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P. Bucchi

Love Canal Remedial Design

Black and Bergholtz Creeks Remediation

Removal/Destruction/Disposal
of Creek and Sewer Sediments

City of Niagara Falls, New York

Conceptual Design Report

Prepared for:

New York State
Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Thomas C. Jorling, Commissioner

Division of Solid and Hazardous Waste
Norman H. Nosenchuck, P.E. Director

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TAMS CONSULTANTS, Inc.

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PRELIMINARY REMEDIAL DESIGN REPORT FOR REMOVAL/DESTRUCTION/DISPOSAL OF CREEK AND SEWER SEDIMENTS AT LOVE CANAL

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I. INTRODUCTION

Authorization

By letter dated 27 July 1987, attached as Appendix A, the New York State Department of Environmental Conservation (NYSDEC) requested TAMS to prepare a preliminary design report addressing the entire scope of the Black and Bergholtz Creek remediation and sewer sediment cleanup from waste removal through thermal treatment to final disposition. The work has been authorized under Supplemental Agreement under Contract No. D001339 for the remediation of Black and Bergholtz Creeks, Niagara Falls, New York.

Background and Scope

In 1985, the Environmental Protection Agency (EPA) issued a report entitled "Love Canal Sewers and Creeks Remedial Alternatives Evaluation and Risk Assessment." That report recommended the removal and interim storage of dioxin contaminated sediments found in the storm and sanitary sewers and Black and Bergholtz Creeks. Since at that time, no viable alternative for destruction or disposal of the sediments existed, they were to be stored in an interim containment facility (ICF) to be constructed at Love Canal proper. As it was also determined that staging of the material was necessary and dewatering of the sediments prior to final thermal treatment would be beneficial in any event, the ICF would be utilized as a dewatering containment facility.

The interim containment facility (ICF) 1/ was designed to meet the substantive requirements of all Federal and NYS environmental statutes for hazardous waste treatment storage and disposal facilities. The facility design and details of creek remediation are presented in the TAMS May 1987, 95% contract documents submission.

In June 1987, EPA issued a feasibility study entitled "Alternatives for Destruction/Disposal of Love Canal Creek and Sewer Sediments." This report, a supplement to the 1985 report, identified three major remedial alternatives for final destruction/disposal of the wastes at Love Canal: (1) On-site land disposal of all waste, (2) on-site thermal destruction of waste/on-site disposal and (3) on-site thermal destruction of waste/off-site disposal of residuals.

In August 1987, EPA issued a report entitled "Proposed Plan for Destruction/Disposal of Love Canal Creek and Sewer Sediments", which was based on the feasibility study issued in June 1987. This Proposed Plan recommended Alternative 2- on-site thermal destruction of waste/on-site disposal for final disposition of the creek and sewer sediments. The proposed plan will be finalized based on a full consideration of public comments received at the public meeting on August 25 and in writing.

The scope of this report is to evaluate and describe the integration of the current Black and Bergholtz Creek remediation project with the thermal destruction of the wastes to be stored in the Dewatering Containment Facility (DCF) at the Love Canal site. The report also describes options to the Proposed Plan which merit consideration. Figure 2 illustrates the general Flow Path for the combined project.

1/The interim facility was referenced to in the 95% contract documents as an Interim Containment Facility. In this discussion, based upon the intent of the EPA Proposed Plan for Destruction/ Disposal of Love Canal Creek and Sewer Sediments, the term Dewatering Contaiment Facility (DCF) has been adopted.

II. EPA PROPOSED PLAN

The EPA Proposed Plan for site cleanup (attached as Appendix B) provides a description of key project components, operational and timing considerations and estimated capital and operating costs. The proposed plan is subject to revisions based on public comment.

In brief, the EPA plan proposes:

- Removal of Black and Bergholtz Creek sediments to the limits shown on the 95% Contract Documents submitted by TAMS in May, 1987;
- Construction of a Dewatering Containment Facility (DCF) for temporary storage and dewatering of creek and sewer sediments;
- Construction of a Construction/Demolition Debris Facility (CDDF) for basement debris and other reportedly non-hazardous wastes excavated during remedial construction.
- Thermal treatment of sediments containing greater than 1 ppb of dioxin via an on-site Thermal Destruction Facility (TDF) per criteria of Center for Disease Control (CDC).
- Disposal of TDF residuals in the DCF or elsewhere on-site; sediments not requiring thermal treatment would be contained in the DCF.

It is the objective of the proposed plan to thermally treat sediment containing average dioxin contaminations greater than 1 ppb (1 ppb is a level prescribed by the Center For Disease Control as a level of concern for dioxin in residential soils) if it is technically feasible to separate sediments having less than 1 ppb contamination from sediments having greater than 1 ppb contamination. To comply with the Superfund Amendment and Reauthorization Act (SARA) and all "applicable, relevant and appropriate requirements" (ARAR's) a six 9's destruction and removal efficiency (DRE) would be required. This DRE would provide the performance standard for measuring the capability of the thermal destruction unit to produce delisted waste. This DRE level has been demonstrated for dioxin contaminated soils as discussed in Section VII of this report.

III. WASTE MATERIALS REQUIRING REMOVAL/DESTRUCTION/DISPOSAL

Creek Remediation (1985 Record of Decision - ROD)

The materials which require storage and/or thermal treatment will come from four sources: (1) creek and sewer remediation; (2) excavation and backfilling for the construction and filling of the DCF, CDDF and DDSF; (3) on-site storage of wastes generated by other remediation activities; and (4) residuals from thermal treatment. The tabulation below presents an estimate of the volume to be stored/treated to implement the Remedial Design as stipulated in the 1985 Record of Decision.

Quantities of Soil/Sediment/Debris

Activity	Waste Stream Generated	Quantity (cubic yards)	Remarks
Creek Remediation	Creek Sediments	15,000	-
	Creek haul roads, access and staging areas	6,500	
DCF/CDDF	Excavation	2,400	CDDF to be constructed as a compartment of the DCF.
	Haul Road Fill	800	
	Basement Debris	4,000	
	Daily Cover	6,000	
	DCF Drainage Blanket	2,500	
DDSF	Excavation and Debris	1,500	
On-Site Storage	Drums	1,200	
	Sewer Sediment	1,000	

TDF Residuals	Ash (soil-like)	-	Quantity dependent on total volume requiring thermal treatment.

The above volumes would result if creek remediation were carried out in accordance with the 1985 ROD; however, the objective of the proposed EPA plan is to thermally treat only those sediments contaminated with an average dioxin concentration of greater than 1 ppb if separation is practical. To meet this objective and to reduce the quantity of material requiring high cost thermal treatment, a re-evaluation of waste generation from creek remediation activities was performed.

Minimization of Quantities to be Stored and Treated

To implement creek remediation, access and haul roads are needed. Engineering studies have shown that creek haul roads should be comprised of stone, underlain by and combined with geotextiles, due to the low bearing strength of the creek bed sediments. The materials used in the haul road construction will come in direct contact with the contaminated creek sediments and therefore must be considered as potentially contaminated materials.

To minimize the amount of haul road material to be either stored or thermally treated, the following measures should be considered:

- o Construct the creek haul roads as close to the banks (but within the remediation zone) as feasible. Sediments may have their highest bearing strength (and possibly lowest moisture content) along the banks, which will minimize the lateral and vertical displacement of the creek sediments during access road construction, excavation and hauling.

- o Maximize the stone size to be used. Large size stones (12-inch shot rock) could directly overlie the geotextile, and, in turn, would be overlain by smaller size gravel or ballast.

- Reuse stone in successive creek reaches to the greatest extent possible to minimize the total volume of stone subject to potential contamination.

- Permit hydraulic "scalping" of the stone at the dewatering facility to clean the stone of its fine grained soil coating (and potential dioxin contamination) and permanently dispose of the cleaned stone in the Construction/Demolition Debris Facility (assumed non-hazardous). The removed soil coating and the smaller size stone (say less than 3-inches) which can not be effectively cleaned should be stored in the DCF for thermal destruction (assumed hazardous).

Incorporating the above measures could reduce the original estimated 6,500 cubic yards generated, to 4,000 cubic yards with the re-use option. Furthermore, hydraulic "scalping" would reduce to 2,000 cubic yards (smaller size stone) the amount requiring for thermal treatment.

It is estimated that approximately 6,000 cubic yards of daily soil cover would be required to minimize environmental impacts of waste storage operations at the DCF. Placement of the cover material would be performed by berm based construction equipment, such as a dragline, due to the expected soft and wet nature of the material being filled into the storage facility. The cover material would require thermal treatment since there is considered to be no practical construction methodology to separate this material from the contaminated sediments.

Elimination of this quantity of material in its entirety could be achieved by the use of stabilizing foam. Use of such foam will prevent particulate and odor emission problems. The foam will evaporate in a one to two week period, and would be applied/re-applied as required at the DCF and stockpiling sites.

TAMS is further investigating the options presented above during completion of the 100 percent Contract Documents. Implementation of these measures could result in the following quantities of soil/sediment/debris.

Quantities of Soil/Sediment/Debris
(considering minimization)

Activity	Waste Stream Generated	Quantity (cubic yards)	Remarks
Creek Remediation	Creek Sediments	15,000	-
	Creek haul roads, access and staging areas	2,000	
DCF/CDDF	Excavation	2,400	CDDF to be constructed as a compartment of the DCF.
	Haul Road Fill	800	
	Basement Debris	4,000	
	Daily Cover	0	
	DCF Drainage Blanket	2,500	
DDSF	Excavation and Debris	1,500	
On-Site Storage	Drums	1,200	
	Sewer Sediment	1,000	
TDF Residuals	Ash (soil-like)	-	Quantity dependent on total volume requiring thermal treatment.

Treatment Options

As stated in the EPA Proposed Plan, the major operational consideration of the project is what sediments to treat thermally. The plan for thermal treatment considers: 1) thermal treatment of those sediments that test for greater than 1 ppb of dioxin contamination and 2) thermal treatment of all sediments contained within the DCF if separation of sediments below 1 ppb from those above 1 ppb is not practical.

Thermal treatment of those sediments contained within the DCF that test for greater than 1 ppb of dioxin contamination after containment would be difficult. The sediments to be excavated from the creeks and deposited within the DCF will be "soft and runny" even after gravity separation of free water. It would be impractical to separate this soft and runny creek bottom material within the DCF, until the results of analytical tests are evaluated, to determine whether removal and thermal treatment is required. Furthermore, there remains the possibility of cross-contamination following sampling due to settling out of potentially contaminated suspended solids from an aqueous layer which may be generated during filling operations.

Removal of material from the creek in a controlled manner (i.e. 6" increments) would slow excavation production rates. Because only 6 months within 1989 are allotted for this activity, slower excavation could hinder the completion of excavation in one season. Furthermore, filling of the DCF with sediments would need to be controlled so that sampling can occur concurrently with filling of undesignated sediments. This filling method presents a severe restriction on the Contractor's operations

The option for thermal treatment of all creek sediments would be based on existing data and considerations other than engineering. No detailed analysis or design can be performed to show that such implementation is warranted due to the lack of adequate data or precision with regard to previous testing of the sediments. This is the most costly option to implement because of the high estimated cost of thermal destruction. If this option were chosen, it is likely that the activities presented in the Proposed Plan can be achieved in accordance with the plan schedule. In addition, the Contract Documents for the Black and Bergholtz Creek Remediation prepared by TAMS require only minor modification to account for waste generation minimization.

A third option not addressed in the EPA Proposed Plan is a complete re-characterization of the creek sediments for dioxin in-situ. Those sediments containing greater than 1 ppb of dioxin which would require thermal treatment could be handled separately prior to placement in the DCF from those containing less than 1 ppb of dioxin.

This re-characterization should be done before the material is placed in the DCF, either as it is excavated from the creeks or in situ, before it is excavated. Re-characterization during excavation would be carried out by placing the excavated creek sediments in temporary storage containers and staging the material. Each storage container would be sampled and tested to determine its contamination level. Based on the results of this testing the materials would be deposited in segregated compartments of the DCF. This method however appears to be impractical and expensive because of the large temporary staging area required, the number of containers needed and the inability to predict size and design of the various components of the DCF which might be required.

The objective of re-characterization of creek sediments in situ would be to isolate zones of contamination above and below 1ppb prior to removal. A sampling effort to delineate these zones would need to be developed, implemented and evaluated in accordance with protocols. The development of this in situ plan would require statistical studies and until these statistical studies can be performed assume that 10 random samples per 100 cubic yards of in-situ sediment, or a total of 1000 samples, could be required for analytical testing. It would take approximately 9 months (by June 1988 assuming a September 1987 initiation) to evaluate, report and decide on material excavation requirements based on these samples. Full implementation of a program of this type could cost 0.5 to 1.0 million dollars. Since it is assumed in the EPA Proposed Plan that all creek sediments will require removal from the creeks, the award and construction of DCF as presented in the 95% Contract Documents can proceed in 1988 as a separate contract from creek remediation, in accordance with the Proposed Plan time schedule.

IV. CREEK SEDIMENT REMOVAL

The excavation of the creeks will be in accordance with the 1985 ROD and associated requirements of NYSDEC. Excavation requirements are shown on the 95% Design Plans, and include 18-inches of creek bed material and a minimum of 6 inches of creek bank material to El.566; the project limits include:

- o Bergholtz Creek: From 150 feet upstream of the confluence with Black Creek to its confluence with Cayuga Creek;
- o Black Creek: From the 98th Street culverts to its confluence with Bergholtz Creeks.

Drawing 1 presents an overall site plan of the remediation area.

Site Zones/Access/Preparation

An exclusion zone will be established by erection of a chain-link security fence to enclose all creek remediation site activities. Within this zone will be a secondary zone or Remediation Zone defined by temporary fencing within which all excavation activities will occur. The only activities permitted outside the remediation zone, but within the exclusion zone, would be stockpiling of excavated materials for dewatering prior to placement within the DCF and decontamination facilties.

Site access will be through vehicle gates within the Exclusion Zone fence. All vehicles will exit through the gates following decontamination. Access to the creeks will be limited to 3 or 4 locations.

The Contractor's trailers, equipment storage areas, laydown areas, etc. will be confined to the Exclusion Zone. Clearing, access road construction, preparation of stockpile or dewatering areas will occur within the Exclusion Zone, but outside of the Remediation Zone during the first construction season. Within the Remediation Zone similar activities including tree and debris removal will also be performed as required during the second construction season. Non-hazardous wastes such as trees and vegetation which have been cleared and grubbed, and those which have not come in contact with excavated contaminated creek sediments could be disposed off-site. However, no off-site facility may be willing to accept these items. Other trees and debris which are considered to be contaminated shall be filled in the DCF. Efforts should be made to localize the placement of this material in the DCF so as not to interfere with excavation and feed preparation activities prior to thermal treatment. It is proposed by this study, that all access road material which can not be effectively decontaminated by hydraulic "scalping" at the NYSDEC dewatering facility or other facility, (i.e., 3-inch sizes or less) will be placed into the DCF for thermal treatment.

Surveys

Before beginning work within the Remediation Zone (except construction of cofferdams and dewatering operations), a survey of the creek beds will be performed at 50-foot centers and at intermediate locations deemed necessary. Survey results and final creek profiles will be plotted by the Contractor. As soon as practicable after excavation, the Contractor will resurvey the excavated creek bottom for determination of under- and over-excavation. To help minimize the amount of material requiring storage and thermal destruction, the maximum deviation permitted during excavation in the beds is 3 inches.

Creek Diversion and Cofferdams

In order to remove creek materials in a relatively dry workplace, a diversion system comprised of cofferdams, pumps and pipelines is required. To divert upstream flow from entering the creek remediation zone, a diversion pipeline would be required as shown on the 95% plans. Diversion capacity of 30 cfs would be reasonable for most of the time during construction; however, overtopping or breaching of the cofferdams could still occur under high flow events. The actual diversion capacity, pipe sizes and details will be selected by the Contractor, and may include, for example, a 30-inch diameter steel pipe constructed along the northern section of the creeks.

Cofferdams can be constructed of earth, sheet piling or other materials as may be selected by the Contractor. Cofferdams will be limited in height and number to minimize backwater levels during large flow events. Floodway enlargements would be required at each cofferdam to pass large flows without significantly raising water levels upstream.

A special arrangement of cofferdams and bypass pumps, etc. will be designed by the Contractor to accomplish excavation in Black Creek. It is likely that the by-pass system established for Black Creek will no longer be required following remediation of the first reach.

Creek Dewatering

The creeks will be excavated in three reaches as shown on the 95% Contract Plans. Pumping will be required to maintain a relatively dry workplace within each reach. Continuous pumping may be required due to cofferdam seepage (assumed small) and natural inflow of groundwater. Water management control will include ditches, pipes or extended suction hoses, as appropriate.

Creek Sediment Removal

Following the previously described surveys and removal of trees, debris, etc. within the Remediation Zone, creek bed and bank sediments will be excavated in a controlled manner to avoid under and over-excavation. Cleaning of storm sewers outfalls as specified in the 95% Contract Documents will be phased to allow completion prior to haul road construction and creek sediment excavation, but following dewatering of the creek reaches.

The proposed method of creek diversion with cofferdams, followed by dewatering and excavation of creek sediments involves conventional construction techniques and provides for a high efficiency (low cost) of removal, particularly if selective excavation and storage (based on greater or lesser than 1 ppb) is not required. Crawler mounted hydraulic backhoes could be utilized to excavate the stream beds. An average size bucket for this machinery is 2 cubic yards. An extension boom can be used to reach up to 100 feet, thereby enabling excavation from a haul road along the side reaches of the remediation zone. It is more likely, however, that excavation by the backhoe will be performed on timber mats placed in the vicinity of the active excavated creek faces. Haul roads will still be required, however, to remove the excavated material from the creeks.

The excavated sediments can be loaded onto haul vehicles for transport to stockpile areas. The material should be drained of its free water to the greatest extent possible. This effort is probably best performed by allowing free gravity drainage in the bucket over special collection bins. These bins are necessary for dewatering of contaminated soil, since finer-grained contaminated sediment may remain in suspension in the drained water. The bins may be flat bed truck or trailer-mounted. Disposal of drained water would be required at the refurbished dewatering facility and sediments backfilled into the DCF.

Following excavation of sediments from the creek and haul road removal, gravel fill will be placed in the creek beds to an approximate thickness of 12-inches. This placement will assist in preventing the migration of exposed creek sediments. Precautions are to be taken to prevent cross-contamination of gravel fill and/or exposed active excavation surfaces. Such precautions may include temporary dikes or placement of plastic sheeting.

V. MATERIALS HANDLING AND STORAGE

Materials handling is greatly dependent on the physical characteristics of the sediments, the excavation methods utilized and the success of the pumping dewatering operations. In areas of the creeks where sediments of low moisture are encountered, mechanical equipment would remove contaminated sediments in discrete, bulk quantities. However, when fine grained muddy sediments (silt and clay) are encountered, materials handling is messier and dewatering of these fine-grained sediments generally cannot be accomplished at the excavation site. If their consistency is too soft, they must be mechanically excavated with special care and transported in water tight containers to prevent spillage.

In those cases where firm or free draining creek bed material is excavated, say along the side banks, transport directly to the DCF may be acceptable. Since most of the free water would drain over the collection bins, no stockpiling for further dewatering would be required. In those cases where excavated sediment is in dilute form, temporary sand drying beds within either the Exclusion or Remediation Zone would be used to dewater the spoil.

The stockpile/dewatering areas would consist of a small diked containment area with a surface layer of 12-inches of coarse sand underlain by graded gravel. The composite bottom, consisting of earth, preferably clay, and a flexible membrane liner is sloped slightly to vitrified clay tile underdrains placed in trenches. Dewatering is accomplished by gravity drainage and air drying. However, if odor and dust control are required by use of foam or other cover, then air drying would be reduced. The drained water, collected in tile underdrains, may be gravity discharged to the creeks if the results of sampling and testing would allow it. Alternatively, this water may be stored in tanks or tankers and hauled to the Love Canal Sewer Sediment Dewatering Facility for further treatment. The dewatered soil can be removed from the drying bed by a front-end loader and truck-loaded for transport to the DCF.

Because of limited space within the Exclusion Zone, the capacity of the stockpile/dewatering facility would be limited, but the size would need to be sufficient to maximize production removal efficiency. It is estimated that a facility capable of dewatering 1,000 cubic yards would be required to meet the above criteria.

Alternatives to the use of a drying bed are mechanical means such as a belt filter press or large centrifuges. These types of devices have been successfully used to handle municipal sludge wastes which contain low solids concentrations. With the belt filter press, the sediment would be placed on a moving belt, where water first drains off under gravity. The sediment would then be deposited on a second belt, where pressure rises and forces out more water. Near the end of the belt, rollers distort the screens to aid in solids removal. Modifications to "off-the-shelf" presses used for municipal sludge would need to be made since these devices typically handle solids loading in the 4 to 6% range. In addition, some pretreatment may be required to remove materials from the excavated sediment which may damage the screens. The size requirements for setting up a belt press filter dewatering process would likely be the same as that required for a drying bed. The belt press filter could also be used as pretreatment equipment prior to thermal destruction.

Dewatering Containment Facility (DCF) and Construction/Demolition Debris Facility (CDDF)

The DCF/CDDF in which the Creek Sediment will be dewatered and staged will be a compartmentalized earthen berm type containment facility designed to meet all appropriate substantive requirements of RCRA and 6 NYCRR Parts 360 and 373. The DCF will be located on the southwest portion of the Love Canal site, would have a total height of 25 feet above surrounding ground surface, and will be approximately 300 feet wide and 900 feet long. Some modifications may be required depending on the final waste stream size and definition. Drawing 2 presents a conceptual layout at the DCF and TDF areas.

Prior to berm placement, the site subgrade will be prepared by stripping of topsoil and excavating the debris and basement rubble from the abandoned Ring 2 homes underlying the DCF/CDDF. The rubble and soil (approximately 6500 cu yds) above El. 570.25 will be temporarily stored in watertight containers at the proposed staging area just south of Read Avenue. This material will then be filled into a separate compartment of the DCF/CDDF for final disposal. If it is determined that residuals from thermal treatment can be disposed of elsewhere on-site, or off-site, then the excavated subgrade material may be spread in the DCF for final disposal following excavation and treatment of these soils. This could eliminate the need for a CDDF compartment altogether, and significantly reduce the size and final height of the proposed DCF. A final resolution of the TDF residual disposal needs to be made to ultimately determine the size requirements of the DCF.

The earth berms will provide lateral confinement for the filled material. The berms will be about 12 feet high 70 feet wide at the base, 11.5 feet wide at the crest and have side slopes of 1V:3H.

The primary and secondary liners are composite liners having the same cross-sectional dimensions and consisting of compacted clay and high density polyethylene (HDPE). The compacted clay portion of both liners will be 3 feet thick and will have a maximum hydraulic conductivity of 1 x 10 -7 cm/sec. The HDPE liner will be 80 mils thick.

The primary and secondary liners will be separated by a leak detection system consisting of a layer of filter stone sandwiched between filter fabric. This layer will be capable of conveying water to the lower collection pipe which traverses the west side of the DCF. This pipe will lead to a collection/monitoring sump at the edge of the facility.

A collection system which provides the primary dewatering path for the sediment will be placed on top of the primary liner. It will be a 1.5 foot thick blanket of clean, well graded, crushed stone. The blanket will extend to the top of the earthen berms to protect the HDPE liners from damage and to provide continuity of the collection system. A perforated collection pipe will be located along the western side of the DCF and the floor of the DCF will be sloped to drain. The pipe will empty into a manhole on the edge of the DCF. The leachate will then drain to a holding tank from which it will be pumped to the existing leachate treatment facility.

The construction of the DCF will utilize conventional construction technology and equipment. Assuming an April 1988 notice-to-proceed for DCF construction, it is expected that the facility would not be completed until May 1989, assuming no winter construction. If the size of the facility is reduced due to any reduction in the amount of materials to be contained, and thermal residual disposal is done elsewhere on-site, then construction of the facility may be completed by 1988 winter shutdown. In either case, winterization of the DCF liner would be required. It is estimated that a 2.5 foot (15,000 cubic yards) soil blanket would be required above grade within the DCF to protect the primary clay liner from freeze/thaw effects and subsequent cracking. (Since the volume of material to protect the liner during the winter is large, it seems practical to complete berm construction in 1989 utilizing the blanket material).

Filling of the DCF in 1989 would first consist of hauling the material via end or bottom-dump trucks. A crawler mounted dozer would work the material up against the side slopes of the berms and progress along the length of the facility. Due to the potentially soft and runny nature of the sediment placed in the DCF, a point may be reached where the haul trucks and dozers can not work within the facility. The backfilling operations would then consist of end dumping from the top of the berm into the facility. A dragline with a 2-1/2 cubic yard bucket and 100 foot throw reach would rework the material within the facility. The dragline and trucks would need to operate from the crest of the berm, and it is estimated that a 20 to 25 foot wide berm crest would be required, at least in part, around the facility (say the northern and eastern flanks). During filling and temporary storage in the DCF, odor and dust control must be provided by placing cover material daily. Intermediate and final cover material is generally clean earthen materials which would be appropriate for this site. However, because of the desirability of minimizing the amount of potentially contaminated material generated during construction, the use of foam systems for odor and dust control will be incorporated to the greatest extent possible. Longer term cover will however require the use of earthen materials.

To overcome further infringement on the existing Love Canal cap due to the potential wider berm requirements discussed above, the outer slopes of the berm could be constructed of material able to stand on a 1V:2H slope. Since dragline operation would also be required for excavation for thermal treatment, this widened berm section should exist until excavation requirements are met. If it is determined that the DCF is required for long term storage of residuals or non-treated soils, then the widened 1V:2H could be cut back to 1V:3H for long term stability.

VI. OTHER PROJECT COMPONENTS

Decontamination/Drum Storage Facility (DDSF)

The DDSF will consist of a pre-engineered building, to be selected and built by the Contractor. The DDSF will include a storage area for drums containing hazardous materials, a separate facility for future decontamination of equipment used at the Love Canal Site and an office and emergency shower.

Features of the work to be performed for DDSF construction include:

- o Clearing and grubbing.
- o Excavation of topsoil and overburden (the by-products to be spread and seeded at the designated location at the Love Canal Site).
- o Excavation of rubble and debris contained in the basements of former homes which are located at the proposed DDSF location (the by-products to be stored for disposal in the CDDF).
- o Backfill of excavations with structural fill.
- o Construction of the DDSF; the building features include:
  - approximate dimensions 60 feet x 160 feet,
  - reinforced concrete slab on grade,
  - overhead rolling doors comprising the east and west side walls,
  - paved access road on fill along the building perimeter,

- storage area separated from the decontamination area by partition wall,

- small office and emergency shower attached to the building,

- drainage trench in the building leading to an outside sump to be connected to NYSDEC Leachate Treatment Facility at the Love Canal Site.

NYSDEC's Sewer Sediment Dewatering Facility

This work is clearly outlined in the 95% Contract Documents and includes:

- o Cleaning sediment from the existing facility and disposing of it in the DCF.

- o Replacing bottom filter and rehabilitating the facility for safe operation during performance of other construction activities including disposal of decontamination water, and if necessary, water from dewatering the creek.

- o Cleaning the facility during the work, as required, and after completion of creek remediation, sediments will be disposed of in the DCF.

- o Replacing piping and mechanical components as required for future use.

VII. THERMAL DESTRUCTION OPTIONS

The thermal destruction options for dioxin contaminated soils are numerous when considering demonstrated and emerging technologies. The major thermal technologies are included in Table 1. Most of these technologies have developed acceptable DRE's during pilot testing with some systems obtaining dioxin destruction data during fullscale incinerator field testing and/or operation.

A review of these systems in Table 1, indicates that the Infrared System, the Circulating Fluidized Bed Combustor and the Rotary Kiln Incinerator are the main technologies compatible with the handling and thermal destruction of contaminated soils. These three options have accumulated significant operating experience with dioxin contaminated soils through trial burns and field operations. Specifically, the rotary kiln has demonstrated successful field operations at Denney Farm Site (EPA Mobile Incineration System), and at Gulfport, Mississippi (ENSCO Mobile Rotary Kiln). A successful sub-scale burn (prototype(DRE's 99.999989) has been achieved at the EPA Combustion Research Facility on Vertac Chemical Company stillbottoms waste.

The Infrared System (Shirco Portable Unit) has operated on-site with dioxin laden soils at the Times Beach Dioxin Research Facility and achieved dioxin destruction efficiencies above 99.9999%.

Successful test burns in a pilot Circulating Fluidized Bed Combuster (Ogden Martin) have been run on contaminated soils from Gulf Oil in New Jersey and achieved a destruction efficiency of (99.99999%).

Based on a review of the available technologies and the presently available testing results, the Rotary Kiln, the Infrared System, and the Circulating Fluidized Bed Combustor appear applicable to the on-site thermal destruction of dioxin contaminated soil.

VIII. BASELINE THERMAL DESTRUCTION SYSTEM

To develop general system requirements, a rotary kiln incineration system was selected as a baseline Thermal Destruction Facility (TDF). For this study, a description of only one representative unit is considered adequate. A system description, location and design criteria are presented.

System Description

For the dioxin contaminated sediment, a TDF rotary kiln incinerator with a capacity of 5 to 10 tons per hour of contaminated soil and sediments was considered. This unit consists of an auger fed rotary kiln followed by a cylindrical secondary combustor. The exhaust gases from the secondary combustor are quenched prior to entering the air emissions control system. A rotary kiln is presented schematically in Figure 1. The system can achieve 1500 to 1800°F in the rotary kiln for volatilizing the dioxins compounds. The secondary combustor provides for raising the exhaust gases to 2200°F with a minimum retention time of two seconds to assure destruction.

Following the secondary combustion process, the incineration system includes a quench chamber so that exhaust gas temperatures can be lowered to acceptable levels prior to entering the air emissions control system.

The air emissions control system consists of a venturi scrubber to remove particulates followed by a packed vertical tower to provide chemical/ absorption of noxious gases. This approach to air emission control was chosen because it is reliable and has been demonstrated in other hazardous waste incineration applications.

Auxiliary systems required for the above incineration approach are as follows:

(1) A soil drainage and/or blending system;

(2) A bottom ash removal system from the rotary kiln;

(3) A wastewater treatment system for the venturi scrubber and packed tower water system;

(4) A chemical preparation and feed system for the scrubber recirculation system;

(5) A sludge collection and removal system.

System Design Criteria

The general systems design and performance criteria are presented in Table 2. Based on these design criteria, a mass and thermal balance was developed for the following variations in operating parameters:

(1) Soil moisture content between 0% to 50%.

(2) Incinerator design feed rates of 5 to 10 tons/hour.

The results of these analyses are presented in Appendix C. Two typical design/performance results are summarized in Table 3 and the details are presented in Appendix D. These tables represent preliminary design and performance estimates for two cases:

(1) a 5 ton/hr mobile TDF and

(2) a 10 ton/hr transportable TDF.

Both mobile and transportable TDF are considered to be portable units. They differ primarily in the type and amount of set up required on-site prior to operation. A mobile unit can be moved to the site as complete component pieces ready for setup and operation. A transportable unit, which is usually larger and heavier cannot be transported as complete components and requires some fabrication and additional set-up time on site prior to operation.

Soil Feed and Ash Handling System

Partially drained, contaminated soils from the DCF could be excavated from the DCF berm using a drag line and would be transported to the TDF area for additional drainage and storage on a controlled drainage slab. Depending on the Thermal Destruction Facility chosen and the physical characteristics of the contaminated materials, additional pre-treatment of the material may be required. Coarser grained soils or other large materials may require grinding or crushing prior to being fed to the incinerator conveyor. A front end loader would be used to load the drained sediments to a feed conveyor or screw conveyor hopper of the rotary kiln. The drainage area may also be used to blend soils to reduce moisture content and improve the handling qualities of the soil.

The ash or residual quantities from the TDF will be based upon soil properties and TDF operation and capacities. Estimated ash quantities and generation rates are presented in Table 4. The ash will be a fine soil-like material which can be handled by standard earth moving equipment. Numerous options are available for the final disposition of this material including; on-site in either the DCF or spread in low non-capped areas of the canal or off-site at a solid waste disposal facility.

System location and Space Requirements

Based on the previous design data, soil feed quantities, and ash generation rates, preliminary space requirements have been determined. These space requirements are presented in Table 5 for the case of a 10 ton/hr transportable TDF. These requirements are considered conservative in that the use of a 5 ton/hr mobile TDF will require less space. Drawing 2 shows one possible location and layout of the TDF.

IX. TDF ENVIRONMENTAL IMPACTS

TDF environmental impacts on the surrounding community would principally concern ambient air quality, water quality, noise, and odor.

Air Quality Impacts

The control system proposed (venturi scrubber for particulates and packed tower for acid gases) should be adequate for control of particulates, smoke/odor, acid gases, metals & trace organics. Experience in monitoring and modeling similar facilities show that the ground level concentrations meet most states toxic level regulations i.e. 1 in 1,000,000 cancer risk. Added insurance for this system would be the installation of a dry scrubber/baghouse system which may provide a higher level of control efficiency.

Water Quality Impacts

The only wastewater discharges from the TDF system would be from any spills or drainage and the controlled discharge bleed from the scrubbers. Any discharges from the TDF would be sent to the NYSDEC Leachate Treatment Facility. Average discharge from the bleed of the scrubbers would be approximately 10 gpm.

Noise Impacts

The major source generating noise at a thermal destruction (TDF) is the burner. The estimated noise values from a 40 x 10^6 BTU/hr burner could be in the decibel range indicated in Table 6. Additional noise sources at the TDF include the fan(s) for the air pollution control system, and combustion air blowers. It is not anticipated that the community noise standards will be exceeded by an on-site TDF for this action.

Odor Impacts

The only significant odor from the TDF site would be from the storage of fuel oil and the re-excavation of the sediments from the DCF. The only hydrocarbon releases would be from the storage tanks at the time of filling or when the pressure release valve opens, which only occurs under extremely hot weather conditions. This should not pose any problem or cause any environmental impact in the surrounding area.

X. MONITORING REQUIREMENTS

TDF/Process Monitoring and Control

As a minimum, the TDF will be provided with a control room which includes performance monitoring devices with continuous data recording. At a minimum, the performance monitoring will include the following parameters and such others as may be required in accordance with the requirements of RCRA and the State of New York.

(1) Primary and secondary chamber temperatures

(2) Stack gas concentrations of:

- (a) Oxygen (continuous)
- (b) Carbon Dioxide (periodic)
- (c) Carbon Monoxide (continuous)
- (d) Total Hydrocarbons (continuous)

The control room must have an automatic control system which:

(1) Maintains the following parameters in the TDF:

- (a) Primary and secondary combustion chamber temperatures.
- (b) Contaminated soil feed rates.
- (c) Desired stack gas concentrations for oxygen, carbon monoxide, and total hydrocarbon.
- (d) Negative pressure within the combustion zone components.

(2) Stops waste feed to the system when permitted limits are exceeded.

(3) Activates system by-pass as required.

On-Site and Off-Site Ambient Air Monitoring

To determine the potential air quality impacts from the TDF, an air monitoring network will be required in the immediate vicinity of the site and in affected surrounding area. To insure that the TDF operation will have a minimum impact on air quality during normal operations and no negative environmental impacts on-site and in the nearby community during start-up, shut down and/or malfunction of the incineration systems, air dispersion modeling of the incinerator exhaust gases must be conducted to determine points of maximum ground level concentration during various operating conditions and meteorological conditions. The results of this air dispersion modeling can then be used to design a monitoring network for measuring concentrations of particulates and organic compounds in the ambient air. The air monitoring network should be started at least 6 months prior to TDF start-up to determine background air quality, and should continue to operate during the entire clean-up/closure activities at the site.

Any ambient air monitoring network should be operated in conjunction with an on-site network designed for the protection of health and safety of on-site personnel.

Specifically the Ambient Air Monitoring Network should:

(1) Provide ambient air monitoring systems capable of monitoring all particulate and gaseous emissions from the TDF as required by federal, state, and local regulations. The sampling equipment and sample requirements required for the TDF may be combined with those covered in Contractor Site Safety Plan;

(2) Meet the requirements of the USEPA Air Quality Monitoring Guidelines and the New York State Guidelines

XI. CONCLUSIONS

Based on the studies performed by EPA and TAMS, it is concluded that the Proposed Plan is achievable. A flow network of the pertinent elements of the project are illustrated on Figure 2.

Under the proposed plan, it would be necessary, based on discussions in the previous section, to treat all sediments after removal from the DCF. Segregation of the materials on the basis of contamination levels is impractical, whether during placement in the DCF or during removal from the DCF. A recharacterization of the creek materials in situ is the only practical alternative for segregating material based on contamination levels. Drawings 1 and 2 illustrate the site activities, equipment requirements and work area necessary to implement the Proposed Plan. The final disposition of the thermal residuals (ash), either in the DCF, elsewhere on-site or possibly off-site are all technically feasible alternatives. Pros and cons exist to support either on-site or off-site disposal, included are the following:

<u>On-Site Disposal</u>

pro - least cost; ample land readily available; ash need only be "delistable"

con - raises existing grade; soil conditioning, surface drainage modification and re-landscaping required; activity around Love Canal EDA

<u>Off-site Disposal</u>

pro - minimizes construction activities in the EDA

con - more costs; availability of disposal site unknown; additional traffic on public roads within and outside EDA; matrial needs to be "delisted".

Schedule

Figure 3 shows the overall project schedule for complete removal/destruction/disposal of creek and sewer sediments at Love Canal. This schedule is consistent with the time frames presented in the Proposed Plan Schedule (Appendix B). The overall completion of the thermal destruction could be realistically accomplished by mid 1994.

For the TDF component of the project, the proposed schedule includes:

(1) Remedial Design Phase

This phase includes on-site definition of physical and chemical soil parameters and quantities, detailed TDF design and specifications, sub-scale testing, and preparation of an RFP.

(2) Procure Vendor For Remedial Action (RA)

This phase includes the issuance of an RFP, proposal evaluation, contractor selection, and contractor go-ahead.

(3) Prepare and meet requirements of RCRA Permit Application

This phase includes the preparation to meet the requirements of RCRA permit by the TDF contractor and a review of the submittals by New York State DEC and USEPA officials. The time frame assumes the contractor has previous experience in the permit process and has standard QA/QC and Health and Safety packages available.

(4) TDF Mobilization

This phase includes on-site mobilization of mobile unit or transportable unit.

(5) System Start-Up and Completion of Trial Burn

This phase includes incinerator start-up, and check out and subsequent completion of a trial burn. Based on current state requirements the schedule assumes separate trial burn periods for surrogates and dioxin. If concurrent trial burns were permitted this phase might be substantially reduced.

(6) Evaluation of Trial Burn

This phase includes testing and evaluation of trial burns by engineers and actions by state and federal agencies to assess system.

(7) Operational Approval

This phase includes a review of trial burn data and the establishment of TDF operating conditions.

(8) Clean Closure Analysis (Delist Waste)

This phase includes application and review periods necessary to meet requirements for delisting of residuals.

(9) Production Burn

This phase consists of thermal detoxification of the on-site soils as required.

(10) Demobilization

This phase concludes the project and requires TDF decontamination and removal and site decontamination and closure.

TDF Cost Analysis

The preliminary estimate of TDF cost is presented in Table 8. This table shows cost per ton for a 5 ton/hr and a 10 ton/hr unit based on equipment life and total soil throughput assumptions. The details for this table are presented in Appendix E.

The cost data is based on the procedure in EPA's "Engineering Handbook for Hazardous Waste Incineration," Chapter 6, "Estimating Incineration Costs" (September 1981).

Vendor Procurement: Two-Step Formal Advertising

EPA's regulation governing procurement under Superfund Cooperative Agreements with the States, 40 CFR Part 33, requires the use of the formal advertising (sealed bidding) method for procurement for construction subagreements. This method is less suitable for projects where complex innovative and alternative technologies exist, such as in the thermal destruction of contaminated creek and sewer sediments, because the technical requirements and the means of satisfying those requirements cannot be specified in the traditional A/E plans and specifications package.

An alternative is the Two-Step Formal Advertising (Sealed Bidding) method. This method is used when it is possible to prepare a performance based specification to describe the requirements of the work but impractical to initially prepare detailed specifications to support an award based on price.

In the first step, a Request for Technical Proposals (RFTP) is solicited based on performance specifications prepared by the Agency (Department) or its representative. Proposals are submitted by Offerors (Cleanup Contractors), evaluated by a technical evaluation board comprised of experts in the various components of the project, and, if necessary, discussed during formal interviews. No costs are submitted during this step, and the objective of this step is to determine the acceptability of the Offeror.

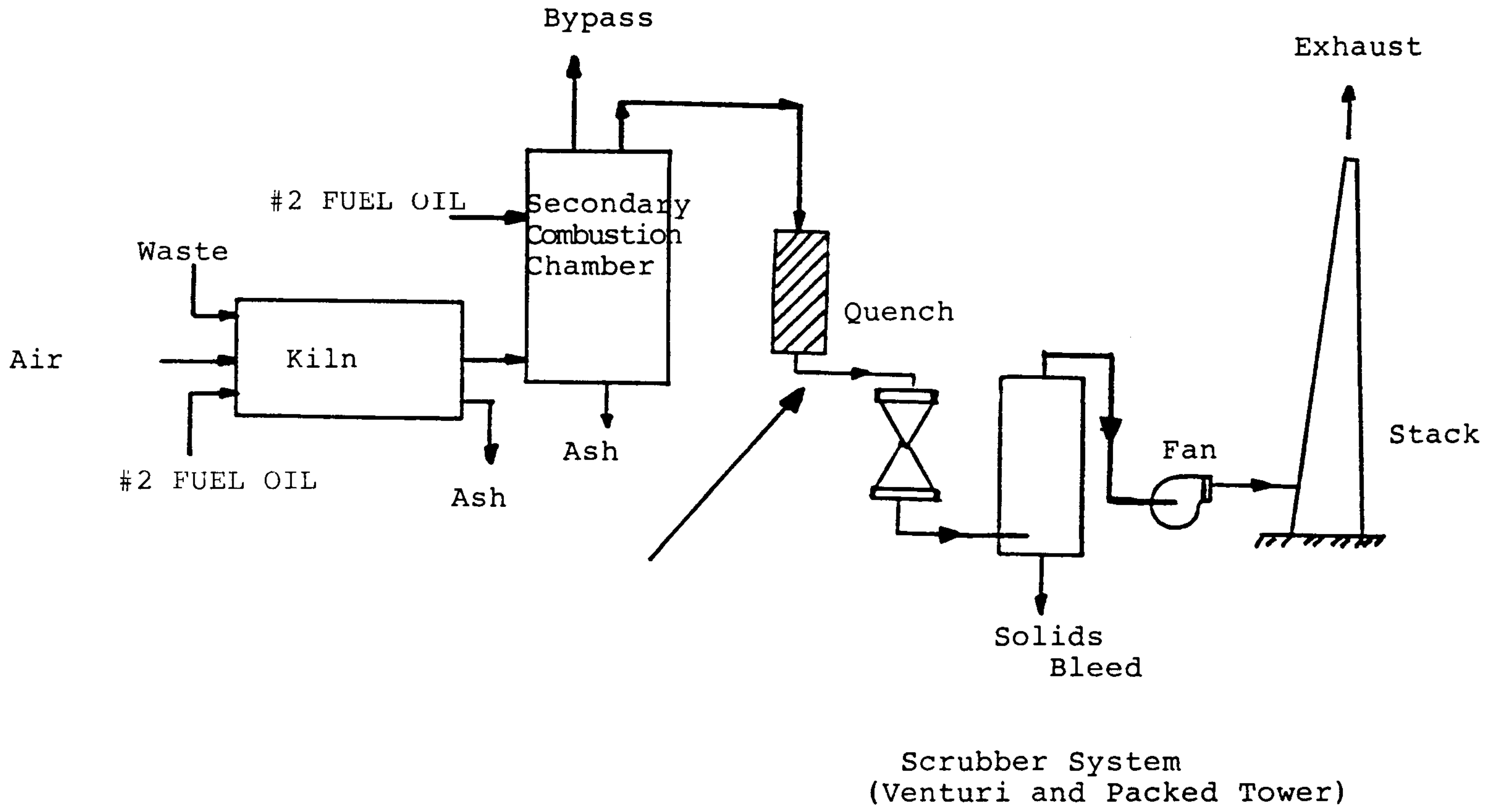
Evaluation of the proposals in Step One is based on criteria stated in the RFTP. In general, proposals are categorized as: acceptable, unacceptable or reasonably susceptible of being made acceptable if clarifying or supplementing information is requested.

Step Two (Invitation for Bids - IFB) involves the submission of sealed priced bids by those who submitted acceptable technical proposals in Step One. Bids submitted in Step Two are evaluated and award is made to the lowest responsible bidder.

TAMS is currently using the above methodology to procure TDF vendors on another large Superfund site in New Jersey, along with the COE and EPA Region II. Consideration should be given to this methodology at Love Canal, and the proposed schedule includes the time required for this type of procurement effort.

FIGURE 1

CONCEPTUAL TDF PLAN FOR BLACK AND BERGHOLTZ CREEKS



NOT TO SCALE

CROSS/TESSITORE & ASSOC., P.A.
ENVIRONMENTAL ENGINEERS ORLANDO, FLORIDA

REMOVAL/DESTRUCTION/DISPOSAL OF CREEK AND SEWER SEDIMENTS AT LOVE CANAL

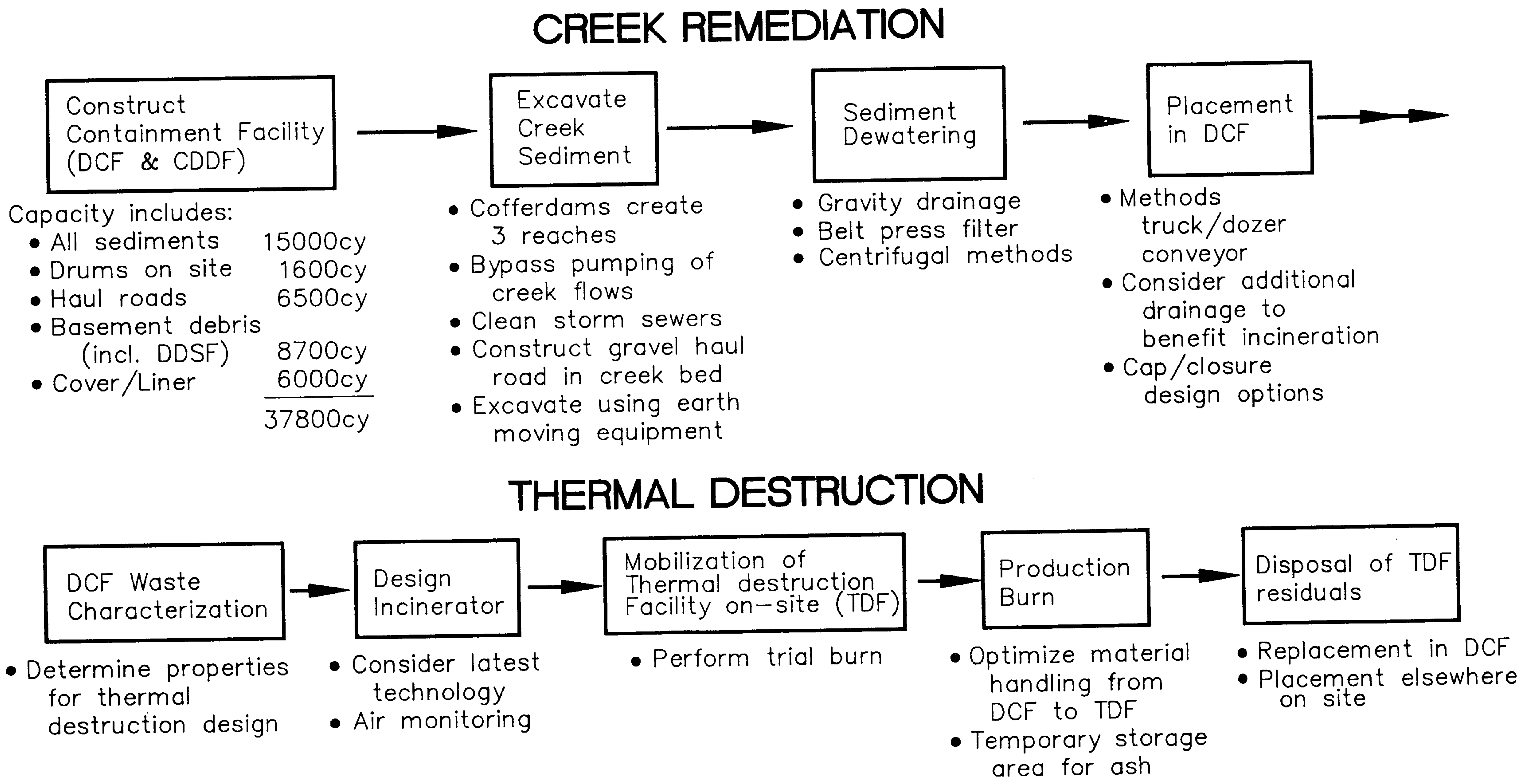
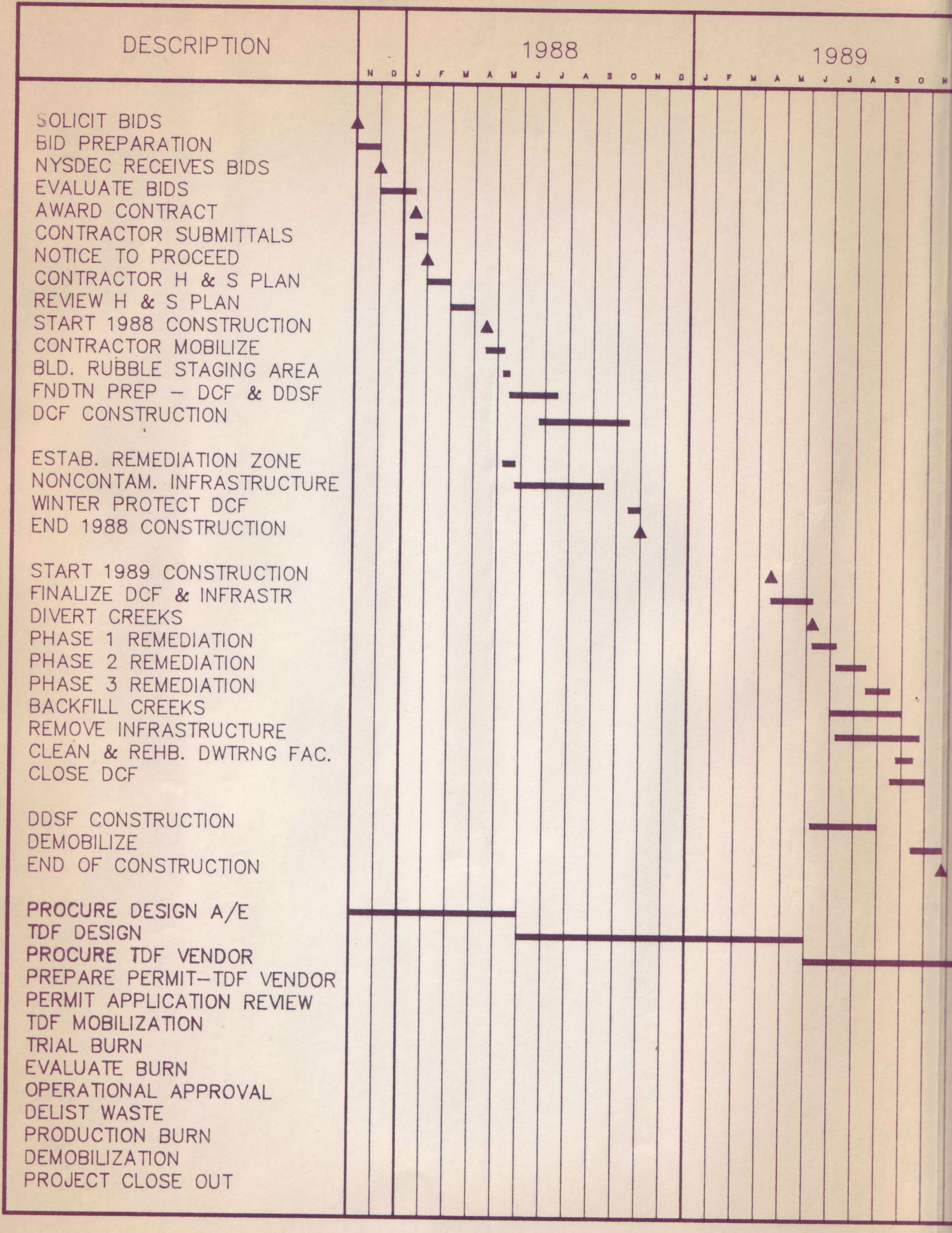
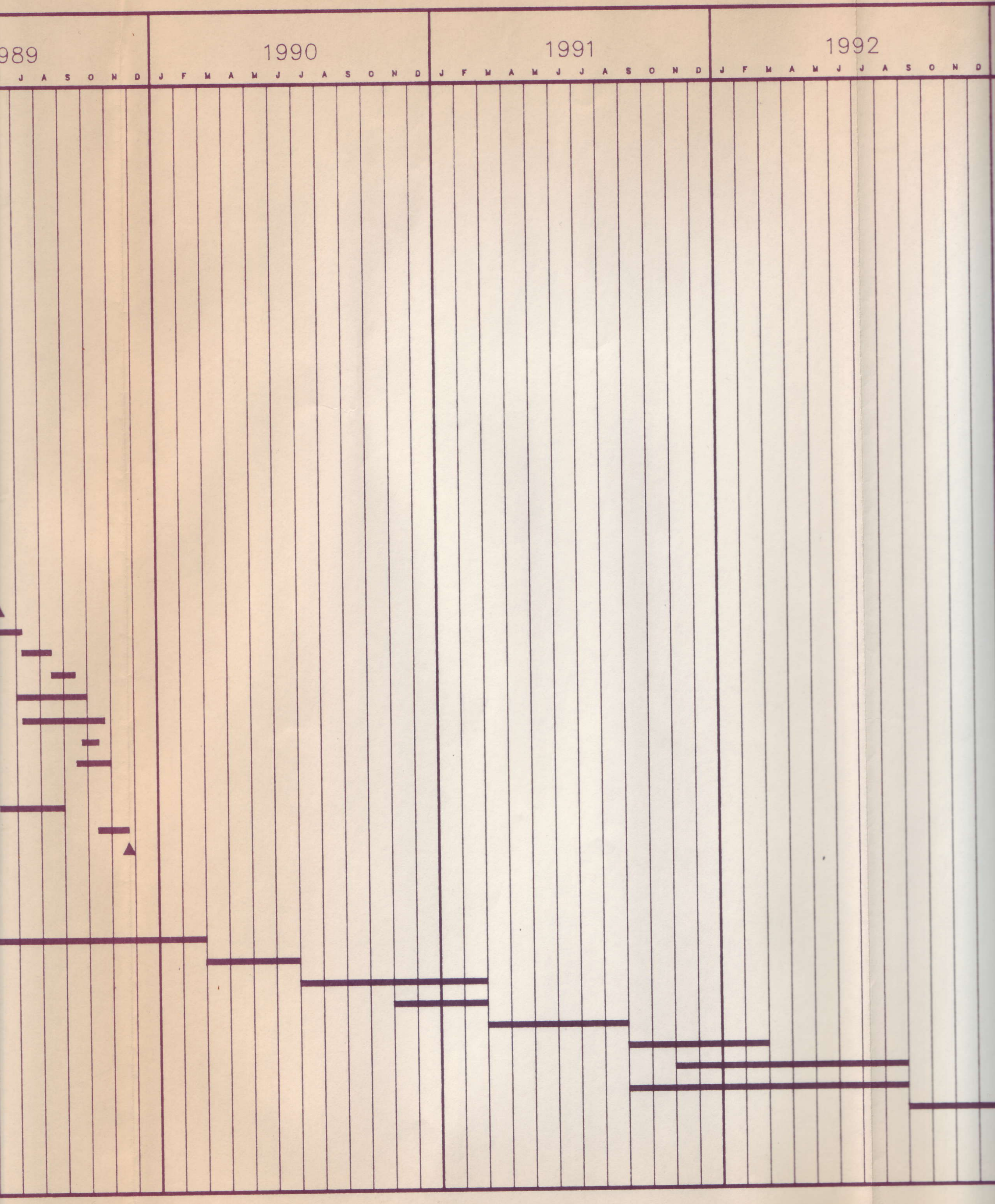


FIGURE 2


DESCRIPTION
1988
1989
N D J F M A M J J A S O N D J F M A M J J A S O N
SOLICIT BIDS
BID PREPARATION
NYSDEC RECEIVES BIDS
EVALUATE BIDS
AWARD CONTRACT
CONTRACTOR SUBMITTALS
NOTICE TO PROCEED
CONTRACTOR H & S PLAN
REVIEW H & S PLAN
START 1988 CONSTRUCTION
CONTRACTOR MOBILIZE
BLD. RUBBLE STAGING AREA
FNDTN PREP – DCF & DDSF
DCF CONSTRUCTION
ESTAB. REMEDIATION ZONE
NONCONTAM. INFRASTRUCTURE
WINTER PROTECT DCF
END 1988 CONSTRUCTION
START 1989 CONSTRUCTION
FINALIZE DCF & INFRASTR
DIVERT CREEKS
PHASE 1 REMEDIATION
PHASE 2 REMEDIATION
PHASE 3 REMEDIATION
BACKFILL CREEKS
REMOVE INFRASTRUCTURE
CLEAN & REHB. DWTRNG FAC.
CLOSE DCF
DDSF CONSTRUCTION
DEMOBILIZE
END OF CONSTRUCTION
PROCURE DESIGN A/E
TDF DESIGN
PROCURE TDF VENDOR
PREPARE PERMIT–TDF VENDOR
PERMIT APPLICATION REVIEW
TDF MOBILIZATION
TRIAL BURN
EVALUATE BURN
OPERATIONAL APPROVAL
DELIST WASTE
PRODUCTION BURN
DEMOBILIZATION
PROJECT CLOSE OUT


989
J A S O N D
1990
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J F M A M J J A S O N D
1992
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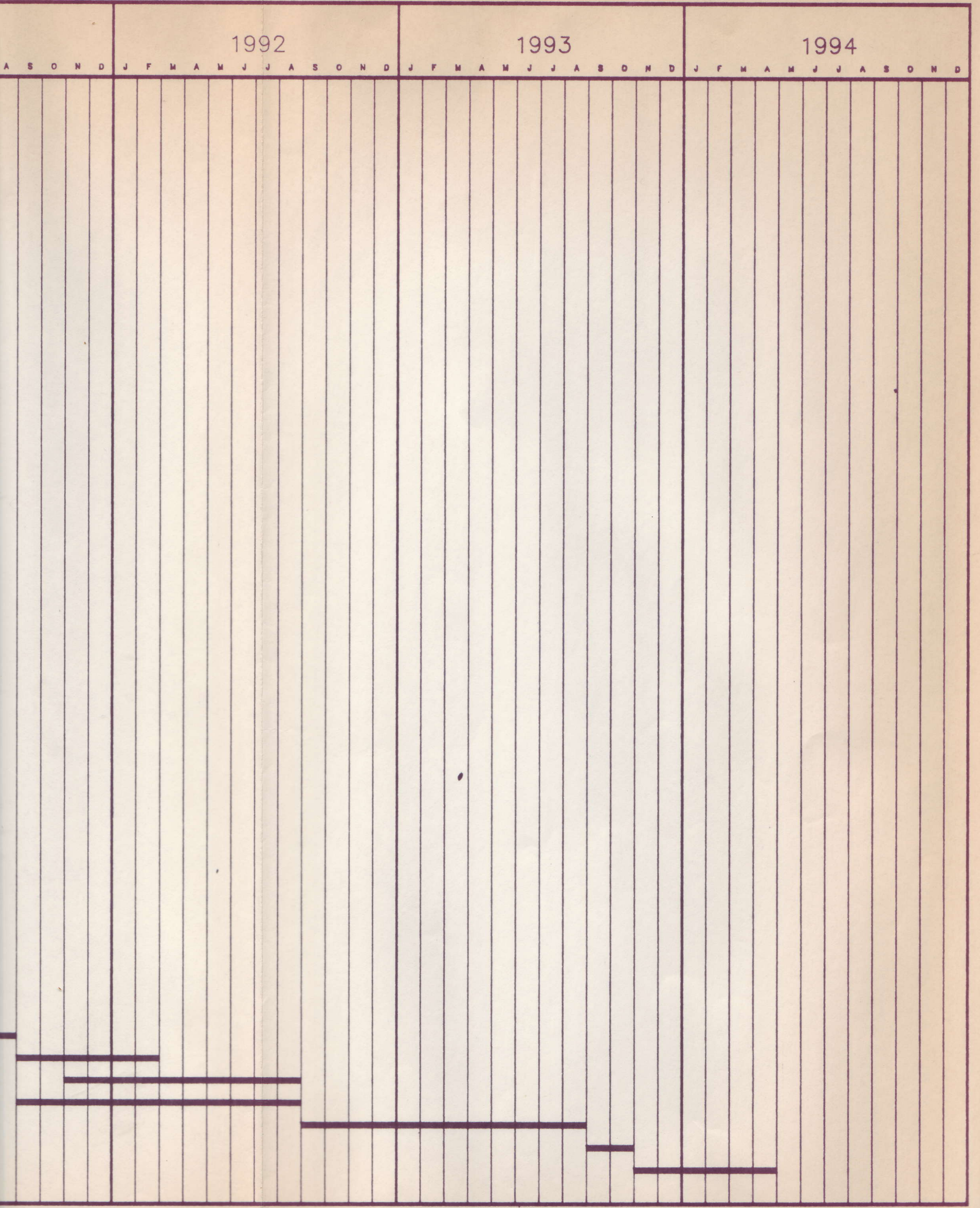

1992
1993
1994
A S O N D
J F M A M J J A S O N D
J F M A M J J A S O N D
J F M A M J J A S O N D

FIGURE 3

TABLE 1

PERFORMANCE OF DIOXIN TREATMENT TECHNOLOGIES *

Process	Applicable waste streams	Scale	Performance[a]	Cost ($/ton)
Stationary rotary kiln incineration	Solids, liquids, and sludges	Full	>99.999% (PCBs >99.9999%)	$500 - $1400
Mobile rotary kiln incineration	Solids, liquids, and sludges	Full	>99.9999%	NA[b]
Liquid injection incineration	Pumpable liquids and sludges	Full	>99.9% (PCBs >99.9999%)	$200 - $500
Fluidized-bed incineration (circulating bed combustor)	Solids and sludges	Full	NA (PCBs >99.9999%)	$60 - $320
High temperature fluid wall (Huber AER)	Granular soils and liquids	Pilot	>99.999% <1 ppb	$300 - $600
Infrared incineration (Shirco)	Soils and sludges	Pilot	>99.9999%	$200 - $1200
Molten salt (Rockwell)	Solids, liquids, and sludges	Pilot	NA (PCBs >99.9999%)	NA
Supercritical water oxidation	Aqueous solutions or slurries	Pilot	>99.9999%[c]	$77 - $480
Plasma arc pyrolysis	Liquids	Full	NA (PCBs >99.9999%)	$300 - $1400
In situ vitrification	Soils	Pilot	>99.9%	$75 - $160
Solvent extraction	Soils and still bottoms	Pilot	200 ppb (still bottoms) 60 - 90% extracted (soil)	NA
Stabilization/ fixation	Soils	Lab	NA	NA
Ultraviolet photolysis (UV)	Liquids, soils, and still bottoms	Full	<1 ppb	$250 - $1250
Chemical dechlorination	Soils	Pilot	<1 ppb	$91 - $296
Biological degradation	Liquids, soils	Lab	50 - 60% metabolized in a week	NA
Chemical degradation using ruthenium tetraoxide[d]	Liquids, soils, and furniture	Lab	<10 ppb	NA
Chemical degradation using chloroiodides[d]	Liquids, soils, furniture, and buildings	Lab	92% degradation	NA
Gamma ray radiolysis[d]	Liquids	Lab	3 ppb	NA

[a] Performance of thermal technologies are destruction and removal efficiencies (DRE); performance of nonthermal technologies given in parts per billion (ppb) dioxin remaining in treated waste, where possible.

[b] NA = not available.

[c] 99.9999% DRE was reported by developer, but supporting data has not been released.

[d] No research is currently being conducted.

Source: Adapted from M. Arienti et al.

TABLE 2

GENERAL INCINERATION SYSTEM DESIGN CRITERIA

Waste Mixture Incineration Rate	= 5 to 10 tons/hr
Waste Mixture Net Heat Content	= Negligible
Auxiliary Fuel:	No. 2 Fuel Oil
Afterburner Design	2 seconds retention time @ 2200°F
Air Pollution Control System	Particulate Emissions less than 0.08 gr/DSCF @ 7% O_2
	HCl Emissions - 99% removal efficiency (if feed contains in excess of 0.5% Cl)
Incineration System:	DRC (Dioxin) - 99.9999%*
	Combustion Efficiency 99.90%

---

*According to RCRA Requirements for Dioxin Waste.

TABLE 3

TDF SYSTEM DESIGN/PERFORMANCE REQUIRMENTS

A. ROTARY KILN TDU	5 TON/HR	10 TON/HR
Feed	10,000 lb/hr	20,000 lb/hr
Moisture	20 % wt	20 % wt
Ash	80 % wt	80 % wt
HCl	27.5 lb/hr	55 lb/hr
Net Heat Value	0 Btu/lb	0 Btu/hr
Feed Temp.	70 °F	70 °F
Incineration Temp.	1,800 °F	1,800 °F
Combustion Air	100 %	100 %
Auxiliary Fuel	No. 2 Fuel Oil	No. 2 Fuel Oil
Burners	38 MMBtu/hr	76 MMBtu/hr
Mass Flow (Exhaust)	61,163 lb/hr	122,326 lb/hr
Gas Flow	60,761 ACFM@1800°F	121,396 ACFM@1800°F
Dimensions	10' ID x 40' long	12' ID x 40' long

B. SECONDARY COMBUSTION/ AFTERBURNER	5 TON/HR	10 TON/HR
Feed	None	None
Gas Inlet Temp.	1,800 °F	1,800 °F
Incineration Temp.	2,200 °F	2,200 °F
Combustion Air	20 %	20 %
Auxiliary Fuel	No. 2 Fuel Oil	No. 2 Fuel Oil
Burners	23 MMBtu/hr	45 MMBtu/hr
Mass Flow (Exhaust)	89,912 lb/hr	165,824 lb/hr
Gas Flow	96,728 ACFM@2200°F	193,455 ACFM@2200°F
Retention Time	2 Seconds	2 Seconds
Dimensions	12' ID x 30' high	14' ID x 40' High

C. VENTURI/PACKED TOWER SYS	5 TON/HR	10 TON/HR
Combustion Products		
IN	96,728 ACFM@2200°F	999,445 ACFM@2200°F
OUT	22,182 ACFM@150°F	44,364 ACFM@150°F
Particulate	0.08 gr/DSCF @ 7% O_2	0.08 gr/DSCF @ 7% O_2
Dioxin	99.9999% DRE	99.9999% DRE
HCl	99% Removal Eff. (if feed contains 0.05% Cl)	99% Removal Eff (if feed contains 0.05% Cl)
Na (OH) Required	31 lb/hr	62 lb/hr
Precooler H_2O	20 gal/min	40 gal/min
Venturi H_2O	133 gal/min	266 gal/min
Packed Tower H_2O	50 gal/min	111 gal/min
Bleed Rate	1-10 gal/min	1-10 gal/min

TABLE 4

ESTIMATED TDU ASH GENERATION RATES

	% MOISTURE		
	20	30	40
Soil Ash Content (%)	80	70	60
Wet Soil Density (lb/cy)	3510	3510	3510
Moisture in 1 cy Wet Soil (lbs)	702	1053	1404
Dry Soil (Ash) in 1 cy Wet Soil (lb)	2808	2457	2106
Density of Water @ 70 deg. F (lb/cy)	1684.8	1684.8	1684.8
Vol. of Water in 1cy of Wet Soil(cy)	0.417	0.625	0.833
Vol. of Ash in 1 cy of Wet Soil (cy)	0.583	0.375	0.167
Ash @ 5 tph Wet Soil Feed Rate			
ton/hr	4	3.5	3
cy/hr	1.662	1.068	0.475
Ash @ 10 tph Wet Soil Feed Rate			
ton/hr	8	7	6
cy/hr	3.324	2.137	0.950

TABLE 5

BASIC SPACE REQUIREMENTS FOR TDP SYSTEM (10 TpH unit)

Components	Approximate Space Required
Incineration System	
--Solid Waste Handling	60' x 60'
--TDU/Air Emission Control	50' x 85'
--Detoxified Soil Storage	40' x 40'
--Fuel Storage	40' x40'
--Decontaminated Area/Office	40' x 60'
Waste Storage	
--Excavated soil(s)	40' x 40'

TABLE 6

PREDICTED NOISE LEVELS FOR TDF (10 TON/HR)

Frequency	Predicted Noise Level (dB)	
	115'	225'
31.5	73.5	62.0
63	78.4	66.9
125	77.6	66.1
25	80.2	68.7
500	70.5	59.0
1000	64.6	53.1
2000	59.7	48.2
4000	55.3	42.8
8000	49.7	35.7

TABLE 7

SUMMARY OF TDU AVAILABILITY SURVEY FOR CONTAMINATED SOIL CLEAN-UP

COMPANY	TDU TECHNOLOGY	TDU MOBILITY	CAPACITY (ton/hr)	ON-LINE AVAILABILITY (%)	TIME REQUIRED TO FABRICATE UNIT	TIME REQUIRED TO MOBILIZE ON-SITE	TIME REQUIRED TO CONDUCT TRIAL BURN	TIME REQUIRED* FOR PRODUCTION BURN	COMMENTS
ENSCO	ROTARY KILN	PORTABLE	5	80	NOT APPLICABLE	1-2 MONTHS	3 MONTHS	12 to 24 Months	ASSUMES PORTABLE UNIT IS AVAILABLE
WASTE TECH	FLUIDIZED BED	PORTABLE	4.3	80-85	6-7 MONTHS	1-2 MONTHS	3 MONTHS	14 to 28 Months	UNIT NOT AVAILABLE MUST BE FABRICATED AFTER CONTRACT AWARD
INDUSTRONICS	ROTARY KILN	TRANSPORTABLE	5-8.5	80	11-12 MONTHS	2 MONTHS	3 MONTHS	12 to 24 Months	UNIT MUST BE FABRICATED AFTER CONTRACT AWARD
OGDEN ENVIRONMENTAL SERVICES	FLUIDIZED BED	PORTABLE	3	80-85	NOT APPLICABLE (IF AVAILABLE)	< 1 MONTH	3 MONTHS	20 to 40 Months	IF UNIT NOT AVAILABLE WOULD REQUIRED 6 MONTHS TO FABRICATE
SHIRCO	INFRARED	PORTABLE	4	80-90	NOT APPLICABLE	< 1 MONTH	3 MONTHS	15 to 30 Months	IF UNIT NOT AVAILABLE REQUIRES 6 MONTHS TO FABRICATE
CLEAVER BROOKS	ROTARY KILN	TRANSPORTABLE	8-10	85	8-10 MONTHS	1-2 MONTHS	3 MONTHS	8 to 15 Months	UNIT MUST BE FABRICATED AFTER CONTRACT AWARD

*Time range required for production burn is based on material quantities which range from 20,000 to 40,000 yd^3.

TABLE 8

INCINERATION COST COMPARISON BASED ON UNIT LIFE*

Excavated Material Quantity = 20,000 cy and 40,000 cy

Soil Density = 3,510 lb/cy

		UNIT SIZE	
		5 ton/hr	10 ton/hr
Clean Up Period (years)	20,000 cy	1.00	0.50
	40,000 cy	2.00	1.00

			UNIT SIZE	
Unit Life	Volume of Soil		5 ton/hr	10 ton/hr
Clean Up Period	20,000 cy	Cost per Ton	$458	$698
		Total Cost	$16,063,551	$24,485,603
	40,000 cy	Cost per Ton	$284	$394
		Total Cost	$19,929,552	$27,625,493
5 Years	20,000 cy	Cost per Ton	$180	$150
		Total Cost	$6,305,511	$5,274,461
	40,000 cy	Cost per Ton	$180	$150
		Total Cost	$12,611,022	$10,548,923
10 Years	20,000 cy	Cost per Ton	$145	$120
		Total Cost	$5,085,756	$4,207,176
	40,000 cy	Cost per Ton	$145	$120
		Total Cost	$10,171,512	$8,414,351

*TDU cost only. Base on 30% moisture content in soil.

APPENDIX A

LETTER FROM DEC

XC ARD
J Fiteni
A.DiBi

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233-4012

Thomas C. Jorling
Commissioner

JUL 27 1987

Telex

Mr. Eugene O'Brien
TAMS Consultants, Inc.
655 Third Avenue
New York, NY 10017

Dear Mr. O'Brien:

Re: Black and Bergholtz Creek Remediation, Love Canal, Niagara Falls (C), Niagara County, Site Number 9-32-020, Contract Number D001339

At the request of the United States Environmental Protection Agency, the New York State Department of Environmental Conservation (NYSDEC) has agreed to evaluate the integration of the current Black and Bergholtz Creek remediation project with the thermal destruction of the wastes to be stored in the interim containment facility at the Love Canal site.

The NYSDEC, therefore, hereby directs TAMS Consultants, Inc. (TAMS), to prepare a preliminary design report to address the entire scope of the subject sewer and creek cleanup. This effort should address the entire scope of the wastes from removal from the creeks through thermal treatment to final disposition. This report should be available by August 14, 1987. Additionally, TAMS should be prepared to participate in one workshop in Niagara Falls which will address alternative technologies for disposal of these wastes and also attend one public meeting, in Niagara Falls, subsequent to the workshop, where the preliminary design report will probably be part of the presentation.

We will pay for this work under Task 2 of TAMS Contract No. D001339. TAMS shall submit a scope of work and cost and pricing data to us so that the scope of work and costs may be approved and adequate funds transferred to Task 2 to cover this activity.

If you have any questions, please call Mr. Guy T. Bobersky, P.E., of my staff, at (518) 457-4343.

Sincerely,

Norman H. Nosenchuck, P.E.
Director
Division of Solid and Hazardous Waste

cc: S. Luftig, USEPA, Region II
K. Stoller, USEPA, Region II
G. Pavlou, USEPA, Region II
J. Fiteni, TAMS Consultants, Inc.

APPENDIX B

EPA PROPOSED PLAN

EMBARGOED FOR RELEASE
UNTIL AUGUST 5, 1987

PROPOSED PLAN
FOR
DESTRUCTION/DISPOSAL OF
LOVE CANAL CREEK AND
SEWER SEDIMENTS

Prepared By

U.S. ENVIRONMENTAL PROTECTION AGENCY

August 1987

FOREWORD

The U.S. Environmental Protection Agency (EPA) recently issued a draft feasibility (FS) study for public review entitled Alternatives for Destruction/Disposal of Love Canal Creek and Sewer Sediments, dated June 1987.

As called for in Section 117 of the Superfund Amendments and Reauthorization Act of 1986 (SARA), EPA is hereby presenting the Proposed Plan for the Destruction/Disposal of Love Canal Creek and Sewer Sediments for public review. EPA will accept written comments until September 11, 1987. In addition, a public meeting will be held on August 25, 1987, at 7:00 p.m. in the Frontier Avenue Firehall, Wheatfield, New York.

The aforementioned draft feasibility study will serve as a companion to this Proposed Plan, and EPA also solicits comments on this study during the comment period and at the August 25, 1987 public meeting.

After the above comment period and public meeting, EPA will then develop a Final Plan which will be based on a full consideration of all relevant information including public comment. This Final Plan will be made available to the public before initiation of remedial action. It will contain a discussion of any significant changes, including reasons for such changes from the Proposed Plan. Also included will be a response to each of the significant comments, criticisms, and new data submitted by the public in review of the Proposed Plan. Although the Agency now favors the Proposed Plan, the Final Plan may adopt any of the alternatives discussed herein. Accordingly, comment on those alternatives is solicited as well.

Comments should be addressed to:

Doug R. Garbarini
Remedial Project Manager
U.S. Environmental Protection Agency
Room 747
26 Federal Plaza
New York, New York 10278
(212) 264-0106

CONTENTS

INTRODUCTION

The Love Canal hazardous waste site is located in the southeast corner of the City of Niagara Falls and is approximately one-quarter mile north of the Niagara River. Hooker Chemical & Plastics Corp. (now Occidental Chemical Corporation) disposed of over 21,000 tons of various chemicals (including dioxin-tainted trichlorophenols) into Love Canal between 1942 and 1953.

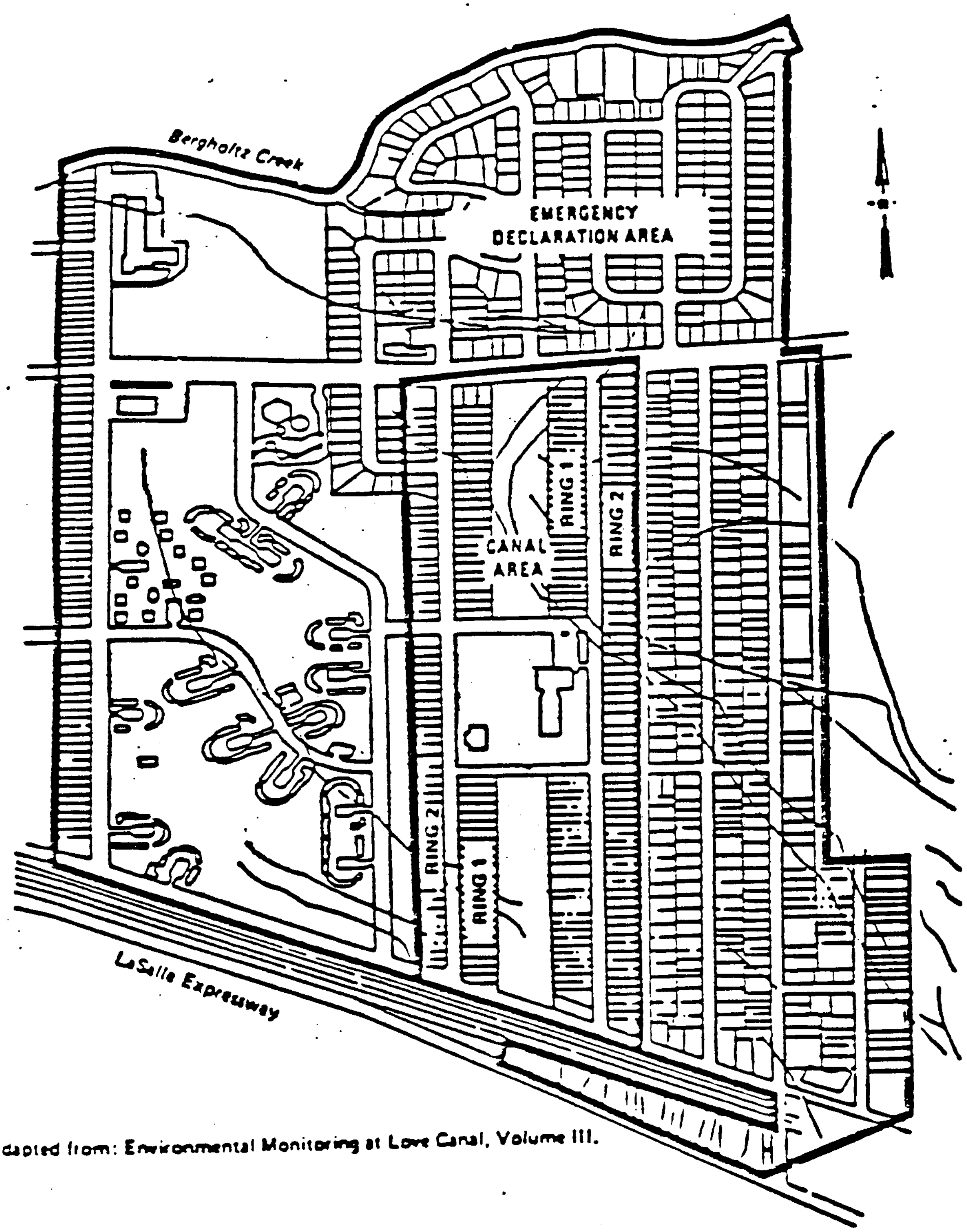
The Love Canal property (see Figure 1) was deeded by Hooker in April 1953 to the City of Niagara Falls Board of Education. During the mid 1950's, home construction accelerated in the area and in 1954 a public school was built adjacent to the middle portion of the Canal. Over the course of the next two decades, contaminated leachate migrated to the surface of the Canal and to nearby residential basements which have since been demolished. Contaminants also migrated through area sewers to nearby Black and Bergholtz creeks.

The subject of this document is the proposed remedial action directed toward the destruction/disposal of the dioxin-contaminated sediments from the sanitary and storm sewers in the Love Canal Emergency Declaration Area (EDA) and portions of Black and Bergholtz creeks. The majority of the sewers which required remediation were cleaned in 1986. The creek excavation would occur in 1989.

In this section, the primary background studies leading to the Proposed Plan are noted, followed by brief discussions of the major alternatives considered, and, finally, by the factors used in evaluating the various alternatives. The Proposed Plan is described in Section 2, with a comparative analysis of all three options contained in Section 3.

BACKGROUND STUDIES

On March 28, 1985, EPA issued a report entitled "Love Canal Sewers and Creeks Remedial Alternatives Evaluation and Risk Assessment". That report recommended the removal and interim storage of the dioxin-contaminated sediments found in the storm and sanitary sewers and Black and Bergholtz creeks. Interim storage of the creek and sewer sediments was necessary, since, at that time, no alternative was considered viable for the final destruction or disposal of the sediments. The design of the creek sediment excavation and the interim containment facility is at the 95 percent completion stage.



Adapted from: Environmental Monitoring at Love Canal, Volume III.

Figure 1
LOVE CANAL STUDY AREA

There are approximately 500 cubic yards (cy) of contaminated sewer sediment. The estimated quantity of sediment to be excavated from creeks is 10,000 - 15,000 cy. An additional 15,000 20,000 cy could be generated during the actual excavation activities (e.g., haul road construction). Approximately 5,500 cy would be generated from the removal of Ring II basement debris (necessary for construction of the containment facility).

In June 1987, a draft feasibility study (FS) entitled "Alternatives for Destruction/Disposal of Love Canal Creek and Sewer Sediments" was released. This report provides the basic technical background for the Proposed Plan through the analysis of three major remedial alternatives. Brief summaries of these alternatives as provided in the draft FS are provided below.

ALTERNATIVE 1, ON-SITE LAND DISPOSAL

This alternative would make use of the recently designed on-site containment facility required for implementation of the 1985 creek remedy. Although the facility was intended to provide only interim storage, it was required to be designed to meet all substantive requirements for a Resource Conservation and Recovery Act (RCRA) facility and Title 6 of the New York Compilation of Rules and Regulations. The facility would contain leachate detection and leachate collection systems, as well as a double liner, cap, and monitoring system.

To implement this alternative, the sediments would be removed from the creeks and sewers, placed in the storage facility, where it would undergo further dewatering and the facility capped.

ALTERNATIVE 2, THERMAL DESTRUCTION/ON-SITE DISPOSAL

In this option, an on-site thermal destruction unit would be used to treat any creek and sewer sediments which contain more than one part per billion (ppb) of dioxin. An on-site containment facility, similiar to that described in Alternative 1 above, would be used to dewater the sediments destined for thermal treatment. These dewatered sediments would then be fed to a thermal destruction unit where a 99.9999% destruction and removal efficiency (six 9s DRE) for dioxin, and a delistable residual material would be the performance standard. A delistable residual material refers to material which would not be listed as hazardous under the Resource Conservation and Recovery Act (RCRA). Such a material would not pose a threat to human health and the environment, and could therefore be disposed of on-site.

ALTERNATIVE 3, THERMAL DESTRUCTION/OFF-SITE DISPOSAL

This alternative also makes use of both the designed containment facility and an on-site thermal destruction unit. In addition, this option would require an off-site disposal facility for the residuals of the thermal destruction. As with Alternative 2, the sediments would be removed from the creeks and placed in the containment facility where they would be dewatered. Those sediments contaminated with an average dioxin concentration greater than 1 ppb would be thermally destroyed, subject to a delisting analysis, and disposed in an off-site disposal facility.

As with Alternative 2, discussed previously, this alternative would require that the performance standards for the thermal destruction unit meet a six 9s DRE for dioxin and residual material would be subject to a delisting process.

EVALUATION CRITERIA

The above three alternatives were evaluated using evaluation criteria derived from the National Contingency Plan (NCP) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). These criteria relate directly to factors mandated by SARA in Section 121 including Section 121(b)(1)(A-G). The criteria are as follows:

- Protection of human health and the environment
- Compliance with legally applicable or relevant and appropriate requirements
- Reduction of toxicity, mobility or volume
- Short-term effectiveness
- Long-term effectiveness and permanence
- Implementability
- Cost
- Community acceptance
- State acceptance

Based on a comparative analysis of the three alternatives, a Proposed Plan was developed and is described in Section 2. Details of the comparative analysis, using the above criteria, are provided in Section 3.

Section 2

PROPOSED PLAN

The three remedial alternatives outlined in Section 1 were subjected to the analysis required in Section 121 of the Superfund Amendments and Reauthorization Act of 1986 (SARA). At this time, based on all of the available information, the Agency's preferred option is Alternative 2 (on-site thermal destruction/on-site residual disposal) as the remedial alternative proposed for public comment. We have expanded our options for the on-site residual disposal as explained below. Details of the analysis of the three alternatives are provided in Section 3.

This section describes the Proposed Plan, including a physical description of the plan components, key operational and timing considerations, and the estimated capital and operating costs of the plan.

PLAN CONCEPT

To briefly review the problem status, sediments from sewers and creeks in the Love Canal area are contaminated with dioxin. The May 6, 1985 Record of Decision (ROD) specifically called for the removal of contaminated sediments from specific stretches of the sewers and creeks. It was determined that the sediments should be placed in an interim containment facility for several reasons, including: a viable option for destruction/disposal of the sediments did not appear to exist at that point in time; the creek material would require dewatering, sizing, shredding etc., prior to implementation of any treatment alternative; the rate of sediment removal would be much greater than the rate at which the wastes could be treated (i.e., the creek excavation would be completed in approximately 18 weeks, whereas thermal destruction of the sediment would require at least one year of operation).

Fifty-eight thousand linear feet of sewer were hydraulically cleaned in 1986. The sewer sediment was dewatered in the on-site sewer sediment dewatering facility, where it is currently stored. The sewer cleaning resulted in approximately 400 cy of dioxin-contaminated sediments. An additional 3000-4000 feet of sewer will be cleaned in the fall of 1987.

The design of the creek remedy (i.e., sediment excavation and construction of the interim containment facility) is currently at the 95% completion stage. The original design calls for the construction of a containment facility which would be approximately 1000 feet long, 300 feet wide and 25 feet above grade (at crest). As such, the facility would be approximately 12 feet above the crest of Love Canal proper, but below the roof of the on-site Leachate Treatment Facility. The facility would be constructed in the southwest corner of the Love Canal proper.

Due to the required size of the facility and site limitations, the facility would have to be constructed over approximately 24 of the demolished Ring II homes (see Figure 1). The old basement foundations and house debris would have to be removed in order to provide a stable foundation for the containment facility. The designed containment facility was scheduled for construction in 1988, so that it could receive the creek sediment scheduled for removal in 1989. The facility has been designed and sited to minimize the number of demolished homes that require excavation. A change in the lateral dimensions of the facility would require the removal of Ring I basement debris and would further encroach on the Love Canal cap, which is not preferred.

During the time when the interim containment facility was being designed, EPA and the State were evaluating final treatment and disposal options for the creek and sewer sediments. As specified in this Proposed Plan, the preferred option is Alternative 2, On-site Thermal Destruction/On-site Disposal.

As a consequence, EPA and the State are revisiting the interim containment design to assure that it meets the goals and objectives outlined in this Proposed Plan. Specifically the review includes re-estimating the quantity of associated material requiring thermal treatment, and will focus on the fact that the sediments need to be dewatered and that a storage area is needed for staging material prior to thermal treatment. The scale of the facility is not likely to change significantly since it would still receive approximately the same quantity of material as planned earlier for interim storage. The "new" facility would be termed a dewatering containment facility (DCF).

The DCF would receive approximately 500 cy of sewer sediment and 15,000 cy of creek sediment. The sewer sediment contains up to several hundred parts per billion (ppb) of dioxin; dioxin has been detected in the creek sediment up to about 46 ppb, but in many samples no dioxin was found. Approximately

15,000 - 20,000 cy of "associated" wastes may also be generated as a result of the creek cleaning effort including such items as haul road construction. In addition,approximately, 5,500 cy is expected to be non-hazardous basement debris. About 2400 drums of waste currently stored on-site would also require treatment.

This Proposed Plan would make use of the DCF, a construction/ demolition debris facility for the basement debris, and an on-site thermal destruction unit.

To begin implementation of the Proposed Plan, the DCF would be constructed in 1988. Final details of the DCF dimensions would be determined after public comment on this plan and during detailed design engineering. Sewer sediment stored in the sewer sediment dewatering facility would be placed in the DCF upon its construction where it would remain until the thermal treatment unit would be ready for full-scale operation. The sewer sediment dewatering facility will remain on-site to be used as needed during other Love Canal remedial/operational efforts. The sewers were hydraulically cleaned and resulted in a waste that contained a very large volume of water and a small volume of sediments (400 cy) which have since been dewatered in a facility designed to treat such wastes. The sewer sediment dewatering facility could not be used to dewater the creek sediments since it is not nearly large enough, nor is it designed to treat wastes that have the physical characteristics of the creek sediment.

The creek sediment would be removed from the creeks in 1989 and placed in the DCF. The sediment contaminated with an average dioxin concentration greater than 1 ppb would be thermally treated. (One ppb is a level prescribed by the Centers for Disease Control (CDC) as a level of concern for dioxin in residential soils). As a performance standard, the residuals from thermal destruction would have to be delistable (i.e., be declared non-hazardous).

In order to comply with all "applicable, relevant and appropriate requirements" (ARARs) of the Superfund Amendments and Reauthorization Act of 1986, and to provide protection of human health and the environment during implementation, the thermal destruction unit would be required to demonstrate that it can achieve 99.9999 percent destruction and removal efficiency (six 9s DRE). The material being thermally treated would be the organic content of the sediment; the majority of the sediment and associated material is not organic and thus not subject to thermal destruction. The residual sediment that is left after thermal destruction would have virtually no organic material remaining. It is anticipated that thermal treatment would destroy the toxicity of the dioxin-contaminated sediments, and it is anticipated that the residual material would be delistable.

OPERATIONAL AND SCHEDULING CONSIDERATIONS

There are two major operational considerations involved in the proposed plan. The first has to do with the mechanics of introducing sediments of only one ppb, or above, to the thermal treatment unit. The second is concerned with the options for disposal of the treated residuals on the site.

First, with respect to the one ppb, or above, which would be fed into the thermal treatment unit, a number of engineering alternatives exist, including the following:

- o Remove creek sediments down to a predetermined depth, dewater in the DCF, and send all sediment to the thermal treatment unit.
- o Remove sediments down to various predetermined levels (e.g. 6" increments) and place in the DCF. Statistically sample the sediments, with those testing above 1 ppb going to thermal treatment. Those testing below 1 ppb could stay in the DCF.

Secondly, regarding the final disposal of the thermally treated sediments, there are also two options under considerration. The first option would be to dispose of the treated residuals in the DCF. The second option would be to place the residuals elsewhere on the Love Canal site. As a point of reference, if 35,000 cy of residuals were spread over the existing 40-acre cap, the depth would be approximately eight inches.

The final decision on which of the above options to use will be made following public comment and detailed engineering design.

In order to project the schedule for the creek and sewer clean-up, an estimate would be needed for the volume of sediment requiring remediation. It is anticipated that the entire quantity of sewer sediment (approximately 500 cy) and creek sediment (approximately 15,000 cy) would require treatment. The majority of the 2400 drums of waste stored on-site (activated carbon from the leachate treatment plant, inner sewer sediments, and miscellaneous solid waste from remedial efforts) would also be expected to require treatment. The 5,500 cy of basement debris is expected to be non-hazardous and therefore, would not require treatment and could be disposed of in a construction/demolition debris facility on the site.

It is difficult to determine the precise amount of material generated during the creek cleaning that would require treatment. As noted earlier, the volume of this "associated" material is currently estimated at 15,000 - 20,000 cy. EPA and the

State have directed the design contractor to revisit the design to determine if the volume of the material can be reduced. Specifically, to determine whether design modifications could eliminate or reduce the 6,000 cy of haul road material which may come into contact with contaminated creek sediments; and to evaluate replacing the daily cover (6,000 cy) with other similarly effective means of reducing potential odors and particulate releases. Since the revised estimates are not currently available, the total quantity of material requiring treatment, including associated material, is still estimated to be 25,000 - 35,000 cy.

The above estimates can be used with an approximate thermal destruction unit capacity of 5.0 tons/hr (based on 75% operational efficiency) to give an approximate thermal treatment period of about 12 to 16 months for 25,000 - 35,000 cy of sediments respectively. This leads to the estimated overall project schedule as shown in Figure 2 (assuming 25,000 cy of material would require treatment with a 5.0 ton/hr. unit).

COST ESTIMATES

A cost estimate of approximately $13 million has been prepared by the State for the DCF and creek excavation. This includes construction of the DCF, complete with a double liner, leachate collection and detection systems, and cap, as well as excavation of about 15,000 cy of sediment material and 25,000 cy of associated material.

Based on the estimate of 25,000 - 35,000 cy of material requiring thermal treatment, and a cost of $450 per ton for thermal treatment, $11.3 - 15.8 million would be required for thermal treatment. In addition, design, trial burns, and pre-treatment expenses would raise the total treatment to $13.4 - 18.1 million for the 25,000 - 35,000 cy of material. Thus, the estimated total cost is in the range of $26.4 - 31.1 million.

Figure 2

OVERALL REMEDIAL SCHEDULE

		1987	1988	1989	1990	1991
1.	Record of Decision	X				
2.	Construction of DCF		X			
3.	Excavate Creeks/Fill DCF			X		
4.	Thermal treatment procurement package	X	X			
5.	Installation of thermal treatment unit/test burn			X		
6.	Treat sediment above 1 ppb				X	X

Section 3

COMPARISON OF ALTERNATIVES

The recent draft feasibility study (FS) report entitled "Alternatives for Destruction/Disposal of Love Canal Creek and Sewer Sediments" described a large number of remedial alternatives. These alternatives were screened to three major options, which were also evaluated in the draft FS report. It is the purpose of Section 3 to summarize the comparative evaluations which led to the Proposed Plan.

In this section the statutory and regulatory requirements for selection of remedial action are first outlined, followed by the necessary comparative analyses of alternatives. The conclusion of the analyses is furnished at the end of this section.

STATUTORY AND REGULATORY REQUIREMENTS

The major directions provided for Superfund selection of remedy are provided by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the regulations contained in the National Contingency Plan (NCP). The evaluation of alternatives reflects the mandate to utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, as specified in Section 121 of SARA.

The SARA and NCP factors which relate to selection of Superfund remedies have been grouped into nine evaluation criteria. These nine criteria were listed in Section 1 of this report.

COMPARISONS

A comparative discussion of the three alternatives using the evaluation criteria are provided below.

Protection of Human Health and the Environment

Protection of human health and the environment is the central mandate of CERCLA as amended be SARA. Protection is achieved by reducing threats to acceptable levels and taking appropriate action to ensure that, in the future, there will be no unacceptable risks to human health and the environment through any exposure pathways.

All of the alternatives evaluated here are protective of human health and the environment. As noted above, the CDC level of concern for dioxin in residential soils is 1 ppb. The on-site thermal destruction alternatives provide the greatest degree of protection because both eliminate the toxicity of the materials which pose the threat from the creek and sewer sediments. Because thermal treatment of the sediment is expected to destroy the dioxin in the sediment, the potential mobility of dioxin in those sediments would also be eliminated.

Appropriate measures would need to be taken during creek excavation work and construction of the DCF (applicable to all three options) to protect workers and the community. In addition, prior to implementing either treatment alternative, measures would have to be taken to assure that implementation of these alternatives does not pose a threat to human health or the environment. A few of the potential problems which would need to be controlled are detailed below.

The possibility exists that an on-site transportable thermal destruction unit (TTDU) and/or associated air pollution control equipment, materials handling equipment, or materials pretreatment equipment may generate noise during routine operation. Any such noise would probably not be noticeable except during night-time operation (if night-time operation is acceptable to the community). Proprietors of TTDUs have indicated a willingness to house or insulate any noisy pieces of equipment or take any other measures necessary to eliminate the generation of noise.

There would be potential for dust and particulate generation during materials handling and pretreatment. The potential for air releases of products of incomplete combustion also exists. Measures would be taken to ensure that all these potential hazards are controlled prior to full-scale operation. Workers would be protected through measures outlined in project specific health and safety plans and through contractor adherence to Occupational Safety and Health Act (OSHA) regulations.

Under these alternatives, the DCF would be designed to meet all Federal and State applicable or relevant and appropriate requirements. The DCF may remain as a permanent structure and would, therefore, continue to impact the community aesthetically. If the residuals were disposed of off-site or on-site but not in the containment facility, the aesthetic aspect would be lessened since the size of the DCF could potentially be reduced.

For the thermal treatment/off-site disposal option, a major potential safety and noise impact would be the need to transport approximately 1500 - 2000 truckloads of the treated residuals to an off-site disposal facility. On balance, the on-site containment option would have the least problems during the remedial action implementation phase.

Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, as amended by SARA, requires that remedial actions comply with requirements or standards under Federal and State environmental laws. The requirements that must be complied with are those that are applicable or relevant and appropriate to the hazardous substances, pollutants, or contaminants that remain on-site.

Each of the alternatives would comply with applicable or relevant and appropriate requirements (ARARs). The on-site containment facility will comply with all the requirements of Part 264 Subpart N of RCRA (Subpart N specifies design requirements such as the DCF) for a Subtitle C facility and Title 6, Part 373 of the New York Compilation of Rules and Regulations (e.g., secondary containment, leachate collection and detection systems). The construction/demolition debris facility would comply with Part 257 of RCRA for a Subtitle D facility and Title 6, Part 360 of the New York Compilation of Rules and Regulations. Consistent with SARA, the continued effectiveness of the DCF would be evaluated every five years to assure continued protection of human health and the environment.

The land ban regulations governing the disposal of dioxin-contaminated wastes are expected to go into effect in November 1988. It has become apparent that the creek sediment will not be excavated until 1989. Therefore, final disposal of the sediment in the DCF (i.e., Alternative 1) would have to comply with the land ban regulations. The land ban regulations state that dioxin-contaminated materials may only be land disposed if they pass the proposed toxicity characteristics leaching procedure (TCLP) test (see Appendix A of the 1987 draft FS for a more detailed discussion). Based upon existing results of the dioxin analyses of the creek sediment (see data tables provided in CH2M Hill report), it is expected that the excavated sediment would pass the existing proposed TCLP test. Under Alternatives 2 and 3 the treated sediments (residuals) are required to be delistable and, therefore, would also pass the TCLP.

Permits are not required for on-site remedial actions at Superfund sites. Although formal permits are not required, any action must meet the substantive technical requirements of the permit process. The thermal destruction process would comply with all the applicable requirements of Part 264 Subpart O of RCRA (Subpart O specifies design requirements for operation of hazardous waste incinerators).

Operation of an on-site thermal destruction unit would require that the transportable unit undergo waste specific trial or demonstration burns to demonstrate satisfactory destruction of the toxic components of the waste. Of specific importance during trial burn or demonstration burn evaluations are the need to achieve six 9s DRE, and ensure that air emissions of products of incomplete combustion and particulates are controlled. Specific requirements for operation of a unit would be established based upon results of trial or demonstration burns. Under Alternative 3, off-site disposal of residuals would require that the residuals be delistable (i.e., certified as non-hazardous). Similarly, if it was determined under Alternative 2 that the residuals should not be placed in the DCF, but rather disposed of on-site in some other fashion, the material would also be subject to a delisting analysis.

Reduction of Toxicity, Mobility, or Volume

This evaluation criteria relates to the performance of a technology or remedial alternative in terms of eliminating or controlling risks posed by the toxicity, mobility or volume of hazardous substances.

Under Alternative 1, in addition to dewatering the sediments, the DCF is meant to contain the contaminants and prevent their migration out of the facility (vs. leaving the sediments in the creeks and sewers where the potential for migration and bio-accumulation would be high). Dioxin, the contaminant of concern, has limited solubility in water, is not volatile, and binds tightly to sediments. Therefore, the DCF should effectively prevent the migration of dioxin (i.e., it reduces mobility). The land disposal alternative does not provide a reduction in the toxicity or volume of sediments since it is not a treatment alternative.

While the thermal destruction alternatives would certainly reduce the toxicity of the creek and sewer sediments, the volume of the material would not be reduced to any great degree since the creek sediments have a very low organic matter content. Only the volume of highly organic vegetative material overlying the creek bed and the sewer sediment (which together only represent a small percentage of the total quantity of material) would be substantially reduced. The long-term mobility of the contamination would be reduced by thermal destruction since the materials would be detoxified, but there would be a limited increase in the mobility of contaminants over the short-term due to air releases of products of incomplete combustion and increased materials handling. This would be controlled through careful implementation of the thermal process. The only difference between the thermal destruction alternatives is that Alternative 3 would result in a smaller volume of material being disposed on-site.

Short-Term Effectiveness

Short-term effectiveness measures how well an alternative is expected to perform, the time to achieve performance and the potential adverse impacts of its implementation.

Alternative 1, final on-site land disposal of creek and sewer sediments in the DCF, provides a greater degree of protection over the short-term. This is due to the fact that there are no short-term construction activities associated with this alternative (beyond those already called for in the 1985 Record of Decision) and, therefore, no related short term impacts of concern. The on-site thermal destruction alternatives would require some additional degree of materials handling on-site, such as pretreatment (e.g., shredding, crushing) of the material prior to feeding to the thermal destruction unit. The thermal destruction alternatives may result in air emissions from operation of the thermal destruction unit. As noted above, strict measures would be implemented to ensure that such emissions would not be harmful to human health or the environment.

Alternative 3 would require off-site disposal of residuals. This would require the loading of the residuals onto trucks for off-site transport. If 25,000 cy are thermally treated and it is assumed that 1 cy of untreated sediment would result in 1 cy of treated residual, then more than 1500 17 cy trucks would have to be loaded for transport of residuals to an off-site facility. This would result in a great deal of truck traffic through the community and other communities enroute to an off-site disposal site.

There is a wide variation in the time required to implement and complete action called for in the alternatives. The excavation of the creeks is not likely to be completed until 1989. It is possible that the sediments may not be sufficiently dewatered until 1990, at which time the facility could be capped and closed if necessary. Alternative 1 calls for final disposal of the sediments in the DCF and, therefore, would not require any additional time or action to implement.

The on-site thermal destruction options (Alternatives 2 and 3) would require similar steps and timeframes leading up to full-scale operation. Figure 3 outlines those steps and estimated time-frames. The required time ranges from 32 to 60 months. It is envisioned that the first element, the procurement of a design contractor for preparation of bid specifications for treatment of the wastes, could begin immediately. The procurement of a contractor to treat the wastes could be carried out upon the completion of the design phase.

Figure 3

Transportable Thermal Destruction Unit - Estimated Time Frames for Events Leading to Start-Up Full-Scale Operation

State procurement of design contractor*
6 months - 10 months

Performance of RD
9 months - 1 year

State procurement of a vendor for RA
6 months - 1 year

Permitting/Approval to trial burn (TB) or demonstration burn
4 months - 1 year

Mobilization
2-3 months

Trial burn/ demonstration burn
1-4 months

Review TB/demonstration burn results.
Petition to delist Process residues.
Issue full approval or permit to operate
4-7 months

Start-up Full-Scale Operation

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*Design contractor will perform necessary studies/tests to adequately define waste characteristics and prepare performance based bid specifications used for the selection of a vendor, as well as establishing criteria for evaluating different vendor technologies.

It is not likely that trial burns would begin until after the summer of 1989. At best, the initiation of full-scale operation could probably come close to coinciding with the completion of the sediment placement in the DCF. Using the longer end of the range, full-scale operation would not begin until the fall of 1992. After full scale operation is initiated, the treatment of the wastes (assume 25,000 cy) under Alternative 2 could be conducted in about one year if a unit with a capacity of 5.0 tons per hour (capacity based on 75% operational efficiency) were operated 24 hours a day. This would put the completion date for treatment at 1991 to 1993. Under Alternative 2, there would be two options for disposal of the residuals. The first option would involve putting the residuals back in the DCF. The second option would be to dispose of the residuals on-site in some other fashion rather than in the DCF. If the DCF was used for residual disposal, the closure of the DCF would place the final completion date to 1992 to 1994. It is anticipated that other on-site disposal options could be accomplished in the same time frame. The timeframe for capping and closing the DCF under Alternative 3 would essentially be the same as for Alternative 2.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence addresses the long-term protection and reliability an alternative affords.

Over the long-term the on-site thermal destruction options provide essentially equivalent protection to the local community. As mentioned earlier, the residuals from thermal destruction are expected to be decontaminated; therefore, whether the residuals are disposed off-site or on-site is of no concern from a health perspective. Both of the on-site destruction options provide greater protection than the final on-site land disposal alternative since both eliminate the toxicity threat posed by sediments which contain an average concentration of dioxin above 1 ppb.

The final disposal in the DCF under Alternative 1 prevents exposure to the sediments. Dioxin, the contaminant of concern in the creek and sewer sediments, has been found at the low ppb level in the top 12" of creek sediment/bed (highest detected concentration = 46 ppb). No dioxin has been detected in sediment/bed below the one foot mark. Current plans call for removal of the top 18" of creek sediment/bed. In addition to the 25,000 - 35,000 cy of creek sediment and associated material (less basement material) approximately 500 cy of sewer sediment would be stored in the facility. Based on previous sample results the average concentration of dioxin in the sewer sediment is expected to be higher than the average concentration of dioxin in the creek sediment. The quantity of sewer sediment only represents 1% of the quantity of creek sediment. Dioxin has a very limited solubility in water, is not volatile, and binds tightly to sediment soil.

Therefore, exposure to the sediments, not the leachate generated from dewatering during storage, is of most concern. Human exposure to the sediments during containment in the DCF designed to meet all applicable or relevant and appropriate requirements for a RCRA facility would not be likely.

Under Alternative 1, the stored sediments would continue to contain dioxin and, therefore, would not be as "clean" as material generated from thermal destruction of the sediments. The permanent disposal option does not provide a permanent reduction in toxicity of the waste and would require some degree of long-term waste management such as general maintenance or replacement of the facility. In addition, the disposal remedy would have to be revisited every five years (as part of revisiting the wastes contained in Love Canal proper) to ensure the continued effectiveness of the facility.

Implementability

Implementability considerations address how easy or difficult, feasible or infeasible it would be to carry out a given alternative from design through construction and operation and maintenance.

The implementability of the alternatives is evaluated in terms of technical and administrative feasibility, and availability of needed goods and services. The alternatives evaluated here are all technically feasible. However, there are some minor implementation problems associated with each of the alternatives.

As noted above, interim storage of the sediments is necessary prior to the implementation of any treatment alternative so that the sediments could be further dewatered, characterized, crushed, etc. Routine maintenance and monitoring of the DCF during the timeframe for further dewatering and processing would ensure reliability and minimize the potential for failure. If monitoring indicates a problem with the DCF, the appropriate maintenance or repairs would be made. It should be noted that selection of Alternative 1 may require that the DCF facility undergo major repair or replacement over the long-term. Such repairs may result in a limited increase in the potential for human exposure to the sediments.

In implementing Alternatives 2 and 3, it is important to note that it may be very difficult from an engineering perspective to selectively separate sediments which contain average levels of dioxin above 1 ppb from those below 1 ppb. It may turn out that this separation could not be implemented and that the entire 35,000 cy of material may need to be treated.

As noted above, Alternative 2 and 3 are expected to be completed in 1992 to 1994 (assuming 25,000 cy require treatment and using a 5 ton/hr. unit). The time required for actual on-site thermal destruction could potentially be decreased by using two or more transportable units; however, due to space limitations, it is unlikely that two or more units would be used at the site.

Routine maintenance and monitoring of the thermal destruction unit would ensure reliability and minimize the potential for failure. If monitoring indicates the potential for failure of the thermal destruction unit, the unit would be shut down until corrective measures are taken.

Operation of thermal destruction units has shown that they are capable of successfully destroying dioxin-contaminated materials and are able to meet applicable or relevant and appropriate requirements. In addition, operation of the EPA mobile incinerator system has demonstrated that the residues from the treatment of dioxin-contaminated materials can be successfully delisted. Process wastewater from the on-site thermal destruction could be treated at the Love Canal leachate treatment plant. Depending upon the size of the thermal destruction unit and the equipment required for pretreatment of materials, the fenceline at Love Canal may have to be expanded to site the unit and accessories.

It should be noted that full-scale operation of transportable units at hazardous waste sites has been limited. Units have experienced extended periods of downtime. It is likely that operation of a unit at Love Canal would also result in some extended downtime periods. The downtime periods would delay the completion of thermal destruction of wastes and ultimately closure of the DCF.

As stated above, transportable thermal destruction units are currently available for use at hazardous waste sites and could be used at Love Canal. There would also be sufficient disposal capacity on-site in the DCF for final disposal of the creek and sewer sediments.

The residuals from the thermal destruction process are expected to be delisted, however; it is unlikely that an off-site facility would accept Love Canal materials. Therefore, the residual materials would have to be returned to the DCF or disposed of on-site in some other manner. If an off-site subtitle D facility agreed to accept the delisted material, the DCF would still be needed to contain those materials which contain less than 1 ppb dioxin (if it would be technically feasible to separate sediments above 1 ppb from sediments below 1 ppb). It is possible that the size of the facility could be altered if a

TABLE 1
TRANSPORTABLE THERMAL DESTRUCTION UNIT
TOTAL COST/TON ($/TON)

Based on a Total of 25,000 - 40,000 Cubic Yards of Sediment

% Moisture		
20(1)	Range	150-450
	Median	200
	Mean	230
50(2)	Range	150-400
	Median	260
	Mean	260
70(3)	Range	170-350
	Median/Mean	260

(1) Costs at 20% moisture were obtained from responses to questionaires received from five thermal destruction unit designers and/or manufacturers.

(2) Costs at 50% moisture were obtained from six designers and/or manufacturers.

(3) Costs at 70% moisture were obtained from two designers/ manufacturers.

substantial quantity of material were treated and disposed of off-site or disposed on-site in some fashion other than in the DCF. Therefore, some degree of aesthetic impacts of the DCF may continue under any of the three on-site alternatives.

Cost

Costs are evaluated in terms of remedial action costs and replacement costs. As noted above, the baseline cost for the creek remedy selected under the 1985 ROD (i.e., construction of the DCF and creek sediment excavation) is estimated to be $13 million. This $13 million would be included in the anticipated costs for Alternatives 1-3.

The final on-site land disposal alternative has the lowest cost over the short-term since it does not require any additional action above that called for in 1985 ROD. Therefore, the total cost for this alternative would be the baseline cost of $13 million for creek remediation. However, this alternative does not provide a permanent reduction in the toxicity of those sediments which pose the threat.

Table 1 provides cost/ton estimates for on-site thermal destruction of the sediments. The estimates were provided by proprietors of transportable thermal destruction units. The estimates are for the introduction of the waste to the unit and removal of ash residue from the unit. It should be noted that the estimates do not include site preparation or waste preparation and handling, etc. Materials pretreatment (sizing, shredding, crushing) is estimated to add approximately 10% to the processing costs. Estimates also exclude trial burn expenses, which are estimated to be $500,000.

An estimated cost of $450/cy for on-site thermal destruction of 25,000 cy was determined using the median value provided in Table 1; an estimate of a percent moisture content of 50% (1985 ROD); and a bulk density representative of moisture free sediments equal to 1.33 (g/ml). These assumptions result in a conversion factor of 1.68 tons of sediment per cy sediment and a total cost of $11.3 - $15.8 million to treat 25,000 - 35,000 cy of sediment. Applying the same assumptions and using the cost range in Table 1, it can be seen that there is a very large range in total cost for on-site thermal destruction. The costs range from $6.3 - $16.8 million for processing the 25,000 cy materials from the front end to back end of the TTDU and $8.8 - $23.5 million if 35,000 cy of material requires treatment.

Using the median value, the total costs for treating 25,000 cy of the waste (including trial burns and pretreatment) is estimated to be $12.9 million. The performance of tests and studies necessary for the preparation of bid specifications is estimated to add approximately $500,000 to the total. Therefore, the complete remedial cost for excavation of the creeks (1985 ROD) and treatment of 25,000 cy of sediments would be approximately $26.4 million. Assuming 35,000 cy of material require treatment and making the same assumptions as above, the cost for implementing Alternative 2 would $31.3 million.

The costs for the treatment portion of Alternative 3 are identical to those provided under Alternative 2. Additional costs would be incurred for transportation of residual material to the off-site disposal facility and disposal of the residuals.

Assuming 25,000 cy of sediments require treatment and that the volume of the residual treated sediment (moisture free) is also about 25,000 cy, then approximately 1500 (17cy) truck loads of material would need to be disposed off-site. Assuming that a disposal facility is located within 100 miles of the facility, and cost per loaded mile is $3.50, then transporation costs would total $525,000. Disposal costs at a subtitle D facility are estimated to be $980,000 (assuming a tipping fee of $35 per ton and a conversion factor of 1.12 tons/cy for moisture free residuals).

Under Alternative 3, the estimated cost for thermal destruction and disposal of 25,000 cy of sediment would be $14.9 million. Therefore, the complete remedial action cost for excavation of the creeks (1985 ROD) and treatment and disposal of the sediments would be approximately $27.9 million. Applying the same assumptions and basing estimate on treatment of 35,000 cy of sediments the estimated cost for implementing Alternative 3 is $33.4 million.

Under Alternatives 2 and 3, additional costs may be incurred if the residuals are not returned to the DCF and the DCF is altered or dismantled to accommodate a smaller volume of material.

As stated above, it may be very difficult from an engineering perspective to selectively separate sediments which contain average levels of dioxin above 1 ppb from those below 1 ppb. It may turn out that this separation could not be implemented and that the entire 35,000 cy of material may need to be treated. Conversely, segregation of materials and sampling of the sediments could indicate that the quantity of material requiring treatment is less than 25,000 cy, and concurrently the cost estimate would decrease. A smaller quantity of material may result in a higher treatment cost per ton depending on the quantity of material requiring treatment. The cost per ton to thermally treat wastes with transportable units generally increases as the quantity of material requiring treatment decreases. This effect becomes more pronounced as the quantity of material is reduced below 10,000 cy.

All of the alternatives examined here may require long-term operation and maintenance of the DCF. These costs are expected to be low since the DCF will be built on land currently being maintained under the remedial program (e.g., limited incremental lawn maintenance costs) and since the DCF would utilize the existing Love Canal leachate treatment plant for treatment of any leachate (generation of leachate is expected to be minimal after the sediments are dewatered and the facility is closed (1990)). In addition, monitoring wells would be monitored as part of the existing Love Canal perimeter well monitoring program.

The operation and maintance costs for a 20,000 cy containment facility were estimated by CH2M Hill (1985 FS report) to be $3000/yr. It is estimated that it would cost $5000/yr for operation of a 40,000 cy facility. Replacement or major repair costs may be necessary over the long-term (i.e. 20-40 yrs.). Both on-site thermal destruction options would also require similar expenses for operation and maintenance if the DCF was not dismantled.

Studies to be performed every five years to ensure the continued effectiveness of Alternative 1 would be included as part of a larger five year study to ensure the continued effectiveness of the containment of Love Canal proper. The costs associated with the review of the DCF as part of a five year review are not expected to exceed $100,000 per review.

Community Acceptance

This evaluation criteria addresses the degree to which members of the local community support the remedial alternatives being evaluated.

The local community may have a mixed degree of acceptance of all alternatives due to various short-term remedial action impacts and aesthetic impacts.

It appears as though the community in general opposes storage or final disposal of any sediments in an on-site containment facility. As noted above, it is possible that each of the alternatives evaluated here would require disposal of material in the DCF. In addition, the on-site treatment alternatives require interim storage of sediments that require treatment. The DCF is needed so that the materials may be further dewatered, characterized, sized, crushed, ground, etc., prior to treatment.

Some members of the community are opposed to the operation of an on-site thermal destruction unit, while others are in favor of final destruction of the wastes. Members of the community have questioned whether the operation of an on-site thermal destruction unit would delay rehabitation of the Emergency Declaration Area (EDA) until 1992-1994. Some members of the community even oppose the removal of the sediments from the creeks (required under 1985 ROD). It is apparent that the community in general would prefer off-site treatment or disposal of the sediments, yet this is not feasible since no off-site commercial facilities are permitted to treat or dispose of dioxin-contaminated wastes.

State Acceptance

The State acceptance addresses the concern and degree of support that the State government has expressed regarding the remedial alternative being evaluated.

The State appears to support the thermal destruction of excavated creek and sewer sediments and the thermal destruction of all existing waste material stored on the Love Canal site ending up with a delistable waste.

CONCLUSION

Based on the information available to evaluate the three remedial options against these nine criteria, EPA has concluded that Alternative 2 would be the Agency's preferred alternative at this point in time. This alternative would be protective of human health and the environment, attain all applicable or relevant and appropriate requirements, and be cost-effective. Additionally, because this alternative employs thermal destruction to eliminate the principal threat at the site (dioxin greater than 1 ppb), this option would also satisfy SARA's preference for remedies which employ treatment, as their principal element to reduce toxicity, mobility or volume.

Although this remedy would require measures to control possible risks related to its construction and operation, the Agency's analysis indicates that all of these risks can be satisfactorily controlled. Additionally, any short-term risks appear heavily outweighed by the long-term effectiveness and permanence this remedy would provide. The Agency believes this remedy would avoid the long-term uncertainties associated with land disposal, and would utilize a permanent solution and alternative treatment technology to the maximum extent practicable for this site.

The Agency solicits public comment on the preferred option. All relevant comments will be incorporated into the Final Plan.

APPENDIX C

TDF MASS AND THERMAL BALANCE DATA

FUEL CONSUMPTION AND TOTAL HEAT INPUT FOR KILN

INLET TEMP. = 70 DEG. F
OUTLET TEMP. = 1,800 DEG. F
EXCESS AIR = 100%
FUEL = NO. 2 FUEL OIL
NET HEAT AVAILABLE @ 1,800 DEG. F = 25,858 BTU/GAL
HEAT LOSS = 5%

% MOISTURE OF KILN FEED	NO. 2 FUEL OIL CONSUMPTION (GAL/HR) AT GIVEN SOIL FEED RATE			TOTAL HEAT INPUT (MMBTU/HR) AT GIVEN SOIL FEED RATE		
	5 TON/HR	10 TON/HR	15 TON/HR	5 TON/HR	10 TON/HR	15 TON/HR
0	140.85	281.70	422.55	19.677	39.354	59.032
5	173.25	346.51	519.76	24.204	48.408	72.612
10	205.66	411.32	616.97	28.731	57.462	86.193
15	238.06	476.12	714.19	33.258	66.516	99.774
20	270.47	540.93	811.40	37.785	75.570	113.355
25	302.87	605.74	908.61	42.312	84.624	126.936
30	335.27	670.55	1005.82	46.839	93.678	140.516
35	367.68	735.36	1103.03	51.366	102.732	154.097
40	400.08	800.16	1200.25	55.893	111.785	167.678
45	432.49	864.97	1297.46	60.420	120.839	181.259
50	464.89	929.78	1394.67	64.947	129.893	194.840

KILN EXHAUST GAS FLOW RATES

SOIL FEED RATE = 5 TON/HR

		TOTAL DRY GAS		TOTAL WATER		TOTAL EXHAU
MOISTURE KILN FEED	FUEL (GAL/HR)	LB/HR	ACFM	LB/HR	ACFM	LB/HR
0	140.85	29,424.88	27,937.45	1,385.26	2,114.83	30,810.14
5	173.25	36,194.37	34,364.74	2,203.96	3,364.71	38,398.32
10	205.66	42,963.86	40,792.03	3,022.65	4,614.58	45,986.50
15	238.06	49,733.34	47,219.32	3,841.34	5,864.45	53,574.68
20	270.47	56,502.83	53,646.61	4,660.04	7,114.32	61,162.87
25	302.87	63,272.32	60,073.90	5,478.73	8,364.19	68,751.05
30	335.27	70,041.80	66,501.19	6,297.42	9,614.06	76,339.23
35	367.68	76,811.29	72,928.48	7,116.12	10,863.94	83,927.41
40	400.08	83,580.78	79,355.77	7,934.81	12,113.81	91,515.59
45	432.49	90,350.27	85,783.06	8,753.50	13,363.68	99,103.77
50	464.89	97,119.75	92,210.35	9,572.20	14,613.55	106,691.95

SOIL FEED RATE = 10 TON/HR

		TOTAL DRY GAS		TOTAL WATER		TOTAL EXHAU
MOISTURE KILN FEED	FUEL (GAL/HR)	LB/HR	ACFM	LB/HR	ACFM	LB/HR
0	281.70	58,849.76	55,809.19	2,770.52	4,229.67	61,620.29
5	346.51	72,388.74	68,648.65	4,407.91	6,729.41	76,796.65
10	411.32	85,927.71	81,488.11	6,045.30	9,229.15	91,973.01
15	476.12	99,466.69	94,327.57	7,682.68	11,728.90	107,149.37
20	540.93	113,005.66	107,167.03	9,320.07	14,228.64	122,325.73
25	605.74	126,544.63	120,006.49	10,957.46	16,728.39	137,502.09
30	670.55	140,083.61	132,845.96	12,594.84	19,228.13	152,678.45
35	735.36	153,622.58	145,685.42	14,232.23	21,727.87	167,854.81
40	800.16	167,161.56	158,524.88	15,869.62	24,227.62	183,031.17
45	864.97	180,700.53	171,364.34	17,507.00	26,727.36	198,207.54
50	929.78	194,239.51	184,203.80	19,144.39	29,227.10	213,383.90

SOIL FEED RATE = 15 TON/HR

		TOTAL DRY GAS		TOTAL WATER		TOTAL EXHAU
MOISTURE KILN FEED	FUEL (GAL/HR)	LB/HR	ACFM	LB/HR	ACFM	LB/HR
0	422.55	88,274.64	83,713.79	4,155.79	6,344.50	92,430.43
5	519.76	108,583.10	102,972.98	6,611.87	10,094.12	115,194.97
10	616.97	128,891.57	122,232.17	9,067.95	13,843.73	137,959.51
15	714.19	149,200.03	141,491.36	11,524.03	17,593.35	160,724.05
20	811.40	169,508.49	160,750.55	13,980.11	21,342.96	183,488.60
25	908.61	189,816.95	180,009.74	16,436.19	25,092.58	206,253.14
30	1005.82	210,125.41	199,268.93	18,892.27	28,842.19	229,017.68
35	1103.03	230,433.87	218,528.12	21,348.35	32,591.81	251,782.22
40	1200.25	250,742.34	237,787.32	23,804.43	36,341.42	274,546.76
45	1297.46	271,050.80	257,046.51	26,260.51	40,091.04	297,311.30
50	1394.67	291,359.26	276,305.70	28,716.59	43,840.66	320,075.85

FUEL CONSUMPTION AND TOTAL HEAT INPUT FOR AFTERBURNER

INLET TEMP. = 1,800 DEG. F
OUTLET TEMP. = 2,200 DEG. F
EXCESS AIR = 20%
FUEL = NO. 2 FUEL OIL
NET HEAT AVAILABLE @ 2200 DEG. F = 49,294
HEAT LOSS = 5%

% MOISTURE OF KILN FEED	NO. 2 FUEL OIL CONSUMPTION (GAL/HR) AT GIVEN SOIL FEED RATE			TOTAL HEAT INPUT (MMBTU/HR) AT GIVEN SOIL FEED RATE		
	5 TON/HR	10 TON/HR	15 TON/HR	5 TON/HR	10 TON/HR	15 TON/HR
0	78.96	157.93	236.89	11.031	22.063	33.094
5	99.71	199.42	299.14	13.930	27.860	41.790
10	120.46	240.92	361.38	16.829	33.657	50.486
15	141.21	282.42	423.63	19.727	39.455	59.182
20	161.96	323.92	485.88	22.626	45.252	67.878
25	182.71	365.42	548.12	25.525	51.050	76.574
30	203.46	406.91	610.37	28.423	56.847	85.270
35	224.21	448.41	672.62	31.322	62.644	93.967
40	244.95	489.91	734.86	34.221	68.442	102.663
45	265.70	531.41	797.11	37.120	74.239	111.359
50	286.45	572.90	859.36	40.018	80.036	120.055

AFTERBURNER EXHAUST GAS FLOW RATES

KILN SOIL FEED RATE = 5 TON/HR

% MOISTURE	FUEL	TOTAL DRY GAS		TOTAL WATER		TOTAL EXHAL
F KILN FEED	(GAL/HR)	LB/HR	ACFM	LB/HR	ACFM	LB/HR
0	78.96	39,337.63	43,927.02	2,076.27	3,733.82	41,413.89
5	99.71	48,711.88	54,394.93	3,076.53	5,532.63	51,788.41
10	120.46	58,086.12	64,862.84	4,076.80	7,331.45	62,162.92
15	141.21	67,460.37	75,330.75	5,077.07	9,130.26	72,537.44
20	161.96	76,834.62	85,798.66	6,077.33	10,929.07	82,911.96
25	182.71	86,208.87	96,266.57	7,077.60	12,727.89	93,286.47
30	203.46	95,583.12	106,734.48	8,077.87	14,526.70	103,660.99
35	224.21	104,957.37	117,202.39	9,078.14	16,325.52	114,035.50
40	244.95	114,331.62	127,670.30	10,078.40	18,124.33	124,410.02
45	265.70	123,705.86	138,138.21	11,078.67	19,923.14	134,784.54
50	286.45	133,080.11	148,606.13	12,078.94	21,721.96	145,159.05

SOIL FEED RATE = 10 TON/HR

% MOISTURE	FUEL	TOTAL DRY GAS		TOTAL WATER		TOTAL EXHAL
F KILN FEED	(GAL/HR)	LB/HR	ACFM	LB/HR	ACFM	LB/HR
0	157.93	78,675.25	87,854.03	4,152.53	7,467.63	82,827.78
5	199.42	97,423.75	108,789.86	6,153.06	11,065.26	103,576.82
10	240.92	116,172.25	129,725.68	8,153.60	14,662.89	124,325.85
15	282.42	134,920.75	150,661.50	10,154.13	18,260.52	145,074.88
20	323.92	153,669.24	171,597.32	12,154.67	21,858.15	165,823.91
25	365.42	172,417.74	192,533.14	14,155.20	25,455.78	186,572.94
30	406.91	191,166.24	213,468.96	16,155.74	29,053.40	207,321.98
35	448.41	209,914.73	234,404.79	18,156.27	32,651.03	228,071.01
40	489.91	228,663.23	255,340.61	20,156.81	36,248.66	248,820.04
45	531.41	247,411.73	276,276.43	22,157.34	39,846.29	269,569.07
50	572.90	266,160.22	297,212.25	24,157.88	43,443.92	290,318.10

SOIL FEED RATE = 15 TON/HR

% MOISTURE	FUEL	TOTAL DRY GAS		TOTAL WATER		TOTAL EXHAL
F KILN FEED	(GAL/HR)	LB/HR	ACFM	LB/HR	ACFM	LB/HR
0	236.89	118,012.88	131,781.05	6,228.80	11,201.45	124,241.68
5	299.14	146,135.63	163,184.78	9,229.60	16,597.89	155,365.23
10	361.38	174,258.37	194,588.52	12,230.40	21,994.34	186,488.77
15	423.63	202,381.12	225,992.25	15,231.20	27,390.78	217,612.32
20	485.88	230,503.86	257,395.98	18,232.00	32,787.22	248,735.87
25	548.12	258,626.61	288,799.71	21,232.81	38,183.66	279,859.42
30	610.37	286,749.35	320,203.45	24,233.61	43,580.11	310,982.96
35	672.62	314,872.10	351,607.18	27,234.41	48,976.55	342,106.51
40	734.86	342,994.85	383,010.91	30,235.21	54,372.99	373,230.06
45	797.11	371,117.59	414,414.64	33,236.02	59,769.43	404,353.61
50	859.36	399,240.34	445,818.38	36,236.82	65,165.88	435,477.15

APPENDIX D

TDF DESIGN DATA

KILN AND AFTERBURNER DESIGN

ASSUMPTIONS:

Soil Moisture Content	20 %
Kiln Excess Air	100 %
Kiln Heat Release	20,000 BTU/hr-cu.ft.
5 TPH Kiln Inside Diameter	10.0 ft.
10 TPH Kiln Inside Diameter	13.0 ft.
5 TPH Afterburner Inside Diameter	12.0 ft.
10 TPH Afterburner Inside Diameter	17.0 ft.
Afterburner Retention Time	2.0 sec
Refractory Thickness	0.75 ft.

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Kiln No. 2 Fuel Oil Consumption (gal/hr)	270.47	540.93
Kiln Natural Gas Consumption (cu.ft./hr)	37,785	75,570
Kiln Heat Input (MMBTU/hr)	37.785	75.570
Kiln Volume (cu.ft.)	1889.25	3778.5
Kiln Length (ft.)	24.05	28.47
Afterburner No. 2 Fuel Oil Consumption (gal/hr)	161.96	323.92
Afterburner Natural Gas Consumption (cu.ft./hr)	22,626	45,253
Afterburner Gas Flow Rate (ACFM)	96,727.73	193,455.47
Afterburner Gas Velocity (ft./sec.)	14.25	14.21
Afterburner Length (ft.)	28.51	28.41

DESIGN AND WATER USAGE OF PRECOOLER, VENTURI SCRUBBER, AND PACKED TOWER

PRECOOLER WATER USAGE ASSUMPTIONS:

Inlet Temperature = 600 Deg. F
Outlet Temperature = 150 Deg. F
Enthalpy of Water @ Inlet Temperature = 1307.12 BTU/lb
Enthalpy of Air @ Inlet Temperature = 131.69 BTU/lb
Enthalpy of Water @ Outlet Temperature = 1091.92 BTU/lb
Enthalpy of Air @ Outlet Temperature = 21.61 BTU/lb
Precooler Water Entalpy = 970 BTU/lb
Precooler Water Density = 8.354 lb/gal

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Exhaust Gas Water Flow Rate (lb/hr)	6,077.33	12,154.67
Exhaust Gas Air Flow Rate (lb/hr)	76,834.62	153,669.24
Heat Loss Due to Temperature Reduction (MMBTU/hr)	9.77	19.53
Precooler Water Required (lb/hr)	10,067.83	20,135.66
Precooler Water Required (gal/hr)	1,205.15	2,410.30
Precooler Water Required (gal/min)	20.09	40.17

VENTURI SCRUBBER AND PACKED TOWER DESIGN AND WATER USAGE ASSUMPTIONS:

Afterburner Exit Temperature = 2,200 Deg. F
Venturi Scrubber Inlet Temperature = 150 Deg. F
Venturi Scrubber Throat Velocity = 400 ft/sec
Venturi Scrubber Water Required = 6 gal/1000 cu.ft.
Packed Tower Water Required = 2.5 gal/1000 cu.ft.

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Afterburner Exhaust Gas Flow Rate (ACFM)	96,727.73	193,455.47
Venturi Srubber Inlet Gas Flow Rate (ACFM)	22,181.92	44,363.85
Venturi Scrubber Throat Area (sq.ft.)	0.924	1.848
Venturi Scrubber Water Required (gal/min)	133.09	266.18
Packed Tower Water Required (gal/min)	55.45	110.91

KILN AND AFTERBURNER DESIGN

ASSUMPTIONS:

Soil Moisture Content	40 %
Kiln Excess Air	100 %
Kiln Heat Release	20,000 BTU/hr-cu.ft.
5 TPH Kiln Inside Diameter	11.0 ft.
10 TPH Kiln Inside Diameter	15.5 ft.
5 TPH Afterburner Inside Diameter	14.5 ft.
10 TPH Afterburner Inside Diameter	20.5 ft.
Afterburner Retention Time	2.0 sec
Refractory Thickness	0.75 ft.

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Kiln No. 2 Fuel Oil Consumption (gal/hr)	400.08	800.16
Kiln Natural Gas Consumption (cu.ft./hr)	55,893	111,785
Kiln Heat Input (MMBTU/hr)	55.893	111.785
Kiln Volume (cu.ft.)	2794.65	5589.25
Kiln Length (ft.)	29.41	29.62
Afterburner No. 2 Fuel Oil Consumption (gal/hr)	244.95	489.91
Afterburner Natural Gas Consumption (cu.ft./hr)	34,220	68,442
Afterburner Gas Flow Rate (ACFM)	145,794.63	291,589.27
Afterburner Gas Velocity (ft./sec.)	14.72	14.72
Afterburner Length (ft.)	29.43	29.45

DESIGN AND WATER USAGE OF PRECOOLER, VENTURI SCRUBBER, AND PACKED TOWER

PRECOOLER WATER USAGE ASSUMPTIONS:

Inlet Temperature = 600 Deg. F
Outlet Temperature = 150 Deg. F
Enthalpy of Water @ Inlet Temperature = 1307.12 BTU/lb
Enthalpy of Air @ Inlet Temperature = 131.69 BTU/lb
Enthalpy of Water @ Outlet Temperature = 1091.92 BTU/lb
Enthalpy of Air @ Outlet Temperature = 21.61 BTU/lb
Precooler Water Entalpy = 970 BTU/lb
Precooler Water Density = 8.354 lb/gal

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Exhaust Gas Water Flow Rate (lb/hr)	10,078.40	20,156.81
Exhaust Gas Air Flow Rate (lb/hr)	114,331.62	228,663.23
Heat Loss Due to Temperature Reduction (MMBTU/hr)	14.75	29.51
Precooler Water Required (lb/hr)	15,210.82	30,421.64
Precooler Water Required (gal/hr)	1,820.78	3,641.57
Precooler Water Required (gal/min)	30.35	60.69

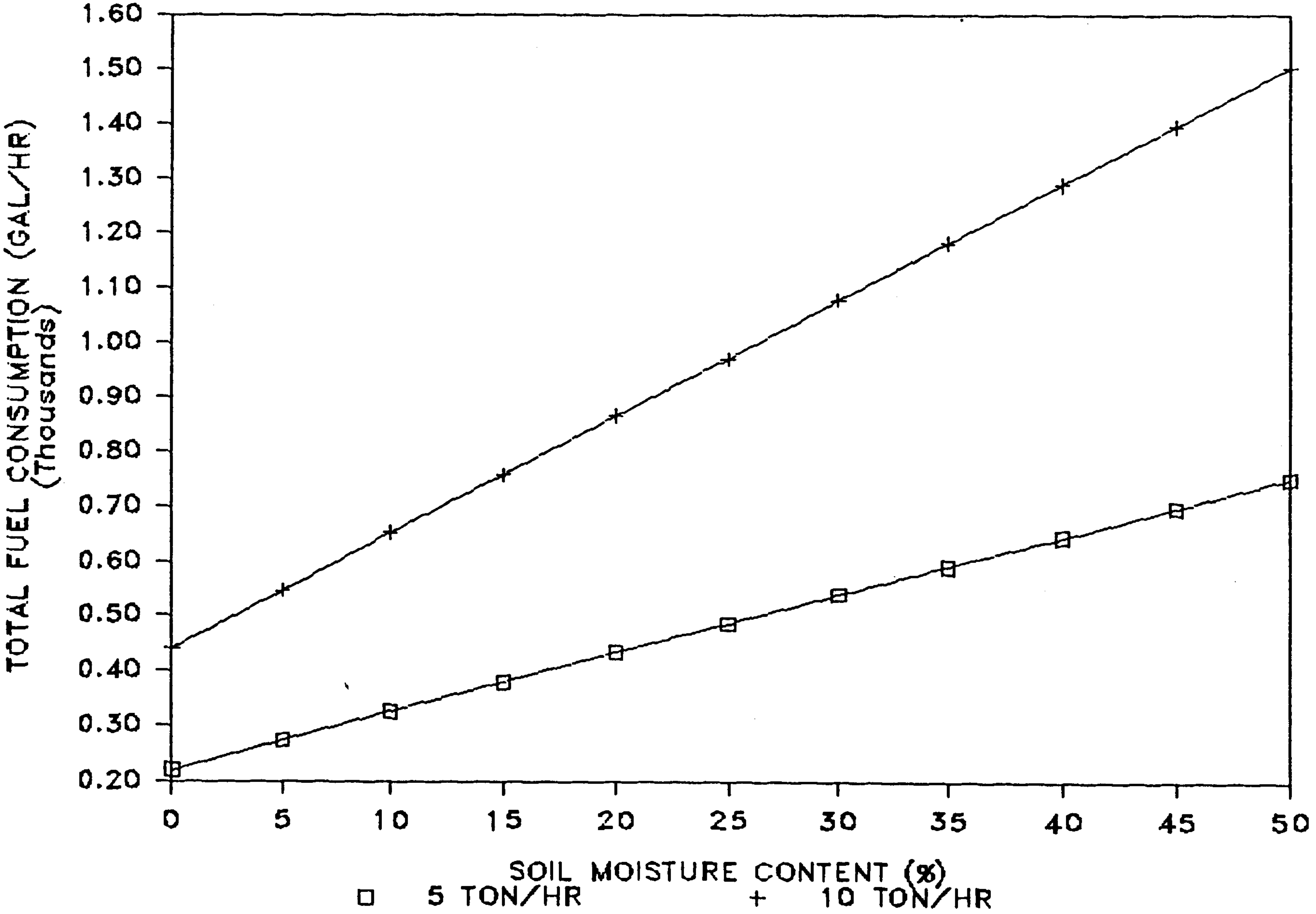
VENTURI SCRUBBER AND PACKED TOWER DESIGN AND WATER USAGE ASSUMPTIONS:

Afterburner Exit Temperature = 2,200 Deg. F
Venturi Scrubber Inlet Temperature = 150 Deg. F
Venturi Scrubber Throat Velocity = 400 ft/sec
Venturi Scrubber Water Required = 6 gal/1000 cu.ft.
Packed Tower Water Required = 2.5 gal/1000 cu.ft.

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Afterburner Exhaust Gas Flow Rate (ACFM)	145,794.00	291,589.27
Venturi Srubber Inlet Gas Flow Rate (ACFM)	33,433.96	66,868.22
Venturi Scrubber Throat Area (sq.ft.)	1.393	2.786
Venturi Scrubber Water Required (gal/min)	200.60	401.21
Packed Tower Water Required (gal/min)	83.58	167.17

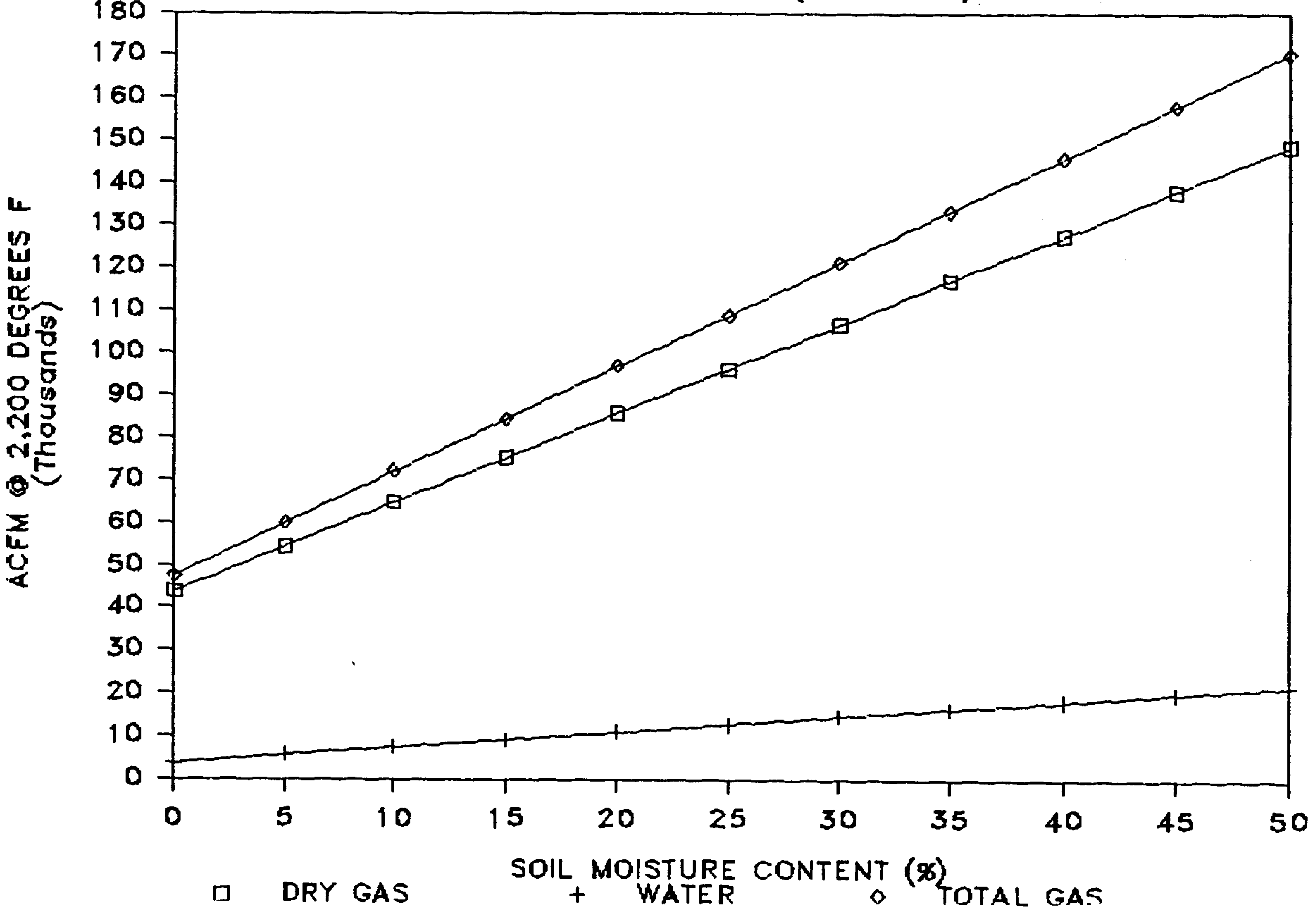
TOTAL NO. 2 FUEL OIL CONSUMPTION

TAMS/LOVE CANAL



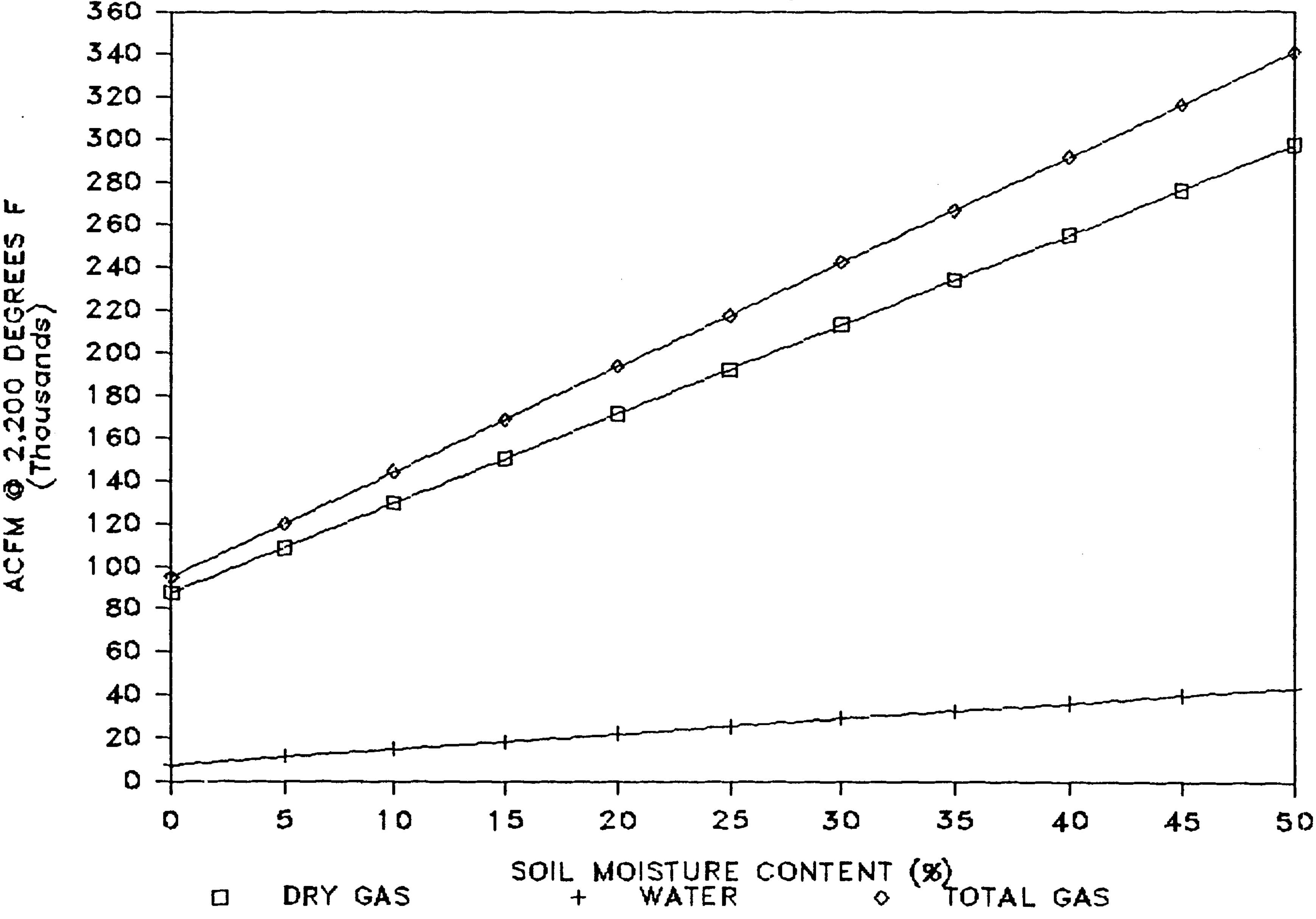
AFTERBURNER EXHAUST GAS FLOW

TAMS/LOVE CANAL (5 TON/HR)



AFTERBURNER EXHAUST GAS FLOW

TAMS/LOVE CANAL (10 TON/HR)



APPENDIX D

TDU PRODUCTION BURN DATA

TAMS/LOVE CANAL

INCINERATION TIME REQUIRED (MONTHS)

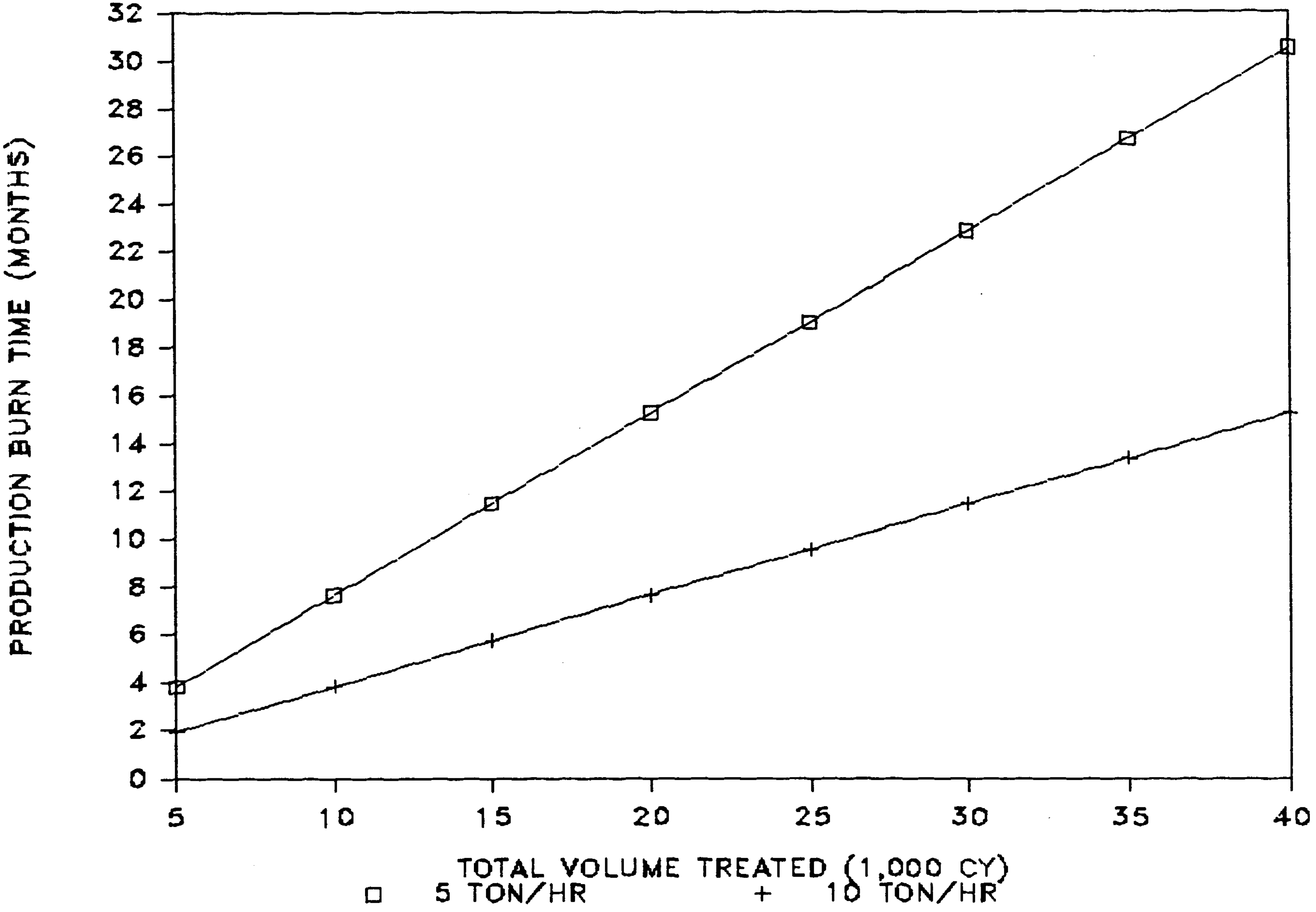
SOIL DENSITY = 3,510 LB/CY

ON-LINE AVAILABILITY = 80%

UNIT SIZE (TON/HR)	VOLUME TREATED (CY)	
	20,000	40,000
3.0	20.31	40.63
4.0	15.23	30.47
4.3	14.17	28.34
5.0	12.19	24.38
8.0	7.62	15.23

ESTIMATED INCINERATION TIME

TAMS/LOVE CANAL (80% AVAIL.)



APPENDIX E

TDF COST DATA

TAMS/LOVE CANAL

CAPITAL COST AND ANNUAL OPERATING COST ESTIMATES

BASED ON USING NO. 2 FUEL OIL

The costing methodology is based on data presented in EPA's "Engineering Handbook for Hazardous Waste Incineration", Chapter 6, "Estimating Incineration Costs" (September 1981).

Cost Estimates are based on a Soil Moisture Content of 20% and each unit's Total Heat Input (MMBTU/hr).

BREAKDOWN OF TOTAL CAPITAL COST

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Purchased Equipment Items	$6,401,347	$11,232,059
Installed Equipement Cost	$960,202	$1,684,809
Cost of Piping	$384,081	$673,924
Buildings, Structures, and Foundations	$336,071	$589,683
Electrical and Instrumentation	$50,000	$50,000
TOTAL PHYSICAL PLANT COST	$8,131,700	$14,230,475
TOTAL PHYSICAL PLANT COST	$8,131,700	$14,230,475
Engineering, Construction, and Contigencies	$4,065,850	$7,115,238
TOTAL CAPITAL COST	$12,197,550	$21,345,713
Range of Cost of Rotary Kiln and Afterburner	$3,200,673 to $4,480,943	$5,616,030 to $7,862,442

ANNUAL FUEL COST

Hours of Operation

= 24 hr/day x 365 day/yr x 80 % Availabil

= 7008 hr/yr

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Kiln No. 2 Fuel Oil Consumption (gal/hr)	270.47	540.93
Afterburner No. Fuel Oil Consumption (gal/hr)	161.96	323.92
No. 2 Fuel Oil Consumption (gal/yr)	3,030,469	4,925,853
Annual No. 2 Fuel Oil Cost ($/yr @ $1.00/gal)	$3,030,469	$4,925,853

BREAKDOWN OF ANNUAL OPERATING COST

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Annual Utilities Cost	$243,951	$561,087
Annual Maintenance Cost	$274,445	$396,420
Annual Labor Cost	$317,136	$396,420
Annual No. 2 Fuel Oil Cost	$3,030,469	$4,925,853
TOTAL ANNUAL OPERATING COST	$3,866,001	$6,279,780

TAMS/LOVE CANAL

CAPITAL COST AND ANNUAL OPERATING COST ESTIMATES

BASED ON USING NO. 2 FUEL OIL

The costing methodology is based on data presented in EPA's "Engineering Handbook for Hazardous Waste Incineration", Chapter 6, "Estimating Incineration Costs" (September 1981).

Cost Estimates are based on a Soil Moisture Content of 40% and each unit's Total Heat Input (MMBTU/hr).

BREAKDOWN OF TOTAL CAPITAL COST

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Purchased Equipment Items	$6,658,985	$12,971,116
Installed Equipement Cost	$998,848	$1,945,667
Cost of Piping	$399,539	$778,267
Buildings, Structures, and Foundations	$349,597	$680,984
Electrical and Instrumentation	$50,000	$50,000
TOTAL PHYSICAL PLANT COST	$8,456,968	$16,426,034
TOTAL PHYSICAL PLANT COST	$8,456,968	$16,426,034
Engineering, Construction, and Contigencies	$4,228,484	$8,213,017
TOTAL CAPITAL COST	$12,685,452	$24,639,051
Range of Cost of Rotary Kiln and Afterburner	$3,329,492 to $4,661,289	$6,485,558 to $9,079,781

ANNUAL FUEL COST

Hours of Operation

= 24 hr/day x 365 day/yr x 80 % Availabil

= 7008 hr/yr

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Kiln No. 2 Fuel Oil Consumption (gal/hr)	400.08	800.16
Afterburner No. Fuel Oil Consumption (gal/hr)	244.95	489.91
No. 2 Fuel Oil Consumption (gal/yr)	4,520,370	7,324,131
Annual No. 2 Fuel Oil Cost ($/yr @ $1.00/gal)	$4,520,370	$7,324,131

BREAKDOWN OF ANNUAL OPERATING COST

	UNIT SIZE	
	5 ton/hr	10 ton/hr
Annual Utilities Cost	$402,519	$817,236
Annual Maintenance Cost	$359,828	$481,803
Annual Labor Cost	$365,927	$426,914
Annual No. 2 Fuel Oil Cost	$4,520,370	$7,324,131
TOTAL ANNUAL OPERATING COST	$5,648,644	$9,050,084

INCINERATION COST COMPARISON BASED ON UNIT LIFE

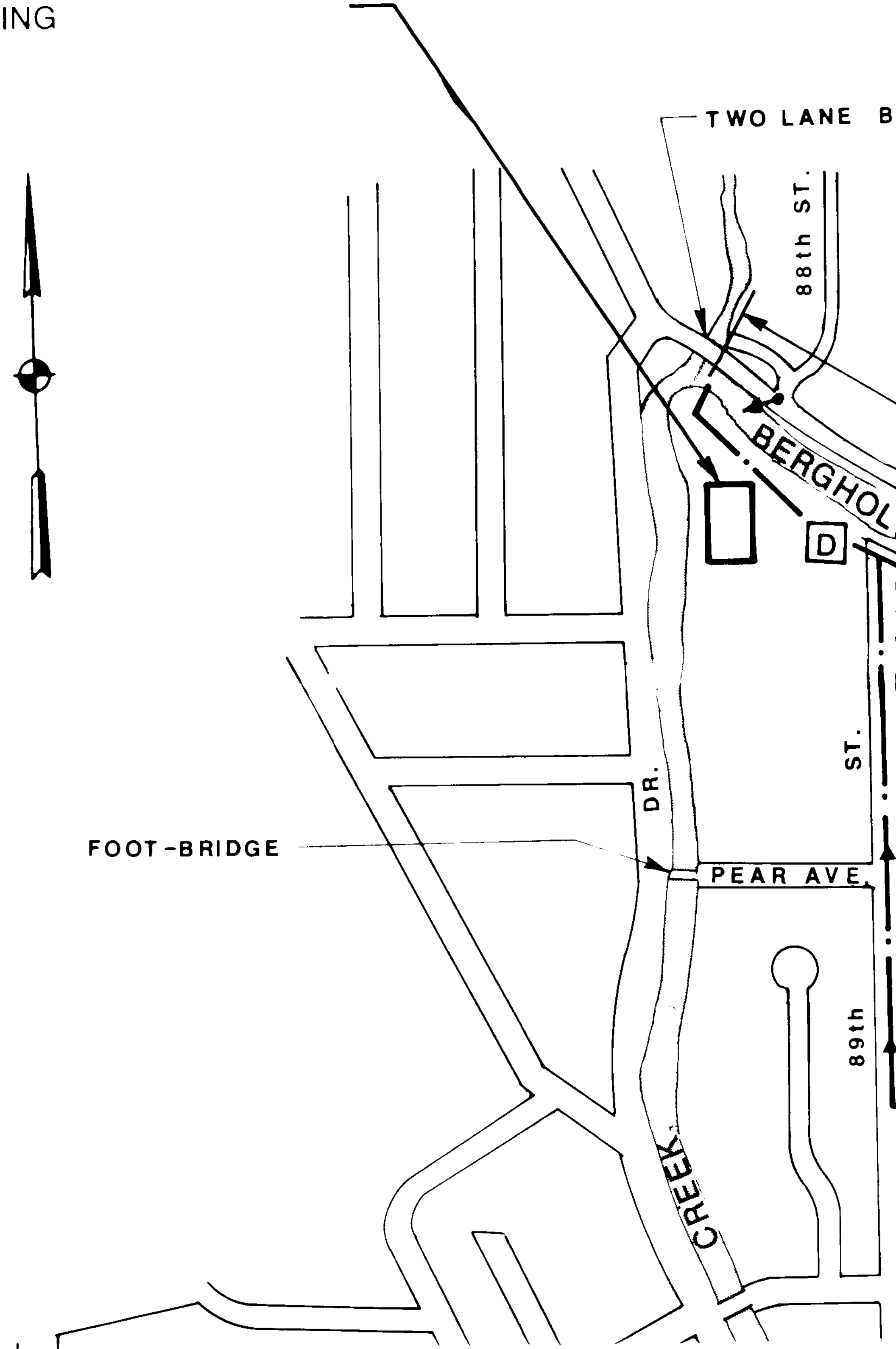
Excavated Material Quantity = 20,000 cy and 40,000

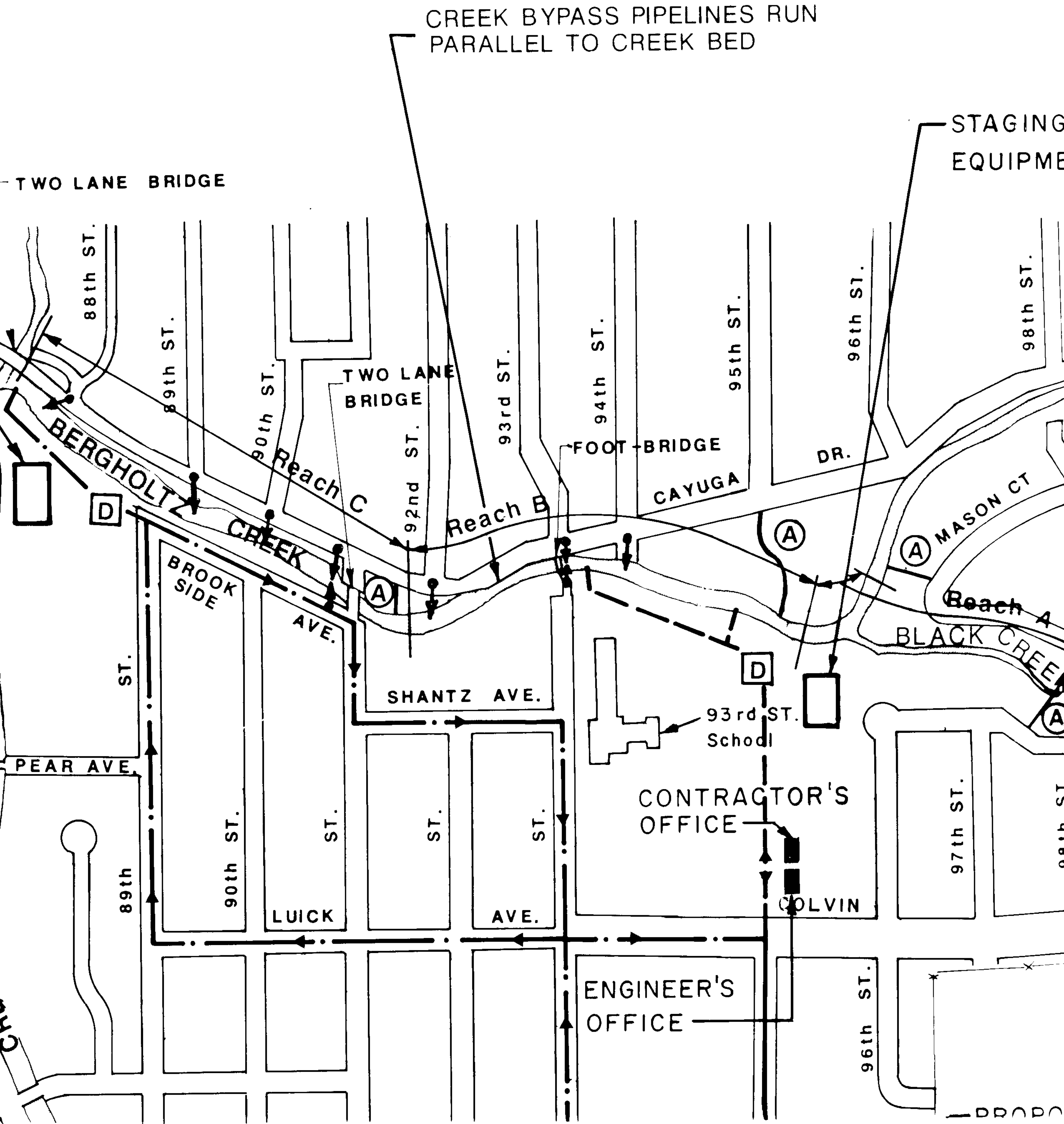
Soil Density = 3,510 lb/cy

		UNIT SIZE	
		5 ton/hr	10 ton/hr
Clean Up Period (years)	20,000 cy	1.00	0.50
	40,000 cy	2.00	1.00

Unit Life	Volume of Soil		UNIT SIZE	
			5 ton/hr	10 ton/hr
Clean Up Period	20,000 cy	Cost per Ton	$522	$831
		Total Cost	$18,334,096	$29,164,093
	40,000 cy	Cost per Ton	$342	$480
		Total Cost	$23,982,740	$33,689,135
5 Years	20,000 cy	Cost per Ton	$233	$199
		Total Cost	$8,185,734	$6,988,947
	40,000 cy	Cost per Ton	$233	$199
		Total Cost	$16,371,469	$13,977,894
10 Years	20,000 cy	Cost per Ton	$197	$164
		Total Cost	$6,917,189	$5,756,995
	40,000 cy	Cost per Ton	$197	$164
		Total Cost	$13,834,378	$11,513,989

STAGING AREA FOR DECONTAMINATED EQUIPMENT AND MATERIAL DEWATERING




CREEK BYPASS PIPELINES RUN PARALLEL TO CREEK BED
STAGING
EQUIPME
TWO LANE BRIDGE
88th ST.
89th ST.
90th ST.
TWO LANE BRIDGE
92nd ST.
93rd ST.
94th ST.
95th ST.
96th ST.
98th ST.
BERGHOLTZ CREEK
Reach C
Reach B
FOOT BRIDGE
CAYUGA DR.
MASON CT
Reach A
BLACK CREEK
A
D
BROOK SIDE AVE.
SHANTZ AVE.
93rd ST. School
CONTRACTOR'S OFFICE
ENGINEER'S OFFICE
PEAR AVE.
ST.
89th
90th ST.
ST.
ST.
ST.
LUICK AVE.
COLVIN
97th ST.
96th ST.
PROPO

CREE

-Insta

-Cons
stagi

-After

-Phas
seco
sewe

-Phas
clear
back
demo

-Phas
back
reflo
remo

LEGE

Allowa

D

Ⓐ

REEK REMEDIATION ACTIVITIES SEQUENCE

nstall Demarcation Fence defining Remediation Zone

Construct temporary facilities: haul roads, decontamination facilities, taging areas, pipelines, pumps.

After DCF constructed, establish access to creek bed.

Phase I: construct primary cofferdams at ends of work area and econdary cofferdam between Reaches A and B. clean storm ewers and excavate creek bed in Reach A. backfill creek bed.

Phase II: construct secondary cofferdam between Reaches A and C.
lean storm sewers and excavate creek bed in Reach B.
ackfill creek bed.
emolish and replace 93rd St. Bridge.

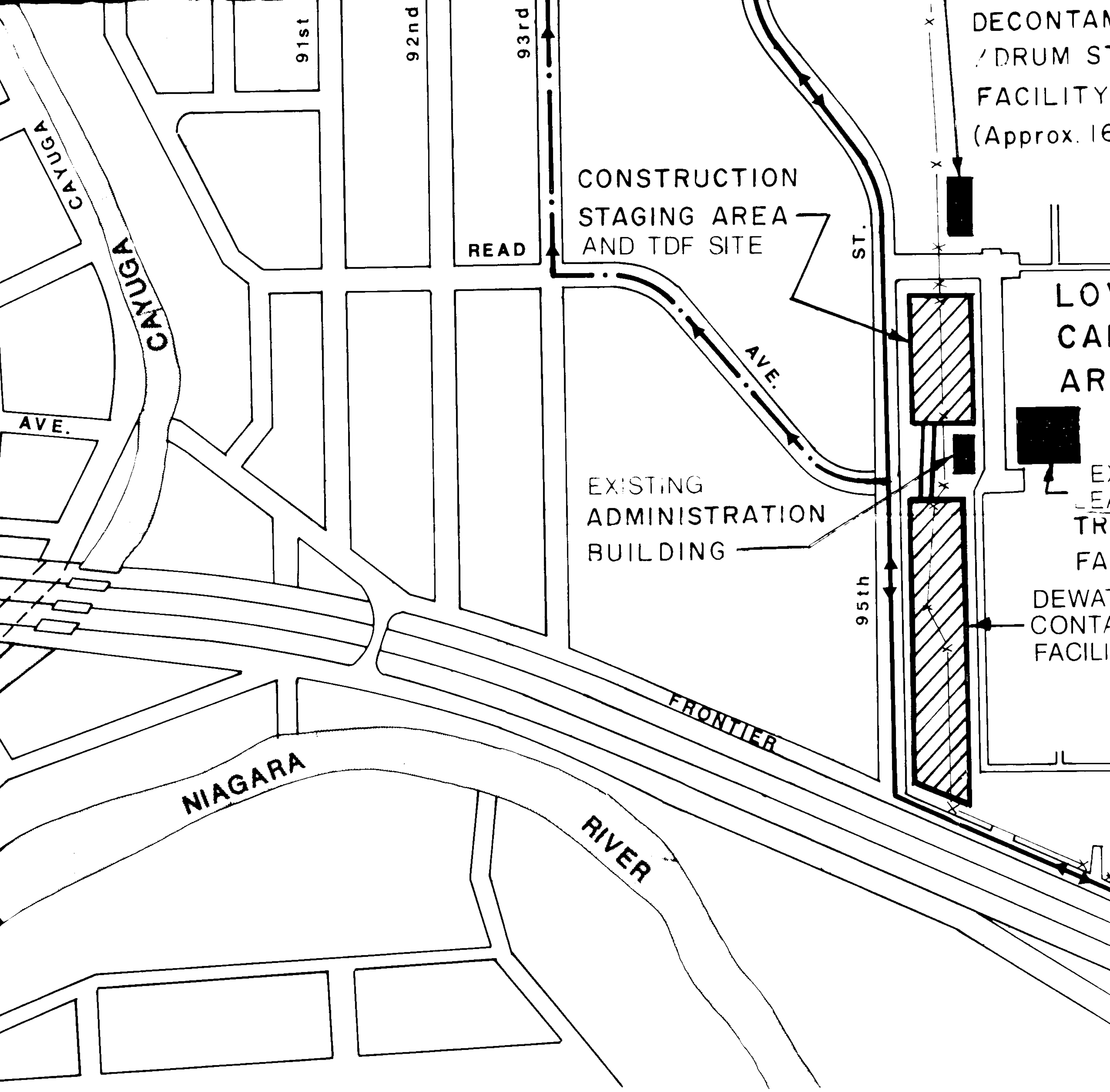
Phase III: clean storm sewers and excavate creek bed in Reach C.
ackfill creek bed.
eflood creeks, remove cofferdams, pumps and discharge lines.
emove temporary facilities.

EGEND:

lowable Traffic Routes

– – –	Phase I and II
—·—	Phase III
———	All Phases
D	Decontamination Facility
Ⓐ	Temporary Access for pumps and cofferdams
→	Storm Sewer Cleanup

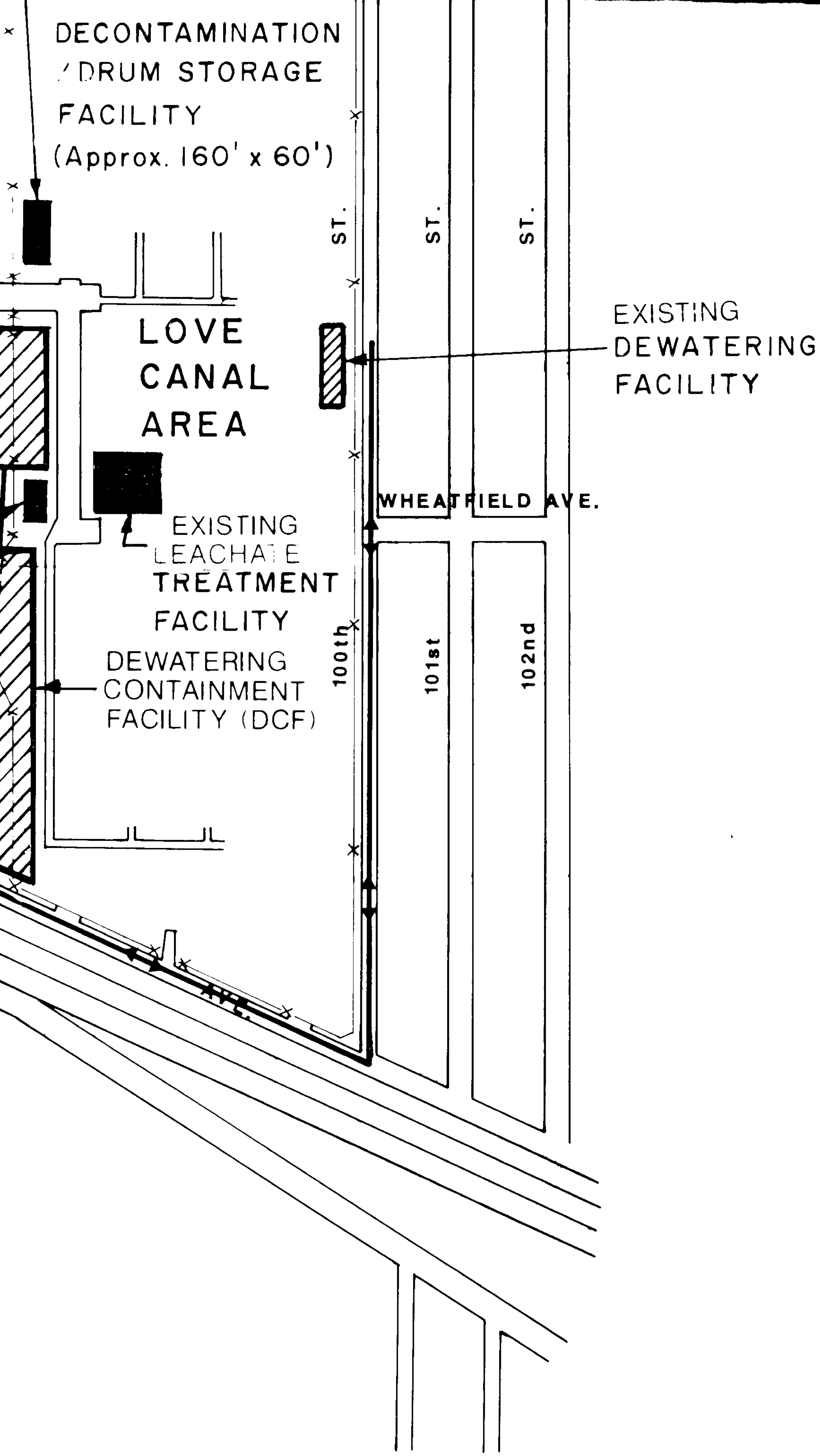

PERSHING
AVE.
ST.
ST.
ST.
ST.
ST.
MUNSON
AVE.
MANG
AVE.
FRONTIER
AVE.
82nd
83rd
84th
85th
86th
LITTLE
0



PLAN

0 400 800 1200 1600

SCALE: 1IN. 400FT.


DECONTAMINATION /DRUM STORAGE FACILITY (Approx. 160' x 60')
LOVE CANAL AREA
EXISTING DEWATERING FACILITY
EXISTING LEACHATE TREATMENT FACILITY
DEWATERING CONTAINMENT FACILITY (DCF)
WHEATFIELD AVE.
100th ST.
101st ST.
102nd ST.
AVE.

REVISIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVED

Prepared By:

TAMS CONSULTANTS, Inc.
THE TAMS BUILDING, 655 THIRD AVENUE, NEW YORK, N.Y. 10017

Prepared For:

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233
Thomas C. Jorling, *Commissioner*
Division of Solid and Hazardous Waste
Norman H. Nosenchuck, P.E., *Director*

DESIGNED BY:

DRAWN BY:

CHECKED BY:

SUBMITTED BY:

BLACK & BERGHOLTZ CREEKS REMEDIATION
CITY OF NIAGARA FALLS, NEW YORK

LOVE CANAL SITE PLAN AND PROJECT FEATURES

SCALE:

DATE: August 1987

SHEET NO.:

DRAWING NO.: 1