatures and sodium eutectics would encourage slag and cake formation, which must be removed.
Sodium salts	Penetration of kiln refractory causes gradual deterioration and requires replacement.
Clays, fly ash	Carryover to the SCC causes cake formation, which must be removed to maintain operating conditions.
Variations in feedstock composition	Would require conservative operation of incinerator and potential adjustments of operating parameters during extreme input conditions.
Materials handling	Incinerator operates at capacity level of slowest unit operation.
Particulate entrainment	Loading on APCS would require frequent monitoring and potential adjustments. Could result in reduction in system throughput.

TABLE 7.7

TRIAL BURN PROCESS

- Prepare trial burn plan and submit to Federal and State agencies (required 6 months after notification).

- Prepare responses to any questions or deficiencies in the trial burn plan (1 month).

- Make any additions or modifications to the incinerator that may be necessary (1 to 3 months).

- Prepare for trial burn.

  - Prepare for all sampling and analysis (S&A) (2 to 3 months).
  - Select date for trial burn, in concert with S&A staff or contractor (completed 1 month prior to test).
  - Notify all appropriate regulatory agencies (1 month).
  - Obtain required quantities of waste having specified characteristics (est. 2 months).
  - Calibrate all critical incinerator instrumentation (2 weeks).

- Conduct trial burn sampling (1 week).

- Conduct sample analysis (1 to 1-1/2 months).

- Calculate trial burn results (1/2 month).

- Prepare results for submittal to EPA (1/2 to 1 month). Include requested permit operating conditions.

- Obtain permit to accept candidate waste (3 months).

TOTAL DURATION: 20-24 months

Source: EPA, 1987.

TABLE 7.8

ALTERNATIVE SCHEDULE AND COST SUMMARY
OPERABLE UNIT ONE

Alternative	Implementation Schedule (months)	Present Worth Costs
1	0	$1,380,000
2A	1	$1,800,000
2B	5	$9,620,000
2C	5	$9,510,000
2D	6	$9,860,000
2E	6	$10,700,000
3A	6	$9,550,000
3B	10	$17,600,000
3C	12	$16,600,000
3D	12	$16,700,000
3E	10	$21,300,000
3F	12	$20,300,000
5A	72	$77,100,000 - $144,000,000
5B	72	$80,400,000 - $148,000,000

TABLE 7.9

ALTERNATIVE SCHEDULE AND COST SUMMARY
OPERABLE UNIT TWO

Alternative	Implementation Schedule (months)	Present Worth Costs
1	0	$415,000
2A	3	$1,800,000 - $2,730,000
2C	4	$3,660,000 - $4,480,000
4	8	$4,620,000 - $6,180,000
6A	6	$3,600,000 - $5,570,000
6C	14	$11,800,000 - $13,200,000

TABLE 7.10

ALTERNATIVE SCHEDULE AND COST SUMMARY
OPERABLE UNIT THREE

Alternative	Implementation Schedule (months)	Present Worth Costs
1	0	$375,000
2A	3	$605,000
2B	2	$718,000
3A	8	$2,990,000
3B	10	$4,950,000

8.0 RECOMMENDED REMEDIAL ALTERNATIVES

Statement of Basis and Purpose

Selection of the most appropriate remedial alternatives for each operable unit at the 102nd Street Site is based on the nine CERCLA decision criteria, particularly protection of human health and the environment and compliance with ARARs. The selection is in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the draft National Contingency Plan. The selection is based on the analytical data presented in the final Remedial Investigation report (July 1990) that was filed initially in November 1988, on the Companies' Baseline Risk Assessments (July 1990) and technical evaluations presented in this Feasibility Study report.

Operable Unit One

Alternative OU1-3F is the recommended remedial action for Operable Unit One. Alternative OU1-3F consists of the following elements:

- a synthetic liner cap over the landfill and perimeter soils
- consolidation of off-site soils above organic SSI survey levels beneath the cap
- a circumferential slurry wall along the perimeter of the cap that is keyed into the impermeable geology beneath the site
- groundwater recovery and treatment
- NAPL recovery and off-site incineration
- long-term groundwater monitoring.

The landfill area presents no significant risks to human health or the environment under current conditions. Construction of a coordinated cap and circumferential wall would essentially create an impermeable enclosure for the landfill area and provide long-term stability of Site conditions, thus preventing the occurrence of any significant risks in the future. The circumferential wall would control migration in the saturated zone and allow more effective collection of groundwater and NAPL. The treatment and/or destruction of groundwater and NAPL would permanently reduce the volume and toxicity of Site residuals and address the requirements of ARARs. Implementation of Alternative OU1-3F would involve demonstrated technologies and present minimal health concerns for the community. Long-term maintenance would preserve the integrity of the cap and slurry wall. The effectiveness of the remedy would be verified through long-term groundwater monitoring.

Operable Unit Two

Alternative OU2-2A is the recommended remedial action for Operable Unit Two. Sediments in the areas of elevated concentration would be removed, dewatering and placed under the landfill cap. This alternative would be implemented in conjunction with alternative OU1-3F. Removal of these sediments would satisfy State ambient water quality standards and be protective of the environment. Enclosure beneath a cap would permanently reduce the mobility and toxicity of sediment chemicals. Implementation of Alternative OU2-2A involves demonstrated technologies and would present no significant risks to the environment.

Operable Unit Three

Alternative OU3-2A is the recommended alternative for Operable Unit Three. Sliplining would require a reduced and safer level of surface preparation in the storm sewer and would use materials with proven chemical resistance. Implementation of Alternative OU3-2A involves demonstrated technologies and would present no significant risks to the environment. Sliplining would eliminate Site groundwater infiltration, although such remediation of the storm sewer is not necessary to protect human health or aquatic life.

Effect of Selected Remedy

Implementation of the recommended alternatives would eliminate the limited areas of potentially significant risk associated with the Site and create conditions that would provide long-term control of Site residuals. The selected remedy would provide a permanent reduction in the mobility and effective toxicity of fill materials along with the destruction of groundwater chemicals and NAPL. No adverse effects on human health or the environment are expected during implementation or operation of the recommended alternatives. The effectiveness of the concerted remedial actions will be verified through long-term monitoring and a review of Site conditions every five years.

APPENDIX A

SITE CHEMICAL INVENTORIES

Source: Remedial Investigation Report (CRA/WCC, July 1990)

APPENDIX A

OLIN CORPORATION CHEMICAL INVENTORY
102ND STREET LANDFILL SITE

The following inventory of chemicals was developed from all available records, the Interagency Task Force (ITF) Report on Hazardous Waste (1978) and additional information.

INORGANICS[1]

"Black Cake"[2]	19,760	cubic yards
Graphite	742	tons
Concrete	6,625	tons
Flyash	5,472	truckloads
Lime Sludge	22,695	cubic yards
Brine Sludge	15,899	cubic yards

ORGANICS[3]

Benzene Hexachloride (BHC) Trichlorophenol (TCP) Trichlorobenzene (TCB) and Benzene	295 truckloads
V-Tetrachlorobenzene	310,550 gallons

(1) Disposal quantities of inorganic were generally based on production factors rather than actual recorded amounts. Inorganics can roughly be translated to tonnages through the use of the conversion factors. Estimated tonnages are as follows:

"Black Cake"	18,673	tons
Graphite	742	tons
Concrete	6,625	tons
Lime Sludge	22,978	tons
Brine Sludge	67,186	tons
	116,204	tons (excluding flyash)

(2) "Black Cake" resulted from the production of sodium chlorite and had a dry basis composition approximately as follows:

OLIN CORPORATION CHEMICAL INVENTORY
102ND STREET LANDFILL SITE

Approximately 2% soluble material (sodium chloride, sodium chlorite, sodium chlorate)

18% carbon

80% calcium carbonate/calcium hydroxide

(3) Available records indicate truckload shipments of these materials to the landfill. There is no way to determine the specific quantities of the different chemicals, however, there is also no reason to believe they constitute a mixture. Rather, it is believed they were simply loads of some bulk and some drummed material on the same truck. Tetrachlorobenzene is a separate known quantity. Trichloroanisole was a probable impurity in one of the production processes. It was not disposed of as a separate item.

All the organic materials are solids at STP except benzene and 1,2,4-trichlorobenzene. The quantity of benzene and 1,2,4-trichlorobenzene (if the 1,2,4-isomer was disposed of at the Site) are unknown.

The organic disposal can roughly be translated to tonnages through use of the conversion factors of eight cubic yards per truckload and a density of 0.85 grams per cubic centimeter (g/cc). Tetrachlorobenzene has a density of 1.8 g/cc.

BHC, TCP, TCB, and Benzene	2,000	tons
Tetrachlorobenzene	2,327	tons
	4,327	tons

Ref.: Table 1.2 of the Remedial Investigation Report (CRA/WCC, July 1990).

APPENDIX A (Continued)

OCCIDENTAL CHEMICAL CORPORATION CHEMICAL INVENTORY
102ND STREET LANDFILL SITE

Type of Waste	State	Estimated Quantity (Tons)	Container
Organic phosphites	L,S	<100	D
Sodium Hypophosphite mud	S	20,000	B
Phosphorus and inorganic phosphorus derivatives (excluding sodium hypophosphite)	L,S	1,300	D
BHC cake (including Lindane)	S	300	D
Chlorobenzenes*	S	(?)	(?)
Misc. 10% including cell parts used in chlorate production	S	2,200	D,B
SUB-TOTAL		23,800	
Brine, sludge & gypsum		53,200	
TOTAL WASTE REPORTED		77,000	

* Quantity Unknown.

Notes:

L = liquid
S = solid
D = drummed
B = bulk

From Occidental Chemical Corporation's November 17, 1978 and May 23, 1979 responses to the New York State Interagency Task Force.

Ref.: Table 1.3 of the Remedial Investigation Report (CRA/WCC, July 1990).

APPENDIX B

GROUNDWATER SUMMARY DATA

Source: Remedial Investigation Report (CRA/WCC, July 1990)

TABLE 5.1

COMPREHENSIVE WASTE ANALYSIS SUMMARY OF DETECTIONS/OLIN
102ND STREET LANDFILL
PART 1

Concentrations in micrograms per liter, except where noted.

Monitoring Well No.	MW-1	MW-2	MW-2(R)	MW-4	CW-18	CW-35	CW-35(R)
COMPOUND							
VOLATILES							
Benzene	75	1900	1800	8200	240	610	
Chlorobenzene	190	2200	2200	16,000	93	880	
Chloroform		< 44 (1)	< 43 (1)		< 4 (1)	30	
Acetone	20	< 130 (1)	150	< 640 (1)			
Trans-1,2-Dichloroethene	5.4	200	200				
Trichloroethene		160	160				
Tetrachloroethene		430	450				
SEMI-VOLATILES (B/NA)							
1,2-Dichlorobenzene	150	< 43 (1)	< 37 (1)	< 820 (1)	< 15 (1)	28	
1,3-Dichlorobenzene	110	340	310	< 220 (1)	< 18 (1)	30	
1,4-Dichlorobenzene	120	120	110	< 1200 (1)	< 15 (1)	54	
1,2,4-Trichlorobenzene	170	1000	820	2900	370	110	
2,4,5-Trichlorophenol		410	< 290 (1)				
				11,000*	< 8.4 (1)*		
2,4,6-Trichlorophenol		< 8.4 (1)					
PESTICIDES/PCB's							
Alpha Hexachlorocyclohexane	160	200	190	12,000	73	94	
Delta Hexachlorocyclohexane	110	13	10	71,000		100	
GENERAL PARAMETERS (Concentrations in milligrams per kilogram)							
Total Kjeldahl Nitrogen	1.9	4.9		1.6	0.1	0.1	0.3
Total Organic Carbon	27	67		41	14	20	16
Mercury	0.0006	0.026		0.0084	0.0086	0.007	0.0065
Phosphorus (Filtered)	0.21	0.16		0.11	0.16	0.16	0.26
Total Organic Halide (Feb)	2.392	15.21		52.40	2.117	1.20	1.158
Total Organic Halide (Apr)	1.5/1.5	5.2/4.4		43/48	2.1/1.8	1.1/1.2	

* Denotes indistinguishable isomers
Blank indicates not detected at or above survey level.
(1) Estimated concentration used for TOX balance.
(R) Denotes replicate sample.

TABLE 5.1 (Continued)

Compound	Molecular Weight	Wt Frac Chlorine	MW-2(R) Total ug/L	MW-2(R) ug/L CL	MW-2(R) % of Tot TOX	MW-4 Total ug/L	MW-4 ug/L CL	MW-4 % of Tot TOX
Chlorobenzene	112.56	0.3150	2200	692.9		16,000	5039.5	11.1
Chloroform	119.38	0.8909	< 43 (1)	38.3			0.0	0.0
Trans-1,2-Dichloroethene	96.94	0.7314	200	146.3			0.0	0.0
Trichloroethene	131.29	0.8101	160	129.6			0.0	0.0
Tetrachloroethene	165.83	0.8552	450	384.8			0.0	0.0
Alpha Hexachloro- Cyclohexane	290.83	0.7314	190	139.0		12,000	8777.0	19.3
Delta Hexachloro- Cyclohexane	290.83	0.7314	10	7.3		71,000	51,930.6	114.1
1,2-Dichlorobenzene	147.01	0.4823	< 37 (1)	17.8		< 820 (1)	395.5	8.9
1,3-Dichlorobenzene	147.01	0.4823	310	149.5		< 220 (1)	106.1	0.2
1,4-Dichlorobenzene	147.01	0.4823	110	53.1		< 1200 (1)	578.8	1.3
1,2,4-Trichlorobenzene	181.45	0.5862	820	480.7		2900	1699.9	3.7
2,4,5-Trichlorophenol	197.45	0.5387	<290 (1)	156.2		11,000	5925.3	13.0
2,4,6-Trichlorophenol	197.45	0.5387		0.0		*	0.0	0.0
Methylene Chloride	84.93	0.8349		0.0			0.0	0.0
Bis(2-Chloroethyl) ether	143.02	0.4958		0.0			0.0	0.0
2-Chlorophenol	128.56	0.2758	2.2	0.6			0.0	0.0
2,4-Dichlorophenol	163.00	0.4350	< 23 (1)	10.0			0.0	0.0
SUBTOTAL ug/L				2406.2			74,452.7	
TOTAL TOX							45,500	
SUBTOTAL ug/L/TOTAL TOX (%)							163.6	163.6
1,3,5-Trichlorobenzene	181.45	0.5862	<140 (1)	82.1			0.0	0.0
1,2,3,5-Tetrachlorobenzene	215.90	0.6568	<960 (1)	630.6			0.0	0.0
2,5-Dichlorophenol	163.00	0.4350		0.0			0.0	0.0
Pentachlorobenzene	250.14	0.7087	< 66 (1)	46.8			0.0	0.0
Tetrachlorobenzene	215.90	0.6568	<480 (1)	262.7		< 1100 (1)	722.5	1.6
Hexachlorocyclohexane	290.83	0.7314		0.0			0.0	0.0
Aromatic Halide (TCB)	181.45	0.5862	<680 (1)	398.6		< 7700 (1)	4513.4	9.9
1-chloro-2-ethylbenzene	140.61	0.2521		0.0			0.0	0.0
1,4-Dichloro-2-ethylbenzene	173.06	0.4050						
TOTAL ug/L				3826.9			79,688.7	
TOTAL TOX(2)							45,500	
TOTAL ug/L/TOTAL TOX (%)						175.1	175.1	

* Denotes indistinguishable isomers
Blank indicates not detected at or above survey level.
(1) Estimated concentration used for TOX balance.
(2) Calculated from chlorine content of compounds listed.

TABLE 5.1 (Continued)

Compound	Molecular Weight	Wt Frac Chlorine	CW-18 Total ug/L	CW-18 ug/L CL	CW-18 % of Tot TOX	CW-35 Total ug/L	CW-35 ug/L CL	CW-35 % of Tot TOX
Chlorobenzene	112.56	0.3150	93	29.3	1.5	880	277.2	24.1
Chloroform	119.38	0.8909	< 4 (1)	3.6	0.2	30	26.7	2.3
Trans-1,2-Dichloroethene	96.94	0.7314		0.0	0.0		0.0	0.0
Trichloroethene	131.29	0.8101		0.0	0.0		0.0	0.0
Tetrachloroethene	165.83	0.8552		0.0	0.0		0.0	0.0
Alpha Hexachloro-Cyclohexane	290.83	0.7314	73	53.4	2.7	94	68.8	6.0
Delta Hexachloro-Cyclohexane	290.83	0.7314		0.0	0.0	180	73.1	6.4
1,2-Dichlorobenzene	147.01	0.4823	<15 (1)	7.2	0.4	28	13.5	1.2
1,3-Dichlorobenzene	147.01	0.4823	<18 (1)	8.7	0.4	30	14.5	1.3
1,4-Dichlorobenzene	147.01	0.4823	<15 (1)	7.2	0.4	54	26.0	2.3
1,2,4-Trichlorobenzene	181.45	0.5862	370	216.9	11.1	110	64.5	5.6
1,2,4-Trichlorophenol	197.45	0.5387	<8.4 (1)	4.5	0.2		0.0	0.0
2,4,6-Trichlorophenol	197.45	0.5387		0.0	0.0		0.0	0.0
Methylene Chloride	84.93	0.8349	<7.8 (1)	6.5	0.3		0.0	0.0
Bis(2-Chloroethyl)ether	143.02	0.4958		0.0	0.0	<7.2 (1)	3.6	0.3
2-Chlorophenol	128.56	0.2758		0.0	0.0	<7.2 (1)	0.6	0.1
2,4-Dichlorophenol	163.00	0.4350	<8.4 (1)	3.7	0.2		0.0	0.0
SUBTOTAL ug/L				341.0			568.5	
TOTAL TOX				1950			1150	
SUBTOTAL ug/L/TOTAL TOX (%)				17.5	17.5		49.4	49.4
1,3,5-Trichlorobenzene	181.45	0.5862	< 24 (1)	14.1	0.7		0.0	0.0
1,2,3,5-Tetrachlorobenzene	215.90	0.6568		0.0	0.0		0.0	0.0
2,5-Dichlorophenol	163.00	0.4350		0.0	0.0		0.0	0.0
Pentachlorobenzene	250.14	0.7087		0.0	0.0		0.0	0.0
Tetrachlorobenzene	215.90	0.6568	< 18 (1)	11.8	0.6		0.0	0.0
Hexachlorocyclohexane	290.83	0.7314	<332 (1)	242.8	12.5	< 78 (1)	51.2	4.5
Aromatic Halide (TCB)	181.45	0.5862	< 38 (1)	22.3	1.1	14	8.2	0.7
1-chloro-2-ethylbenzene	140.61	0.2521		0.0	0.0	<222 (1)	56.0	4.9
1,4-Dichloro-2-ethylbenzene	175.06	0.4050		0	0.0	< 32 (1)	13.0	1.1
TOTAL ug/L				632.0			696.8	
TOTAL TOX(2)				1950			1150	
TOTAL ug/L/TOTAL TOX (%)			32.4	32.4		60.6	60.6	

* Denotes indistinguishable isomers
Blank indicates not detected at or above survey level.
(1) Estimated concentration used for TOX balance.
(2) Calculated from chlorine content of compounds listed.

TABLE 5.1 (Continued)

PRIORITY POLLUTANTS

Metal	Detection Limit	MW-1	MW-1D	MW-2	MW-2D	MW-4	MW-4 (Duplicate)	MW-4D	MW-4D (Duplicate)
Mercury		60	68	52.4	54.2	10.5	9.5	10.5	9.5
Beryllium	0.3								
Cadmium	3	16.7	19.3			6.53	7.36	7.70	8.39
Lead	42			64.7	76.2				
Zinc		21.1	25.4	47	51	153	154	152	155
Copper		20.3	28.4	41.6	44.7	19.9	10	15.6	15.6
Arsenic	53	56.4		68.4			85.1		87.6
Selenium	75								
Chromium	7	8.97	9.04	9.03	10.4				
Nickel	15					89.1	87.8	98.2	88.6
Thallium	40		49.2			47.5	66.2	101	
Antimony	32	54.3	47.2						49.7
Silver	7								

Metal	Detection Limit	CW-18	CW-18D	CW-35	CW-35 (Duplicate)	CW-35D	CW-35D (Duplicate)
Mercury		8.6	9.2	7.8	8.2	8.0	7.9
Beryllium	0.3						
Cadmium	3			3.4			
Lead	42						
Zinc		20.5	21.0	931	796	803	932
Copper		11.0	9.5	14.3	19.3	12.3	14.1
Arsenic	53	60.8	58.2		69.3		
Selenium	75						
Chromium	7						
Nickel	15			26.1	38.5	24.8	23.9
Thallium	40			108	72.8		73.0
Antimony	32		48.9	49.5		69.7	45.1
Silver	7						

* Denotes indistinguishable isomers
Blank indicates not detected at or above survey level.
D Denotes duplicate analysis.

TABLE 5.1 (Continued)

COMPREHENSIVE WASTE ANALYSIS/OLIN
PART 3

TOX BALANCE

Compound	Molecular Weight	Wt Frac Chlorine	MW-1 Total ug/L	MW-1 ug/L CL	MW-1 % of Tot TOX	MW-2 Total ug/L	MW-2 ug/L CL	MW-2 % of Tot TOX
Chlorobenzene	112.56	0.3150	190	59.8	4.0	2200	692.9	14.4
Chloroform	119.38	0.8909		0.0	0.0	< 44 (1)	39.2	0.8
Trans-1,2-Dichloroethene	96.94	0.7314	5.4	3.9	0.3	200	146.3	3.0
Trichloroethene	131.29	0.8101		0.0	0.0	160	129.6	2.7
Tetrachloroethene	160.33	0.8552		0.0	0.0	430	367.7	7.7
Alpha Hexachloro-Cyclohexane	290.83	0.7314	160	117.0	7.8	200	146.3	3.0
Delta Hexachloro-Cyclohexane	290.83	0.7314	110	80.5	5.4	13	9.5	0.2
1,2-Dichlorobenzene	147.01	0.4823	150	72.3	4.8	< 43 (1)	20.7	0.4
1,3-Dichlorobenzene	147.01	0.4823	110	53.1	3.5	340	164.0	3.4
1,4-Dichlorobenzene	147.01	0.4823	120	57.9	3.9	120	57.9	1.2
1,2,4-Trichlorobenzene	181.45	0.5862	170	99.6	6.6	1000	586.2	12.2
2,4,5-Trichlorophenol	197.45	0.5387		0.0	0.0	410	220.9	4.6
2,4,6-Trichlorophenol	197.45	0.5387		0.0	0.0	<8.4 (1)	4.5	0.1
Methylene Chloride	84.93	0.8349		0.0	0.0		0.0	0.0
Bis(2-Chloroethyl)ether	143.02	0.4958	<10 (1)	5.0	0.3		0.0	0.0
2-Chlorophenol	128.56	0.2758	<6.6(1)	1.8	0.1	< 10 (1)	2.8	0.1
2,4-Dichlorophenol	163.00	0.4350	3.8	1.7	0.1	< 24 (1)	10.4	0.2
SUBTOTAL ug/L				552.6			2598.9	
TOTAL TOX				1500			4800	
SUBTOTAL ug/L/TOTAL TOX (%)				36.8	36.8		54.1	54.1
1,3,5-Trichlorobenzene	181.45	0.5862	< 38 (1)	22.3	1.5	<170 (1)	99.6	2.1
1,2,3,5-Tetrachlorobenzene	215.90	0.6568	<130 (1)	85.4	5.7	<1300(1)	853.9	17.8
2,5-Dichlorophenol	163.00	0.4350		0.0	0.0	< 46 (1)	20.0	0.4
Pentachlorobenzene	250.14	0.7087		0.0	0.0	< 71 (1)	50.3	1.0
Tetrachlorobenzene	215.90	0.6568	< 71 (1)	46.6	3.1	<150 (1)	98.5	2.1
Hexachlorocyclohexane	290.83	0.7314	< 84 (1)	61.4	4.1		0.0	0.0
Aromatic Halide (TCB)	181.45	0.5862	<510 (1)	298.9	19.9		0.0	0.0
1-chloro-2-ethyl benzene	140.61	0.2521		0.0	0.0		0.0	0.0
1,4-Dichloro-2-ethyl benzene	175.06	0.4050						
TOTAL ug/L				1067.3			3721.3	
TOTAL TOX(2)				1500			4800	
TOTAL ug/L/TOTAL TOX (2)			71.2	71.2		77.5	77.5	

* Denotes indistinguishable isomers
Blank indicates not detected at or above survey level.
(1) Estimated concentration used for TOX balance.
(2) Calculated from chlorine content of compounds listed.

TABLE 5.1 (Continued)

PART 2
COMPOUNDS TENTATIVELY IDENTIFIED IN SOME SAMPLES BUT BELOW DETECTION LIMITS IN ALL SAMPLES

Methylene chloride
Ethylbenzene
Phenol
Bis(2-chloroethyl)ether
2-Chlorophenol
4-Methylphenol
2,4-Dichlorophenol
Naphthalene

NON-TARGETED COMPOUNDS TENTATIVELY IDENTIFIED BY COMPUTER MATCHING

1,3,5-Trichlorobenzene
1,2,3,5-Tetrachlorobenzene
2,5-Dichlorophenol
2-Cyclohexen-1-one
Pentachlorobenzene
Tetrachlorobenzene (isomer not specified)
Halobenzene
Aromatic Halide
Hexane isomer
1-Chloro-2-ethylbenzene
1,4-Dichloro-2-ethylbenzene
Alkyl Phosphonate

(1) These tentative compound identifications are unconfirmed and concentrations are estimated using an assumed response factor. The information is uncertain and cannot be used in loading calculations. The information was used in a sub-calculation to further estimate closure of the TOX balance.

TABLE 5.2

COMPREHENSIVE WASTE ANALYSIS SUMMARY, OCC
102ND STREET LANDFILL
PART 1

COMPLETE LISTING OF COMPOUNDS (ug/L)

Compound	OW33	OW35	OW36	OW37	OW38
Acetone	800	800		800	800
Aliphatic Hydrocarbons		540			
Aliphatic Sulfur Compounds	19			19	
Aniline		16			18
Arochlor 1242			62		
Benzaldehyde		27			
Benzene		2100		310	230
Benzene Acetic Acid					25
Benzene Propanoic Acid					8
Benzoic Acid		25,000			
Benzyl Alcohol		110			
Biphenyl Acetic Acid					2
$C_7H_5NO_2Cl$		33			
$C_9H_{10}O$		100			
$C_{10}H_{18}O$		6100			
$C_{13}H_{11}ON_2Cl$					11
$C_{14}H_{14}S$		64			
$C_{14}H_{20}O_2$				35	
Carbon Disulfide			50		
Chlorendic Acid	180	1500			
Chloroaniline		1100			3400
Chlorobenzene		2800	12	210	6900
Chlorobenzene Acetic Acid					1
Chlorobenzoic Acids		10,000			
Chloroform		21			
bis(Chloroethyl)ether				37	
Chlorophenols		230			4
Chlorophenyl Acetamide					14
Chlorothiophene					5
Chlorotoluenes		560			9
Dibutylphthalate		97			
Dichloroaniline		16,000			3900
Dichlorobenzenes		720			300
Dichlorobenzoic Acids		740			9
Dichlorobutene					9
trans-1,2-Dichloroethylene		10	720		
Dichloromethoxybenzene		700			
Dichloromethylbenzoic Acid					31
Dichlorophenols		1200			190
Dichlorothiophene					1
Dichlorotoluenes		340			2
Dimethylethylphenol					16
Dimethylphenol		87			1
Diphenyl Ketone					
Dodecanoic Acid		79	3		

TABLE 5.2 (Continued)

Compound	OW33	OW35	OW36	OW37	OW38
Ethoxychloroaniline		300			
2-Ethylcyclohexanone					31
bis(2-Ethyl hexyl)phthalate		25	11	180	12
Ethyl Methyl Benzene				2	
Hexachlorocyclohexane		1210		39	530
Hexathiepane				15	
Methoxychloroaniline		7200			
Methoxydichloroaniline		750			
Methyl Cyclohexanol					14
Methylethylcyclohexanone					15
Methyl Ethyl Phenol					28
Methyl Phenol		39			110
Nitroaniline					56
Nitrobenzoic Acid		2900			
Oxathiane				42	
1,1'-Oxybis(2-chloro)ethane				37	
Pentachlorobenzene		39			100
Pentachlorophenol		36			38
Phenol		110		25	34
Phenylcyclohexanol					50
Phenylethyl Phenol					36
Phosphorus			22		
Propyl Benzene				1	
Propyl Phenol		230			
bis-Sulfonyl Benzene					17
Sulfur			780		
Tetrachlorobenzene		660			2700
Tetrachloroethylene		14			
Tetrachlorophenol		10			540
Thiobisbenzene					10
Toluene		5700			300
Trichlorobenzenes		800			2400
Trichlorocresol		58			
Trichloroethylene		15	730		
Trichlorophenols		420		220	
Trichloropropane					9
Trichlorotoluene		110			
Trifluoromethylbenzamine			58		
Trimethylbenzene				12	
Trimethylbicycloheptanone		2500		7	20
Trioxane			8		
Trithiane			36		
Trithiolane				5	
Vinyl Chloride			22		
Xylene				22	24
Unidentified Chlorinated Compounds		120			100

TABLE 5.2 (Continued)

TOX BALANCE (ug/L)
PART 2

Compound	OW33	OW35	OW36	OW37	OW38
Aroclor 1242			62		
Chlorendic Acid	180	1500			
Chloroaniline		1100			3400
Chlorobenzene		2800	12	210	6900
Chlorobenzoic Acids		10,000			
Chloroform		21			
bis(Chloroethyl)ether				37	
Chlorophenols		230			4[illegible]
Chlorophenyl Acetamide					1[illegible]
Chlorothiophene					53
Chlorotoluenes		560			92
Dichloroaniline		16,000			390[illegible]
Dichlorobenzenes		720			310[illegible]
Dichlorobenzoic Acids		740			98
trans-1,2-Dichloroethylene		10	720		
Dichloromethylbenzoic Acid					3[illegible]
Dichloromethoxybenzene		700			
Dichlorophenols		1200			19[illegible]
Dichlorotoluenes		340			2[illegible]
Ethoxychloroaniline		300			
Hexachlorocyclohexane		1210		39	530
Methoxychloroaniline		7200			
Methoxydichloroaniline		750			
Pentachlorobenzene		39			100
Pentachlorophenol		36			38
Tetrachlorobenzene		660			2700
Tetrachloroethylene		14			
Tetrachlorophenol		10			540
Trichlorobenzenes		830			3100
Trichlorocresol		58			
Trichloroethylene		15	730		
Trichlorophenols		420			214
Trichlorotoluene		110			
Vinyl Chloride			22		
Unidentified Chlorinated Compounds		75			110
Total TOX(1)	110	18,500	1160	113	11,100
OBG TOX(2)	457	43,100	1377	1129	13,225
%	25	43	84	10	84
OCC TOX(3)	300	32,000	1000	900	16,000
%	37	58	116	13	69

(1) Calculated from chlorine content of compounds listed.
(2) O'Brian and Gere laboratory data.
(3) Occidental Chemical Corporation laboratory data

TABLE 5.2 (Continued)

INORGANIC AND GENERAL PARAMETERS (ug/L)
PART 3

Parameter	OW33	OW35	OW36	OW37	OW38
TOX	457	43,100	1377	1129	13,225
TOC	12,000	350,000	22,000	35,000	80,000
TKN	2700	19,700	2400	2400	14,100
Phosphorus	260	50	2430	1320	50
Mercury				2.3	
Antimony		62			
Arsenic		230	62	56	
Beryllium					
Cadmium		33	8	15	10
Chromium		12		3	20
Copper	9	18	11	9	9
Lead		70			
Nickel	10	108	10	5	29
Selenium					
Silver					
Thallium		89			
Zinc	27	233	31	46	36

APPENDIX C

Detailed Cost Estimates

TABLE C.1

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-1
NO ACTION

ITEM	COMMENTS	COST ($)
SITE WORK	None.	$0
TOTAL CONSTRUCTION COSTS	None.	$0
WORK PLAN	Lump sum.	$50,000
MONITORING COSTS		
Labor	Based on 2 workers, 5 days.	$7,500
Travel, per diem.	Airfare, rental car.	$2,500
Supplies, shipping.	Lump sum.	$2,000
Analyses.	Based on 16 samples, SSI parameters.	$12,800
Health and safety.	Monitoring, PPE.	$2,500
Reporting.	Document, meeting.	$7,500
TOTAL SAMPLING COSTS		$34,800
ANNUAL MAINTENANCE	Continue grass cutting, insp.	$8,000
ANNUAL SAMPLING COSTS	Sampling twice a year.	$77,600
PRESENT WORTH COSTS	Based on 30 years, 5% interest.	$1,192,867
REMEDY REVIEW	Every 5 years, $50,000 ea.	

Year	PWF (5%)
5	0.7835
10	0.6139
15	0.4810
20	0.3769
25	0.2953
30	0.2314
	2.7820

PRESENT WORTH COSTS	$139,100
TOTAL PRES. WORTH COSTS	$1,381,967

TABLE C.2

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2A
UPGRADE FENCE, SECURE CELL

ITEM	COMMENTS	COST ($)
SITE WORK	Lump sum.	$25,000
FENCING		
Upgrade	Assume half length (2250'), $20/ft.	$45,000
Signs	20 @ $25/ea.	$500
SECURE CELL		
Exc., transport soils	Lump sum (300 c.y.)	$15,000
Replace soils	Clean fill, gravel	$5,000
Construct cell	Based on scaled cost for existing spoil cells	$215,000
TOTAL INSTALLED COSTS		$280,500
FACTORED COSTS		
Health & Safety	3% of installed costs	$8,415
	1% of installed costs	$2,805
	20% of installed costs	$56,100
	15% of installed costs	$42,075
TOTAL CONSTRUCTION COSTS		$389,895
MONITORING, REVIEW	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRES. WORTH COSTS		$1,796,862

TABLE C.3

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2B
SECURE CELL, GROUNDWATER TREATMENT, CUTOFF WALL

ITEM	COMMENTS	COST ($)
SITE WORK	Lump sum.	$50,000
GW RECOVERY SYSTEM	From Table C.3.1.	$1,305,468
GW TREATMENT SYSTEM	From Table C.3.2.	$727,632
GW O&M	From Table C.3.3.	$3,435,258
TOTAL GROUNDWATER REMEDIATION COSTS		$5,518,358
CUTOFF WALL	From Table C.3.4.	$2,325,235
FENCING, SECURE CELL	From Alt. OU1-2A (Table C.2)	$390,590
MONITORING	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRES. WORTH COSTS		$9,616,150

TABLE C.3.1

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2B
GROUNDWATER RECOVERY SYSTEM

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
EXTRACTION WELLS				
Installed wells	400	Feet	110	$44,000
Level B contingency	Multiplier		1.5	$22,000
Pumps, controllers	10	Ea.	4000	$40,000
PIPING				
Excavation (Level B)	6000	Feet	7.50	$45,000
Conduit	6000	Feet	6.00	$36,000
CPVC Piping	6000	Feet	9.75	$58,500
Heat tracing	6000	Feet	12.50	$75,000
Insulation	6000	Feet	5.00	$30,000
Manifolding	Multiplier		0.50	$99,750
Manholes @ 100'	60	Ea.	2400	$144,000
Level B contingency	Multiplier		0.50	$72,000
TOTAL INSTALLED COSTS				$666,250
FACTORED COSTS				
Health and safety	3% of installed costs			$19,988
Bonds and insurance	1% of installed costs			$6,663
Contingency	25% of installed costs			$166,563
Eng. and Const. Mgt.	10% of installed costs			$66,625
TOTAL CONSTRUCTION COSTS				$926,088
OPERATIONS & MAINTENANCE				
Electricity (10 hp)	66050	kWh	0.1	$6,605
Maintenance @ 5%				$18,075
Annual costs				$24,680
PWF (30 years, 5%)	15.372			
Present worth costs				$379,381
TOTAL PRES. WORTH COSTS				$1,305,468

References

Means Site Work Cost Data, 1989

TABLE C.3.2

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2B
GROUNDWATER TREATMENT SYSTEM

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
EQUIPMENT				
Equiliz. tank	1	Ea.	10000	$10,000
Pump	1	Ea.	5000	$5,000
M-M filter	1	Ea.	50000	$50,000
Chem. precip. system	1	Ea.	120000	$120,000
GAC system	1	Ea.	150000	$150,000
Sampling station	1	Ea.	2000	$2,000
Total Equip. Costs				$337,000
INSTALLATION				
Electrical	6% of equip. costs			$20,220
Piping	6% of equip. costs			$20,220
Instrumentation	3% of equip. costs			$10,110
ENCLOSURE				
Foundation	30	CY	400	$12,000
Footings				$3,000
Building	750	SF	75	$56,250
FORCE MAIN (SEWER)				
Installed line	1500	LF	21	$31,500
Pumping system	1	EA	15000	$15,000
TOTAL INSTALLED COSTS				$505,300
FACTORED COSTS				
Health and safety	3% of installed costs			$15,159
Bonds, insurance	1% of installed costs			$5,053
Contingency	25% of installed costs			$126,325
Eng./Const. Mgt.	15% of installed costs			$75,795
TOTAL CONSTRUCTION COSTS				$727,632

TABLE C.3.3

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2B
GROUNDWATER TREATMENT OPERATIONS AND MAINTENANCE

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
OPERATIONS				
Energy (20 hp)	132100	kWh	0.1	$13,210
Labor	960	hours	40	$38,400
Chemicals	15000	LS		$15,000
Carbon	27400	lbs	4	$109,600
- 25 mg/l TOC,				
0.1 lb TOC/lb GAC				
Sludge disposal	15000	LS		$15,000
Sewer charges				$7,000
MAINTENANCE				
Based on 5% of installed costs				$25,265
ANNUAL O&M COSTS				$223,475
PWF (30 years, 5%)	15.372			
PRESENT WORTH O&M COSTS				$3,435,258

References

Arthur Young's Wastewater Rates, 1988

TABLE C.3.4

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2B
CUTOFF WALL

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
SITE PREPARATION	1	LS	50000	$50,000
Guardhouse	1	LS	20000	$20,000
Security	5	Months	10000	$50,000
COMPATABILITY TESTING	1	LS	100000	$100,000
GEOTECHNICAL TESTING				
Mobilization.	1	LS	10000	$10,000
Prepare work area.	1	LS	5000	$5,000
Conduct borings.	20	EA	2500	$50,000
Report preparation.	1	LS	8000	$8,000
COFFERDAM				
Mobilization		LS		$25,000
Cofferdam	16500	CY	20	$330,000
New bulkhead	2350	CY	40	$94,000
Dewatering		LS		$20,000
Add'l fill material	19050	CY	10	$190,500
SLURRY WALL				
Mobilization	1	LS	135000	$135,000
Install slurry wall	68000	SF	8	$544,000
QA/QC	1	LS	75000	$75,000
TOTAL INSTALLED COSTS				$1,586,500
FACTORED COSTS				
Health and safety	3% of installed costs			$47,595
Bonds and insurance	1% of installed costs			$15,865
Contingency	25% of installed costs			$396,625
Eng. and Const. Mgt.	10% of installed costs			$158,650
TOTAL PRESENT WORTH COSTS				$2,325,235

TABLE C.4

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2C
UPGRADE FENCE, INCINERATE DIOXIN SOILS

ITEM	COMMENTS	COST ($)
SITE WORK	Lump sum.	$15,000
FENCING		
Upgrade	Assume half length (2250'), $20/ft.	$45,000
Signs	20 @ $25/ea.	$500
INCINERATE AT OCC		
Excavate soils	Lump sum (300 c.y.)	$10,000
Load bags	Labor (2 men, supervisor)	$9,600
Poly bags	Materials: 140 @ $35	$4,900
Transportation	24 loads @ $500	$12,000
Incineration	140 bags @ $750	$105,000
Replace soils	Clean fill, gravel	$5,000
TOTAL INSTALLED COSTS		$192,000
FACTORED COSTS		
Health and safety	3% of installed costs	$5,760
Bonds and insurance	1% of installed costs	$1,920
Contingency	20% of installed costs	$38,400
Eng. and Const. Mgt.	15% of installed costs	$28,800
GROUNDWATER REMEDIATION	From Alt. OU1-2B (Table C.3)	$5,518,358
CUTOFF WALL	From Table C.3.4	$2,325,235
MONITORING	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRES. WORTH COSTS		$9,507,440

TABLE C.5

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2D
PERIMETER AND OFF-SITE SOILS IN SECURE CELL, GROUNDWATER REMEDIATION

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
SITE PREPARATION	1	LS	50000	$50,000
Additional security	1	Month	10000	$10,000
CELL CONSTRUCTION				
Mobilization	1	LS	10000	$10,000
Exc. off-site soils	2300	CY	15	$34,500
Exc. perimeter soils	3500	CY	10	$35,000
Replace soils	5800	CY	12	$69,600
Clay delivered	2500	CY	9	$22,500
Sand delivered	1850	CY	4	$7,400
Loam delivered	1850	CY	6	$11,100
Clay compaction	1600	CY	6	$9,600
Clay - fine compact.	900	CY	18	$16,200
20 mil liner	40000	SF	1	$40,000
10 mil liner	40000	SF	1	$40,000
Sand placement	1850	CY	12	$22,200
40 mil liner	48000	SF	1	$48,000
Loam placement	1850	CY	16	$29,600
Topsoil placement	600	CY	20	$12,000
Vegetation	44	MSF	40	$1,760
Fence replacement	4500	LF	20	$90,000
INSTALLED COST				$409,460
FACTORED COSTS				
Health and Safety	3% of installed costs			$20,473
Bonds, insurance	1% of installed costs			$4,095
Contingency	20% of installed costs			$81,892
Eng./Constr. Mgt.	15% of installed costs			$61,419
TOTAL CELL COSTS				$637,339
GW REMEDIATION/CUTOFF WALL	From Alt. OU1-2B (Table C.3)			$7,843,593
MONITORING	From Alt. OU1-1 (Table C.1)			$1,381,967
TOTAL PRESENT WORTH COSTS				$9,862,899

References

Means Site Work Cost Data, 1989

TABLE C.6

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-2E
STABILIZATION OF PERIMETER AND OFF-SITE SOILS, GROUNDWATER REMEDIATION

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
SITE PREPARATION	1	LS	50000	$50,000
Additional security	1	Month	10000	$10,000
Utilities	1	LS	20000	$20,000
STABILIZATION				
Mobilization	1	LS	35000	$35,000
Exc. off-site soils	2300	CY	15	$34,500
Exc. perimeter soils	3500	CY	10	$35,000
Replace soils	5800	CY	12	$69,600
Stabilization	5800	CY	50	$290,000
Fence replacement	4500	LF	20	$90,000
Analyses	1	LS		$75,000
Air monitoring	2	Months	35000	$70,000
INSTALLED COST				$699,100
FACTORED COSTS				
Health and Safety	3% of installed costs			$34,955
Bonds, insurance	1% of installed costs			$6,991
Contingency	25% of installed costs			$174,775
Eng./Constr. Mgt.	10% of installed costs			$69,910
TOTAL STABIILIZATION COSTS				$1,065,731
SECURE CELL	From Alt. OU1-2D (Table C.5)			$361,900
GW REMEDIATION/CUTOFF WALL	From Alt. OU1-2B (Table C.3)			$7,843,593
MONITORING	From Alt. OU1-1 (Table C.1)			$1,381,967
TOTAL PRESENT WORTH COSTS				$10,653,191

References

Means Site Work Cost Data, 1989

TABLE C.7

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3A
CAP LANDFILL AND PERIMETER SOILS, NO GROUNDWATER REMEDIATION

ITEM	QUANTITY	UNITS	UNIT COST ($)	TOTAL
SITE PREPARATION				
General	Lump sum		50000	$50,000
Site utilities	Lump sum		20000	$20,000
Guardhouse	1	EA	20000	$20,000
Security	6	Months	10000	$60,000
Well abandonment				
- Deep bedrock	1	EA	12000	$12,000
- Bedrock	12	EA	3400	$40,800
- Overburden	102	EA	2240	$228,480
Surveying	Lump sum		20000	$20,000
Fence removal	3100	LF	4	$12,400
Temporary fencing	4800	LF	8	$38,400
Clearing/grubbing	25	AC	2500	$62,500
Tree removal	Lump sum		10000	$10,000
Soil testing	Lump sum		25000	$25,000
CAPPING				
Common fill	180000	CY	10.00	$1,800,000
Select fill	60000	CY	15.00	$900,000
Lowland bulkhead	600	CY	25.00	$15,000
Proof roll site	25	AC	150.00	$3,750
Geotextile cushion	1089000	SF	0.20	$217,800
60 mil HDPE liner	1089000	SF	0.70	$762,300
Drainage net	1089000	SF	0.30	$326,700
Filter fabric	1089000	SF	0.20	$217,800
Treat sub-base	25	AC	1000.00	$25,000
Top soil	20000	CY	16.00	$320,000
Fine grading	25	AC	1500.00	$37,500
Hydromulching	25	AC	1800.00	$45,000
Drainage -north (24")	1600	LF	75.00	$120,000
Drainage (east/west)	1600	LF	20.00	$32,000
Replace fence	4800	LF	20.00	$96,000
Fence gates	4	EA	750.00	$3,000
Equip. decon area	1	EA	50000	$50,000
Monitoring wells				
- Bedrock	4	EA	30000	$120,000
- Overburden	12	EA	6500	$78,000
INSTALLED COST				$5,619,430

TABLE C.7 (Cont.)

FACTORED COSTS		
Health and Safety	3% of installed costs	$168,583
Bonds, insurance	1% of installed costs	$56,194
Contingency	25% of installed costs	$1,404,858
Eng./Constr. Mgt.	10% of installed costs	$561,943
TOTAL CAPPING COSTS		$7,961,008
PRES. WORTH O&M COSTS	From Table C.7.1	$207,522
MONITORING	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRESENT WORTH COSTS		$9,550,497

References

Means Site Work Cost Data, 1989

TABLE C.7.1

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3 OPTIONS
CAPPING MAINTENANCE

ITEM	FREQUENCY	UNIT COST	ANNUAL COST
Fence inspection, repair	Annually	2500	$2,500
Grass cutting	3x/year	2000	$6,000
Drainage inspection, repair	2x/year	2500	$5,000
TOTAL ANNUAL COSTS			$13,500
TOTAL PRESENT WORTH COSTS	PWF = 15.372		$207,522

Remedial period - 30 years
Interest rate - 5%

TABLE C.8

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3B
CAP LANDFILL AND PERIMETER SOILS, CUTOFF WALL, GROUNDWATER REMEDIATION

ITEM	QUANTITY	UNITS	UNIT COST ($)	TOTAL
SITE PREPARATION				
General	Lump sum		50000	$50,000
Utilities	Lump sum		20000	$20,000
Guardhouse	1	EA	20000	$20,000
Security	10	Months	10000	$100,000
Well abandonment				
- Deep bedrock	1	EA	12000	$12,000
- Bedrock	12	EA	3400	$40,800
- Overburden	102	EA	2240	$228,480
Surveying	Lump sum		20000	$20,000
Fence removal	3100	LF	4	$12,400
Temporary fencing	4850	LF	8	$38,800
Clearing/grubbing	25	AC	2500	$62,500
Tree removal	Lump sum		10000	$10,000
Soil testing	Lump sum		25000	$25,000
CAPPING				
Common fill	181000	CY	10.00	$1,810,000
Select fill	62000	CY	15.00	$930,000
Lowland bulkhead	600	CY	25.00	$15,000
Proof roll site	26	AC	150.00	$3,900
Geotextile cushion	1132560	SF	0.20	$226,512
60 mil HDPE liner	1132560	SF	0.70	$792,792
Drainage net	1132560	SF	0.30	$339,768
Filter fabric	1132560	SF	0.20	$226,512
Treat sub-base	26	AC	1000.00	$26,000
Top soil	20700	CY	16.00	$331,200
Fine grading	26	AC	1500.00	$39,000
Hydromulching	26	AC	1800.00	$46,800
Drainage -north (24")	1600	LF	75.00	$120,000
Drainage (east/west)	1650	LF	20.00	$33,000
Replace fence	4800	LF	20.00	$96,000
Fence gates	4	EA	750.00	$3,000
Equipment decon area	1	EA	50000	$50,000
Storm sewer extension	Lump sum			$12,000
Monitoring wells				
- Bedrock	4	EA	30000	$120,000
- Overburden	12	EA	6500	$78,000
INSTALLED COST				$5,749,464

TABLE C.8 (Cont.)

FACTORED COSTS		
Health and Safety	3% of installed costs	$172,484
Bonds, insurance	1% of installed costs	$57,495
Contingency	25% of installed costs	$1,437,366
Eng./Constr. Mgt.	10% of installed costs	$574,946
TOTAL CAPPING COSTS		$8,181,755
PRES. WORTH O&M COSTS	From Table C.7.1	$207,522
GROUNDWATER REMEDIATION	From Alt. OU1-2B (Table C.3)	$5,518,358
CUTOFF WALL	From Table C.3.4	$2,325,235
MONITORING	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRESENT WORTH COSTS		$17,614,837

References

Means Site Work Cost Data, 1989

TABLE C.9

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3C
CAP LANDFILL AND PERIMETER SOILS, CIRCUMFERENTIAL WALL, GROUNDWATER REMEDIATION

ITEM	QUANTITY	UNITS	UNIT COST ($)	TOTAL
SITE PREPARATION				
General	Lump sum		50000	$50,000
Utilities	Lump sum		20000	$20,000
Guardhouse	1	EA	20000	$20,000
Security	12	Months	10000	$120,000
Well abandonment				
- Deep bedrock	1	EA	12000	$12,000
- Bedrock	12	EA	3400	$40,800
- Overburden	102	EA	2240	$228,480
Surveying	Lump sum			$20,000
Fence removal	3100	LF	4	$12,400
Temporary fencing	4850	LF	8	$38,800
Clearing/grubbing	25	AC	2500	$62,500
Tree removal	Lump sum			$10,000
Soil testing	Lump sum			$25,000
CAPPING				
Common fill	181000	CY	10.00	$1,810,000
Select fill	62000	CY	15.00	$930,000
Lowland bulkhead	600	CY	25.00	$15,000
Proof roll site	26	AC	150.00	$3,900
Geotextile cushion	1132560	SF	0.20	$226,512
60 mil HDPE liner	1132560	SF	0.70	$792,792
Drainage net	1132560	SF	0.30	$339,768
Filter fabric	1132560	SF	0.20	$226,512
Treat sub-base	26	AC	1000.00	$26,000
Top soil	20700	CY	16.00	$331,200
Fine grading	26	AC	1500.00	$39,000
Hydromulching	26	AC	1800.00	$46,800
Drainage -north (24")	1600	LF	75.00	$120,000
Drainage (east/west)	1650	LF	20.00	$33,000
Replace fence	4800	LF	20.00	$96,000
Fence gates	4	EA	750.00	$3,000
Equip. decon area	1	EA	50000	$50,000
Storm sewer extension	Lump sum			$12,000
Monitoring wells				
- Bedrock	4	EA	30000	$120,000
- Overburden	12	EA	6500	$78,000
INSTALLED COST				$5,749,464

TABLE C.9 (Cont.)

FACTORED COSTS		
Health and Safety	3% of installed costs	$172,484
Bonds, insurance	1% of installed costs	$57,495
Contingency	25% of installed costs	$1,437,366
Eng./Constr. Mgt.	10% of installed costs	$574,946
TOTAL CAPPING COSTS		$8,201,755
PRES. WORTH O&M COSTS	From Table C.7.1	$207,522
CIRCUMFERENTIAL WALL	From Table C.9.1	$3,775,920
GROUNDWATER REMEDIATION	From Table C.9.2	$3,066,833
MONITORING	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRESENT WORTH COSTS		$16,633,997

References

Means Site Work Cost Data, 1989

TABLE C.9.1

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3C
CIRCUMFERENTIAL WALL

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
SITE PREPARATION	1	LS	50000	$50,000
COMPATABILITY TESTING	1	LS	100000	$100,000
GEOTECHNICAL TESTING				
Mobilization.	1	LS	10000	$10,000
Prepare work area.	1	LS	10000	$10,000
Borings (river)	20	EA	2500	$50,000
Borings (landfill)	30	EA	1000	$30,000
Report preparation.	1	LS	8000	$8,000
COFFERDAM				
Mobilization		LS		$25,000
Cofferdam	16500	CY	20	$330,000
New bulkhead	2350	CY	40	$94,000
Dewatering		LS		$20,000
Add'l fill material	19050	CY	10	$190,500
SLURRY WALL				
Mobilization	1	LS	135000	$135,000
Install slurry wall	161000	SF	8	$1,288,000
QA/QC	1	LS	75000	$75,000
Interception Trench	12500	SF	15	$187,500
Collection sumps	10	EA	2500	$25,000
Pumps (installed)	10	EA	4000	$40,000
TOTAL INSTALLED COSTS				$2,518,000
FACTORED COSTS				
Health and safety	3% of installed costs			$75,540
Bonds and insurance	1% of installed costs			$25,180
Contingency	25% of installed costs			$629,500
Eng. and Const. Mgt.	15% of installed costs			$377,700
TOTAL PRESENT WORTH COSTS				$3,775,920

TABLE C.9.2

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3C
GROUNDWATER COLLECTION AND DISPOSAL

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
EQUIPMENT				
Steel tank (20,000 gal.)	1	LS	35000	$35,000
Resistant coating	850	SF	12	$10,200
Insulation, heating	1	LS	15000	$15,000
Sampling station	1	Ea.	2000	$2,000
Total Equip. Costs				$62,200
INSTALLATION				
Electrical	5% of equip. costs			$3,110
Piping	5% of equip. costs			$3,110
Instrumentation	2% of equip. costs			$1,244
FOUNDATION				
Slab	22	CY	400	$8,800
Footings	1	LS	3000	$3,000
Containment	20	SF	400	$8,000
TOTAL INSTALLED COSTS				$89,464
FACTORED COSTS				
Health and safety	3% of installed costs			$2,684
Bonds, insurance	1% of installed costs			$895
Contingency	15% of installed costs			$13,420
Eng./Const. Mgt.	10% of installed costs			$8,946
TOTAL CONSTRUCTION COSTS				$115,409
OPER. & MAINT COSTS				
Truck transport (5,000 gal.)	190	EA	400	$76,000
Treatment charge	912500	Gallons	0.12	$109,500
Electricity	25000	kWh	0.1	$2,500
Tank insp., repair	1	LS	4000	$4,000
TOTAL ANNUAL COSTS				$192,000
PRES. WORTH ANNUAL COSTS	30 years, 5% = 15.372			$2,951,424
TOTAL PRESENT WORTH COSTS				$3,066,833

TABLE C.10

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3D
CAP OFF-SITE AND PERIMETER SOILS, CIRCUMFERENTIAL WALL, GROUNDWATER REMEDIATION

ITEM	COMMENTS	TOTAL COST
EXC./REP. OFF-SITE SOILS	From Alt. OU1-2D (Table C.5)	$88,319
TOTAL CAPPING COSTS	From Alt. OU1-3C (Table C.9)	$8,201,755
CAPPING O&M COSTS	From Table C.7.1	$207,522
CIRCUMFERENTIAL WALL	From Table C.9.1	$3,775,920
GROUNDWATER REMEDIATION	From Table C.9.2	$3,066,833
MONITORING	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRESENT WORTH COSTS		$16,722,316

TABLE C.11

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3E
CAP OFF-SITE/PERIMETER SOILS, CUTOFF WALL, GROUNDWATER REMEDIATION, NAPL RECOVERY

ITEM	COMMENTS	TOTAL COST
EXCAVATE OFF-SITE SOILS	From Alt. OU1-2D (Table C.5)	$88,319
TOTAL CAPPING COSTS	From Alt. OU1-3B (Table C.8)	$8,181,755
CAPPING O&M COSTS	From Table C.7.1	$207,522
CUTOFF WALL	From Table C.3.4	$2,325,235
GROUNDWATER REMEDIATION	From Table C.3	$5,518,358
NAPL RECOVERY/INCINERATION	From Table C.11.1	$3,615,894
MONITORING	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRESENT WORTH COSTS		$21,319,050

TABLE C.11.1

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3E
NAPL COLLECTION AND TREATMENT

ITEM	QUANTITY	UNITS	UNIT COST	COST ($)
EQUIPMENT				
Extraction wells	10	EA	8000	$80,000
Recovery pumps	10	EA	5000	$50,000
Controllers	10	EA	3000	$30,000
Traced, dbl. wall pipe.	6000	LF	62	$372,000
Air line	1600	LF	25	$40,000
Air source	1	EA	25000	$25,000
Storage tank (5000 gal)	1	EA	15500	$15,500
Coating	362	SF	20	$7,240
Insulation/heating	1	EA	7000	$7,000
Sampling station	1	Ea.	2000	$2,000
Total Equip. Costs				$626,740
INSTALLATION				
Electrical	5% of equip. costs			$31,337
Piping	5% of equip. costs			$31,337
Instrumentation	2% of equip. costs			$12,535
ENCLOSURE				
Foundation (air)	4	CY	400	$1,600
Building	80	SF	75	$6,000
Foundation (storage)	9	CY	400	$3,600
Containment	8	CY	400	$3,200
Footings				$3,000
TOTAL INSTALLED COSTS				$709,549
FACTORED COSTS				
Health and safety	3% of installed costs			$21,286
Bonds, insurance	1% of installed costs			$7,095
Contingency	25% of installed costs			$177,387
Eng./Const. Mgt.	15% of installed costs			$106,432
TOTAL CONSTRUCTION COSTS				$1,021,750

TABLE C.11.1 (Cont.)

ANNUAL O&M COSTS				
Trucking (5000 gal)	4	Loads	5000	$20,000
Analytical	4	Loads	2000	$8,000
Incineration	20000	Gallons	13.50	$270,000
Electricity	66050	kWh	0.10	$6,605
Maintenance, repair	5% of equipment costs			$31,337
Total annual costs				$335,942
Present worth factor	10 years, 5% = 7.722			
PRES. WORTH ANNUAL COSTS				$2,594,144
TOTAL PRESENT WORTH COSTS				$3,615,894

TABLE C.12

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-3F
CAPPING, CIRCUMFERENTIAL WALL, GROUNDWATER REMEDIATION, NAPL RECOVER

ITEM	COMMENTS	TOTAL COST
EXCAVATE OFF-SITE SOILS	From Alt. OU1-2D (Table C.5)	$88,319
TOTAL CAPPING COSTS	From Alt. OU1-3C (Table C.9)	$8,201,755
CAPPING O&M COSTS	From Table C.7.1	$207,522
CIRCUMFERENTIAL WALL	From Table C.9.1	$3,775,920
GROUNDWATER REMEDIATION	From Table C.9.2	$3,066,833
NAPL RECOVERY/INCINERATION	From Table C.11.1	$3,615,894
MONITORING	From Alt. OU1-1 (Table C.1)	$1,381,967
TOTAL PRESENT WORTH COSTS		$20,338,210

TABLE C.13

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5A
INCINERATE ORGANIC AREAS, CUTOFF WALL, GROUNDWATER TREATMENT

ITEM	COMMENTS	QUANTITY	UNITS	UNIT COST	TOTAL
SITE PREPARATION					
General	Access, staging areas	Lump sum		150000	$150,000
Site utilities		Lump sum		50000	$50,000
Guardhouse		1	EA	20000	$20,000
Security	Full-time on-site	54	Months	10000	$540,000
Well abandonment					
- Deep bedrock		1	EA	12000	$12,000
- Bedrock		12	EA	3400	$40,800
- Overburden		102	EA	2240	$228,480
Surveying		Lump sum		20000	$20,000
Permitting	Trial burn plan, delist	Lump sum		150000	$150,000
INCINERATION					
Mobilization	Included				
Decon facility	Lump sum				$700,000
Trial burn	Lump sum				$1,000,000
Standby time	During TBP review	4	Months	500000	$2,000,000
Excavation	Vendor quote	120900	Tons	50.00	$6,045,000
Incineration	Quote, inc. H&S, analyt.	120900	Tons	185.00	$22,366,500
Ash replacement		98400	CY	10.00	$984,000
Air monitoring		36	Months	35000	$1,260,000
INSTALLED COST					$34,806,780
FACTORED COSTS					
Add'l H&S		2% of installed costs			$696,136
Bonds, insurance		1% of installed costs			$348,068
Level B efficiency		30% of installed costs			$10,442,034
Contingency		25% of installed costs			$8,701,695
Eng./Constr. Mgt.		10% of installed costs			$3,480,678
TOTAL INCINERATION COSTS					$59,235,390
CAPPING COSTS	From Alt. OU1-3B (Table C.8)				$8,181,755
CAPPING O&M COSTS	From Table C.7.1				$207,522
GW REMEDIATION/CUTOFF WALL	From Alt. OU1-2B (Table C.3)				$7,843,593
LONG-TERM MONITORING	From Alt. OU1-1 (Table C.1)				$1,381,967
TOTAL PRESENT WORTH COSTS					$77,050,227

TABLE C.13.1

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5A
SENSITIVITY ANALYSIS
INCINERATE ORGANIC AREAS, OFF-SITE LANDFILLING OF INCINERATOR ASH

ITEM	COMMENTS	TOTAL COST
INCINERATION	From Table C.13	$77,050,227
OFF-SITE LANDFILLING	From Table C.13.2	$39,513,296
TOTAL PRESENT WORTH COSTS		$116,563,523

TABLE C.13.2

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5
SENSITIVITY ANALYSIS: OFF-SITE LANDFILLING OF INCINERATOR ASH

ITEM	COMMENTS	QUANTITY	UNITS	UNIT COST ($)	TOTAL
SITE PREPARATION					
Mobilization		Lump sum		50000	$50,000
Access road	To handle 20 CY rolloffs	Lump sum		20000	$20,000
Truck wash	Decon before leaving site	Lump sum		40000	$40,000
LANDFILLING					
Ash handling	Included in OU1-5 estimate	98400	CY	10	($984,000)
Hauling	20 CY, 20 mile radius	4920	Trips	440	$2,164,800
Disposal	Vendor quote	98400	CY	250.00	$24,600,000
Replacement fill	Common fill, delivered	98400	CY	12.00	$1,180,800
INSTALLED COST					$27,945,600
FACTORED COSTS					
Health and safety		3% of installed costs			$1,397,280
Bonds, insurance		1% of installed costs			$279,456
Contingency		25% of installed costs			$6,986,400
Eng./Constr. Mgt.		10% of installed costs			$2,794,560
TOTAL LANDFILLING COSTS					$39,513,296

TABLE C.13.3

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5A
SENSITIVITY ANALYSIS
INCINERATE ORGANIC AREAS, STABILIZE ASH AND PLACE IN ON-SITE RCRA CE

ITEM	COMMENTS	TOTAL COST
INCINERATION	From Table C.13	$77,050,227
STABILIZATION, RCRA CELLS	From Table C.13.4	$18,301,820
TOTAL PRESENT WORTH COSTS		$95,352,047

TABLE C.13.4

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5A
SENSITIVITY ANALYSIS: STABILIZATION OF INCINERATOR ASH, ON-SITE RCRA CELL

ITEM	COMMENTS	QUANTITY	UNITS	UNIT COST ($)	TOTAL
SITE PREPARATION					
Mobilization		Lump sum		50000	$50,000
Access road	To handle 20 CY rolloffs	Lump sum		20000	$20,000
Truck wash	Decon before leaving site	Lump sum		40000	$40,000
STABILIZATION					
Ash handling	Included in OU1-5 estimate	98400	CY	10	($984,000)
Stabilization	Vendor quote	98400	CY	80.00	$7,872,000
Construct RCRA cells	Apportioned estimate	98400	CY	50.00	$4,920,000
INSTALLED COST					$12,902,000
FACTORED COSTS					
Health and safety		3% of installed costs			$645,100
Bonds, insurance		1% of installed costs			$129,020
Contingency		25% of installed costs			$3,225,500
Eng./Constr. Mgt.		10% of installed costs			$1,290,200
TOTAL STABILIZATION COSTS					$18,301,820

TABLE C.14

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5B
INCINERATE ORGANIC AREAS, CUTOFF WALL, GROUNDWATER TREATMENT, NAPL RECOVERY

ITEM	COMMENTS	QUANTITY	UNITS	UNIT COST	TOTAL
SITE PREPARATION					
General	Access, pilings	Lump sum		150000	$150,000
Site utilities	Gas, water, electricity	Lump sum		50000	$50,000
Guardhouse		1	EA	20000	$20,000
Security	Full-time, on-site	54	Months	10000	$540,000
Well abandonment					
- Deep bedrock		1	EA	12000	$12,000
- Bedrock		12	EA	3400	$40,800
- Overburden		102	EA	2240	$228,480
Surveying		Lump sum		20000	$20,000
Permitting	Trial burn plan, delist	Lump sum		150000	$100,000
INCINERATION					
Mobilization	Included				
Trial burn	Lump sum				$1,000,000
Standby time	During TBP review	4	Months	500000	$2,000,000
Excavation	Vendor quote	120900	Tons	50.00	$6,045,000
Incineration	Quote, inc. H&S, analyt.	120900	Tons	185.00	$22,366,500
Ash replacement		98400	CY	10.00	$984,000
Air monitoring		36	Months	35000	$1,260,000
Decon facility		1	EA	700000	$700,000
INSTALLED COST					$34,756,780
FACTORED COSTS					
Add'l H&S		2% of installed costs			$695,136
Bonds, insurance		1% of installed costs			$347,568
Level B efficiency		30% of installed costs			$10,427,034
Contingency		25% of installed costs			$8,689,195
Eng./Constr. Mgt.		10% of installed costs			$3,475,678
TOTAL INCINERATION COSTS					$59,151,390
CAPPING COSTS	From Alt. OU1-3B (Table C.8)				$8,181,755
CAPPING O&M COSTS	From Table C.7.1				$207,522
GW REMEDIATION/CUTOFF WALL	From Alt. OU1-2B (Table C.3)				$7,843,593
NAPL RECOV./INCINERATION	From Alt. OU1-3E (Table C.11.1)				$3,615,894
LONG-TERM MONITORING	From Alt. OU1-1 (Table C.1)				$1,381,967
TOTAL PRESENT WORTH COSTS					$80,382,121

TABLE C.14.1

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5B
SENSITIVITY ANALYSIS
INCINERATE ORGANIC AREAS, OFF-SITE LANDFILLING OF ASH, NAPL RECOVERY

ITEM	COMMENTS	TOTAL COST
INCINERATION	From Table C.14	$80,382,121
OFF-SITE LANDFILLING	From Table C.13.2	$39,513,296
TOTAL PRESENT WORTH COSTS		$119,895,417

TABLE C.14.2

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5B
SENSITIVITY ANALYSIS
INCINERATE ORGANIC AREAS, STABILIZE ASH AND PLACE IN RCRA CELLS

ITEM	COMMENTS	TOTAL COST
INCINERATION	From Table C.14	$80,382,121
STABILIZATION, RCRA CELLS	From Table C.13.4	$18,301,820
TOTAL PRESENT WORTH COSTS		$98,683,941

TABLE C.15

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5C
INCINERATE ORGANIC AREAS TO CLAY/TILL LAYER, CUTOFF WALL, GROUNDWATER TREATMENT

ITEM	COMMENTS	QUANTITY	UNITS	UNIT COST	TOTAL
SITE PREPARATION					
General	Access, staging areas	Lump sum		150000	$150,000
Site utilities		Lump sum		50000	$50,000
Guardhouse		1	EA	20000	$20,000
Security	Full-time on-site	194	Months	10000	$1,940,000
Well abandonment					
- Deep bedrock		1	EA	12000	$12,000
- Bedrock		12	EA	3400	$40,800
- Overburden		102	EA	2240	$228,480
Surveying		Lump sum		20000	$20,000
Permitting	Trial burn plan, delist	Lump sum		150000	$150,000
INCINERATION					
Mobilization	Included				
Decon facility	Lump sum				$700,000
Trial burn	Lump sum				$1,000,000
Standby time	During TBP review	4	Months	500000	$2,000,000
Excavation	Vendor quote	575000	Tons	50.00	$28,750,000
Incineration	Quote, inc. H&S, analyt.	575000	Tons	185.00	$106,375,000
Ash replacement		400000	CY	10.00	$4,000,000
Air monitoring		160	Months	35000	$5,600,000
Dewatering	Cofferdam, pumps, etc.	Lump sum			$10,000,000
INSTALLED COST					$158,876,280
FACTORED COSTS					
Add'l H&S		2% of installed costs			$3,177,526
Bonds, insurance		1% of installed costs			$1,588,763
Level B efficiency		30% of installed costs			$47,662,884
Contingency		25% of installed costs			$39,719,070
Eng./Constr. Mgt.		10% of installed costs			$15,887,628
TOTAL INCINERATION COSTS					$269,072,150
CAPPING COSTS	From Alt. OU1-3B (Table C.8)				$8,181,755
	Add'l fill/cap (from OU2-4)				$1,300,000
CAPPING O&M COSTS	From Table C.7.1				$207,522
GW REMEDIATION/SLURRY WALL	From Alt. OU1-2B (Table C.3)				$7,843,593
LONG-TERM MONITORING	From Alt. OU1-1 (Table C.1)				$1,381,967
TOTAL PRESENT WORTH COSTS					$288,186,987

TABLE C.15.1

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5C
SENSITIVITY ANALYSIS: STABILIZATION OF INCINERATOR ASH, ON-SITE RCRA CELL

ITEM	COMMENTS	QUANTITY	UNITS	UNIT COST ($)	TOTAL
SITE PREPARATION					
Mobilization		Lump sum		50000	$50,000
Access road	To handle 20 CY rolloffs	Lump sum		20000	$20,000
Truck wash	Decon before leaving site	Lump sum		40000	$40,000
STABILIZATION					
Ash handling	Included in OU1-5 estimate	400000	CY	10	($984,000)
Stabilization	Vendor quote	400000	CY	80.00	$32,000,000
Construct RCRA cells	Apportioned estimate	400000	CY	40.00	$16,000,000
INSTALLED COST					$48,110,000
FACTORED COSTS					
Health and safety		3% of installed costs			$2,405,500
Bonds, insurance		1% of installed costs			$481,100
Contingency		25% of installed costs			$12,027,500
Eng./Constr. Mgt.		10% of installed costs			$4,811,000
TOTAL STABILIZATION COSTS					$67,945,100

TABLE 15.2

102nd STREET SITE
NIAGARA FALLS, NEW YORK
OPERABLE UNIT OU1-5C
SENSITIVITY ANALYSIS: OFF-SITE LANDFILLING OF INCINERATOR ASH

ITEM	COMMENTS	QUANTITY	UNITS	UNIT COST ($)	TOTAL
SITE PREPARATION					
Mobilization		Lump sum		50000	$50,000
Access road	To handle 20 CY rolloffs	Lump sum		20000	$20,000
Truck wash	Decon before leaving site	Lump sum		40000	$40,000
LANDFILLING					
Ash handling	Included in OU1-5 estimate	400000	CY	10	($984,000)
Hauling	20 CY, 20 mile radius	20000	Trips	440	$8,800,000
Disposal	Vendor quote	400000	CY	250.00	$100,000,000
Replacement fill	Common fill, delivered	400000	CY	12.00	$4,800,000
INSTALLED COST					$113,600,000
FACTORED COSTS					
Health and safety		3% of installed costs			$5,680,000
Bonds, insurance		1% of installed costs			$1,136,000
Contingency		25% of installed costs			$28,400,000
Eng./Constr. Mgt.		10% of installed costs			$11,360,000
TOTAL LANDFILLING COSTS					$160,286,000

TABLE C.16

102nd STREET SITE
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-1
NO ACTION - RIVER SEDIMENTS

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
SITE WORK	NONE			
EQUIPMENT	NONE			
CONSTRUCTION	NONE			
TOTAL CONSTRUCTION COSTS	NONE			$0
OPERATIONS COSTS				
SEDIMENT MONITORING	Annual event			
Labor	Includes management	5 Days/2 Men		$5,000
Expenses	Boat,Travel,Shipping			$7,000
Analyses	Samples	10	1000	$10,000
Report				$5,000
MAINTENANCE COSTS	NONE			
TOTAL O & M COSTS				$27,000
LIFE OF PROJECT,YEARS	30			
PRESENT WORTH FACTOR (5%)	15.372			
PRESENT VALUE OF O & M				$415,044
TOTAL PRESENT WORTH COSTS				$415,044

TABLE C.17.1

102ND STREET SITE
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-2A
ELEV. CONC.: HYDRAULIC DREDGING/PORTABLE COFFERDAM/CAPPING

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM	Operate for 3 months			
Mobilization/Demobilization				$75,000
Rental	Includes Discounts	1200 LF	$35/LF/MO	$94,500
DREDGING & DEWATERING				
Mobilization	Vendor quote			$290,000
Staging	Vendor quote			$480,000
Processing	Vendor quote	4600 CY	96	$441,600
Health & Safety	Vendor quote			$126,000
Demobilization	Vendor quote			$106,000
TEMPORARY STORM SEWER		150 FT	$100/LF	$15,000
DISPOSAL				
Move Under Cap	Means Cost Data, 1989	4600 CY	16	$73,600
TOTAL INSTALLATION COSTS				$1,701,700
Contingency(20%)				$340,340
Bonds & Insurance(1%)				$17,017
Eng. & Const. Mgt.(15%)				$255,255
TOTAL CONSTRUCTION COSTS				$2,314,312
OPERATIONS COSTS				
SEDIMENT MONITORING	Annual event			
Labor	Includes management	5 Days/2 Men		$5,000
Expenses	Boat,Travel,Shipping			$7,000
Analyses		10 Samples	$1000 ea	$10,000
Report				$5,000
MAINTENANCE COSTS	NONE			
TOTAL O & M COSTS				$27,000
PRESENT VALUE OF O & M	30 year life, 5% interest rate			$415,044
TOTAL PRESENT WORTH COSTS				$2,729,356

TABLE C.17.2

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-2A
ELEV. CONC.: MECHANICAL DREDGING/SHEET PILES/CAPPING

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM				
Construction/Removal	Vendor quote	1200 LF/10' H	$35/SF	$420,000
DREDGING & DEWATERING				
Pump Contained Water				$20,000
Water Treatment- Filt.		500,000 GAL	0.05	$25,000
Carbon			0.10	$50,000
Mechanical Excavation	Vendor quote	4600 CY	50	$230,000
Staging				$50,000
Dewater - Filter Press	Vendor quote			$80,000
TEMPORARY STORM SEWER		150 FT	100	$15,000
DISPOSAL				
Move Under Cap		4600 CY	16	$73,600
TOTAL INSTALLED COST				$963,600
Contingency (20%)				$192,720
Health & Safety (5%)				$48,180
Mobilization (3%)				$28,908
Bonds & Insurance (1%)				$9,636
Eng. & Const. Mgt. (15%)				$144,540
TOTAL CONSTRUCTION COSTS				$1,387,584
OPERATIONS COSTS				
SEDIMENT MONITORING				
Labor	Includes management	5 Days/2 Men		$5,000
Expenses	Boat,Travel,Shipping			$7,000
Analyses		10 Samples	$1000 ea	$10,000
Report				$5,000
MAINTENANCE COSTS	NONE			
TOTAL O & M COSTS				$27,000
LIFE OF PROJECT,YEARS	30			
PRESENT WORTH FACTOR (5%)	15.372			
PRESENT VALUE OF O & M				$415,044
TOTAL PRESENT WORTH COSTS				$1,802,628

TABLE C.18.1

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-2C
ELEV. CONC.: HYDRAULIC DREDGING/PORTABLE COFFERDAM/INCINERATION

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM	Operate for 3 months			
Mobilization/Demobilization				$75,000
Rental	Includes Discounts	1200 LF	$35/LF/MO	$94,500
DREDGING & DEWATERING				
Mobilization	Vendor quote			$290,000
Staging	Vendor quote			$480,000
Processing	Vendor quote	4600 CY	96	$441,600
Health & Safety	Vendor quote			$126,000
Demobilization	Vendor quote			$106,000
TEMPORARY STORM SEWER		150 FT	$100/LF	$15,000
DISPOSAL				
Stage for Incineration	Means Cost Data, 1989	4600 CY	16	$73,600
Incinerate	Re Alt. OU1-5	6440 tons	200	$1,288,000
TOTAL INSTALLED COST				$2,989,700
Contingency (20%)				$597,940
Bonds & Insurance (1%)				$29,897
Engr. & Const. Mgt. (15%)				$448,455
TOTAL CONSTRUCTION COSTS				$4,065,992
OPERATIONS COSTS				
SEDIMENT MONITORING	Annual event			
Labor	Includes management	5 Days/2 Men		$5,000
Expenses	Boat, travel, shipping			$7,000
Analyses		10 Samples	$1000 ea	$10,000
Report				$5,000
MAINTENANCE COSTS	NONE			
TOTAL O & M COSTS				$27,000
LIFE OF PROJECT,YEARS	30			
PRESENT WORTH FACTOR (5%)	15.372			
PRESENT VALUE OF O & M				$415,044
TOTAL PRESENT WORTH COSTS				$4,481,036

TABLE C.18.2

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-2C
ELEV. CONC.: MECHANICAL DREDGING/SHEET PILES/INCINERATION

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM				
Construction/Removal	Vendor quote	1200 LF/10' H	35	$420,000
DREDGING & DEWATERING				
Pump Contained Water				$20,000
Water Treatment- Sand Filt.		500,000 GAL	0.05	$25,000
Carbon			0.10	$50,000
Mechanical Excavation	Vendor quote	4600 CY	50	$230,000
Staging				$50,000
Dewater - Filter Press	Vendor quote			$80,000
TEMPORARY STORM SEWER		150 FT	100	$15,000
DISPOSAL				
Stage for Incineration		4600 CY	16	$73,600
Incinerate		6440 tons	200	$1,288,000
TOTAL INSTALLED COST				$2,251,600
Contingency (20%)				$450,320
Health & Safety (5%)				$112,580
Mobilization (3%)				$67,548
Bonds & Insurance (1%)				$22,516
Eng. & Const. Mgt. (15%)				$337,740
TOTAL CONSTRUCTION COSTS				$3,242,304
SEDIMENT MONITORING	Annual event			
Labor	Includes management	5 Days/2 Men		$5,000
Expenses	Boat, travel, shipping			$7,000
Analyses		10 Samples	$1000 ea	$10,000
Report				$5,000
MAINTENANCE COSTS	NONE			
TOTAL O & M COSTS				$27,000
LIFE OF PROJECT, YEARS	30			
PRESENT WORTH FACTOR (5%)	15.372			
PRESENT VALUE OF O & M				$415,044
TOTAL PRESENT WORTH COSTS				$3,657,348

TABLE C.19.1

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-4
FULL SSI: HYDRAULIC DREDGING/PORTABLE COFFERDAM/EXTEND CAP

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM	Operate for 6 months			
Mobilization/Demobilization				$100,000
Rental	Includes Discounts	2000 LF	$35/LF/MO	$262,500
BULKHEAD				
Construction	Clay - 870 LF,15' W	8700 CY	20	$174,000
	Rip-rap (2'), front face	1300 CY	40	$52,000
DREDGING & DEWATERING				
Mobilization	Vendor Quote			$290,000
Staging	Vendor Quote			$480,000
Processing	Vendor Quote	4600 CY	96	$441,600
Health & Safety	Vendor Quote			$126,000
Demobilization	Vendor Quote			$106,000
EXTEND CAP				
Additional Fill		11,500 CY	12	$138,000
Incremental Cost		2.9 ACRE	SEE OU1-3A	$800,000
EXTEND STORM SEWER	Permanent extension	120 FT	200	$24,000
TOTAL INSTALLED COST				$2,994,100
Contingency (20%)				$598,820
Bonds & Insurance (1%)				$29,941
Eng. & Const. Mgt. (15%)				$449,115
TOTAL CONSTRUCTION COSTS				$4,071,976
OPERATIONS COSTS	NONE			
MAINTENANCE COSTS	NONE			
PRESENT VALUE OF O & M				$0
TOTAL PRESENT WORTH COSTS				$4,071,976

TABLE C.19.2

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-4
FULL SSI: MECHANICAL DREDGING/SHEET PILES/EXTEND CAP

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM				
Construction/Removal	Vendor Quote	1900 LF/10' H	35	$665,000
BULKHEAD				
Construction	Clay - 870 LF,15' W	8700 CY	20	$174,000
	Rip Rap - 2 FT,Front Face	1300 CY	40	$52,000
DREDGING & DEWATERING				
Pump Contained Water				$30,000
Water Treatment- Sand Filters		2MM GAL	0.05	$100,000
Carbon			0.10	$200,000
Mechanical Excavation		15,000 CY	50	$750,000
EXTEND CAP				
Additional Fill		11,500 CY	12	$138,000
Incremental Cost		2.9 ACRE	SEE OU1-3A	$800,000
EXTEND STORM SEWER	Permanent extension	120 FT	200	$24,000
TOTAL INSTALLED COST				$2,933,000
Contingency (20%)				$586,600
Mobilization (3%)				$87,990
Health & Safety (5%)				$146,650
Bonds & Insurance (1%)				$29,330
Eng. & Const. Mgt. (15%)				$439,950
TOTAL CONSTRUCTION COSTS				$4,223,520
OPERATIONS COSTS	NONE			
MAINTENANCE COSTS	NONE			
TOTAL O & M COSTS				
PRESENT VALUE OF O & M				$0
TOTAL PRESENT WORTH COSTS				$4,223,520

TABLE C.20.1

102nd STREET LANDFIL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-6A
FULL SSI: HYDRAULIC DREDGING/PORTABLE
COFFERDAM/CAPPING

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM	Operate for 6 months			
Mobilization/Demobilization				$100,000
Rental	Includes Discounts	1900 LF	$35/LF/MO	$249,375
BERM	For dewatering cell			
Construction	15 feet wide across top	8700 CY	20	$174,000
Removal		8700 CY	10	$87,000
DREDGING & DEWATERING				
Mobilization	Vendor quote			$290,000
Staging	Vendor quote			$480,000
Processing	Vendor quote			$1,800,000
Health & Safety	Vendor quote			$312,000
Demobilization	Vendor quote			$106,000
TEMPORARY STORM SEWER		280 FT	100	$28,000
DISPOSAL				
Move Under Cap	Means Cost Data, 1989	29,200 CY	16	$467,200
TOTAL INSTALLED COST				$4,093,575
Contingency (20%)				$818,715
Bonds & Insurance (1%)				$40,936
Engr. & Const. Mgt. (15%)				$614,036
TOTAL CONSTRUCTION COSTS				$5,567,262
OPERATIONS COSTS	NONE			
MAINTENANCE COSTS	NONE			
PRESENT VALUE OF O & M				$0
TOTAL PRESENT WORTH COSTS				$5,567,262

TABLE C.20.2

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-6A
FULL SSI: MECHANICAL DREDGING/SHEET PILES/CAPPING

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM				
Construction/Removal	Vendor Quote	1900 LF/10' H	35	$665,000
BERM	For dewatering cell			
Construction	15 feet wide across top	8700 CY	20	$174,000
Removal		8700 CY	10	$87,000
DREDGING & DEWATERING				
Pump Contained Water				$30,000
Water Treatment- Sand Filters		2MM GAL	0.05	$100,000
Carbon			0.10	$200,000
Mechanical Excavation		15,000 CY	50	$750,000
TEMPORARY STORM SEWER		280 FT	100	$28,000
DISPOSAL				
Move Under Cap	Means Cost Data, 1989	29,200 CY	16	$467,200
TOTAL INSTALLED COST				$2,501,200
Contingency (20%)				$500,240
Health & Safety (5%)				$125,060
Mobilization (3%)				$75,036
Bonds & Insurance (1%)				$25,012
Eng. & Const. Mgt. (15%)				$375,180
TOTAL CONSTRUCTION COSTS				$3,601,728
OPERATIONS COSTS	NONE			
MAINTENANCE COSTS	NONE			
PRESENT VALUE OF O & M				$0
TOTAL PRESENT WORTH COSTS				$3,601,728

TABLE C.21.1

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-6C
FULL SSI: MECHNICAL DREDGING/SHEET PILES/INCINERATION

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM				
Construction/Removal	Vendor Quote	1900 LF/10' H	$35/CY	$665,000
BERM	For dewatering cell			
Construction	15 foot wide across top	8700 CY	20	$174,000
Removal		8700 CY	10	$87,000
DREDGING & DEWATERING				
Pump Contained Water				$30,000
Water Treatment- Sand Filters		2MM GAL	0.05	$100,000
Carbon			0.10	$200,000
Mechanical Excavation		16,500 CY	50	$825,000
TEMPORARY STORM SEWER		280 FT	100	$28,000
DISPOSAL				
Stage for Incineration	Means Cost Data, 1989	20,500 CY	16	$328,000
Incinerate		28,700 tons	200	$5,740,000
TOTAL INSTALLED COST				$8,177,000
Contingency (20%)				$1,635,400
Health & Safety (5%)				$408,850
Mobilization (3%)				$245,310
Bonds & Insurance (1%)				$81,770
Eng. & Const. Mgt. (15%)				$1,226,550
TOTAL CONSTRUCTION COSTS				$11,774,880
OPERATIONS COSTS	NONE			
MAINTENANCE COSTS	NONE			
PRESENT VALUE OF O & M				$0
TOTAL PRESENT WORTH COSTS				$11,774,880

TABLE C.21.2

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU2-6C
FULL SSI: HYDRAULIC DREDGING/PORTABLE COFFERDAM/INCINERATION

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
COFFERDAM				
Mobilization/Demobilization				$100,000
Rental	Includes discounts	2000 LF	$35/LF/MO	$262,500
BERM				
Construction		8700 CY	20	$174,000
Removal		8700 CY	10	$87,000
DREDGING & DEWATERING				
Mobilization	Vendor quote			$290,000
Staging	Vendor quote			$480,000
Processing	Vendor quote			$1,800,000
Health & Safety	Vendor quote			$312,000
Demobilization	Vendor quote			$106,000
DISPOSAL				
Stage for Incineration		20,500 CY	16	$328,000
Incinerate		28,700 tons	200	$5,740,000
TOTAL INSTALLED COSTS				$9,679,500
Contingency (20%)				$1,935,900
Bonds & Insurance (1%)				$96,795
Engr. & Const. Mgt. (15%)				$1,451,925
TOTAL CONSTRUCTION COSTS				$13,164,120
OPERATIONS COSTS	NONE			
MAINTENANCE COSTS	NONE			
PRESENT VALUE OF O & M				$0
TOTAL PRESENT WORTH COSTS				$13,164,120

TABLE C.22

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU3-2A
HDPE SLIPLINER

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
SITE WORK				
Diversion piping		700 LF	6	$4,200
Diversion pump station	Need for two weeks, 1000 g	Lump sum		$87,000
Temporary wet well				$10,000
Utility connections	Temporary, lump sum			$10,000
Clean sewer	Contractor Estimate			$100,000
EQUIPMENT				
HDPE Pipe		640 LF	77	$49,280
Grout	Remaining Annular Space	1700 CF	20	$34,000
INSTALLATION				
Mobilize Barge	Means Cost Data, 1989			$40,000
Fuse Pipes	Vendor quote			$15,000
Installation	Vendor quote			$30,000
TOTAL INSTALLED COSTS				$379,480
Health & Safety (5%)				$18,974
Bonds & Insurance (1%)				$3,795
Eng. & Const. Mgt. (15%)				$56,922
Contingency (20%)				$75,896
TOTAL CONSTRUCTION COSTS				$535,067
OPER. & MAINT. COSTS				
Sewer inspection every 5 years		Lump sum		$25,000
TOTAL O & M COSTS				$25,000
PRESENT WORTH FACTOR	30 years, every 5 years, 5	2.782		
PRESENT VALUE OF O & M				$69,550
TOTAL PRESENT WORTH COSTS				$604,617

TABLE C.23

102nd STREET LANDFILL
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU3-2B
"INSITUFORM" LINER

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
SITE WORK				
Diversion piping	To control upstream infilt	700 LF	6	$4,200
Diversion pumps		2	1000	$2,000
Portable generator		4 days	500	$2,000
Temporary wet well	Lump sum			$10,000
Clean sewer	Contractor estimate			$100,000
EQUIPMENT & INSTALLATION				
Insituform Liner		640 LF	445	$284,800
TOTAL INSTALLED COSTS				$403,000
Contingency (20%)				$80,600
Health & Safety (5%)				$20,150
Bonds & Insurance (1%)				$4,030
Eng. & Const. Mgt. (15%)				$60,450
Level B (sewer cleaning) (20%)				$80,600
TOTAL CONSTRUCTION COSTS				$648,830
OPER. & MAINT. COSTS				
Sewer inspection every 5 years		Lump sum		$25,000
TOTAL O & M COSTS				$25,000
PRESENT WORTH FACTOR	30 years, every 5 years, 5	2.782		
PRESENT VALUE OF O & M				$69,550
TOTAL PRESENT WORTH COSTS				$718,380

TABLE C.24

102nd STREET SITE
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU3-3A
PLUG STORM SEWER/LIFT STATION/FORCE MAIN

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
SITE WORK				
Utilities (new), access	Lump sum			$20,000
Utilities (relocating)	Lump sum			$100,000
EQUIPMENT				
Mobilization	Lump sum			$25,000
Lift station	Reference below	26,000 gpd	Lump sum	$673,000
Force main	Reference below	1300 LF	275	$357,500
PLUG SITE SEWER	Pressure grout entire length	6200 CF	20	$124,000
TOTAL INSTALLED COSTS				$1,299,500
FACTORED COSTS				
Health & Safety (5%)				$64,975
Bonds & Insurance (1%)				$12,995
Eng. & Const. Mgt. (15%)				$194,925
Contingency (20%)				$259,900
TOTAL CONSTRUCTION COSTS				$1,832,295
OPERATIONS COSTS				
Power	45 hp used 35% of the time			$10,403
MAINTENANCE COSTS	Set at 5% of installed costs			$64,975
TOTAL O & M COSTS				$75,378
PRESENT WORTH FACTOR	30 year lifetime, 5%	15.372		
PRESENT VALUE OF O & M				$1,158,710
TOTAL PRESENT WORTH COSTS				$2,991,005

References

"Innovative and Alternative Technology Assessment" (EPA, 1980)
Engineering News Record cost factors

TABLE C.25

102nd STREET SITE
NIAGARA FALLS, NEW YORK
ALTERNATIVE OU3-3B
EXCAVATE STORM SEWER/LIFT STATION/FORCE MAIN

ITEM	COMMENTS	QUANTITY	UNIT COST	TOTAL($)
SITE WORK				
Utilities (new), access	Lump sum			$20,000
Utilities (relocating)	Lump sum			$100,000
EQUIPMENT				
Mobilization	Lump sum			$25,000
Lift station	Reference below	26,000 gpd	Lump sum	$673,000
Force main	Reference below	1300 LF	275	$357,500
EXCAVATE SITE SEWER				
Excavate		2300 CY	50	115000
Backfill		2300 CY	15	34500
Sizing		2300 CY	20	46000
Incineration	In conjunction with Alt. OU1-5	2600 tons	200	520000
Level B contingency	Loss in efficiency, etc.	Multiplier	1.3	930150
TOTAL INSTALLED COSTS				$2,821,150
FACTORED COSTS				
Health & Safety (5%)				$141,058
Bonds & Insurance (1%)				$28,212
Eng. & Const. Mgt. (15%)				$423,173
Contingency (20%)				$564,230
TOTAL CONSTRUCTION COSTS				$3,977,822
OPERATIONS COSTS				
Power	45 hp operated 35% of the time			$10,403
MAINTENANCE COSTS	Set at 5% of equipment costs			$52,775
TOTAL O & M COSTS				$63,178
PRESENT WORTH FACTOR	30 year lifetime, 5%	15.372		
PRESENT VALUE OF O & M				$971,171
TOTAL PRESENT WORTH COSTS				$4,948,993

References

"Innovative and Alternative Technology Assessment" (EPA, 1980)
Engineering News Record cost factors

APPENDIX D

Groundwater Gradient Control Calculations

```
/-----------------------------------------------------------------\
/PROJECT - 102ND ST. LANDFILL, NIAGARA FALLS, NEW YORK             \
/JN G-8217                                                          \
/WORKSHEET 1                  RUN-NO:          4                     \
/DLH, 16 OCTOBER 1989         FILENO:   8217LF-4.WK1                  \
/TEMPLATE:8217GWIT.WK1        DATE:     16 OCT 89                      \
/=================================================================\
/SUMMARY WORKSHEET FOR CALCULATION OF SHALLOW GROUNDWATER FLOW       \
/  IN AQUIFER AT SOUTH AND WEST SIDES OF THE LANDFILL                 \
/-----------------------------------------------------------------\
/INPUT SET FOR RECHARGE TO LANDFILL ------------------------------\
/          RECHARGE RATE (CM/S) ----------------- 1.00E-07 -------\
/          FACILITY AREA (ACRES) ----------------       27 -------\
/    HYDRAULIC RECHARGE RATE (CALC) ============> 3.45E+06 (L/YR) \
/                                                 2.49E+03 (GPD)   \
/                                                                   \
/INPUT SET FOR AQUIFER FLOW FROM UPGRADIENT ----------------------\
/          HYDRAULIC CONDUCTIVITY (CM/S) -------- 1.00E-07 -------\
/          GRADIENT (E.G. 0.001) ----------------    0.009 -------\
/          INDUCED DRAWDOWN DEPTH (FT) ----------        5 -------\
/          UPGRADIENT WINDOW LENGTH (FT) --------     2700 -------\
/    AQUIFER FLOW RATE (CALC) ==================> 3.56E+02 (L/YR) \
/                                                 2.58E-01 (GPD)   \
/                                                                   \
/INPUT SET FOR INDUCED BACKFLOW FROM DOWNGRADIENT ----------------\
/          HYDRAULIC CONDUCTIVITY (CM/S) -------- 1.00E-07 -------\
/          BACKGRADIENT (E.G. 0.001) ------------      0.2 -------\
/          INDUCED DRAWDOWN DEPTH (FT) ----------        5 -------\
/          BACKGRADIENT WINDOW LENGTH (FT) ------     2700 -------\
/    AQUIFER FLOW RATE (CALC) ==================> 7.91E+03 (L/YR) \
/                                                 5.73E+00 (GPD)   \
/                                                                   \
/TOTAL INFLOW (= EXTRACTION FLOW)                ******************
/          (CALC) ============================> * 3.45E+06 (L/YR) *
/                                               * 2.50E+03 (GPD)  *
/                                               ******************
/-----------------------------------------------------------------\
/COMMENTS:                                                          \
/This scenario predicts leakage and aquifer through-flow based on   \
/the following assumptions:                                          \
/          Recharge rate at 1E-07 cm/s for cap.                       \
/            (Actually only when moisture available via precip).      \
/          Facility Area = 27 Acres based on DLH estimate.              \
/          Horizontal Ksat for slurry wall = 1E-07 cm/s.                 \
/          DownGradient = 0.009 per Fill in RI.                           \
/          UpGradient = 0.20 per 5 ft./25 ft. arbitrary.                   \
/          Mixing Depth = 564 river elev. - 5 ft.                           \
/          Downgradient Window Length on S+W=900+1850 ft.                    \
/                                                                            \
/                                                                            \
/                                                                            \
/                                                                            \
/                                                                            \
/-----------------------------------------------------------------\
```

```
PROJECT - 102nd ST. LANDFILL, NIAGARA FALLS, NEW YORK
JN G8217.00
WORKSHEET L-1                        RUN-NO:
DLH, 16 OCT 89                       FILENO:   8217-LK1.WK1
TEMPLATE:9200LKT2.WK1                DATE:     16 OCT 89
=======================================================================
CALCULATION OF LEAKAGE RATE THROUGH FML/SOIL COMPOSITE PER GIROUD, ETC
-----------------------------------------------------------------------
EQUATION FORM   FLOW = (CONSTANT) * (AREA TO A POWER) *
                       (HEAD TO A POWER) * (CONDUCTIVITY TO A POWER)

REFERENCE BONAPARTE ET AL. PAPER, "RATES OF LEAKAGE THROUGH
          LANDFILL LINERS", GEOSYNTHETICS '89 CONFERENCE.

EQUATION (2)    Q = 0.21*(A^0.1)*(H^0.9)*(Ks^0.74)

EQUATION (3)    Q = 1.15*(A^0.1)*(H^0.9)*(Ks^0.74)  *

EQUATION (4)    Q = 3.0*(A^0.75)*(H^0.75)*(Kd^0.5)
-----------------------------------------------------------------------
INPUT SET FOR LEAKAGE RATE PER GIROUD EMPIRICAL FORMULA (& VARIATIONS)

          CONSTANT                      1.15
          AREA (SQ.M.)                0.0001  0.0001       1 (SQ.CM.)
          AREA EXPONENT                 0.10  0.0000
          CONDUCTIVITY (M/S)         1.0E-09 1.0E-09 1.0E-07 (CM/S)
          COND. EXPONENT                0.74 0.0E+00
          HEAD (M)                    0.0300  0.0300       3 (CM)
          HEAD EXPONENT                 0.90  0.0000
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
          LEAKAGE RATE Q (cu.m./s) 4.27E-09
          LEAKAGE RATE Q (L/d)     3.69E-01
          LEAKAGE RATE Q (gpd)     9.74E-02
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
TOTAL LEAKAGE RATE (gpd)
                        HOLE FREQUENCY
                        --------------------
                AREA    1 / ACRE  10 / ACRE
               (ACRES)  --------------------
                   1           0          1
                  27           3         26
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
COMMENTS: Based on 1 cm hole size, soil conductivity of 1E-07 cm/s
          (per clay cap permeability), 3 cm head, landfill area of 27
          acres, hole frequency per table, and per equation 3.

          This model estimates the volume of flow (leakage) through a
          flexible membrane assuming a certain size and frequency of
          holes as may be expected due to ordinary installation
          practices.  Note that leakage will occur as function of
          precipitation available for infiltration.

          Note annual precipitation is 104,146 gpd (3720 gpd/ac).
-----------------------------------------------------------------------
```

PROJECT - 102nd ST. LANDFILL, NIAGARA FALLS, NEW YORK
JN G8217.00

WORKSHEET L-2	RUN-NO:
DLH, 16 OCT 89	FILENO: 8217-LK2.WK1
TEMPLATE:9200LKT2.WK1	DATE: 16 OCT 89

==

CALCULATION OF LEAKAGE RATE THROUGH FML/SOIL COMPOSITE PER GIROUD, ETC

EQUATION FORM FLOW = (CONSTANT) * (AREA TO A POWER) * (HEAD TO A POWER) * (CONDUCTIVITY TO A POWER)

REFERENCE BONAPARTE ET AL. PAPER, "RATES OF LEAKAGE THROUGH LANDFILL LINERS", GEOSYNTHETICS '89 CONFERENCE.

EQUATION (2) Q = 0.21*(A^0.1)*(H^0.9)*(Ks^0.74)

EQUATION (3) Q = 1.15*(A^0.1)*(H^0.9)*(Ks^0.74) *

EQUATION (4) Q = 3.0*(A^0.75)*(H^0.75)*(Kd^0.5)

INPUT SET FOR LEAKAGE RATE PER GIROUD EMPIRICAL FORMULA (& VARIATIONS)

CONSTANT	1.15			
AREA (SQ.M.)	0.0001	0.0001	1	(SQ.CM.)
AREA EXPONENT	0.10	0.0000		
CONDUCTIVITY (M/S)	1.0E-06	1.0E-06	1.0E-04	(CM/S)
COND. EXPONENT	0.74	0.0E+00		
HEAD (M)	0.0300	0.0300	3	(CM)
HEAD EXPONENT	0.90	0.0000		

- -

LEAKAGE RATE Q (cu.m./s)	7.08E-07
LEAKAGE RATE Q (L/d)	6.12E+01
LEAKAGE RATE Q (gpd)	1.62E+01

- -

TOTAL LEAKAGE RATE (gpd)

AREA (ACRES)	HOLE FREQUENCY 1 / ACRE	10 / ACRE
1	16	162
27	436	4364

- -

COMMENTS: Based on 1 cm hole size, soil conductivity of 1E-04 cm/s (per fill permeability), 3 cm head, landfill area of 27 acres, hole frequency per table, and per equation 3.

This model estimates the volume of flow (leakage) through a flexible membrane assuming a certain size and frequency of holes as may be expected due to ordinary installation practices. Note that leakage will occur as function of precipitation available for infiltration.

Note annual precipitation is 104,146 gpd (3720 gpd/ac).

APPENDIX E

Incinerator Sound Intensity Calculations

INCINERATOR SOUND INTENSITY CALCULATIONS

Basis

1. Incinerator located on Griffon Park per Figure 7.9.

2. Sound intensity at 3 feet from incinerator is 107dB (OCC, 1989).

3. Distance to Cayuga Island is approximately 400 feet (Figure H.1).

Calculations

β_1 = Sound intensity @ Cayuga Island
β_2 = Sound intensity @ 3 feet from incinerator (107dB)
r_1 = Distance of B_1 from source (400')
r_2 = Distance of B_2 from source (3')

$$\beta_2 - \beta_1 = 10 \log_{10} \frac{r_1^2}{r_2^2}$$

$$107 - \beta_1 = 10 \log_{10} \frac{(400)^2}{(3)^2} = 42.5$$

$$\beta_1 = 65 \text{ dB}$$

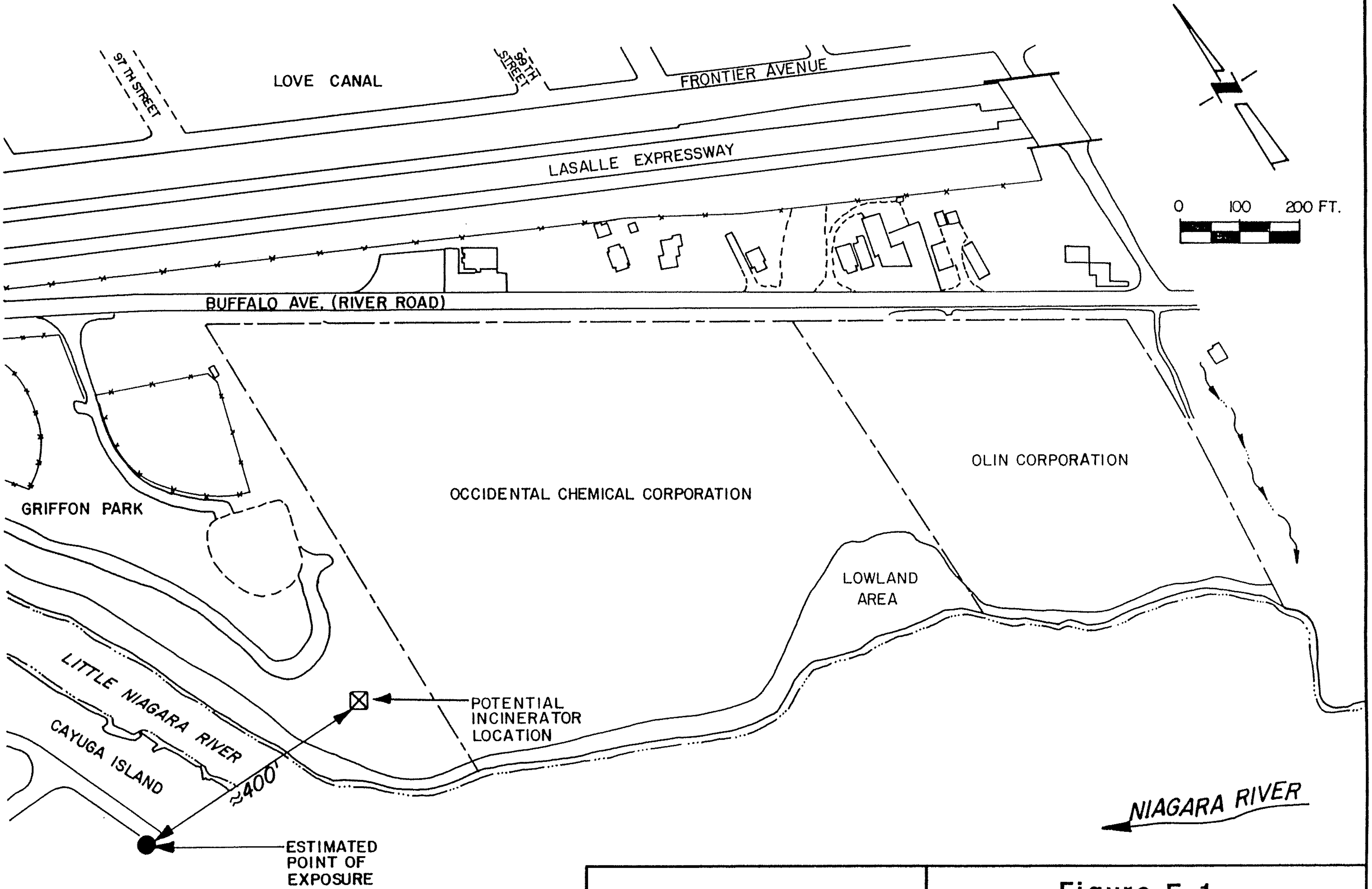
This is equal to the City of Niagara Falls noise ordinance. With a set back of 10 dB at night, the incinerator may exceed community standards. [NOTE: A limit of 65 dB is high for a residential community at night (usu. 45-50 dB).]

Ambient noise levels in a normal suburban residential setting are approximately 43 dB (Community Noise Control, undated). EPA generally applies a 10 dB setback (LDN) at night to account for lower ambient levels and a heightened perception of noise. The average night time noise level on Cayuga Island would therefore be approximately 33 dB. The difference between the incinerator level and ambient conditions would be 32 dB. Since the decibel scale is logarithmic, the increase in sound intensity would be:

$$\text{dB} = 10 \log_{10} \frac{\text{Noise from incinerator}}{\text{Ambient noise}} = 10 \log_{10} \frac{Ni}{Na}$$

$$\frac{Ni}{Na} = 10^{(\text{dB}/10)} = 10^{(32/10)} = 1,585$$

The increase in noise level on Cayuga Island at night due to the incinerator would be approximately 1,600 times the current level.



LEGEND

— — — Property Line

SIRRINE ENVIRONMENTAL CONSULTANTS
Greenville, South Carolina

Figure E.1

Proximity of Incinerator to Cayuga Island

SOURCE: CRA/WCC, 1988

APPENDIX F
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