NOTICE

All drawings located at the end of the document.

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OPTIONS ANALYSIS REPORT
for the
ACCELERATED SLUDGE REMOVAL PROJECT

FINAL REPORT

234353GG Under MTS 225456RR

Prepared By:

ICF Kaiser Engineers, Inc.
165 South Union Blvd., Suite 400
Lakewood, Colorado

July 26, 1993

ICF KAISER
ENGINEERS

A-OU04-000206

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LIST OF ACRONYMS

AIP	Agreement in Principle
CA	Compliance Agreement
CDH	Colorado Department of Health
CERCLA	Comprehensive Environmental Response, Compensation, and Recovery Act
cP	centiPoise
CX	Compliance Agreement
DOE	Department of Energy
EA	Environmental Assessment
EC	Environmental Checklist
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ER	Environmental Restoration
FONSI	Finding of No Significant Impact
gm/cc	grams per cubic centimeter
gpm	gallons per minute
HDPE	High Density Polyethylene
HNUS	Haliburton NUS
IAG	Interagency Agreement
IM/IRA	Interim Measures/Interim Remedial Actions
LDR	Land Disposal Restrictions
OU	Operable Unit
pH	potential of Hydrogen
PSIG	Pounds per Square Inch Gauge
RCRA	Resource Conservation Recovery Act
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RFP	Rocky Flats Plant
SEP	Solar Evaporation Pond
TCLP	Toxicity Characterization Leaching Procedure
TDS	Total Dissolved Solids
TSD	Treatment, Storage and Disposal
TSS	Total Solution Solids
wt	weight
%	percent
??	Equipment Requiring Purchase

OPTIONS ANALYSIS REPORT
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1.0 INTRODUCTION AND BACKGROUND

The Department of Energy (DOE) is negotiating an agreement with the Colorado Department of Health (CDH) and the Environmental Protection Agency (EPA) to accelerate closure of the Solar Evaporation Ponds (SEPs) at Rocky Flats Plant (RFP). This negotiation is proceeding during the informal phase of the formal Dispute Resolution process for the Operable Unit (OU) 4 Draft and Final Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) Report Milestones.

A major element of this accelerated closure is a decision to remove the remaining sludge from the SEPs in an expedited manner (removal to be completed at least by December 1995) and to store the removed sludge in containers. The sludge will be stored in containers until final processing and disposal activities are completed.

The DOE directed EG&G to plan the actions required to accomplish pond sludge removal and containerize storage. The major planning elements include:

1) Development of a streamlined Phase I Report schedule;
2) Evaluation of options for pond sludge removal and containerization;
3) Development of a design criteria package; and
4) Development of a streamlined Interim Measures/Interim Remedial Action (IM/IRA) schedule for pond closure.

This report documents the efforts and conclusions associated with planning element 2, above: Evaluation of options for pond sludge removal and containerization.

Two technical teams were established to evaluate options for pond sludge removal (the process option team), and pond sludge storage (the storage option team). The teams consisted of individuals from EG&G, Halliburton NUS, and ICF Kaiser Engineers, with EG&G providing the team leaders. The pond sludge removal team and the pond sludge storage team convened activities on July 6, 1993 at a facility provided by EG&G. The teams co-located in the same facility in order to accommodate the exchange of information necessary to complete the analysis on an aggressive schedule.

Both teams developed a "short list" of the most technically sound options on July 9, 1993. The short lists were documented in the preliminary version of this report prepared on July 14, 1993. The short listed options were further evaluated, factoring in cost and schedule considerations. The result of this evaluation was the definition of the preferred method for pond sludge removal and the preferred method for pond sludge storage. These methods are the technical starting points for development of the design criteria package and subsequent Title II design package for pond sludge removal and storage.

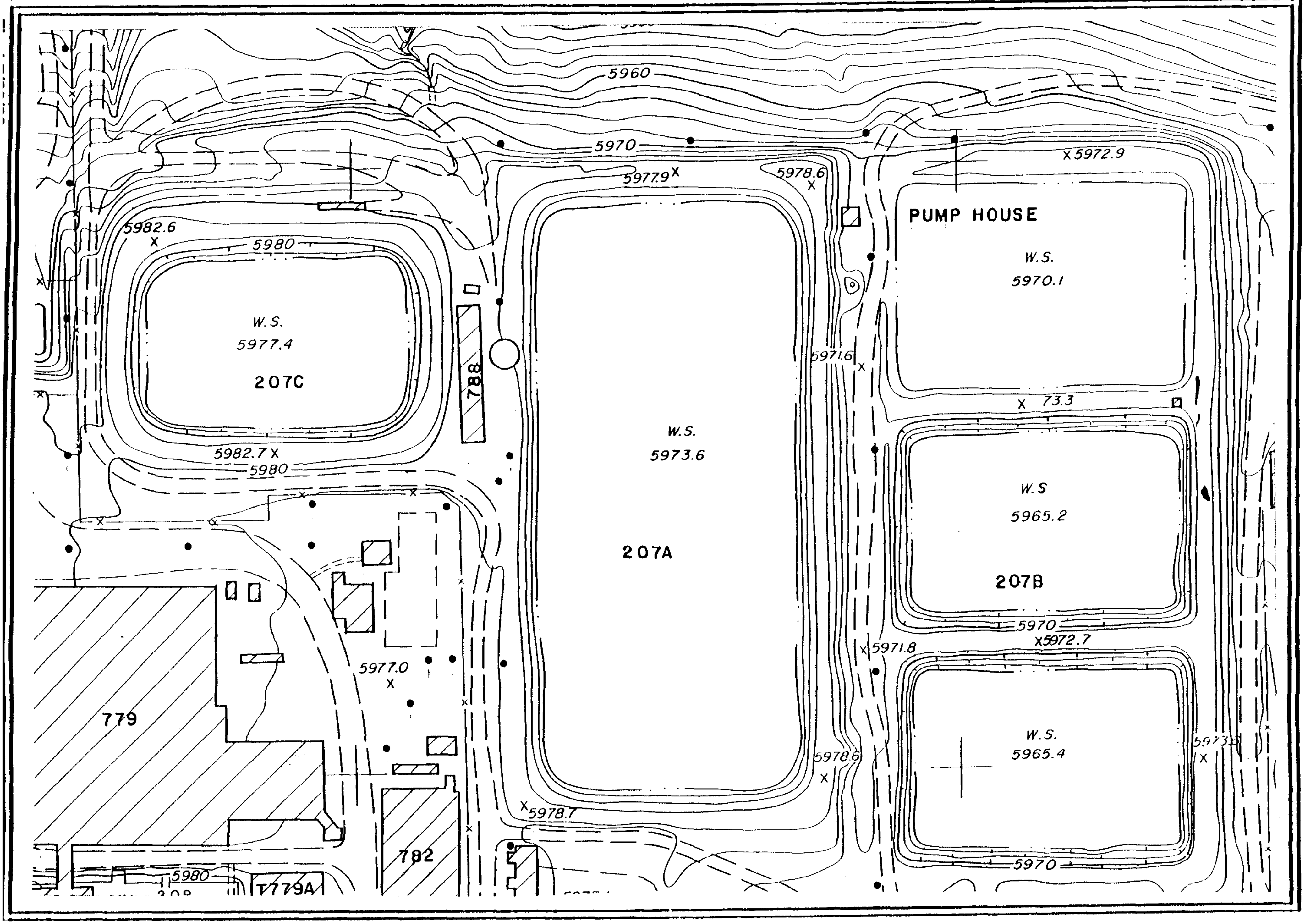
All cost estimates and schedules are considered preliminary and will be further refined during the design criteria phase.

1.1 REGULATORY SETTING

Presented in this section is a discussion of regulatory matters related to the SEPs (Figure 1-1), the 750 Pad (Figure 1-2) and the 788 Clarifier. Information is presented on existing laws, regulations, and agreements; and certain proposed or draft regulations that have not yet been promulgated. While an attempt has been made to discuss and evaluate all pertinent regulations, detailed regulatory requirements are subject to interpretation and negotiation.

The text includes references to the Code of Federal Regulations (CFR) and the Federal Register (FR) where appropriate. Federal Regulatory citations are provided where Colorado

Solar Evaporation Ponds



regulations are equivalent to Federal regulations or where a Colorado agency has enforcement authority for Federal programs.

Regulations governing the ponds, Clarifier, and 750 Storage Pad are complex and detailed. Any operation or activity proposed for these areas must be analyzed for compliance prior to implementation. Since Colorado is authorized to administer RCRA, the Colorado Hazardous Waste Regulations must be consulted to obtain accurate information on the requirements for the Rocky Flats Plant. Design criteria must include appropriate regulatory constraints.

1.1.1 Solar Evaporation Ponds

The following section provides a detailed overview of the Solar Evaporation Pond Regulatory Status.

1.1.1.1 Overview of Solar Evaporation Pond Regulatory Status

In this report, the Solar Evaporation Ponds are considered to be separate RCRA interim status units consisting of C Pond as a unit, the B Consolidated Pond as a unit, the A Pond as a unit, and the Clarifier as a unit. The units are undergoing site characterizations and, potentially, remediation activities in response to both RCRA "closure" and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements. A RCRA Part A Permit promulgates interim status for the SEPs. The first regulatory document that addressed closure and remediation of the SEPs was the Compliance Agreement (CA) signed on July 31, 1986 by the EPA, CDH, and DOE. The SEPs were also the subject of a 1989 Agreement in Principle (AIP) signed by the Governor of the State of Colorado and by the Secretary of the DOE. The AIP required that all sludge be removed from the SEPs, as well as shipping all pondcrete off-site, by October 1991. It has not been possible for RFP to comply with the schedule for sludge removal and pondcrete shipment identified in the AIP.

In January 1991, the CA and the documents required by it were superseded by the Interagency Agreement (IAG) signed by the EPA, CDH, and DOE. The IAG creates a unique blending of RCRA and CERCLA requirements. For interim status closure units outside the buildings, the IAG required that the site characterization work be broken up into two phases. Phase I characterizes soils and sources of contamination and determines the risk associated with the source of contamination at each interim status closure unit external to buildings. Following these Phase I characterization activities, an IM/IRA decision document is to be prepared in accordance with Paragraphs 15 and 150 of the IAG. The IM/IRA decision provides the information necessary to recommend an alternative consistent with the CDH closure regulations and address cleanup of all hazardous substance source areas with risk levels greater than 10^{-6} measured at the source. Phase II site characterization and remediation activities address ground water contamination at these interim status closure units outside of buildings.

Closure activities at the SEPs have been ongoing since approximately August 1985 when activities related to sludge removal and treatment began on a nearly full-time basis. Consistent with the desire to close the SEPs, and consistent with the terms of the 1986 CA, a RCRA interim status closure plan for the SEPs was submitted to the EPA and CDH in August 1986. A slightly revised RCRA interim status closure plan for the SEPs was submitted to the agencies in November 1986. An interim status closure plan, revised to address written and verbal comments received from CDH on the earlier closure plans, was submitted to the agencies on July 1, 1988. This final closure plan contained revisions in response to written and verbal comments from CDH and EPA regarding a March 1987 closure plan. None of the closure plans were approved by the agencies.

A 1992 IM/IRA addresses the design and construction of storage tanks and evaporators to store and treat contaminated groundwater collected in the SEP area, is currently ongoing, and is not the IM/IRA planned in the IAG for Phase I closure. This precursor IM/IRA was necessary to allow the IAG Phase I characterization to be completed.

1.1.1.2 RCRA Part A Interim Status

The Solar Ponds are two RCRA Part A, Interim Status, Units, containing both solid (sludge) and liquid (pond water). The ponds' contents are RCRA F-Listed and characteristic wastes and must be handled as such throughout this project. No Part B Permit will be sought for the ponds since the impoundments are undergoing closure. No wastes may be introduced into any of the pond impoundments, no wastes may be removed and subsequently returned to the ponds, and waste may not be moved between C Pond and the A/B Ponds (though movement within C Pond or within the A/B Ponds is acceptable). No chemicals may be added to the ponds without the concurrence of the CDH, and no treatment can be initiated without obtaining a permit from the CDH. Domestic [Non-Land Disposal Restriction (LDR)] water may be added, and some evaporation enhancements are allowed.

1.1.2 750 Pad

The following section provides a detailed overview of the current and proposed changes to the 750 Pad regulatory status.

1.1.2.1 Overview of 750 Pad Regulatory Status

The 750 Pad is regulated under RCRA. The mechanisms for implementing these acts include the RFP RCRA Part A Application, the RCRA Part B Application, and the Interagency Agreement (IAG). In general, a RCRA Part A Application is a brief document which lists those hazardous waste treatment, storage, and disposal (TSD) facilities which are allowed to operate on an "interim status" basis. This interim status is intended as a temporary condition leading to either permanent TSD operation under a Part B Permit or the cessation of operations under a "closure plan."

The 750 Pad includes a RCRA Part A, Interim Status storage unit and a reprocessing area. A Part B Permit is being sought. Storage is allowed only for wastes described by the F and D EPA Waste Codes assigned to the pad. The Interim Status neglects to specify storage of liquids, and therefore probably does not cover liquids. Storage of containers only is allowed, and relevant Interim Status requirements for container storage must be followed. It is anticipated that changes to the 750 Pad Interim Status and to the existing Part B Modification request will be necessary to complete this project.

1.1.2.2 RCRA Part A Interim Status

Hazardous waste is managed within several facilities at RFP. These facilities are referred to as RCRA "units." The mixed waste storage area on the 750 Pad is listed as RCRA Unit 25 in the RFP RCRA Part A Permit Application. Units in the RCRA Part A Permit are regulated under the Colorado Code of Regulations (CCR), 6 CCR 1007-3, Part 265 (Standards for Owners and Operators of Interim Status Hazardous Waste Treatment, Storage and Disposal Facilities). The waste management activities currently allowed on the 750 Pad, under Part 265, include storage of pondcrete and saltcrete in containers with a volume not to exceed 14,000 cubic yards. A change to interim status must be obtained to support accelerated sludge removal on the required schedule. Discussions with regulators have indicated that change in the Part A Permit Interim Status will be received for options favorably considered.

1.1.2.3 RCRA Part B Permit

On November 6, 1992, RFP requested that CDH include the 750 Pad in the RFP RCRA Part B Permit. Units in the RCRA Part B Permit are regulated under 6 CCR 1007-3, Part 264 (Standards for Owners and Operators of Permitted Hazardous Waste Treatment, Storage, and Disposal Facilities). The request indicates that "no liquids" are to be stored on the Pad and the request must be revised and resubmitted to support sludge storage. Processing this type of permit modification currently requires at least a year from the date of submittal (Figures 1-3 and 1-4); completion of this requested permit change is therefore not anticipated before November 1994. Ultimately, completion of the RCRA Part B Permit will be required.

Completion of the Part B Permit process is required for ongoing activities such as storage in tanks or any type of treatment activities. Upon definition of a minimum amount of design information, approximately 17 months should be allowed for RFP permit modification request preparation and subsequent CDH processing before these types of waste management activities could be conducted. Design and procurement could be conducted concurrently with the process.

1.1.3 Clarifier

The following section provides an overview of the Clarifier regulatory status.

Figure 1-3
Generic RCRA Permit Modification Cycle

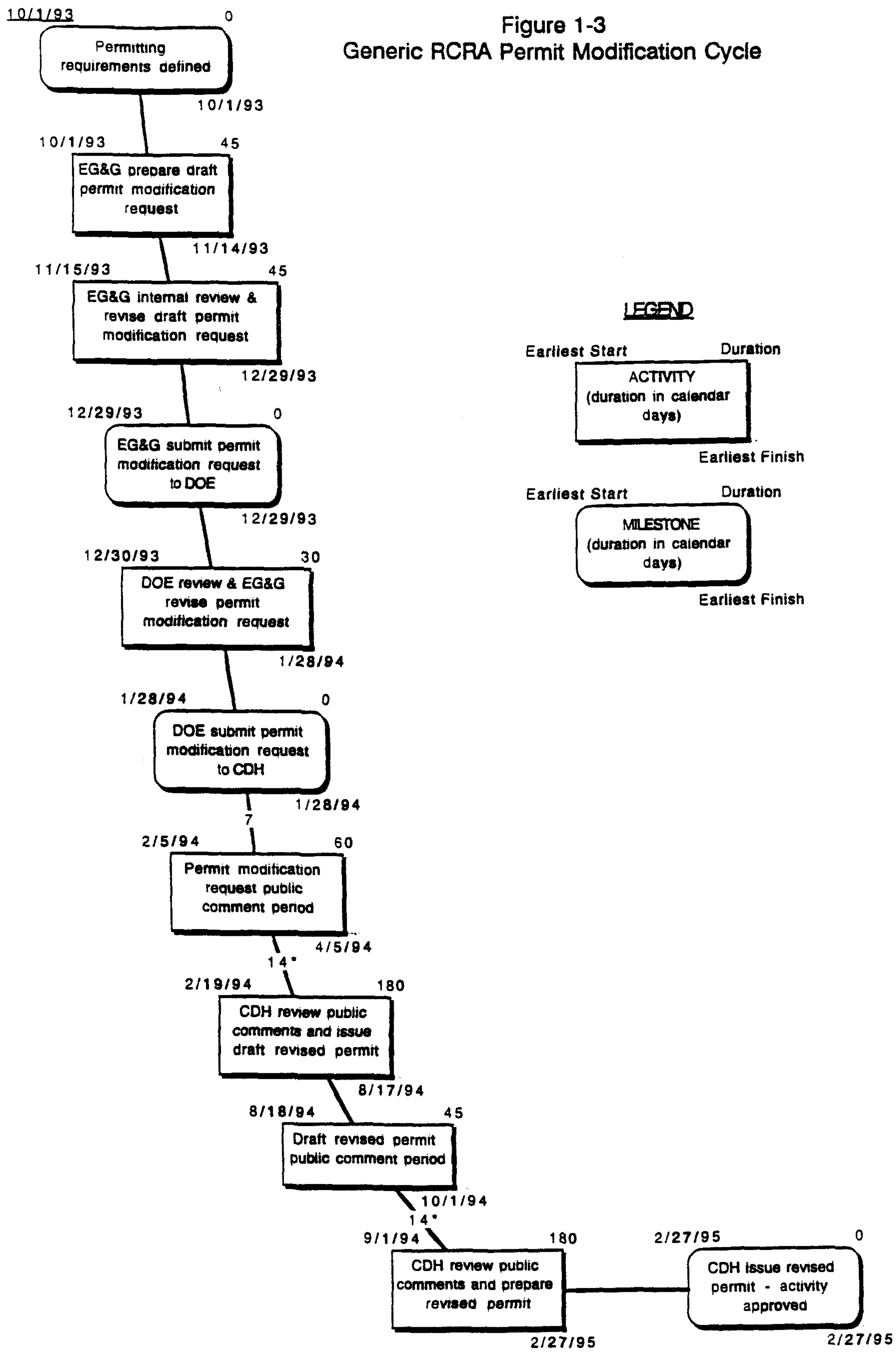
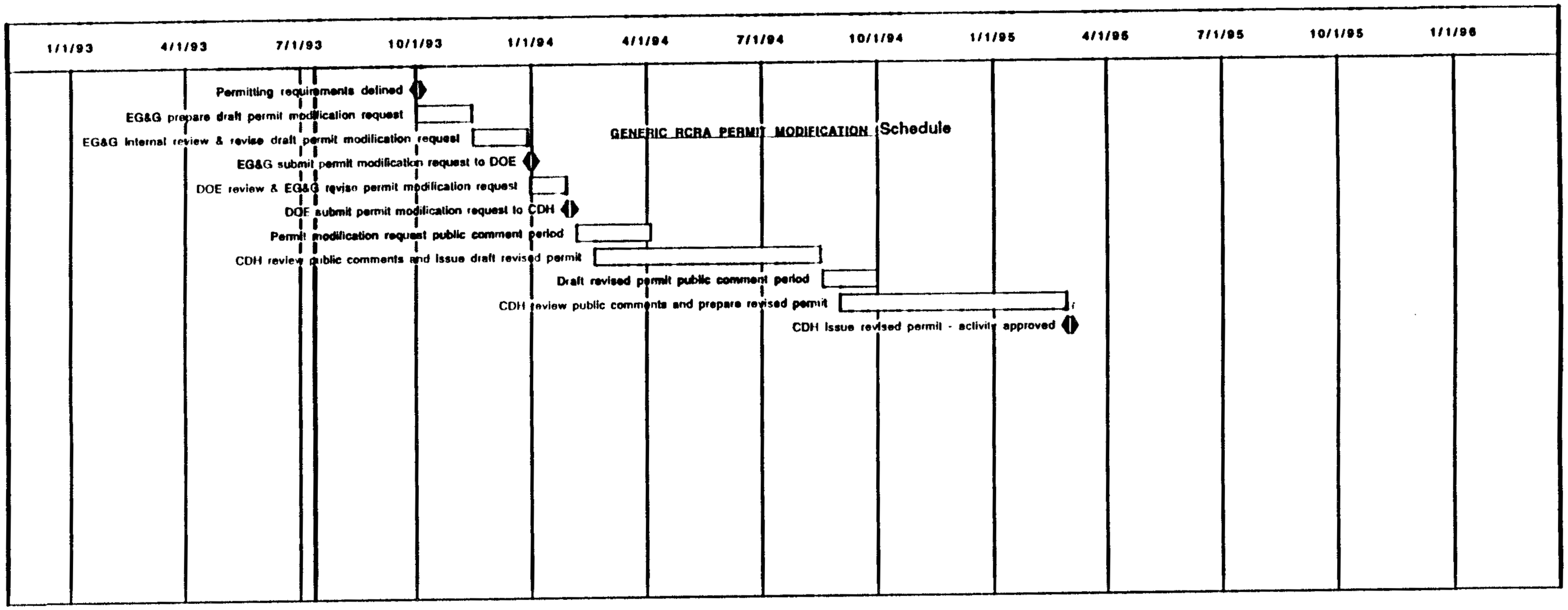


Figure 1-4
Generic RCRA Permit Modification Schedule



1.1.3.1 RCRA Part A Interim Status

The clarifier is a RCRA Part A , Interim Status treatment unit associated with the A/B-Pond wastes. A RCRA Part B Permit has been requested. Since the Clarifier is a tank, not a surface impoundment, waste may be added to the unit provided such waste is consistent with the treatment process described in the Interim Status.

1.1.4 NEPA Requirements

The National Environmental Policy Act (NEPA) requires that federal facilities consider the impact of their actions on human health and the environment. NEPA requirements are intended to ensure that reasonable alternative courses of action are identified and that the environmental consequences of proposed actions are investigated. NEPA requires that an Environmental Assessment (EA) be prepared for all activities that significantly impact the environment and that an Environmental Impact Statement (EIS) be published for all major Federal projects. At RFP, the SEPs are currently covered by the 1980 RFP EIS. DOE published its intent to prepare an EIS on the overall operations at RFP in the March 13, 1991 FR. The EIS will identify and assess potential impacts and present a full evaluation of the cumulative environmental impacts of all current operations and future actions, including proposed near-term environmental restoration activities, at RFP.

In addition, an evaluation of the potential environmental impacts of individual projects or action at DOE facilities in accordance with DOE orders is conducted. For minor actions, the completion of an environmental checklist (EC) is usually sufficient to establish that the action is covered by a categorical exclusion (CX) and no further NEPA documentation is required. For actions that have a greater potential for environmental impact, either an EA or an EIS will be completed. The decision to prepare an EIS rather than an EA is generally based upon the extent of the impacts and the degree of public interest.

NEPA requirements for the Environmental Restoration (ER) Program are met by conducting an EA for OUs that may require remedial action and integration of these EAs with the new facility EIS, which has been initiated by DOE. The EA/Finding of No Significant Impact (FONSI) for the original pondcrete plan may need to be modified. The options outlined in this document may require the insertion of a storage-of-sludge step not previously considered in the original EA/FONSI. A review of the presented options will be needed to determine if these options change the environmental or human health impacts. If the options do not cause changes in the impacts, the NEPA requirements are satisfied. If the options do cause changes in the environmental or human health impacts, the EA/FONSI must be revised as appropriate.

2.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

As part of the accelerated closure of the Solar Evaporation Ponds at Rocky Flats, a project was initiated to develop a plan for the expedited removal and on-site containerization storage of the remaining contents in the ponds. Two technical teams were established to evaluate the options for the removal and storage of the pond contents and develop the recommended plan:

- Process Options Team
- Storage Options Team

Each team developed separate short lists of the most technically sound options. The short listed options were further evaluated, factoring in technical, operational, cost, and schedule considerations. The evaluation criteria for pond contents removal are listed in Table 2-1 and for pond storage in Table 2-2. The teams then screened the options using the rating criteria. The results of applying the rating criteria to each of the removal options are summarized as a matrix in Table 2-3 and in Table 2-4 for the storage options. The recommended options for pond sludge removal are shown in Table 2-5 below:

TABLE 2-5

Process Options Recommendation

Waste Source		Options
B Consolidated Pond	1.0	Pump Everything to Interim Storage (without volume reduction)
207C Pond	2.0	Pump Everything to Interim Storage After Composition Adjustment
Clarifier	3.0	Pump Everything to Interim Storage by Adding Transport Water

Recommended pond sludge storage options are shown in Table 2-6.

Table 2-1
Rating Criteria for Process Options

RATING CRITERIA (Assigned Maximum Point Value)*	
Schedule Difficulty (50)	Extent to which the alternative will have difficulty meeting the schedule constraint (December 1995).
Cost (50)	Probability of exceeding the available funding.
Process Complexity (50)	The number of process units and their interrelations likely to increase probability of difficulty in start up and/or operations.
Regulatory (40)	Potential for regulating issues requiring schedule or funding difficulties.
Engineering Requirements (40)	Engineering or designs required for installation.
Health and Safety (30)	The extent of engineering required to meet specific H&S requirements.
Stored volume (20)	The amount of storage capacity required for the 10 year period (interim storage).
Procurement (10)	Estimate of time required to specify, purchase/rent/lease, and deliver to site.
Mobilize - Demobilize (10)	Requirements for bringing together resources for initiating the project and the dispersement of resources at the end of the project (personnel and equipment).
Maintenance (5)	The extent of maintenance that will be required during the reclaim and transport operations.
Secondary Waste (10)	The quantity of non-process materials (containers, equipment, tools, etc.) which must be disposed of during or at the end of the project.

* High score is a better attribute. These relative scores were determined as team consensus values following evaluation and discussion of the importance of each criterion as it pertains to the objectives of this project. For example, the schedule for meeting the 1995 completion date is a critical issue; whereas, anticipated maintenance will be a minor issue because of the short duration of process operations.

TABLE 2-2

Rating Criteria for Storage Options

Criteria	Definition	Base Case Definitions
Heated Real Estate	The land space required to store the waste. Heating capabilities are required.	Adequate heated storage space on the 750 Pad
Chemical Resistance	The ability to contain C Pond contents. Materials of construction are a concern for C Pond contents	The base case is a combination of chemical-resistant and non chemical-resistant containers.
Ease of Sludge Removal	The capability to have the contents removed for final future treatment.	Moderate difficulties in removing sludge.
Hazards Analysis/SAR	The ease of hazards analysis.	Minor modifications to the SAR.
Ease of Sampling/Inspection	The proficiency of container inspection	Mid-range quantity of containers.
NEPA Requirements	NEPA requirements for the containers	Minor modifications to NEPA document.
Maintenance	The general upkeep of the containers.	Minor container upkeep.
Emergency Liquid Removal/Repair	The ability to transfer material from container for repairs.	Moderate difficulties transferring materials and making repairs.
Susceptibility to Operator error	The potential for operator errors based on number of operations involving containers.	A moderate amount of associated operator activities.
Secondary Waste Stream	The amount of waste created during setup and operations.	A moderate amount of secondary waste is created.
Decant Capabilities	The ability to remove liquied from the container.	Moderate amount of difficulties in decanting.
Decontamination and Decommissioning	The ability to decontaminate and dispose of container.	Moderate difficulty for D & D.
Permitting	The ability to permit operation per RCRA requirements.	Moderate modifications to the existing RCRA permit
Construction	The amount of construction required for proposed option.	Minor amount of on-site construction involved.
Design	The amount of design involved with the proposed option.	Minor amount of design involved.

Table 2-3
Pond Sludge Removal Matrix

CRITERIA	MAX WEIGHTED VALUE	SLUDGE REMOVAL OPTIONS																
		B CONSOLIDATED POND (B-SOUTH)									POND 207C			CLARIFIER				
		1	4.1	4.2	4.3	4.4	4.5	7.1	7.2	7.3	2	5	8	3	6.1	6.2	6.3	9
COST	50	50	5	45	40	35	5	45	35	3	50	0	45	50	45	40	20	45
SCHEDULE DIFFICULTY	50	50	20	40	40	35	25	50	50	50	50	10	50	50	40	35	25	50
PROCESS COMPLEXITY	50	50	5	40	40	15	5	45	15	5	50	0	45	50	45	15	5	45
REGULATORY	40	40	1	20	20	15	1	40	15	1	40	0	40	40	40	15	1	40
ENGINEERING REQ.	40	40	5	35	35	30	5	35	30	10	40	0	35	40	40	30	5	35
H & S	30	30	5	25	25	15	5	30	15	5	30	0	30	30	30	15	5	25
STORED VOLUME	20	5	20	10	10	15	20	10	15	20	5	20	5	5	10	15	20	10
SECONDARY WASTE	10	10	0	6	6	3	0	9	3	0	10	0	8	10	9	3	0	9
PROCUREMENT	10	10	0	6	6	4	0	10	6	0	10	1	10	10	10	6	0	10
MOB/DEMOB	10	10	0	8	8	6	0	9	5	0	10	1	9	10	10	8	0	10
MAINT. REQ.	5	5	1	4	4	2	1	4	2	1	5	0	4	5	4	4	2	4
TOTAL	315	300	62	239	234	175	67	287	191	95	300	32	281	300	283	186	83	283

Shaded area shows highest score.

Table 2-4
Pond Sludge Storage Matrix

CRITERIA	OPT. 1	OPT. 2	OPT. 3	OPT. 4	OPT. 5	OPT. 6	OPT. 7	OPT. 8	OPT. 9	OPT. 10	BASE CASE
TECHNICAL FEASIBILITY											
HEATED REAL ESTATE NECESSARY	0	+	0	–	–	–	+	+	0	–	0
CHEMICAL RESISTANCE	–	–	+	+	–	+	+	–	–	+	0
EASE OF SLUDGE REMOVAL	+	–	+	–	0	0	–	–	–	–	0
HAZARDS ANALYSIS/SAR	0	0	0	–	–	–	0	0	0	–	0
EASE OF SAMPLING/INSPECTION	0	+	0	–	–	–	+	+	+	–	0
NEPA REQUIREMENTS	0	0	0	–	–	–	0	0	0	–	0
MAINTENANCE	0	0	0	0	0	0	0	0	0	0	0
EMERGENCY LIQUID REMOVAL/REPAIR	–	–	–	+	0	+	–	–	–	–	0
SUSCEPTIBILITY TO OPERATOR ERROR	0	+	0	–	–	–	+	+	+	0	0
SECONDARY WASTE STREAM	0	0	0	0	0	0	0	0	0	0	0
DECANT CAPABILITIES	+	0	+	–	–	–	–	–	–	0	0
D AND D	0	–	+	0	0	0	–	–	–	0	0
PERMITTING	0	0	0	–	–	–	0	0	0	–	0
SCHEDULING											
CONSTRUCTION	+	+	+	+	+	+	0	0	+	–	0
DESIGN	+	+	+	+	+	+	–	0	+	–	0
TOTAL	2	+1	5	–4	–6	–3	–1	–2	–1	–8	0

TABLE 2-6		
Storage Options Short List		
Waste Source		Options
B Consolidated Pond and Clarifier	2	Mobile FRAC Tanks with External Secondary Containment
C Pond	3	Roll-Offs, Open Top Containers with HDPE Liner

These recommendations are the technical starting points for development of the design criteria package and subsequent Title II design package for pond sludge removal and storage.

2.1 CONCLUSIONS

The recommended processes for pond sludge removal and transfer to interim storage are identified in Section 4.3.4. These recommendations are:

- A/B Pond Sludge - Option 1: Pump Everything to Interim Storage;
- C Pond Sludge - Option 2: Pump Everything to Interim Storage After Composition Adjustment; and
- Clarifier Sludge - Option 3: Pump Everything to Interim Storage by Adding Transport Water.

The recommended sludge storage options are identified in Section 5.3.4. The recommended option for pond sludge storage is a combination of Options 2 and 3:

- A/B Pond and Clarifier Sludge - Mobile FRAC Tanks Located in Tent 6, Using External Secondary Containment, and

- C Pond Sludge - High Density Polyethylene (HDPE)-Lined Roll-Off Containers Stored in Tents 3, 4, and 6 (Figure 2-1).

The combination of pond sludge removal and storage options provides a technically feasible approach for providing 10-year interim storage of pond sludge. In addition, sludge removal from the ponds can be accomplished prior to December 1995. The estimated cost for accomplishing sludge removal and storage is $6,000,000 (Appendices 6A and 6B).

The following table summarizes these recommendations:

TABLE 2-7

Recommended Pond Sludge Removal and Storage Options

RECOMMENDATIONS	COST	SCHEDULE (Projected removal date)
B Consolidated Ponds: Option 1: Pump Everything to Interim Storage	$1,303,793	Before 12/95
C Pond: Option 2: Pump Everything to Interim Storage After Composition Adjustment	$1,224,106	Before 12/95
Clarifier: Option 3: Pump Everything to Interim Storage by Adding Transport Water	$471,832	Before 12/95
Recommended Option for Storage	$3,120,274	Before 12/95
TOTAL	$6,120,005	Before 12/95

Elements of the transfer and storage proposals include the following:

- Maximum use of existing process equipment for sludge transfer;

- Interim storage (10 years) in heated enclosures to prevent freezing and resultant container damage;
- Use of high capacity (18,900 gallon) Mobile FRAC Tanks for A/B Pond and Clarifier sludge;
- Use of HDPE-lined Roll-Off containers for C Pond sludge; and
- Secondary containment with leak detection capability.

2.2 RECOMMENDATIONS

Analyses of the recommended options has identified technically viable methodology for accomplishing pond sludge removal and storage by December 1995. It is recommended that the options suggested in this study be taken to the design criteria phase of technical definition. The design criteria package will refine the equipment, cost estimates, and schedules presented in this report, and potentially reduce the total cost of the project, as follows:

- Reduction of the number of sludge containers required for storage accomplished by decanting excess water; and
- The current cost estimate contingency will be reduced by refining the level of definition of the process and storage arrangements.

In addition, the design criteria package will address design requirements not evaluated in this study, including:

- Evaluation of the need for a variance to DOE 6430.1A (Reference 12) seismic qualification requirements for process equipment and storage containers;
- Evaluation of ventilation requirements for the storage containers and tents;
- Definition of leak detection requirements;

- Definition of personnel access requirements for container inspection and maintenance;
- Definition of decant techniques; and
- Potential disposal of decant water.

3.0 TECHNICAL APPROACH

The following sections discuss the waste characteristics and volume of the A/B Series Ponds, C Pond, and Clarifier materials and the methodology used to select and evaluate various options.

3.1 WASTE CHARACTERISTICS OF POND MATERIAL

Pond material is comprised of sludge and wastewater from any of five (5) SEPs (A, B-North, B-Center, B-South, and C) or from the clarifier at the 788 building. The SEPs were used to treat (by evaporation) the majority of RFP's aqueous waste products discharged from the Process Waste Treatment Plant. Physical and chemical characterizations of the pond material from each of the ponds and the clarifier were performed by Weston (Reference 1) in 1991 and again in 1991 and 1992 by Halliburton NUS (HNUS) (Reference 2). Reported characteristics from these reports and various other sited sources are presented in the sections that follow. Only those properties which apply to pumping and storage of the pond material are presented. Properties such as specific gravity, total dissolved solids, weight percent solids, and viscosity are needed for sizing pumps and pipelines. Chemical constituents and pH for determination of corrosivity and any other observed properties of the pond material such as solids settling, nature of the sludge, and temperature effects are necessary for the selection of storage options.

A summary of the relative physical and chemical characterizations and pond material observations pertinent to this study are included in Section 3.1.1. The information is provided for the individual A and B Series Ponds prior to consolidation, C Pond, and Clarifier.

In 1992, consolidation of Ponds A and B began. The contents of A Pond were emptied into the B Series Ponds and A Pond was declared clean and dry. The B-Center Pond was emptied into B-South Pond and is in the cleaning process. For the purposes of this study, plans are to empty B-North into B-South Pond and once the sludge has settled, the excess water will be pumped from above the sludge layer to the 374 Building evaporator. When the accelerated reclamation of the ponds and clarifier begins, A Pond, B-North, and B-Center will be empty, and B-South Pond will contain the settled contents of the A and B Series Ponds. Section 3.1.2 describes the physical and chemical characteristics of the pond material which is expected to be present in Pond B-South at the start of the accelerated pumping and storage project.

3.1.1 Waste Characterization Prior to Consolidation

As the consolidated waste from the A/B Ponds has not been characterized, data from the individual ponds must be examined before a reasonable estimate as to the characteristics of the combined ponds can be made. The following sections refer to data pertaining to the individual A/B Ponds as well as C Pond and Clarifier.

3.1.1.1 Specific Gravity

The specific gravity of the materials contained in the pond correlates the estimated volume to weight. As all estimates of pond contents are based on volumes, the specific gravity is required to calculate the weight of the dry sludge, the solution in the sludge, and the solution above the sludge. This information is necessary for any A/B Pond material volume reduction strategies. The information is also critical for the dilution of the C Pond sludge. Maximizing the salt solubility requires knowledge of the quantity of salt and water present.

The specific gravity of the wet sludge can be calculated from the specific gravities of the dry solids and the solution contained within the dry solids, as well as the weight percent solids. The specific gravity of the wet sludge is critical to pump and line sizing as well as specification of structure requirements. The following tables provide an indication of the relative dry solids and solution specific gravities.

TABLE 3-1		
SOURCE	SPECIFIC GRAVITY OF DRY SOLIDS	
	AVERAGE	RANGE
A POND	2.195	2.03 - 2.39
B-NORTH	2.445	2.43 - 2.46
B-CENTER	1.840	1.80 - 1.93
B-SOUTH	1.975	1.85 - 2.08
C POND	2.230	1.93 - 2.41
CLARIFIER	2.73	Not Available

TABLE 3-2		
SOURCE	SPECIFIC GRAVITY OF SOLUTION CONTAINED IN THE SLUDGE	
	AVERAGE	RANGE
A POND	1.013	1.012 - 1.014
B-NORTH	1.003	1.003 - 1.003
B-CENTER	1.014	1.011 - 1.015
B-SOUTH	1.013	1.012 - 1.014
C POND	1.407	1.402 - 1.418
CLARIFIER	1.041	Not available

The specific gravity of the solution above the sludge for all ponds and the Clarifier will vary due to evaporation and precipitation, and in the case of C Pond where the solution may be saturated, the ambient temperature. The following tables provide an indication of the relative solution specific gravities.

TABLE 3-3

SOURCE	SPECIFIC GRAVITY OF SOLUTION ABOVE THE SLUDGE	
	AVERAGE	RANGE
A POND	1.011	1.010 - 1.012
B-NORTH	1.008	1.008 - 1.008
B-CENTER	1.017	1.016 - 1.018
B-SOUTH	1.019	1.016 - 1.020
C POND	1.332	1.316 - 1.348
CLARIFIER	1.041	1.038 - 1.044

TABLE 3-4

SOURCE	SPECIFIC GRAVITY OF C POND CRYSTAL LAYER	
	AVERAGE	RANGE
CRYSTALS	2.20	2.20 - 2.20
SOLUTION IN CRYSTALS	1.407	1.402 - 1.418

The values shown are from sampling events overseen by HNUS in 1991 and are reported in Reference 2. Due to sampling difficulties, the Clarifier values are based on solids taken from only the top of the sludge layer. The actual solids and solution specific gravities may be quite different.

3.1.1.2 Viscosity

Viscosity is used in pump calculations and line sizing and is a particularly important variable for defining the flow characteristic of cross-country pipelines for slurry suspensions. Viscosity data for C Pond shows that as the weight percent of total dissolved solids (TDS) increases the viscosity also increases. The table below is a summary of data presented in the process design criteria for C Pond (Reference 3).

TABLE 3-5		
C Pond Slurry/Brine Viscosity		
Wt % TSS	Wt % TDS	Viscosity (cP)
0	35	20
0	27	16
0	12	12

A linear correlation for viscosity of the brine versus TDS for the data available at 11.3 to 11.6% Total Solution Solids (TSS) accurately predicts the slurry viscosity and indicates a slurry viscosity increase of 30.3 centiPoise (cP) for every 1.0% increase in TSS (Reference 4). In addition, the slurry viscosity also increases as the % TSS increases. Thus, both variables (TDS and TSS) are important.

Viscosity measurements of the A/B Pond material taken during the belt filter cake studies indicates that the sludge displayed fluid character only up to 12 weight (wt) % solids (Reference 5).

3.1.1.3 <u>Weight Percent Solids</u>

The weight percent solids in the sludge and crystals indicates the quantity of dry solids which are present in the sludge and crystal layers, respectively.

In the case of the A and B Ponds this is an important variable because the solution above the sludge will be removed from the pond and pumped to the 374 Building. If the solution contained in the sludge could be decreased by natural gravity settling, thickening, or filtration, a decrease in the total volume of sludge to be stored would result.

The volume of C Pond material to be stored is dependent primarily on the contained dissolved salts and not on the suspended solids in the sludge. The weight percent solids in the crystal layer is a necessary part in the total salt determination.

The value shown for the weight percent solids in the Clarifier is based on a sample taken from the top of the sludge layer due to sampling constraints and difficulties. It is possible that the sludge at the bottom of the Clarifier could have a terminal weight percent solids as high as 80%. Therefore, the overall weight percent solids in the clarifier could be as high as 60%. The following tables summarize weight percent solids information.

TABLE 3-6

SOURCE	WEIGHT PERCENT SOLIDS IN SLUDGE	
	AVERAGE	RANGE
A POND	26.35 %	15.9 % - 44.0 %
B-NORTH	26.22 %	25.3 % - 27.5 %
B-CENTER	5.6 %	4.5 % - 6.7 %
B-SOUTH	10.12 %	6.0 % - 14.5 %
C POND	59.98 %	43.9 % - 70.5 %
CLARIFIER	36 %	Not Available

TABLE 3-7		
SOURCE	WEIGHT PERCENT SOLIDS IN CRYSTAL LAYER	
	AVERAGE	RANGE
CRYSTALS	56.00 %	51.2 % - 65.2 %

3.1.1.4 Particle Size Distribution of Sludge

Particle size distribution data from sludge samples show that the majority of solids in A and B Ponds are less than 200 mesh. The majority of solids in the C Pond are larger than 10 mesh. Table 3-8 is a summary of the particle size distribution data.

TABLE 3-8

Particle Size Distribution

Screen Size	207A(1)	207B				207C	Clarifier
		North		Center	South		
		Weston	HNUS				
+10 mesh	8.9	1.3	0.6	7.9	3.0	89.8	0
-10 +200	25.8	15.3	22.9	23.5	19.5	9.3	21.0
-200 mesh	65.3	83.4	76.5	68.6	77.6	0.9	79.0

The values represent the amount of solids expressed in weight percent retained or passed through the screen sizes shown. A positive (+) sign in front of the mesh size indicates that the solids were retained on that screen. A negative (-) sign indicates that the solids passed through that particular screen. The particle size data was taken from a Weston report (Reference 1). Additional data was provided by HNUS regarding B-North Pond (Reference 6). Particle size of the salt crystals in the C Pond will vary according to temperature. This characteristic is discussed in more detail in Section 3.1.1.7.

Samples collected from the A/B Ponds in the summer months were consolidated, chlorinated, and wet sieved in the laboratory in preparation for a filtration study. The sludges exhibited a "gelatinous" nature, making them impossible to dewater. Upon subsequent testing in the laboratory with additional samples taken during early winter, this phenomenon was not observed. A possible explanation is that the sludge was sieved through a -325 mesh screen thereby changing its physical characteristics. Another likely explanation is that the characteristics of the B Pond wastes may vary significantly with the seasons or change its characteristics over time.

3.1.1.5 Total Dissolved Solids (TDS) and pH

Total dissolved solids (TDS) is an indication of the amount of inorganic salts dissolved in the waste. During the winter months when temperatures were the coldest, the C Pond was comprised of distinct layers consisting of surface brine, extremely hard salt formations, mushy salts, and silt. During warmer weather some of the salt dissolved, thereby decreasing the thickness of the crystal layer. Salt solubility increases with increasing temperature facilitating this dissolution. The TDS of the C Pond material will be analyzed before pumping begins, thus assuring that enough of the salt layer has been dissolved to make pumping of the entire pond contents feasible. If necessary, additional water for dilution to ensure salt dissolution will be added.

TDS is also used to calculate the specific gravity of the C Pond brine which is used in pump calculations and line sizing (Reference 3). A TDS value of 45.8% or less is needed to assure that all the salts are dissolved for ease of pumping. Table 3-9 shows the TDS ranges in the water and sludge from ponds and the Clarifier (References 1 and 2).

TABLE 3-9

Total Dissolved Solids and pH

	207A	207			207C	Clarifier
		North	Center	South		
TOTAL DISSOLVED SOLIDS						
water	7600-7900	2700-3200	13000-16000	14000-16000	400,000-510,000	46,000-68,000
sludge	480	160-220	670-770	740-790	18,000-24,000	4,600-5,400
pH						
water	9.7-9.9	8.3-8.5	9.0-9.2	9.0-9.2	10.0-10.2	9.9-10.2
sludge	8.9	7.3-7.7	9.1-9.2	9.1	10.2-10.5	9.7-9.8

Table 3-2 includes a list of the pH values for each pond and the Clarifier. pH values are used in the determination of the proper materials of construction.

3.1.1.6 Chemical Constituents

An important factor to consider when determining the materials of construction for the transport and storage equipment is the corrosivity of the pond material, as the interim storage in containers may be required for up to 10 years. Information regarding the chemical constituents and ionic strength of the pond material, including cations and anions, is included in Appendix A. This information was provided to a corrosion engineer as the basis for determining the materials of construction and is presented here to support the conclusions of the corrosion engineer.

In addition to corrosion, the chemical constituents present in a wastestream and the subsequent waste code designations are a deciding factor in the hazardous or non-hazardous nature of the wastestream. Since the pond material is considered hazardous, special handling procedures must be incorporated into its transport, for example, a double contained transport pipeline and secondary containments for the storage containers. Tables 2.1.8.1 and 2.1.8.2 from the Brown & Root Standard Process Data Specification (000-020-00-001) issued June 4, 1992 are included in Appendix B. These tables summarize the positive detections of selected constituents present in Ponds A, B-North, B-Center, B-South, C, and the Clarifier which exceed the regulatory standards pertaining to LDR and/or Toxicity Characterization Leaching Procedure (TCLP) for pond water and pond sludge, respectively. The values in the shaded boxes exceed the LDR and/or the TCLP standard.

3.1.1.7 Temperature Effects

Data has shown that temperature has an effect on the pond material from C Pond. During the winter months when temperatures were the coldest, the C Pond was comprised of distinct layers consisting of surface brine, extremely hard salt formations, and mushy salts and silt.

During warmer weather some of the salt dissolves, thus decreasing the thickness of the crystal layer. This indicates that the salt solubility increases with increasing temperature. Based on this information, it is suggested that the C Pond be homogenized and emptied during the warmer summer months to take advantage of this higher salt solubility. Laboratory data indicates that the growth of salt crystals, which occurs during cold weather, also causes an increase in volume. This may have an effect on the storage containers. Since the C Pond will be emptied and placed into storage containers during warm weather it is expected that little or no salt crystals will be present. The growth of salt crystals may occur within the storage containers during the winter and some expansion of containerized material may occur. It is expected that the expansion will be minimal in heated enclosures, and if the maximum TDS limits are controlled.

Viscosity also varies with temperature. At colder temperatures the salt crystals precipitate out of solution thus causing a decrease in TDS but an increase in TSS. As was shown in Section 3.1.1.2, change in viscosity results in a change in pumping characteristics.

3.1.1.8 Settling Data

Solids contained in chlorinated and unchlorinated samples from the A and B Ponds were not readily settled out. The addition of a polymer is required for thickening to occur at a reasonable rate. Successful coagulants were found to be very high charge cationic, high molecular weight polymers (Reference 7). Settling rates were increased from four to ten times the appropriate flocculants.

3.1.1.9 Chlorination

Chlorination is not currently planned during the accelerated pumping and storage project. Chlorination is a requirement for final stabilized waste for pathogen treatment to meet Waste

Acceptance Criteria and not required for continued interim storage. However, it should be noted that chlorination may play a role in settling. Laboratory testing by HNUS showed that pond sludge (A/B) treated with high dosages of calcium hypochlorite [5900 to 16,700 milligrams/Liter (mg/L)] settled at a faster rate than pond sludge that was not chlorinated (Reference 7).

3.1.1.10 Waste Codes

Since the pond sludges are a mixed waste, storage of the pond material will require compliance with Federal and State regulations that apply to the storage and disposal of hazardous waste. Tables 2.1.9.1 and 2.1.9.2 from the Brown & Root Standard Process Data Sheets issued June 4, 1992 are included in Appendix C. These tables summarize the LDR treatment standards which would apply to the pond waters and the pond sludges, respectively. The treatment standards are listed under the corresponding waste code(s) for each constituent.

3.1.2 Physical & Chemical Description After Consolidation

A and B Ponds will be consolidated in B-South. No consolidation of Clarifier or C Pond materials will occur. As discussed in Section 3.1.1.7, the physical characteristics of C Pond materials can change depending upon ambient conditions as well as saturation conditions within the pond (affected by dilution with rainwater). The following sections discuss the physical characteristics of the ponds and clarifier expected during the accelerated pumping and storage project.

3.1.2.1 Expected Physical Data for Consolidated B-South

The physical and chemical characteristics of A and B Ponds materials, as shown in Section 3.1.1, are similar. Therefore, the combined contents of the A and B Ponds in Pond B-

South should be similar. The following list is an estimate of the physical properties of the A/B Ponds combined slurry. The information was taken from the Brown & Root Material Balances, (Reference 8).

A/B Slurry Data:

Specific Gravity	1.013-1.132 (Range)
% Solids	0-20 wt % (Range)
pH	7-10 (Range)
Viscosity	20 cP (estimated @ 3% solids)
	105 cP (@ 10% solids)

A/B Solids Data:

Specific Gravity	2.095

3.1.2.2 Expected Physical Data for C Pond

The following C Pond slurry information was taken from Brown & Root Material Balances (Reference 9).

C Pond Slurry Data:

Specific Gravity	1.040-1.308 (Range)
% Solids	1-11.4 wt % (Range)
pH	10.0-10.5 (Range)
Viscosity	50 cP (basis for design)

C Pond Solids Data (Salt Crystals plus Silt Solids):

Specific Gravity	2.12 (nominal)
Particle Size:	-10 mesh (100% passing)
	-400 mesh (max 80% passing)

3.1.2.3 Expected Physical Data for the Clarifier

The following Clarifier slurry information was taken from Brown & Root Material Balances. (Reference 9).

Clarifier Slurry Data:

Specific Gravity	1.281
% Solids	36 wt% (nominal)
pH	10-10.5
Viscosity	50 cP (basis for design)

Clarifier Solids Data:

Specific Gravity	2.167
Particle Size	-10 mesh (100% passing)

3.1.3 Corrosion Considerations

Based on a preliminary review of the chemical analyses performed for the Halliburton NUS Characterization Study and a required 10-year lifespan, the following materials seem to be acceptable for storage containers of the B Consolidated Ponds, the C Pond, and the Clarifier:

- Suitably lined on the interior and coated on the exterior carbon steel;
- Suitably lined on the interior and coated on the exterior stainless steel;
- Thick walled polypropylene; and/or
- Vinyl ester resin laminated fiberglass.

Additional information on the linings, coatings and, resins are contained in the draft copy of the corrosion engineers report attached in Appendix D.

3.2 WASTE VOLUME DETERMINATION

The total storage volumes for the pond material are estimated based on the following options:

Option A - Store all material including wash waters:

A/B Ponds	350,000 gallons
C Pond	456,000 gallons
Clarifier	90,000 gallons
TOTAL	896,000 gallons

Option B	-	Decant excess water from A/B ponds and Clarifier materials:
A/B Ponds		230,000 gallons
C Pond		456,000 gallons
Clarifier		15,000 gallons
TOTAL		701,000 gallons
Option C	-	Dewater A/B Sludge and added waters to 20 wt% solids using the Rotary Screen Thickener:
A/B Ponds		169,000 gallons
C Pond		456,000 gallons
Clarifier		15,000 gallons
TOTAL		640,000 gallons
Option D	-	Filter A/B Sludge and added waters to 40 wt % solids using a filter press:
A/B Ponds		65,000 gallons
C Pond		456,000 gallons
Clarifier		15,000 gallons
TOTAL		536,000 gallons

All processing options discussed in Section 4.2 assume that the volume of material received from the ponds are those of Option A above. The volumes to be stored for Options B, C, and D, above, result from a dewatering technique or treatment of the sludge to treat the obtain stated. These volumes are based on the following best estimates.

3.2.1 B Consolidated Pond Volume

When the sludge contained in the A and B Series Ponds is consolidated into in the B-South, the pond is estimated to contain the following:

TABLE 3-10			
B Consolidated Pond Volume			
	BEST ESTIMATE	MINIMUM	MAXIMUM
DRY SOLIDS, LB.	319,600	280,600	367,700
TDS, LB.	23,300	18,500	29,000
WATER, LB.	1,758,600	1,778,000	1,734,600
TOTAL, LB.	2,101,500	2,077,100	2,131,300

The storage volume estimates are based on the following values:

<u>Option A - Sludge, Water to Slurry, and Wash Water</u>

Sludge	228,800 gallons		
Water Cover (3")	75,000 gallons		
<u>Wash Water</u>	<u>44,000 gallons</u>		
Total	**347,800 gallons**	→	**<u>350,000 gallons</u>**

<u>Option B - Same as Option A Except Decant All Excess Water</u>

<u>Sludge</u>	<u>228,800 gallons</u>		
Total	**228,800 gallons**	→	**<u>230,000 gallons</u>**

<u>Option C - Dewater Sludge and Added Waters to 20 wt%</u>

Sludge (starting)	228,800 gallons		
<u>Solution removed</u>	<u>59,900 gallons</u>		
Total	**168,900 gallons**	→	**169,000 gallons**

Option D values are based on filtering the material to a higher weight percent solids using a filter press.

Option D - Filter Sludge and Added Waters to 40 wt%

Sludge (starting)	228,800 gallons		
Solution removed	165,400 gallons		
Total	**63,400 gallons**	→	**65,000 gallons**

The supporting calculations for these estimates are attached in Appendix E.

3.2.2 C Pond Volume

On September 10, 1992, when the last depth sampling was performed, the C Pond contained the following:

TABLE 3-11

C Pond Volume

	BEST ESTIMATE	MINIMUM	MAXIMUM
DRY SOLIDS, LB.	350,200	226,000	455,100
DRY SALT, LB.	2,105,800	2,013,400	2,250,000
WATER, LB.	2,332,100	2,429,900	2,250,000
TOTAL, LB.	4,788,100	4,669,300	4,931,400

Based on these values the quantity of water required to dissolve the precipitated salt can be calculated, resulting in the total pond volume storage volume required.

TABLE 3-12			
Total C Pond Volume			
	BEST ESTIMATE	MINIMUM	MAXIMUM
TOTAL POND VOLUME REQUIRED TO DISSOLVE SALTS, GALLONS	411,700	332,300	486,700
WASH WATER, GALLONS	44,000	44,000	44,000
TOTAL VOLUME, GALLONS	455,700	376,300	530,700

The best estimate of 455,700 gallons is rounded up to **456,000 gallons** and is based on a salt concentration of 45.8% wt %.

The supporting calculations for these estimates are attached in Appendix F.

3.2.3 Clarifier Volume

On May 20, 1992, the sludge depth in the Clarifier was measured. As the material had most likely already reached its terminal density in the many years that it has been in place, the measured values should still be reliable:

Clarifier Sludge Volume 11,900 gallons → 15,000 gallons

As the sludge in the Clarifier has likely attained it's terminal density, and based on the assumption that the Clarifier rake shear pin sheared due to solids in the Clarifier, it may take several thousand gallons of water to make the sludge pumpable, followed by sufficient water to flush the Clarifier.

Clarifier Sludge Volume	15,000 gallons
Slurry and Wash Water	75,000 gallons
Total Volume to be Stored	90,000 gallons

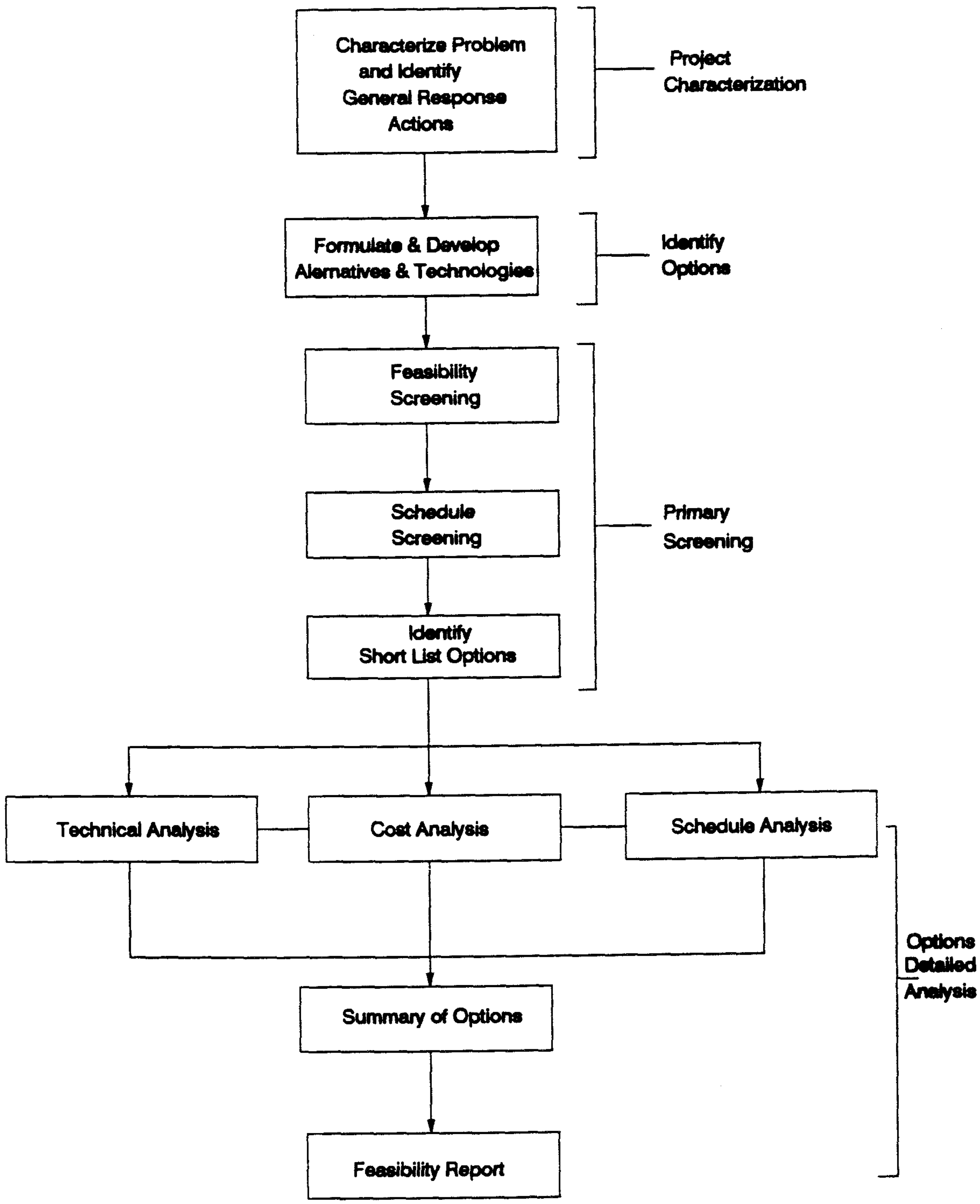
The supporting calculations for these estimates are attached in Appendix G.

3.3 STUDY METHODOLOGY

This document utilizes the guidance of the EPA Feasibility Guidance Document, dated September 1985 (Reference 11). The EPA document provides a structure for identifying, evaluating, and selecting alternatives for evaluation (Figure 3-1). The feasibility study process begins with the development of specific alternatives for a long list. These alternatives are then screened for their technical applicability with specific and appropriate categories. Alternatives that pass the screening process become a short list of alternatives and undergo detailed analyses to provide information for selecting the alternative that is cost-effective and meets the draft schedule. The detailed analysis also encompasses engineering, scheduling, and budgetary constraints. The engineering analysis evaluates constructibility and reliability. The scheduling analysis evaluates practicality to meet the scheduling limitations. The budgetary analysis examines capital and operation costs and involves present worth analysis. Upon completion of the detailed analysis it is the purpose of this document to provide an alternative that will meet the provided limitations of engineering, scheduling, and budget.

FIGURE 3-1

MODIFIED FEASIBILITY STUDY PROCESS



4.0 PROCESS OPTIONS

4.1 PROCESS OPTIONS METHODOLOGY

Team members for this analysis were selected based on previous Solar Evaporation Pond project experience, which for most members was in excess of two years association with the project. Development of the process options commenced with review and specification of the key characteristics of the individual wastestreams and their impact on the reclaim and transport of the waste. The team members toured the pond area to familiarize themselves with current status and to review the current efforts to consolidate the B Series Ponds and the relevant lessons learned. The current volumes of the waste streams were calculated based on the most recent observations, laboratory data or sludge density and other relevant data. A number of process options to achieve the project goals were developed, ranging from simple pumping of all the sludge to containers on the 750 Pad to options which would reduce the volume of waste requiring pad storage. These volume reduction strategies could be done either at the pond or at the storage pad.

After development of rudimentary options, Health and Safety, Radiological Engineering, and Traffic and Operations personnel were briefed and input from their respective disciplines solicited. A refined list of potential process options were developed for further review. These options are presented Figures 4-1 through 4-9, the Process Logic Diagrams (PLDs). The following sections discuss the requirements identified by the team as the fundamental considerations for further development of these options.

4.1.1 Volumes and Key Characteristics of the Pond Wastes

Volumes and key characteristics of the pond wastes are as follows:

Figure 4-1
B Pond - Pump Everything to Interim Storage

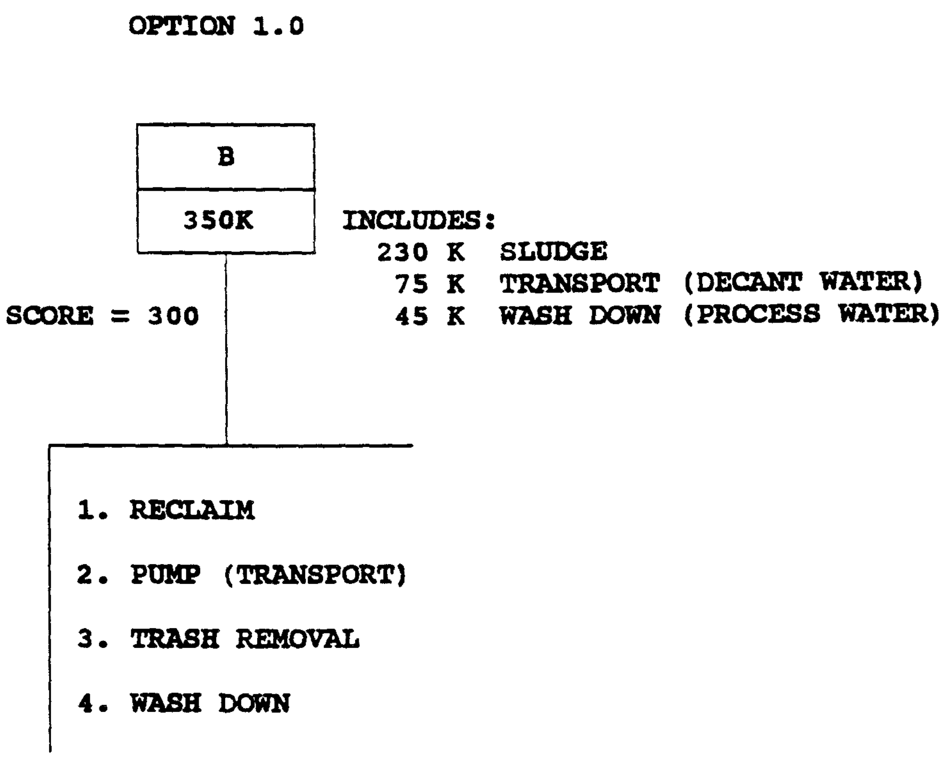


Figure 4-2
B Pond - Options to Reduce Volume
Prior to Interim Storage

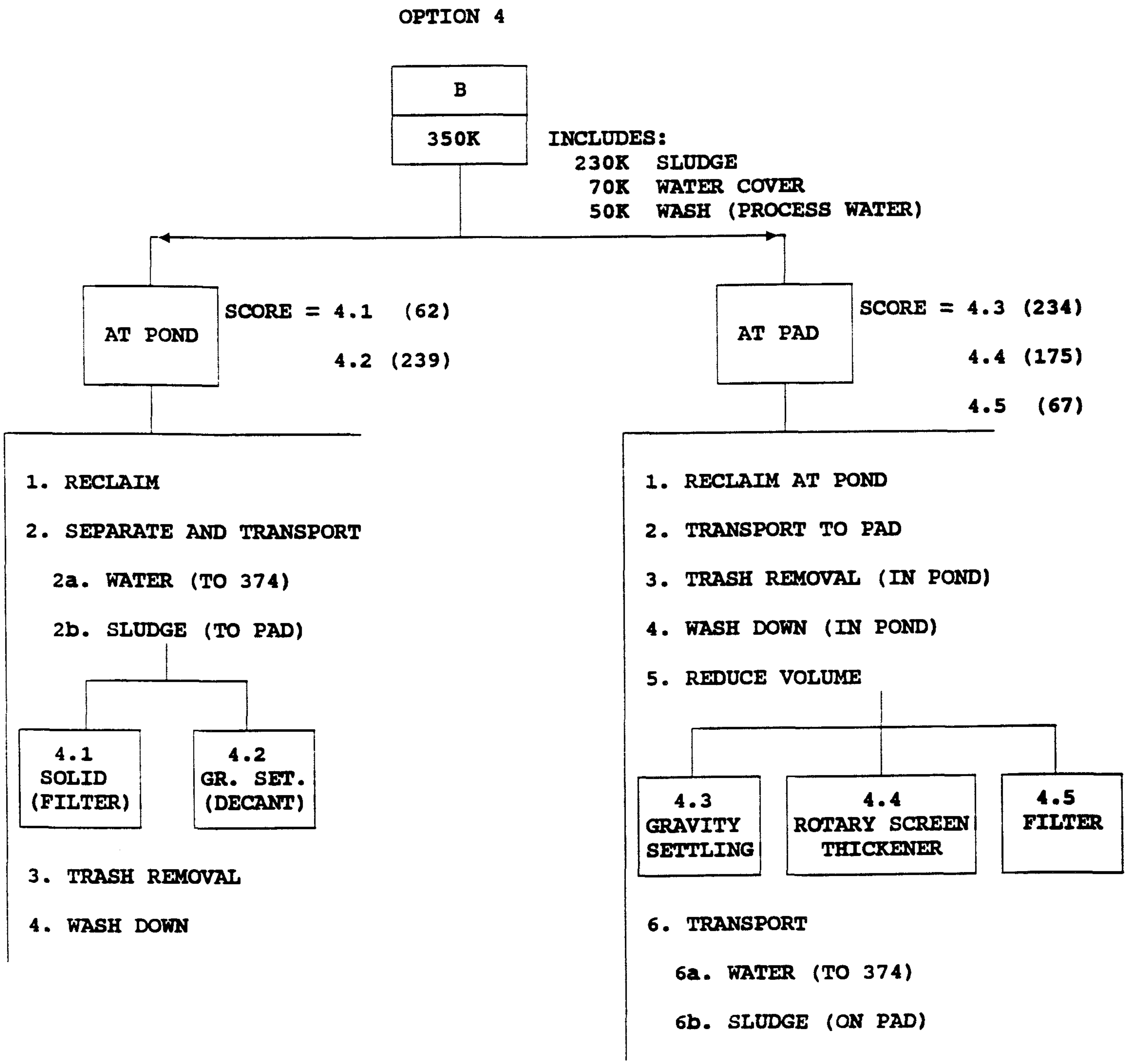


Figure 4-3
B Pond - Options to Reduce Volume
While in Interim Storage

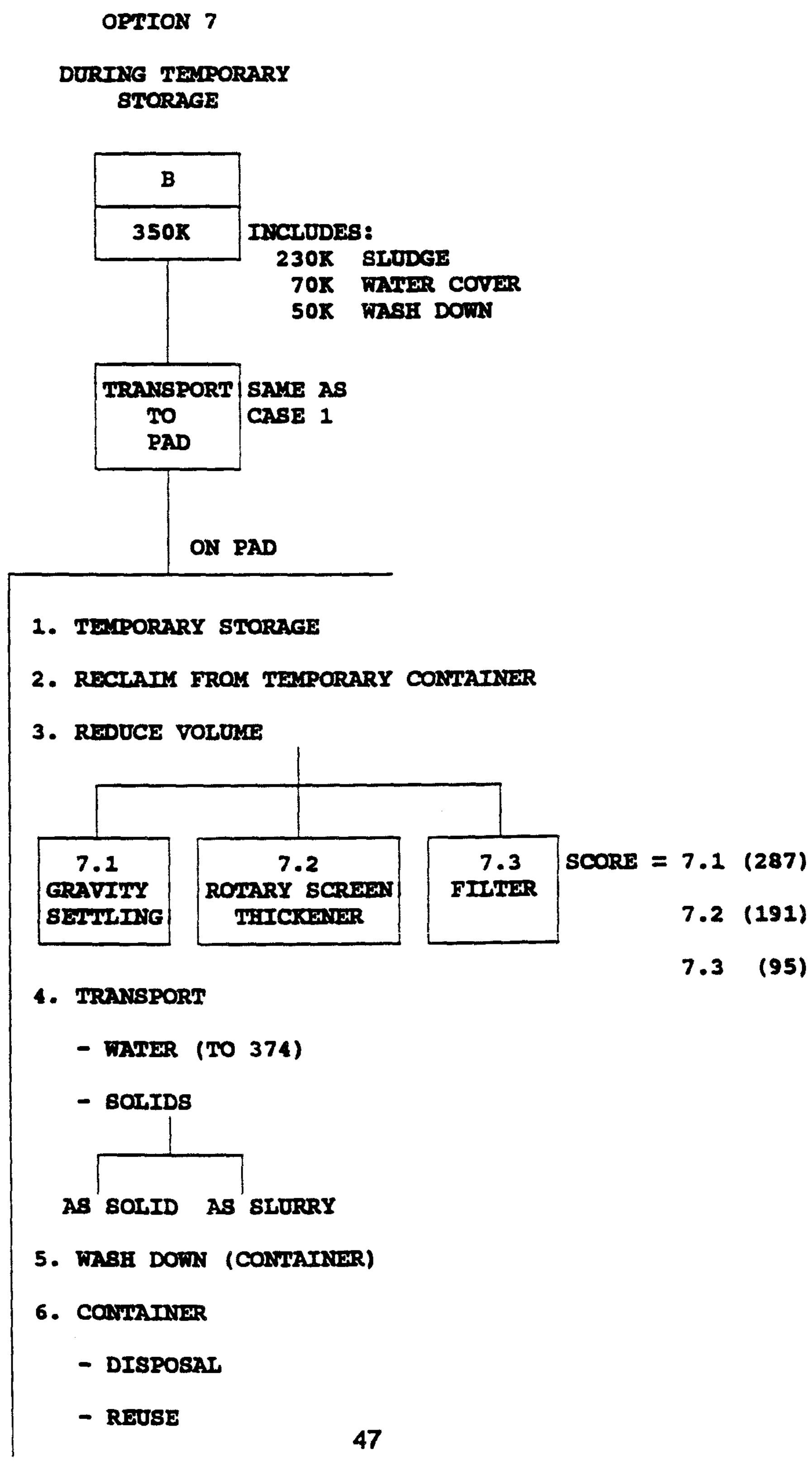


Figure 4-4
C Pond - Pump Everything to Interim Storage

OPTION 2.0

C

450K

INCLUDES:
350K IN POND (BRINE + SILT)
50K DILUTION (PROCESS WATER)
50K WASH DOWN (PROCESS WATER)

SCORE = 300

1. RECLAIM
   1a. DISSOLVE SALT
   1b. ADJUST COMPOSITION
2. PUMP (TRANSPORT)
3. TRASH REMOVAL
4. WASH DOWN

Figure 4-5
C Pond - Reduce Volume During Interim Storage
Using Gravity Settling at the Pad

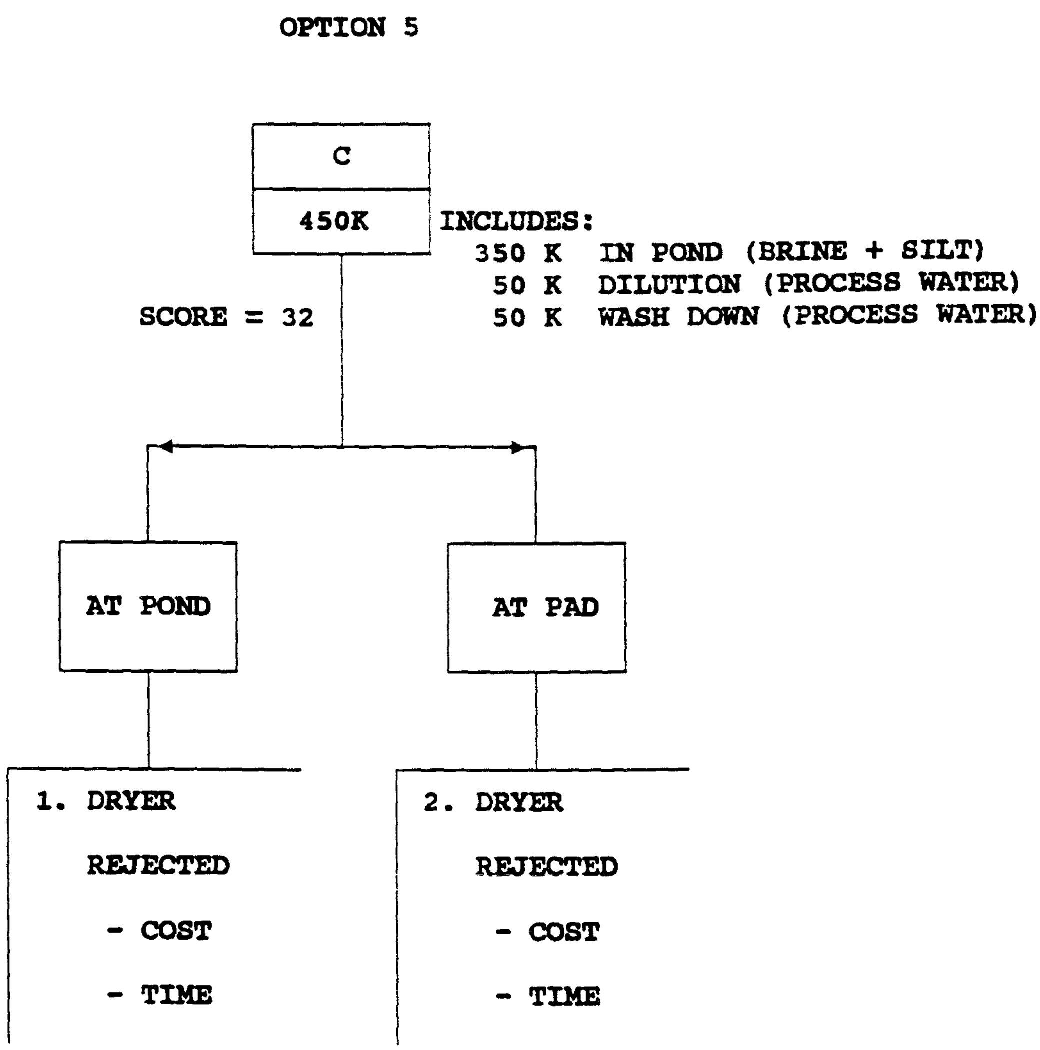


Figure 4-6
C Pond - Option to Reduce Volume
While in Interim Storage

OPTION 8

DURING TEMPORARY
STORAGE

C

450K — INCLUDES:
- 350K IN POND (BRINE + SILT)
- 50K DILUTION (PROCESS WATER)
- 50K WASH WATER (PROCESS WATER)

TRANSPORT TO PAD — SAME AS CASE 2

ON PAD

1. TEMPORARY STORAGE

2. RECLAIM FROM TEMPORARY CONTAINERS

3. REDUCE VOLUME

   8.0 GRAVITY SETTLING — SCORE = 8.0 (281)

4. TRANSPORT

   - WATER (TO 374)

   - CONSOLIDATE SLURRY

5. WASH DOWN (CONTAINER)

6. CONTAINER

   - DISPOSAL

   - REUSE

Figure 4-7
Clarifier - Option to Pump Everything to Interim Storage

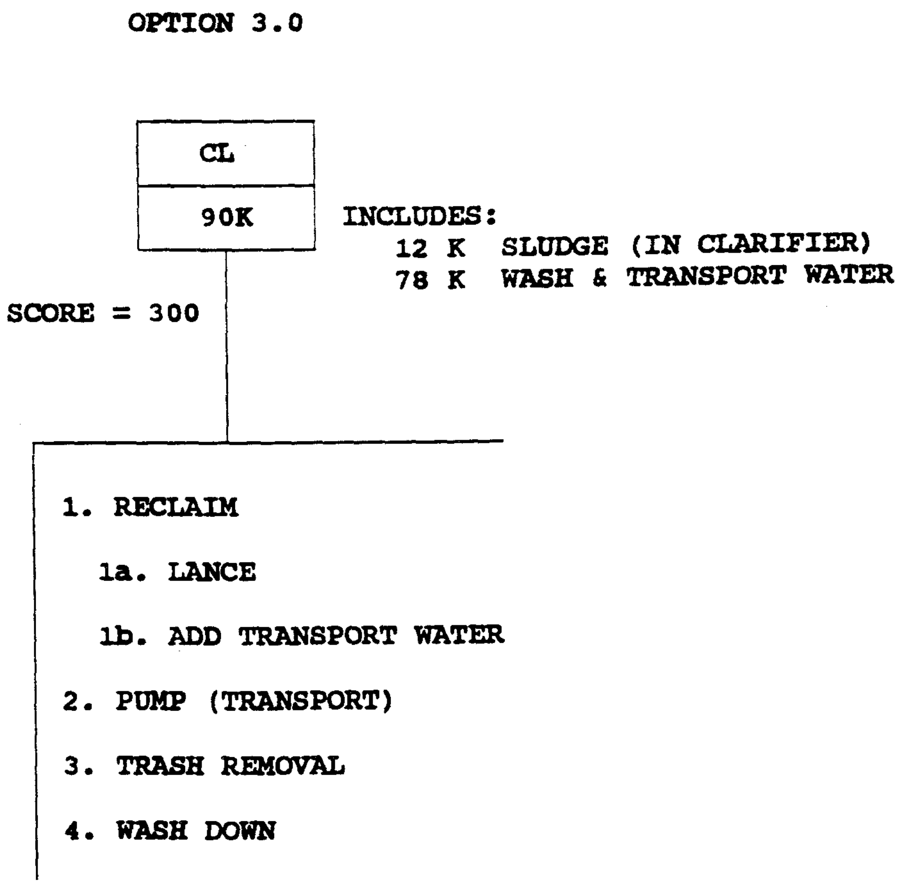


Figure 4-8
Clarifier - Option to Reduce Volume
Prior to Interim Storage

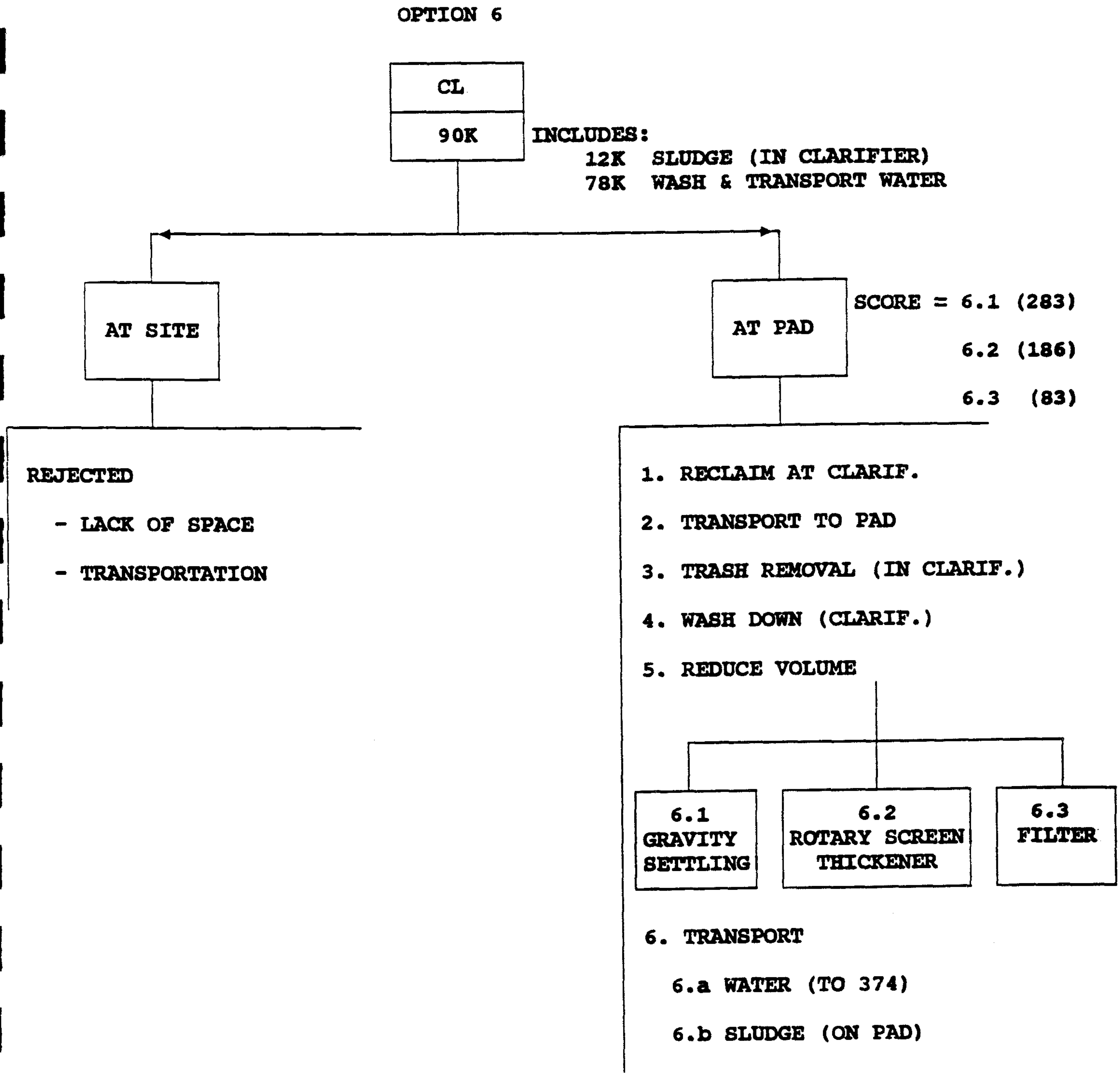


Figure 4-9
Clarifier - Options to Reduce Volume
While in Interim Storage

OPTION 9

DURING TEMPORARY
STORAGE

CL

90K

INCLUDES:
12K CLARIFIER
78K WASH & TRANSPORT WATER

TRANSPORT
TO
PAD

SAME AS
CASE 3

ON PAD

1. TEMPORARY STORAGE

2. RECLAIM FROM TEMPORARY CONTAINERS

3. REDUCE VOLUME

9.0
GRAVITY
SETTLING

SCORE = 9.0 (283)

4. TRANSPORT

- WATER (TO 374)

- CONSOLIDATE SLURRY

5. WASH DOWN (CONTAINER)

6. CONTAINER

- DISPOSAL

- REUSE

-B Consolidated Pond: Contains a total waste volume of 350,000 gallons, including 230,000 gallons of sludge contained in the pond plus reclaim water and pond washdown water. A requirement for disinfecting the reclaimed contents to prevent biological degradation and resultant gas evolution in storage was considered to be the same for all storage options. Ventilation requirements will be included in the detailed design development. The contents of this pond will freeze around 32° Fahrenheit (F). Other concerns include settling velocity, and the potential for encountering a gelatinous phase which will hinder volume reduction and increase pumping difficulties.

-C Pond: Contains a total waste volume of 456,000 gallons, including 412,000 gallons pond waste at 45.8% TDS plus 44,000 gallons wash water. The existing solid salt crystals will be removed form the pond by dissolving, if possible, in lieu of a crystal mining type operations likely to damage the existing liners. At a pH of 10.5 and high ionic concentrations, materials of construction may be an issue for long-term storage. Failure of salt crystals to dissolve either in recirculated brine or practical amounts of added fresh water may pose an additional reclamation problem. The solubility of these salts is known to be sensitive to temperature. Summertime operations to reclaim and transport are desirable since average temperature is higher. Varying layers of brine, hard salt, mushy salt, and silt are currently present in the pond. The dissolution process during reclaim is targeted to achieve an overall brine concentration of about 45.8% TDS. The solid salt phases should redissolve and the brine phase should be comfortably below the critical maximum concentration. The silt solids (≈6.7 wt %) should present little problems during reclaim or transport. This material will freeze at about -6 °F.

-Clarifier: Contains a total volume of 90,000 gallons, including 5,000 gallons of solids in 12,000 to 20,000 gallons of water plus additional water required to mobilize and transport. The density of the existing sludge ranges from 20% to 70% solids by weight. The diluted clarifier solids after reclaim will constitute approximately 10 wt % solids and will be transportable at that slurry density.

4.1.2 Other General Considerations

Other general considerations include:

- Required homogeneity of the pond contents will be achieved during the slurrying and reclaiming steps;
- The integrity of the pond liners must be maintained during operation. Reclaim methods must satisfy this criteria as well as produce the required volumetric rate; and
- The existing equipment will be used to the extent possible.

4.1.3 Definitions Used in Selecting the Process Options

The definitions used in selection of the process options are shown in Table 4-1.

4.1.4 Process Options List

Table 4-2 lists the process options the team considered to be feasible and worth further consideration based on the objective of removing the sludge from the ponds as soon as possible and team experience.

4.1.5 Rating Criteria

Rating Criteria and relative weight to be given to each criteria for screening the process options were developed by team consensus and based on the project objectives. These rating criteria and relative weights are summarized in Table 4-3.

Table 4-1
Process Options Definitions

Interim	The 10 year period during which the wastes are to be maintained in storage before stabilization for permanent disposal.
Mixture	All ponds considered together without regard to maintaining the contents as segregated waste.
Immediate	During reclamation and pumping either at pond side or pad site.
Later	After all ponds are empty and dry - at the pad.
Reclaim	Removal of sludge and water from pond to pond side including decant from pondside back to pond for reuse as transfer medium.
Pump	Transport from the pond side to 750 pad - No liquid return from pad to pond.
Wash down	Wash down of the pond liners with clean process water using approximately 45K gallons of water.
Disinfect	Adding a disinfectant, chlorine or lime, to the waste for the purpose of preventing the formation of gas or reducing biological activity.
Trash removal	Use of a scalping screen during reclaim operations to remove oversize solids prior to pumping and the manual removal of larger waste material.
Composition Adjustment	Addition of water to dissolve hard crystalline salt layers (with mixing).
Maintenance	Repairs required during reclaim and transport operations.

Table 4-2
Process Options

Waste Source		Options
B Consolidated Pond	1.0	Pump Everything to Interim Storage (without volume reduction)
	4.1	Reduce Volume Before Interim Storage Using Filters at the Pond.
	4.2	Reduce Volume Before Interim Storage Using Gravity Settling at the Pond.
	4.3	Reduce Volume Before Interim Storage Using Gravity Settling at the Pad.
	4.4	Reduce Volume Before Interim Storage Using Rotary Screen Thickeners at the Pad
	4.5	Reduce Volume Before Interim Storage Using Filters at the Pad
	7.1	Reduce Volume During Interim Storage Using Gravity Settling at the Pad
	7.2	Reduce Volume During Interim Storage Using Rotary Screen Thickeners at the Pad
	7.3	Reduce Volume During Interim Storage Using Filters at the Pad
207C Pond	2.0	Pump Everything to Interim Storage After Composition Adjustment
	5.0	Reduce Volume Before Interim Storage Using Dryers at the Pond or Pad
	8.0	Reduce Volume During Interim Storage Using Building 374
Clarifier	3.0	Pump Everything to Interim Storage by Adding Transport Water
	6.1	Reduce Volume Before Interim Storage Using Gravity Settlers at the Pad
	6.2	Reduce Volume Before Interim Storage Using Rotary Screen Thickeners at the Pad
	6.3	Reduce Volume Before Storage Using Filters at the Pad
	9.0	Reduce Volume During Interim Storage Using Gravity Settling at the Pad

Table 4-3
Process Options Rating Criteria

RATING CRITERIA (Assigned Maximum Point Value)*	
Schedule Difficulty (50)	Extent to which the alternative will have difficulty meeting the schedule constraint (December 1995).
Cost (50)	Probability of exceeding the available funding.
Process Complexity (50)	The number of process units and their interrelations likely to increase probability of difficulty in start up and/or operations.
Regulatory (40)	Potential for regulating issues requiring schedule or funding difficulties.
Engineering Requirements (40)	Engineering or designs required for installation.
Health and Safety (30)	The extent of engineering required to meet specific H&S requirements.
Stored volume (20)	The amount of storage capacity required for the 10 year period (interim storage).
Procurement (10)	Estimate of time required to specify, purchase/rent/lease, and deliver to site.
Mobilize - Demobilize (10)	Requirements for bringing together resources for initiating the project and the dispersement of resources at the end of the project (personnel and equipment).
Maintenance (5)	The extent of maintenance that will be required during the reclaim and transport operations.
Secondary Waste (10)	The quantity of non-process materials (containers, equipment, tools, etc.) which must be disposed of during or at the end of the project.

* High score is a better attribute. These relative scores were determined as team consensus values following evaluation and discussion of the importance of each criterion as it pertains to the objectives of this project. For example, the schedule for meeting the 1995 completion date is a critical issue; whereas, anticipated maintenance will be a minor issue because of the short duration of process operations.

4.1.6 Short List Selection

The team evaluated the process options (listed in Table 4-1) using the rating criterion (summarized in Table 4-2). The results of applying the weighted criteria to each of the process options are summarized in Table 4-4 Accelerated Sludge Removal Project - Sludge Removal Options Matrix. The following sections discuss these results and their use in the process option short list selection. In considering these screening scores it is important to remember that options for each waste source were evaluated separately and are meaningful only for comparisons within the options for that source. The scores associated with options for one waste source can not be compared to those applicable to another source.

This evaluation procedure, in addition to providing a consistent method for selecting preferred options, highlights the importance of the premise that there was no serious constraint in the availability of the appropriate storage space. If a higher premium were to be placed upon such space, a reevaluation of the options in which stored volume was assigned a higher maximum value might show different results. However, unless the premium on storage space were very large, the options which were retained on the short list, for example, those requiring volume reduction by settling, could still cover the scenario.

4.1.6.1 B Consolidated Pond

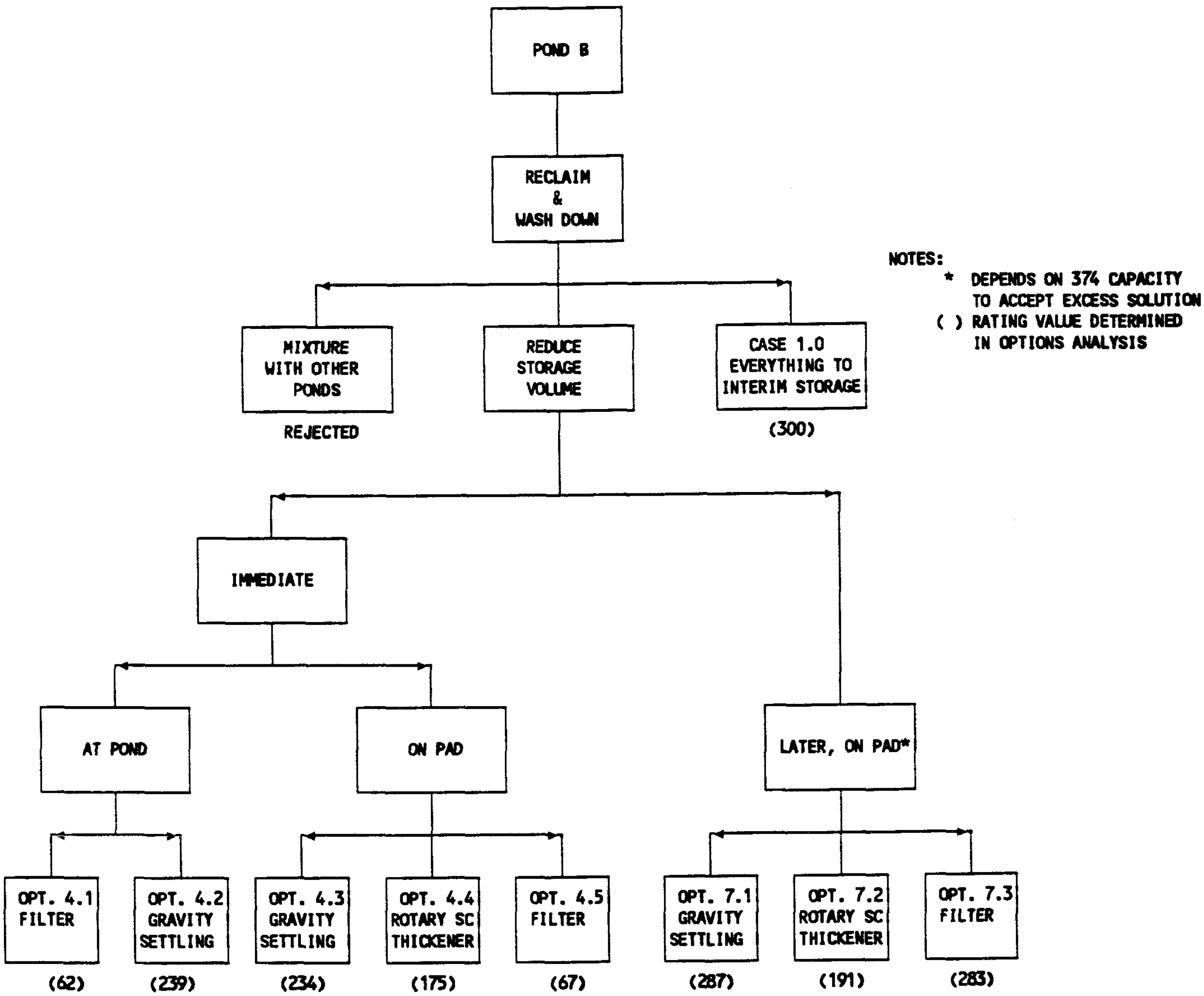
From the results shown in Figure 4-10, Options 1 is seen to have the highest screening score, approximately 300 out of a maximum of 315. This score reflects the advantage of simplicity given the schedule and cost constraints. This option scored the maximum points under every criterion except "Stored Volume". Those options utilizing filtration scored high for stored volume but scored low for complexity. Delaying volume reduction until after the ponds are clean and dry received relatively high scores for schedule consideration as shown for Option 7.1, 7.2,

Table 4-4
Accelerated Sludge Removal Project
Sludge Removal Options Matrix

CRITERIA	MAX WEIGHTED VALUE	SLUDGE REMOVAL OPTIONS																
		B CONSOLIDATED POND (B-SOUTH)									POND 207C			CLARIFIER				
		1	4.1	4.2	4.3	4.4	4.5	7.1	7.2	7.3	2	5	8	3	6.1	6.2	6.3	9
COST	50	50	5	45	40	35	5	45	35	3	50	0	45	50	45	40	20	45
SCHEDULE DIFFICULTY	50	50	20	40	40	35	25	50	50	50	50	10	50	50	40	35	25	50
PROCESS COMPLEXITY	50	50	5	40	40	15	5	45	15	5	50	0	45	50	45	15	5	45
REGULATORY	40	40	1	20	20	15	1	40	15	1	40	0	40	40	40	15	1	40
ENGINEERING REQ.	40	40	5	35	35	30	5	35	30	10	40	0	35	40	40	30	5	35
H & S	30	30	5	25	25	15	5	30	15	5	30	0	30	30	30	15	5	25
STORED VOLUME	20	5	20	10	10	15	20	10	15	20	5	20	5	5	10	15	20	10
SECONDARY WASTE	10	10	0	6	6	3	0	9	3	0	10	0	8	10	9	3	0	9
PROCUREMENT	10	10	0	6	6	4	0	10	6	0	10	1	10	10	10	6	0	10
MOB/DEMOB	10	10	0	8	8	6	0	9	5	0	10	1	9	10	10	8	0	10
MAINT. REQ.	5	5	1	4	4	2	1	4	2	1	5	0	4	5	4	4	2	4
TOTAL	315	300	62	239	234	175	67	287	191	95	300	32	281	300	283	186	83	283

Shaded area shows highest score.

Figure 4-10
B Pond Options



and 7.3. Option 7.1 which scored relatively high under all criteria has the second highest score. Options retained for the short list are:

- Option 1.0 Pump Everything to Interim Storage (without volume reduction).
- Option 7.1 Reduce Volume During Interim Storage Using Gravity Settling at the Pad.

4.1.6.2 C Pond

From the results shown in Figure 4-11, Option 2 is seen to have the highest screening score. This option, Pumping Everything to Interim Storage, showed the advantage of simplicity in the meeting of cost and schedule constraints. It scores low under the criteria for storage volume, having the maximum volume of all the options considered. Option 8, requiring volume reduction after all ponds are clean and dry, also scored high but lost a few points under several criteria. The options retained for the short list are:

- Option 2 Pump Everything to Interim Storage After Composition Adjustment.
- Option 8 Reduce Volume During Interim Storage Using Gravity Settling at the Pad.

4.1.6.3 Clarifier

In the application of the criteria to the options available for reclaiming and transporting the Clarifier contents, those options requiring volume reduction were considered to apply to a scenario in which the waste were processed along with the waste from B Consolidated Pond. From the results shown in Figure 4-12, Option 3, Pumping Everything to Interim Storage, scored the maximum points in every category except that of stored volume. Option 9, requiring volume

Figure 4-11
C Pond Options

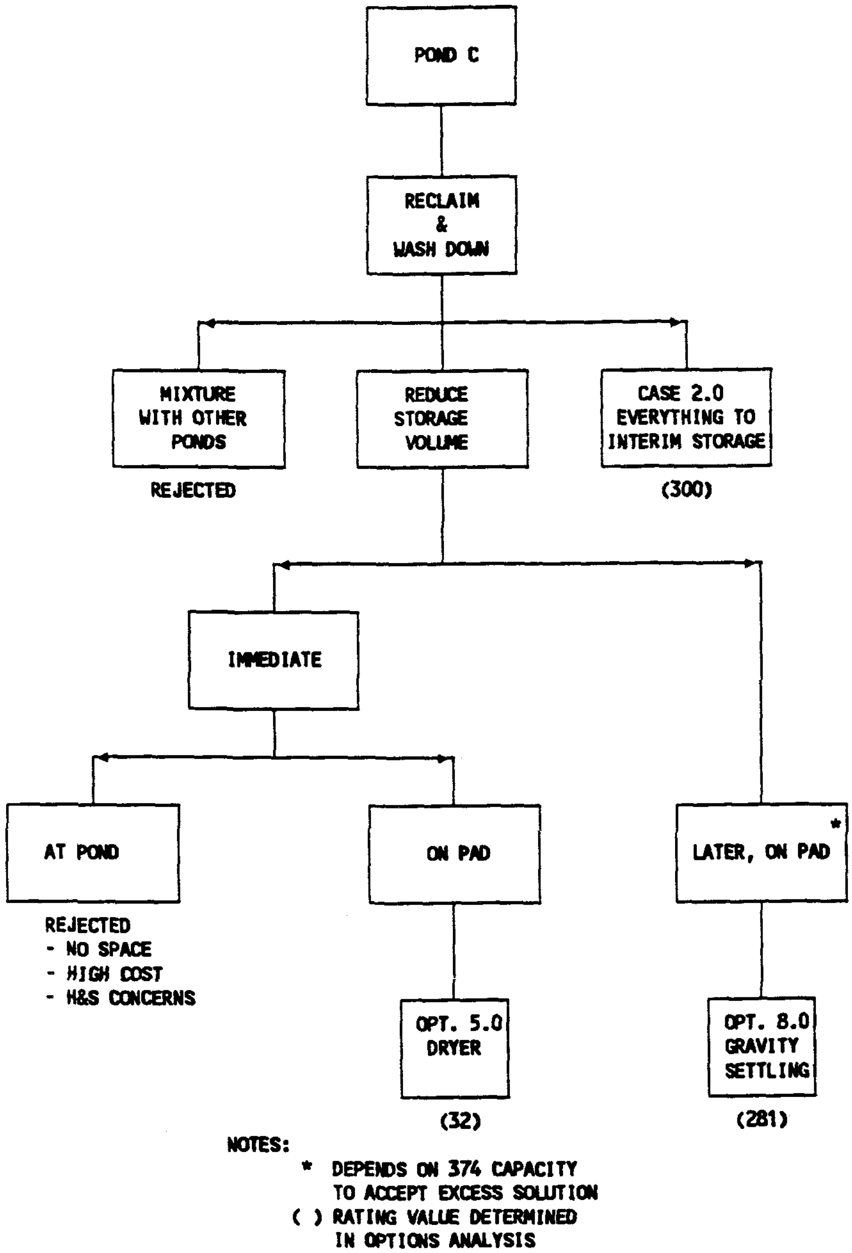
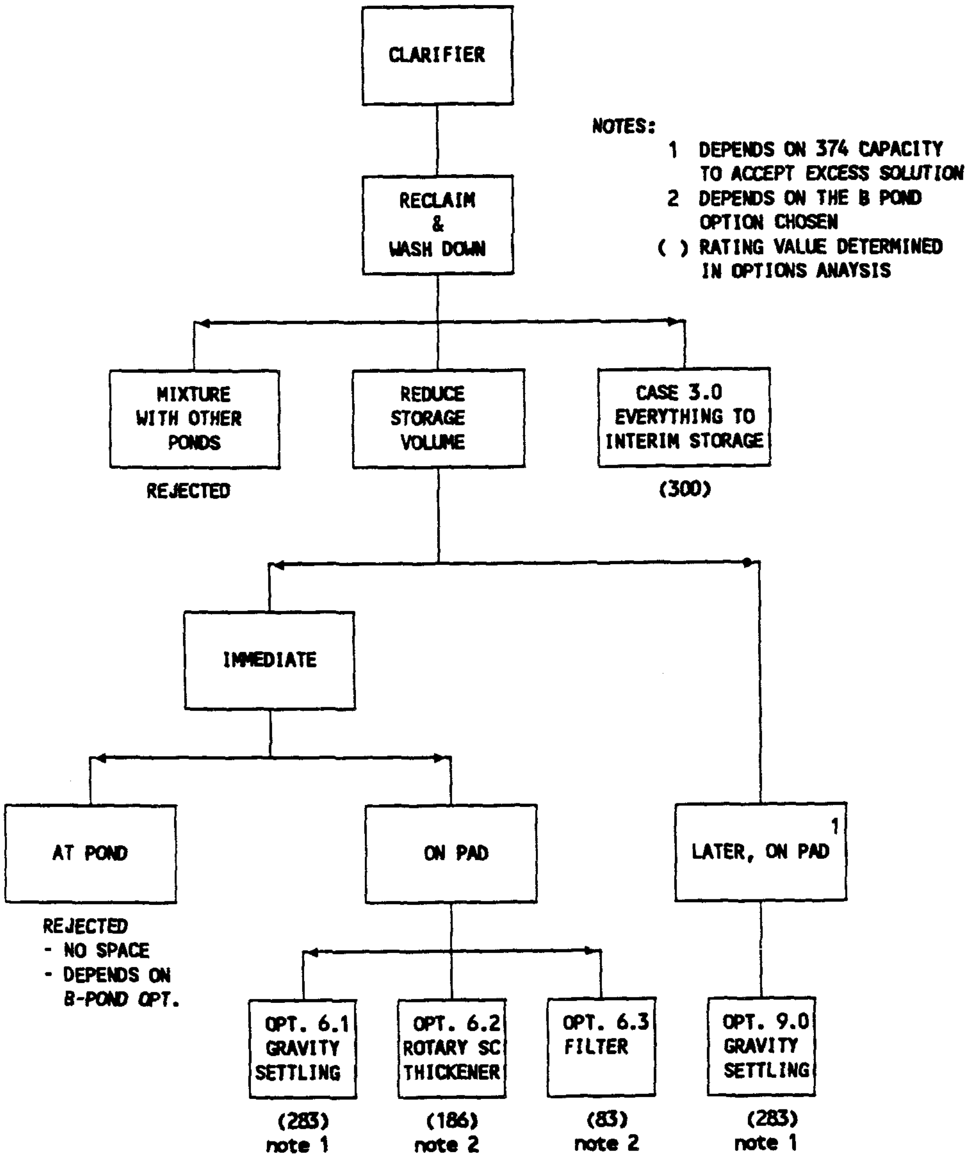


Figure 4-12
Clarifier Options



reduction after all ponds are clean and dry and Option 6.1, requiring volume reduction during reclaim and transport operations, also scored high but are feasible only if Option 4.3, which uses the same equipment on the pad for B Pond, is being exercised. Otherwise, Option 9, where the gravity settling is being done over a longer time frame, is the alternative option for the Clarifier wastes. Those options requiring volume reduction by mechanical means scored low in spite of their advantage under this criteria (generally because of low scores in criteria reflecting increased complexity, cost, schedule, and engineering requirements.) Options retained on the short list are:

- Option 3 Pump Everything to Interim Storage by Adding Transport Water.
- Option 9 Reduce Volume During Interim Storage Using Gravity Settling at the Pad.

4.2 DESCRIPTION OF ALL PROCESS OPTIONS

The Accelerated Sludge Removal Project has the overall goal of removing the contents of the B Consolidated Pond, the C Pond and the 788 Area Clarifier and transporting the material to the 750 Pad. The material, once at the 750 Pad, will be deposited into 10-year design-life, interim storage containers. The basic guidelines which are to govern this project are discussed in the following sections.

4.2.1 Options Considered and Dismissed

A number of potential options to accomplish the desired goal of emptying the SEP system before the December 1995 deadline were considered. Those considered and immediately rejected due to qualitative judgements that they could not satisfy the required objectives include:

- Any "processing" options which would attempt to stabilize the waste to satisfy permanent disposal and shipping requirements **were rejected** for this study. Included were:
  - Operate the existing C Pond stabilization train (by HNUS) to stabilize the C Pond wastes on an accelerated schedule;
  - Install and make operational the (HNUS) B Pond stabilization train, also on an accelerated schedule; and
  - Install any alternate stabilization process.

These options were dismissed from further consideration primarily due to budget constraints. Other factors such as schedule uncertainties and the uncertain requirements for future disposal of such stabilized wastes also were considered.

- Any options for interim storage of partially-treated wastes were also excluded. Although these would present several options for more secure storage by producing a semi-solid waste form, and would reduce the volume requiring storage or would prepare the waste material in a manner which would facilitate future processing requirements, these options were also dismissed from further consideration. The primary reasons were: the uncertainty of permitting requirements or schedule, potential costs, and limited significance of benefits.
- Mixing or consolidation of the SEP wastes together during interim storage was rejected since this would invalidate all previous Waste Characterization and Treatability studies. Even if possible from a chemical, physical or listed waste code basis, this was deemed undesirable.
- Any options which used any chemical additives to facilitate materials handling or to increase the volume reduction of the wastes. These included:

- Disinfecting the wastes with lime or chlorine which would reduce any potential for noxious gas emissions due to biological activity. These treatments are currently required for disposal and shipment of stabilized wastes. Ventilation requirements will be addressed during design criteria development. It was assumed that no health and safety risks would be created for the interim storage scenarios without such treatment of the wastes.
- Flocculation to enhance settling or filter aids to improve filtration rate or product character were also considered and rejected since this would be interpreted as adding chemicals or "treatment" of the wastes by regulators. Although significant volume reductions could be realized, the additional permitting requirements would have a negative schedule impact.

- An option to reduce the liquid waste volumes (prior to pond removal) by accelerating the planned process improvements in the 374 Building evaporator and spray dryer circuits was also rejected due to budgetary and schedule constraints. Although feasible and would produce a more stable waste form for interim storage, it was not clear that storage volume would ultimately be reduced in the short run.
- Options, other than pumping of liquid wastes, for transportation were also rejected from further consideration due to the potential handling risks, container requirements (costs and procurement time), low volume per load or other schedule constraints.

- Options requiring extensive equipment located near the 788 Clarifier or at the C Pond were also rejected since such space does not exist or would require extensive and time-consuming site preparation.

4.2.2 Options Considered and Evaluated

Options considered for processes to transport the Solar Pond wastes to the 750 Pad for interim storage were developed using the maximum available equipment from the HNUS stabilization processing and materials handling trains for the C Pond, 788 Area Clarifier and B Consolidated Pond wastes. As such, the transport *circuits for the B Consolidated Pond, Clarifier* and C Pond used different equipment (except for common pipelines and 750 Pad distribution equipment). This decision was made to insure maximum flexibility in transporting material from any source without dismantling the other transport process trains. Only limited additional equipment would be required to accomplish this; thus this additional flexibility and potential improvement to the schedule were deemed to be desirable. From the available equipment, the transport options (Sections 4.2.4 through 4.2.6) were developed for further evaluation. The logic of each option is presented in Block Flow Diagrams (BFDs) shown in Figures 4-13 through 4-18.

The process descriptions (and the BFDs of the selected options in Section 4.3) use the available HNUS equipment numbers where appropriate. Names given to the equipment reflect their current use in the transport process circuits. The Master Equipment Lists are included as Appendix H.

(Note: Equipment requiring purchase is denoted by ??.)

Figure 4-13
B Pond Sludge Removal to Interim Storage Option 1.0
Pump Everything to Interim Storage

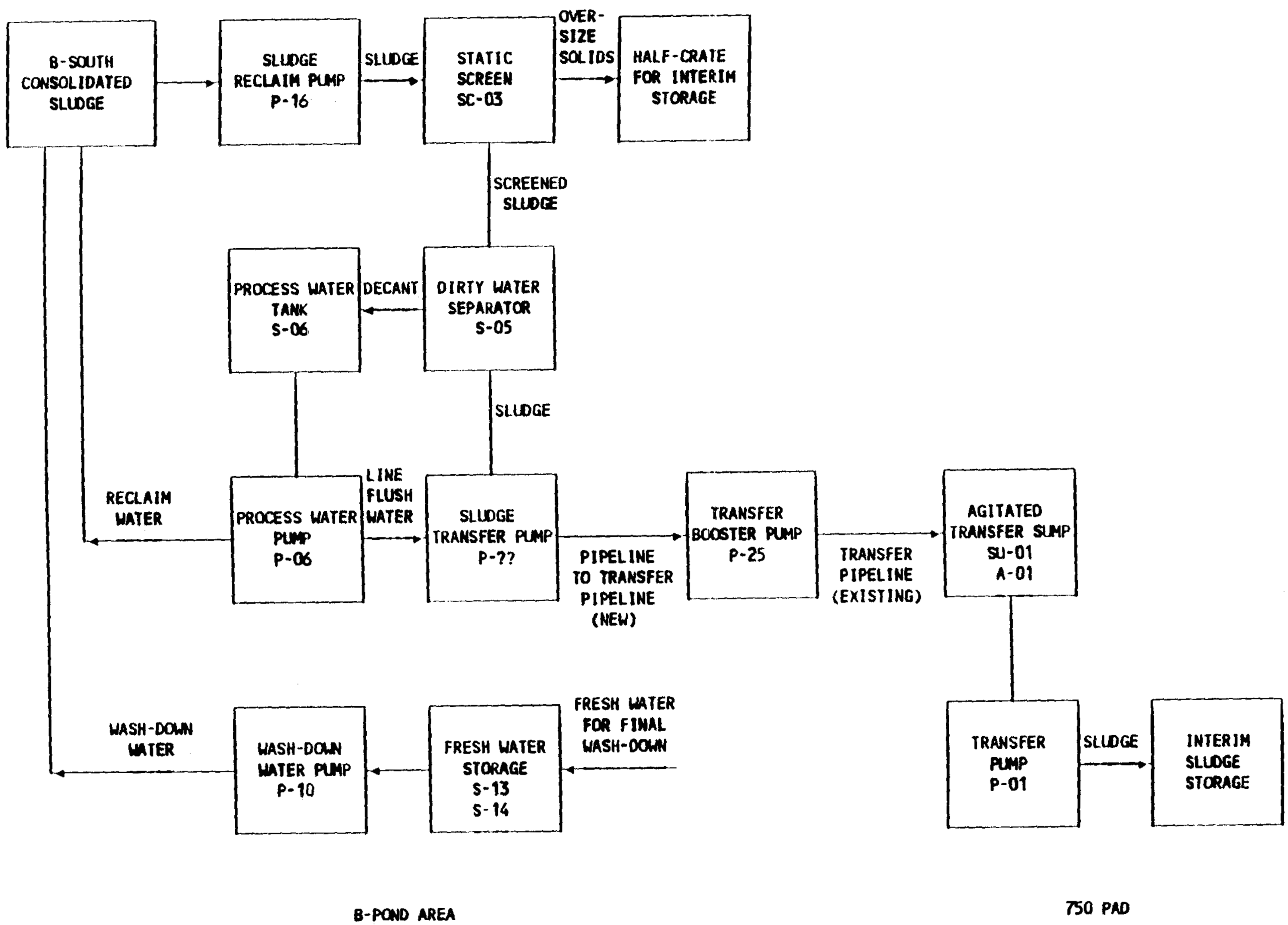


Figure 4-14
B Pond Sludge Removal to Interim Storage Option 4.2
Reduce Volume Before Interim Storage Using Gravity Settling at the Pond

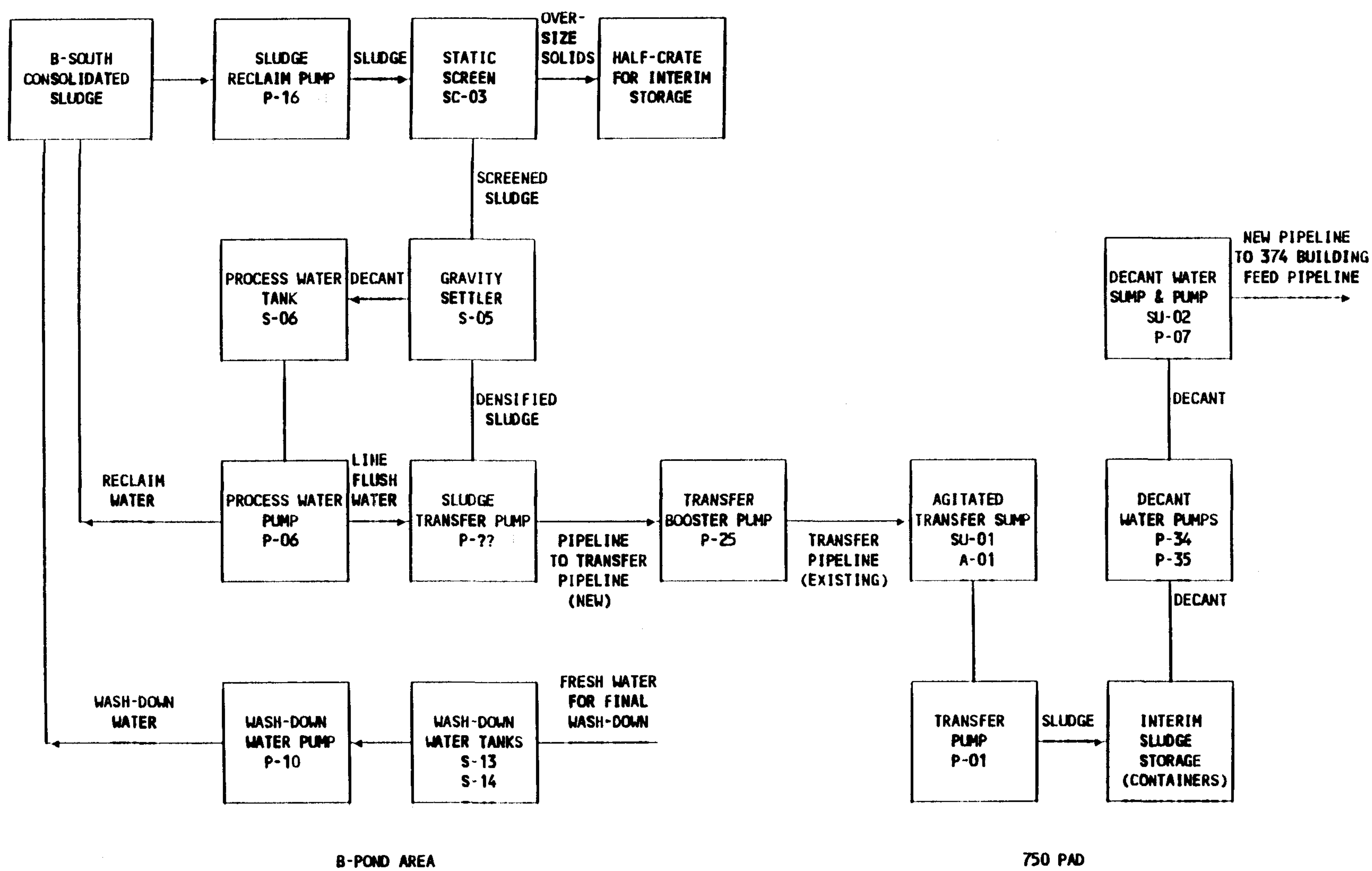


Figure 4-15
B Pond Sludge Removal to Interim Storage Option 4.3
Reduce Volume Before Interim Storage Using Gravity Settling at the Pad

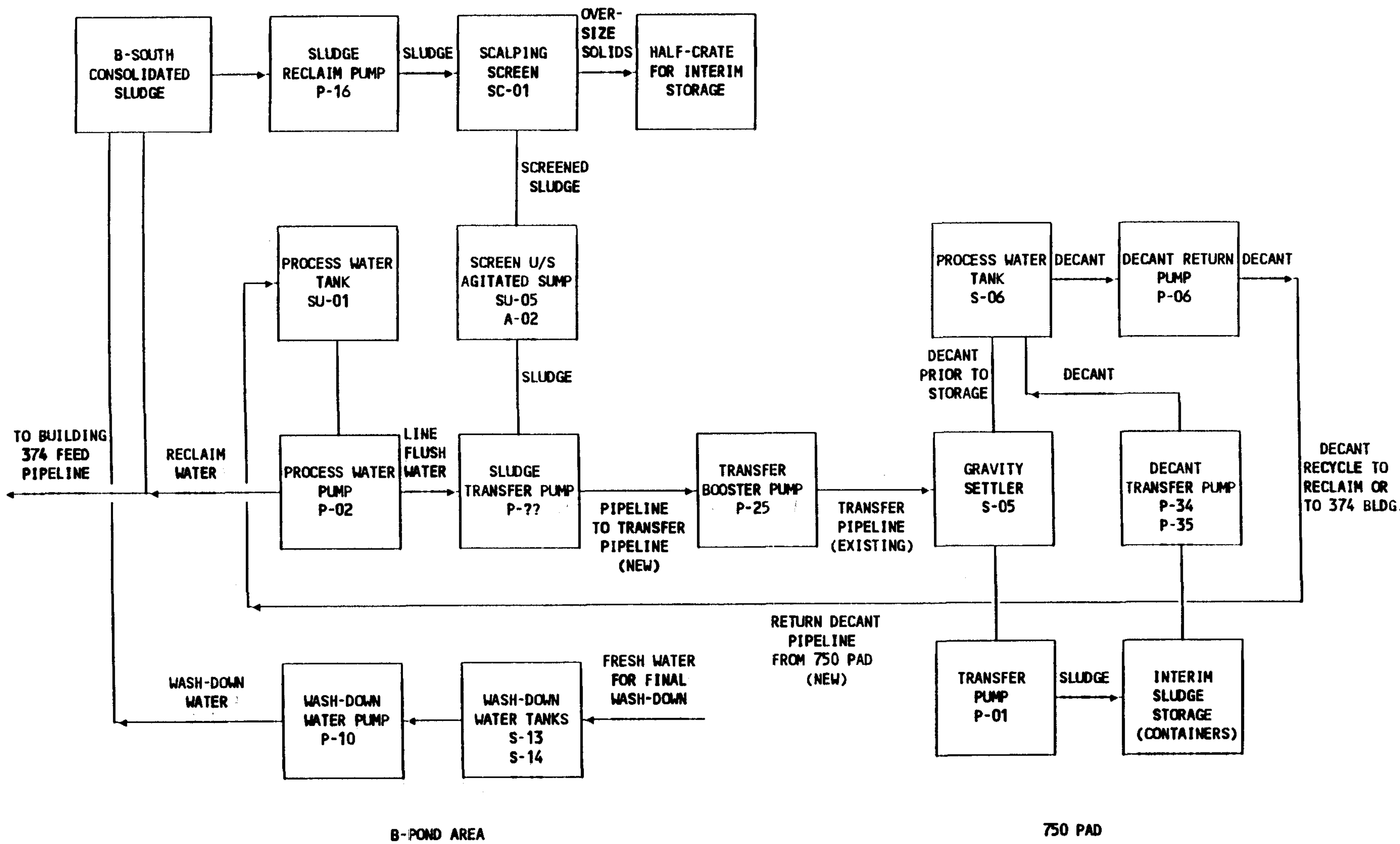


Figure 4-16
B Pond Sludge Removal to Interim Storage Option 7.1
Reduce Volume During Interim Storage Using Gravity Settling at the Pad

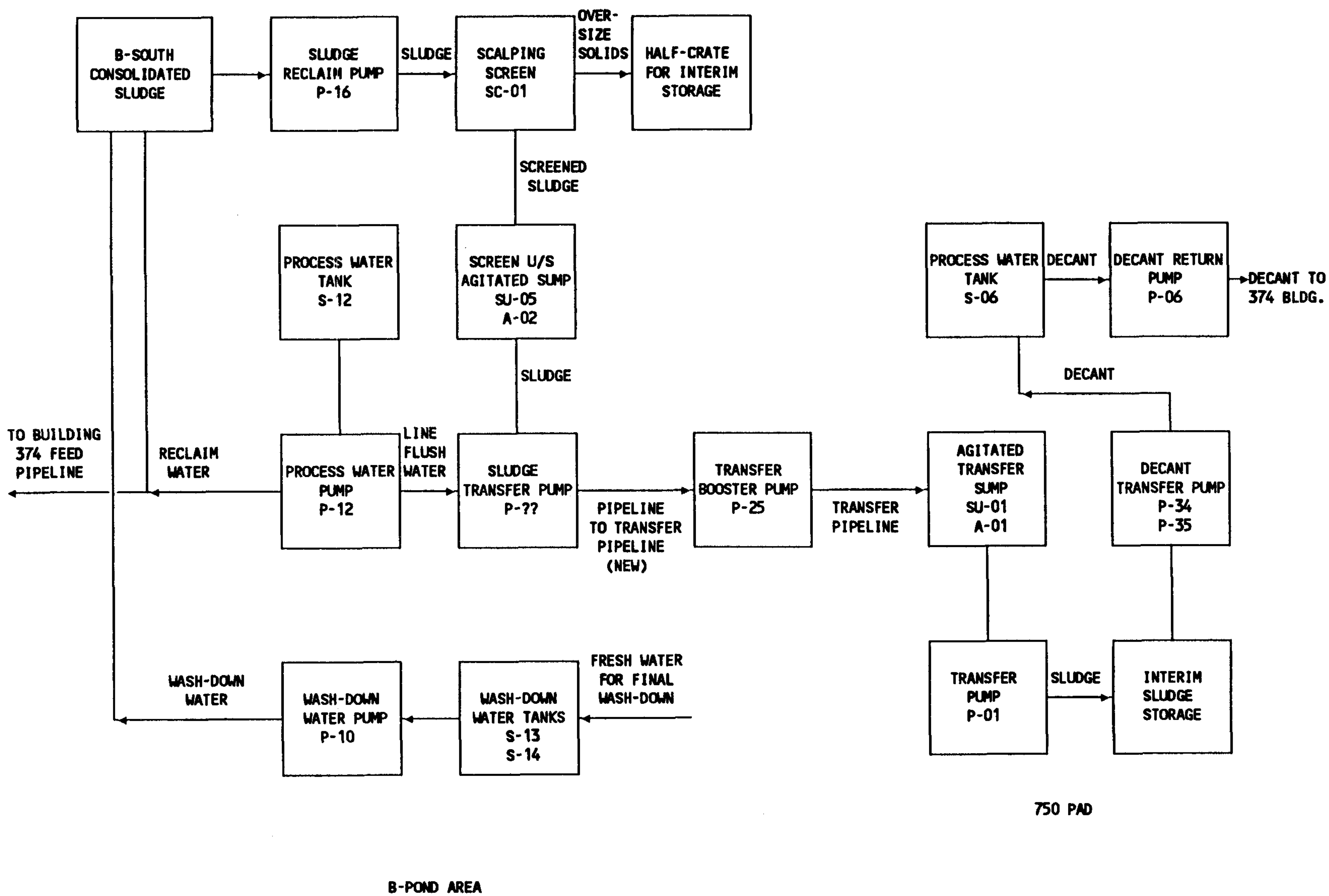


Figure 4-17
C Pond Sludge Removal to Interim Storage Option 2.0
Pump Everything to Interim Storage After Composition Adjustment

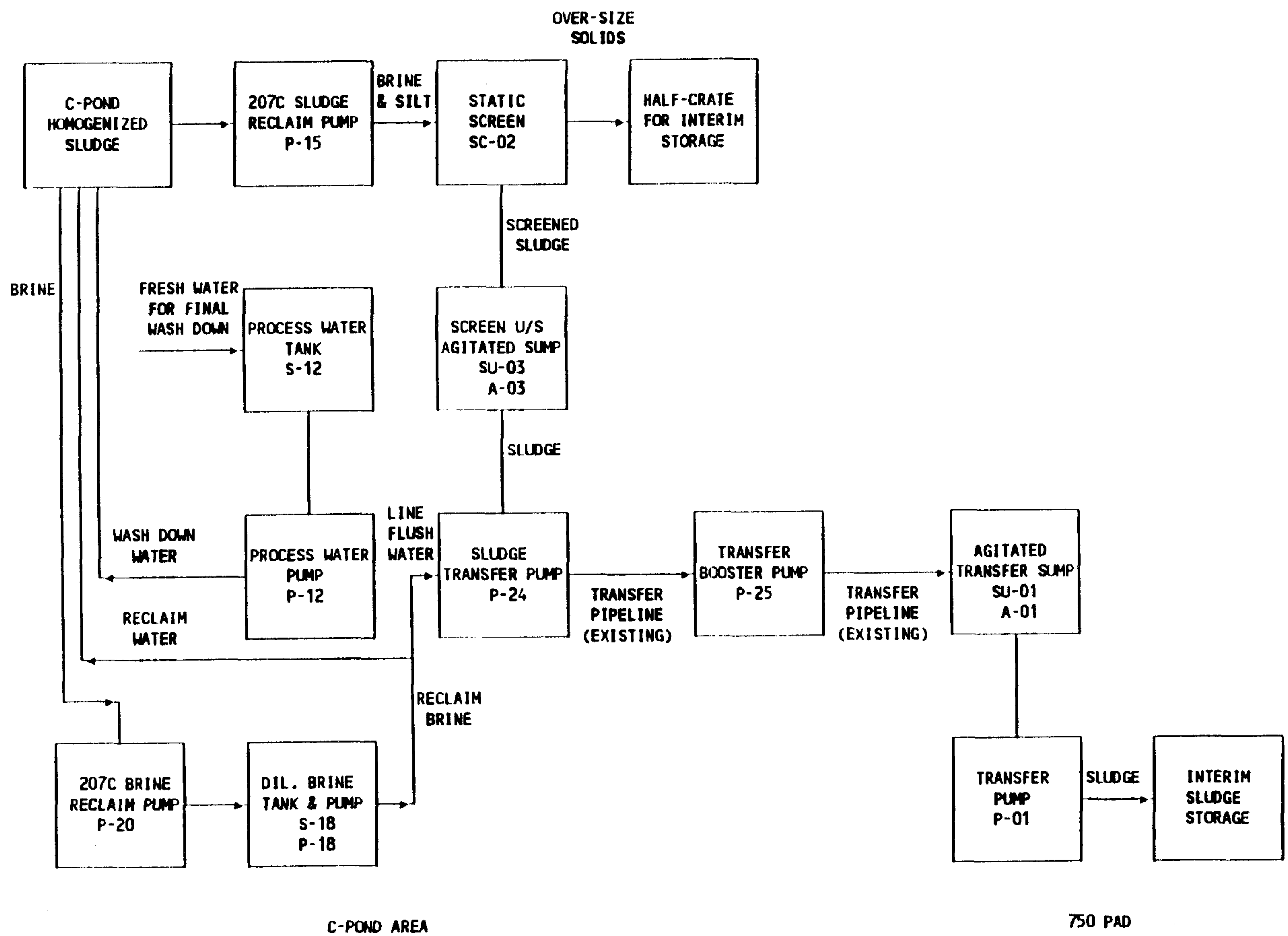
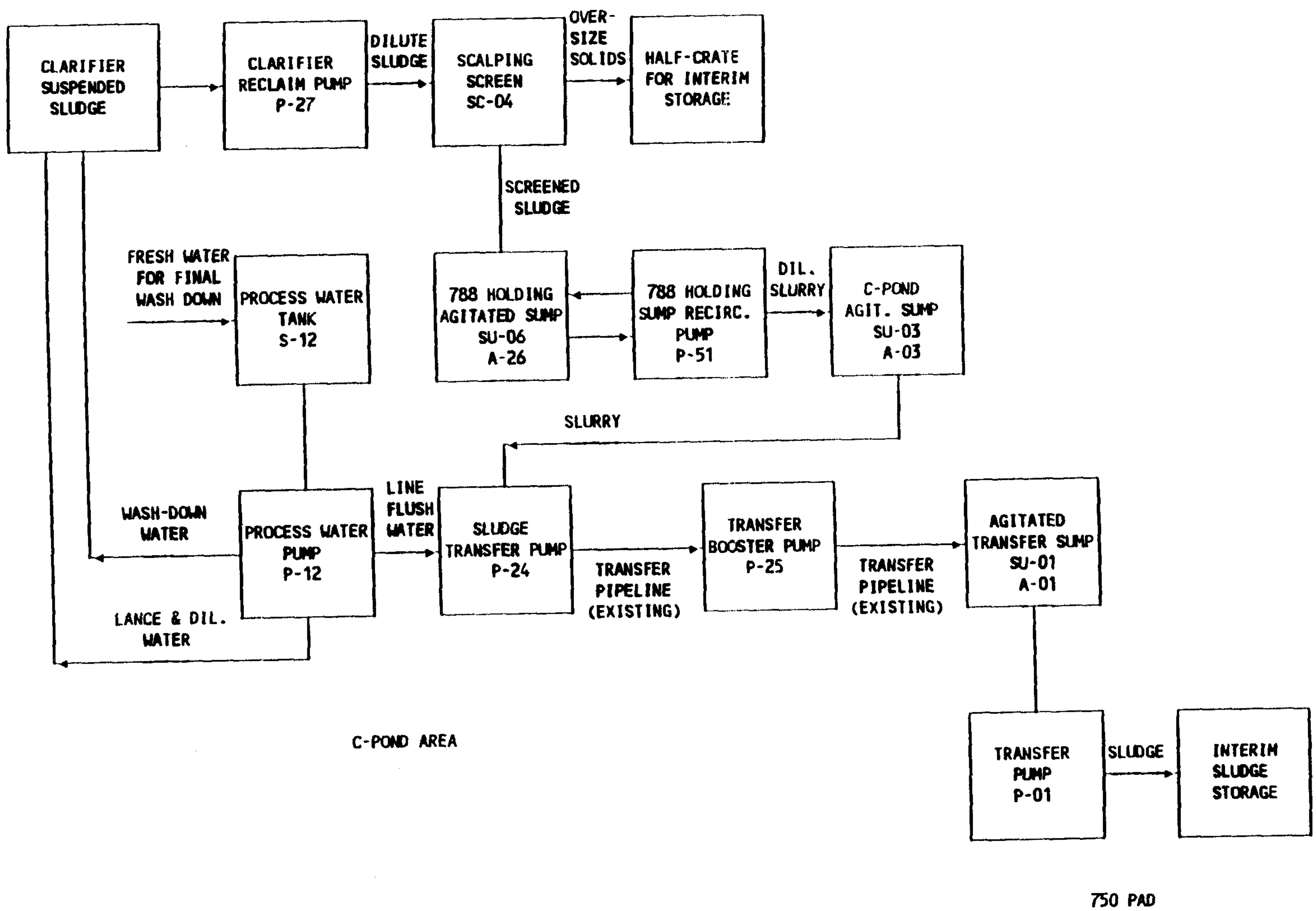


Figure 4-18
Clarifier Sludge Removal to Interim Storage Option 3.0
Pump Everything to Interim Storage by Adding Transport Water



4.2.3 Reclaim, Washdown, and Trash Removal Techniques

The "reclaim" operation required for each pond and the Clarifier is the process of removing the sludge, slurry, and liquids from the ponds and Clarifier. This process includes a shaker screen and holding sump. The ponds have sloped liners to the sump in one corner. The removal process is typically accomplished with a sump placed in the pump area and using water to move the sludge to the reclaim pump.

4.2.3.1 B Consolidated Pond

The A and B Series Ponds are currently being consolidated into the B-South Pond. Consolidation will be completed by the fall of 1993. The expected volume considered to be remaining within the pond for the reclaim operation is 230,000 gallons.

It is expected that an additional 75,000 gallons of water will be required to remain in the pond as a liquid blanket and as a motive liquid to carry the solids in suspension through the pumping phase to the storage containers on the 750 Pad. This motive water would be decanted and returned through a pipeline to the pond reclaiming operation and reused, thereby minimizing the volume in storage.

The washdown water for the B-South Pond is estimated at 44,000 gallons. This operation can be distinguished as two types, liner side washing and liner floor washing. The liner side washing occurs during lowering of the pond levels and must be performed to wash any solids remaining on the liner surface exposed to sun and wind. It must be noted that this water also will be used as motive source for carrying sludge to the destination containers.

The characteristic description of the solids that are in B-South range from "fluffy" solids in the low range 3% by weight to higher solids in the 25% by weight including sand, silt, and gravel.

The techniques and equipment that have been and are currently being utilized at the SEPs to transfer the sludges from A, B-Center, and B-North to B-South are:

- Air Driven Double Diaphragm Pumps
- Electric Submersible Centrifugal Pumps
- Floating Pump Assemblies
- Pumps Mounted on Dollies for On-Grade Movement
- Suction "T" Pipes with Diaphragm Pumps
- Hose Nozzles to Move Sludge
- Squee-Gees
- Shovels

The techniques required to clean the B-South Pond are the same as experienced during the A to B Series Pond transfer, and the B-Center to B-South, as well as the currently ongoing B-North to B-South transfer. The reclaim steps are described below in an overview fashion.

Initially, the B-South Pond will be approximately 1/3 full with a water blanket over the sludge. A submersible pump (floating/suspended in the sludge layer, on-grade in the sump, suction hose placed in sump or sludge layer) will be maneuvered into the sludge layer of the sump or moved throughout the pond to enable the removal of sludge.

The maneuvering operation of the pumps has previously been performed manually with ropes for the floating pumps and for the dollie mounted pump depending on the amount of liquid remaining within the pond. Typically two ropes connected to the pump and secured to opposite sides of the pond enable personnel to manually move the pump assembly into a desired pumping location.

When pumping lower solids (5-10% by weight) these sludges typically have the ability to move to the suction side of the pump and provide a stable pumping technique. When the liquid in the pond is substantial, the reclaim operation must keep the pump moving within the underlying sludges. This prevents the pump from cavitating and pulling only the surface liquid, which typically has less than optimum solids.

Higher solids in the reclaim slurry (greater than 15%) have a tendency to cavitate the pump and cause the pump to cease working or result in the surface water being drawn into the pump. The solution to this operational difficulty is to keep moving the pump suction to enable the suction to be continuously exposed to the higher solid sludge layer.

As the liquid and sludge levels are reduced, the sludge layer that is remaining will be pumped using "Recirculated Decant Liquid" from the storage containers at the 750 Pad. The "Recirculated Decant Liquid" will be returned to the pond area and pumped through a hose nozzle. This water acts as a motive carrier to suspend the sludge into solution to enable the pumping assembly to remove the sludge from the pond.

All sludges and slurries will be pumped over a scalping screen with a large mesh (3/8") screen to remove gross debris and trash prior its to entering the transport pumping system. The underflow from the screen will be held in a sump tank to act as a surge tank for the transport pump.

Depending on the nature of the sludge and how it lays on the liner within the pond, this sludge thickness may be as low as a few inches to a height of 14 to 16 inches. Since the B-North and the B-Center Ponds have been emptied into the east side to the B-South Pond; it is a fair assumption that when the reclaim pumping process is undertaken, this area would expose sludge first, with a greater thickness than seen in the other ponds, since the sludge has been pumped to the B-South Pond recently (within the past year).

It is not anticipated that the sludge within the B-South Pond will be any more difficult to transport than that of the A Pond, B-Center Pond, or B-North Pond. There are additional pumping systems that could be made available in the event that the dilution of sludge becomes a significant issue with respect to reclaim and pumping operations.

The trash and debris removal process is defined as the manual cleaning operation for removing the remaining solids that are unable to be removed by pumping. The remaining trash and debris is generally described as rocks, tools, gloves, hardhats, and other miscellaneous debris that cannot be easily size reduced. This trash removal involves a manual shovelling operation of this debris directly into half-crates or other containers as appropriate for the waste. This operation usually takes place during the final stages of cleaning, although it can be performed at any time during the reclaim process if debris is exposed or identified.

The washdown operation of pond cleaning is defined as the ongoing cleaning of the pond liner as the liquid is removed, and the final cleaning when the sludge reclaiming operation and trash removal are completed. As the pond liner is exposed when the liquid level is lowered, a clean water hose/nozzle system will be used to wash any exposed surface particles down into the pond liquid/sludge reclaiming.

As the sludge is finally exposed and the "Recirculated Decant Liquid" is used to push the sludge and expose clean surfaces, these exposed clean surfaces will be washed down to define a completely clean liner surface. This process continues until the entire pond is completely clean and ready for the contamination survey by Radiological Engineering.

4.2.3.2 C Pond

The characteristic contents of C Pond is the most unusual of all the ponds, with the following description:

- Surface Brine
- Extremely Hard Salt Formations

- Mushy Salts
- Silt

Since the salts are fundamentally a monolithic crystal layer and difficult to break up, the environmentally sound solution is to redissolve these crystals. The volume within the pond is will to be 412,000 gallons at a TDS of 45.8% (which includes brine, redissolved salt, and silt).

The 412,000 gallons includes the dilution water required to place the salt into solution assuming a pond water temperature in the range of 60 to 70 °F.

The washdown water for C Pond is estimated at 44,000 gallons. This operation can be distinguished as two types, liner side washing and liner floor washing. The line side washing occurs during the lowering of the pond levels and must be performed to wash any solids remaining on the liner surface exposed to sun and wind. It must be noted that this water also will be used as motive source for carrying sludge to the destination containers as well as putting salt solids into solution.

The added operation required for the C Pond reclaim is the recirculation of the existing brine required to place the salts into solution. This could be accomplished using an electric submersible pump with a controllable slurry gate. This slurry gate has a controlled opening such that when in the open position, the liquid/slurry is discharged immediately at the pump rather than up the pipeline discharge hose. This enables the pump to circulate liquid in a local area. Remote control over the pump can be accomplished with a crane which will hold the suspended pump over the areas within the pond.

The techniques and equipment to reclaim the sludge are the same as described previously:

- Air Driven Double Diaphragm Pumps
- Electric Submersible Centrifugal Pumps

- Floating Pump Assemblies
- Pumps Mounted on Dollies for On-Grade Movement
- Scalping Screen and Buffer Holding Sump Tank
- Suction "T" Pipes with Diaphragm Pumps
- Hose Nozzles to Move Sludge
- Squee-Gees
- Shovels

The additional equipment that is expected to be used are:

- Electric Submersible Centrifugal Pump with Slurry Gate
- Long Reach Crane to Maneuver Pump

The reclaim steps following salt dissolution are described below in an overview fashion.

A long reach crane will suspend an electric submersible pump with a movable slurry gate to enable a slurry operation within the pond areas. A supply hose may be incorporated with this system to specifically place the process dilution water in the vicinity of this pump to maximize dilution effects. The boom enables the pump to be continuously moved to direct the mechanical energy to promote dilution within areas of the pond. The movement of the pump will be done on a grid basis with follow-up sampling to determine effectiveness.

A submersible pump (floating/suspended in the sludge layer, on-grade in the sump, suction hose placed in sump or sludge layer) will be maneuvered into the sludge layer of the sump or throughout the pond. This enables the removal of a sludge that matches the requirements of the pump operation which has been initially identified as approximately 50% dissolved brine concentration.

The quantity of silt is very small and is anticipated to be transferred in the circulating process and carried off in the reclaim pumping.

The maneuvering operation of the pumps can be performed manually with ropes for the floating pumps and for the dollie mounted pump depending on the amount of liquid remaining within the pond. Typically two ropes connected to the pump and secured to opposite sides of the pond enable personnel to manually move the pump assembly into a pumping location.

As the liquid and sludge levels are reduced, the sludge layer that is remaining will be flushed to the reclaim pump. Additional water, if required, will be provided through a hose nozzle. This water acts as a motive carrier to suspend the sludge into solution and enable the pumping assembly to remove the sludge from the pond.

All sludges and slurries will be pumped over a scalping screen with a large mesh (3/8") screen to prevent gross debris and trash from entering the transport pumping system. The underflow from the screen will be held in a sump tank to act as a surge tank for the transport pump.

It is not anticipated that the sludge reclaim within the C Pond will be any more difficult than that of the B Consolidated Pond. There are additional pumping systems that could be made available in the event that the dilution of sludge becomes a significant issue with respect to reclaim and pumping operations.

The trash and debris removal process is defined as the manual cleaning operation of removing the remaining solids that are unable to be removed in the reclaim operation. The remaining trash and debris is described as rock, tools, gloves, hard hats, and other miscellaneous debris that cannot be easily broken down in size through the hosing operation.

This trash removal involves a manual shovelling operation of this debris directly into half crates or other containers as appropriate for the waste. This operation usually takes place during the final stages of cleaning, although it can be performed at any time during the reclaim process if debris is exposed or identified.

The washdown operation of the pond cleaning is defined as the ongoing cleaning of the pond liner as the surface is exposed, and the final cleaning when the sludge reclaiming operation and trash removal is completed. As the pond liner is exposed, when the liquid level is lowered, a clean water hose/nozzle system will be used to wash any exposed surface particles down into the pond liquid/sludge.

As the sludge is finally exposed and the "Recirculated Decant Liquid" is used to push the sludge and expose clean surfaces, these exposed clean surfaces will be washed down to define a completely clean liner surface. This process continues until the entire pond is completely clean and ready for a contamination survey by Radiological Engineering.

4.2.3.3 Clarifier

The Clarifier is an above ground open-top circular steel tank with a cone bottom. The current estimate of sludge is 15,000 gallons, which ranges from 20% solids by weight up to 70% solids by weight. The Clarifier has very limited access with a vertical ladder up the side from the ground to a man-way crossing the top of the tank.

It is expected that the solids within the clarifier will require 75,000 gallons of process water for dilution and suspension pumping to the storage containers.

The equipment and techniques to remove the sludge from the Clarifier are the following:

- Air Driven Double Diaphragm Pumps
- Scalping Screen and Buffer Holding Sump Tank
- Hose/Lance Nozzles to Move Sludge

The solids within the Clarifier will be manually washed with the hose lance assembly directing the loosened solids to the suction of the diaphragm pump. The diaphragm pump will pump this slurry over a scalping screen with a large mesh (3/8") screen to remove gross debris and trash prior to entering the transport pumping system. The underflow from the screen will be held in a sump tank to act as a surge tank for the transport pump.

It is anticipated that, since the solids are relatively heavy, the motive water may be decanted and this "Recirculated Decant Liquid" can be recycled to the hose/lance system to minimize the overall volume of added liquid. This "Recirculated Decant Liquid" could be obtained at the 750 Pad and returned through a pipeline as described in the previous processes. The sludge would have to meet the criteria of the pipeline/pumps of the transport system.

The trash and debris removal process is defined as the manual cleaning operation of removing the remaining solids that are unable to be removed in the reclaim operation. The remaining trash and debris is described as rock, tools, gloves, hard hats, and other miscellaneous debris that cannot be easily broken down in size through the hosing operation.

This trash removal involves a manual operation of moving debris directly into half-crates or other containers as appropriate for the waste. This operation usually takes place during the final stages of cleaning, although it can be performed at any time during the reclaim process if debris is exposed or identified. It is anticipated that a very small amount of trash and debris will be remaining in the Clarifier and will be able to be removed with a custom-fabricated shovel or other refined device.

The wash down operation of the Clarifier will take place with hose/lance operation as the Clarifier is reclaimed. If "Recirculated Decant Liquid" is used, then a separate hose/nozzle with process water will be required to wash down the Clarifier during and at the end of the reclaim operation. This is accomplished by washing exposed surfaces down toward the bottom of the Clarifier. This water will also act as motive water except for the final fresh water rinse.

4.2.4 B Consolidated Pond

The following sections discuss process options for the B Consolidated Pond material.

4.2.4.1 Option 1: Pump Everything to Interim Storage

This transport process is based on the premise that all of the remaining B Pond Consolidated contents (after any additional volume reductions by decanting water from the pond) are pumped to the 750 Pad for interim storage without any volume reduction. This option was considered to be potentially the simplest (requiring the minimum of transport equipment), the easiest to accomplish within the time constraints and one which would use primarily the available materials handling equipment of the existing HNUS stabilization processing trains. A BFD is included as Figure 4-13.

This Option 1 includes the following unit operations:

- Introduction of the screened (to remove trash and oversize solids) waste slurry from the slurry reclaim systems into a 3,250 gallon cone-bottomed holding and Settling Tank (S-05). In this tank, some limited separation by gravity settling of the pond solids and liquid occurs. Reclaim rates of up to 400 gallons per minute (gpm) can be accommodated for short periods of time. This surge permits intermittent operation of the reclaim system and provides some time for limited settling of the pond solids to occur.
- The pond water is decanted to provide a source of recycle water back to the pond to minimize the volume of excess liquid required for sludge reclaim and handling from the pond. This decant overflows the Settling Tank by gravity to the 3,600 gallon Process Water Tank (S-06).

- Recycle water is recirculated back to the ponds to reclaim and consolidate the solids using a centrifugal pump (P-06) which has ≈200 gpm maximum capacity. Also it is used as a source of slurry pipeline flush water which is required after every transport cycle.
- The slightly thickened underflow sludge from the Settling Tank is pumped through a connecting pipeline from the South side of the B Consolidated Pond to intercept the suction of the existing Booster Pump (P-25) in the cross-country pipeline connecting C Pond and the 750 Pad stabilization circuit. A new connecting pipeline of about 200 feet of 3" 200 pound per square inch gauge (PSIG) HDPE will be required. A new centrifugal Sludge Transfer Pump (P-??) will be also be required. The pump should be similar to the C Pond Transfer Pump (P-24) or the Booster Pump (P-25). With the estimated percent solids of 5 to 10%, a viscosity of 50 to 100 cP, this Transfer Pump (P-??) is estimated to have a capacity of about 75 gpm in this service.
- Fresh Water Storage for final pond wash-down or other uses at the B Consolidated Pond transport system location is provided by using the existing modified FRAC Tanks (S-13 and S-14) for this purpose.
- This fresh water (estimated to be less than 44,000 gallons) is used at the ponds for final wash-down (or for other reasons) using the existing Recycle Water Pump (P-10).
- The slurry being transported along the double-containment HDPE pipeline is received at the 750 Pad area into an Agitated Transfer Sump (SU-01 and A-01) with 1,000 gallons capacity. This agitated sump provides surge capacity at the

receiving end of the pumping transfer system and will keep the slurry in suspension until pumped into the interim storage containers.

- The entire SEP waste slurry volume received on the 750 Pad is pumped into the Interim Storage Containers (without any volume reduction). This includes not only the pond sludge, any covering water required and additional reclaim water or transport water required, but also the final pond wash-down water. A centrifugal slurry Transfer Pump (P-01) with approximately 30 gpm flow capacity is used to pump the slurry into the containers using a flexible hose system.

(Note: For any or all options considered, long-term reduction of storage volume can be achieved by gravity settling of the sludge and decant of the excess decant liquid to the 374 Building evaporators. This is contingent on excess capacity being available at that facility. To achieve this, a decant recovery system, on-Pad surge capacity, a transfer pump and connecting pipeline to the 374 Building Feed Pipeline would be required in addition to the basic Transfer Circuit Systems for each Option. This additional option will not be considered in this project for the base transfer options. It is considered in Options 7 through 9 for longer-term volume reductions.)

4.2.4.2 Option 4.1: Reduce Volume Before Interim Storage Using Filters at the Pond

This transport process is based on the premise that all of the remaining B Consolidated Pond Consolidated contents (after any additional volume reductions by decanting water from the pond) are pumped through a Pressure Chamber Filter Press to produce a semi-dry filter cake product (≈45% solids by weight) and a clarified filtrate pond liquid. Approximately 160 dry tons of solids are in the B Consolidated Pond. This translates into approximately 65,000 gallons or 8,700 cubic feet of moist, solid filter cake. This would translate into about 250 lined half-crates of interim storage of the filter cake. The approximately 285,000 gallons of B Consolidated Pond water would have to be accommodated in the 374 Building evaporator system. Temporary liquid storage capacity for the 285,000 gallons would have to be provided at the 750 Pad until it can be evaporated. This option results in the minimum storage requirements for B Consolidated Pond wastes. A new filter unit and its ancillaries would need to be purchased.

Option 4.1 includes the following unit operations:

- Introduction of the screened (to remove trash and oversize solids) waste slurry from the slurry reclaim systems into a 3,250 gallon cone-bottomed holding and Settling Tank (S-05). In this tank, some limited separation by gravity settling of the pond solids and liquid occurs. Reclaim rates of up to 400 gpm can be accommodated for short periods of time. This surge permits intermittent operation of the reclaim system and provides some time for limited settling of the pond solids to occur.
- The pond water is decanted to provide a source of recycle water back to the pond to minimize the volume of excess liquid required for sludge reclaim and handling from the pond. This decant overflows the Settling Tank by gravity to the 3,600 gallon Process Water Tank (S-06).
- Recycle water is recirculated back to the ponds to reclaim and consolidate the solids using a centrifugal pump (P-06) which has ≈200 gpm maximum capacity.
- The slightly thickened underflow sludge from the Settling Tank is pumped through the Filter Press System (F-??) which includes a Filtrate Receiver (R-??) and filter cake Conveying Screw transport system (CS-??). About a 100-cubic foot capacity cake filter is envisioned. This will allow approximately 4.1 tons of moist solids (or 1.85 tons dry solids) to be processed for each filter cycle. About 3

hours per filter cycle would be required; thus requiring about 87 cycles to process all of the estimated pond solids. At two filter batches per day about 43 days would be required to complete this process. Three filter batches per day would require 29 days. These filter press systems can be adapted to the required containment and Health & Safety requirements.

- The filtrate will be pumped from the Receiver using a centrifugal Liquid Transfer Pump (P-02)with a capacity of about 100 gpm liquid. It will be introduced into the suction of the existing Booster Pump (P-25) in the pipeline connecting C Pond and the 750 Pad stabilization circuit. A new connecting pipeline of about 200 feet of 3" 200 PSIG HDPE will be required.
- Fresh Water Storage for final pond washdown or other uses at the B Pond transport system location is provided by using the existing modified FRAC Tanks (S-13 and S-14).
- This fresh water (estimated to be 44,000 gallons) is used at the ponds for final wash-down (or for other reasons) using the existing Recycle Water Pump (P-10).
- The liquid being transported along the double-containment HDPE pipeline is received at the 750 Pad into an Agitated Transfer Sump (SU-01 and A-01) with 1,000 gallons capacity. This sump provides surge capacity at the receiving end of the pumping transfer system until pumped into the interim storage containers.
- A centrifugal Transfer Pump (P-01) with approximately 30 gpm flow capacity is used to pump the slurry into the containers using a flexible hose system.
- The moist pond solids (filter cake) will be stored in half-crates and would not require freeze protection due to the low relative volume of water and the solids void volume which will allow expansion upon freezing.

4.2.4.3 Option 4.2: Reduce Volume Before Interim Storage Using Gravity Settling at the Pond

This transport process is based on the premise that all of the remaining B Consolidated Pond contents (after any additional volume reductions by decanting water from the pond) are pumped to a pre-transport Gravity Settling System which will partially reduce the volume of sludge needing transport to the 750 Pad for interim storage. This option would primarily use the available materials handling equipment of the existing HNUS stabilization processing trains without addition of any flocculent or other chemicals to improve the slurry settling characteristics.

In order to achieve the partial densification of the slurry prior to transport, intermittent operation of the reclaim system and transport system would be required. This would provide time (minimum 12 hours) for gravity settling to occur in the cone-bottomed Gravity Settling Tank (S-05). The system will be operated to fill the tank with reclaimed slurry, allow it to settle, pump off the settled sludge to the 750 Pad and decant and pump the clarified liquid to the Process Water Tank.

The risk associated with this option is that the relatively-slow, natural gravity settling dewatering is being done as the material is being reclaimed from the pond. This will slow down the reclaim operation to allow for the intermittent settling operation. An additional risk is the pumping requirements of the partially-thickened sludge. However, in the range anticipated here, there should be little problems if the proper Transfer Pump were used. The advantage is that the decant liquid would already be stored in temporary containers which could be reused as they were emptied. This option would reduce interim storage requirements by approximately 129,000 gallons. A BFD for this transport process is included as Figure 4.14.

Option 4.2 includes the following unit operations:

- Introduction of the screened (to remove trash and oversize solids) waste slurry from the slurry reclaim systems into a 3,250 gallon cone-bottomed holding and Settling Tank (S-05). In this tank, separation by gravity settling of the pond solids and liquid occurs to about 10-15% solids with an average feed solids of 5-7% from the pond. Reclaim rates of up to 400 gpm can be accommodated for short periods of time. This surge permits intermittent operation of the reclaim system and provides some time for limited settling of the pond solids to occur.
- The reclaim is done intermittently to introduce about 3,300 gallons into the Settling Tank. The slurry is allowed to settle (up to 12 hours per batch).
- The pond water is decanted (or pumped after settled sludge transfer to the 750 Pad) to provide a source of recycle water back to the pond to minimize the volume of excess liquid required for sludge reclaim and handling from the pond. This decant overflows the Settling Tank by gravity to the 3,600 gallon Process Water Tank (S-06).
- Recycle water is recirculated back to the ponds to reclaim and consolidate the solids using a centrifugal pump (P-06) which has ≈200 gpm maximum capacity. Also it is used as a source of slurry pipeline flush water which is required after every transport cycle.
- Using this process, about 230,000 gallons of thickened sludge and 120,000 gallons of liquid would be produced. Only the thickened sludge will require interim (10-year) storage on the pad; the liquid would require only temporary storage until evaporation in the 374 Building.

- The excess water separated from the sludge is also pumped to the 750 Pad for temporary storage in containers and ultimate evaporation at the 374 Building process.
- The partially-thickened underflow sludge from the Settling Tank (from 10-15 wt % solids) is pumped through a connecting pipeline from the South side of the B Consolidated Pond to intercept the suction of the existing Booster Pump (P-25) in the cross-country pipeline connecting C Pond and the 750 Pad stabilization circuit. A new connecting pipeline of about 200 feet of 3" 200 PSIG HDPE will be required. A new Sludge Transfer Pump (P-??) will be required also. It should be similar to the C Pond Transfer Pump (P-24) or the Booster Pump (P-25). With the estimated percent solids of 10 to 15%, a viscosity of 100 to 400 cP, this Transfer Pump (P-??) will have a capacity of about 40-50 gpm in this service.
- Fresh Water Storage (S-13 and S-14) for final pond washdown or other uses at the B Pond transport system location is provided by using the existing mobile FRAC Tanks.
- This fresh water (estimated to be less than 44,000 gallons) is used at the ponds for final washdown (or for other reasons) using the existing Recycle Water Pump (P-10).
- The slurry being transported along the double-containment HDPE pipeline is received at the 750 Pad into an Agitated Transfer Sump (SU-01 and A-01) with 1,000 gallons capacity. This agitated sump provides surge capacity at the receiving end of the pumping transfer system and will keep the slurry in suspension until pumped into the interim storage containers.

- A centrifugal slurry Transfer Pump (P-01) with approximately 20 gpm flow capacity is used to pump the slurry into the containers using a flexible hose system.

4.2.4.4 Option 4.3: Reduce Volume Before Interim Storage Using Gravity Settling at the Pond

This transport process is based on the premise that all of the remaining B Consolidated Pond contents (after any additional volume reductions by decanting water from the pond) are pumped to the 750 Pad (similar to Option 1) and a Gravity Settling system located at the 750 Pad will partially reduce the volume of sludge needing to be put into containers for interim storage. This option would primarily use the available materials handling equipment of the existing HNUS stabilization processing trains without addition of any flocculent or other chemicals to improve the slurry settling characteristics.

In order to achieve the partial densification of the slurry after transport, intermittent operation of the transport system would be required. This would provide time (minimum 12 hours) for gravity settling to occur in the cone-bottomed Gravity Settling Tank (S-05). The system will be operated to fill the tank with reclaimed slurry which is transported by pumping to the 750 Pad, allow it to settle, pump off the settled sludge to the interim containers and the decant clarified liquid to the Temporary storage containers.

The risk associated with this option is that the dewatering is completed as the material is reclaimed from the pond. This will slow down the reclaim operation to allow for the intermittent settling operation. Compared to Option 4.2, there are no additional risks in the transport pumping requirements of the sludge; this is the same as Option 1. An additional advantage is that the decant liquid would already be stored in temporary containers on the 750 Pad which could be reused as they were emptied. This option would reduce interim storage requirements by approximately 129,000 gallons (similar to Option 4.2). A BFD for this transport process option is provided as Figure 4-15.

Option 4.3 includes the following unit operations:

- Introduction of the screened (to remove trash and oversize solids) waste slurry from the slurry reclaim systems into a 3,600 gallon Agitated Sump (SU-05 and A-02). In this tank surge and solids suspension of the screened reclaim sludge will be provided prior to transport pumping feed solids of 5-7% from the pond. Reclaim rates of up to 400 gpm can be accommodated for short periods of time. This surge permits intermittent operation of the reclaim system and provides some time for limited settling of the pond solids to occur.
- The transported sludge is directly received into the 3,250 gallon, cone-bottomed, Gravity Settling Tank (S-05) located at the 750 Pad.
- The reclaim is done intermittently to introduce about 3,300 gallons into the Agitated sump (i.e. the capacity of the Settling Tank). The slurry is pumped to the 750 Pad (as in Option 1) and allowed to settle (up to 12 hours) in S-05.
- The excess pond water is decanted to provide a source of recycle water back to the pond to minimize the volume of excess liquid required for sludge reclaim and handling from the pond. This decant overflows the Settling Tank by gravity to the 3,600 gallon Process Water Tank (S-06) located on the same skid on the 750 Pad.
- Recycle water is recirculated back to the ponds to reclaim and consolidate the solids using a centrifugal pump (P-06) which has ≈200 gpm maximum capacity. Recycle water is used as a source of slurry pipeline flush water which is required after every transport cycle. A new 3" HDPE, double-contained pipeline (or

extensive valving of the existing slurry transport pipeline) would be required to return these liquids.

- Using this process, about 230,000 gallons of thickened sludge and 120,000 gallons of liquid would be produced. Only the thickened sludge will require interim (10-year) storage on the pad; the liquid would require only temporary storage until evaporation in the 374 Building.
- The excess water separated from the sludge and not needed for reclaim or transport, is pumped to Temporary storage in containers and ultimate evaporation at the 374 Building.
- The partially-thickened underflow sludge from the Settling Tank (from 10-15 wt % solids) is pumped using a centrifugal slurry Transfer Pump (P-01) with approximately 20 gpm flow capacity into the interim storage containers using a flexible hose system.
- Fresh Water Storage for final pond wash-down or other uses at the B Pond transport system location is provided by using the existing modified FRAC Tanks (S-13 and S-14) .
- This fresh water (estimated to be less than 44,000 gallons) is used at the ponds for final wash-down (or for other reasons) using the existing Recycle Water Pump (P-10).

4.2.4.5 Option 4.4: Reduce Volume Before Interim Storage Using a Rotary Screen Thickener at the Pad

This volume reduction option is similar to Option 4.3 (Gravity Settling at the Pad) except that a more-efficient existing Rotary Screen Thickener system (TH-01) and its ancillaries would be used. However, the additional space requirements for the thickener and ancillaries, operating complexity, and additional equipment required are not offset by the advantages of the additional volume reduction (60,000 gallons of additional free liquid as compared to Options 4.2 or 4.3). This would be a net reduction to 170,000 gallons of 20% solids sludge requiring interim storage. (Note: As long as the 750 Pad storage space requirements were deemed to be below the available space, no extraordinary penalties for additional volume were considered.)

All equipment required for Option 4.4 is the same as 4.3 with the following exceptions:

- There would need to be an agitated slurry receiving tank (SU-01 and A-01) to receive the pumped slurry from the B Consolidated Pond area.
- The slurry would be pumped to the Rotary Screen Thickener (TH-01) using the slurry Transfer Pump (P-01).
- The thickened sludge would be sent to the agitated Slurry Surge Tank (S-04, A-04).
- The slurry would be pumped to the interim containers using the progressive cavity Slurry Pump (P-03).

(Note: The above equipment is an existing skid module built as part of the B Pond Stabilization System; thus would require no additional equipment purchase.)

The decant liquid would be handled identically to Option 4.3.

4.2.4.6 Option 4.5 Reduce Volume Before Interim Storage Using a Filter at the Pad

This volume reduction option is similar to Option 4.3 and 4.4 (Gravity Settling and Rotary Screen Thickening at the Pad) except that a more-efficient Batch Pressure Filtration (TH-01) and its ancillaries would be used. The same system as described in Option 4.1 would now be located on the 750 Pad. However, operating complexity and additional equipment required would not justify the additional interim storage volume reduction (to 65,000 gallons of moist filter cake and 285,000 gallons of additional free liquid which can be evaporated) given that no extraordinary penalties or premium is placed on pad storage space.

All equipment required for Option 4.5 is the same as 4.3 with the following exceptions:

- There would need to be an agitated slurry receiving tank (SU-01 and A-01) to receive the pumped slurry from the B Consolidated Pond area.
- The slurry would be pumped to the batch Pressure Filter Press (e.g. plate and frame or chambered filter press) (F-01) using the slurry Transfer Pump (P-01).
- The filter cake would report to half-crates for interim storage using the Conveying Screw (CS-01) system described in Option 4.1.
- The filtrate would be contained in the decant tank and be pumped to the temporary containers using the an appropriate Liquid Pump (P-??) or returned to the B Consolidated Pond for use as reclaim water as in Option 4.3.

(Note: Option 4.5 would require significant additional equipment purchase.)

4.2.4.7 Option 7.1: Reduce Volume During Interim Storage Using Gravity Settling at the Pad

All initial operations and equipment required for Option 7.1 are identical to Option 1. The starting point for the gravity settling is the initial condition with the entire B Consolidated Pond waste contents pumped to storage containers on the 750 Pad.

The premise for Option 7.1 is that during the first few years after the initial, temporary storage, natural settling would occur; thus allowing the liquids to be decanted and subsequently evaporated in the 374 Building. This would allow a consolidation of the settled sludge and an accompanying reduction in the interim storage requirements.

It would require only the additional Decant Handling systems described in Option 4.3 over and above the requirements of Option 1. Like Option 1, this option for volume reduction would require the maximum initial storage volume to be available upon reclaim and transport to the 750 Pad. It is estimated that the ultimate volume of B Consolidated Pond sludge in interim storage could be reduced to 230,000 gallons (at a terminal density of 15% solids). A BFD for this option is included as Figure 4-16.

4.2.4.8 Option 7.2: Reduce Volume During Interim Storage Using a Rotary Screen Thickener at the Pad

All initial operations and equipment required for Option 7.2 are identical to Option 1. The starting point for the Rotary Screen Thickening is the initial condition with the entire B Consolidated Pond waste contents pumped to temporary storage containers on the 750 Pad.

The premise is that during the first few years after the initial, temporary storage, the slurry would be reclaimed from the temporary containers, and processed through the Rotary Screen Thickener System (described in Option 4.4); thus providing a reduction in interim storage requirements. All operational considerations are similar to that option.

The complexity of reclaiming from the temporary storage containers to reduce the volume would not justify the additional volume reduction. Like Option 1, this option for volume reduction would require the maximum initial storage volume to be available upon reclaim and transport to the 750 Pad. It is estimated that the ultimate volume of B Consolidated Pond sludge in interim storage could be reduced to 170,000 gallons (at a terminal density of 20% solids). The advantage that this approach would have, however, is that these volume reductions could continue during the temporary storage period (up to two years) unconnected to any pond reclaim operations. Thus, it could be an activity conducted during winter months in a heated storage tent.

4.2.4.9 Option 7.3: Reduce Volume During Interim Storage Using a Filter at the Pad

All initial operations and equipment required for Option 7.3 are identical to Option 1. The starting point for the Pad Pressure Filtration is the initial condition with the entire B Consolidated Pond waste contents pumped to temporary storage containers on the 750 Pad.

The premise is that during the first few years after the initial, temporary storage, the slurry would be reclaimed from the temporary containers, processed through the Batch Pressure Filtration system (described in Option 4.5); thus providing a reduction in interim storage requirements and storing the B Consolidated Pond solids in a more-stable, semi-solid form in half-crates. This filter cake product would not be particularly sensitive to freezing; thus could be stored in unheated tents. All operational considerations of Option 7.3 are similar to those discussed for Option 4.5.

The complexity of reclaiming from the temporary storage containers to reduce the volume would not justify the additional volume reduction if there is no premium on heated storage space. Like Option 1, this option for volume reduction would require the maximum initial storage volume to be available upon reclaim and transport to the pad. It is estimated that the ultimate volume of B Consolidated Pond sludge in interim storage could be reduced to 65,000 gallons (at a terminal density of 45 wt % solids). This is the maximum possible volume reduction for the B Consolidated Pond waste material during interim storage. It was assumed that if excess heated storage capacity on the pad exists, the advantages of volume reduction would be minimal.

The advantage that the approach of Option 7.3 would have, however, is that these volume reductions could continue during the temporary storage period (up to two years) unconnected to any pond reclaim operations. The filtering option is particularly conducive to intermittent, batch operation. Thus, filtration could be an activity conducted during winter months in a heated storage tent on an intermittent basis. Filtrate produced could be transported to the 374 Building for evaporation in small volumes as excess capacity is available. Tank trucks could be used for this purpose, eliminating the need for a pipeline connection to the 374 Building feed pipeline.

4.2.5 Options Evaluated for Pond C

The following sections discuss process options for the C Pond material.

4.2.5.1 Option 2: Pump Everything to Interim Storage After Composition Adjustment

The addition of a limited amount of process water to the C pond to insure that nearly all soluble salts in the pond are in solution was discussed in Section 3.3. This mechanism not only significantly simplifies the reclaim and transport requirements for the C Pond material, but provides a more consistent feed material to the ultimate stabilization processes. Therefore, prior to the reclaiming operations, the dilution water is added and circulation of the liquid phase in the pond would redissolve most of the solid salt phases. Only the relatively-small percentage of silty, non-soluble solids (about 6 wt % or 4 volume %) would remain as solids.

The brine concentration would be maintained below the maximum solubility of the salts at the ambient temperature during reclaim (or for storage conditions). Based on laboratory tests and pond sampling campaigns, the maximum % TDS ranges between 45 and 50%. For reclaim and storage, the dilution of the brine phase to 45.8% TDS is expected to result in the minimum quantity of suspended, undissolved salts.

Option 2 for Pond C is the analog of Option 1 for the B Ponds. All contents in the C Pond are pumped to the 750 Pad and stored in the interim (up to 10 years) storage containers.

No volume reduction except for minimization of dilution and wash water additions to the pond is assumed. A conceptual BFD for Option 2 is provided as Figure 4-17.

The C Pond transport process unit operations are described below:

- The reclaimed brine and suspended solids are passed through a screen (SC-02, static or shaking) to remove any tramp or oversize material which could not be easily transported by the overland slurry pumping system. A mesh of approximately 3/8" should be compatible with the pumping system and produce minimal oversize material. The oversize and trash solids would be deposited in half-crates for storage and ultimate disposal.
- The screen undersize brine slurry reports by gravity to a 3,600 gallon Agitated Sump Tank (SU-03 and A-03) which keeps any solids in suspension and serves as the feed sump for the overland slurry pumping and pipeline systems.
- The nearly saturated (45-50%TDS) brine solutions have a density of about 1.50 grams per cubic centimeter (gm/cc). With added suspended solids, the slurry density can be over 1.60 gm/cc. Viscosities of the brine can be up to 50 cP. For the slurry with silty solids, this can increase to 100 cP. The density and viscosity of the brine slurry have significant impacts on the pumping and pipeline requirements. Such slurries exhibit significant non-Newtonian flow behavior; thus making pumping system design, without empirical data, somewhat difficult. For a given pipeline size, critical pumping rates (thus pipeline velocities) need to be maintained in order to keep the solids in suspension.
- The Sludge Transfer Pump (P-24) is a high-head, centrifugal slurry pump with about 100 gpm capacity with the brine slurry and approximately 700 feet of

pipeline to the Booster Pump station. The overland slurry transport pipeline is an existing 3", 200 PSIG rated, double-contained HDPE pipe.

- An existing identical sludge Transfer Booster Pump (P-25) is provided at a pumping station approximately halfway between the 750 Pad and the C Pond area. An existing 700 feet of similar pipeline delivers the C Pond brine slurry wastes to the 750 Pad.
- The brine slurries will be reclaimed and pumped to the 750 Pad intermittently. At low percentage suspended solids, the pipeline should not require flushing between pumping cycles for short time intervals. This is due to the relatively slow settling characteristics of the silty solids in the pond. Process water will used to flush out the pipeline between pumping cycles, if required. Between extended shut-downs, the pipeline will be flushed. Reclaimed C Pond brine is pumped from the Brine Reclaim Pump (P-20) and stored in the 3,000 gallon Dilution Brine Tank (S-18) and pumped by the Dilution Brine Pump (P-18), which has about 200 gpm capacity. The flush water will be introduced into the Transfer Pump (P-24) suction. If necessary, process water from the Process Water Pump (P-12) can be used for final line flushing.
- The fresh water for pond washdown (or line flushing, as required) is provided from a fire hydrant near the C Pond and is stored in the 3,000 gallon Process Water Tank (P-12) located adjacent to the C Pond. It is pumped to the pond return line or transfer pipeline suction by the Process Water Pump (P-12) with a capacity of about 200 gpm. This tank and pump is also used as the system to supply dilution water to the pond, as required, and for transport and lance water required for the Clarifier reclaim (Section 4.2.3.3).

- The transported brine slurry is received at the 750 Pad into the 1,000 gallon Agitated Transfer Sump (SU-01 and A-01) in the same manner as the B Consolidated Pond Option 1.
- The brine slurry waste is pumped, on an intermittent basis, into the appropriate interim containers using the 20 gpm, centrifugal slurry Transfer Pump (P-01).

4.2.5.2 Option 5: Reduce Volume Before Interim Storage Using Dryers at Pond or Pad

There are no options to reduce the C Pond brine slurry volume requiring storage which involve liquid/solid separation techniques (as for B Pond). This is because the brine salts are part of the waste; thus the brine and pond solids require stabilization disposal.

The only identified alternative which could reduce storage requirements for the C Pond material is to dry the material. This could be done prior to transport or after the transport following reclaim from the pond. This could, in part, be accomplished in the existing 374 Building spray drying system for the C Pond brine (with suspended solids removed). However, the current capacity of that facility does not permit significant quantities of C Pond brine to be processed. The alternative considered was to install a new dryer facility near the C Pond or near the 750 Pad in order to reduce the waste volume for storage. This option was rejected during initial evaluations due to the likely high capital and operating costs, health and safety considerations for airborne dust, and the known oxidizing character of these predominantly-nitrate salts. This latter consideration likely prohibits storage in the dry salt form in any convenient container. No further analysis of dryer options during reclaim were considered.

4.2.5.3 Option 8: Reduce Volume During Interim Storage Using Gravity Settling at the Pad

During interim storage at the pad, the silty solids will settle out from the brine solution. In addition, some salt precipitation is likely to occur. This could result in some brine solutions which can be decanted and evaporated in the 374 Building systems if such excess capacity exists. Liquid decant evaporation potential for reducing the pad storage depends on the available excess capacity of the 374 Building systems. Due to the unlikely probability that there will be such excess capacity, this case was not evaluated further.

If the 374 Building systems were upgraded, excess capacity could be available in the future during the interim storage period (up to 10 years). The opportunity to reduce the brine storage could present itself. It would be decanted and transported (by pumping through a pipeline connection to the 374 Building feed pipeline or by tank truck) to the 374 Building.

4.2.6 Options Evaluated for the Clarifier

The following sections discuss process options for the Clarifier material.

4.2.6.1 Option 3: Pump Everything to Interim Storage by Adding Transport Water

The waste material (from the former A Pond contents) stored in the 788 Area Clarifier tank consists of about 15,000 gallons of heavy, settled solids (at about 60 wt % settled solids terminal density) with a water cover. The solids have a relatively-high specific gravity (over 2.2) when compared to the C Pond or B Pond solids. Therefore, these solids settle to a high terminal density. The water cover has some dissolved solids at an intermediate level between the low quantities in B Pond and the saturation levels in C Pond.

In order to reclaim the heavy settled solids, a high-pressure jet lance using fresh or recycled process water will be used to initially suspend the solids in the Clarifier tank. Additional quantities of water (up to 75,000 gallons of combined fresh and recycled water) are expected to be required to dilute the slurry, transport it to a holding tank and provide media to suspend the solids and transport them by pumping to the 750 Pad.

The Clarifier options considered for transport to interim storage or to partially dewater the slurry for storage volume reduction parallel those described in Section 4.2.5 for the B Consolidated Pond wastes. The significant difference is in the character of the solids which settle significantly better and the addition of transport water to permit dilute-phase (<10 wt % solids) materials handling.

The Clarifier transport systems utilize most of the same components as the C Pond system (Option 2.0). A BFD for this process option is included as Figure 4-18. The additional unit operations required include:

- The Scalping Screen (SC-04) will remove any coarse oversize material prior to introduction into the transport system. It is located on the double-containment skid above the 3,600 gallon 788 Holding Agitated Sump (SU-06, A-26). The reclaimed slurry from the Clarifier is pumped to this screen using the Reclaim Pump (P-27).
- The 788 Holding Agitated Sump (SU-06 and A-26) receives the undersized Clarifier slurry. To assist solids suspension and to insure a homogeneous distribution in the Holding Tank, the slurry is diluted to the required (<10 wt % solids) density for transport. A Recirculation Pump (P-51) is provided to circulate the slurry around the 788 Holding Tank.

- The Clarifier slurry is pumped to the C Pond Agitated Sump (SU-03, A-03) using a bleed from the circulating Pump (P-51). This slurry is pumped to the 750 Pad using the same C Pond Transfer Pump (P-24) and overland pipeline system.
- Once received on the 750 Pad, distribution to the interim storage containers is the same as for Option 1 or for Option 2 for B and C Pond wastes, respectively.

4.2.6.2 Option 6.1: Reduce Volume Before Interim Storage Using Gravity Settling at the Pad

The volume reduction options for the diluted Clarifier solids (a total of about 90,000 gallons including reclaim, transport and washdown water) are virtually the same as those of B Consolidated Pond Options 4.3, 4.4, and 4.5. However, due to the limited volume of the Clarifier solids and due to their natural settling character, any volume reduction during reclaim would be done only if these systems are installed on the 750 Pad to process the B Consolidated Pond slurries. Therefore, all volume-reduction options for the Clarifier are contingent on the B Consolidated Pond transport process selection and would "piggy-back" on those systems. Therefore, the Clarifier Gravity Settling Option 6.1 depends on installation of the B Consolidated Pond Gravity Settling Option 4.3. The equipment and procedures, once the Clarifier slurry is transported to the Pad (as in Option 3), are the same as described in Section 4.2.4.4.

(Note: No volume reduction options for the Clarifier slurry were considered at the 788 Area due to the need for dilute slurry for transport and due to the lack of any available space in the 788 area. Thus, only options which could be carried out on the 750 Pad were considered.)

4.2.6.3 Option 6.2: Reduce Volume Before Interim Storage Using a Rotary Screen Thickener at the Pad

In the event that Rotary Thickening on the Pad Option 4.4 is chosen for the B Consolidated Pond transport process option, the Clarifier Option 6.2 becomes viable. Otherwise, it is not. The equipment and operation would be identical to Option 4.4.

4.2.6.4 Option 6.3: Reduce Volume Before Interim Storage a Using Filter at the Pad

Similarly, Option 6.3 depends on the installation of the B Consolidated Pond on Pad Filtration Option 4.5. In that event, this equipment and operating strategy would be used for the Clarifier slurry.

4.2.6.5 Option 9: Reduce Volume During Interim Storage Using Gravity Settling at the Pad

Option 9 for the Clarifier solids is the same as the longer-term Gravity Settling Option 7.1 for the B Consolidated Pond solids. The equipment and unit operations would be the same as that option. However, the available capacity to dispose of the decant solutions in the 374 Building evaporator systems is still a given requirement. The clarifier solids, due to their favorable settling characteristics, should be readily dewatered to less than 15,000 total gallons which would require long-term interim storage. Thus, most of the water added for reclaim and transport could be removed from the material in interim storage using the longer-term gravity settling in the storage containers.

4.3 PROCESS OPTIONS SHORT LIST

The results of applying the weighted criteria to each of the process options is summarized in Table 4-4, Accelerated Sludge Removal Project — Sludge Removal Options List. The following sections discuss these results and their use in the short list selection. In considering these scores it is important to remember that options available for each waste source were evaluated separately from those available to other waste sources and are meaningful only for comparisons within the set of options for that source. The scores associated with options for one waste source should not be compared to those applicable to another source. Brief descriptions of the preferred options are presented here along with equipment availability, cost estimates, and projected schedule. Detailed descriptions are found in Section 4.2.4, included with process descriptions of all options considered.

4.3.1 B Consolidated Pond: Option 1: Pump Everything to Interim Storage

B Consolidated Pond comprises those waste materials collected previously from A Pond, B-North Pond and B-Central Pond. From the results shown in Table 4-4, Option 1 (Figure 4-13) is seen to have the highest score — 300 out of a maximum of 315. This score reflects the advantage of simplicity given the schedule and cost constraints. This option scored the maximum points under every criterion except "Stored Volume". Those options utilizing filtration scored high in this category but scored low in other criteria. Delaying volume reduction until after the ponds are clean and dry received high scores for schedule consideration as shown for Option 7.1, 7.2, and 7.3. Option 7.1 (Figure 4-16) scored relatively high under all criteria and has the second highest score.

4.3.1.1 Process Description and Equipment List

The processing of this material requires two processing operations - reclaiming from the pond and transporting to storage at 750 Pad.

The reclaiming operations is common to all options considered in the options evaluations. This operation, discussed in Section 4.2.3, consists of initially maneuvering a submersible pump over the bottom of the pond and picking up the sludge layer along with clean liquid to produce an approximate 10% solid slurry. When the available clean liquid is exhausted, additional liquid decanted from the previous slurry will be recirculated to the pond to provide additional transport medium. It is believed that in total, the solid and clean liquid contents of the pond are such that no additional clean liquid will be required except that used for wash water.

Following the initial step, the pond is washed with clean water to remove any material left behind in the initial step.

Finally, the larger pieces of trash and debris are removed manually from the pond, combined with oversize solids removed by screening during the initial step, and stored as solids. This reclaiming step is patterned after that used successfully in previous operations to clean B-North Pond and B-Central Pond.

As pond contents are reclaimed they are collected in a slurry at pond side from which they are pumped to 750 Pad using one of the preferred options. These options are summarized here briefly and included in more detailed discussions of all evaluated options in Section 4.2.4.

a) Pump everything to interim storage, including several unit operations. Underflow from the reclaim sumps is pumped to the section of an existing transport booster pump. This pump can transport approximately 75 gpm. Then discharge from the booster pump will flow through existing and new connecting pipelines to a sump at the 750 Pad. From this agitated sump, the B Consolidated Pond waste, including wash water, are transferred to interim storage without any volume reduction.

b) Option 4.2 includes the unit operation of volume reduction at the pond using the reclaim pump as a gravity settler. From the settler, thickened sludge is pumped to 750 Pad using the existing HNUS stabilization equipment. Intermittent operation is required to allow settling time before transport to the 750 Pad. At the pad, the slurry is held in an agitated receiver sump from which it is pumped to interim storage. The disadvantage of this option is the reduced transport capability due to the required intermittent operation. The advantage is the approximately 129,000 gallon volume reduction of material required for interim storage. Decant water from the settler is collected separately at the pond in a process water tank for use as reclaim water, line flushing, and transport to 750 Pad where it is held temporarily pending transport to 374 Building for evaporation.

c) Option 4.3 is similar to Option 4.2 except gravity settling before interim storage is accomplished after transporting all contents of B-South Pond to the 750 Pad. Sludge from the reclaim sump is pumped to the transport booster pumps and transferred to a gravity settler. The thickened, reduced sludge is transferred intermittently to the interim storage. Clarified water from the settler is pumped back to the pond for use as reclaim process water and line flushing. Excess clarified water, approximately 129,000 gallons, is temporarily stored at the pad pending transfer to 374 Building for evaporation. The advantages are the reduced storage requirements and the pumping of a reduced solids content slurry, compared to Option 4.2. The disadvantage of this option is the requirement for an additional line to return process water to the pond and the capacity reduction associated with the intermittent operation of the settler.

d) Option 7.1 is a combination of Option 1 and Option 4.3. All of the B-South Pond contents are transferred to the 750 Pad as in Option 1. From the agitated sump at the pad, the waste is transferred to temporary interim storage. In storage, the solid contents will settle in time. From temporary storage, after the pond is completely clean, the settled interim storage containers will be decanted and the decant transferred to 374 Building for evaporation. The settled solids will be combined to free up space for the remainder of the interim period. The advantage of this option is that it provided the most expedient and minimum risk route to cleaning B-South Pond within the schedule constraint. The disadvantage of this option is that it requires the maximum storage initially. Approximately 350,000 gallons of initial storage are required with a later reduction to 230,000 gallons.

4.3.1.2 Schedule

The schedule for completing the reclaiming and pumping to interim storage of B-South Pond waste under Option 1, Pump Everything to Interim Storage, is the shortest of all options short listed for this pond. This reflects the fact that fewer unit operations are involved. Additionally, the elapsed time between pumping the maximum volume of slurry to 750 Pad represented by this option, and pumping a smaller volume represented by Option 4.2, coupled with intermittent operations favors pumping the larger volume.

The schedule, shown graphically in Appendix I, is dependent upon permitting and contracting being completed as shown. Additionally the actual pumping of waste to 750 Pad depends upon the timely installation of the interim storage tanks. Not all tanks must be in place with secondary containment for pumping to begin. The pumping process completion will lag tank installation. The schedule shows approximately four week float in this constraint. One week is allotted for pond circulation followed by 20 days for reclaiming and pumping to the 750 Pad. This assumes five actual pumping hours per day at 60 gpm with three days contingency. Fifteen days are allowed for pond rinsing and trash/debris removal. Finally, 10 days are allocated for demobilization and cleaning the operating area. There is no contingency built in the schedule. With an early start constraint for starting pumping operations on April 15, and a designed finish date of October 31 for the last day of activity for 1994, there are 106 days of float or contingency allowed based on cleaning only this pond. The October 31 date was chosen as representative of the need to conclude activities before winter weather begins.

The schedule for completing the reclaiming and pumping to interim storage of B-South Pond under Option 4.2, Reduce Volume by Gravity Settling, at the Pond follows essentially the same schedule as Option 1 except for the additional time to settle and decant the liquid. Appendix I displays the draft schedule graphically. Thirty-five days are allowed for reclaiming, settling, decanting and pumping to the 750 Pad. This allows approximately equal time for settling and pumping. It is noted that in a scenario where the operational sequence is reclaim one day, settle one day, and pump one day, an additional 17 days will be required unless two settlers are installed at the pond. The additional resources required to install and demobilize this option have been assumed to be covered by adding personnel during these periods rather than extending the elapsed time. There is no contingency added to this schedule. There are allowances of 20 days for installation, 15 days for washdown, rinse, and trash/debris removal, and 10 days for demobilization. Assuming an early start date of April 15 for pond operations and a last day to complete 1994 activities of October 31, there are 91 days of total contingency based on this pond option.

The schedule for completing the reclaiming and pumping to interim storage of B-South Pond under Option 4.3, Reduce Volume Before Interim Storage Using Gravity settlers at the Pad, follows essentially the same schedule as that of Option 4.2 as shown graphically in Appendix I. The activities are identical except:

a) installation of a return to pond pipeline is required; and

b) decant water must be returned to the pond during operation.

These additional activities are assumed to be covered by additional personnel during process installation and operation rather that by extending the elapsed time of the project. Thirty-five days are allowed in the schedule for reclaiming and pumping to the pad. The process is intermittent to permit gravity separation of a dense sludge, at the pad, between receipt at that location and transfer to storage. As noted above under item B, a scenario of pump, settle, and transfer to storage on three consecutive days would add an additional 17 days to the actual process of reclaiming from the pond and pumping to interim storage with volume reduction. Transfer from the settler to interim storage is assumed to follow immediately after settling so that only one day is added to the schedule at the end of the pump and settle operations to complete the operations. The schedule has no built in contingency with an early start constraint of April 15 and a last day to complete activities on October 31 in 1994, 91 days of float on project contingency are available based on operation at B-South Pond only.

The schedule for completing the reclaiming of B-south Pond under Option 7.1, Reduce Volume During Interim Storage Using Gravity Settling at the Pad, follows the same schedule as Option 1. In this option, volume reduction follows reclaiming of the two ponds and clarifier after they are all clean and dry. The delayed activities of volume reduction by decanting clear liquid and consolidating the remaining sludge in fewer tanks are considered to occur after the completion of this project. This concept is illustrated in Appendix L; however, the extended settling and decanting activities are shown for concept only and have not been considered as to their actual schedule requirements. No particular distinction, between Option 1 and Option 7.1, of activities to transfer to storage have been made because each received a detailed analysis in this study. In practice, a distinction may be made to provide access for the decanting and consolidation activity at a later date in Option 7.1.

4.3.1.3 Cost

The total estimated costs for implementing Option 1, Pump Everything to Interim Storage (without volume reduction) is $1,303,793. This cost includes $770,000 estimated direct cost,

$237,000 for maintenance and operation (M and O) contractor costs, $250,000 in contingency, and $47,500 in escalation.

The total estimated costs for implementing Option 4.2, Reduce Volume Before Interim Storage Using Gravity Settling at the Pond, is $1,876,000. This costs includes $1,162,000 estimated direct cost, $286,500 for maintenance and operation (M & O) Contractor costs, $360,000 in contingency, and $68,500 in escalation.

The total estimated costs for implementing Option 4.3, Reduce Volume Before Interim Storage Using Gravity Settling at the Pad, is $2,029,000. This cost includes $1,282,000 estimated direct cost, $291,000 for M and O Contractor costs, $386,000 in contingency, and $70,000 in escalation.

The total estimated costs for implementing Option 7.1, Reduce Volume During Interim Storage Using Gravity Settling at the Pad, is $1,304,000. This cost includes $770,000 estimated direct cost, $237,000 for M and O Contractor costs, $250,000 in contingency, and $47,500 in escalation. This estimated cost is identical to that of Option 1 because activities required to reduce the volume during interim storage are beyond the completion of this project to clean the ponds and place the waste in interim storage with ultimate disposal at some latter date.

4.3.2 C Pond: Option 2: Pump Everything to Interim Storage After Composition Adjustment

From the results shown in Table 4-4, Option 2 (Figure 4-17) is shown to have the highest score. This option, Pumping Everything to Interim Storage, showed the advantage of simplicity in the meeting of cost and schedule constraints. It scores low under the criteria for storage volume due to having the maximum volume of all the options considered. Option 8, requiring volume reduction after all ponds are clean and dry, also scored fairly high but lost points under several criteria. Option 5 scored low because it would required a drier at the 750 Pad and was not considered feasible under schedule constraints. The option retained for the short list is Option 2.

4.3.2.1 <u>Process Description and Equipment List</u>

Detailed process descriptions of Option 2 are included in Section 4.2.5 along with the options considered.

In summary, Option 2 involved two operations, reclaiming from the pond and pumping the material to interim storage at 750 Pad. The waste material includes surface brine, salt formations, mushy salts, and silt.

Reclaiming waste from this pond involves pumping to pond side, circulation of its contents to dissolve the salt crystals and salt formations, adjusting its composition if required, screening to remove oversize, and collecting in a storage container for the pumping to the 750 Pad. Recirculated brine is pumped to the pond for salt crystal dissolution using a submersible centrifugal pump suspended from a movable crane.

The pond contents will be pumped at pond side using a submersible pump maneuvered manually with ropes to cover the pond area. Additional water will be added as required to maintain brine at below 50% TDS and to wash the pond sides and bottom. Pond contents will be collected in reclaim sumps with decant used to provide recirculation water. Oversize from the reclaim pumping operation will be separated by screening. After the ponds have been emptied of brine and silt and have been washed, debris and trash will be removed manually. Screen oversize and trash will be stored as solids.

Transporting of the reclaimed waste is achieved by an existing transport pump to an existing booster pump and through an existing transfer line. Transported waste are collected in an agitated receiver sump at 750 Pad. From the receiver sump the wastes are pumped to the interim storage.

4.3.2.2 Schedule

The schedule for processing the contents of C Pond, Option 2, has the same constraints regarding regulatory and contractual matters as did the schedule for processing B-South Pond. The initiation of pumping activities at C Pond is constrained by the task of installing interim storage containers through preparatory activities. Pumping may begin in early 1994 as weather permits.

The schedule shown in Appendix I reflects the scenario which the processing of these wastes will follow after the completion of processing activities at B-South Pond and those of the Clarifier. Under this scenario, seasonal weather and container installation are not the controlling constrains. This sequence of processing the three waste sources was chosen for purposes of this study so as to take advantage of the warmer weather to assist in dissolving the salt crystals of C Pond.

Hook-up and installation of equipment tasks are shown to begin after the completion of similar tasks at B-South Pond. The task of dissolving the salt crystals in the pond then begins while pumping of other waste to interim storage is in progress. Four weeks have been allocated for this purpose. Immediately following the dissolution of the salt crystals, reclaiming and pumping to interim storage may begin. At 60 gpm and based on an estimate of 456,000 gallons to be processed, 25 days are allotted for pumping to 750 Pad and transfer to interim storage. No contingency has been shown in this schedule. The end date of September 20, as shown in the figure, is based upon field activities beginning in mid-May in coordination with activities at the

B-South Pond and the Clarifier. The float shown in the figure is based upon an end date of October 31 for all 1994 field activities.

4.3.2.3 Cost

The total estimated costs for implementing Option 2, Pump Everything to Interim Storage (without reducing volume) is $1,411,000. This cost includes $739,000 estimated direct cost, $348,000 for M and O Contractor costs, $270,000 in contingency, and $55,000 in escalation.

4.3.3 Clarifier: Option 3: Pump Everything to Interim Storage by Adding Transport Water

In the application of the criteria to the options available for reclaiming and transporting the clarifier contents, those options requiring volume reduction were considered to apply to a scenario in which the waste were processed along with the waste from B Consolidated Pond. From the results shown in Table 4-4, Option 3 (Figure 4-18), Pumping Everything to Interim Storage, scored the maximum points in every category except that of stored volume. Option 9 requiring volume reduction after all ponds are clean and dry and Option 6.1 requiring volume reduction during reclaim and transport operations also scored high and are assumed to piggy back onto similar operations described under Section 4.3.1. The options requiring volume reduction by mechanical means scored low in spite of their advantage under this criteria generally because of low scores in criteria reflecting increased complexity, cost, schedule, and engineering requirements. The option retained on the short list is Option 3.

This evaluation procedure in addition to providing a consistent method for selecting preferred options, also highlights the importance of the premise that there is serious constraint in the availability of storage space. If a higher premium were to be placed upon space, a reevaluation of the options in which stored volume was assigned a higher maximum value might show different results. However, unless such a premium were very large, the options retained on the short list, requiring volume reduction by settling, would still cover that scenario.

4.3.3.1 Process Description and Equipment List

The detailed process description for Option 3 is continued in Section 4.2.6 with descriptions of all options considered. In summary, this option contains two operating units, reclaiming and pumping to interim storage. The Clarifier is an above ground open-top tank with a high density solidified sludge. These contents will be loosened by a manually-operated water lance with solids directed to a section of the diagram pump. The pump will discharge over a screen for oversize removal before the waste slurry is collected in a reclaim sump. The empty Clarifier will be washed with clean water and wash water also collected in the sump. Trash and debris removal is by hand and is combined with screen oversize for storage as solids. Decant water from 750 Pad may be used as source water. In this case, a separate clean system is required for washing.

Transport of the waste to 750 Pad requires pumping from the sump through the existing C Pond to 750 Pad pipeline transportation to an agitated tank at the 750 Pad. From the agitated tank at the pad, the Clarifier waste is pumped to interim storage.

4.3.3.2 Schedule

For purposes of this study, the scheduling of processing of waste from the Clarifier, Option 3, is assumed to follow immediately after processing the waste from B-South Pond. For purposes of this study, hook-up and installation of equipment for reclaiming and pumping to interim storage is scheduled to begin immediately following the completion of processing of the waste in B-South Pond. The reclaiming of the Clarifier contents with a water lance and pumping to 750 Pad is expected to take 10 days at 30 gpm, assuming 90,000 gallons to be pumped (including wash water and five hours per day actual pumping time). The schedule, shown in Appendix I, illustrates this schedule including the prerequisite regulatory and container task completions.

4.3.3.3 Cost

The total estimated costs for implementing Option 3, Pump Everything to Interim Storage (without volume reduction) is $476,000. This cost includes $192,00 estimated direct cost, $164,000 for M and O Contractor costs, $104,000 in contingency, and $16,000 in escalation.

4.3.4 Summary of Process Options Short List

The process option team selected four options for processing B-South Pond contents, one option for C Pond, and one option for the clarifier. These options, 1, 4.2, 4.3, and 7.1 for B-South Pond; 2 for C Pond, and 3 for the Clarifier are described briefly above and in more detail in Section 4.2.

Analysis of the schedule shows that all three of these waste sources can be processed in one season if regulatory issues, contractual arrangements, and interim storage capacity are complete. A significant slip in any activity will push processing into the winter and require dividing it into two process seasons. This will still allow completion of the project within the time constraint of December 1995. Training of personnel is not shown on the schedule bar chart but is included in the cost (Appendix I). The schedule assumes that training will begin in late winter and will not have a significant impact on the completion schedule.

The budget constraints appear to be to be tight pending a more detailed analysis of personnel requirements. The breakdown of available funds may also preclude the completion of the task within one process season (April through October). Delaying completion to coincide with funding will undoubtedly mean more total cost associated with stop and restart of activities.

The preferred options from a cost and schedule point of view are to reclaim and pump to storage without any reduced volume. A high premium for storage space may change this conclusion.

5.0 STORAGE OPTIONS

5.1 STORAGE OPTIONS METHODOLOGY

Pond storage team meetings were conducted to generate and discuss possible storage options. The storage options determined to be feasible and worth consideration (Table 5-1) based upon the team member experience, prior experience at RFP, and team consensus, are discussed in detail in the following sections. A hypothetical base case was created for comparison purposes to evaluate the advantages and disadvantages of the options under consideration (Table 5-2).

Recommendations for the storage and future retrieval of waste from the three waste sources, B Consolidated Pond, C Pond, and the Clarifier, were arrived at through the following method:

- generating a list of options available for storage of waste from B Consolidated Pond, C Pond, and the Clarifier for a period of up to 10-years, without processing or stabilizing for permanent disposal (discussion in Section 5.2).
- evaluating schedule considerations for each option with regard to a December 1995 deadline for having the ponds clean and dry.
- evaluating cost considerations for each option with regard to maintaining a budget of $3.6 million in fiscal year 1994 and $2.1 million in fiscal year 1995.

Table 5-1
Storage Options

Option 1	Roll-offs, Open Top Containers with External Secondary Containment
Option 2	Mobile FRAC Tanks with External Secondary Containment
Option 3	Roll-offs, Open Top Containers with HDPE Liner
Option 4	55-Gallon Poly Drums
Option 5	TRU-PAC Metal Boxes with External Secondary Containment
Option 6	TRU-PAC Metal Boxes with Liner
Option 7	Vertical Poly Tanks
Option 8	Vertical Steel Tanks
Option 9	Horizontal Steel Tanks
Option 10	Modular Tanks

TABLE 5-2		
Storage Options Rating Criteria		
Criteria	Definition	Base Case Definitions
Heated Real Estate	The land space required to store the waste. Heating capabilities are required.	Adequate heated storage space on the 750 Pad
Chemical Resistance	The ability to contain C Pond contents. Materials of construction are a concern for C Pond contents	The base case is a combination of chemical-resistant and non chemical-resistant containers.
Ease of Sludge Removal	The capability to have the contents removed for final future treatment.	Moderate difficulties in removing sludge.
Hazards Analysis/SAR	The ease of hazards analysis.	Minor modifications to the SAR.
Ease of Sampling/Inspection	The proficiency of container inspection	Mid-range quantity of containers.
NEPA Requirements	NEPA requirements for the containers	Minor modifications to NEPA document.
Maintenance	The general upkeep of the containers.	Minor container upkeep.
Emergency Liquid Removal/Repair	The ability to transfer material from container for repairs.	Moderate difficulties transferring materials and making repairs.
Susceptibility to Operator error	The potential for operator errors based on number of operations involving containers.	A moderate amount of associated operator activities.
Secondary Waste Stream	The amount of waste created during setup and operations.	A moderate amount of secondary waste is created.
Decant Capabilities	The ability to remove liquied from the container.	Moderate amount of difficulties in decanting.
Decontamination and Decommissioning	The ability to decontaminate and dispose of container.	Moderate difficulty for D & D.
Permitting	The ability to permit operation per RCRA requirements.	Moderate modifications to the existing RCRA permit
Construction	The amount of construction required for proposed option.	Minor amount of on-site construction involved.
Design	The amount of design involved with the proposed option.	Minor amount of design involved.

- using a simple approach philosophy in keeping with the cost and schedule constraints.
- selecting a short list of preferred options using a criteria evaluation procedure (discussed in Sections 5.2 and Section 5.3).
- preparing a rough estimate of the cost and schedule requirements for the preferred options (discussed in Section 5.3).
- making a recommendation as to the preferred storage option for each of the ponds and the clarifier based upon the cost and schedule requirements of the preferred options discussed in Section 2.2.

A matrix (Table 5-3) was developed using the following rating system:

+ Positive rating indicates that this option provides a benefit compared to the other alternatives.

0 Neutral rating indicates that this option, compared to the other options, provides no benefit or disadvantage.

- Negative rating indicates that this option provides a disadvantage compared to the other alternatives.

5.1.1 Short List Selection

Following the identification of available options for storage, the options were reduced to a short list. The methodology included:

- Selecting a set of criteria appropriate for the purpose of the project and the rating criteria given in Table 5.2

Table 5-3
Storage Options Matrix

CRITERIA	OPT. 1	OPT. 2	OPT. 3	OPT. 4	OPT. 5	OPT. 6	OPT. 7	OPT. 8	OPT. 9	OPT. 10	BASE CASE
TECHNICAL FEASIBILITY											
HEATED REAL ESTATE NECESSARY	0	+	0	–	–	–	+	+	0	–	0
CHEMICAL RESISTANCE	–	–	+	+	–	+	+	–	–	+	0
EASE OF SLUDGE REMOVAL	+	–	+	–	0	0	–	–	–	–	0
HAZARDS ANALYSIS/SAR	0	0	0	–	–	–	0	0	0	–	0
EASE OF SAMPLING/INSPECTION	0	+	0	–	–	–	+	+	+	–	0
NEPA REQUIREMENTS	0	0	0	–	–	–	0	0	0	–	0
MAINTENANCE	0	0	0	0	0	0	0	0	0	0	0
EMERGENCY LIQUID REMOVAL/REPAIR	–	–	–	+	0	+	–	–	–	–	0
SUSCEPTIBILITY TO OPERATOR ERROR	0	+	0	–	–	–	+	+	+	0	0
SECONDARY WASTE STREAM	0	0	0	0	0	0	0	0	0	0	0
DECANT CAPABILITIES	+	0	+	–	–	–	–	–	–	0	0
D AND D	0	–	+	0	0	0	–	–	–	0	0
PERMITTING	0	0	0	–	–	–	0	0	0	–	0
SCHEDULING											
CONSTRUCTION	+	+	+	+	+	+	0	0	+	–	0
DESIGN	+	+	+	+	+	+	–	0	+	–	0
TOTAL	2	+1	5	–4	–6	–3	–1	–2	–1	–8	0

- Evaluating the options available for storage for each waste stream based on the consensus of the evaluation team.
- Summing the scores for each option and selecting the options with the top scores as the preferred options for each of the three wastes.

Based on the numerical scores in Table 5-3, the short list of storage options is:

Option 1: Roll-offs, open top containers with external secondary containment;

Option 2: Mobile Frac Tanks with external secondary containment;

Option 3: Roll-off, open top containers with an HDPE liner.

5.2 DISCUSSION OF ALL OPTIONS

The following sections discuss the technical feasibility aspects of each option.

5.2.1 Option 1: Roll-Offs, Open Top Containers with External Secondary Containment

A roll-off is an open top, rectangular carbon steel tank. External secondary containment will be provided. Refer to Appendix J for further information on the roll-off containers, and for further information on the external secondary containment refer to Appendix K.

5.2.1.1 Technical Feasibility

The following sections discuss the technical feasibility aspects of Option 1.

5.2.1.1.1 Heated Real Estate Necessary

RATING: 0 (Equivalent to Base Case)

Due to the characteristics of the pond contents, the real estate needed for storage area is required to be heated for freeze protection. With Option 1 it is estimated that the storage space available within the heated tents will be adequate (Figure 5-1).

5.2.1.1.2 Chemical Resistance

RATING: - (Disadvantage compared to Base Case)

Due to the characteristics of the C Pond contents, unlined carbon steel tanks will not adequately store C Pond contents for the required 10-year life-term.

5.2.1.1.3 Ease of Sludge Removal

RATING: + (Advantage compared to Base Case)

The open top to the container will aid in the sludge removal capability. The sludge may be removed with minor difficulties from catwalks above the containers without any personnel entry.

5.2.1.1.4 Safety Analysis Documentation

RATING: 0 (Equivalent to Base Case)

Safety analysis documentation has been written for the 750 Pad. This documentation will require minor modification in order to address this storage option.

5.2.1.1.5 Ease of Sampling/Inspection

RATING: 0 (Equivalent to Base Case)

With the Option 1 containers, any necessary sampling and inspections should be relatively less difficult than with a greater quantity of smaller containers. Option 1 has a mid-range quantity of containers.

5.2.1.1.6 NEPA Requirements

RATING: 0 (Equivalent to Base Case)

The NEPA Requirements will become much more involved if it becomes necessary to find an additional storage area other than the 750 Pad. Since it is estimated that with this option the storage space on 750 Pad will be adequate, the NEPA requirements will be less complicated.

5.2.1.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on the Option 1 containers are predicted to be minimal. Any required maintenance should not be difficult to accomplish.

5.2.1.1.8 Emergency Liquid Removal/Repair

RATING: - (Disadvantage compared to Base Case)

Emergency liquid removal with Option 1 containers will require an empty container of equal or greater size for transferring purposes. Furthermore, full Option 1 containers cannot be moved for repair. This increases the difficulty in repair because a large quantity of liquid will have to be removed before repair can be made. Also, the Option 1 containers have particular spacing limitations that will make it difficult to reposition the container for repair.

5.2.1.1.9 Susceptibility to Operator Error

RATING: 0 (Equivalent to Base Case)

It is suspected that the greater the number of operations associated with the containers, the susceptibility for operator errors increases and, conversely the fewer operations decreases the susceptibility for operator errors. The Option 1 containers have a moderate number of repetitive operations because of the small number of containers.

5.2.1.1.10 Secondary Wastestreams

RATING: 0 (Equivalent to Base Case)

Option 1 containers are anticipated to have no useable value after utilization. The containers and the external secondary containment will become waste. It is believed that Option 1 containers will create a moderate amount of secondary waste which is similar to the base case.

5.2.1.1.11 Decant Capabilities

RATING: + (Advantage compared to Base Case)

The Option 1 containers have a minor amount of difficulties associated with decanting. This will permit the decanted water to be sent to the 374 Building evaporator which minimizes the waste to be stored on the 750 Pad.

5.2.1.1.12 Decontamination and Decommissioning

RATING: 0 (Equivalent to Base Case)

It is anticipated that the decontamination and decommissioning of the Option 1 container will be no greater or no more difficult than the base case.

5.2.1.1.13 Permitting

RATING: 0 (Equivalent to Base Case)

The 750 Pad is permitted to store waste (discussed in Section 1.1.2). Only moderate modifications will be necessary to store the pond contents on the 750 Pad. If other storage locations are necessary then initial permitting efforts will be required for the new location. Option 1 containers are estimated to fit on the 750 Pad and a moderate amount of modifications will have to be made to the existing permit.

5.2.1.2 <u>Schedule</u>

The following sections discuss scheduling concerns related to Option 1.

5.2.1.2.1 Construction

RATING: + (Advantage compared to Base Case)

On-site construction of the Option 1 containers will be non-existent. All the containers are manufactured off-site and will simply be delivered to the site.

5.2.1.2.2 Design

RATING: + (Advantage compared to Base Case)

Design of the Option 1 containers is minimal. These containers are supplier designed, standard containers and will have no scheduling delays due to engineering design.

5.2.2 Option 2: FRAC Tank with External Secondary Containment

Mobile FRAC Tanks are closed top, carbon steel, large capacity storage tanks. External secondary containment is provided. Refer to Appendix J for further information on tanks and external secondary containment.

5.2.2.1 Technical Feasibility

The following sections discuss the technical feasibility aspects of Option 2. Additional rating information is provided in Table 5-3.

5.2.2.1.1 Heated Real Estate Necessary

RATING: + (Advantage compared to Base Case)

The Option 2 containers are large capacity containers which lowers the square footage necessary for storage. It is estimated that the proposed 750 Pad will have more than adequate heated storage space available for the Option 2 containers (Figure 5-2).

5.2.2.1.2 Chemical Resistance

RATING: - (Disadvantage compared to Base Case)

Due to the characteristics of the C Pond contents, an unlined carbon steel tank will not adequately store C Pond contents for the required 10-year life-term.

5.2.2.1.3 Ease of Sludge Removal

RATING: - (Disadvantage compared to Base Case)

Option 2 containers are closed top which hinders the sludge removal capabilities. Also, personnel tank entry could be required for sludge removal.

5.2.2.1.4 Safety Analysis Documentation

RATING: 0 (Equivalent to Base Case)

Safety analysis documentation has been written for the 750 Pad storage area. This documentation will require moderate modification in order to address this storage option. The scope of this modification is no more difficult than that required for the base case.

5.2.2.1.5 Ease of Sampling/Inspection

RATING: + (Advantage compared to Base Case)

With the large containers in Option 2, any necessary sampling and inspections should be relatively easy because of the smaller quantity of containers.

5.2.2.1.6 NEPA Requirements

RATING: 0 (Equivalent to Base Case)

The NEPA Requirements will become much more involved if it becomes necessary to find additional storage area other than the 750 Pad. Since it is estimated that with this option the storage space on 750 Pad will be adequate, the NEPA documentation modifications will be minor.

5.2.2.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on the Option 2 containers is predicted to be minimal.

5.2.2.1.8 Emergency Liquid Removal/Repair

RATING: - (Disadvantage compared to Base Case)

Emergency liquid removal with Option 2 containers will require an empty equal or greater sized container for transferring purposes. Furthermore, full Option 2 containers cannot be moved for repair. This increases the difficulty in repair because the larger quantity of liquid will have to transferred before repairs can be made. Also the Option 2 containers have particular configuration and space limitations that will make it difficult to reposition the container for repair.

5.2.2.1.9 Susceptibility to Operator Error

RATING: + (Advantage compared to Base Case)

It is suspected that the greater the number of operations associated with the containers the susceptibility for operator errors increases and conversely, the fewer operations decreases the susceptibility for operator errors. The Option 2 containers have a minimal number of operations.

5.2.2.1.10 Secondary Wastestream

RATING: 0 (Equivalent to Base Case)

Option 2 containers are anticipated to have no useful value after utilization. The containers and external secondary containment will become waste. It is believed that Option 2 containers will create a moderate amount of secondary waste.

5.2.2.1.11 Decant Capabilities

RATING: - (Disadvantage compared to Base Case)

The closed top containers in Option 2 lead to difficult decanting capabilities.

5.2.2.1.12 Decontamination and Decommissioning

RATING: 0 (Equivalent to Base Case).

It is anticipated that the decontamination and decommissioning of the Option 2 containers will be no more difficult than the base case.

5.2.2.1.13 Permitting

RATING: 0 (Equivalent to Base Case)

Option 2 containers are estimated to fit on the 750 Pad; therefore, moderate modifications will have to be made to the existing permit.

5.2.2.2 <u>Schedule</u>

The following sections discuss the scheduling aspects related to Option 2.

5.2.2.2.1 Construction

RATING: + (Advantage compared to Base Case)

On-site construction of the Option 2 containers will be non existent. All the containers are manufactured off-site and will simply be delivered to the site.

5.2.2.2.2 Design

RATING: + (Advantage compared to Base Case)

Option 2 containers have minimal design involved.

5.2.3 Option 3: Roll-Offs, Open Top Containers with HDPE Liner

A roll-off is an open top, rectangular carbon steel tank. An HDPE chemical resistant liner will provide primary containment. Refer to Appendix J for further information on the roll-off containers.

5.2.3.1 Technical Feasibility

The following sections discuss the technical feasibility aspects of Option 3.

5.2.3.1.1 Heated Real Estate Necessary

RATING: 0 (Equivalent to Base Case)

With Option 3 it is estimated that the storage space available within the heated tents will be adequate.

5.2.3.1.2 Chemical Resistance

RATING: + (Advantage compared to Base Case)

Option 3 provides HDPE tank linings adequate for corrosion protection against C Pond contents.

5.2.3.1.3 Ease of Sludge Removal

RATING: + (Advantage compared to Base Case)

The open top to the container will aid in the sludge removal capabilities. The sludge may be removed from above the container from catwalks with out any personnel entry into the container.

5.2.3.1.4 Safety Analysis Documentation

RATING: 0 (Equivalent to Base Case)

Safety analysis documentation has been written for the 750 Pad storage area. This documentation will require minor modification in order to address this storage option.

5.2.3.1.5 Ease of Sampling/Inspection

RATING: 0 (Equivalent to Base Case)

With the smaller quantity of containers, any necessary sampling and inspections should be relatively less difficult than with a greater quantity of smaller containers. Option 3 has an mid-range number of containers.

5.2.3.1.6 NEPA Requirements

RATING: 0 (Equivalent to Base Case)

The NEPA Requirements become much more involved if it is necessary to find additional storage area other than the 750 Pad. Since it is estimated that with Option 3 the storage space on 750 Pad will be adequate, the NEPA documentation modifications will be minor.

5.2.3.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on the Option 3 containers is predicted to be minimal.

5.2.3.1.8 Emergency Liquid Removal/Repair

RATING: - (Disadvantage compared to Base Case)

Emergency liquid removal with Option 3 containers will require an empty container of equal or greater size for transferring purposes. Furthermore, Option 3 full containers cannot be moved for repair. This increases the difficulty in repair because a large quantity of liquid will have to removed before repair can be made. Also the Option 3 containers have particular spacing limitations that will make it difficult to reposition the container for repair.

5.2.3.1.9 Susceptibility to Operator Error

RATING: 0 (Equivalent to Base Case)

It is suspected that the greater the number of operations associated with the containers the susceptibility for operator errors increases and conversely, the fewer operations decreases the susceptibility for operator errors. Option 3 containers have an moderate amount of associated operations.

5.2.3.1.10 Secondary Wastestream

RATING: 0 (Equivalent to Base Case)

The Option 3 containers and secondary containment liner will become waste. It is believed that Option 3 containers will create a moderate amount of secondary waste as compared to the base case.

5.2.3.1.11 Decant Capabilities

RATING: + (Advantage compared to Base Case)

The Option 3 containers are relatively easy to decant. This will permit the decanted water to be sent to the 374 Building evaporator which minimizes the waste to be stored on the 750 Pad.

5.2.3.1.12 Decontamination and Decommissioning

RATING: + (Advantage compared to Base Case)

Option 3 containers after utilization may be used on-site for construction dumpsters after removal of the HDPE liners and the containers pass the radiological detection measures. This is a benefit because of waste minimization.

5.2.3.1.13 Permitting

RATING: 0 (Equivalent to Base Case)

Option 3 containers are estimated to fit on the 750 Pad. Moderate modifications are necessary to the existing permit.

5.2.3.2 <u>Schedule</u>

The following sections discuss the scheduling aspects related to Option 3.

5.2.3.2.1 Construction

RATING: + (Advantage compared to Base Case)

On-site construction of the Option 3 will be non-existent. All the containers are manufactured off-site and will simply be delivered to the site.

5.2.3.2.2 Design

RATING: + (Advantage compared to Base Case)

Design of the Option 3 containers is minimal. These containers are supplier designed standard containers and have no scheduling delays due to engineering design.

5.2.4 Option 4: 55-Gallon Poly Drums

This option is the use of 55-gallon poly drums, packed in 80 gallon steel drums for secondary containment.

5.2.4.1 <u>Technical Feasibility</u>

The following sections discuss the technical feasibility aspects of Option 4.

5.2.4.1.1 Heated Real Estate Necessary

RATING: - (Disadvantage compared to Base Case)

The estimated heated real estate or storage space needed for Option 4 exceeds the limitations of the 750 Pad and other locations will be necessary for storage (Figure 5-3).

5.2.4.1.2 Chemical Resistance

RATING: + (Advantage compared to Base Case)

Option 4 stores the Pond contents in polyethylene drums which provides adequate chemical resistance for the proposed contents.

5.2.4.1.3 Ease of Sludge Removal

RATING: - (Disadvantage compared to Base Case)

The Option 4 drums have increased difficulty in sludge removal due to the large quantity of containers.

5.2.4.1.4 Safety Analysis Documentation

RATING: - (Disadvantage compared to Base Case)

Safety analysis documentation has been written for the 750 Pad storage area. Additional safety analysis documentation will be necessary since additional storage area will be required for this option.

5.2.4.1.5 Ease of Sampling/Inspection

RATING: - (Disadvantage compared to Base Case)

Option 4 has a large quantity of containers and this increases the difficulty of sampling and inspections.

5.2.4.1.6 NEPA Requirements

RATING: - (Disadvantage compared to Base Case)

The NEPA Requirements will become much more involved if it becomes necessary to find additional storage areas. Since it is estimated that with Option 4 the storage space on 750 Pad will not be adequate, the NEPA documentation will be more involved.

5.2.4.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on the Option 4 containers is predicted to be minimal.

5.2.4.1.8 Emergency Liquid Removal/Repair

RATING: + (Advantage compared to Base Case)

Option 4 has smaller volume within each container and therefore will be less difficult to manage should an emergency arise.

5.2.4.1.9 Susceptibility to Operator Error

RATING: - (Disadvantage compared to Base Case)

It is suspected that the greater the number of operations associated with the containers the susceptibility for operator errors increases. Option 4 containers has a large number of associated operations.

5.2.4.1.10 Secondary Wastestreams

RATING: 0 (Equivalent to Base Case)

Option 4 will create a moderate amount of secondary waste.

5.2.4.1.11 Decant Capabilities

RATING: - (Disadvantage compared to Base Case)

Decanting for Option 4 is relatively difficult due to the large quantity of containers.

5.2.4.1.12 Decontamination and Decommissioning

RATING: 0 (Equivalent to Base Case)

It is anticipated that the decontamination and decommissioning of the Option 4 containers will be no greater or no more difficult than the base case.

5.2.4.1.13 Permitting

RATING: - (Disadvantage compared to Base Case)

Permitting for Option 4 will be relatively easy for the 750 Pad and more difficult for the supplementary storage area.

5.2.4.2 Schedule

The following sections discuss the scheduling aspects related to Option 4.

5.2.4.2.1 Construction

RATING: + (Advantage compared to Base Case)

The containers required for this option would be constructed off-site and delivered ready for use. However, construction of a heated facility for container storage would be required.

5.2.4.2.2 Design

RATING: + (Advantage compared to Base Case)

No design is involved with Option 4 containers. Design of an additional storage facility could be required.

5.2.5 Option 5: TRU-PAC Metal Boxes with External Secondary Containment

TRU-PAC metal boxes are 4 feet by 4 feet by 7 feet metal containers currently used on the 750 Pad. External secondary containment is provided.

5.2.5.1 Technical Feasibility

The following sections discuss the technical feasibility aspects of Option 5.

5.2.5.1.1 Heated Real Estate Necessary

RATING: - (Disadvantage compared to Base Case)

The estimated heated real estate or storage space needed for Option 5 exceeds the limitations of the 750 Pad and additional locations will be necessary for storage.

5.2.5.1.2 Chemical Resistance

RATING: - (Disadvantage compared to Base Case)

Option 5 provides for the storage the pond contents directly in the box without a liner. This does not provide adequate chemical resistance for the proposed contents.

5.2.5.1.3 Ease of Sludge Removal

RATING: 0 (Equivalent to Base Case)

Due to the open top accessibility into the TRU-PAC containers, sludge removal will be easily accessible. The sludge may be removed from above the container without any personnel entry in the container.

5.2.5.1.4 Safety Analysis Documentation

RATING: - (Disadvantage compared to Base Case)

Safety analysis documentation has been written for the 750 Pad storage area. Additional safety analysis documentation will be required since additional storage area will be necessary for this option.

5.2.5.1.5 Ease of Sampling/Inspection

RATING: - (Disadvantage compared to Base Case)

Option 5 has a large quantity of containers which increases the difficulty of sampling and inspections.

5.2.5.1.6 NEPA Requirements

RATING: - (Disadvantage compared to Base Case)

The NEPA Requirement will become more involved if it becomes necessary to find additional storage area than the 750 Pad. Since it is estimated that with Option 5 the storage space on 750 Pad will not be adequate, the NEPA document requirements will be more involved.

5.2.5.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on the Option 5 containers is predicted to be minimal.

5.2.5.1.8 Emergency Liquid Removal/Repair

RATING: + (Advantage compared to Base Case)

Option 5 has smaller volume within each container and therefore will be less difficult to manage should an emergency arise.

5.2.5.1.9 Susceptibility to Operator Error

RATING: - (Disadvantage compared to Base Case)

It is suspected that the greater the number of operations associated with the containers the susceptibility for operator errors increases. Option 5 containers have a large number of associated operations.

5.2.5.1.10 Secondary Wastestreams

RATING: 0 (Equivalent to Base Case)

The Option 5 will create a moderate amount of secondary waste.

5.2.5.1.11 Decant Capabilities

RATING: - (Disadvantage compared to Base Case)

Decanting for Option 5 is relatively difficult due to the large quantity of containers.

5.2.5.1.12 Decontamination and Decommissioning

RATING: 0 (Equivalent to Base Case)

It is anticipated that the decontamination and decommissioning of the Option 5 containers will be no greater or no more difficult than the base case.

5.2.5.1.13 Permitting

RATING: - (Disadvantage compared to Base Case)

Permitting for Option 5 will be relatively easy for the 750 Pad and much more difficult for the supplementary storage area.

5.2.5.2 Schedule

The following sections discuss the scheduling aspects related to Option 5.

5.2.5.2.1 Construction

RATING: + (Advantage compared to Base Case)

No on-site construction is involved with the Option 5 containers. However, construction may be necessary to provide additional storage facility.

5.2.5.2.2 Design

RATING: + (Advantage compared to Base Case)

No design is involved with the Option 5 containers. However, design of an additional storage facility could be required.

5.2.6 Option 6 Tru-Pac Metal Boxes with Liner

TRU-PAC metal boxes are 4 feet by 4 feet by 7 feet metal containers currently used on the 750 Pad. A liner is provided for primary containment.

5.2.6.1 Technical Feasibility

The following sections discuss the technical feasibility of Option 6.

5.2.6.1.1 Heated Real Estate Necessary

RATING: - (Disadvantage compared to Base Case)

Option 6, TRU-PAC metal boxes with liners were given a negative rating due to the small capacity of the containers. It is estimated the 750 Pad will not have adequate storage space for Option 6 and an additional heated storage space must be provided.

5.2.6.1.2 Chemical Resistance

RATING: + (Advantage compared to Base Case)

Due to the characteristics of C Pond, contents the lined TRU-PAC metal boxes will adequately store C Pond contents for the required 10-year life-term.

5.2.6.1.3 Ease of Sludge Removal

RATING: 0 (Equivalent to Base Case)

Due to the open top accessibility into the TRU-PAC containers, sludge removal will be easily accessible. The sludge may be removed from above the container without any personnel entry in the container.

5.2.6.1.4 Safety Analysis Documentation

RATING: - (Disadvantage compared to Base Case)

Safety analysis documentation has been written for the 750 Pad storage area. However, safety analysis documentation will be required in order to address the supplementary storage area required for this option.

5.2.6.1.5 Ease of Sampling/Inspection

RATING: - (Disadvantage compared to Base Case)

With the smaller containers in Option 6, any necessary sampling and inspections should be more difficult due to the large number of containers.

5.2.6.1.6 NEPA Requirement

RATING: - (Disadvantage compared to Base Case)

The NEPA requirements will become much more involved if it becomes necessary to find an additional storage area other than the 750 Pad. Since it is estimated that with Option 6 the storage space on 750 Pad not be adequate, the NEPA document requirements will be more involved for the supplementary storage area required.

5.2.6.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on the Option 6 containers is predicted to be minimal.

5.2.6.1.8 Emergency Liquid Removal/Repair

RATING: + (Advantage compared to Base Case)

For the Option 6 containers, emergency liquid containers will require an empty, equal or greater sized container for transferring purposes. Option 6 containers can be readily moved with a forklift for making repairs. Also, the liner prevents the shutdown of the entire tent when emergency arises.

5.2.6.1.9 Susceptibility to Operating Error

RATING: - (Disadvantage compared to Base Case)

It is suspected that the greater the number of operations associated with the containers the susceptibility for operator errors increases. Option 6 containers have a large number of associated options comparability to the other options.

5.2.6.1.10 Secondary Wastestream

RATING: 0 (Equivalent to Base Case)

Option 6 containers are predicted to have no reuse value. The liner will also become secondary waste. Option 6 will have an moderate amount of secondary waste as compared to the other options.

5.2.6.1.11 Decant Capabilities

RATING: - (Disadvantage compared to Base Case)

Decanting for Option 6 is relatively difficult due to the large number of containers.

5.2.6.1.12 Decontamination/Decommission

RATING: 0 (Equivalent to Base Case)

It is anticipated that the decontamination/decommission of the Option 6 containers will be no greater than the base case.

5.2.6.1.13 Permitting

RATING: - (Disadvantage compared to Base Case)

Permitting for Option 6 will be relatively easy for the 750 Pad and more difficult for the supplementary storage area.

5.2.6.2 Schedule

The following sections discuss the scheduling aspects related to Option 6.

5.2.6.2.1 Construction

RATING: + (Advantage compared to Base Case)

On-site construction of Option 6 containers will be virtually non-existent. All the containers and liners are manufactured off-site and will simply be delivered to the site.

5.2.6.2.2 Design

RATING: + (Advantage compared to Base Case)

Design of the Option 6 containers is minimal. The containers and liners are supplier-designed standard containers and have no scheduling delays due to engineering design.

5.2.7 Option 7, Vertical Poly Tanks

Option 7 consists of vertically positioned, round, closed top, poly tanks of various sizes as primary containment. Secondary containment is a large, steel, round, open top tank.

5.2.7.1 Technical Feasibility

The following sections discuss the technical feasibility of Option 7.

5.2.7.1.1 Heated Real Estate Necessary

RATING: + (Advantage compared to Base Case)

Vertical poly tanks can take full advantage of the height of the heated tents which will lower the square footage necessary. It is estimated that the 750 Pad will have enough heated storage space for Option 7 tanks.

5.2.7.1.2 Chemical Resistance

RATING: + (Advantage compared to Base Case)

Option 7 provides a vertical poly tank adequate for C Pond contents to prevent deterioration.

5.2.7.1.3 Ease of Sludge Removal

RATING: - (Disadvantage compared to Base Case)

The Option 7 poly tanks have closed tops which makes sludge removal very difficult and also requires personnel tank entry.

5.2.7.1.4 Safety Analysis Documentation

RATING: 0 (Equivalent to Base Case)

Safety analysis documentation has been written for the 750 Pad storage area. This documentation will require minor modification in order to address this storage option. The scope of this modification is no more difficult than that required for the base case.

5.2.7.1.5 Ease of Sampling/Inspection

RATING: + (Advantage compared to Base Case)

The poly tanks are large containers making inspection and sampling less difficult due to the overall smaller number of containers.

5.2.7.1.6 NEPA Requirements

RATING: 0 (Equivalent to Base Case)

The NEPA requirement will be much more involved if it becomes necessary to find additional storage area other than the 750 Pad. Since it is estimated that with Option 7 the storage space on 750 Pad will be adequate, the NEPA documentation modifications will be minor.

5.2.7.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on the Option 7 containers is predicted to be minimal.

5.2.7.1.8 Emergency Liquid Removal/Repair

RATING: - (Disadvantage compared to Base Case)

Poly tanks are large which makes the removal of liquid difficult for repairs.

5.2.7.1.9 Susceptibility to Operator Error

RATING: + (Advantage compared to Base Case)

It is suspected that the greater the number of operations associated with the tanks, the susceptibility for operators errors increases and conversely the fewer operations decreases the susceptibility for operator errors. The Option 7 tanks have a small number of repetitive operations.

5.2.7.1.10 Secondary Wastestream

RATING: 0 (Equivalent to Base Case)

Containers will become waste after use. Option 7 will create a moderate amount of waste as compared to the other options.

5.2.7.1.11 Decant Capabilities

RATING: - (Disadvantage compared to Base Case)

The closed top tanks in Option 7 will lead to difficult decanting capabilities.

5.2.7.1.12 Decontamination & Decommission

RATING: 0 (Equivalent to Base Case)

Due to the double tanks associated with Option 7, decontamination and decommissioning will be difficult.

5.2.7.1.13 Permitting

RATING: 0 (Equivalent to Base Case)

The 750 Pad is permitted to store waste. Only moderate modifications will be necessary to store the Pond contents on the 750 Pad. If other storage locations are necessary, then initial permitting efforts will be required for the new location. Option 7 containers are estimated to fit on the 750 Pad and a moderate amount of modifications will have to be made to the existing permit.

5.2.7.2 Schedule

The following sections discuss the scheduling aspects related to Option 7.

5.2.7.2.1 Construction

RATING: 0 (Equivalent to Base Case)

Tanks would have to be constructed off-site to various sizes designed to fit the 750 Pad tents. On-site construction would be minimal.

5.2.7.2.2 Design

RATING: - (Disadvantage Compared to Base Case)

A design for the various sizes would be required for the Option 7 tanks.

5.2.8 Option 8, Vertical Steel Tanks

Option 8 consists of vertically positioned, round, closed top, carbon steel tanks as primary containment. Secondary containment is a large, steel, round, encapsuling, open top tank.

5.2.8.1 Technical Feasibility

The following sections discuss the technical feasibility of Option 8.

5.2.8.1.1 Heated Real Estate Necessary

RATING: + (Advantage compared to Base Case)

Vertical carbon steel tanks can take full advantage of the height of the heated tents which will lower the square footage of storage space necessary. It is estimated that the 750 Pad will have plenty of heated storage space for Option 8 tanks.

5.2.8.1.2 Chemical Resistance

RATING: - (Disadvantage compared to Base Case)

Option 8 provides vertical carbon steel tanks that are not adequate for C Pond contents.

5.2.8.1.3 Ease of Sludge Removal

RATING: - (Disadvantage compared to Base Case)

Carbon steel tanks have closed tops which makes sludge removal very difficult and may also requires personnel tank entry.

5.2.8.1.4 Safety Analysis Documentation

RATING: 0 (Equivalent to Base Case)

Safety analysis documentation has been written for the 750 Pad storage area. This documentation will require minor modification in order to address this storage option. The scope of this modification is no more difficult than that required for the base case.

5.2.8.1.5 Ease of Sampling/Inspection

RATING: + (Advantage compared to Base Case)

The carbon steel tanks are large containers making inspection and sampling less difficult due to the smaller number of containers.

5.2.8.1.6 NEPA Requirements

RATING: 0 (Equivalent to Base Case)

The NEPA requirements will become much more involved if it is necessary to find additional storage area other than the 750 Pad. Since it is estimated that with Option 8 the storage space on 750 Pad will be adequate, the NEPA documentation modifications will be minor.

5.2.8.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on the Option 8 containers is predicted to be minimal.

5.2.8.1.8 Emergency Liquid Removal/Repair

RATING: - (Disadvantage compared to Base Case)

Carbon steel tanks are large which makes the removal of liquid difficult for repairs.

5.2.8.1.9 Susceptibility to Operator Error

RATING: + (Advantage compared to Base Case)

It is suspected that the greater the number of operations associated with the tanks, the susceptibility for operators errors increases and conversely the fewer operations decreases the susceptibility for operator errors. The Option 8 tanks have a small number of repetitive operations.

5.2.8.1.10 Secondary Wastestream

RATING: 0 (Equivalent to Base Case)

The containers will become waste after use. Option 8 will create a moderate amount of waste as compared to the other options.

5.2.8.1.11 Decant Capabilities

RATING: - (Disadvantage compared to Base Case)

The closed top tanks in Option 8 lead to difficult decanting capabilities.

5.2.8.1.12 Decontamination & Decommission

RATING: 0 (Equivalent to Base Case)

Due to the double tanks associated with Option 8 decontamination and decommissioning will be difficult.

5.2.8.1.13 Permitting

RATING: 0 (Equivalent to Base Case)

The 750 Pad is permitted to store waste. Only moderate modifications will be necessary to store the pond contents on the 750 Pad. If other storage locations are necessary then initial permitting efforts will be required for the new location. Option 8 containers are estimated to fit on the 750 Pad and a moderate amount of modifications will have to be made to the existing permit.

5.2.8.2 Schedule

The following sections discuss the scheduling aspects related to Option 8.

5.2.8.2.1 Construction

RATING: 0 (Equivalent to Base Case)

Tanks would have to be constructed to various sizes off-site to fit the 750 Pad tents. On-site construction would be minimal.

5.2.8.2.2 Design

RATING: 0 (Equivalent to Base Case)

A minor amount of design would be required for Option 8 containers.

5.2.9 Option 9: Horizontal Steel Tank

Option 8 consists of horizontally positioned, round, closed top, carbon steel tanks as primary containment. Secondary containment is a large, steel, rectangular, encapsuling, open top tank.

5.2.9.1 <u>Technical Feasibility</u>

The following sections discuss the technical feasibility of Option 9.

5.2.9.1.1 Heated Real Estate Necessary

RATING: 0 (Equivalent to Base Case)

It is estimated that the 750 Pad will have adequate heated storage space for Option 9 tanks.

5.2.9.1.2 Chemical Resistance

RATING: - (Disadvantage compared to Base Case)

Option 9 provides horizontal carbon steel tanks, which are not adequate for C Pond contents.

5.2.9.1.3 Ease of Sludge Removal

RATING: - (Disadvantage compared to Base Case)

Horizontal carbon steel tanks have closed tops which makes sludge removal very difficult and also may require personnel tank entry.

5.2.9.1.4 Safety Analysis Documentation

RATING: 0 (Equivalent to Base Case)

Safety analysis documentation has been written for the 750 Pad storage area. This documentation will require minor modification in order to address this storage option. The scope of this modification is no more difficult than that required for the base case.

5.2.9.1.5 Ease of Sampling/Inspection

RATING: + (Advantage compared to Base Case)

The carbon steel tanks are large containers making inspection and sampling less difficult due to the smaller number of containers.

5.2.9.1.6 NEPA Requirements

RATING: 0 (Equivalent to Base Case)

The NEPA requirement will become much more involved if it becomes necessary to find additional storage areas other than the 750 Pad. Since it is estimated that with Option 9 the storage space on 750 Pad will be adequate, the NEPA documentation modifications will be minor.

5.2.9.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on Option 9 containers is predicted to be minor.

5.2.9.1.8 Emergency Liquid Removal/Repair

RATING: - (Disadvantage compared to Base Case)

Carbon steel tanks are large which makes the removal of liquids difficult for repairs.

5.2.9.1.9 Susceptibility to Operator Error

RATING: + (Advantage compared to Base Case)

It is suspected that the greater the number of operations associated with the tanks, the susceptibility for operators errors increases and conversely the fewer operations decreases the susceptibility for operator errors. The Option 9 tanks have a small number of repetitive operations.

5.2.9.1.10 Secondary Wastestream

RATING: 0 (Equivalent to Base Case)

Containers will become waste after use. Option 9 will create an moderate amount of waste as compared to the other options.

5.2.9.1.11 Decant Capabilities

RATING: - (Disadvantage compared to Base Case)

The closed top tanks in Option 9 lead to difficult decanting capabilities.

5.2.9.1.12 Decontamination & Decommission

RATING: 0 (Equivalent to Base Case)

Due to the double tanks associated with Option 9 decontamination and decommissioning will be difficult.

5.2.9.1.13 Permitting

RATING: 0 (Equivalent to Base Case)

The 750 Pad is permitted to store waste. Only moderate modifications will be necessary to store the Pond contents on the 750 Pad. If other storage locations are necessary then initial permitting efforts will be required for the new location. Option 9 containers are estimated to fit on the 750 Pad and a moderate amount of modifications will have to be made to the existing permit.

5.2.9.2 <u>Schedule</u>

The following sections discuss the scheduling aspects related to Option 9.

5.2.9.2.1 Construction

RATING: 0 (Equivalent to Base Case)

Tanks would have to be constructed to various sizes off site and on site construction would be minimal.

5.2.9.2.2 Design

RATING: 0 (Equivalent to Base Case)

A minor amount of design would be required for Option 9 containers.

5.2.10 Option 10: Modular Tanks

Modular tanks are field fabricated tanks consisting of an HDPE liner as primary containment and galvanized steel walls as secondary containment.

5.2.10.1 Technical Feasibility

The following sections discuss the technical feasibility of Option 10.

5.2.10.1.1 Heated Real Estate Necessary

RATING: - (Disadvantage compared to Base Case)

Modular tanks are too large to be installed on the 750 Pad in the available heated storage space. Additional heated storage space must be provided.

5.2.10.1.2 Chemical Resistance

RATING: + (Advantage compared to Base Case)

The HDPE liner in the tanks will be chemically resistant to the C Pond contents.

5.2.10.1.3 Ease of Sludge Removal

RATING: - (Disadvantage compared to Base Case)

Due to the large size of the modular tanks, sludge removal is thought to be difficult due to the depth and size of the tank.

5.2.10.1.4 Safety Analysis Documentation

RATING: - (Disadvantage compared to Base Case)

Safety analysis documentation from existing on-site modular tanks could be used to help prepare new safety analysis documents. However, revisions and reviews would still exist for new SAR documents. This affects schedule and cost.

5.2.10.1.5 Ease of Sampling/Inspection

RATING: + (Advantage compared to Base Case)

Due to the size and small number of tanks, inspection and sampling would be very easy compared to base case.

5.2.10.1.6 NEPA Requirements

RATING: - (Disadvantage compared to Base Case)

NEPA documents from existing modular tanks on-site, could be used to help prepare new NEPA documents. Revisions and reviews would be required for the new NEPA documents, which would impact schedule and cost.

5.2.10.1.7 Maintenance

RATING: 0 (Equivalent to Base Case)

The maintenance required on Option 10 tanks is predicted to be minimal.

5.2.10.1.8 Emergency Liquid Removal/Repair

RATING: - (Disadvantage compared to Base Case)

Emergency liquid removal with Option 10 tanks will require an empty, equal or greater size container for transferring purposes. Furthermore, Option 10 tanks can not be moved for repair. This increases the difficultly in repair because the larger quantity of liquid will have to be removed before repairs are made.

5.2.10.1.9 Susceptibility to Operator Error

RATING: 0 (Equivalent to Base Case)

It is suspected that the greater the number of operations associated with the containers susceptibility increases for operator errors and conversely, the fewer operations decreases the susceptibility for operator errors. Option 10 tanks have a small number of associated operations compared to the other options.

5.2.10.1.10 Secondary Wastestreams

RATING: 0 (Equivalent to Base Case)

Modular tanks will become waste after use. Option 10 will create an average amount of waste.

5.2.10.1.11 Decant Capabilities

RATING: 0 (Equivalent to Base Case)

Modular tanks are large open top tanks making decanting for Option 10 relatively easy.

5.2.10.1.12 Decontamination & Decommission

RATING: 0 (Equivalent to Base Case)

It is estimated that the decontamination and decommission of the Option 10 tanks will be no greater or no less than the base case.

5.2.10.1.13 Permitting

RATING: - (Disadvantage compared to Base Case)

Modular tanks will not fit on the 750 Pad. Therefore, permitting is a moot issue.

5.2.10.2 Schedule

The following sections discuss the scheduling aspects related to Option 10.

5.2.10.2.1 Construction

RATING: - (Disadvantage compared to Base Case)

On-site construction would be required. This would create problems of getting workers on-site, which greatly effects the schedule.

5.2.10.2.2 Design

RATING: - (Disadvantage compared to Base Case)

Tanks would have to be completely designed to fit project needs and constraints. Also, the area where tanks are being installed would have to be evaluated.

5.3 STORAGE OPTIONS SHORT LIST

The following sections discuss the storage options deemed relevant and appropriate for the short list.

5.3.1 Option 1: Roll-Offs, Open Top Containers with External Secondary Containment

The results of evaluating the criteria against each of the storage options is summarized in Table 5-3. The following sections discuss these results and their use in the short list selection.

5.3.1.1 Cost

The direct costs of Option 1 were calculated using two different sizes of Roll-off containers. The first estimate was for a 14-foot Roll-Off (Galbreath Model OS1472-1). The second estimate was for a 24-foot Roll-Off (Galbreath Model OS22-1). In addition to the container costs, external secondary containment (Terrastar Model TS 1632 Galvanized Steel Structure and Tension Cables; Liner Reinforced XR-5; Over & Under Liner Geotextile 100 mil) costs are included. With the use of roll-off containers, an added cost is incurred for a truck-mounted roll-off trailer hoist. It was found to be slightly cheaper to rent the hoist for four months opposed to buying a used hoist. Due to the weight of the filled Roll-Off containers, support pads must be placed under points of container contact with the external secondary containment to prevent damage to the containment. Also included in estimate were calculated costs per foot to install catwalks with handrails (to meet OSHA regulations). Cost estimate worksheets are attached as Appendix L.

5.3.1.2 Schedule

The sequence of operations required to install roll-off containers with external secondary containment is as follows:

1. Removal of stored pondcrete and saltcrete from Tents 3 and 4. Removal of process conveyor from Tent 6;
2. Installation of the external secondary containment floor (i.e. bottom) in the tent;
3. Delivery and installation of the Roll-Offs in the tent on the external secondary containment floor;
4. Erection of the walls of the external secondary containment; and
5. Filling the Roll-Offs with pond sludge.

The key issue associated with accomplishing the above activities is the delivery schedule for with the roll-offs. The manufacturer has indicated that the delivery schedule will match the installation schedule for the containers.

5.3.2 Option 2: Mobile FRAC Tanks with External Secondary Containment

The results of evaluating the criteria against each of the storage options is summarized in Table 5-3. The following sections discuss these results and their use in the short list selection.

5.3.2.1 Cost

The direct costs of Option 2 consist of 21,000 gallon mobile storage Mobile FRAC tanks (VE Sinule step "V" bottom, deep well corrugations, no internal cross rods) and external secondary containment (Terrastar Model TS 1632 Galvanized Steel Structure and Tension Cables; Liner Reinforced XR-5; Over & Under Liner Geotextile 100 mil). The external secondary containment will provide for the secondary containment. Due to the weight of either the Mobile

FRAC Tanks or Roll-Offs, support pads must be placed under points of container in contact with the external secondary containment to prevent external secondary containment damage. Costs of Option 2 are shown in the cost estimate detail worksheet (Appendix L). Costs shown on the worksheet include shipping and handling.

5.3.2.2 Schedule

The sequence of operations to install Mobile FRAC Tanks with external secondary containment is as follows:

1. Removal of stored pondcrete and saltcrete from Tents 3 and 4. Removal of process conveyor from Tent 6;
2. Installation of the secondary containment floor in the tent;
3. Delivery and installation of the Mobile FRAC Tanks in the tent on the secondary containment floor;
4. Erection of the walls of the secondary containment; and
5. Filling the Mobile FRAC Tanks with pond sludge.

The Mobile FRAC Tank manufacturer has indicated a delivery schedule of two tanks per week can be maintained. This delivery rate will support the required installation schedule.

5.3.3 Option 3: Roll-Offs, Open Top Containers with HDPE Liners

The results of evaluating the criteria against each of the storage options is summarized in Table 5-3. The following sections discuss these results and their use in the short list selection.

5.3.3.1 Cost

The direct costs of Option 3 were calculated using two different sizes of Roll-Off containers. The first consists of 21 cubic yard Roll-Offs (Galbreath Model 051472-1) and the second estimate uses 34 cubic yard Roll-Offs (Galbreath Model 0522-1). Primary containment costs include HDPE liners (Gundline 60 mil. high-density polyethylene liner) with an HDPE net providing an air space between the tank and the 60 mil. liner for leak detection and the actual roll-off containers provide for the secondary containment. Option 3 will also incur the cost of renting a truck-mounted roll-off trailer hoist. Costs of Option 3 are shown in the cost estimate worksheet (Appendix L). Costs shown on worksheet include shipping and handling.

5.3.3.2 Schedule

Delivery of the roll-off containers with an internal HDPE liner will define the critical path for C Pond sludge removal and storage. Delivery times on a container basis will be longer than for unlined roll-offs due to the requirement to install and test the liner. The HDPE lined roll-offs require no external secondary containment. Therefore, unlike the unlined roll-offs, the HDPE-lined containers can be placed in service as soon as they are positioned in the tents. There is no need to await the delivery of all containers prior to completing the erection of the secondary containment and starting fill operations.

The vendor has indicated that a delivery schedule consistent with C Pond pumping operations can be achieved.

5.3.4 Summary of Storage Options Short List

As indicated in Section 5.1, the methodology used to establish the short list resulted in the following storage options:

Option 1 - Roll-Offs with external secondary containment

Option 2 - Mobile FRAC tanks with external secondary containment

Option 3 - Roll-Offs with HDPE liners

Only Option 3, Roll-Offs with HDPE liners, provides a suitable storage arrangement. Because of the HDPE liner, Option 3 is suitable for storage of corrosive C Pond sludge in addition to A/B Pond sludge. However, a cost analysis indicated that Option 1 is the most expensive of the short-listed options. The table below, summarizes the results of technical, cost, and schedule evaluations of the short listed options.

TABLE 5-4

Summary of Technical, Cost, and Schedule Evaluation of Short Listed Storage Options

OPTION	SUITABILITY FOR A/B POND	SUITABILITY FOR C POND	COST (EQUIPMENT ONLY)	SCHEDULE (PROJECTED REMOVAL DATE)
1. Roll-offs/External Secondary Containment	Yes	No	$2.3 M	Before 12/95
2. Mobile FRAC Tanks/External Secondary Containment	Yes	No	$1.2 M	Before 12/95
3. Roll-offs/HDPE Liner	Yes	Yes	$2.7 M	Before 12/95

As a result of the technical and cost/schedule analysis, it was determined that a combination of Option 2 and Option 3 would provide technically suitable interim storage at the lowest cost, and at the lowest expenditure of storage space. In addition, the Option 2/3 combination is anticipated to be capable of completing sludge removal ahead of the December 1995 target date.

Figure 2-1 provides a layout of this combination of containers on 750 Pad. The combination of Mobile FRAC Tanks for A/B Pond and Clarifier sludge and HDPE-lined Roll-Offs for C Pond sludge will fit into the heated storage space afforded by existing Tents 3, 4, and 6.

5.4 STORAGE RECOMMENDATION

The result of the storage option analysis activity is a recommendation for interim storage of Solar Evaporation Pond sludge on the 750 Pad. The recommended approach has the following characteristics:

1. C Pond sludge will be stored in HDPE lined Roll-Off containers located in heated Tents 3, 4, and 6. The combination of liner and container satisfies secondary containment requirements.
2. A/B Pond sludge will be stored in Mobile FRAC Tanks with external secondary containment, located in heated Tent 6. Secondary containment will be external to the tanks.
3. Estimated cost: $3.2 million. This estimate includes equipment, installation, other direct costs, and indirect costs.
4. Projected sludge removal date: Prior to December 1995.
5. Leak detection capability will be provided.
6. Tent and container ventilation will be provided.

7. Personnel access capability will be provided for inspections, filling, and removal.

8. Spare containers will be provided to allow container pumpdown for maintenance.

9. A variance to DOE 6430.1A seismic qualification requirements may be required.

6.0 REFERENCES

1 Weston, Pond Sludge Sampling Report, Issued, July, 1991.

2 HNUS Pittsburgh, Pond Sludge and Clarifier Sludge Waste Characterization Report, Deliverables 224A and 224E Combined, Final Report, March, 1992.

3 Process Design Criteria Pond C and Clarifier Sludge, Issue B, May 6, 1992.

4 Brown & Root Interoffice memorandum, W.C. Henderson to J.R. Zak, Viscosity Basis for Pond C to 750 Pad Slurry Transport Pipeline and Pump Sizing, May 14, 1992.

5 HNUS Pittsburgh Internal Correspondence, S. Matthew to D. Brenneman, Treatability Studies Status Report, January 26, 1992.

6 HNUS Pittsburgh, Memo of Pond Sludge Characterization Data, November 14, 1991.

7 HNUS interoffice memorandum, Mark Speranza to Arnie Allen, Settling of Unchlorinated Solar Pond Sludge, October 22, 1992.

8 Brown & Root Interoffice Memorandum, W.C. Henderson to J.R. Zak, Material Balances for Pond A/B, Issue 6, Revision 5, Dated April 27, 1992:

9 Brown & Root Interoffice Memorandum, W.C. Henderson to J.R. Zak, Material Balances for Pond C/Clarifier, Issue 2, Revision 3, Dated April 28, 1992.

10 Brown & Root Interoffice Memorandum, Draft Copy, R. G. Posgay to J. H. Templeton, Container Materials of Construction, Dated July 16, 1993.

11 USEPA Feasibility Studies Guidance Document, Dated September 1985.

12 USDOE Order Number 6430.1A, General Design Criteria, April 6, 1989.

APPENDIX A
Pond Water and Sludge Characterization Data

[redacted]BLE[redacted]

SUMMARY OF POND WATER CHARACTERIZATION DATA - POND 207A
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)	ug/l	0/3	ND	ND	ND	ND
SEMIVOLATILES(2)	ug/l	0/3	ND	ND	ND	ND
ALCOHOLS(2)	mg/l	0/3	ND	ND	ND	ND
INORGANICS						
Arsenic	ug/l	3/3	188-224	205	18	8.8
Barium	ug/l	3/3	135-141	139	5.2	2.3
Boron	ug/l	3/3	1400-1460	1430	30	2.1
Cadmium	ug/l	1/3	5	3	1.4	45
Calcium	ug/l	0/3	ND	ND	ND	ND
Chromium	ug/l	3/3	38-49	44	5.6	13
Lead	ug/l	0/3	ND	ND	ND	ND
Magnesium	ug/l	3/3	120,000-124,000	123,000	2300	1.9
Mercury	ug/l	0/3	ND	ND	ND	ND
Nickel	ug/l	0/3	ND	ND	ND	ND
Potassium	ug/l	3/3	388,000-397,000	394,000	4900	1.2
Selenium	ug/l	0/3	ND	ND	ND	ND
Silver	ug/l	0/3	ND	ND	ND	ND
Sodium	ug/l	3/3	1,840,000-1,870,000	1,850,000	17,320	0.9
TCLP LEACH						
Arsenic	ug/l	3/3	233-246	238	6.8	2.8
Barium	ug/l	0/3	ND	ND	ND	ND
Cadmium	ug/l	R	R	R	R	R
Chromium	ug/l	0/3	ND	ND	ND	ND
Lead	ug/l	0/3	ND	ND	ND	ND
Mercury	ug/l	0/3	ND	ND	ND	ND
Nickel	ug/l	0/3	ND	ND	ND	ND
Selenium	ug/l	0/3	ND	ND	ND	ND
Silver	ug/l	1/3	6	4	1.7	43
pH	units	3/3	9.6-9.7	9.6		--

TABLE 3-2
SUMMARY OF POND WATER CHARACTERIZATION DATA - POND 207A
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
MISCELLANEOUS						
Alkalinity (Methyl Orange)	mg/l	3/3	250	250	0.0	0.0
Alkalinity (Phenolphthalein)	mg/l	3/3	84-89	87	2.5	2.9
Ammonia	mg/l	3/3	0.3	0.3	0.0	0.0
Chloride	mg/l	3/3	380-430	400	25	6.2
Cyanide-Amenable	mg/l	0/3	(-0.79)-(-0.47)	-0.63	--	--
Cyanide-Total	mg/l	3/3	0.39-0.47	0.43	0.04	9.3
Gross Alpha	pCi/l	3/3	510-790	690	91.6	15
Gross Beta	pCi/l	3/3	1000	1000	0.0	0.0
Nitrate	mg/l	3/3	970-1000	980	17.3	1.8
pH	units	3/3	9.7	9.7	0.0	0.0
Phosphorus, Total (as P)	mg/l	3/3	0.06-0.07	0.06	0.006	9.1
Specific Gravity		3/3	1.010-1.012	1.011	0.001	0.1
Sulfate (as SO_4)	mg/l	3/3	460-510	480	26.4	0.8
TDS (Total Dissolved Solids)	mg/l	3/3	7600-7900	7800	153	2.0
TOC (Total Organic Carbon)	mg/l	3/3	68-70	69	1.0	1.4
TSS (Total Suspended Solids)	mg/l	3/3	14-23	19	4.6	24

ND Not Detected
R Rejected

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the <u>Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)</u>. Interim Final, December 1989.

(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.

TABLE 3-3

SUMMARY OF POND SLUDGE CHARACTERIZATION DATA - POND 207A
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS
...ES(1)			
1...-Trichloroethane	ug/kg	1/1	26
1...-Trichloro-1,2,2-trifluoroethane	ug/kg	1/1	260
...trachloroethene (PCE)	ug/kg	1/1	290
...ichloroethene (TCE)	ug/kg	1/1	29
V...ATILES(1)	ug/kg	0/1	
...HOLS(1)	mg/kg	0/1	
...LANEOUS			
...nia	mg/kg	1/1	36
...terberg - Liquid Limit	--	1/1	83
...terberg - Plastic Index	--	1/1	49
...rberg - Plastic Limit	--	1/1	34
... Density (Dried Solids)	g/cc	NA	NA
...anide-Amenable	mg/kg	NA	NA
...anide-Total	mg/kg	1/1	1.6
...s Alpha	pCi/g	1/1	570
...s Beta	pCi/g	1/1	95
...ture-Gravimetric	%	1/1	87.3
...isture-Karl Fisher	%	1/1	34
...H	units	1/1	8.9
...ific Gravity	--	1/1	1.1
...l Test	%	1/1	40
...OC (Total Organic Carbon)	mg/kg	1/1	14,000
...hloride(2)	mg/l	1/1	20
...rate(2)	mg/l	1/1	35
...covery of Solids(2)	%	1/1	11.6
...phorus, Total (as P)(2)	mg/l	1/1	0.1
...ulfate(2)	mg/l	1/1	20
...DS (Total Dissolved Solids)(2)	mg/l	1/1	480
...ANICS			
...senic	mg/kg	1/1	40.2
...arium	mg/kg	1/1	210
...on	mg/kg	1/1	84.3
...mium	mg/kg	1/1	1300
...omium	mg/kg	1/1	658
...ead	mg/kg	1/1	89
...agnesium	mg/kg	1/1	11,400
...rcury	mg/kg	0/1	ND
...kel	mg/kg	1/1	102
Potassium	mg/kg	0/1	ND
Selenium	mg/kg	0/1	ND
S...ver	mg/kg	0/1	ND
S...ium	mg/kg	1/1	14,500
...LP LEACH			
Arsenic	ug/l	1/1	185
...rium	ug/l	1/1	1710
...mium	ug/l	1/1	485
Chromium	ug/l	0/1	ND
Lead	ug/l	0/1	ND
...rcury	ug/l	0/1	ND
...ckel	ug/l	0/1	ND
...lenium	ug/l	0/1	ND
Silver	ug/l	0/1	ND
pH	units	1/1	6.1

Not Analyzed
/ Picocuries per Gram
Not Detected
Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.
Following ASTM Leach

SUMMARY OF POND WATER CHARACTERIZATION [illegible]
[redacted] P[redacted]ON[redacted]TS [redacted]ECT[redacted]
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION (1)	STANDARD DEVIATION (1)	% RELATIVE STANDARD DEVIATION (1)
VOLATILES (2)	ug/l	0/4	ND	ND	ND	ND
SEMIVOLATILES (2)	ug/l	0/4	ND	ND	ND	ND
ALCOHOLS (2)	mg/l	0/4	ND	ND	ND	ND
INORGANICS						
Arsenic	ug/l	3/4	60-63	51	21	41
Barium	ug/l	4/4	117-120	118	1	1
Boron	ug/l	4/4	149-171	157	10	6
Cadmium	ug/l	0/4	ND	ND	ND	ND
Calcium	ug/l	4/4	137,000-140,000	138,000	1400	1
Chromium	ug/l	2/4	10-16	9	5	58
Lead	ug/l	0/4	ND	ND	ND	ND
Magnesium	ug/l	4/4	64,800-65,900	65,200	480	0.7
Mercury	ug/l	0/4	ND	ND	ND	ND
Nickel	ug/l	0/4	ND	ND	ND	ND
Potassium	ug/l	4/4	55,700-56,400	55,900	340	0.6
Selenium	ug/l	1/4	76	42	23	55
Silver	ug/l	0/4	ND	ND	ND	ND
Sodium	ug/l	4/4	254,000-345,000	296,000	41,000	14
TCLP LEACH						
Arsenic	ug/l	R	R	R	R	R
Barium	ug/l	4/4	215-230	221	7	3
Cadmium	ug/l	0/4	ND	ND	ND	ND
Chromium	ug/l	1/4	16	8	6	71
Lead	ug/l	0/4	ND	ND	ND	ND
Mercury	ug/l	0/4	ND	ND	ND	ND
Nickel	ug/l	0/4	ND	ND	ND	ND
Selenium	ug/l	0/4	ND	ND	ND	ND
Silver	ug/l	0/4	ND	ND	ND	ND
pH	units	4/4	8.3-8.5	8.4	--	--

SUMMARY OF POND WATER CHARACTERIZATION DATA
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
MISCELLANEOUS						
Alkalinity (Methyl Orange)	mg/l	4/4	110	110	0.0	0.0
Alkalinity (Phenolphthalein)	mg/l	3/4	2-3	2	1	55
Ammonia	mg/l	4/4	0.3-0.5	0.4	0.1	28
Chloride	mg/l	4/4	96-100	98	1.7	2
Cyanide-Amenable	mg/l	4/4	(-0.017)-(-0.014)	-0.006	--	--
Cyanide-Total	mg/l	4/4	0.016-0.043	0.030	0.01	56
Gross Alpha	pCi/l	4/4	40-52	47	6.4	14
Gross Beta	pCi/l	4/4	75-510	290	177	61
Nitrate	mg/l	4/4	310-330	320	8	3
pH	units	4/4	8.3-8.5	8.4	--	--
Phosphorus, Total (as P)	mg/l	4/4	0.02-0.08	0.05	0.02	52
Specific Gravity	--	4/4	1.008	1.008	0.0	0.0
Sulfate (as SO_4)	mg/l	4/4	120-160	130	20	15
TDS (Total Dissolved Solids)	mg/l	4/4	2700-2800	2800	50	1.8
TOC (Total Organic Carbon)	mg/l	4/4	35-37	36	1	2.3
TSS (Total Suspended Solids)	mg/l	1/4	15	7.5	5	65

ND Not Detected
R Rejected
pCi/l Picocuries per Liter

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Interim Final, December 1989.

(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.

SUMMARY OF POND SLUDGE CHARACTERIZATION DATA
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)	ug/kg	0/4	ND	ND	ND	ND
SEMIVOLATILES(2)	ug/kg	0/4	ND	ND	ND	ND
ALCOHOLS(2)	mg/kg	0/4	ND	ND	ND	ND
MISCELLANEOUS						
Ammonia	mg/kg	4/4	9.8-35	22	10.4	47
Atterberg - Liquid Limit	--	4/4	71-75	73	1.7	2
Atterberg - Plastic Index	--	4/4	34-40	37	3.2	8
Atterberg - Plastic Limit	--	4/4	33-37	36	1.9	5
Bulk Density (Dried Solids)	g/cc	4/4	0.84-0.90	0.87	0.025	3
Cyanide-Amenable	mg/kg	NA	NA	NA	NA	NA
Cyanide-Total	mg/kg	0/4	ND	ND	ND	ND
Gross Alpha	pCi/g	4/4	5.2-11	8.9	2.55	29
Gross Beta	pCi/g	4/4	5.1-9.8	7.3	2.38	33
Moisture-Gravimetric	%	4/4	71.8-76.8	75.1	2.25	3
Moisture-Karl Fisher	%	4/4	23.5-27.9	25.6	1.81	7
pH	units	4/4	7.6-7.7	7.7	--	
Specific Gravity	-	4/4	1.2	1.2	0.00	0.0
Swell Test	%	4/4	0-10	7.5	5.00	67
TOC (Total Organic Carbon)	mg/kg	4/4	3000-3400	3200	170	5
Chloride(3)	mg/L	4/4	4-24	12	8.6	71
Nitrate(3)	mg/l	4/4	1.7-9.8	6.8	3.6	53
% Recovery of Solids(3)	%	4/4	16.6-25.8	20.8	4.16	20
Phosphorus, Total (as P)(3)	mg/l	4/4	0.01-0.05	0.03	0.02	61
Sulfate(3)	mg/l	4/4	150-160	155	5.8	40
TDS (Total Dissolved Solids)(3)	mg/l	4/4	180-220	190	25.8	14
INORGANICS						
Arsenic	mg/kg	0/4	ND	ND	ND	ND
Barium	mg/kg	4/4	89.1-116	105	11.7	11
Boron	mg/kg	1/4	12.8	7.3	1.2	16
Cadmium	mg/kg	3/4	6.7-8.5	7.1	0.9	13
Chromium	mg/kg	4/4	7.9-33.3	23.2	11.9	51
Lead	mg/kg	4/4	13.8-21.3	15.8	3.6	23
Magnesium	mg/kg	4/4	3270-4160	3805	380	10
Mercury	mg/kg	2/4	0.7-0.8	0.5	0.3	72
Nickel	mg/kg	2/4	7.1-9.5	6.2	2.6	42
Potassium	mg/kg	0/4	ND	ND	ND	ND
Selenium	mg/kg	0/4	ND	ND	ND	ND
Silver	mg/kg	0/4	ND	ND	ND	ND
Sodium	mg/kg	0/4	ND	ND	ND	ND

[redacted] OF [redacted] SL[redacted]GE CH[redacted]CTERI[redacted]ATION DATA - POND ...
SOLAR POND/PONDCRE[redacted] PROJECT
ROCKY FLATS PLANT, COLORADO
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION (1)	STANDARD DEVIATION (1)	% RELATIVE STANDARD DEVIATION (1)
TCLP LEACH						
Arsenic	ug/l	R	R	R	R	R
Barium	ug/l	4/4	1060-1210	1140	76.1	7
Cadmium	ug/l	4/4	54-104	73	21.6	29
Chromium	ug/l	3/4	10-57	22	24.2	111
Lead	ug/l	0/4	ND	ND	ND	ND
Mercury	ug/l	0/4	ND	ND	ND	ND
Nickel	ug/l	3/4	20-56	28	19.8	69
Selenium	ug/l	0/4	ND	ND	ND	ND
Silver	ug/l	0/4	ND	ND	ND	ND
pH	ug/l	4/4	5.7-5.9	5.8	0.1	2

NA Not Analyzed
ND Not Detected
pCi/g Picocuries per Gram
R Rejected

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Interim Final, December 1989.
(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.
(3) Following ASTM Leach

SUMMARY OF POND WATER CHARACTERIZATION DATA - POND 207B CENTER
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)	ug/l	0/4	ND	ND	ND	ND
SEMIVOLATILES(2)	ug/l	0/4	ND	ND	ND	ND
ALCOHOLS(2)	mg/l	0/4	ND	ND	ND	ND
INORGANICS						
Arsenic	ug/l	4/4	314-330	321	7	2.1
Barium	ug/l	4/4	68-70	69	1	1.4
Boron	ug/l	4/4	3440-3530	3480	40	1.1
Cadmium	ug/l	0/4	ND	ND	ND	ND
Calcium	ug/l	4/4	26,400-27,700	27,000	600	2.3
Chromium	ug/l	4/4	22-32	28	5	16.7
Lead	ug/l	0/4	ND	ND	ND	ND
Magnesium	ug/l	4/4	216,000-220,000	218,000	2000	0.7
Mercury	ug/l	0/4	ND	ND	ND	ND
Nickel	ug/l	4/4	28-31	29	1	4.9
Potassium	ug/l	4/4	791,000-807,000	800,000	8000	1.0
Selenium	ug/l	1/4	81	43	26	59.6
Silver	ug/l	0/4	ND	ND	ND	ND
Sodium	ug/l	4/4	2,060,000-4,060,000	3,150,000	823,000	26.1
TCLP LEACH						
Arsenic	ug/l	4/4	180-251	221	31	14.2
Barium	ug/l	2/4	214-258	162	87	53.8
Cadmium	ug/l	1/4	5	3	1	40.0
Chromium	ug/l	3/4	20-27	20	8	42.2
Lead	ug/l	0/4	ND	ND	ND	ND
Mercury	ug/l	0/4	ND	ND	ND	ND
Nickel	ug/l	3/4	21-30	24	4	17.0
Selenium	ug/l	0/4	ND	ND	ND	ND
Silver	ug/l	0/4	ND	ND	ND	ND
pH	units	4/4	9.1-9.2	9.1	--	--

TABLE 3-6
SUMMARY OF POND WATER CHARACTERIZATION DATA - POND 207B CENTER
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
MISCELLANEOUS						
Alkalinity (Methyl Orange)	mg/l	4/4	1400	1400	0.0	0.0
Alkalinity (Phenolphthalein)	mg/l	4/4	230-240	235	6	2.4
Ammonia	mg/l	4/4	0.2-0.4	0.3	0.1	27.2
Chloride	mg/l	0/4	ND	ND	ND	ND
Cyanide-Amenable	mg/l	4/4	(-0.83) - (-5.3)	-1.97	--	--
Cyanide-Total	mg/l	4/4	0.34-0.57	0.40	0.12	28.9
Gross Alpha	pCi/l	4/4	1800-2300	2100	210	10.1
Gross Beta	pCi/l	4/4	2700-3000	2900	130	4.5
Nitrate	mg/l	4/4	1900-2100	2000	100	5.1
pH	units	4/4	9.1-9.2	9.1	--	
Phosphorus, Total (as P)	mg/l	4/4	4.2	4.2	0.0	0.0
Specific Gravity	--	4/4	1.016-1.018	1.017	0.001	0.10
Sulfate (as SO_4)	mg/l	4/4	740-1000	880	109	12.4
TDS (Total Dissolved Solids)	mg/l	4/4	16,000	16,000	0.0	0.0
TOC (Total Organic Carbon)	mg/l	4/4	93-320	155	110	71.4
TSS (Total Suspended Solids)	mg/l	2/4	11-16	9	5.3	57.5

ND Not Detected
pCi/l Picocuries per liter

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Interim Final, December 1989.

(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.

TABLE 3-7
SUMMARY OF POND SLUDGE CHA[redacted]IO[redacted]A [redacted]ND [redacted] CE[redacted]R
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)						
Tetrachloroethene (PCE)	ug/kg	2/4	37-180	70	73	105
SEMIVOLATILES(2)	ug/kg	0/4	ND	ND	ND	ND
ALCOHOLS(2)	mg/kg	0/4	ND	ND	ND	ND
MISCELLANEOUS						
Ammonia	mg/kg	4/4	25-58	43	14	32
Atterberg - Liquid Limit	--	4/4	77-85	83	4	5
Atterberg - Plastic Index	--	4/4	20-40	29	9	33
Atterberg - Plastic Limit	--	4/4	45-65	52	9	18
Bulk Density (Dried Solids)	g/cc	4/4	0.81-0.88	0.84	0.03	4
Cyanide-Amenable	mg/kg	NA	NA	NA	NA	NA
Cyanide-Total	mg/kg	4/4	0.34-1.3	0.64	0.45	71
Gross Alpha	pCi/g	4/4	13-19	17	3	17
Gross Beta	pCi/g	4/4	12-16	15	2	13
Moisture-Gravimetric	%	4/4	89.9-93.4	91.3	1.5	2
Moisture-Karl Fisher	%	4/4	42-53	48	5	10
pH	units	4/4	9.1-9.2	9.2	---	---
Specific Gravity	--	4/4	1.0	1.0	0.0	0.0
Swell Test	%	4/4	60-70	63	5	08
TOC (Total Organic Carbon)	mg/kg	4/4	5500-8800	7400	1500	20
Chloride(3)	mg/l	3/4	210-300	200	80	40
Nitrate(3)	mg/l	4/4	50-74	66	11	16
% Recovery of Solids(3)	%	4/4	9.3-13.7	10.5	2.2	21
Phosphorus, Total (as P)(3)	mg/l	4/4	1.4-3.9	2.1	1.1	56
Sulfate(3)	mg/l	4/4	33-90	49	28	57
TDS (Total Dissolved Solids)(3)	mg/l	4/4	670-770	740	45	6

TABLE 3-7
SUMMARY OF POND SLUDGE CHARACTERIZATION DATA - POND 207B CENTER
SOLAR POND/PONDCRETE PROJECT - ROCKY FLATS PLANT
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
INORGANICS						
Arsenic	mg/kg	0/4	ND	ND	ND	ND
Barium	mg/kg	4/4	46.5-120	82.3	30	37
Boron	mg/kg	1/4	151	84	46	55
Cadmium	mg/kg	4/4	46.5-84.4	57.9	17.9	31
Chromium	mg/kg	3/4	48.5-130	63.1	52	82
Lead	mg/kg	0/4	ND	ND	ND	ND
Magnesium	mg/kg	4/4	7,190-19,800	12,400	5,300	43
Mercury	mg/kg	1/4	5.5	1.8	2.5	142
Nickel	mg/kg	0/4	ND	ND	ND	ND
Potassium	mg/kg	3/4	10,900-15,400	10,700	4,350	41
Selenium	mg/kg	0/4	ND	ND	ND	ND
Silver	mg/kg	0/4	ND	ND	ND	ND
Sodium	mg/kg	4/4	35,200-54,200	42,000	8,400	20
TCLP LEACH						
Arsenic	ug/l	4/4	122-181	145	26	18
Barium	ug/l	4/4	2660-3690	3220	430	13
Cadmium	ug/l	4/4	114-153	136	17	12
Chromium	ug/l	4/4	11-54	34	22	65
Lead	ug/l	0/4	ND	ND	ND	ND
Mercury	ug/l	0/4	ND	ND	ND	ND
Nickel	ug/l	1/4	28	14.5	9	62
Selenium	ug/l	0/4	ND	ND	ND	ND
Silver	ug/l	0/4	ND	ND	ND	ND
pH	units	4/4	4.9-6.1	5.8	----	----

ND Not Detected
NA Not Analyzed
pCi/g Picocuries per Gram

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A), Interim Final, December 1989.
(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.
(3) Following ASTM Leach

TABLE

SUMMARY OF POND WATER CHARACTERIZATION DATA - POND 207 B SOUTH
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)	ug/l	0/5	ND	ND	ND	ND
SEMIVOLATILES(2)	ug/l	0/5	ND	ND	ND	ND
ALCOHOLS(2)	mg/l	0/5	ND	ND	ND	ND
INORGANICS						
Arsenic	ug/l	5/5	263-276	270	6	[illegible]
Barium	ug/l	5/5	110-118	115	3	3
Boron	ug/l	5/5	2730-2800	2760	30	1
Cadmium	ug/l	0/5	ND	ND	ND	ND
Calcium	ug/l	5/5	52,000-52,700	52,400	270	0.5
Chromium	ug/l	3/5	14-21	13	8	59
Lead	ug/l	0/5	ND	ND	ND	ND
Magnesium	ug/l	5/5	187,000-190,000	188,000	1225	0.6
Mercury	ug/l	0/5	ND	ND	ND	ND
Nickel	ug/l	3/5	20-32	19	9	49
Potassium	ug/l	5/5	684,000-696,000	691,000	5100	0.7
Selenium	ug/l	0/5	ND	ND	ND	ND
Silver	ug/l	0/5	ND	ND	ND	ND
Sodium	ug/l	5/5	2,010,000-2,660,000	2,360,000	281,000	12
TCLP LEACH						
Arsenic	ug/l	5/5	167-390	228	93	41
Barium	ug/l	5/5	269-319	291	19	64
Cadmium	ug/l	0/5	ND	ND	ND	ND
Chromium	ug/l	2/5	10-87	22	36	161
Lead	ug/l	0/5	ND	ND	ND	ND
Mercury	ug/l	0/5	ND	ND	ND	ND
Nickel	ug/l	3/5	21-24	17	7	39
Selenium	ug/l	0/5	ND	ND	ND	ND
Silver	ug/l	0/5	ND	ND	ND	ND
pH	units	5/5	9.0	9.0	0.0	0.0

Deliverable (Combined) 224A and 224E

[illegible]

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
MISCELLANEOUS						
Alkalinity (Methyl Orange)	mg/l	5/5	900-910	905	5.5	0.6
Alkalinity (Phenolphthalein)	mg/l	5/5	140-160	150	7.1	5
Ammonia	mg/l	5/5	0.5-0.6	0.6	0.05	10
Chloride	mg/l	0/5	ND	ND	ND	ND
Cyanide-Amenable	mg/l	0/5	(-0.86) – (-2.6)	----	----	----
Cyanide-Total	mg/l	5/5	0.28-0.31	0.29	0.01	4
Gross Alpha	pCi/l	5/5	1500-2100	1900	250	13
Gross Beta	pCi/l	5/5	2500-2900	2700	164	6
Nitrate	mg/l	5/5	1600-1800	1700	84	5
pH	units	5/5	9.1	9.1	0.0	0.0
Phosphorus, Total (as P)	mg/l	5/5	2.6-2.8	2.8	0.09	3
Specific Gravity		4/4	1.016-1.020	1.019	0.002	0.2
Sulfate (as SO_4)	mg/l	5/5	540-600	560	26	5
TDS (Total Dissolved Solids)	mg/l	5/5	14,000-15,000	15,000	550	4
TOC (Total Organic Carbon)	mg/l	5/5	58-110	92	22	24
TSS (Total Suspended Solids)	mg/l	5/5	11-39	22	11	49

(1) Average calculated using 1/2 detection limit for nondetects, based on guidance contained in the Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation manual (Part A), Interim Final, December 1989.

(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-5. The complete database is included in Appendix A.

TABLE 3-9

SUMMARY OF POND SLUDGE CHARACTERIZATION DATA - POND 207B SOUTH
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)						
Tetrachloroethene (PCE)	ug/kg	5/5	32-460	238	153	64
Trichloroethene (TCE)	ug/kg	3/5	47-57	41	14	34
SEMIVOLATILES(2)	ug/kg	0/5	ND	ND	ND	ND
ALCOHOLS(2)	mg/kg	0/5	ND	ND	ND	ND
MISCELLANEOUS						
Ammonia	mg/kg	4/5	17-34	20	10	53
Atterberg - Liquid Limit	---	4/4	70-101	85	15	18
Atterberg - Plastic Index	--	4/4	28-41	36	6	18
Atterberg - Plastic Limit	--	4/4	41-60	49	9	18
Bulk Density (Dried Solids)	g/cc	NA	NA	NA	NA	NA
Cyanide-Amenable	mg/kg	NA	NA	NA	NA	NA
Cyanide-Total	mg/kg	5/5	0.46-4.1	1.3	1.5	115
Gross Alpha	pCi/g	5/5	31-61	38	13	33
Gross Beta	pCi/g	5/5	21-47	27	11.1	41
Moisture-Gravimetric	%	5/5	88.3-92.3	90.2	1.9	2
Moisture-Karl Fisher	%	4/4	39-50	45	5	11
pH	units	5/5	9.1	9.1	0.0	0.0
Specific Gravity	---	4/4	1.0-1.1	1.1	0.05	5
Swell Test	%	4/4	30-60	45	13	29
TOC (Total Organic Carbon)	mg/kg	5/5	6,800-11,000	8600	1,600	18
Chloride(3)	mg/l	0/5	ND	ND	ND	ND
Nitrate(3)	mg/l	5/5	77-89	84	5	6
% Recovery of Solids(3)	%	5/5	6.4-12.4	8.9	2.2	24
Phosphorus, Total (as P)(3)	mg/l	5/5	0.09-1.7	0.8	0.7	85
Sulfate(3)	mg/l	5/5	23-40	32	6	20
TDS (Total Dissolved Solids)(3)	mg/l	5/5	740-790	760	20	2

TABLE 3-[illegible]
SUMMARY OF POND SLUDGE CHARACTERIZATION DATA - POND 207B SOUTH
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
INORGANICS						
Arsenic	mg/kg	1/5	59.7	27.7	18.2	65
Barium	mg/kg	5/5	62.2-134	107	33.2	31
Boron	mg/kg	2/5	336-349	166	161	96
Cadmium	mg/kg	5/5	7.4-30.4	22.7	9.3	41
Chromium	mg/kg	5/5	25.2-51.9	38.1	12.0	31
Lead	mg/kg	1/5	61	24	21	86
Magnesium	mg/kg	5/5	5140-15,200	10,500	4,100	39
Mercury	mg/kg	1/5	5	1.4	2.0	72
Nickel	mg/kg	0/5	ND	ND	ND	ND
Potassium	mg/kg	1/5	8910	5720	2,300	40
Selenium	mg/kg	0/5	ND	ND	ND	ND
Silver	mg/kg	0/5	ND	ND	ND	ND
Sodium	mg/kg	4/5	30,000-44,600	30,000	17,000	56
TCLP LEACH						
Arsenic	ug/l	5/5	194-233	211	21	10
Barium	ug/l	5/5	1660-2770	1960	460	23
Cadmium	ug/l	5/5	19-32	24	6	24
Chromium	ug/l	5/5	23-56	41	12	29
Lead	ug/l	0/5	ND	ND	ND	ND
Mercury	ug/l	0/5	ND	ND	ND	ND
Nickel	ug/l	0/5	ND	ND	ND	ND
Selenium	ug/l	0/5	ND	ND	ND	ND
Silver	ug/l	0/5	ND	ND	ND	ND
pH	units	5/5	5.4-5.9	5.7	----	----

ND Not Detected
NA Not Analyzed
pCi/g Picocuries per Gram

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final, December 1989.
(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete data base is included in Appendix A.
(3) Following ASTM Leach

SUMMARY OF POND WATER CHARACTERIZATION DATA - POND 207C
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)						
2-Butanone	ug/l	4/5	77-110	76	43	56
Methylene Chloride	ug/l	1/5	8	5.6	1.3	24
SEMIVOLATILES(2)	ug/l	0/5	ND	ND	ND	ND
ALCOHOLS(2)	mg/l	0/5	ND	ND	ND	ND
INORGANICS						
Arsenic	ug/l	5/5	3350-4110	3690	374	10.1
Barium	ug/l	5/5	110-150	130	14	10.9
Boron	ug/l	5/5	437,000-494,000	463,000	26,000	5.6
Cadmium	ug/l	5/5	430-560	490	50	10.3
Calcium	ug/l	0/5	ND	ND	ND	ND
Chromium	ug/l	5/5	3320-3940	3520	250	7.2
Lead	ug/l	2/5	300	210	80	39.1
Magnesium	ug/l	5/5	1300-3870	2790	930	33.3
Mercury	ug/l	0/5	ND	ND	ND	ND
Nickel	ug/l	5/5	2540-2920	2680	170	6.5
Potassium	%	5/5	5.45-5.92	5.58	0.19	3.5
Selenium	ug/l	2/5	600-3000	1980	1400	70.7
Silver	ug/l	0/5	ND	ND	ND	ND
Sodium	%	5/5	13.6-14.2	13.8	0.25	1.8
TCLP LEACH						
Arsenic	ug/l	5/5	4660-5510	4960	330	6.5
Barium	ug/l	0/5	ND	ND	ND	ND
Cadmium	ug/l	5/5	350-560	430	80	18.6
Chromium	ug/l	5/5	2240-9160	3780	3000	19.8
Lead	ug/l	0/5	ND	ND	ND	ND
Mercury	ug/l	0/5	ND	ND	ND	ND
Nickel	ug/l	5/5	2330-4930	2980	1100	37.0
Selenium	ug/l	0/5	ND	ND	ND	ND
Silver	ug/l	5/5	150-430	250	110	44.3
pH	units	5/5	10.2	10.2	0.0	0.0

TABLE 3-10
SUMMARY OF POND WATER CHARACTERIZATION DATA - POND 207C
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
MISCELLANEOUS						
Alkalinity (Methyl Orange)	mg/l	5/5	58,000-63,000	60,000	1900	3.2
Alkalinity (Phenolphthalein)	mg/l	5/5	25,000-32,000	29,000	2500	8.6
Ammonia	mg/l	5/5	1.8-6.4	3.7	2	53.2
Chloride	mg/l	5/5	21,000-25,000	23,000	1600	6.9
Cyanide-Amenable	mg/l	0/5	(-120)-(-0.77)	.34	---	---
Cyanide-Total	mg/l	5/5	3.3-20	7.7	7	91.3
Gross Alpha	pCi/l	5/5	63-130	99	27	27.3
Gross Beta	pCi/l	5/5	170-230	190	23	11.9
Nitrate	mg/l	5/5	57,000-66,000	62,000	3500	5.6
pH	units	5/5	10.0-10.1	10	---	---
Phosphorus, Total (as P)	mg/l	5/5	520-610	570	32	5.7
Specific Gravity	--	5/5	1.316-1.348	1.332	0.02	0.01
Sulfate (as SO_4)	mg/l	5/5	16,000-18,000	17,000	700	4.1
TDS (Total Dissolved Solids)	mg/l	5/5	300,000-510,000	460,000	88,500	19.4
TOC (Total Organic Carbon)	mg/l	5/5	1200-1600	1400	150	11.1
TSS (Total Suspended Solids)	mg/l	5/5	220-1400	530	490	91.5

ND Not Detected
pCi/l Picocuries per Liter

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the <u>Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)</u>. Interim Final, December 1989.

(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.

SUMMARY OF POND SLUDGE CHARACTERIZATION
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)						
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/kg	1/5	33	10.2	12.7	125
2-Butanone	ug/kg	5/5	16-160	110	63.3	57
Benzene	ug/kg	2/5	7-31	10.5	11.5	109
Tetrachloroethene (PCE)	ug/kg	5/5	8-73	22.2	28.4	128
Trichloroethene (TCE)	ug/kg	2/5	5-7	3.9	0.96	25
SEMI-VOLATILES(2)						
Pyrene	ug/kg	2/5	190-320	286	56.5	20
ALCOHOLS(2)	mg/kg	0/5	ND	ND	ND	ND
MISCELLANEOUS						
Ammonia	mg/kg	0/5	ND	ND	ND	ND
Atterberg - Liquid Limit	--	4/4	NP	NP	NP	NP
Atterberg - Plastic Index	--	4/4	NP	NP	NP	NP
Atterberg - Plastic Limit	--	4/4	NP	NP	NP	NP
Bulk Density (Dried Solids)	g/cc	NA	NA	NA	NA	NA
Cyanide-Amenable	mg/kg	NA	NA	NA	NA	NA
Cyanide-Total	mg/kg	5/5	13-170	72	80.5	111
Gross Alpha	pCi/g	5/5	2700-8700	5000	2,400	49
Gross Beta	pCi/g	5/5	420-1200	710	314	44
Moisture-Gravimetric	%	5/5	34.8-48.8	44.0	5.9	13
Moisture-Karl Fisher	%	NA	NA	NA	NA	NA
pH	units	5/5	10.2-10.5	10.4	--	--
Specific Gravity	-	NA	NA	NA	NA	NA
Swell Test	%	4/4	0-10	3	5	200
TOC (Total Organic Carbon)	mg/kg	5/5	6400-9000	7700	1100	14
Chloride(3)	mg/l	5/5	660-990	770	126	16
Nitrate(3)	mg/l	5/5	8900-11,000	10,000	750	7
% Recovery of Solids(3)	%	5/5	9.2-11.8	11.6	4.0	35
Phosphorus, Total (as P)(3)	mg/l	5/5	22-38	31	7.5	24
Sulfate(3)	mg/l	5/5	810-1300	970	190	20
TDS (Total Dissolved Solids)(3)	mg/l	5/5	18,000-24,000	21,000	2,600	12

SUMMARY OF POND SLUDGE CHARACTERIZATION [illegible]
SOLAR POND/[illegible]CRE[illegible] PRO[illegible]
ROCKY FLATS PLANT, COLORADO
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
INORGANICS						
Arsenic	mg/kg	5/5	18-37	28	7.9	28
Barium	mg/kg	5/5	13.2-61.5	31	18.3	59
Boron	mg/kg	5/5	455-781	612(3)	128.3	21
Cadmium	mg/kg	5/5	27.3-665	164(4)	280.5	171
Chromium	mg/kg	5/5	252-960	618	256.9	42
Lead	mg/kg	5/5	7.9-38.5	19.4	11.6	60
Magnesium	mg/kg	5/5	1340-6250	3370	1836.0	54
Mercury	mg/kg	5/5	0.7-1.0	0.9	0.1	16
Nickel	mg/kg	5/5	17.4-146	52.3(5)	52.8	101
Potassium	mg/kg	5/5	64,500-87,200	78,100	8640	11
Selenium	mg/kg	0/5	ND	ND	ND	ND
Silver	mg/kg	5/5	35.1-73.6	54.1	14.0	26
Sodium	mg/kg	5/5	139,000-193,000	157,600	21,570	14
TCLP LEACH						
Arsenic	ug/l	5/5	447-538	506	37.5	7
Barium	ug/l	3/5	481-559	377	186.0	49
Cadmium	ug/l	5/5	342-5230	1490(6)	2100	142
Chromium	ug/l	5/5	1840-3940	2770	841	30
Lead	ug/l	2/5	33-52	26	16.5	63
Mercury	ug/l	1/5	0.4	0.2	0.13	84
Nickel	ug/l	5/5	565-2140	986(7)	654	66
Selenium	ug/l	0/5	ND	ND	ND	ND
Silver	ug/l	5/5	9-23	18	5.9	33
pH	units	5/5	4.8-5.3	5.1	--	--

ND Not Detected
NA Not Analyzed
pCi/g Picocuries per Gram
NP Not possible to analyze due to nature of solids

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the Risk Assessment Guidance for Superfund Volume 1, Human Health Evaluation Manual (Part A). Interim Final, December 1989.

(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.

(3) Following ASTM Leach

(4) When the Pond Sludge Berm Composite (Sample PS207C-CB) value of 665 is excluded, the average falls to 38.8 mg/kg.

(5) When the Pond Sludge Berm Composite (Sample PS207C-CB) value of 146 is excluded, the average falls to 28.9 mg/kg.

(6) When the Pond Sludge Berm Composite (Sample PS207C-CB) value of 5230 is excluded, the average falls to 552 mg/kg.

(7) When the Pond Sludge Berm Composite (Sample PS207C-CB) value of 2140 is excluded, the average falls to 698 mg/kg.

TABLE 3-12

SUMMARY OF POND WATER CHARACTERIZATION DATA - CLARIFIER
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
VOLATILES(2)	ug/l	0/4	ND	ND	ND	ND
SEMI-VOLATILES(2)	ug/l	0/4	ND	ND	ND	ND
ALCOHOLS(2)	mg/l	0/4	ND	ND	ND	ND
INORGANICS						
Arsenic	ug/l	4/4	272-342	313	32	10
Barium	ug/l	4/4	30-91	49	29	58
Boron	ug/l	4/4	23,300-34,700	28,000	5,400	19
Cadmium	ug/l	4/4	38-570	221	250	113
Calcium	ug/l	0/4	ND	ND	ND	ND
Chromium	ug/l	4/4	138-825	355	319	90
Lead	ug/l	2/4	34-46	28	15	55
Magnesium	ug/l	4/4	2580-6710	3900	1910	50
Mercury	ug/l	4/4	2.2-4.6	3.5	1.0	28
Nickel	ug/l	4/4	258-393	320	58	18
Potassium	mg/l	4/4	4860-7000	5720	1020	18
Selenium	ug/l	0/4	ND	ND	ND	ND
Silver	ug/l	4/4	66-110	85	20	24
Sodium	mg/l	4/4	9940-14,800	11,940	2310	19
TCLP LEACH						
Arsenic	ug/l	4/4	1400-1800	1540	180	12
Barium	ug/l	0/4	ND	ND	ND	ND
Cadmium	ug/l	1/1(3)	50	50	0	0
Chromium	ug/l	2/4	110-140	58	45	51
Lead	ug/l	0/4	ND	ND	ND	ND
Mercury	ug/l	0/4	ND	ND	ND	ND
Nickel	ug/l	3/4	240-350	250	110	44
Selenium	ug/l	0/4	ND	ND	ND	ND
Silver	ug/l	0/4	ND	ND	ND	ND
pH	units	4/4	10.1	10.1	0	0

TABL[illegible]-12
SUMMARY OF POND WATER CHARACTERIZATION DATA - CLARI[illegible]
SOLAR POND/PONDCRETE PROJECT
ROCKY FLAT PLANT, COLORADO
PAGE 2 OF 2

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
MISCELLANEOUS						
Alkalinity (Methyl Orange)	mg/l	4/4	5500-8200	6800	1130	17
Alkalinity (Phenolphthalein)	mg/l	4/4	2300-3100	2800	340	12
Ammonia	mg/l	4/4	5-14	9	4	40
Chloride	mg/l	4/4	1600-3200	2090	750	36
Cyanide-Amenable	mg/l	0/4	(-14)-(-3.3)	---	---	---
Cyanide-Total	mg/l	4/4	2.4-3	2.7	0.3	9
Gross Alpha	pCi/l	4/4	16-19	17	2	9
Gross Beta	pCi/l	4/4	22-30	25	4	14
Nitrate	mg/l	4/4	5700-10,000	7300	1900	26
pH	units	4/4	9.9-10	10	---	---
Phosphorus, Total (as P)	mg/l	4/4	78-84	81	3	3
Specific Gravity	---	3/3	1.038-1.044	1.041	0.003	0.3
Sulfate (as SO_4)	mg/l	4/4	2600-3200	2800	280	10
TDS (Total Dissolved Solids)	mg/l	4/4	46,000-68,000	59,000	2200	16
TOC (Total Organic Carbon)	mg/l	4/4	140-190	165	21	13
TSS (Total Suspended Solids)	mg/l	4/4	68-180	140	51	36

ND Not Detected
NA Not Analyzed
pCi/l Picocuries per Liter

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the <u>Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)</u>. Interim Final, December 1989.

(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.

(3) Three out of four values were rejected during data validation.

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
INORGANICS						
Arsenic	mg/kg	2/4	13.5-21.9	12	7.2	59
Barium	mg/kg	4/4	94.8-217	183	59.2	32
Boron	mg/kg	4/4	420-1380	930	450	48
Cadmium	mg/kg	4/4	2010-4660	3660	1170	32
Chromium	mg/kg	4/4	1180-3190	2480	894	36
Lead	mg/kg	4/4	83-191	161	52	32
Magnesium	mg/kg	4/4	10,400-24,200	20,500	6250	33
Mercury	mg/kg	4/4	5-14	9	5	51
Nickel	mg/kg	4/4	339-902	700	250	36
Potassium	mg/kg	4/4	28,700-67,900	56,500	18,700	33
Selenium	mg/kg	0/4	ND	ND	ND	ND
Silver	mg/kg	4/4	64.6-166	134.9	47.2	35
Sodium	mg/kg	4/4	39,200-96,300	78,900	27,040	34
TCLP LEACH						
Arsenic	ug/l	4/4	224-282	245	26	10
Barium	ug/l	1/4	530	260	180	70
Cadmium	ug/l	4/4	14,800-25,900	20,650	5390	26
Chromium	ug/l	4/4	214-485	362	119	33
Lead	ug/l	1/4	34	20	10	48
Mercury	ug/l	2/4	0.9-4.9	1.5	2.3	153
Nickel	ug/l	4/4	6990-8300	7400	620	8
Selenium	ug/l	0/4	ND	ND	ND	ND
Silver	ug/l	3/4	10-11	8.5	3.7	43
pH	units	4/4	4.6-4.9	4.75	---	---

ND Not Detected
NA Not Analyzed
pCi/g Picocuries per Gram

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the <u>Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)</u>. Interim Final, December 1989.
(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.
(3) Following ASTM Leach
(4) Samples included: CS-001, CS-001D, CS-002, CS-003.
(5) When the apparent low value of 33.1% from CS-001D is omitted, the average % moisture is 69.8%.

Deliverable (Combined) 22AA and 22AE
POND SLUDGE AND CLARIFIER SLUDGE

APPENDIX B
Summary of Positive Detections of Selected Constituents for Pond Water

TABLE [illegible]8.

SUMMARY OF POSITIVE DETECTIONS OF SELECTED CONSTITUENTS FOR POND WATER

ANALYSIS	UNITS	207A	207B-NORTH	207B-CENTER	207B-SOUTH	CLARIFIER	207C	STANDARDS LDR	STANDARDS TCLP
MEK	ug/l	ND	ND	ND	ND	ND	77-110 (1)	50 (3)	
Cyanide-Total	ug/l	390-470	16-43	340-570	280-310	2400-3000	3300-20000	1200 (2)	
Chromium	ug/l	38-49 (2) ND (3)	10-16 (2) 18 (3)	22-32 (2) 20-27 (3)	14-21 (2) 10-87 (3)	138-825 (2) 110-140 (3)	3320-3940 (2) 2240-9160 (3)	320 (2)	5000
Lead	ug/l	ND	ND	ND	ND	34-46	300	40 (2)	
Nickel	ug/l	ND	ND	28-31	20-32	258-393	2540-2920	440 (2)	
Arsenic	ug/l	233-246	R	180-251	167-390	1400-1800	4660-5510		5000

(1) The LDR standard for MEK (50 ug/l) is based on the CCWE concentration. Only the CCW concentration for pond waters was determined. However, for waters with less than 0.5% solids, the TCLP method includes analysis of the water following filtration, and does not include the Zero Headspace Extraction procedure. Therefore, the CCWE concentration would be equal to the CCW concentration if all the MEK was soluble.

(2) Concentration in waste (CCW)

(3) Concentration in waste extract (CCWE)

Note: Values in shaded areas exceed the LDR and/or TCLP standard.

Reference: HNUS, Pittsburgh, Pa., Pond Sludge Waste Characterization and Clarifier Sludge Waste Characterization Report, Deliverables 224A and 224E Combined, Draft Issued January, 1992, Final Report, March, 1992.

TABLE 2.1.8.2

SUMMARY OF POSITIVE DETECTIONS OF SELECTED CONSTITUENTS FOR POND SLUDGE

ANALYSIS	UNITS	207A	207B-NORTH	207B-CENTER	207B-SOUTH	CLARIFIER	207C	STANDARDS	
								LDR (2)	TCLP
PCE (1)	ug/l	290	ND	37-180	32-460	280-1000	8-73	50	
Cadmium	ug/l	485	54-104	114-153	19-32	14800-25900	342-5230	66	1000
Nickel	ug/l	ND	20-56	28	ND	6990-8300	563-2140	320	

(1) Note that the values reported for Tetrachloroethylene (PCE) represent the concentration in the waste (CCW) and the LDR Standard reported (50 ug/l) represents the concentration in the waste extract (CCWE). This indicates a potential for PCE to exceed the CCWE standard following the TCLP Zero Headspace Extraction.

(2) Concentration in waste extract (CCWE)

Note: Values in shaded areas exceed the LDR and/or TCLP standard.

Reference: HNUS, Pittsburgh, Pa., Pond Sludge Waste Characterizatin and Clarifier Sludge Waste Characterization Report, Deliverables 224A and 224E Combined, Draft Issued January, 1992, Final Report, March, 1992.

APPENDIX C
LDR Treatment Standards
Pond Water and Sludge

LDR TREATMENT STANDARDS - POND WATERS

REGULATED HAZARDOUS CONSTITUENT	UNITS	LDR TREATMENT STANDARD (WASTEWATERS) (1)				
		F001-F003,F005	F006	F007	F009	D006
Acetone	mg/l	0.05 (2)	NA	NA	NA	NA
n-Butyl Alcohol	mg/l	5.0 (2)	NA	NA	NA	NA
Carbon Disulfide	mg/l	1.05 (2)	NA	NA	NA	NA
Carbon Tetrachloride	mg/l	0.05 (2)	NA	NA	NA	NA
Chlorobenzene	mg/l	0.15 (2)	NA	NA	NA	NA
Cyclohexanone	mg/l	0.125 (2)	NA	NA	NA	NA
1,2-Dichlorobenzene	mg/l	0.65 (2)	NA	NA	NA	NA
Ethyl Acetate	mg/l	0.05 (2)	NA	NA	NA	NA
Ethylbenzene	mg/l	0.05 (2)	NA	NA	NA	NA
Ethyl Ether	mg/l	0.05 (2)	NA	NA	NA	NA
Isobutanol	mg/l	5.0 (2)	NA	NA	NA	NA
Methanol	mg/l	0.25 (2)	NA	NA	NA	NA
Methylene Chloride	mg/l	0.20 (2)	NA	NA	NA	NA
2-Butanone (MEK)	mg/l	0.05 (2)	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	mg/l	0.05 (2)	NA	NA	NA	NA
Pyridine	mg/l	1.12 (2)	NA	NA	NA	NA
Tetrachloroethene (PCE)	mg/l	0.079 (2)	NA	NA	NA	NA
Toluene	mg/l	1.12 (2)	NA	NA	NA	NA
1,1,1-Trichloroethane	mg/l	1.05 (2)	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	1.05 (2)	NA	NA	NA	NA
Trichloroethene (TCE)	mg/l	0.062 (2)	NA	NA	NA	NA
Trichlorofluoromethane	mg/l	0.05 (2)	NA	NA	NA	NA
Xylene	mg/l	0.05 (2)	NA	NA	NA	NA
1,1,2-Trichloroethane	mg/l	0.03 (2)	NA	NA	NA	NA
Benzene	mg/l	0.07 (2)	NA	NA	NA	NA
2-Nitropropane	---	(WETOX or CHOXD) (4) followed by CARBN; or INCIN	NA	NA	NA	NA
2-Ethoxyethanol	---	BIODG or INCIN (4)	NA	NA	NA	NA
Cyanides (Total)	mg/l	NA	1.2 (3)	1.9 (3)	1.9 (3)	NA
Cyanides (Amenable)	mg/l	NA	0.86 (3)	0.1 (3)	0.1 (3)	NA

TABLE 2.1.9.1

LDR TREATMENT STANDARDS - POND WATERS

REGULATED HAZARDOUS CONSTITUENT	UNITS	LDR TREATMENT STANDARD (WASTEWATERS) (1)				
		F001-F003,F005	F006	F007	F009	D006
Cadmium	mg/l	NA	1.6 (3)	NA	NA	1.0 (3)
Chromium (Total)	mg/l	NA	0.32 (3)	0.32 (3)	0.32 (3)	NA
Lead	mg/l	NA	0.04 (3)	0.04 (3)	0.04 (3)	NA
Nickel	mg/l	NA	0.44 (3)	0.44 (3)	0.44 (3)	NA

(1) Wastewaters are defined by 40 CFR 268.2(f) as wastes that contain less than 1% TOC and 1% TSS by weight. Also, for F001-F005 solvent mixtures, wastewater must contain less than 1% TOC or 1% total F001-F005 solvents, by weight.
(2) Concentration in waste extract (CCWE)
(3) Concentration in waste (CCW)
(4) Specified treatment technology

LDR - Land Disposal Restrictions, 40 CFR Part 268
NA - Not applicable
WETOX - Wet air oxidation
CHOXD - Chemical or electrolytic oxidation
CARBN - Carbon adsorption
INCIN - Incineration
BIODG - Biodegradation

Reference: HNUS, Pittsburgh, Pa., Pond Sludge Waste Characterization and Clarifier Sludge Waste Characterization Report, Deliverables 224A and 224E Combined, Draft Issued January, 1992, Final Report, March, 1992.

TABLE 2.1.9.2

LDR TREATMENT STANDARDS - POND SLUDGE

REGULATED HAZARDOUS CONSTITUENT	UNITS	LDR TREAT STD (NONWASTEWATERS)(1) F001-F003,F005		F006,F007,F009		D006
Acetone	mg/l	0.59	(2)	NA		NA
n-Butyl Alcohol	mg/l	5.0	(2)	NA		NA
Carbon Disulfide	mg/l	4.81	(2)	NA		NA
Carbon Tetrachloride	mg/l	0.96	(2)	NA		NA
Chlorobenzene	mg/l	0.05	(2)	NA		NA
Cyclohexanone	mg/l	0.75	(2)	NA		NA
1,2-Dichlorobenzene	mg/l	0.125	(2)	NA		NA
Ethyl Acetate	mg/l	0.75	(2)	NA		NA
Ethylbenzene	mg/l	0.053	(2)	NA		NA
Ethyl Ether	mg/l	0.75	(2)	NA		NA
Isobutanol	mg/l	5.0	(2)	NA		NA
Methanol	mg/l	0.75	(2)	NA		NA
Methylene Chloride	mg/l	0.96	(2)	NA		NA
2-Butanone (MEK)	mg/l	0.75	(2)	NA		NA
4-Methyl-2-pentanone (MIBK)	mg/l	0.33	(2)	NA		NA
Pyridine	mg/l	0.33	(2)	NA		NA
Tetrachloroethene (PCE)	mg/l	0.05	(2)	NA		NA
Toluene	mg/l	0.33	(2)	NA		NA
1,1,1-Trichloroethane	mg/l	0.41	(2)	NA		NA
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	0.96	(2)	NA		NA
Trichloroethene (TCE)	mg/l	0.91	(2)	NA		NA
Trichlorofluoromethane	mg/l	0.96	(2)	NA		NA
Xylene	mg/l	0.15	(2)	NA		NA
1,1,2-Trichloroethane	mg/kg	7.6	(3)	NA		NA
Benzene	mg/kg	3.7	(3)	NA		NA
2-Nitropropane	—	INCIN	(4)	NA		NA
2-Ethoxyethanol	—	INCIN	(4)	NA		NA
Cyanides (Total)	mg/kg	NA		590	(3)	NA

TABLE 2.1.9.2

LDR TREATMENT STANDARDS - POND SLUDGE

REGULATED HAZARDOUS CONSTITUENT	UNITS	LDR TREAT STD (NONWASTEWATERS) (1) F001-F003,F005	F006,F007,F009	D006
Cyanides (Amenable)	mg/kg	NA	30 (3)	NA
Cadmium	mg/l	NA	0.066 (2)	1.0 (2)
Chromium (Total)	mg/l	NA	5.2 (2)	NA
Lead	mg/l	NA	0.51 (2)	NA
Nickel	mg/l	NA	0.32 (2)	NA
Silver	mg/l	NA	0.072 (2)	NA

(1) Wastewaters are defined by 40 CFR 268.2(f) as wastes that contain less than 1% TOC and 1% TSS by weight. Also, for F001-F005 solvent mixtures, wastewaters must contain less than 1% TOC or 1% total F001-F005 solvents, by weight.
(2) Concentration in waste extract (CCWE)
(3) Concentration in waste (CCW)
(4) Specified treatment technology

LDR - Land Disposal Restrictions, 40 CFR Part 268
NA - Not applicable
INCIN - Incineration

Reference: HNUS, Pittsburgh, Pa., Pond Sludge Waste Characterization and Clarifier Sludge Waste Characterization Report, Deliverables 224A and 224E Combined. Draft Issued January, 1992, Final Report, March 1992.

APPENDIX D
Accelerated Sludge Removal Study
Container Materials of Construction

DRAFT COPY

INTEROFFICE MEMORANDUM

DATE: 16 July 1993

FILE: 961.283

TO: J. H. Templeton

FROM: R. G. Posgay

SUBJECT: Coating System Recommendations for Waste Storage Containers - Rocky Flats Corrosion Review

REFERENCE: Accelerated Sludge Removal Study - Container Materials of Construction

This memo is presented in response to your request for coating recommendations for various containers (carbon steel, stainless steels, polyethylene, polypropylene and vinyl ester reinforced fiberglass, etc.) subjected to the service conditions associated with the sludge and waste water products in the various holding ponds at subject facility.

The recommendations presented are preliminary, based upon a quick review of tables obtained from the Halliburton NUS Pond/Sludge Characterization Study, and materials of construction suggested by EG&G. These results must be verified by a detailed study utilizing additional project background information and site data.

1. The results of our investigation are summarized as:

    1.1. Carbon steel containers must be suitably lined on the interior and coated on the exterior to withstand corrosion damage for the proposed 10 year design.

    1.2. Stainless steel containers must be suitably lined on the interior and coated on the exterior to withstand corrosion damage for the proposed 10 year design.

    1.3. Thick wall polypropylene containers are acceptable.

    1.4. Vinyl ester resin laminated fiberglass containers can be satisfactorily designed to withstand the 10 year design criteria.

2. The coating systems and/or resins which are satisfactory for the service conditions listed include:

   2.1. Vinyl Ester Laminating Resin
   Dow Derakane 470-36 - 2 layers of glass mat and topcoat = 60 - 70 mils DFT

   2.2. Vinyl Ester Linings - 2 coats @ 10 - 12 mils DFT.

   Awaiting confirmation from suppliers that have been contacted.

   2.3. Epoxy Phenolic Linings - 2 coats @ 10 - 12 mils DFT.

   Awaiting confirmation from suppliers who have been contacted.

   2.4 High Solids Amine Cured Epoxy - 2 coats @ 10 - 12 mils DFT.

   Awaiting confirmation from suppliers who have been contacted.

Development of specifications dealing with abrasives, surface preparation, anchor profile, application procedures, caulking and inspection should be developed.

If you have any questions or require additional information, please call me at 713-676-7061.

Ray Posgay

Raymond G. Posgay

CC: B&R Project File
J.R. Zak
R.P. Negri

APPENDIX E
Calculations for A/B Pond Volume Estimates

A/B PONDS – CONTENTS AND VOLUME REQUIRED FOR STORAGE

JULY 8, 1993

TOTAL SLUDGE VOLUME				
CURRENT, GALLONS	228,770	228,770	228,770	
CURRENT, CU YD	1,132.60	1,132.60	1,132.60	
TOTAL POND CONTENTS	2,101,431	2,077,077	2,131,299	
DRY SOLIDS, LB.	319,564	280,555	367,672	
TDS IN SLUDGE, LB.	23,307	18,478	29,005	
WATER IN SLUDGE, LB.	1,758,559	1,778,045	1,734,621	
TDS WT%	1.11%	0.89%	1.36%	
TDS VOL%	0.41%	0.28%	0.64%	
TSS WT%	15.21%	13.51%	17.25%	
TSS VOL%	7.31%	6.42%	8.33%	
SLUDGE S.G.	1.103	1.090	1.118	
DRY SOLIDS S.G.	2.293	2.294	2.315	
SOLUTION S.G.	1.010	1.008	1.010	
WATER REQUIRED ABOVE SOLUTION	75,000	75,000	75,000	
25,000 GAL PER INCH				
PUMPING S.G.	1.077	1.068	1.089	
WASH WATER, GAL.	44,000	44,000	44,000	MEMO TO DIST. From J. Templeton REF Processing Methodology
POND VOLUME AFTER WATER COVER AND WASHDOWN, GAL.	347,770	347,770	347,770	

OPTION A – SLUDGE + WATER COVER + WASH WATER

TOTAL, GAL	347,770
SLUDGE, GAL	228,770
WATER COVER, GAL	75,000
WASH WATER, GAL	44,000

OPTION B – LIKE A BUT DECANT EXCESS WATER

TOTAL, GAL	228,770
SLUDGE, GAL	228,770

OPTION C – DEWATER SLUDGE TO 20.00% BY WT SOLIDS

TOTAL, LB.	1,597,821	1,402,774	1,838,362
TOTAL, GAL.	168,902	148,494	193,968
SOLUTION REM., LB.	503,610	674,303	292,937
SOLUTION REM., GAL	59,868	80,277	34,802

OPTION D – DEWATER SLUDGE TO 45.00% BY WT SOLIDS

TOTAL, LB.	710,143	623,455	817,050
TOTAL, GAL.	63,377	55,715	72,633
SOLUTION REM., LB.	1,391,288	1,453,622	1,314,249
SOLUTION REM., GAL	165,394	173,055	156,137

-NORTH SLUDGE

OLUME, GALLONS	87,424	87,424	87,424	VOLUME CALC
OLUME, CU YD	432.82	432.82	432.82	VOLUME CALC
T% SOLIDS	26.22%	25.30%	27.50%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
G., DRY SOLIDS	2.445	2.43	2.46	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
G. CONT. SOL'N	1.003	1.003	1.003	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
TDS, CONT. SOL'N	0.16%	0.13%	0.19%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
G. SLUDGE	1.186	1.178	1.198	CALCULATED
RY SOLIDS, LB.	226,552	217,045	239,949	CALCULATED
DS IN SLUDGE, LB.	1,020	833	1,202	CALCULATED
ATER IN SLUDGE, LB.	636,470	640,007	631,392	CALCULATED

-CENTER SLUDGE

OLUME, GALLONS	91,139	91,139	91,139	VOLUME CALC
OLUME, CU YD	451.21	451.21	451.21	VOLUME CALC
T% SOLIDS	5.60%	4.50%	6.70%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
G. DRY SOLIDS	1.840	1.8	1.93	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
G., CONT. SOL'N	1.014	1.011	1.015	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
TDS, CONT. SOL'N	2.02%	1.97%	2.07%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
.G. SLUDGE	1.040	1.031	1.048	CALCULATED
RY SOLIDS, LB.	44,221	35,234	53,322	CALCULATED
DS IN SLUDGE, LB.	15,058	14,731	15,370	CALCULATED
VATER IN SLUDGE, LB.	730,385	733,015	727,159	CALCULATED

-SOUTH SLUDGE

OLUME, GALLONS	48,026	48,026	48,026	VOLUME CALC
OLUME, CU YD	237.77	237.77	237.77	VOLUME CALC
T% SOLIDS	10.12%	6.03%	14.50%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
.G., DRY SOLIDS	1.975	1.85	2.08	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
.G., CONT. SOL'N	1.013	1.012	1.014	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
%TDS, CONT. SOL'N	1.83%	0.69%	3.26%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
.G. SLUDGE	1.066	1.040	1.095	CALCULATED
RY SOLIDS, LB.	43,139	25,099	63,543	CALCULATED
DS IN SLUDGE, LB.	7,011	2,699	12,215	CALCULATED
VATER IN SLUDGE, LB.	376,123	388,433	362,469	CALCULATED

-POND SLUDGE

OLUME, GALLONS	2,181	2,181	2,181	VOLUME CALC
OLUME, CU YD	10.80	10.80	10.80	VOLUME CALC
WT% SOLIDS	26.35%	15.90%	44.00%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
S.G., DRY SOLIDS	2.195	2.03	2.39	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
S.G., CONT. SOL'N	1.013	1.012	1.014	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
%TDS, CONT. SOL'N	1.38%	1.28%	1.58%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-05-92-34
S.G. SLUDGE	1.181	1.100	1.358	CALCULATED
DRY SOLIDS, LB.	5,653	3,177	10,858	CALCULATED
TDS IN SLUDGE, LB.	218	215	218	CALCULATED
WATER IN SLUDGE, LB.	15,581	16,591	13,601	CALCULATED

207 A POND

	cu ft	gallons
SLUDGE VOLUME *	10.80	2,181

DATE	TOTAL VOLUME IN POND		SOLUTION VOLUME
	cu yd **	gallons	gallons
04/20/92	3000.70	606,102	603,921
05/18/92	1834.70	370,586	368,404
06/15/92	2141.52	432,559	430,378
07/02/92	1908.42	385,476	383,295
08/31/92	1631.11	329,463	327,282

* *FROM EARTH 3 - BN420S*

** *FROM EARTH 3 - BNxxxT, where xxx is the date.*

207 B NORTH POND

	cu yds	gallons
MAXIMUM POND VOLUME		
30" Freeboard *	8,224.85	1,661,313
24" Freeboard *	8,944.12	1,806,596
SLUDGE VOLUME **	432.82	87,424

DATE	TOTAL VOLUME IN POND		FILL VOLUME REMAINING		SOLUTION VOLUME
			30" F.B.	24" F.B.	
	cu yd ***	gallons	gallons	gallons	gallons
04/02/92	8255.17	1,667,437	(6,124)	139,159	1,580,013
05/04/92	7535.54	1,522,081	139,232	284,515	1,434,657
05/18/92	6761.90	1,365,816	295,497	440,780	1,278,392
06/15/92	7399.45	1,494,593	166,720	312,003	1,407,169
07/02/92	6956.82	1,405,187	256,126	401,409	1,317,763
08/31/92	6761.90	1,365,816	295,497	440,780	1,278,392

* *FROM EARTH 3 - BN420M AND BN504M*

** *FROM EARTH 3 - BN420S*

*** *FROM EARTH 3 - BNxxxT, where xxx is the date.*

207 B CENTER POND

	cu yds	gallons
MAXIMUM POND VOLUME		
30" Freeboard *	7,442.27	1,503,242
24" Freeboard *	8,178.39	1,651,928
SLUDGE VOLUME **	451.21	91,139

DATE	TOTAL VOLUME IN POND		FILL VOLUME REMAINING		SOLUTION VOLUME
	cu yd ***	gallons	30" F.B. gallons	24" F.B. gallons	gallons
04/02/92	7478.94	1,510,649	(7,407)	141,280	1,419,510
05/04/92	7552.32	1,525,470	(22,229)	126,458	1,434,332
05/18/92	7317.72	1,478,084	25,157	173,844	1,386,946
06/15/92	7478.94	1,510,649	(7,407)	141,280	1,419,510
07/02/92	7317.72	1,478,084	25,157	173,844	1,386,946
08/31/92	6081.48	1,228,380	274,862	423,549	1,137,241

* *FROM EARTH 3 - BC420M AND BC504M*

** *FROM EARTH 3 - BC420S*

*** *FROM EARTH 3 - BCxxxT, where xxx is the date.*

207 B SOUTH POND

	cu yds	gallons
MAXIMUM POND VOLUME		
30" Freeboard *	7,131.10	1,440,389
24" Freeboard *	7,861.82	1,587,985
SLUDGE VOLUME **	237.77	48,026

DATE	TOTAL VOLUME IN POND		FILL VOLUME REMAINING		SOLUTION VOLUME
	cu yd ***	gallons	30" F.B. gallons	24" F.B. gallons	gallons
04/02/92	7010.38	1,416,006	24,384	171,980	1,367,979
05/04/92	6876.77	1,389,018	51,371	198,967	1,340,992
05/18/92	6876.77	1,389,018	51,371	198,967	1,340,992
06/15/92	6724.53	1,358,268	82,122	229,718	1,310,241
07/02/92	6046.31	1,221,276	219,113	366,709	1,173,250
08/31/92	4564.49	921,968	518,422	666,018	873,941

* *FROM EARTH 3 - BS420M AND BS504M*

** *FROM EARTH 3 - BS420S*

*** *FROM EARTH 3 - BSxxxT, where xxx is the date.*

CLIENT: EG&G Rocky Flats
JOB NUMBER: JR-1198
SUBJECT: A/B Ponds Volume Basis
BASED ON:
DRAWING NUMBER:
BY: Templeton | CHECKED BY: | APPROVED BY: | DATE: 7-7-93

① Pond Dimensions: (Approx)

	B-North	B-Center	B-South
Pond Bottom	217.4'x 145'	219'x 149'	219.7'x 147.4'
Pond Top	253' x 182'	~~184'~~ 253' x 184'	253' x 183'

Bottom Elevations

	B-North ABS	B-North REL	B-Center ABS	B-Center REL	B-South ABS	B-South REL
NW	5964.0	0'	5964.5'	0'	5965.0'	0'
SW	5964.5'	0.5'	5965'	0.5'	5965.5'	0.5'
NE	5964.5'	0.5'	5965'	0.5'	5965.5'	0.5'
SE	5964.5	0.5'	5965'	0.5'	5965.5'	0.5'
Sump (NW)	5964.0	0'	5964.5'	0'	5965.0'	0'

Top Elevations

	B-North ABS	B-North REL	B-Center ABS	B-Center REL	B-South ABS	B-South REL
NW	5973.0'	9.0'	5973.0'	8.5'	5973.0'	8.0
SW	5973.0'	9.0'	5973.0'	8.5'	5973.0	8.0
NE	5974.5'	10.5'	5974.5'	10.0'	5974.5	9.5
SE	5974.5'	10.5'	5974.5'	10.0'	5974.5	9.5

~~Sump~~

② On April 20, 1992 depth samples were taken from 16 points (grid pattern) in the pond. The measurements taken were:
1) Solution level to pond bottom; and
2) Sludge layer thickness.

③ On April 20, 1992 the B- ponds' RCRA measurements were:

B-North	44.5" (Slope)	=	29.7" (Vertical)	(using WS Tables)
B-Center	45" (Slope)	:	29.6" (Vertical)	(using WS Tables)
B-South	44.5 (Slope)	=	30.5" (Vertical)	(using WS Tables)

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: EG&G Rocky Flats	JOB NUMBER: JR-1198
SUBJECT: A/B Pond Volume Basis	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

4) From the depth sampling, I determined the following relative solution depths on 4/20/92:

B-North 78.3"
B-Center 68.1"
B-South 65.0"

5) For any succeeding RCRA slope measurements, the pond soln-elevation (relative to the low point in the pond) can be estimated

B-North : Elevation (in.) = 78.3 - x + 29.7
B-Center : Elevation (in.) = 68.1 - y + 31.8
B-South : Elevation (in.) = 65.0 - z + 30.5

Where x, y, and z are the respective RCRA vertical measurements for North, center, and south ponds.

6) From the depth measurements the relative pond bottom elevations at each sampling point were determined. This also required scaling available drawings to determine the coordinates in the pond of any elevation slope change.

With this information an Civil engineering Earthworking program can be used. Using the pond bottom as the base grade, and entering either the solution elevation or the sludge elevation, EARTH3 calculates the strip and fill volumes. The strip volume can be ignored, while the fill volume provides the desired value.

7) The scaled coordinates are shown on the following figures.

B-North Page 4 of 17
B-Center Page 5 of 17
B-South Page 6 of 17

X

CLIENT: EG&G Rocky Flats	JOB NUMBER: JR-1198
SUBJECT: A/B Pond Volume Basis	
BASED ON	DRAWING NUMBER

Templeton	CHECKED BY	APPROVED BY	DATE 7-7-93

(8) The coordinates entered into EARTH3 for the pond bottom are shown in the following Tables:
B-North Page 7 of 17
B-Center Page 8 of 17
B-South Page 9 of 17

(9) The ~~sd~~ sludge depth measurements were converted to elevations relative to the pond low point (NW corner) and the coordinates were entered into EARTH3.

Likewise, the pond solution level measurement, obtained as in item 5, was entered into EARTH3.

The sludge and Total pond volumes obtained from EARTH3 are shown on the following pages:

B-North	Sludge	Page 10 of 17
"	Total	Page 11 of 17
B-Center	Sludge	Page 12 of 17
"	Total	Page 13 of 17
B-South	Sludge	Page 14 of 17
"	Total	Page 15 of 17

(10) The steps involved in the volume determinations for the 207A pond are similar to the above. The primary reason it is not exemplified above is due to the solution level being between the low and high points of the pond bottom at the beginning of sampling.

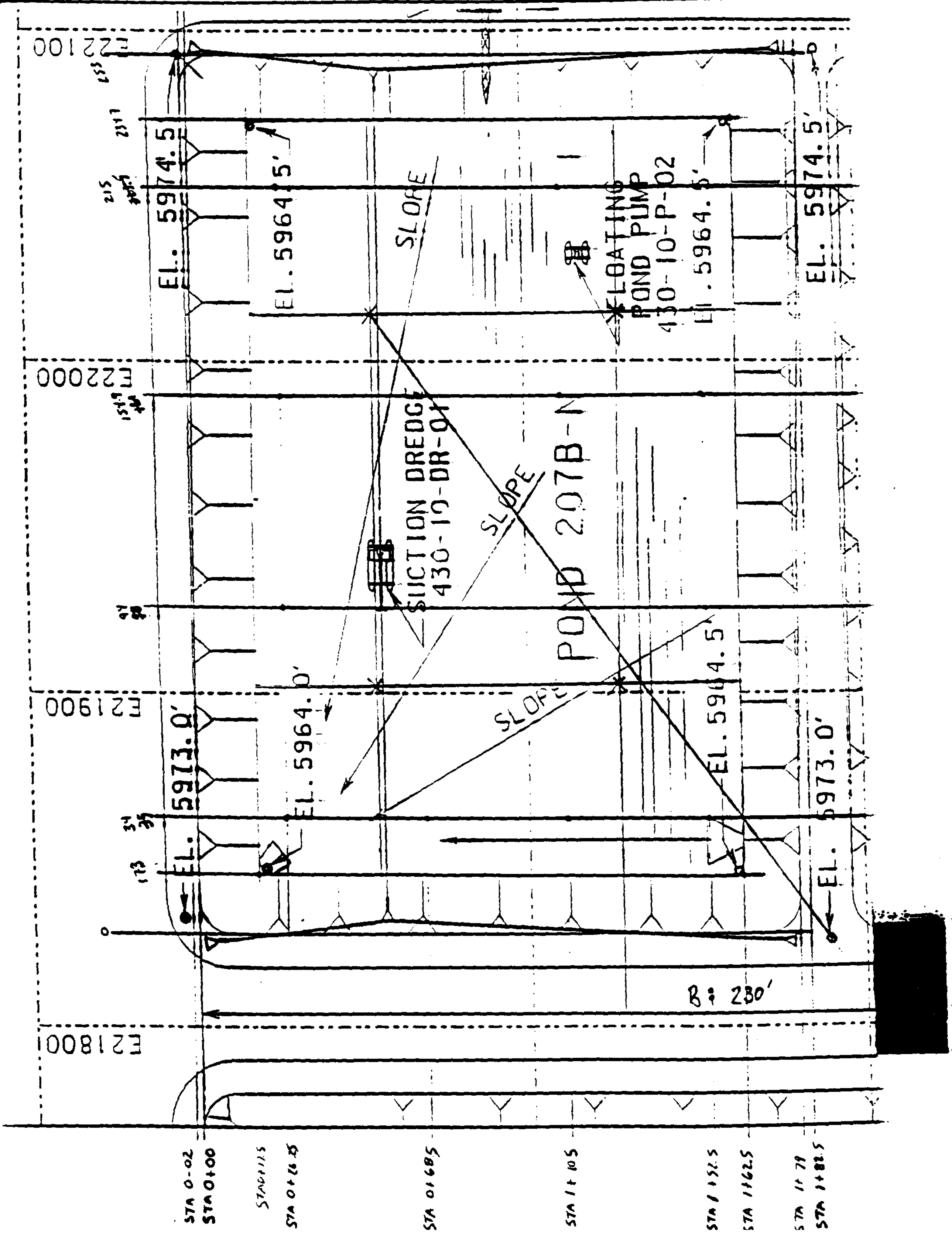
While this provided added complexity to the volume calculation, it does not significantly affect our analysis as:
1) The sludge volume calculated is small (Page 16 of 17); and
2) The volume of water ~~contained~~ is no longer a concern as the pond has been emptied to the B-Series ponds, and the water evaporated at the 374 bldg. (See Page 17 of 17 for total volume).

CALUCLATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: EG&G Rocky Flats	JOB NUMBER: JR-1198
SUBJECT: A/B Pond Volume Basis	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93



CALCULATION WORKSHEET Order No. 18116 (01-91)

CLIENT: EG&G Rocky Flats

JOB NUMBER: JR-1198

SUBJECT: A/B Pond Volume Basis

BASED ON:

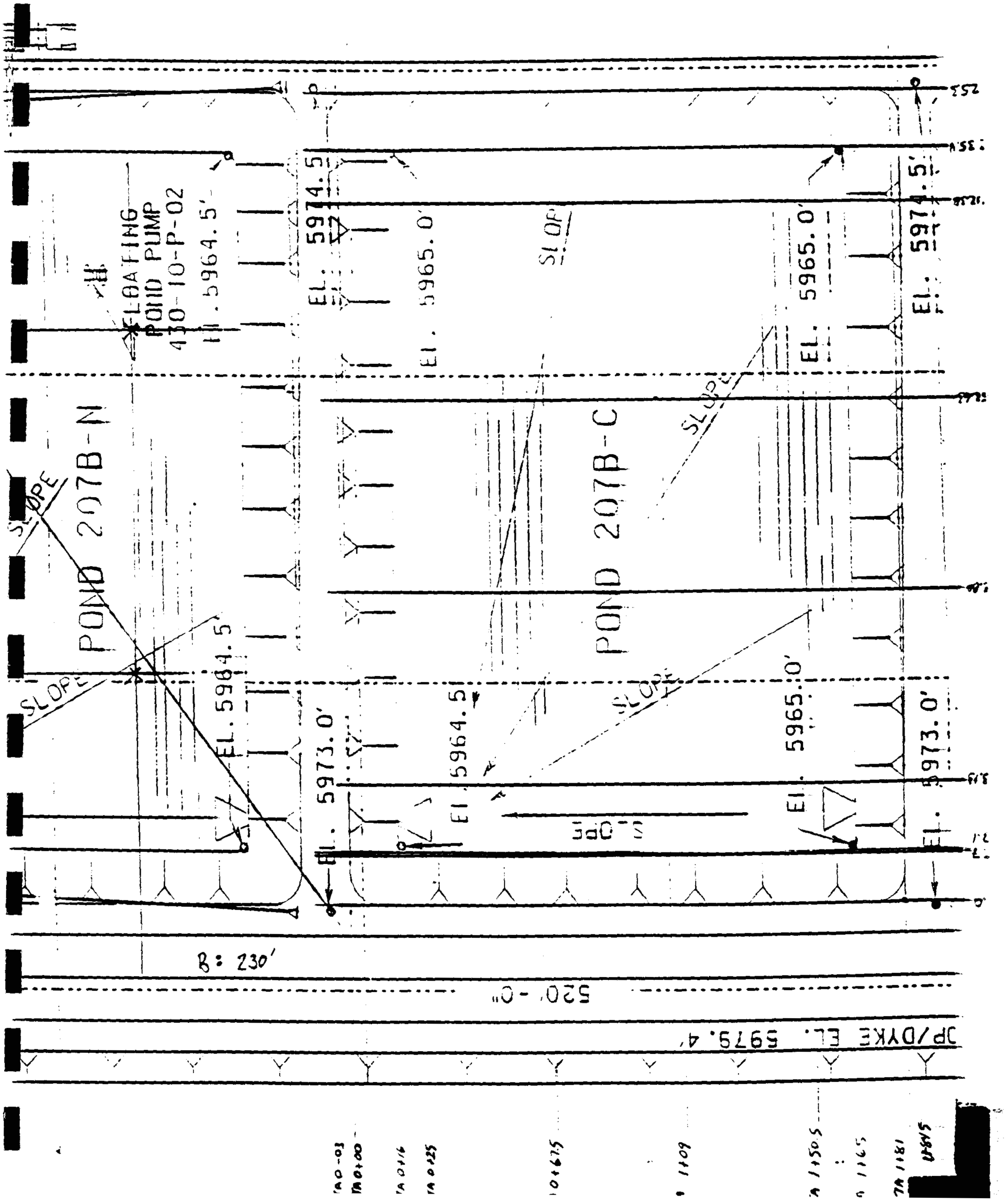
DRAWING NUMBER:

BY: Templeton

CHECKED BY:

APPROVED BY:

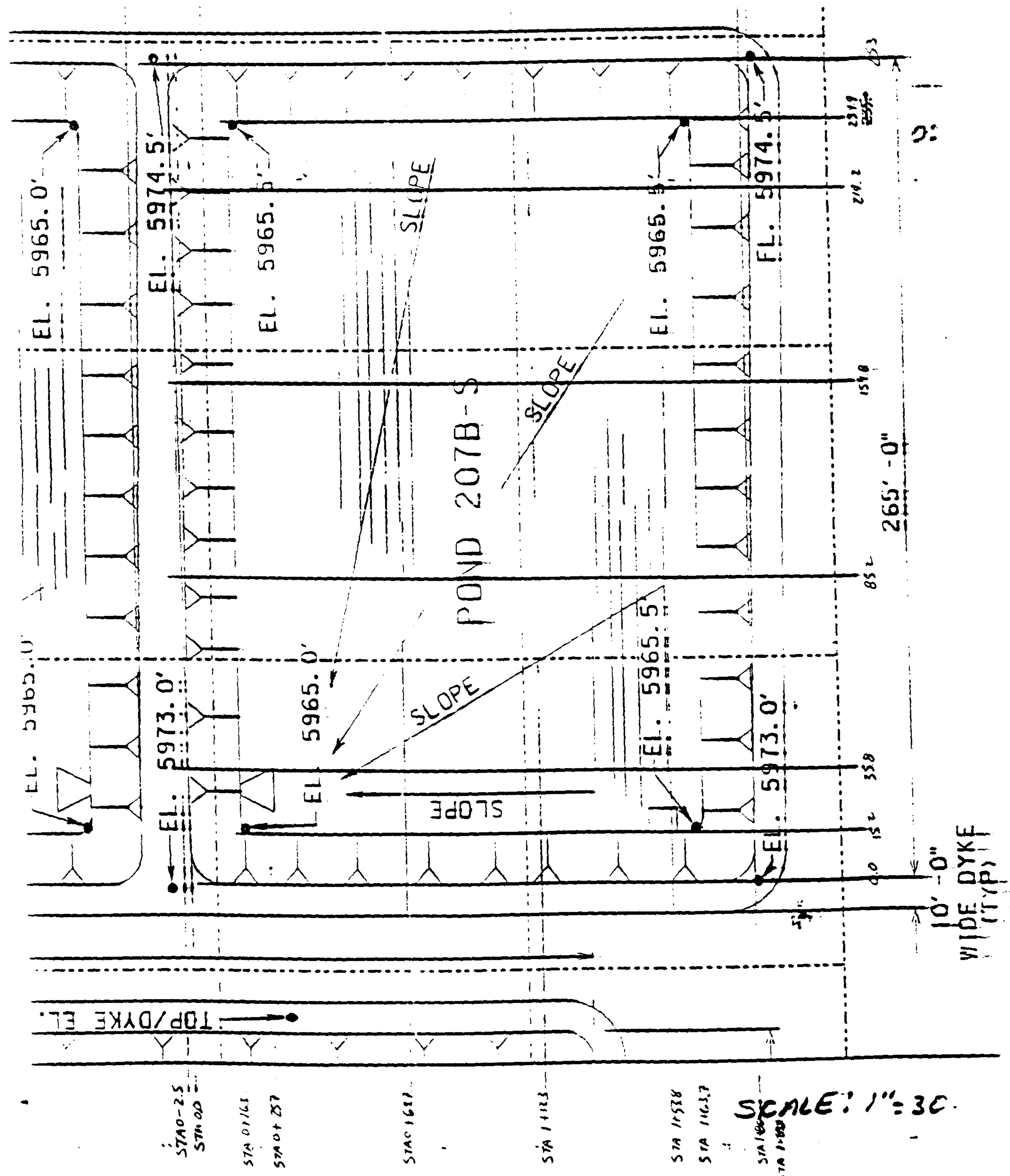
DATE: 7-7-93



CALCULATION WORKSHEET Order No. 19116 (01-81)

CLIENT: EG&G Rocky Flats	JOB NUMBER: JR-1198
SUBJECT: A/B Pond Volume Basis	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93



SCALE: 1" = 30

E EG&G ROCKY FLATS	JOB NUMBER JR-1198
JECT A/B POND VOLUME BASIS	
SED ON	DRAWING NUMBER

	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

207B NORTH POND
BOTTOM COORDINATES

TION NUMBER	EAST-WEST COORDINATE	ELEVATION
0-02	0.00	9.00
	253.00	10.50
+00	0.00	9.00
	250.90	9.41
	253.00	10.50
+17.5	0.00	9.00
	17.30	0.00
	234.70	0.50
	253.00	10.50
0+26.25	0.00	9.00
	17.30	0.03
	34.00	0.15
	94.00	0.36
	154.90	0.44
	215.00	0.61
	234.70	0.50
	253.00	10.50
+68.5	0.00	9.00
	17.30	0.18
	34.00	0.15
	94.00	0.48
	154.90	0.48
	215.00	0.61
	234.70	0.50
	253.00	10.50
+10.5	0.00	9.00
	17.30	0.32
	34.00	0.78
	94.00	0.69
	154.90	0.73
	215.00	0.48
	234.70	0.50
	253.00	10.50
1+52.5	0.00	9.00
	17.30	0.46
	34.00	1.36
	94.00	0.61
	154.90	0.69
	215.00	0.69
	234.70	0.50

STATION NUMBER	EAST-WEST COORDINATE	ELEVATION
1+62.5	0.00	9.00
	17.30	0.50
	234.70	0.5
	253.00	10.5
1+79	0.00	9
	250.90	9.41
	253.00	10.5
1+82.5	0.00	9
	253.00	10.5

CALCULATION WORKSHEET Order No. 19116 (01-81)

CLIENT: EG&G Rocky Flats | JOB NUMBER: JR-1198

SUBJECT: A/B Pond Volume Basis

BASED ON | DRAWING NUMBER

Templeton | CHECKED BY | APPROVED BY | DATE 7-7-93

207B CENTER POND BOTTOM COORDINATES

STATION NUMBER	EAST-WEST COORDINATE	ELEVATION
0-03	0.00	8.50
	253.00	10.00
0+00	0.00	8.50
	250.20	8.50
	253.00	10.00
0+16	0.00	8.50
	17.10	0.00
	235.40	0.50
	253.00	10.00
0+25	0.00	8.50
	17.00	0.06
	33.13	0.35
	92.88	0.56
	152.63	0.43
	212.38	0.48
	235.40	0.50
	253.00	10.00
0+67.5	0.00	8.50
	16.60	0.19
	33.13	0.35
	92.88	0.50
	152.63	0.60
	212.38	0.52
	235.40	0.50
	253.00	10.00
1+09	0.00	8.50
	16.20	0.31
	33.13	0.60
	92.88	0.56
	152.63	0.64
	212.38	0.64
	235.40	0.50
	253.00	10.00
1+50.5	0.00	8.50
	15.80	0.44
	33.13	0.68
	92.88	0.60
	152.63	0.68
	212.38	0.68
	235.40	0.50
	253.00	10.00

STATION NUMBER	EAST-WEST COORDINATE	ELEVATION
1+65	0.00	8.50
	15.70	0.50
	235.40	0.5
	253.00	10
1+81	0.00	8.5
	250.20	8.5
	253.00	10
1+84.5	0.00	8.5
	253.00	10

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER		
EG&G Rocky Flats	JR-1198		
SUBJECT: A/B Pond Volume Basis			
BASED ON	DRAWING NUMBER		
BY: Templeton	CHECKED BY	APPROVED BY	DATE: 7-7-93

207B SOUTH POND
BOTTOM COORDINATES

STATION NUMBER	EAST–WEST COORDINATE	ELEVATION
0–2.5	0.00	8.00
	253.00	9.50
0+00	0.00	8.00
	250.60	8.35
	253.00	9.50
0+16.3	0.00	8.00
	15.20	0.00
	234.90	0.50
	253.00	9.50
0+25.7	0.00	8.00
	15.20	0.06
	35.80	0.00
	85.20	0.21
	154.80	0.67
	214.20	1.17
	234.90	0.50
	253.00	9.50
0+69.7	0.00	8.00
	15.20	0.19
	35.80	0.21
	85.20	0.17
	154.80	0.25
	214.20	0.21
	234.90	0.50
	253.00	9.50
1+12.3	0.00	8.00
	15.20	0.31
	35.80	0.50
	85.20	0.42
	154.80	0.33
	214.20	0.33
	234.90	0.50
	253.00	9.50
1+53.8	0.00	8.00
	15.20	0.44
	35.80	0.58
	85.20	0.25
	154.80	0.42
	214.20	1.17
	234.90	0.50
	253.00	9.50

STATION NUMBER	EAST–WEST COORDINATE	ELEVATION
1+63.7	0.00	8.00
	15.20	0.50
	234.90	0.50
	253.00	9.50
1+80	0.00	8.00
	250.60	8.35
	253.00	9.50
1+83.4	0.00	8.00
	253.00	9.50

CLIENT EG&G ROCKY FLATS	JOB NUMBER JR-1198
SUBJECT A/B POND VOLUME BASIS	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

B-NORTH SLUDGE

EARTHWORK VOLUMES Job - A:BN420S Date - 05/02/1992 Time - 14:48:00

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
-0+02.00	2295.70	0.00	0.00	0.00
0+00.00	2159.39	0.00	165.00	0.00
0+17.50	153.35	91.55	914.50	29.67
0+26.25	153.59	62.23	964.24	54.59
0+68.50	156.19	56.83	1206.61	147.74
1+10.50	147.88	68.03	1443.10	244.86
1+52.50	135.73	73.22	1663.69	354.73
1+62.50	135.98	131.50	1714.00	392.64
1+79.00	2043.39	0.00	2379.92	432.82
1+82.50	2179.70	0.00	2653.64	432.82

Total Volume - Cut = 2653.64 Cu.Yd. Fill = 432.82 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 11112.60 Sq.Ft. Fill = 35565.90 Sq.Ft.
Total Surface Area = 46678.50 Sq.Ft. 1.072 Acres
Totals Less Strip Volumes - Cut = 2653.64 Cu.Yd. Fill = 432.82 Cu.Yd.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER
EG&G ROCKY FLATS	JR-1198

SUBJECT: A/B POND VOLUME BASIS

BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

B-NORTH TOTAL

EARTHWORK VOLUMES Job - A:BN420 Date - 04/30/1992 Time - 12:23:30

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
-0+02.00	815.92	0.00	0.00	0.00
0+00.00	679.61	0.00	55.39	0.00
0+17.50	20.34	1438.32	282.23	466.12
0+26.25	20.36	1408.78	288.83	927.46
0+68.50	20.47	1396.66	320.77	3122.45
1+10.50	20.56	1347.58	352.68	5256.86
1+52.50	20.66	1321.94	384.74	7333.15
1+62.50	20.69	1379.99	392.40	7833.51
1+79.00	679.61	0.00	606.38	8255.17
1+82.50	815.92	0.00	703.32	8255.17

Total Volume - Cut = 703.32 Cu.Yd. Fill = 8255.17 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.

Surface Areas - Cut = 7663.88 Sq.Ft. Fill = 39014.63 Sq.Ft.

Total Surface Area = 46678.50 Sq.Ft. 1.072 Acres

Totals Less Strip Volumes - Cut = 703.32 Cu.Yd. Fill = 8255.17 Cu.Yd.

FOR POND ELEVATION = 6.525'

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER
EG&G ROCKY FLATS	JR-1198
SUBJECT: A/B POND VOLUME BASIS	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

~~B-NORTH~~
B-CENTER SLUDGE

EARTHWORK VOLUMES Job - A:BC420S Date - 05/02/1992 Time - 16:37:02

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
-0+03.00	2159.65	0.00	0.00	0.00
0+00.00	1972.00	0.00	229.54	0.00
0+16.00	142.09	103.04	855.93	30.53
0+25.00	142.16	59.07	903.31	57.55
0+67.50	131.02	76.23	1118.32	164.02
1+09.00	133.89	66.84	1321.91	273.97
1+50.50	130.21	67.80	1524.87	377.44
1+65.00	130.27	98.38	1594.82	422.06
1+81.00	1911.59	0.00	2199.82	451.21
1+84.50	2099.24	0.00	2459.78	451.21

Total Volume - Cut = 2459.78 Cu.Yd. Fill = 451.21 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 10960.52 Sq.Ft. Fill = 36476.98 Sq.Ft.
Total Surface Area = 47437.50 Sq.Ft. 1.089 Acres
Totals Less Strip Volumes - Cut = 2459.78 Cu.Yd. Fill = 451.21 Cu.Yd.

CLIENT	JOB NUMBER
EG&G ROCKY FLATS	JR-1198
SUBJECT A/B POND VOLUME BASIS	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

B-CENTER TOTAL

EARTHWORK VOLUMES Job - A:BC420T Date - 05/02/1992 Time - 16:23:52

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
-0+03.00	860.20	0.00	0.00	0.00
0+00.00	672.55	0.00	85.15	0.00
0+16.00	23.02	1283.42	291.25	380.27
0+25.00	23.03	1239.38	298.92	800.74
0+67.50	22.97	1224.60	335.12	2739.98
1+09.00	22.90	1209.62	370.37	4610.72
1+50.50	22.84	1199.46	405.52	6462.14
1+65.00	22.84	1229.99	417.78	7114.50
1+81.00	672.55	0.00	623.83	7478.94
1+84.50	860.20	0.00	723.17	7478.94

Total Volume - Cut = 723.17 Cu.Yd. Fill = 7478.94 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 7829.80 Sq.Ft. Fill = 39607.70 Sq.Ft.
Total Surface Area = 47437.50 Sq.Ft. 1.089 Acres
Totals Less Strip Volumes - Cut = 723.17 Cu.Yd. Fill = 7478.94 Cu.Yd.

SOL'N @ ELEVATION 5.85'

CLIENT EG&G Rocky Flats

JOB NUMBER JR-1198

SUBJECT A/B Pond Volume Basis

BASED ON

DRAWING NUMBER

BY Templeton

CHECKED BY

APPROVED BY

DATE 7-7-93

B-South Sludge

EARTHWORK VOLUMES Job - A:BS420S Date - 05/02/1992 Time - 17:04:43

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
-0+02.50	2039.72	0.00	0.00	0.00
0+00.00	1896.05	0.00	182.21	0.00
0+16.30	137.87	59.78	796.15	18.04
0+25.70	126.87	40.78	842.24	35.55
0+69.70	135.41	46.33	1055.95	106.53
1+12.30	133.25	32.95	1267.90	169.08
1+53.80	121.35	37.81	1463.56	223.47
1+63.70	136.10	15.19	1510.76	233.18
1+80.00	1880.14	0.00	2119.37	237.77
1+83.40	2023.81	0.00	2365.17	237.77

Total Volume - Cut = 2365.17 Cu.Yd. Fill = 237.77 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 13017.30 Sq.Ft. Fill = 34015.07 Sq.Ft.
Total Surface Area = 47032.70 Sq.Ft. 1.080 Acres
Totals Less Strip Volumes - Cut = 2365.17 Cu.Yd. Fill = 237.77 Cu.Yd.

CALCULATION WORKSHEET

Order No. 18116 (01-91)

CLIENT: EG&G ROCKY FLATS	JOB NUMBER: JR-1198
SUBJECT: A/B POND VOLUME BASIS	
BASED ON:	DRAWING NUMBER:
BY: Templeton	CHECKED BY:
APPROVED BY:	DATE: 7-7-93

B-SOUTH TOTAL

EARTHWORK VOLUMES Job - A:BS420T Date - 05/01/1992 Time - 14:41:30

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
-0+02.50	843.25	0.00	0.00	0.00
0+00.00	699.57	0.00	71.43	0.00
0+16.30	23.10	1187.38	289.57	358.41
0+25.70	23.15	1133.53	297.62	762.42
0+69.70	23.26	1191.88	335.43	2657.20
1+12.30	23.36	1154.84	372.20	4508.51
1+53.80	23.47	1120.50	408.19	6257.15
1+63.70	23.52	1129.08	416.81	6669.57
1+80.00	699.57	0.00	635.08	7010.38
1+83.40	843.25	0.00	732.22	7010.38

Total Volume - Cut = 732.22 Cu.Yd. Fill = 7010.38 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 7790.30 Sq.Ft. Fill = 39242.40 Sq.Ft.
Total Surface Area = 47032.70 Sq.Ft. 1.080 Acres
Totals Less Strip Volumes - Cut = 732.22 Cu.Yd. Fill = 7010.38 Cu.Yd.

POND SOL'N ELEV = 5.42'

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT EG&G Rocky Flats	JOB NUMBER JR-1198
SUBJECT A/B Pond Volume Basis	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

A POND SLUDGE VOLUME

EARTHWORK VOLUMES Job - A:A420S Date - 05/04/1992 Time - 12:52:32

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
0+00.00	29937.50	0.00	0.00	0.00
0+30.00	0.00	0.00	16631.95	0.00
0+37.00	0.00	0.00	16631.95	0.00
0+43.00	296.33	4.31	16664.87	0.48
0+47.00	209.67	9.70	16702.35	1.52
0+52.00	296.32	4.38	16749.20	2.82
0+58.00	328.94	0.00	16818.68	3.31
0+86.00	0.00	0.00	16989.24	3.31
1+19.00	141.73	0.92	17075.85	3.87
1+64.00	145.05	0.89	17314.84	5.38
4+92.00	0.00	0.00	18195.87	10.80
5+03.00	1725.00	0.00	18547.25	10.80
5+20.00	2125.00	0.00	19759.29	10.80

Total Volume - Cut = 19759.29 Cu.Yd. Fill = 10.80 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 27337.33 Sq.Ft. Fill = 10425.67 Sq.Ft.
Total Surface Area = 130000.00 Sq.Ft. 2.984 Acres
Totals Less Strip Volumes - Cut = 19759.29 Cu.Yd. Fill = 10.80 Cu.Yd.

292 Cu.Ft.

2180 gallons

CALCULATION WORKSHEET Order No. 19118 (01-91)

CLIENT		JOB NUMBER	
EG&G Rocky Flats		JR-1198	
SUBJECT A/B Pond Volume Basis			
BASED ON		DRAWING NUMBER	
BY Templeton	CHECKED BY	APPROVED BY	DATE 7-7-93

A-POND TOTAL VOLUME

EARTHWORK VOLUMES Job - a:A420T Date - 05/04/1992 Time - 11:48:27

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
0+00.00	31332.50	0.00	0.00	0.00
0+30.00	782.50	0.00	17841.67	0.00
0+37.00	201.81	224.31	17969.26	29.08
0+43.00	157.25	322.00	18009.16	89.78
0+47.00	151.38	408.09	18032.02	143.86
0+52.00	157.25	322.00	18060.59	211.46
0+58.00	157.87	285.62	18095.61	278.97
0+86.00	150.28	342.87	18255.39	604.86
1+19.00	153.76	328.25	18441.19	1014.99
1+64.00	158.65	247.87	18701.53	1495.10
4+92.00	455.00	0.00	22428.88	3000.70
5+03.00	995.00	0.00	22724.25	3000.70
5+20.00	1395.00	0.00	23476.65	3000.70

Total Volume - Cut = 23476.65 Cu.Yd. Fill = 3000.70 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 77398.63 Sq.Ft. Fill = 52601.38 Sq.Ft.
Total Surface Area = 130000.00 Sq.Ft. 2.984 Acres
Totals Less Strip Volumes - Cut = 23476.65 Cu.Yd. Fill = 3000.70 Cu.Yd.

FOR POND ELEVATION = 4.92'

606,100 gallons TOTAL

APPENDIX F
Calculations for C Pond Volume Estimates

C POND CONTENTS AND VOLUME REQUIRED FOR STORAGE

JULY 7, 1993

TOTAL POND VOLUME

GALLONS ON 9/10/92	392,531	392,531	392,531	
CU FT. ON 9/10/92	1,943.35	1,943.35	1,943.35	
SALT SOLUBILITY				
MAX WT%	45.80%	51.05%	42.77%	
WATER REQUIRED TO DISSOLVE SALT				
WATER, GAL.	299,155	231,759	361,430	
ADDITIONAL, GAL.	19,185	(59,945)	94,162	
TOTAL SOLN REQ., GAL.	411,717	332,586	486,693	
WASH WATER, GAL.	44,000	44,000	44,000	MEMO TO DIST. From J. Templeton REF Processing Methodology
TOTAL VOLUME INCL. DILUTION & WASHDOWN, GAL.	455,717	376,586	530,693	
TDS WT%	45.80%	51.05%	42.77%	PRIOR TO WASH DOWN
TDS VOL%	23.85%	27.24%	22.11%	PRIOR TO WASH DOWN
TSS WT%	6.59%	4.98%	7.48%	PRIOR TO WASH DOWN
TSS VOL%	4.80%	3.58%	5.77%	PRIOR TO WASH DOWN

SLUDGE

VOLUME, GALLONS	38,788	38,788	38,788	VOLUME CALC
VOLUME, CU FT	192.03	192.03	192.03	VOLUME CALC
WT% SOLIDS	59.98%	43.90%	70.50%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-06-92-24
S.G., DRY SOLIDS	2.230	1.93	2.41	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-06-92-24
S.G., CONT. SOL'N	1.407	1.402	1.418	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-06-92-24
%TDS, CONT. SOL'N	44.78%	45.65%	44.43%	MEMO to TAB from R. Ninesteel 6/13/92, REF C-49-06-92-24
S.G. SLUDGE	1.807	1.593	1.998	CALCULATED

CRYSTAL

VOLUME, GALLONS	78,450	78,450	78,450	VOLUME CALC
VOLUME, CU FT	388.39	388.39	388.39	VOLUME CALC
WT% SOLIDS	56.00%	51.20%	65.20%	Table 3-11, PS Characterization Report, 3/92
S.G., DRY SOLIDS	2.200	2.200	2.200	MEMO to TAB from S. Mathew 6/23/92 REF. none
S.G., CONT. SOL'N	1.407	1.402	1.418	Assume to be the same as the sludge.
%TDS, CONT. SOL'N	44.78%	45.65%	44.43%	Assume to be the same as the sludge.
S.G. CRYSTAL	1.763	1.722	1.846	CALCULATED

SOLUTION

VOLUME, GALLONS	275,294	275,294	275,294	VOLUME CALC
VOLUME, CU FT	1,362.93	1,362.93	1,362.93	VOLUME CALC
S.G. OF SOL'N	1.331	1.321	1.343	TDS DATA FROM 9/10/92
%TDS OF SOL'N	36.99%	34.82%	38.72%	TDS DATA FROM 9/10/92

TOTAL POND CONTENTS	4,788,081	4,669,279	4,931,416	
DRY SOLIDS, LB.	350,189	226,004	455,052	
DRY CRYSTAL, LB.	2,105,750	2,013,376	2,250,014	
WATER, LB.	2,332,143	2,429,898	2,226,350	

207 C POND

INPUT DATA FROM EARTH 3

C402M	5584.3	cubic yards
C402L	494.64	cubic yards
C923L	563.00	cubic yards
C402C	192.03	cubic yards
C402S	368.07	cubic yards
C402T	2725.59	cubic yards
C518T	2256.82	cubic yards
C615T	2412.18	cubic yards
C702T	2256.82	cubic yards
C831T	2113.37	cubic yards
C910T	1937.88	cubic yards
C629T	1741.86	cubic yards

UNCHANGING VOLUMES

	cu yds	gallons
MAXIMUM POND VOLUME (30" Freeboard)	5,584.3	1,127,956
CRYSTAL VOLUME - 4/02/92	302.6	61,123
CRYSTAL VOLUME - 9/10/92	388.4	78,456
SLUDGE VOLUME		
measured	368.1	74,345
by difference	192.0	38,788

VOLUMES CHANGING WITH CHANGING SOLUTION LEVEL

DATE	TOTAL VOLUME IN POND gallons	FILL VOLUME REMAINING gallons	SOLUTION VOLUME gallons
04/02/92	550,534	577,422	450,623
05/18/92	455,848	672,108	355,937
06/15/92	487,229	640,727	387,318
07/02/92	455,848	672,108	355,937
08/31/92	426,873	701,083	326,962
09/10/92	392,531	735,425	277,708
06/29/93	351,833	776,123	238,114

CLIENT	JOB NUMBER
EG&G Rocky Flats	JR-1198
SUBJECT	
C Pond Volume Basis	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

C Pond Volume Basis

① **Pond Dimensions:** (Approx)

Pond bottom 205' x 124'

Pond Top 248' x 168'

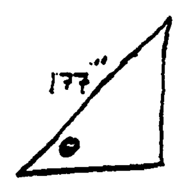
Bottom Elevations	Absolute	Relative
NW	5977.0'	3.0'
SW	5977.0'	3.0'
NE	5976.0'	2.0'
SE	5977.0'	3.0'
Sump (NE)	5974.0'	0'
Top Elevations	5984.0'	10.0'

② Depth Samples were taken (4/2/92) at 16 points (grid pattern) in the ponds the measurements taken were

1) Solution level to top of crystal
2) Solution level to bottom of crystal
3) Solution level to bottom of pond
4) Sludge thickness

③ On 4/2/93 (the day depth sampling was performed) the C Pond RCRA Slope measurement was 177".
The drawings show a slope of 1:3

$\theta = ATAN(1/3) = 18.435°$



④ For a slope of 177" the distance from the pond crest to the solution level is

$(177'')(\sin 18.435) = 56''$

⑤ From the depth Sampling, I determined the relative Solution depth to be 61".

CLIENT		JOB NUMBER	
EG&G Rocky Flats		JR-1198	
SUBJECT			
C Pond Volume Basis			
BASED ON		DRAWING NUMBER	
BY Templeton	CHECKED BY	APPROVED BY	DATE 7-7-93

⑥ For any succeeding RCRA slope measurement, the pond depth (relative to the sump elevation = 0') can be estimated:

$$\text{Pond Elev (inches)} = 61'' - \left[(\text{RCRA Slope, in.})(0.3162) - 56''\right]$$

⑦ From the depth measurements, and knowing that the solution level is constant (during sampling), the relative pond bottom elevations were determined.

⑧ Knowing pond bottom elevations by
- scaling available drawings at all points of elevation slope change, and
- pond measurements

the program EARTH3 can be used.

EARTH 3 is a civil engineering earthworking program which calculates the quantities of fill and strip material required for a base grade (pond bottom) and a final grade (solution level, sludge level, etc.)

⑨ The scaled coordinates are shown on the following figure (Pg 4 of 10)
⑩ The coordinates entered into EARTH3 for the base grade are shown in the following Table (Page 5 of 10).

⑪ As stated in item ② the depth samples were taken on 4/2/92. At the time of the depth sampling, the importance of the total salt content in the pond was not fully understood, so TDS samples of the solution above the crystal layer were not taken.

The crystal layer thickness changes with changes in temperature, and solution evaporation or precipitation. Thus, to fully quantify the contents of the pond, the complete depth sampling (periodic), solution TDS sampling, crystal sampling, and sludge sampling should all occur on the same day.

⑫ During the original sampling many problems were encountered with:

CLIENT EG&G ROCKY FLATS		JOB NUMBER JR-1198	
SUBJECT C POND VOLUME BASIS			
BASED ON		DRAWING NUMBER	
BY Templeton	CHECKED BY	APPROVED BY	DATE 7-7-93

- Breaking up the crystal layer to take crystal samples
- Breaking through the crystal layer to take sludge samples
- Breaking through the crystal layer to measure the bottom of the crystal layer and the depth of the sludge layer.

(13) Based on these difficulties the following was assumed:
- The sludge layer thickness did not change from 4/2/92.
- The sludge layer wt% solids did not change from .
- The sludge layer sol'n TDS did not change from .
- The elevation of the <u>bottom</u> of the crystal layer did not change from 4/2/92.
- The crystal layer wt% solids did not change from .
- The crystal layer sol'n TDS did not change from .

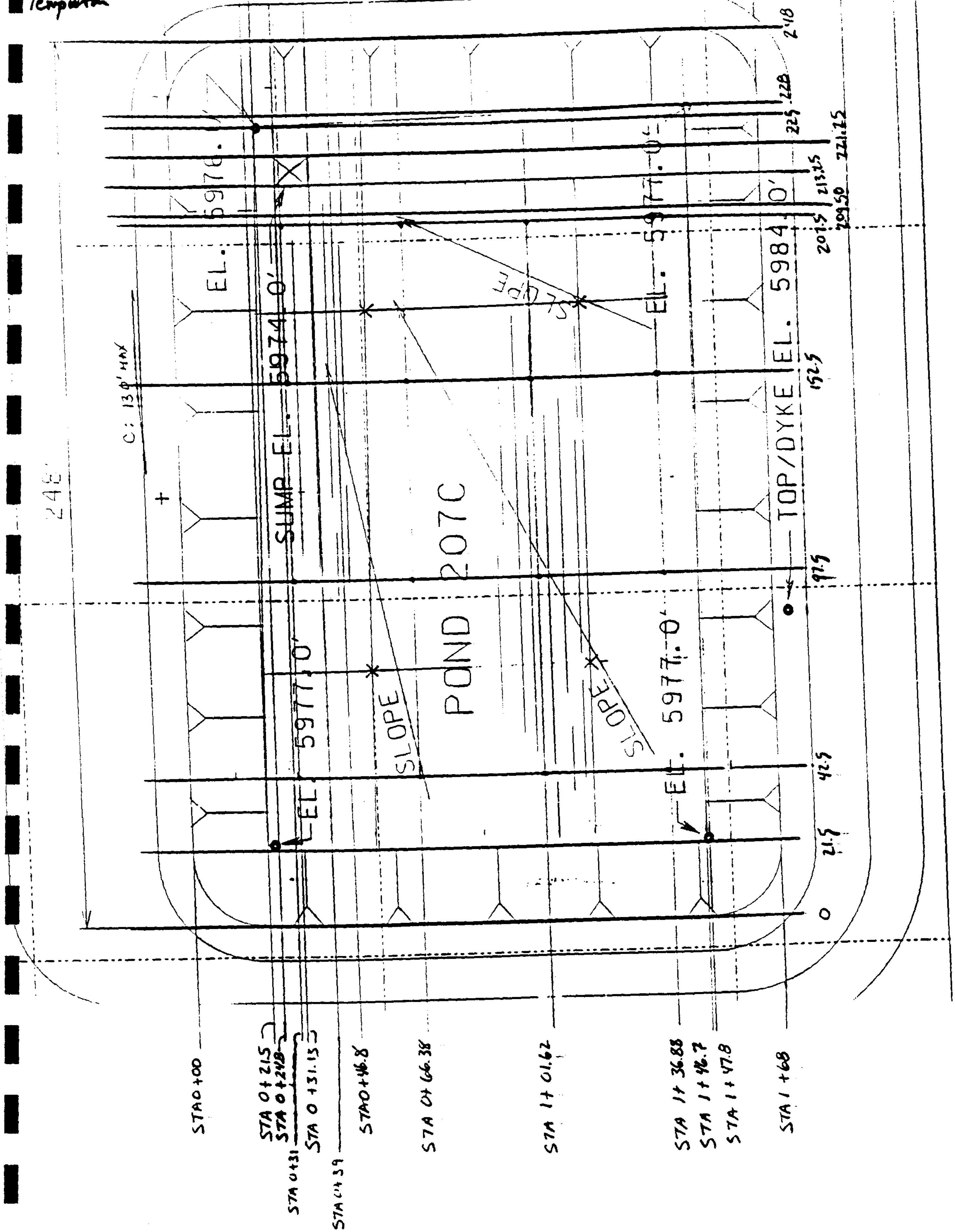
(14) Based on item (13) the following was performed on 9/10/92:
- Measured from sol'n level to top of crystal layer.
- Took 4 sets of TDS samples from the center of each quadrant consisting of:
  - one sample at the solution level;
  - one sample approximately midway between the sol'n level and the top of the crystal layer;
  - one sample directly above the crystal layer;
  - one sample top to bottom, sol'n level to top of crystal layer.

(15) Based on items (13) and (14):

- The sludge volume is based on measurements taken 4/2/92
- The crystal volume is based on measurements taken 4/2/92 the bottom of the layer and 9/10/92 for the top of the layer
- The total Pond Volume (and sol'n volume) is based on measurements taken 9/10/92.

EG&G Rocky Flats
C POND Volume ESTIMATE
Templeton

7-7-93



207C POND
BOTTOM COORDINATES

STATION NUMBER	EAST-WEST COORDINATE	ELEVATION
0+00	0.00	10.00
	248.00	10.00
0+21.5	0.00	10.00
	21.50	3.00
	248.00	10.00
0+24.8	0.00	10.00
	21.50	3.00
	225.00	2.00
	248.00	10.00
0+31.0	0.00	10.00
	21.50	3.00
	209.50	2.00
	213.25	0.00
	221.25	0.00
	225.20	2.05
	248.00	10.00
0+31.13	0.00	10.00
	21.50	3.00
	42.50	2.54
	97.50	2.29
	152.50	1.79
	207.50	1.33
	209.50	2.00
	213.25	0.00
	221.25	0.00
	225.20	2.05
	248.00	10.00
0+39.0	0.00	10.00
	21.50	3.00
	209.50	2.00
	213.25	0.00
	221.25	0.00
	225.40	2.12
	248.00	10.00
0+46.8	0.00	10.00
	21.50	3.00
	209.50	2.00
	225.50	2.18
	248.00	10.00

STATION NUMBER	EAST-WEST COORDINATE	ELEVATION
+66.38	0.00	10.00
	21.50	3.00
	42.50	2.58
	97.50	2.54
	152.50	1.92
	207.50	1.63
	226.00	2.34
	248.00	10.00
1+01.62	0.00	10.00
	21.50	3.00
	42.50	2.75
	97.50	2.63
	152.50	2.42
	207.50	2.29
	226.87	2.62
	248.00	10.00
1+36.8	0.00	10.00
	21.50	3.00
	42.50	2.92
	97.50	2.63
	152.50	2.50
	207.50	2.50
	227.70	2.91
	248.00	10
1+46.7	0.00	10
	21.50	3
	228.00	3
	248.00	10
1+47.8	0.00	10
	20.30	3.39
	228.00	3
	248.00	10
1+68.0	0.00	10
	248.00	10

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT EG&G Rocky Flats	JOB NUMBER JR-1198		
SUBJECT C Pond Volume Basis			
BASED ON	DRAWING NUMBER		
BY Templeton	CHECKED BY	APPROVED BY	DATE 7-7-93

C Pond Volume

Measured Sludge Layer

4/2/92

EARTHWORK VOLUMES Job - A:C402S Date - 05/02/1992 Time - 12:45:56

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
0+00.00	1863.36	0.00	0.00	0.00
0+21.50	995.39	0.03	1138.21	0.01
0+24.80	183.42	13.56	1210.24	0.84
0+31.00	175.82	37.54	1251.49	6.71
0+31.13	170.16	109.55	1252.32	7.06
0+39.00	174.45	38.69	1302.54	28.67
0+46.80	170.20	30.49	1352.33	38.66
0+66.38	162.99	98.46	1473.14	85.41
1+01.62	140.91	101.02	1671.47	215.59
1+36.88	135.83	96.00	1852.17	344.24
1+46.70	135.68	25.38	1901.55	366.31
1+47.80	153.70	3.14	1907.44	366.89
1+68.00	1701.05	0.00	2601.26	368.07

Total Volume - Cut = 2601.26 Cu.Yd. Fill = 368.07 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 17445.13 Sq.Ft. Fill = 23806.64 Sq.Ft.
Total Surface Area = 41664.00 Sq.Ft. 0.956 Acres
Totals Less Strip Volumes - Cut = 2601.26 Cu.Yd. Fill = 368.07 Cu.Yd.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER
EG&G Rocky Flats	JR-1198

SUBJECT: C Pond Volume Basis

BASED ON:

DRAWING NUMBER:

BY	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

C POND VOLUME
TO BOTTOM OF CRYSTAL LAYER

4/2/92

EARTHWORK VOLUMES Job - A:C402C Date - 05/02/1992 Time - 12:12:16

Station	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
0+00.00	1930.41	0.00	0.00	0.00
0+21.50	1062.41	0.00	1191.59	0.00
0+24.80	240.66	3.75	1271.22	0.23
0+31.00	224.28	18.95	1324.60	2.84
0+31.13	183.89	56.23	1325.58	3.02
0+39.00	214.28	22.02	1383.61	14.42
0+46.80	203.53	7.66	1443.96	18.71
0+66.38	177.03	60.70	1581.95	43.50
1+01.62	148.14	45.98	1794.15	113.11
1+36.88	149.67	55.12	1988.60	179.13
1+46.70	179.24	14.23	2048.41	191.74
1+47.80	205.27	0.00	2056.25	192.03
1+68.00	1755.76	0.00	2789.82	192.03

Total Volume - Cut = 2789.82 Cu.Yd. Fill = 192.03 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 20929.59 Sq.Ft. Fill = 20734.41 Sq.Ft.
Total Surface Area = 41664.00 Sq.Ft. 0.956 Acres
Totals Less Strip Volumes - Cut = 2789.82 Cu.Yd. Fill = 192.03 Cu.Yd.

APPENDIX G
Calculations for Clarifier Volume Estimates

INTEROFFICE MEMORANDUM

ATE: May 20, 1992

O: T. A. Bittner

R M: J. H. Templeton JHT

U JECT: Rocky Flats Solar Pond/Pondcrete
Stabilization Project
Brown & Root Job No. JR-1198

E ERENCE: **Clarifier Sludge and Solution Volume**

Th morning EG&G personnel took depth measurements in the clarifier. Based on my earlier onversation with you (T. A. Bittner), you felt the sludge layer would be approximately level and n a single measurement from the top of the solution to the top of the sludge layer would be e ired.

The samplers found that the sludge layer stiff enough to feel when lowering the measuring rod into he clarifier. This made the measurement much easier as they then only had to measure the wet o tion of the stick. After taking that measurement, they took their daily measurement from the op of the overflow weir to the top of the solution. The measurements taken were:

Top of solution to top of sludge	4'-1"
Top of weir to top of solution	1'-2.25"

Based on these measurements and EG&G drawing 8418-E-09 the following volumes were a ulated.

	VOLUME	
	cubic feet	gallons
SLUDGE	1,588	11,880
SOLUTION	2,004	15,000
TOTAL	3,592	26,880
MAXIMUM FILL VOLUME	4,150	31,000

(TO TOP OF CLARIFIER)

JHT 7/9/93

CALCULATION WORKSHEET Order No. 19116 (01-91)

C[redacted]NT	JOB NUMBER
EG&G Rocky Flats	JR-1198

SUBJECT
[redacted] C Pond Volume Basis

B[redacted]ED ON	DRAWING NUMBER

B[redacted]	CHECKED BY	APPROVED BY	DATE
[redacted]Templeton			7-7-93

C Pond Volume
TO TOP OF CRYSTAL LAYER

9/10/92

O[redacted]K VOLUMES Job - a:c9101 Date - 07/03/1993 Time - 09:34:32

ion	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
0.00	1753.08	0.00	0.00	0.00
1[redacted]50	886.18	1.11	1050.82	0.44
4[redacted]80	148.16	88.58	1114.03	5.92
31.00	147.97	119.97	1148.02	29.87
31.13	147.97	197.65	1148.74	30.63
3[redacted]00	146.45	126.36	1191.64	77.85
16[redacted]80	146.21	105.38	1233.92	111.32
56.38	138.30	163.99	1337.08	208.99
0[redacted]62	138.45	119.69	1517.68	394.12
3[redacted]88	133.44	115.06	1695.22	547.40
46.70	133.31	44.45	1743.73	576.41
4[redacted].80	137.00	7.89	1749.24	577.47
5[redacted]00	1579.60	0.00	2428.78	580.42

Total Volume - Cut = 2428.78 Cu.Yd. Fill = 580.42 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 14781.52 Sq.Ft. Fill = 26882.48 Sq.Ft.
Total Surface Area = 41664.00 Sq.Ft. 0.956 Acres
s[redacted]Less Strip Volumes - Cut = 2428.78 Cu.Yd. Fill = 580.42 Cu.Yd.

CALCULATION WORKSHEET Order No. 19116 (01-81)

IENT: EG&G Rocky Flats	JOB NUMBER: JR-1198
SUBJECT: C Pond Volume Basis	
ASED ON	DRAWING NUMBER

Y	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

C Pond Volume
Total

9/10/92

[illegible] VOLUMES Job - a:c910t Date - 07/03/1993 Time - 09:31:28

tion	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
00.00	1395.00	0.00	0.00	0.00
2[illegible].50	560.49	33.49	778.58	13.33
2[illegible].80	94.07	392.57	818.58	39.37
31.00	93.96	424.04	840.17	133.13
3[illegible].13	93.96	501.72	840.62	135.36
·3[illegible].00	93.96	424.11	868.01	270.29
·46.80	94.11	398.89	895.17	389.17
·66.38	94.03	447.15	963.39	695.94
·[illegible].62	93.89	381.53	1086.02	1236.73
·[illegible].88	93.89	360.10	1208.63	1720.98
+46.70	93.79	289.54	1242.76	1839.12
+[illegible].80	93.79	249.28	1246.58	1850.10
+[illegible].00	1395.00	0.00	1803.50	1943.35

Total Volume - Cut = 1803.50 Cu.Yd. Fill = 1943.35 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 12142.79 Sq.Ft. Fill = 29521.21 Sq.Ft.
Total Surface Area = 41664.00 Sq.Ft. 0.956 Acres
Less Strip Volumes - Cut = 1803.50 Cu.Yd. Fill = 1943.35 Cu.Yd.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: EG&G Rocky Flats	JOB NUMBER: JR-1198
SUBJECT: C Pond Volume Basis	
BASED ON	DRAWING NUMBER

	CHECKED BY	APPROVED BY	DATE
Templeton			7-7-93

C POND VOLUME

TOTAL

6/29/93

WORK VOLUMES Job - a:c629t Date - 07/07/1993 Time - 09:34:41

ation	Cut Area Sq.Ft.	Fill Area Sq.Ft.	Cut Volume Cu.Yd.	Fill Volume Cu.Yd.
+00.00	1440.88	0.00	0.00	0.00
+[illegible].50	597.97	25.09	811.76	9.99
+24.80	100.36	352.98	854.44	33.09
+31.00	100.24	384.45	877.47	117.76
+[illegible].13	100.24	462.12	877.95	119.80
+39.00	100.25	384.51	907.17	243.19
+[illegible]5.80	100.40	359.31	936.16	350.63
+[illegible]5.38	100.31	407.56	1008.93	628.69
+01.62	100.16	341.93	1139.76	1117.79
+[illegible]5.88	100.16	320.50	1270.57	1550.33
+46.70	100.06	249.93	1306.98	1654.06
+[illegible]7.80	100.06	209.67	1311.06	1663.43
[illegible]8.00	1440.88	0.00	1887.48	1741.86

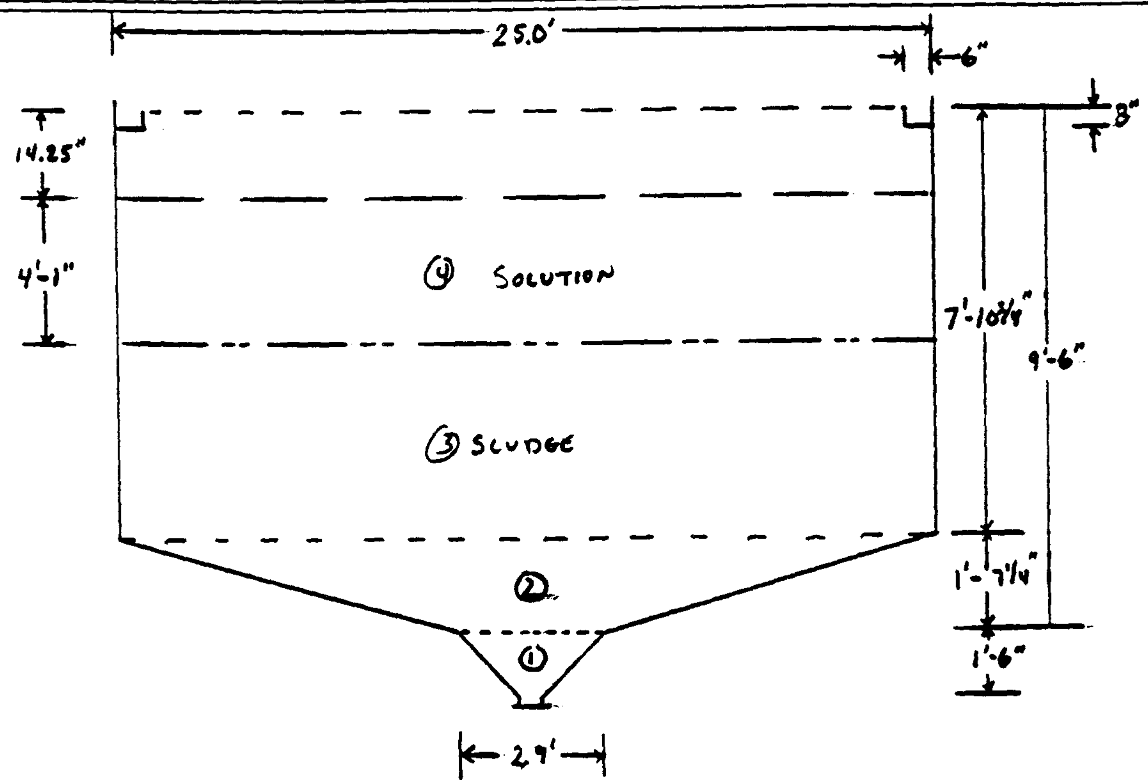
Total Volume - Cut = 1887.48 Cu.Yd. Fill = 1741.86 Cu.Yd.

Strip Volume - Cut = 0.00 Cu.Yd. Fill = 0.00 Cu.Yd.
Surface Areas - Cut = 12372.09 Sq.Ft. Fill = 29291.91 Sq.Ft.
Total Surface Area = 41664.00 Sq.Ft. 0.956 Acres
a[illegible] Less Strip Volumes - Cut = 1887.48 Cu.Yd. Fill = 1741.86 Cu.Yd.

CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: HNUS / EG&G ROCKY FLATS	JOB NUMBER: JR-1198
SUBJECT: VOLUME OF MATERIALS IN CLARIFIER	
BASED ON: Depth measurement & Dwg. 8418-E-09	DRAWING NUMBER:
BY: Templeton	CHECKED BY:
APPROVED BY:	DATE: 5-20-92



① $V = (1/3)\,\pi \left(\frac{2.9'}{2}\right)^2 (1.5') = 3.30$ cu ft

② $V = (1/3)\,\pi h \,(R_1^2 + R_2^2 + R_1R_2) = (1/3)\,\pi\,(1.6042)\left[\left(\frac{25}{2}\right)^2 + \left(\frac{2.9}{2}\right)^2 + \left(\frac{25}{2}\right)\left(\frac{2.9}{2}\right)\right]$

$= 296.5$ cu ft

③ SLUDGE

$(7'\text{-}10\tfrac{3}{4}'') - (14.25'') = 6'\text{-}8\tfrac{1}{2}''$ Solution + Sludge

$(6'\text{-}8\tfrac{1}{2}'') - (4'\text{-}1'') = 2'\text{-}7\tfrac{1}{2}''$ sludge

$V_{SLUDGE} = (\pi)\left(\frac{25}{2}\right)^2 (2.625') = 1288.5$ cu ft

296.5

3.3

1588 cu ft sludge

11,882 gallons sludge

he EG&G daily RCRA measurements can be converted into solution volume contained using the ollowing equations. This assumes the sludge volume does not change.

here X = EG&G daily RCRA measurement (top of solution to top of weir)

For X > 8 inches:

Solution Volume = (14,994) + [(306)(14.25 - X)]

For X < 8 inches:

Solution Volume = (16,906) + [(208)(8 - X)]

ttachments: Calculation sheets
Photocopy of log book page

c: JAS/JdP
JRZ/WCH/B&R Project File No. 816

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: HNUS/EG&G Rocky Flats	JOB NUMBER: JR-1198
SUBJECT: Volume of Materials in Clarifier	
BASED ON: Depth meas. & DWG 8418-E-09	DRAWING NUMBER:
BY: Templeton	CHECKED BY:
APPROVED BY:	DATE: 5-20-92

(4) Solution — Solution above sludge is 4'-1" deep & is entirely below the overflow weir.

$V_{solution} = (\pi)\left(\frac{25}{2}\right)^2(4.083) = 2004$ cu.ft

14,994 gallons

Total volume on May 20, 1992 = 26,880 gallon

(5) Solution Volume Based on EG&G RCRA measurement

Until the solution reaches the bottom of the weir (8" meas.) each inch of depth change is equal to

$(\pi)\left(\frac{25}{2}\right)^2(1/12) = 40.91$ cuft/inch

= 306 gallons/inch

For measurement > 8 inches, x = the measurement

Solution Volume = (14,994) + (306)(14.25 − x), gallons

For Measurements < 8" (inside the weir ring)

$V = (\pi)\left(\frac{24}{2}\right)(1/12) = 37.7$ cuft/inch = 282 gallons/inch

Solution Volume = (16,906) + (282)(8 − x)

4T 1/93 (6) To top of clarifier x=0 using (16,906) + [(208)(8−0)]

Sol'n Volume = 18,570 + Sludge Volume 11,880 ⇒ 30,450 ⇒ 31,000

65

[illegible] 20, 1992

[illegible] ARRIVED at 788 Bldg. Samplers could not locate 2nd 5' length of outer tube, checked all location. will try to sample w/ what we have

[illegible] went to clarifier & put it all together.
Samplers : Brad Bounds
Kathy Johnson
Support : Kristi Arnhold

[illegible]55 moved equipment up to Catwalk
Wind less than 5 miles/hr.
clear skies, sunny

[illegible]956 measured 4'-1" top of solution to top of sludge.
They did not use the outer tube since Mr Bounds could easily feel the sludge layer under the inner tube & he & Ms. Johnson just measured the wet portion of tube.

[illegible]000 top of water to weir overflow 14.25"
top of water to very top of clarifier -18½ to 18¾"

[illegible]002 Samplers moved equipment back into clarifier building

[illegible]005 Bagged tubes & left on clarifier, monitored at.

Gabriel 50th

... continued to page

[illegible]: John H. Templeton

[illegible] 5/20/92

INTEROFFICE MEMORANDUM

DATE: June 25, 1992

TO: T. A. Bittner

FROM: J. H. Templeton JHT

SUBJECT: Rocky Flats Solar Pond/Pondcrete Stabilization Project
Brown & Root Job No. JR-1198

REFERENCE: **207C Pond and Clarifier**
Calculation of Dry Solids in Sludges

For 207 C Pond, based on the following information:

specific gravity of insoluble solids	2.2
specific gravity of dry crystals	3.24
TDS of solution in sludge	46.0
wt % solids in the sludge	59.2
Volume of Sludge in Pond, gallons	38,800

the following calculations can be made:

Calculated sludge specific gravity	1.82
Calculated weight of sludge, lb.	588,200
Calculated weight of dry solids, lb.	348,200
Calculated weight of dry solids, tons	174

Based on the June 16, 1992 reported total pond volume of 487,200 and the preliminary TDS measurements (only two sets of samples, data for four sets expected soon), 30,495 gallons of fresh water must be added to the pond to -

- dissolve the crystal layer,
- dilute the solution to 35 wt% solids, and
- wash down the berm during reclaim (25,000 gallons).

This makes the present estimate of the 207C pond contents prior to processing to be:

dry solids	348,125 lb	174 tons	6.43% of the total
soluble salts	1,701,614 lb	851 tons	31.41% of the total
water	3,368,387 lb	1,684 tons	62.17% of the total

For the Clarifier, based on the following information:

Specific Gravity of Insoluble Solids	2.73 *
Specific Gravity of Solution	1.041
TDS of Solution, %	5.9
Volume of Sludge in Clarifier, gallons	11,880
Total Volume of Material in Clarifier, gallons	26,880

* per TAB

As the weight percent solids in the clarifier sludge is based on the sample taken from the top of the clarifier (36%), it is possible that the material in the bottom of the clarifier has a higher weight percent solids than at the top. Based on this, the calculation for dry solids will be for a range of possible contained solids values in the bottom of the clarifier. These are shown below based on ranges from 36 to 80% solids for the packed material at the bottom of the clarifier.

Wt. % Solids in Clarifier bottom	36.0	50.0	64.0	80.0
Average wt% solids	36.0	43.0	50.0	58.0
Sludge S.G.	1.34	1.42	1.51	1.62
Sludge Weight, lb.	132,600	140,500	149,400	160,300
Dry Solids, lb.	47,700	60,400	74,700	93,000
Dry Solids, tons	23.9	30.2	37.4	46.5
Soluble Salts, lb.	12,700	12,400	12,100	11,600
Water, lb.	202,300	197,800	192,700	185,700
Total in Clarifier, lb.	262,700	270,600	279,500	290,300

Attachments: Calculation Sheets (4)
Backup data sheets

cc: JRZ/WCH/B&R Project File No. 816
JAS

36% overall in sludge layer
overall density in clarifier = 1.173

CALCULATION WORKSHEET Order No. 19118 (01-91)

CLIENT	JOB NUMBER		
HNUS/EG&G ROCKY FLATS	JR-1198		
SUBJECT: DRY WEIGHT OF SOLIDS IN C POND & CLARIFIER			
BASED ON: PREVIOUS & NEW DATA	DRAWING NUMBER		
BY: TEMPLETON	CHECKED BY	APPROVED BY	DATE 6/25/92

C POND

- I PRESENTLY HAVE A S.G. OF THE SLUDGE = 1.613
- TO MAKE SURE THIS IS CONSISTENT WITH NEW DATA

S.G. SOLIDS = 2.2
S.G. CRYSTALS = 3.241 (DRY)

I PERFORM THE FOLLOWING CALCULATIONS

- The SOLUTION IN THE SLUDGE HAS TDS = 46.0%

$1/S.G._{soln} = (.54)/(1.0) + (.46)/(3.24)$

S.G. SOL'N = 1.466

and for wt% SOLIDS = 59.2%

$1/S.G._{sludge} = (.408/1.46) + .592/2.2$

S.G. SLUDGE = 1.82

- VOLUME OF SLUDGE = 38,800 gallons
  - ⇒ 588,200 pounds sludge
  - ⇒ 348,200 pounds dry SOLIDS (174 tons)

CLARIFIER

SOLIDS S.G. = 2.73 (per TAB)
Wt% SOLIDS = 36%
SOLUTION IN SLUDGE
TDS = 5.9%

I do not have a value for S.G. OF THE SOLUTION IN THE CLARIFIER SLUDGE.

AS IT COMES FROM A-POND, AND A pond has S.G. = 1.011 at a TDS OF 0.8%

CLIENT HNUS/EG&G ROCKY FLATS	JOB NUMBER JR-1198		
SUBJECT DRY WEIGHT OF SOLIDS IN C POND & CLARIFIER			
BASED ON PREVIOUS & NEW DATA	DRAWING NUMBER		
BY TEMPLETON	CHECKED BY	APPROVED BY	DATE 6/25/92

$1/1.011 = (.992/1.0) + (.008/x)$

$.9891 - .992 = (.008/x)$

$-.0029$ This indicates the TDS data does not justify

The characterization data for the clarifier solution shows an average S.g. of 1.041 This value may be much higher or lower in the sludge layer.

$1/\text{S.G SLUDGE} = .64/1.041 + .36/2.73$

S.G. SLUDGE = 1.34

11,880 Gallons Sludge ⇒ 132,600 lbs. SLUDGE

= 47,700 lbs SOLIDS (DRY) (36 wt% solids)

= 23.9 tons

IF THE SLUDGE IN THE BOTTOM OF THE CLARIFIER WAS 64 ~~65~~ wt% SOLIDS THE AVERAGE IN THE CLARIFIER WOULD BE ~50 wt%

$1/\text{SG. SLUDGE} = .50/1.041 + .50/2.73$

S.G. SLUDGE = 1.51

11,880 gal Sludge ⇒ 149,400 lbs sludge

74,700 lbs dry solids

37.3 tons

CALCULATION WORKSHEET Order No. 19118 (01-91)

CLIENT: ANUS/EG&G ROCKY FLATS	JOB NUMBER: JR-7198
SUBJECT: DRY WEIGHT OF SOLIDS IN C POND AND CLARIFIER	
BASED ON:	DRAWING NUMBER:

BY	CHECKED BY	APPROVED BY	DATE
Templeton			6/25/92

207C Pond

Based on the preliminary C Pond TDS data (taken 5/7/92) The Average TDS in the pond is 28.7%

The specific gravity of the sludge was changed in the attached spreadsheet to 1.82 per the calculation shown on page 1 of 2.

Based on the attached spreadsheet, to dissolve the crystal layer, dilute the solution to 35 wt% TDS, & to wash down the berm (25,000 gallons) 30,495 gallons of clean water will need to be added to the 207C pond total volume.

CALCULATION WORKSHEET Order No. 19118 (01-91)

CLIENT: HNUS / EG&G ROCKY FLATS	JOB NUMBER: JR-1198
SUBJECT: DRY WEIGHT OF SOLIDS IN C POND & CLARIFIER	
BASED ON	DRAWING NUMBER
BY: Templeton	CHECKED BY
APPROVED BY	DATE: 6/25/92

Clarifier AT 36% (by wt) Solids

47,700 Lbs Solids

84,900 Lbs Liquid in Sludge

+

15,000 gallons Sol'n above sludge ⇒ (15,000)(8.33)(1.041)

130,100 Lbs liquid

47,700 Lbs Solids

215,000 Lbs Solution (5.9% TDS)

(12,700 Lbs dissolved Solids
202,300 Lbs water)

47,700 / 262,700 = 18.16% Solids

$1/\text{s.g. in clarifier} = .8184/1.041 + .1816/2.73$

s.g. in clarifier (36 wt%) = 1.173

IN THE 15,000 gallons of solution there is

7,674 Lb. Soluble Salts

122,399 Lb Water

Break down for Sludge:

	Sol'n, Lb	Salt	Water	TOTAL Salt	TOTAL Water
36%	84,900	5009	79,891	12,683	202,290
50%	80,100	4726	75,374	12,400	197,773
64%	74,700	4409	70,293	12,081	192,692
80%	67,300	3971	63,329	11,645	185,728

HALLIBURTON NUS
Environmental Corporation

INTERNAL CORRESPONDENCE

TO: TED BITTNER

DATE: JUNE 23, 1992

FROM: SHAJ MATHEW

CC: ARNIE ALLEN
DON BRENNEMAN
JERRY CHILDS
RICK NIMESTEEL
TOM SHARE
MARK SPERANZA

SUBJECT: BACKGROUND ON 207C SPECIFIC GRAVITIES

I have attempted in this memo to summarize for the benefit of all parties, all the specific gravity information on 207C that will be discussed later today. Basically, the two sets of data in question are the characterization data (provided by the analytical laboratory) and an independent study conducted at the treatability study facility

I. 207C TDS SPECIFIC GRAVITIES

The apparent specific gravities of the dissolved solids was obtained by measuring the specific gravity of the solution. However, we have to decide between two sets of data

Data Set 1

This group contains all the data gathered during characterization, geotechnical analysis, and stratification sampling (Data plotted in Fig 1).
The average apparent specific gravity of the dissolved solids is 3.241.

Data Set 2

This includes data acquired during a separate series of experiments where the solutions were absolutely free of interference. Large volumes of sample were used for this study (Data plotted in Fig 2).
The average apparent specific gravity of the dissolved solids is 1.774.

II 207C TSS SPECIFIC GRAVITIES

Here again are the two sets of data:

Data Set 1

The geotechnical data (RMN to TB dated May 13, 1992 - Table 6) shows an average TSS specific gravity of 2.23.

Data Set 2

The data from the independent study shows a specific gravity of 2.167.

These two sets of data are very close to each other and can for all practical purposes be considered the same.

III CLARIFIER TSS SPECIFIC GRAVITIES

~~There is no good geotechnical data for this value.~~ 2.73 JB

The independent study showed a TSS specific gravity of 1.738.

However, we know that most of the clarifier contents come from Pond 207A. The geotechnical data (RMN to TB May 13, 1992 - Table 2) shows values around 2, although the values do not all seem to be right.

TABLE 3-10
SUMMARY OF POND WATER CHARACTERIZATION DATA - POND 207C
SOLAR POND/PONDCRETE PROJECT
ROCKY FLATS PLANT, COLORADO

ANALYSIS	UNITS	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTIONS	MEAN CONCENTRATION(1)	STANDARD DEVIATION(1)	% RELATIVE STANDARD DEVIATION(1)
MISCELLANEOUS						
Alkalinity (Methyl Orange)	mg/l	5/5	58,000-63,000	60,000	1900	3.2
Alkalinity (Phenolphthalein)	mg/l	5/5	25,000-32,000	29,000	2500	8.6
Ammonia	mg/l	5/5	1.8-6.4	3.7	2	53.2
Chloride	mg/l	5/5	21,000-25,000	23,000	1600	6.9
Cyanide-Amenable	mg/l	0/5	(-120)-(-0.77)	-34	---	---
Cyanide-Total	mg/l	5/5	3.3-20	7.7	7	91.3
Gross Alpha	pCi/l	5/5	63-130	99	27	27.3
Gross Beta	pCi/l	5/5	170-230	190	23	11.9
Nitrate	mg/l	5/5	57,000-66,000	62,000	3500	5.6
pH	units	5/5	10.0-10.1	10	---	---
Phosphorus, Total (as P)	mg/l	5/5	520-610	570	32	5.7
Specific Gravity	--	5/5	1.316-1.348	1.332	0.02	0.01
Sulfate (as SO_4)	mg/l	5/5	16,000-18,000	17,000	700	4.1
TDS (Total Dissolved Solids)	mg/l	5/5	300,000-510,000	460,000	88,500	19.4
TOC (Total Organic Carbon)	mg/l	5/5	1200-1600	1400	150	11.1
TSS (Total Suspended Solids)	mg/l	5/5	220-1400	530	490	91.5

ND Not Detected
pCi/l Picocuries per Liter

(1) Values calculated using 1/2 detection limit for nondetects, based on guidance contained in the Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Interim Final, December 1989.

(2) Only compounds with positive detections are listed. The complete list of compounds analyzed is shown in Table 2-3. The complete database is included in Appendix A.

APPENDIX H
Master Equipment Lists

DATE: 13 JUL 1993
FILE: CASE1-0.WK1
ISSUE: 1 - Revised
PLAN B

P & ID	ISSUE NO.
0051-1, 2 & 3	B
0052-3	A
0052-1, 2 & 4	B

MASTER EQUIPMENT LIST - ACCELERATED
EG & G ROCKY FLATS
POND SLUDGE, CONSOLIDATED B-POND
BROWN AND ROOT, INC., JOB NO. JR-1198
OPTION 1.0

SEQ. NO.	P&ID NO.	EQUIP. NO.	EQUIPMENT NAME	PROCURE TYPE	DESCRIPTION	PUMP TDH PSI	CAPACITY DESIGN	CAPACITY NOMINAL	TYP. VENDOR	LOC.	H.P.
1	0051/1	430-P-16	SLUDGE RECLAIM PUMP	SUB-CONTR					LEFCO	207A	
2	0051/1	430-P-16-M1		SUB-CONTR					LEFCO	207A	
3		430-P-09	POND DILUTION WATER PUMP	EXISTING					BY EG & G	207A	
4		430-P-09-M1		EXISTING					BY EG & G	207A	
5	0051/2	430-S-13	FRESH WATER STORAGE #1	EXISTING	40' L X 8' W X 9.5' HIGH FRAC TANK		12,800 GAL		V.E. ENTERPRIZES	207A	
6	0051/2	430-S-14	FRESH WATER STORAGE #2	EXISTING	40' L X 8' W X 9.5' HIGH FRAC TANK		12,800 GAL		V.E. ENTERPRIZES	207A	
7	0051/2	430-P-10	WASH-DOWN WATER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT. MODEL AG	120	100 GPM	80 GPM	WILFLEY	207A	
8	0051/2	430-P-10-M1		EXISTING	TEFC					207A	25.0
9	0051/2	430-SU-01	AGITATED TRANSFER SUMP	EXISTING	8' DIA X 6' HIGH		1000 GAL			207A	
10	0052/1	430-SC-03	STATIC SCREEN	EXISTING	2' WIDE X 60 DEGREE ARC WEDGE WIRE SCREEN				KASON	207A	
11	0052/1	430-S-05	GRAVITY SETTLING TANK	EXISTING	8'DIA. X 7'HIGH CYL X 8'DIA. X 65 DEG CONE		3250 GAL			207A	
12	0052/1	430-P-77	SLUDGE TRANSFER PUMP	EXISTING	2E012G1-CDQ-HSA PROGRESSING CAVITY	50	40 GPM	20 GPM	MOYNO	207A	
13	0052/1	430-P-77-M1		EXISTING	TEFC					207A	5.0
14	0053/3	430-P-25	TRANSFER BOOSTER PUMP	EXISTING	3"X1-1/2" HORIZ. CENT., MODEL K	100	100 GPM	80 GPM	WILFLEY	207A	
15	0053/3	430-P-25-M1		EXISTING						207A	20.0
16	0051/2	430-A-01	TRANSFER SUMP AGITATOR	EXISTING	XLQ-500, A-310 IMPELLER				BURHANS-SHARPE	750	
17	0051/2	430-A-01-M1		EXISTING	TEFC					750	7.5
18	0051/2	430-P-01	TRANSFER PUMP	EXISTING	2" X 1" HORIZ. CENT. MODEL K	45	60 GPM	30 GPM	WILFLEY	750	
19	0051/2	430-P-01-M1		EXISTING	TEFC					750	7.5
20	0052/1	430-S-06	PROCESS WATER TANK	EXISTING	8' DIA X 9' HIGH		3000 GAL			207A	
21	0052/1	430-P-06	PROCESS WATER PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	112	200 GPM	150 GPM	WILFLEY	207A	
22	0052/1	430-P-06-M1		EXISTING	TEFC					207A	40.0
23	0052/1	430-P-02	POND FLUSH WATER PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	50	150 GPM	100 GPM	WILFLEY	207A	
24	0052/1	430-P-02-M1		EXISTING	TEFC					207A	20.0
25		430-G-01P	207 AREA PRIME GENERATOR	LEASE					KOHLER	207A	
26		430-W-02	207 AREA M.C.C.	EXISTING					ALLEN BRADLEY	207A	
27		430-K-01	207 AREA AIR COMPRESSOR	LEASE	100 PSI @ 320 ACFM AIR COMPRESSOR		320 ACFM		INGERSOLL RAND	207A	
28		430-K-01-M1		LEASE	TEFC					207A	75.0
29		430-W-04	PORTABLE SLUDGE VACUUM	EG & G	REFER TO EG & G FIELD SPECS.		2 TPH			207A	
30		430-W-04-M1		EG & G	TEFC					207A	20.0

DATE: 13 JUL 1993

FILE: CASE2-0.WK1

ISSUE: 1-Revised

PLAN C

P&ID	ISSUE NO.
[redacted]	D
0053-3	C
0054-1	B
0054-2	D
0054-3	C

[redacted]EG & G ROCK[redacted]FLATS
PONDSLUDGE, RECLAIM C-POND
BROWN AND ROOT, INC., JOB NO. JR-1198
OPTION 2.0

SEQ. NO.	P&ID NO.	EQUIP. NO.	EQUIPMENT NAME	PROCURE TYPE	DESCRIPTION	PUMP TDH PSI	CAPACITY DESIGN	CAPACITY NOMINAL	TYP. VENDOR	LOC.	H.P.
1	0053/1	430-P-20	BRINE RECLAIM PUMP	SUB-CONTR.					LEFCO	207C	
2	0053/1	430-S-18	DILUTION BRINE TANK	EXISTING	8' DIA. X 9' HIGH		3000 GAL			207C	
3	0053/1	430-P-18	DILUTION BRINE PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	120	200 GPM	150 GPM	WILFLEY	207C	
4	0053/1	430-P-18-M1		EXISTING	TEFC					207C	40.0
5	0053/1	430-P-15	207C POND SLUDGE RECLAIM PUMP	SUB-CONTR.					LEFCO	207C	
6	0053/1	430-P-15-M1		SUB-CONTR.					LEFCO	207C	
7	0053/2	430-SC-02	STATIC SCREEN	SUB-CONTR.					LEFCO	207C	
8	0053/2	430-SC-02-M1		SUB-CONTR.					LEFCO	207C	
9	0053/2	430-SU-03	SCREEN UNDERSIZE SUMP	SUB-CONTR.			3600 GAL		LEFCO	207C	
10	0053/2	430-A-03	UNDERSIZE SUMP AGITATOR	SUB-CONTR.					LEFCO	207C	
11	0053/2	430-A-03-M1		SUB-CONTR.					LEFCO	207C	
12		430-W-06	PORTABLE SLUDGE VACUUM	EG & G	REFER TO EG & G FIELD SPECS.		2 TPH			207C	
13		430-W-06-M1		EG & G	TEFC					207C	20.0
14	0053/3	430-P-24	SLUDGE TRANSFER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT. MODEL K	100	100 GPM	80 GPM	WILFLEY	207C	
15	0053/3	430-P-24-M1		EXISTING	TEFC					207C	20.0
16	0054/2	430-S-12	750 PAD PROCESS WATER TANK	EXISTING	8' DIA. X 9' HIGH		3000 GAL			207C	
17	0054/2	430-P-12	750 PAD PROCESS WATER PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	40	200 GPM	150 GPM	WILFLEY	207C	
18	0054/2	430-P-12-M1		EXISTING	TEFC					207C	10.0
19	0053/3	430-P-25	SLUDGE TRANSFER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT. MODEL K	100	100 GPM	80 GPM	WILFLEY	207B	
20	0053/3	430-P-25-M1		EXISTING	TEFC					207B	20.0
21	0053/2	430-SU-01	AGITATED TRANSFER SUMP	EXISTING	6' DIA X 6' HIGH		1000 GAL			750	
22	0053/2	430-A-01	TRANSFER SUMP AGITATOR	EXISTING	XLQ-500, A-310 IMPELLER				BURHANS-SHARP	750	
23	0053/2	430-A-01-M1		EXISTING	TEFC					750	7.5
24	0053/2	430-P-01	TRANSFER PUMP	EXISTING	2" X 1" HORIZ. CENT., MODEL K	45	60 GPM	30 GPM	WILFLEY	750	
25	0053/2	430-P-01-M1		EXISTING	TEFC					750	7.5
26		430-G-02P	207C AREA PRIME GENERATOR	H/NUS			400 KW		CATAPILLAR	207C	
27		430-G-02E	207C AREA EMERGENCY GENERATOR	H/NUS			200 KW		CATAPILLAR	207C	
28		430-S-31	DIESEL FUEL TANK	H/NUS			1000 GAL		CATAPILLAR	207C	
29		430-G-03P	750 AREA PRIME GENERATOR	H/NUS			545 KW		CATAPILLAR	750	
30		430-S-32	DIESEL FUEL TANK	H/NUS			1000 GAL		CATAPILLAR	750	
31		430-W-02	750 AREA M.C.C.	EXISTING					ALLEN BRADLEY	750	
32		430-K-03	207C AREA AIR COMPRESSOR (PRIME)	H/NUS	100 PS1 @ 200 ACFM AIR COMPRESSOR		200 ACFM		INGERSOLL RAND	207C	
33		430-K-03-M1		H/NUS	TEFC					207C	50.0
34		430-K-05	750 AREA AIR COMPRESSOR	H/NUS	100 PS1 @ 200 ACFM AIR COMPRESSOR		200 ACFM		INGERSOLL RAND	750	
35		430-K-05-M1		H/NUS	TEFC					750	50.0

FILE: CASE3-0.WK1
ISSUE: 1-Revised
CLARIFIER

[illegible]	D
0053-5	C
0054-1	B
0054-2	D
0054-3	C

EG & G ROCKY FLATS
CLARIFIER RECLAIM
BROWN AND ROOT, INC., JOB NO. JR-1198
OPTION 3.0

SEQ. NO.	P&ID NO.	EQUIP. NO.	EQUIPMENT NAME	PROCURE TYPE	DESCRIPTION	PUMP TDH PSI	CAPACITY DESIGN	CAPACITY NOMINAL	TYP. VENDOR	LOC.	H.P.
1	0053/1	430-P-20	207C BRINE RECLAIM PUMP	SUB-CONTR.					LEFCO	207C	
2	0053/1	430-S-18	DILUTION BRINE TANK	EXISTING	8' DIA. X 9' HIGH		3000 GAL			207C	
3	0053/1	430-P-18	DILUTION BRINE PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	120	200 GPM	150 GPM	WILFLEY	207C	
4	0053/1	430-P-18-M1		EXISTING	TEFC					207C	40.0
5	0053/2	430-P-27	CLARIFIER RECLAIM PUMP	SUB-CONTR.					LEFCO	207C	
6	0053/2	430-SC-04	SCALPING SCREEN	SUB-CONTR.					LEFCO	207C	
7	0053/2	430-SC-04-M1		SUB-CONTR.					LEFCO	207C	
8	0053/2	430-SU-06	788 HOLDING SUMP	SUB-CONTR.			3600 GAL		LEFCO	207C	
9	0053/2	430-A-26	788 HOLDING SUMP AGITATOR	SUB-CONTR.					LEFCO	207C	
10	0053/2	430-A-26-M1		SUB-CONTR.					LEFCO	207C	
11	0053/2	430-P-51	788 HOLDING SUMP RECIRCULATION PUMP	SUB-CONTR.					LEFCO	207C	
12	0053/2	430-P-51-M1		SUB-CONTR.					LEFCO	207C	
13		430-W-06	PORTABLE SLUDGE VACUUM	EG & G	REFER TO EG & G FIELD SPECS.		2 TPH			207C	
14		430-W-06-M1		EG & G	TEFC					207C	20.0
15	0053/3	430-P-24	SLUDGE TRANSFER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT. MODEL K	100	100 GPM	80 GPM	WILFLEY	207C	
16	0053/3	430-P-24-M1		EXISTING	TEFC					207C	20.0
17	0053/3	430-P-25	SLUDGE TRANSFER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT. MODEL K	100	100 GPM	80 GPM	WILFLEY	207C	
18	0053/3	430-P-25-M1		EXISTING	TEFC					207C	20.0
24	0054/2	430-S-12	750 PAD PROCESS WATER TANK	EXISTING	8' DIA. X 9' HIGH		3000 GAL			207C	
25	0054/2	430-P-12	750 PAD PROCESS WATER PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	40	200 GPM	150 GPM	WILFLEY	207C	
26	0054/2	430-P-12-M1		EXISTING	TEFC					207C	10.0
19	0054/2	430-SU-01	AGITATED TRANSFER SUMP	EXISTING	6' DIA X 6' HIGH		1000 GAL			750	
20	0054/2	430-A-01	TRANSFER SUMP AGITATOR	EXISTING	XLC-500, A-310 IMPELLER				BURHANS - SHARPE	750	
21	0054/2	430-A-01-M1		EXISTING	TEFC					750	7.5
22	0054/2	430-P-01	TRANSFER PUMP	EXISTING	2" X 1" HORIZ. CENT., MODEL K	45	60 GPM	30 GPM	WILFLEY	750	
23	0054/2	430-P-01-M1		EXISTING	TEFC					750	20.0
27		430-G-02P	207C AREA PRIME GENERATOR	H/NUS			400 KW		CATAPILLAR	207C	
28		430-G-02E	207C AREA EMERGENCY GENERATOR	H/NUS			200 KW		CATAPILLAR	207C	
29		430-S-31	DIESEL FUEL TANK	H/NUS			1000 GAL		CATAPILLAR	207C	
30		430-G-03P	750 AREA PRIME GENERATOR	H/NUS			545 KW		CATAPILLAR	750	
31		430-S-32	DIESEL FUEL TANK	H/NUS			1000 GAL		CATAPILLAR	750	
32		430-W-02	750 AREA M.C.C.	EXISTING					ALLEN BRADLEY	750	
33		430-K-03	207C AREA AIR COMPRESSOR (PRIME)	H/NUS	100 PSI @ 200 ACFM AIR COMPRESSOR		200 ACFM		INGERSOLL RAND	207C	
34		430-K-03-M1		H/NUS	TEFC					207C	50.0

DATE: 13 JUL 1993
FILE: CASE4-2.WK1
ISSUE: 1 – Revised
PLAN B

P & ID	ISSUE NO.
0051/1, 2 & 3	B
0052/3	A
0052/1, 2 & 4	B

MASTER EQUIPMENT LIST – ACCELERATED
EG & G ROCKY FLATS
POND SLUDGE, CONSOLATED B-POND
BROWN AND ROOT, INC., JOB NO. JR-1198
OPTION 4.2

SEQ. NO.	P&ID NO.	EQUIP. NO.	EQUIPMENT NAME	PROCURE TYPE	DESCRIPTION	PUMP TDH PSI	CAPACITY DESIGN	CAPACITY NOMINAL	TYP. VENDOR	LOC.	H.P.
1	0051/1	430-P-16	SLUDGE RECLAIM PUMP	SUB-CONTR.					LEFCO	207A	
2	0051/1	430-P-16-M1		SUB-CONTR.					LEFCO	207A	
3	0052/1	430-SC-03	STATIC SCREEN	EXISTING	2' WIDE X 60 DEGREE ARC WEDGE WIRE SCREEN				KASON	207A	
4	0052/1	430-S-05	DIRTY WATER SEPARATOR	EXISTING	8 DIA. X 7'HIGH CYL X 8'DIA. X 65 DEG CONE		3250 GAL			207A	
5	0052/1	430-P-??	SLUDGE TRANSFER PUMP	?????						207A	
6	0052/1	430-P-??-M1		?????	TEFC					207A	
7	0053/3	430-P-25	TRANSFER BOOSTER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT., MODEL K	100	100 GPM	80 GPM	WILFLEY	207B	
8	0053/3	430-P-25-M1		EXISTING						207B	20.0
9	0052/1	430-S-06	PROCESS WATER TANK	EXISTING	8' DIA X 9' HIGH		3000 GAL			207A	
10	0052/1	430-P-06	PROCESS WATER PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	112	200 GPM	150 GPM	WILFLEY	207A	
11	0052/1	430-P-06-M1		EXISTING	TEFC					207A	40.0
12		430-P-09	POND DILUTION WATER PUMP	EXISTING					BY EG & G	207A	
13		430-P-09-M1		EXISTING					BY EG & G	207A	
14	0051/2	430-S-13	WASH DOWN WATER TANK #1	EXISTING	40' L X 8' W X 9.5' HIGH FRAC TANK		12,800 GAL		V.E. ENTERPRIZES	207A	
15	0051/2	430-P-34	DECANT WATER PUMP	EXISTING	2" X 1-1/2" DIAPHRAGM	80	60 GPM	30 GPM	WILDEN	750	
16	0051/2	430-S-14	WASH DOWN WATER TANK #2	EXISTING	40' L X 8' W X 9.5' HIGH FRAC TANK		12,800 GAL		V.E. ENTERPRIZES	207A	
17	0051/2	430-P-35	DECANT WATER PUMP	EXISTING	2" X 1-1/2" DIAPHRAGM	45	60 GPM	30 GPM	WILDEN	750	
18	0051/2	430-P-10	WASH DOWN WATER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT. MODEL AG	120	100 GPM	80 GPM	WILFLEY	207A	
19	0051/2	430-P-10-M1		EXISTING	TEFC					207A	25.0
20	0051/2	430-SU-01	AGITATED TRANSFER SUMP	EXISTING	6' DIA X 6' HIGH		1000 GAL			750	
21	0051/2	430-A-01	TRANSFER SUMP AGITATOR	EXISTING	XLQ-500, A-310 IMPELLER				BURHANS-SHARPE	750	
22	0051/2	430-A-01-M1		EXISTING	TEFC					750	7.5
23	0051/2	430-P-01	TRANSFER PUMP	EXISTING	2" X 1" HORIZ. CENT. MODEL K	45	60 GPM	30 GPM	WILFLEY	750	
24	0051/2	430-P-01-M1		EXISTING	TEFC					750	7.5
25	0052/2	430-SU-02	CEMENT FLUSH WATER SUMP	EXISTING	5' DIA X 5' HIGH		575 GAL			750	
26	0052/2	430-P-07	CEMENT FLUSH WATER PUMP	EXISTING	3"X 60"L VERT. CENT. MODEL 5100	50	200 GPM	150 GPM	GALIGHER	750	
27	0052/2	430-P-07-M1		EXISTING	TEFC					750	25.0
28		430-G-01P	207 AREA PRIME GENERATOR	LEASE					KOHLER	207A	
29		430-W-02	207 AREA M.C.C.	EXISTING					ALLEN BRADLEY	207A	
30		430-K-01	207 AREA AIR COMPRESSOR	LEASE	100 PSI @ 320 ACFM AIR COMPRESSOR		320 ACFM		INGERSOLL RAND	207A	
31		430-K-01-M1		LEASE	TEFC					207A	75.0
32		430-W-04	PORTABLE SLUDGE VACUUM	EG & G	REFER TO EG & G FIELD SPECS.		2 TPH			207A	
33		430-W-04-M1		EG & G	TEFC					207A	20.0

DATE: 13 JUL 1993	P & ID	ISSUE NO.
FILE: CASE7-1.WK1	0051: 1, 2 & 3	B
ISSUE: 1 - Revised	0052: 3	A
PLAN B	0052: 1, 2 & 4	B

MASTER EQUIPMENT LIST - ACCELERATED
EG & G ROCKY FLATS
POND SLUDGE, CONSOLATED B-POND
BROWN AND ROOT, INC., JOB NO. JR-1198
OPTION 7.1

SEQ. NO.	P&ID NO.	EQUIP. NO.	EQUIPMENT NAME	PROCURE TYPE	DESCRIPTION	PUMP TDH PSI	CAPACITY DESIGN	CAPACITY NOMINAL	TYP. VENDOR	LOC.	H.P.
1	0051/1	430-P-16	SLUDGE RECLAIM PUMP	SUB-CONTR					LEFCO	207A	
2	0051/1	430-P-16-M1		SUB-CONTR					LEFCO	207A	
3	0051/2	430-SC-01	SCALPING SCREEN	SUB-CONTR					LEFCO	207A	
4	0051/2	430-SC-01-M1		SUB-CONTR					LEFCO	207A	
5	0051/2	430-SU-05	SCREEN U/S AGITATED SUMP	SUB-CONTR					LEFCO	207A	
6	0051/2	430-A-02	SCREEN U/S SUMP AGITATOR	SUB-CONTR					LEFCO	207A	
7	0051/2	430-A-02-M1		SUB-CONTR					LEFCO	207A	
8	0051/2	430-P-??	SLUDGE TRANSFER PUMP	?????						207A	
9	0051/2	430-P-??-M1		?????						207A	
10	0053/3	430-P-25	TRANSFER BOOSTER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT., MODEL K	100	100 GPM	80 GPM	WILFLEY	207A	
11	0053/3	430-P-25-M1		EXISTING	TEFC					207A	20.0
12		430-P-09	POND DILUTION WATER PUMP	EXISTING					BY EG & G	207A	
13		430-P-09-M1		EXISTING					BY EG & G	207A	
14	0051/2	430-S-13	WASH DOWN WATER TANK #1	EXISTING	40' L X 8' W X 9.5' HIGH FRAC TANK		12.800 GAL		V.E. ENTERPRIZES	207A	
15	0051/2	430-P-34	DECANT TRANSFER PUMP	EXISTING	2" X 1-1/2" DIAPHRAGM	80	60 GPM	30 GPM	WILDEN	750	
16	0051/2	430-S-14	WASH DOWN WATER TANK #2	EXISTING	40' L X 8' W X 9.5' HIGH FRAC TANK		12.800 GAL		V.E. ENTERPRIZES	207A	
17	0051/2	430-P-35	DECANT TRANSFER PUMP	EXISTING	2" X 1-1/2" DIAPHRAGM	45	60 GPM	30 GPM	WILDEN	750	
18	0051/2	430-P-10	WASH DOWN WATER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT. MODEL AG	120	100 GPM	80 GPM	WILFLEY	207A	
19	0051/2	430-P-10-M1		EXISTING	TEFC					207A	25.0
20	0052/1	430-SU-01	TRANSFER SUMP	EXISTING	6' DIA X 6' HIGH		1000 GAL			750	
21	0051/2	430-P-01	TRANSFER PUMP	EXISTING	2" X 1" HORIZ. CENT. MODEL K	45	60 GPM	30 GPM	WILFLEY	750	
22	0051/2	430-P-01-M1		EXISTING	TEFC					750	7.5
23	0051/2	430-S-12	PROCESS WATER TANK	EXISTING	8' DIA X 9' HIGH		3000 GAL			207A	
24	0052/1	430-P-12	PROCESS WATER PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	50	150 GPM	100 GPM	WILFLEY	207A	
25	0052/1	430-P-02-M1		EXISTING	TEFC					207A	20.0
26	0052/1	430-S-06	PROCESS WATER DECANT TANK	EXISTING	8' DIA X 9' HIGH		3000 GAL			750	
27	0052/1	430-P-06	PROCESS WATER DECANT PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	112	200 GPM	150 GPM	WILFLEY	750	
28	0052/1	430-P-06-M1		EXISTING	TEFC					750	40.0
29		430-G-01P	207 AREA PRIME GENERATOR	LEASE					KOHLER	207A	
30		430-W-02	207 AREA M.C.C.	EXISTING					ALLEN BRADLEY	207A	
31		430-K-01	207 AREA AIR COMPRESSOR	LEASE	100 PSI @ 320 ACFM AIR COMPRESSOR		320 ACFM		INGERSOLL RAND	207A	
32		430-K-01-M1		LEASE	TEFC					207A	75.0
33		430-W-04	PORTABLE SLUDGE VACUUM	EG & G	REFER TO EG & G FIELD SPECS.		2 TPH			207A	
34		430-W-04-M1		EG & G	TEFC					207A	20.0

DATE: 13 JUL 1993
FILE: CASE4-3.WK1
ISSUE: 1 – Revised
PLAN B

P & ID	ISSUE NO.
0051: 1, 2 & 3	B
0052: 3	A
0052: 1, 2 & 4	B

MASTER EQUIPMENT LIST – ACCELERATED
EG & G ROCKY FLATS
POND SLUDGE, CONSOLATED B-POND
BROWN AND ROOT, INC., JOB NO. JR-1198
OPTION 4.3

SEQ. NO.	P&ID NO.	EQUIP. NO.	EQUIPMENT NAME	PROCURE TYPE	DESCRIPTION	PUMP TDH PSI	CAPACITY DESIGN	CAPACITY NOMINAL	TYP. VENDOR	LOC.	H.P.
1	0051/1	430-P-16	SLUDGE RECLAIM PUMP	SUB-CONTR					LEFCO	207A	
2	0051/1	430-P-16-M1		SUB-CONTR.					LEFCO	207A	
3	0051/2	430-SC-01	SCALPING SCREEN	SUB-CONTR					LEFCO	207A	
4	0051/2	430-SC-01-M1		SUB-CONTR					LEFCO	207A	
5	0051/2	430-SU-05	SCREEN U/S AGITATED SUMP	SUB-CONTR					LEFCO	207A	
6	0051/2	430-A-02	SCREEN U/S SUMP AGITATOR	SUB-CONTR					LEFCO	207A	
7	0051/2	430-A-02-M1		SUB-CONTR.					LEFCO	207A	
8	0051/2	430-P-??	SLUDGE TRANSFER PUMP	?????						207A	
9	0051/2	430-P-??-M1		?????						207A	
10	0053/3	430-P-25	TRANSFER BOOSTER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT., MODEL K	100	100 GPM	80 GPM	WILFLEY	207A	
11	0053/3	430-P-25-M1		EXISTING	TEFC					207A	20.0
12		430-P-09	POND DILUTION WATER PUMP	EXISTING					BY EG & G	207A	
13		430-P-09-M1		EXISTING					BY EG & G	207A	
14	0051/2	430-S-13	WASH DOWN WATER TANK #1	EXISTING	40' L X 8' W X 9.5' HIGH FRAC TANK		12,800 GAL		V.E. ENTERPRIZES	207A	
15	0051/2	430-P-34	DECANT TRANSFER PUMP	EXISTING	2" X 1-1/2" DIAPHRAGM	80	60 GPM	30 GPM	WILDEN	750	
16	0051/2	430-S-14	WASH DOWN WATER TANK #2	EXISTING	40' L X 8' W X 9.5' HIGH FRAC TANK		12,800 GAL		V.E. ENTERPRIZES	207A	
17	0051/2	430-P-35	DECANT TRANSFER PUMP	EXISTING	2" X 1-1/2" DIAPHRAGM	45	60 GPM	30 GPM	WILDEN	750	
18	0051/2	430-P-10	WASH DOWN WATER PUMP	EXISTING	3" X 1-1/2" HORIZ. CENT MODEL AG	120	100 GPM	80 GPM	WILFLEY	207A	
19	0051/2	430-P-10-M1		EXISTING	TEFC					207A	25.0
20	0052/1	430-S-05	DIRTY WATER SEPARATOR	EXISTING	8'DIA. X 7'HIGH CYL X 8'DIA. X 65 DEG CONE		3250 GAL			750	
21	0051/2	430-A-01	DIRTY WATER SEPARATOR AGITATOR	EXISTING	XLQ-500, A-310 IMPELLER				BURHANS-SHARPE	750	
22	0051/2	430-A-01-M1		EXISTING	TEFC					750	7.5
23	0051/2	430-P-01	TRANSFER PUMP	EXISTING	2" X 1" HORIZ. CENT. MODEL K	45	60 GPM	30 GPM	WILFLEY	750	
24	0051/2	430-P-01-M1		EXISTING	TEFC					750	7.5
25	0051/2	430-SU-01	PROCESS WATER TANK	EXISTING	6' DIA X 6' HIGH		1000 GAL			207A	
26	0052/1	430-P-02	PROCESS WATER PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	50	150 GPM	100 GPM	WILFLEY	207A	
27	0052/1	430-P-02-M1		EXISTING	TEFC					207A	20.0
28	0052/1	430-S-08	PROCESS WATER DECANT TANK	EXISTING	8' DIA X 9' HIGH		3000 GAL			750	
29	0052/1	430-P-08	PROCESS WATER DECANT PUMP	EXISTING	3" X 2" HORIZ. CENT. MODEL AG	112	200 GPM	150 GPM	WILFLEY	750	
30	0052/1	430-P-08-M1		EXISTING	TEFC				•	750	40.0
31		430-G-01P	207 AREA PRIME GENERATOR	LEASE					KOHLER	207A	
32		430-W-02	207 AREA M.C.C.	EXISTING					ALLEN BRADLEY	207A	
33		430-K-01	207 AREA AIR COMPRESSOR	LEASE	100 PSI @ 320 ACFM AIR COMPRESSOR		320 ACFM		INGERSOLL RAND	207A	
34		430-K-01-M1		LEASE	TEFC					207A	75.0
35		430-W-04	PORTABLE SLUDGE VACUUM	EG & G	REFER TO EG & G FIELD SPECS.		2 TPH			207A	
36		430-W-04-M1		EG & G	TEFC					207A	20.0

INTEROFFICE MEMORANDUM

Date: 15 Jul 1993

File: 961.283

To: J. A. Schmidt

From: B. J. York

Subject: E G & G Rocky Flats, Solar Pond Project
Brown and Root, Inc., Job No. JR-1198

Reference: Accelerated Sludge Removal Project
Transfer Pumps

The existing Wilfley horizontal centrifugal and the Wilden diaphragm pumps are included on the six Block Flow Diagrams (BFD) and corresponding Equipment List scenarios. All of these pumps have been sized for a specific application in the Pondsludge process flowsheets. Each pump is designed to pump within a specified flow rate envelope given the target fluid density, solids percent, total dynamic head (TDH), pipe friction losses and viscosity.

The Wilden pumps, (P-34 and P-35) and the Wilfley model AG pumps, (P-02, P-06, P-10, P-12, and P-18) are to be used to pump water and brine solutions. The TDH calculations are generally limited to pipe friction losses with little to no solids, elevation, or pipe fittings corrections. The diaphragm pump capacity can be varied from near zero to its rated capacity by adjustments to the air pressure and volume to the bladders, thus increasing or decreasing the stroke cycle. Recirculation lines can be installed on the discharge of horizontal centrifugal pumps to vary their output from zero (full recycle) to rated capacity (no recycle). In each case, there are no suspended solids and the liquid will flow at widely varying rates.

The transfer of pondsludge slurry to containment will be accomplished with Wilfley model K pumps P-01 and P-24/25. In addition, an unnamed sludge transfer pump, P-?? to be purchased will be used on Block Flow Diagrams 4.2, 4.3 and 7.1 (B-Pond Sludge Removal Options).

The Wilfley, model K pump will move the pondsludge slurry, provided the viscosity is less than 300 to 600 cP. Also a given size pump will only accommodate some maximum size driver. For example, the 2" X 1" pump will accept up to a 15 horsepower motor and the 3" X 1-1/2" pump will accept up to a 100 horsepower motor. Refer to the attached Wilfley fax.

If the viscosity exceeds the 300 to 600 cP range, a progressive cavity (PC) pump must be used for the "unnamed sludge transfer pump." Also, its' capacity must match the minimum flow rate of pump P-25, estimated to be approximately 50 GPM, if the progressive cavity pump is to feed the suction of P-25. The maximum capacity of the Moyno progressive cavity pump P-05 is 30 GPM at 460

PM, according to supplier Bullin Pump in Houston. Therefore a larger PC pump if needed is required as a transfer pump.

The sub-contractors sludge reclaim pump will have a great tendency to "break up" gelatinous and solids chunks. The static or clipping screen used to remove the oversize is assumed to be 1/2" or less. Lacking rheological data on the nature of the sludges, we can reasonably assume that the screen undersize will have sufficiently low viscosity to require only a horizontal centrifugal pump.

None of the model AG pumps discussed above can be used successfully as a slurry/sludge transfer pump. These pumps will handle up to about 15 to 20 percent solids fairly well, but will only clear a 1/8" particle. AG pumps are designed with closer clearances than are the model K pumps. Also, the model AG pumps are designed more for corrosion than for abrasion as are the harder model K pumps. The AG pump impeller, Brinell Hardness Number (BHN) is approximately 250, versus a BHN of 450 to 500 for the model K.

The viscosity component in itself will only affect the motor horsepower requirement for a given flow rate, fluid density, solids percentage and TDH. The larger the viscosity, the larger the horsepower required to deliver the same flow rate. However, since each pump mentioned has been sized, given criteria including viscosity, a new flowrate for a given pump can be estimated if the viscosity changes. For example, the brake horsepower or the TDH are somewhat proportional to the viscosity. If the 80 GPM, P-25 requires 20 HP @ 50 cP, and requires 30 HP at 100 cP, then the approximate flow rate for the 20 HP pump at 100 cP is = 80*20/30 or 53 GPM.

The solids percent and the size fraction of the slurry may dictate what the pump minimum speed and capacity really is. For example, cavitation and/or sanding up of the pump or pipeline will result if the pumping speed is less than the solids settling rate. Therefore, a target flowrate must be stated, the viscosity, solids and pipe length determined, then the line sized to produce approximately 8 to 10 ft/sec.

DISTRIBUTION:
L. A. Collins
J. R. Zak
W. C. Henderson
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A.R. WILFLEY AND SONS, INC.

P.O. BOX 2330
DENVER, COLORADO 80201

TELEPHONE: 303-779-1777

FAX: 303-779-1277

COMPANY:	Brown & Root
ATTENTION:	Boyd York
FAX NUMBER:	469-6354
FROM:	Dave Wheeler
DATE:	July 12, 1993

NUMBER OF PAGES, INCLUDING COVER SHEET: 2

REFERENCE:

Boyd:

Per our telephone conversations last Thursday and Friday, the following comments are offered in regard to three (3) of the pumps provided to Halliburton on their P.O. #080-157-P-0014 of 6/12/92 for EG&G - Rocky Flats.

1. Pump #P-01, Transfer Pump

   This pump is a 2"x1" overhead V-belt driven Model K pump with a 7½ HP, 1800 RPM motor.

   A. At 50 cp this pump would require a 7½ HP motor taking into account the viscosity corrections.

   B. At 100 cp, this pump would require a 10 HP motor to handle this viscosity.

   C. At 1000 cp this pump WOULD NOT WORK! The maximum horsepower motor that can be used with this pump is 15 HP. Therefore, the approximate maximum viscosity of slurry that can be pumped with this pump is 300 cp.

2. <u>Pump #P-24 and P-25</u>

These pumps are 3"x1½" direct connected Model AG pumps with 20 HP, 3600 RPM motors.

A. At 50 cp these pumps would require 20 HP motors taking into account the viscosity corrections.

B. At 100 cp, this pump would require a 30 HP motor to handle this viscosity.

C. At 1000 cp this pump WOULD NOT WORK! The maximum horsepower motor that can be used with this pump is 100 HP. Therefore, the approximate maximum viscosity of slurry that can be pumped with this pump is 600 cp.

Boyd, hopefully this information will provide you with everything that you need for your meetings this week.

Sincerely,

[illegible]. R. Wilfley and Sons, Inc.

David L. Wheeler

David L. Wheeler
Western Regional Manager

DLW/jls

INTEROFFICE MEMORANDUM

ate: 14 Jul 1993

i e: 961.283

: J. A. Schmidt

rom: B. J. York

ject: E G & G Rocky Flats, Solar Pond Project
Brown and Root, Inc., Job No. JR-1198

erence: Accelerated Sludge Removal Project

Six different scenarios of pondsludge removal to satisfy uirements for interim of temporary storage of the Solar Pond ed waste were selected from many alternatives on a weighted ting basis. The pondsludge from the B and C ponds and the larifier contents will be reclaimed and stored in a containment tem for a period of up to ten years. The necessary regulatory rmitting along with an approved reprocessing technology and bsequent permanent storage requirements for the waste will be ined during the interim storage period.

In essence, the pondsludge and Clarifier waste will be pumped itu to containment systems located on the 750 pad area. Much of installed equipment intended for processing the mixed wastes ill be bypassed in favor of a simple reclaim to interim storage. n particular, nearly all of the Halliburton equipment to include Batch and Averaging tanks and the RCM Mixer with their ociated pumps; the pozzolan material handling system and the alf Crate pouring/conveying systems will not be used for sludge oval. In addition, equipment installed for chemical and cessing treatment to include pathogen Chlorination treatment, locculation, and solids densification of the sludge will not be d for sludge removal. The DCS controller philosophy will be ndoned for a simple manual operation.

Selected existing, leased, sub-contractor and support ipment including slurry/water centrifugal and sludge positive placement pumps, screens, tanks, agitators and piping will omprise most of the reclaim options selected. An equipment list ompanies each of the following selected Block Flow Diagrams D's):

- Case 1.0 - B-Pond Sludge Removal to Interim Storage
- Case 2.0 - C-Pond Sludge Removal to Interim Storage
- Case 3.0 - Clarifier Sludge Removal to Interim Storage
- Case 4.2 - B-Pond Sludge Removal to Interim Storage
- Case 4.3 - B-Pond Sludge Removal to Interim Storage
- Case 7.1 - B-Pond Sludge Removal to Interim Storage

h last three cases are variations of Case 1.0. A mobilization nd operation schedule with associated costs are to be developed each by the task committee.

. A. Collins W. C. Henderson
. R. Zak J. H. Templeton

APPENDIX I
Material Transfer Options

Pond 207-B Option #1

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
	Direct and Indirect Costs												
1	Training												
	Personnel	EA	33	20	$91.00				$60,060	$0	$0	$0	$60,060
2	Hook-up and Installation												
2a	Hook-up Labor												
	Journeymen	EA	4	160	$91.00		$5,824		$58,240	$0	$23,296	$0	$81,536
	Foremen	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
2b	Pumping												
	Journeymen	EA	4	160	$91.00		$5,824		$58,240	$0	$23,296	$0	$81,536
	Foremen	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
	Rad Protection Technician	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
2c	Additional Equipment and Material												
	Slurry Pump – 50 GPM	EA	1	40	$48.00	$2,000	$500		$1,920	$2,000	$500	$0	$4,420
	Miscellaneous Equipment	EA	1	20	$48.00	$3,000	$96		$960	$3,000	$96	$0	$4,056
	3" Double Contained Pipe	LF	500	0	$48.00	$31	$2		$0	$15,500	$1,200	$0	$16,700
	Miscellaneous Bulk Material	Lot	1	40	$48.00	$1,200	$192		$1,920	$1,200	$192	$0	$3,312
3	Operations												
3a	Reclaim												
	Pump Rope Pullers	EA	4	208	$91.00				$75,712	$0	$0	$0	$75,712
	Hose Pullers	EA	2	208	$91.00				$37,856	$0	$0	$0	$37,856
	Electrical Puller	EA	1	208	$91.00				$18,928	$0	$0	$0	$18,928
	Pump Operator	EA	1	208	$91.00				$18,928	$0	$0	$0	$18,928
	Screen Operator	EA	1	208	$91.00				$18,928	$0	$0	$0	$18,928
	Foremen	EA	2	208	$91.00				$37,856	$0	$0	$0	$37,856

[redacted] Pond [redacted] Op[redacted]

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
3b	Pumping												
	Pump at Pond	EA	3	120	$91.00				$32,760	$0	$0	$0	$32,760
	Pad Operations	EA	4	120	$91.00				$43,680	$0	$0	$0	$43,680
	Transfer Line Maintenance	EA	1	120	$90.00				$10,800	$0	$0	$0	$10,800
	Foremen	EA	2	120	$91.00				$21,840	$0	$0	$0	$21,840
3c	Debris Removal												
	Journeymen	EA	6	40	$91.00		$4,368		$21,840	$0	$26,208	$0	$48,048
	Foremen	EA	1	40	$91.00		$728		$3,640	$0	$728	$0	$4,368
4	Demobilize												
	Journeymen	EA	6	80	$90.00		$6,480		$43,200	$0	$38,880	$0	$82,080
	Foremen	EA	2	80	$90.00		$2,160		$14,400	$0	$4,320	$0	$18,720
	Subtotal								$625,388	$21,700	$123,084	$0	$770,172
	M&O Contractors Costs												
1	EG&G Superv (1) @ $91/Hr. (440hr)	EA							$40,040				$40,040
2	Waste Management @ $91/Hr. (520 hrs)	EA							$47,320				$47,320
3	Rad Engineers @ $93/Hr. (300 hrs)	EA							$27,900				$27,900
4	H&S Support @ $92/Hr. (300 hrs)	EA							$27,600				$27,600
5	EG&G Project Manag @ 15% of Labor	LOT							$93,808				$93,808
	Total M&O Contractor Costs								$236,668				$236,668
	Total Estimated Costs								$862,056	$21,700	$123,084	$0	$1,006,840
	Contingency @ 15% on Material, 25% on Balance of Costs								$215,514	$3,255	$30,771	$0	$249,540

Pond [redacted] B Option #1

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors					Costs				
				Mhrs.	Lab $	Mat.	Equip.	S/C	Labor	Material	Equipt.	SubCont.	Total
	Escalation @ 4.4%/Year on Labor.								$47,413				$47,413
	Total Project Costs								$1,124,983	$24,955	$153,855	$0	$1,303,793

PRIMAVERA PROJECT PLANNER — 207-B POND CONSOLIDATION -OPTION 1

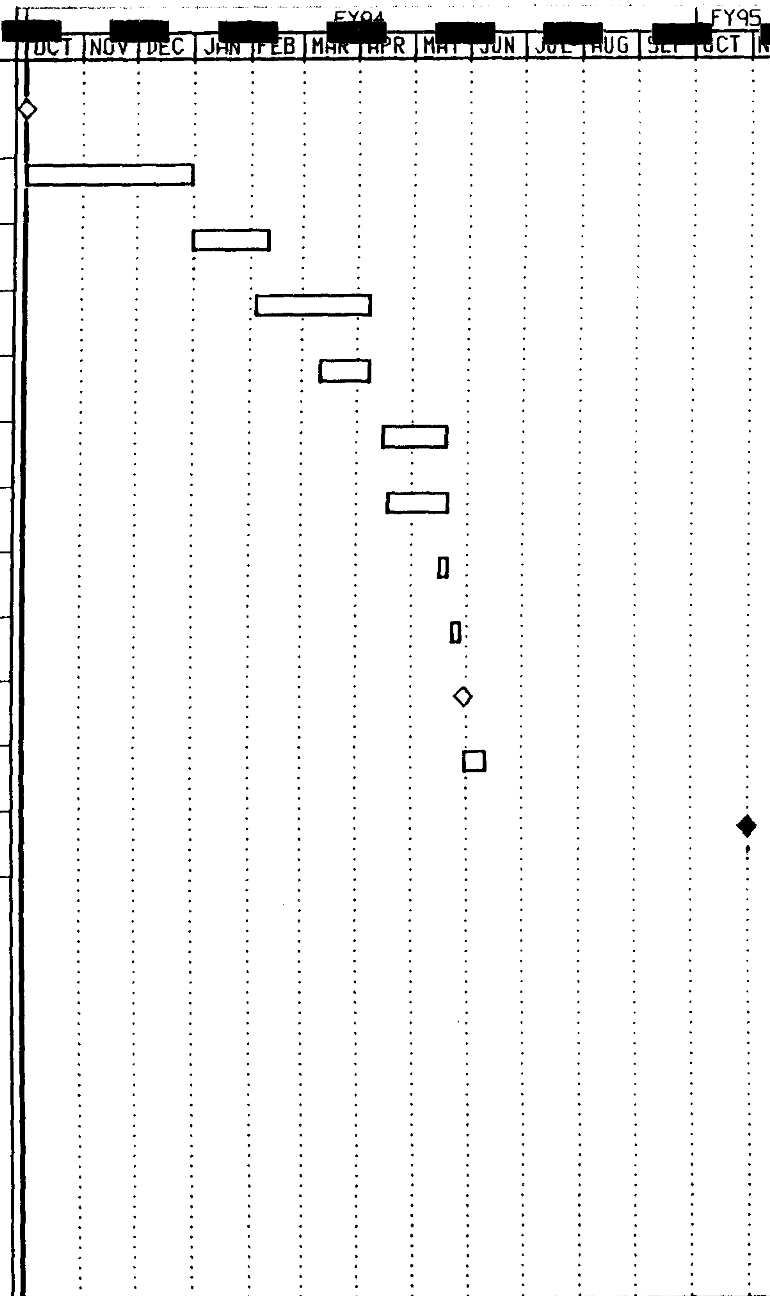
23JUL93 RUN NO. 34 — ROCKY FLATS SOLAR EVAPORATOR PONDS — START DATE 1OCT93 FIN DATE 31OCT94

:49

ED E REPORT - SORT BY ES, TF — DATA DATE 1OCT93 PAGE NO. 1

	RIG UR	REM DUR	%	CODE	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL FLOAT
1	0	0	0		START PROJECT	1OCT93*	30SEP93	28FEB94	25FEB94	106
0	65	65	0		RCRA PERMIT MODIFICATION	1OCT93	30DEC93	28FEB94	27MAY94	106
0	30	30	0		PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10FEB94	30MAY94	8JUL94	106
0	45	45	0		PURCHASE AND INSTALL CONTAINERS	4FEB94	7APR94	4JUL94	2SEP94	106
0	20	20	0		PROCESS HOOK-UP	11MAR94	7APR94	8AUG94	2SEP94	106
0	25	25	0		POND RECLAIM OPERATIONS	15APR94*	19MAY94	5SEP94	7OCT94	101
0	25	25	0		TRANSPORT AND PAD STORAGE	18APR94	20MAY94	6SEP94	10OCT94	101
0	5	5	0		FINAL RINSE POND	16MAY94	20MAY94	4OCT94	10OCT94	101
0	5	5	0		DEBRIS REMOVAL	23MAY94	27MAY94	11OCT94	17OCT94	101
2	0	0	0		PUMPING COMPLETE	30MAY94	27MAY94	18OCT94	17OCT94	101
0	10	10	0		CLEANUP AND DEMOBILIZE	30MAY94	10JUN94	18OCT94	31OCT94	101
3	0	0	0		FINISH 94 ACTIVITIES	1NOV94	31OCT94*	1NOV94	31OCT94	0

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR	TOTL FLT
M1	START PROJECT	1OCT93	30SEP93	0	106
100	RCRA PERMIT MODIFICATION	1OCT93	30DEC93	65	106
150	PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10FEB94	30	106
200	PURCHASE AND INSTALL CONTAINERS	4FEB94	7APR94	45	106
400	PROCESS HOOK-UP	11MAR94	7APR94	20	106
300	POND RECLAIM OPERATIONS	15APR94	19MAY94	25	101
800	TRANSPORT AND PAD STORAGE	18APR94	20MAY94	25	101
500	FINAL RINSE POND	16MAY94	20MAY94	5	101
700	DEBRIS REMOVAL	23MAY94	27MAY94	5	101
M2	PUMPING COMPLETE	30MAY94	27MAY94	0	101
900	CLEANUP AND DEMOBILIZE	30MAY94	10JUN94	10	101
M3	FINISH 94 ACTIVITIES	1NOV94	31OCT94	0	0



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31OCT94

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

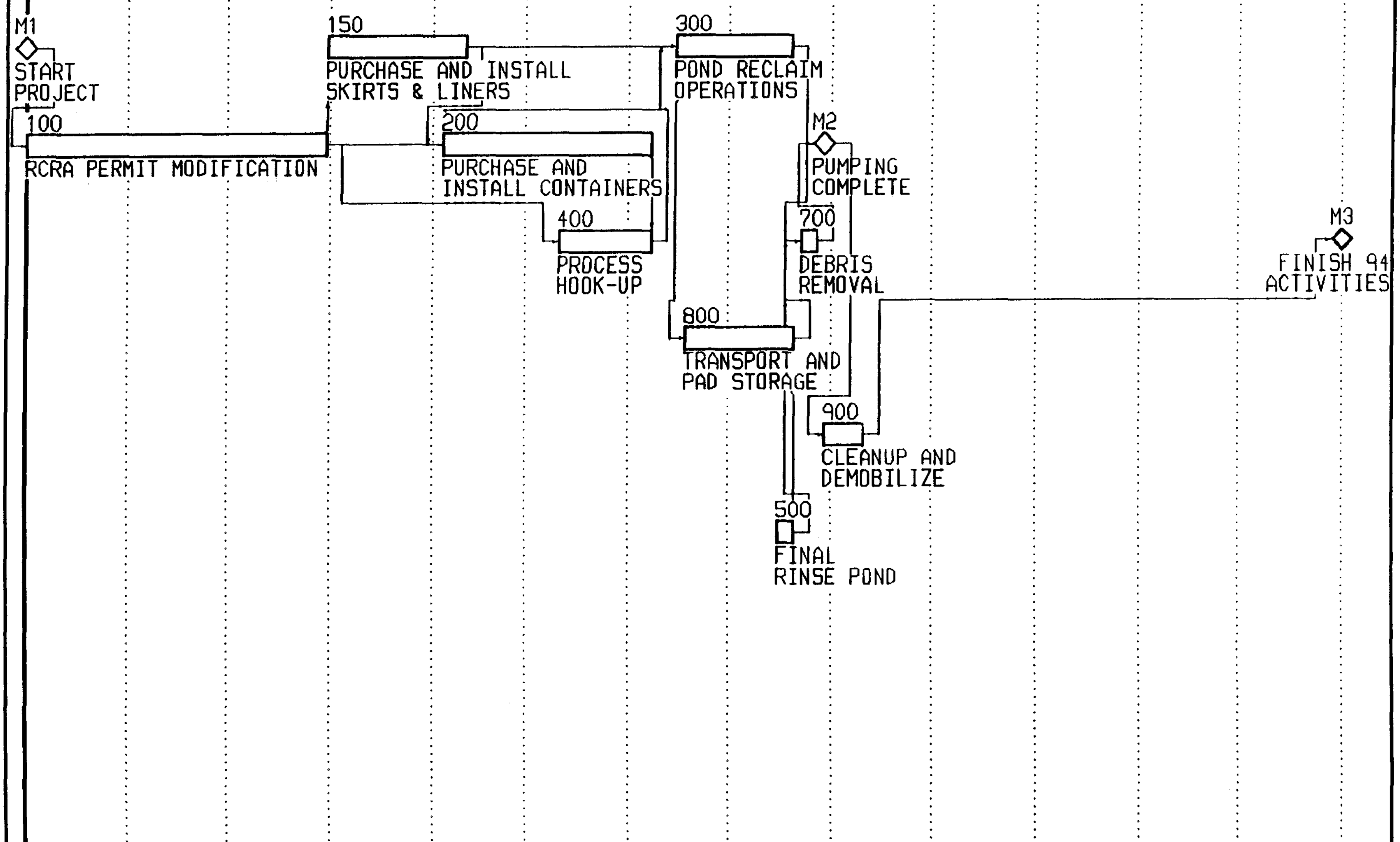
207B

Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-B POND CONSOLIDATION OPTION 1

----PROJECT SCHEDULE----

Date	Revision	Checked	Approved



Plot Date	23JUL93
Data Date	1OCT93
Project Start	1OCT93
Project Finish	31OCT94

act id
- Activity Bar/Early Dates
- Critical Activity
- Progress Bar
- ◇/P Milestone/Flag Activity

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ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-B POND CONSOLIDATION OPTION 1

-----PROJECT SCHEDULE-----

Date	Revision	Checked	Approved

Pond [redacted] C [redacted]#2

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
	Direct and Indirect Costs												
1	Training												
	Personnel	EA	38	20	$91.00				$69,160	$0	$0	$0	$69,160
2	Hook-up and Installation												
2a	Hook-up Labor												
	Journeymen	EA	6	120	$89.00		$6,408		$64,080	$0	$38,448	$0	$102,528
	Foremen	EA	1	120	$89.00		$1,068		$10,680	$0	$1,068	$0	$11,748
2b	Pond Circulation												
	Journeymen	EA	4	213	$91.00		$7,753		$77,532	$0	$31,013	$0	$108,545
	Foremen	EA	1	213	$91.00		$1,938		$19,383	$0	$1,938	$0	$21,321
	RAD Protection Technician	EA	1	212	$90.00		$1,908		$19,080	$0	$1,908	$0	$20,988
	Crane Operators	EA	2	192	$86.00		$3,302		$33,024	$0	$0	$0	$33,024
2c	Additional Equipment and Material												
	Slurry Pump -- 50 GPM	EA	1	40	$48.00	$2,000	$500		$1,920	$2,000	$500	$0	$4,420
	Miscellaneous Equipment	EA	1	20	$48.00	$2,000	$96		$960	$2,000	$96	$0	$3,056
	3" Double Contained Pipe	LF	500	0	$48.00	$31	$2		$0	$15,500	$1,200	$0	$16,700
	Miscellaneous Bulk Material	Lot	1	40	$48.00	$1,200	$192		$1,920	$1,200	$192	$0	$3,312
3	Operations												
3a	Reclaim												
	Pump Operators	EA	1	240	$91.00				$21,840	$0	$0	$0	$21,840
	Screen Operators	EA	1	240	$91.00				$21,840	$0	$0	$0	$21,840
	Foremen	EA	2	240	$91.00				$43,680	$0	$0	$0	$43,680
3b	Transport and Storage												
	Pump at Pond	EA	3	240	$91.00				$65,520	$0	$0	$0	$65,520

Pond 207-B Option #4.2

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Unit Factors: Lab $	Unit Factors: Mat.	Unit Factors: Equip.	Unit Factors: S/C	Costs: Labor	Costs: Material	Costs: Equipt.	Costs: SubCont.	Costs: Total
3b	Pumping												
	Pump at Pond	EA	4	256	$91.00				$93,184	$0	$0	$0	$93,184
	Pad Operations	EA	4	256	$91.00				$93,184	$0	$0	$0	$93,184
	Transfer Line Maintenance	EA	1	256	$90.00				$23,040	$0	$0	$0	$23,040
	Foremen	EA	2	256	$91.00				$46,592	$0	$0	$0	$46,592
3c	Debris Removal												
	Journeymen	EA	6	40	$91.00		$4,368		$21,840	$0	$26,208	$0	$48,048
	Foremen	EA	1	40	$91.00		$728		$3,640	$0	$728	$0	$4,368
4	Demobilize												
	Journeymen	EA	8	80	$90.00		$8,640		$57,600	$0	$69,120	$0	$126,720
	Foremen	EA	2	80	$90.00		$2,160		$14,400	$0	$4,320	$0	$18,720
	Subtotal								$957,424	$21,700	$182,444	$0	$1,161,568
	M&O Contractors Costs												
1	EG&G Supervision (1) @ $91Hr (440hr)	EA							$40,040				$40,040
2	Waste Management (1) @ 91hrs (520hr)	EA							$47,320				$47,320
3	Radiological Engrs. (1) @ $93Hr (300hr)	EA							$27,900				$27,900
4	H&S Support (1) @ $92/Hr. (300hr)	EA							$27,600				$27,600
5	EG&G Project Manag @ 15% of Labor	LOT							$143,614				$143,614
	Total M&O Contractor Costs								$286,474				$286,474
	Total Estimated Costs								$1,243,898	$21,700	$182,444	$0	$1,448,042
	Contingency @ 15% on Material, 25% on Balance of Costs								$310,974	$3,255	$45,611	$0	$359,840

Pond 207—B Option #4.2

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	[redacted]: Labor	Material	Equipt.	SubCont.	Total
	Escalation @ 4.4%/Year on Labor.								$68,414				$68,414
	Total Project Costs								$1,623,286	$24,955	$228,055	$0	$1,876,296

PRIMAVERA PROJECT PLANNER — 207-B POND CONSOLIDATION OPTION 4.2

23JUL93 RUN NO. 37 — ROCKY FLATS SOLAR EVAPORATOR PONDS — START DATE 1OCT93 FIN DATE 31OCT94

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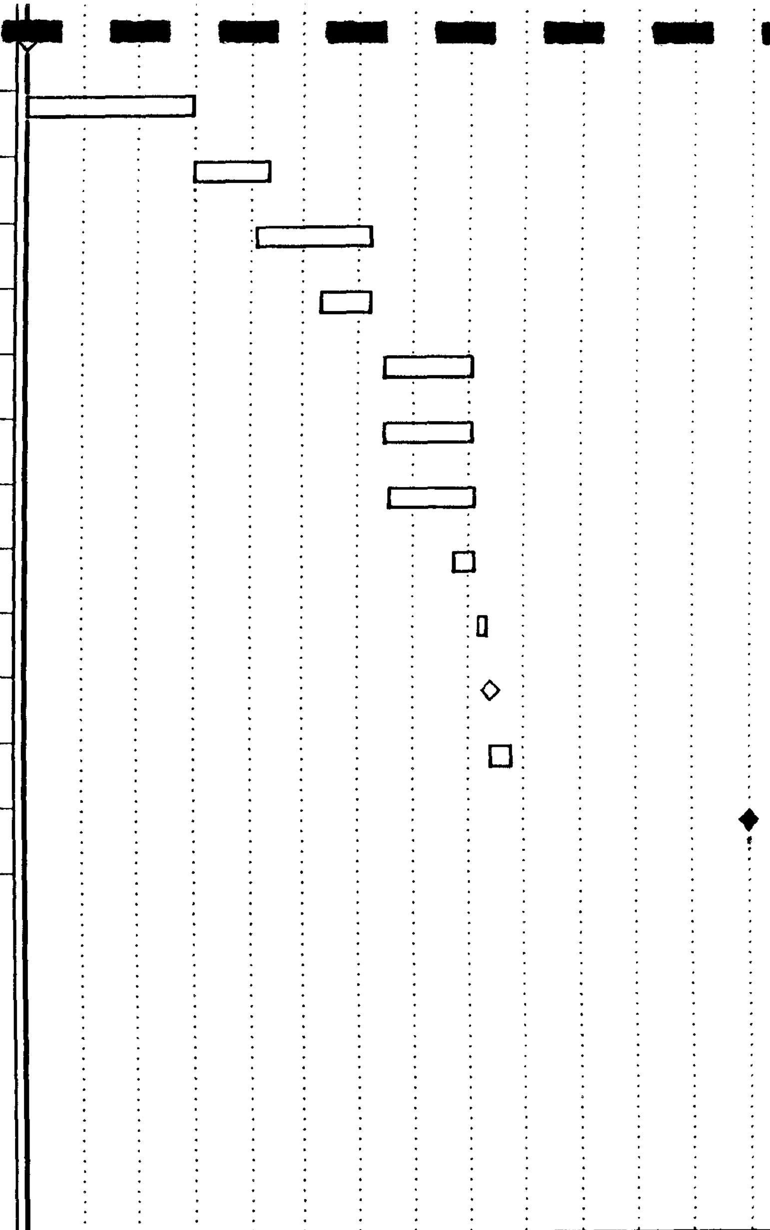
D[illegible]E REPORT - SORT BY ES, TF — DATA DATE 1OCT93 PAGE NO. 1

[illegible]RIG [illegible]UR	REM DUR	%	CODE	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL FLOAT
0	0	0		START PROJECT	1OCT93*	30SEP93	14FEB94	11FEB94	96
65	65	0		RCRA PERMIT MODIFICATION	1OCT93	30DEC93	14FEB94	13MAY94	96
30	30	0		PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10FEB94	16MAY94	24JUN94	96
45	45	0		PURCHASE AND INSTALL CONTAINERS	4FEB94	7APR94	20JUN94	19AUG94	96
20	20	0		PROCESS HOOK-UP	11MAR94	7APR94	25JUL94	19AUG94	96
35	35	0		POND RECLAIM OPERATIONS	15APR94*	2JUN94	22AUG94	7OCT94	91
35	35	0		DECANT AT POND	15APR94	2JUN94	22AUG94	7OCT94	91
35	35	0		TRANSPORT AND PAD STORAGE	18APR94	3JUN94	23AUG94	10OCT94	91
10	10	0		FINAL RINSE POND	23MAY94	3JUN94	27SEP94	10OCT94	91
5	5	0		DEBRIS REMOVAL	6JUN94	10JUN94	11OCT94	17OCT94	91
0	0	0		PUMPING COMPLETE	13JUN94	10JUN94	18OCT94	17OCT94	91
10	10	0		CLEANUP AND DEMOBILIZE	13JUN94	24JUN94	18OCT94	31OCT94	91
0	0	0		FINISH 94 ACTIVITIES	1NOV94	31OCT94*	1NOV94	31OCT94	0

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-B POND CONSOLIDATION OPTION 4.2

M1	START PROJECT	1OCT93	30SEP93	0	96
100	RCRA PERMIT MODIFICATION	1OCT93	30DEC93	65	96
150	PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10FEB94	30	96
200	PURCHASE AND INSTALL CONTAINERS	4FEB94	7APR94	45	96
400	PROCESS HOOK-UP	11MAR94	7APR94	20	96
300	POND RECLAIM OPERATIONS	15APR94	2JUN94	35	91
350	DECANT AT POND	15APR94	2JUN94	35	91
800	TRANSPORT AND PAD STORAGE	18APR94	3JUN94	35	91
500	FINAL RINSE POND	23MAY94	3JUN94	10	91
700	DEBRIS REMOVAL	6JUN94	10JUN94	5	91
M2	PUMPING COMPLETE	13JUN94	10JUN94	0	91
900	CLEANUP AND DEMOBILIZE	13JUN94	24JUN94	10	91
M3	FINISH 94 ACTIVITIES	1NOV94	31OCT94	0	0



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31OCT94

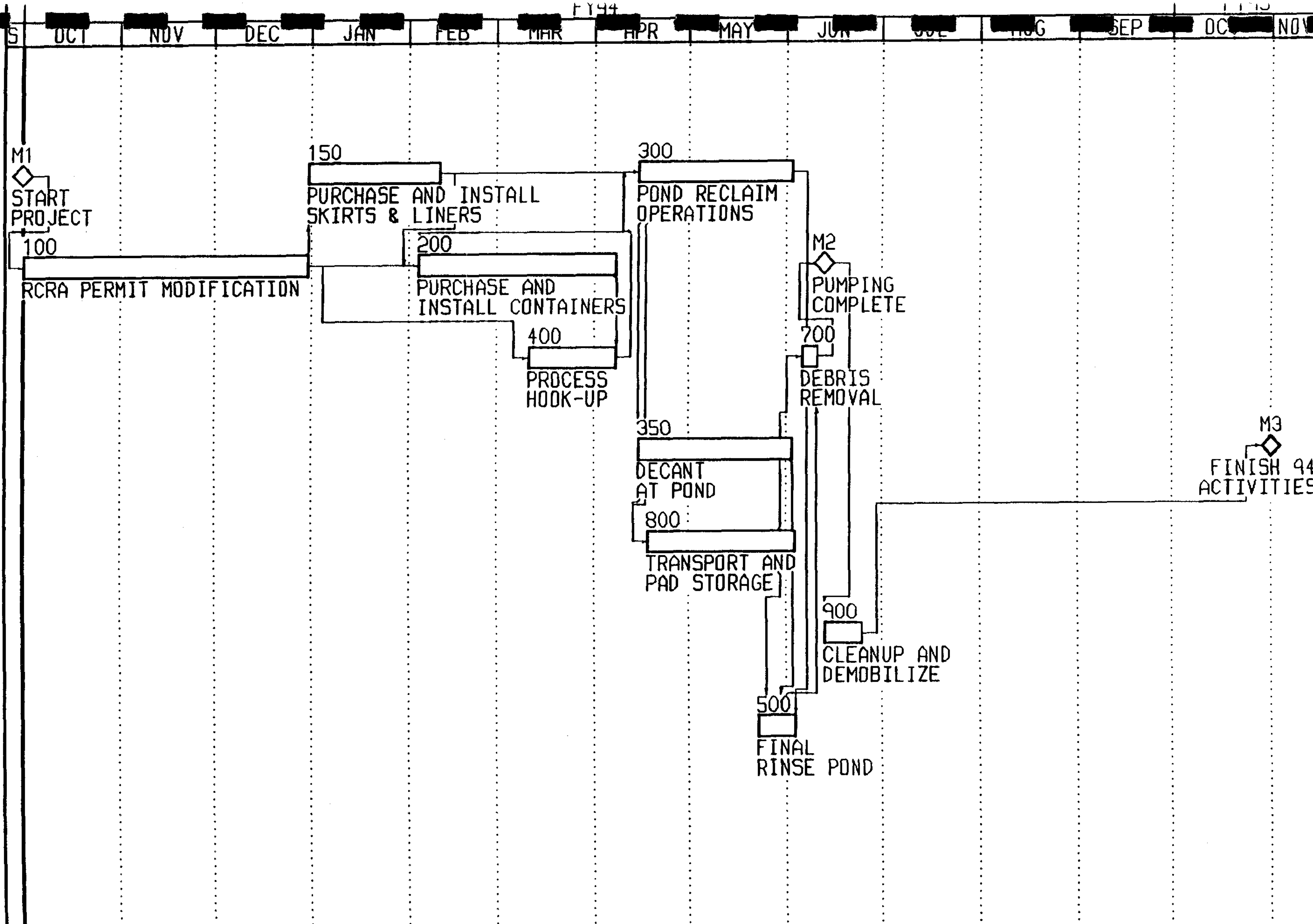
Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

BP42

Sheet 1 of 1

----PROJECT SCHEDULE----

Date	Revision	Checked	Approved



Plot Date	23JUL93
Data Date	1OCT93
Project Start	1OCT93
Project Finish	31OCT94

(c) Primavera Systems, Inc.

act id
- Activity Bar/Early Dates
- Critical Activity
- Progress Bar
- Milestone/Flag Activity

BP42 Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-B POND CONSOLIDATION OPTION 4.2

-----PROJECT SCHEDULE-----

Date	Revision	Checked	Approved

FL[illegible]TS PRIMAVERA PROJECT PLANNER 207-B POND CONSOLIDATION OPTION 4.3

DATE 23JUL93 RUN NO. 39 ROCKY FLATS SOLAR EVAPORATOR PONDS START DATE 1OCT93 FIN DATE 31OCT94
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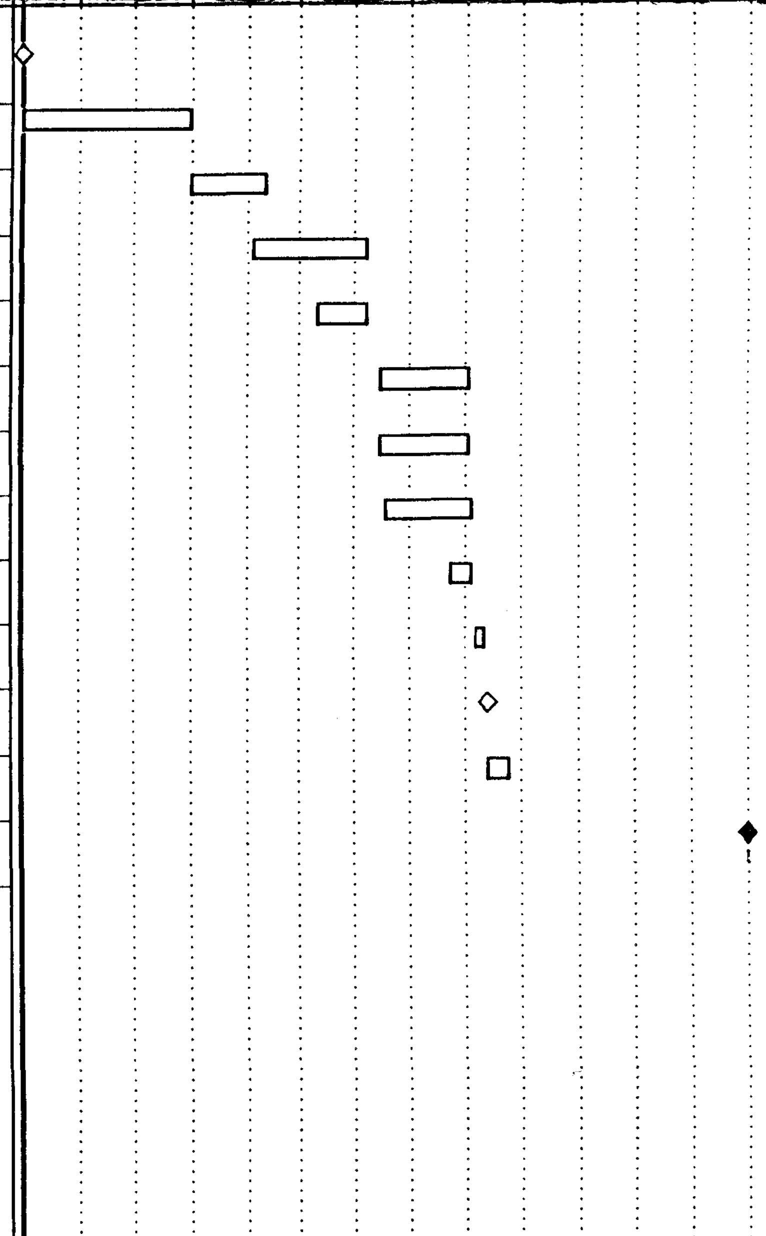
[illegible]HEDULE REPORT - SORT BY ES, TF DATA DATE 1OCT93 PAGE NO. 1

[illegible]TY ID	ORIG DUR	REM DUR	%	CODE	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL FLOAT
M1	0	0	0		START PROJECT	1OCT93*	30SEP93	14FEB94	11FEB94	96
100	65	65	0		RCRA PERMIT MODIFICATION	1OCT93	30DEC93	14FEB94	13MAY94	96
150	30	30	0		PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10FEB94	16MAY94	24JUN94	96
200	45	45	0		PURCHASE AND INSTALL CONTAINERS	4FEB94	7APR94	20JUN94	19AUG94	96
400	20	20	0		PROCESS HOOK-UP	11MAR94	7APR94	25JUL94	19AUG94	96
300	35	35	0		POND RECLAIM OPERATIONS	15APR94*	2JUN94	22AUG94	7OCT94	91
350	35	35	0		DECANT AT PAD	15APR94	2JUN94	22AUG94	7OCT94	91
800	35	35	0		TRANSPORT AND PAD STORAGE	18APR94	3JUN94	23AUG94	10OCT94	91
500	10	10	0		FINAL RINSE POND	23MAY94	3JUN94	27SEP94	10OCT94	91
700	5	5	0		DEBRIS REMOVAL	6JUN94	10JUN94	11OCT94	17OCT94	91
M2	0	0	0		PUMPING COMPLETE	13JUN94	10JUN94	18OCT94	17OCT94	91
900	10	10	0		CLEANUP AND DEMOBILIZE	13JUN94	24JUN94	18OCT94	31OCT94	91
M3	0	0	0		FINISH 94 ACTIVITIES	1NOV94	31OCT94*	1NOV94	31OCT94	0

ACTIVITY ID [redacted]	ACTIVITY DESCRIPTION [redacted]	EARLY START [redacted]	EARLY FINISH [redacted]	ORIG DUR [redacted]	TOTAL FLOAT [redacted]
M1	START PROJECT	1OCT93	30SEP93	0	96
100	RCRA PERMIT MODIFICATION	1OCT93	30DEC93	65	96
150	PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10FEB94	30	96
200	PURCHASE AND INSTALL CONTAINERS	4FEB94	7APR94	45	96
400	PROCESS HOOK-UP	11MAR94	7APR94	20	96
300	POND RECLAIM OPERATIONS	15APR94	2JUN94	35	91
350	DECANT AT PAD	15APR94	2JUN94	35	91
800	TRANSPORT AND PAD STORAGE	18APR94	3JUN94	35	91
500	FINAL RINSE POND	23MAY94	3JUN94	10	91
700	DEBRIS REMOVAL	6JUN94	10JUN94	5	91
M2	PUMPING COMPLETE	13JUN94	10JUN94	0	91
900	CLEANUP AND DEMOBILIZE	13JUN94	24JUN94	10	91
M3	FINISH 94 ACTIVITIES	1NOV94	31OCT94	0	0



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31OCT94

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

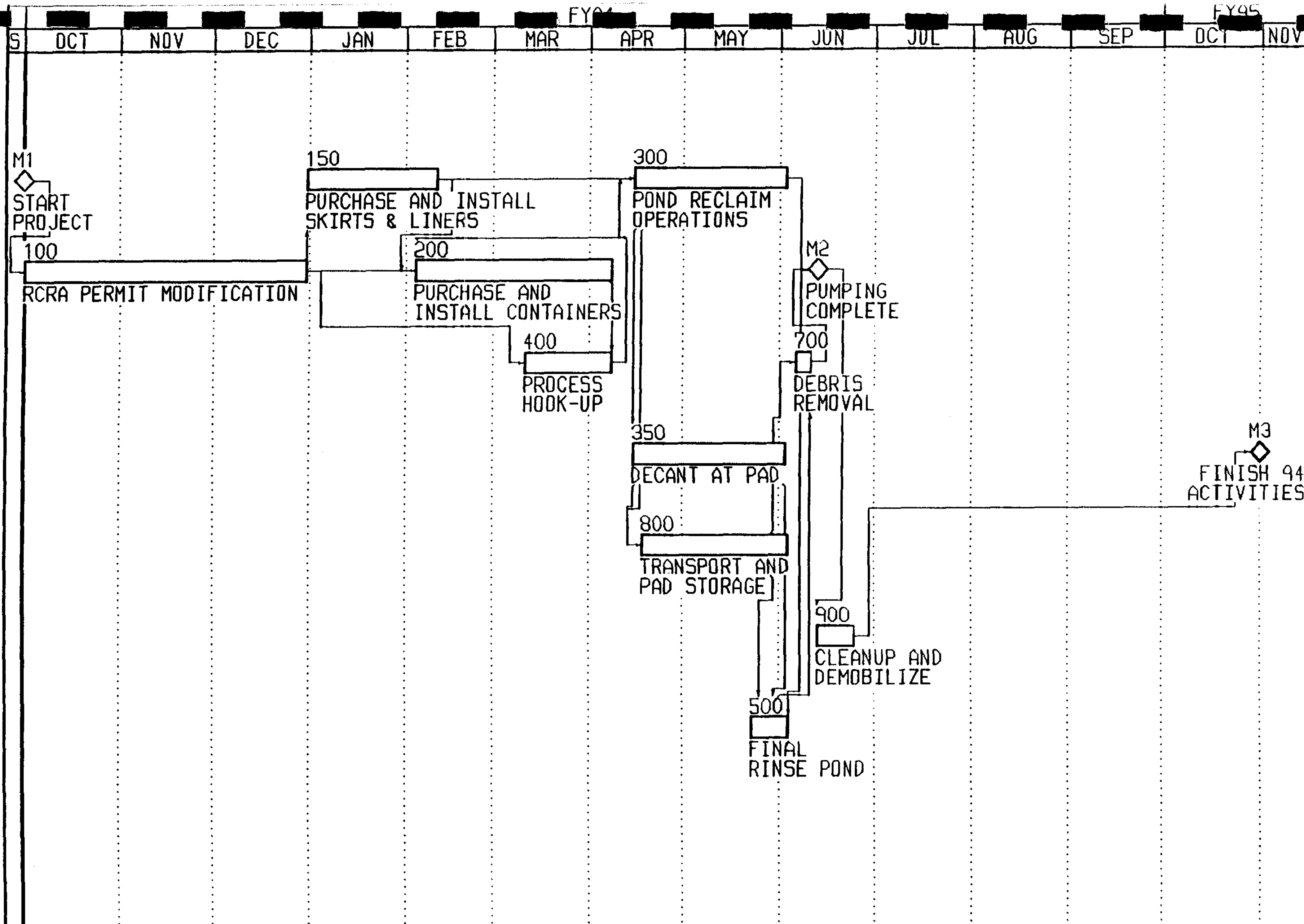
BP43

Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-B POND CONSOLIDATION OPTION 4.3

----PROJECT SCHEDULE----

Date	Revision	Checked	Approved



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31OCT94

act id

- Activity Bar/Early Dates
- Critical Activity
- Progress Bar
- Milestone/Flag Activity

BP43

Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-B POND CONSOLIDATION OPTION 4.3

-----PROJECT SCHEDULE-----

Date	Revision	Checked	Approved

Pond 207–B Option #4.2

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
	Direct and Indirect Costs												
1	Training								$65,520	$0	$0	$0	$65,520
	Personnel	EA	36	20	$91.00								
2	Hook–up and Installation												
2a	Hook–up Labor								$87,360	$0	$52,416	$0	$139,776
	Journeymen	EA	6	160	$91.00		$8,736		$14,560	$0	$1,456	$0	$16,016
	Foremen	EA	1	160	$91.00		$1,456						
2b	Pumping								$58,240	$0	$23,296	$0	$81,536
	Journeymen	EA	4	160	$91.00		$5,824		$14,560	$0	$1,456	$0	$16,016
	Foremen	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
	RAD Protection Technician	EA	1	160	$91.00		$1,456						
2c	Additional Equipment and Material								$1,920	$2,000	$500	$0	$4,420
	Slurry Pump -- 50 GPM	EA	1	40	$48.00	$2,000	$500		$960	$3,000	$96	$0	$4,056
	Miscellaneous Equipment	EA	1	20	$48.00	$3,000	$96		$0	$15,500	$1,200	$0	$16,700
	3" Double Contained Pipe	LF	500	0	$48.00	$31	$2		$1,920	$1,200	$192	$0	$3,312
	Miscellaneous Bulk Material	LOT	1	40	$48.00	$1,200	$192						
3	Operations												
3a	Reclaim								$125,216	$0	$0	$0	$125,216
	Pump Rope Pullers	EA	4	344	$91.00				$62,608	$0	$0	$0	$62,608
	Hose Pullers	EA	2	344	$91.00				$31,304	$0	$0	$0	$31,304
	Electrical Puller	EA	1	344	$91.00				$31,304	$0	$0	$0	$31,304
	Pump Operator	EA	1	344	$91.00				$31,304	$0	$0	$0	$31,304
	Screen Operator	EA	1	344	$91.00				$62,608	$0	$0	$0	$62,608
	Foremen	EA	2	344	$91.00								

Pond 207–B Option #4.3

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors					Costs				
				Mhrs.	Lab $	Mat.	Equip.	S/C	Labor	Material	Equipt.	SubCont.	Total
	Direct and Indirect Costs												
1	Training												
	Personnel	EA	36	20	$91.00				$65,520	$0	$0	$0	$65,520
2	Hook–up and Installation												
2a	Hook–up Labor												
	Journeymen	EA	8	160	$91.00		$11,648		$116,480	$0	$93,184	$0	$209,664
	Foremen	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
2b	Pumping												
	Journeymen	EA	4	160	$91.00		$5,824		$58,240	$0	$23,296	$0	$81,536
	Foremen	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
	RAD Protection Technician	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
2c	Additional Equipment and Material												
	Slurry Pump – 50 GPM	EA	1	40	$48.00	$2,000	$500		$1,920	$2,000	$500	$0	$4,420
	Miscellaneous Equipment	EA	1	20	$48.00	$3,000	$96		$960	$3,000	$96	$0	$4,056
	3" Double Contained Pipe	LF	2000	0	$48.00	$31	$2		$0	$62,000	$4,800	$0	$66,800
	Miscellaneous Bulk Material	Lot	1	40	$48.00	$1,200	$192		$1,920	$1,200	$192	$0	$3,312
3	Operations												
3a	Reclaim												
	Pump Rope Pullers	EA	4	344	$91.00				$125,216	$0	$0	$0	$125,216
	Hose Pullers	EA	2	344	$91.00				$62,608	$0	$0	$0	$62,608
	Electrical Puller	EA	1	344	$91.00				$31,304	$0	$0	$0	$31,304
	Pump Operator	EA	1	344	$91.00				$31,304	$0	$0	$0	$31,304
	Screen Operator	EA	1	344	$91.00				$31,304	$0	$0	$0	$31,304
	Foremen	EA	2	344	$91.00				$62,608	$0	$0	$0	$62,608

Pond 207–B Option #4.3

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
3b	Pumping												
	Pump at Pond	EA	4	256	$91.00				$93,184	$0	$0	$0	$93,184
	Pad Operations	EA	4	256	$91.00				$93,184	$0	$0	$0	$93,184
	Transfer Line Maintenance	EA	1	256	$90.00				$23,040	$0	$0	$0	$23,040
	Foremen	EA	2	256	$91.00				$46,592	$0	$0	$0	$46,592
3c	Debris Removal												
	Journeymen	EA	6	40	$91.00		$4,368		$21,840	$0	$26,208	$0	$48,048
	Foremen	EA	1	40	$91.00		$728		$3,640	$0	$728	$0	$4,368
4	Demobilize												
	Journeymen	EA	8	80	$90.00		$8,640		$57,600	$0	$69,120	$0	$126,720
	Foremen	EA	2	80	$90.00		$2,160		$14,400	$0	$4,320	$0	$18,720
	Subtotal								$986,544	$68,200	$226,812	$0	$1,281,556
	M&O Contractors Costs												
1	EG&G Supervn (1) @ $91/Hr (440hr)	EA							$40,040				$40,040
2	Waste Managm (1) @ $91/Hr. (520hr)	EA							$47,320				$47,320
3	Radiological Eng (1) @ $93/Hr. (300Hr)	EA							$27,900				$27,900
4	H&S Support (1) @ $92/Hr (300hr)	EA							$27,600				$27,600
5	EG&G Project Manag @ 15% of Labor	LOT							$147,982				$147,982
	Total M&O Contractor Costs								$290,842				$290,842
	Total Estimated Costs								$1,277,386	$68,200	$226,812	$0	$1,572,398
	Contingency @ 15% on Material, 25% on Balance of Costs								$319,346	$10,230	$56,703	$0	$386,279

Pond 207–B Option #4.3

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors					Costs				
				Mhrs.	Lab $	Mat.	Equip.	S/C	Labor	Material	Equipt.	SubCont.	Total
	Escalation @ 4.4%/Year on Labor.								$70,256				$70,256
	Total Project Costs								$1,666,988	$78,430	$283,515	$0	$2,028,933

Pond 207–B Option #7.1

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors					Costs				
				Mhrs.	Lab $	Mat.	Equip.	S/C	Labor	Material	Equipt.	SubCont.	Total
	Direct and Indirect Costs												
1	Training												
	Personnel	EA	33	20	$91.00				$60,060	$0	$0	$0	$60,060
2	Hook–up and Installation												
2a	Hook–up Labor												
	Journeymen	EA	4	160	$91.00		$5,824		$58,240	$0	$23,296	$0	$81,536
	Foremen	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
2b	Pumping												
	Journeymen	EA	4	160	$91.00		$5,824		$58,240	$0	$23,296	$0	$81,536
	Foremen	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
	RAD Protection Technician	EA	1	160	$91.00		$1,456		$14,560	$0	$1,456	$0	$16,016
2c	Additional Equipment and Material												
	Slurry Pump – 50 GPM	EA	1	40	$48.00	$2,000	$500		$1,920	$2,000	$500	$0	$4,420
	Miscellaneous Equipment	EA	1	20	$48.00	$3,000	$96		$960	$3,000	$96	$0	$4,056
	3" Double Contained Pipe	LF	500	0	$48.00	$31	$2		$0	$15,500	$1,200	$0	$16,700
	Miscellaneous Bulk Material	Lot	1	40	$48.00	$1,200	$192		$1,920	$1,200	$192	$0	$3,312
3	Operations												
3a	Reclaim												
	Pump Rope Pullers	EA	4	208	$91.00				$75,712	$0	$0	$0	$75,712
	Hose Pullers	EA	2	208	$91.00				$37,856	$0	$0	$0	$37,856
	Electrical Puller	EA	1	208	$91.00				$18,928	$0	$0	$0	$18,928
	Pump Operator	EA	1	208	$91.00				$18,928	$0	$0	$0	$18,928
	Screen Operator	EA	1	208	$91.00				$18,928	$0	$0	$0	$18,928
	Foremen	EA	2	208	$91.00				$37,856	$0	$0	$0	$37,856

Pond 207–B Option #7.1

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors Mhrs.	Lab $	Mat.	Equip.	S/C	Costs Labor	Material	Equipt.	SubCont.	Total
3b	Pumping												
	Pump at Pond	EA	3	120	$91.00				$32,760	$0	$0	$0	$32,760
	Pad Operations	EA	4	120	$91.00				$43,680	$0	$0	$0	$43,680
	Transfer Line Maintenance	EA	1	120	$90.00				$10,800	$0	$0	$0	$10,800
	Foremen	EA	2	120	$91.00				$21,840	$0	$0	$0	$21,840
3c	Debris Removal												
	Journeymen	EA	6	40	$91.00		$4,368		$21,840	$0	$26,208	$0	$48,048
	Foremen	EA	1	40	$91.00		$728		$3,640	$0	$728	$0	$4,368
4	Demobilize												
	Journeymen	EA	6	80	$90.00		$6,480		$43,200	$0	$38,880	$0	$82,080
	Foremen	EA	2	80	$90.00		$2,160		$14,400	$0	$4,320	$0	$18,720
	Subtotal								$625,388	$21,700	$123,084	$0	$770,172
	M&O Contractors Costs												
1	EG&G Supervision (1) @ $91Hr (440hr	EA							$40,040				$40,040
2	Waste Manage (1) @ $91Hr (520Hr)	EA							$47,320				$47,320
3	Radiological Eng (1) @ $93Hr (300Hr)	EA							$27,900				$27,900
4	H&S Support (1) @ $92Hr (300hr)	EA							$27,600				$27,600
5	EG&G Project Manag @ 15% of Labor	LOT							$93,808				$93,808
	Total M&O Contractor Costs								$236,668				$236,668
	Total Estimated Costs								$862,056	$21,700	$123,084	$0	$1,006,840
	Contingency @ 15% on Material, 25% on Balance of Costs								$215,514	$3,255	$30,771	$0	$249,540

Pond 207–B Option #7.1

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
	Escalation @ 4.4%/Year on Labor.								$47,413				$47,413
	Total Project Costs								$1,124,983	$24,955	$153,855	$0	$1,303,793

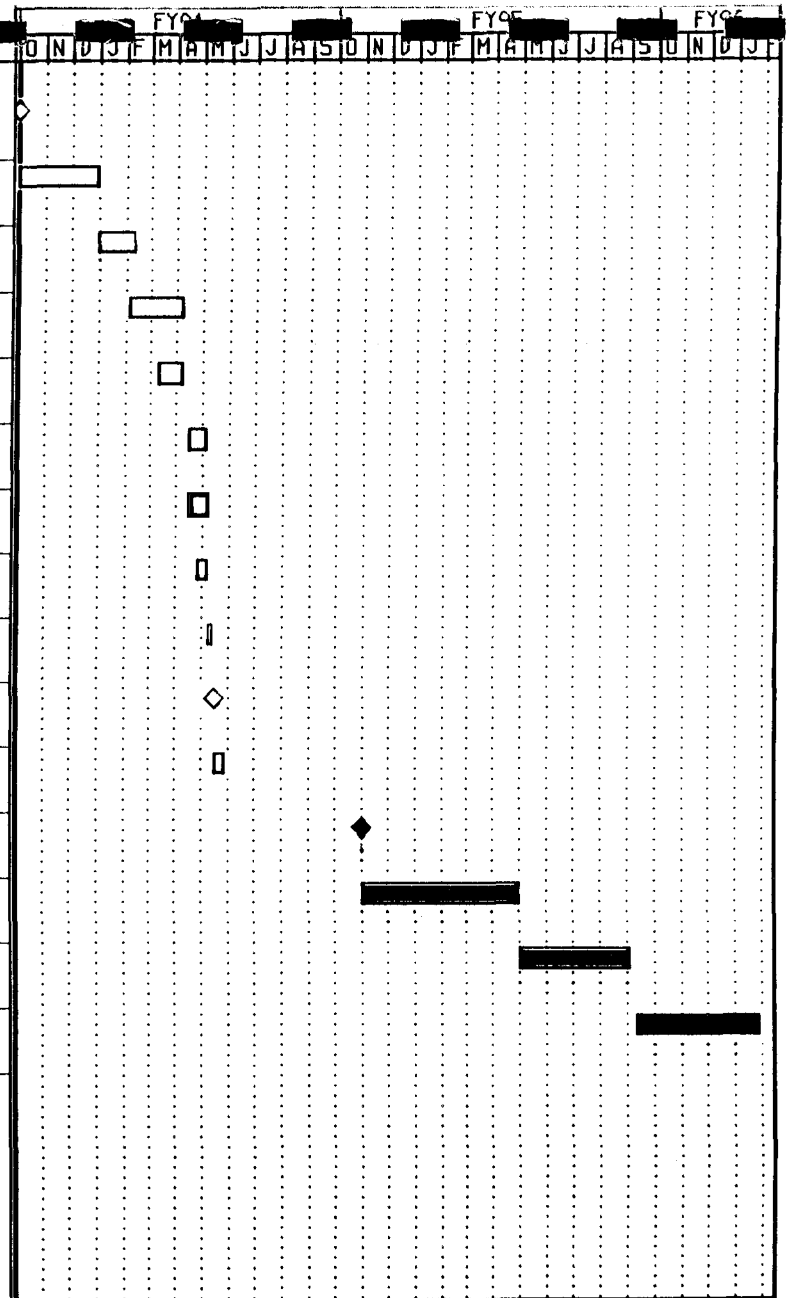
L[illegible]S PRIMAVERA PROJECT PLANNER 207-B POND CONSOLIDATION -OPTION 7.1

D[illegible]E 23JUL93 RUN NO. 36 ROCKY FLATS SOLAR EVAPORATOR PONDS START DATE 1OCT93 FIN DATE 29JAN96
9:03

SCHEDULE REPORT - SORT BY ES, TF DATA DATE 1OCT93 PAGE NO. 1

[illegible]VITY D[illegible]	ORIG DUR	REM DUR	%	CODE	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL FLOAT
[illegible]M1	0	0	0		START PROJECT	1OCT93*	30SEP93	14MAR94	11MAR94	116
[illegible]100	65	65	0		RCRA PERMIT MODIFICATION	1OCT93	30DEC93	14MAR94	10JUN94	116
[illegible]50	30	30	0		PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10FEB94	13JUN94	22JUL94	116
200	45	45	0		PURCHASE AND INSTALL CONTAINERS	4FEB94	7APR94	18JUL94	16SEP94	116
[illegible]00	20	20	0		PROCESS HOOK-UP	11MAR94	7APR94	22AUG94	16SEP94	116
300	15	15	0		POND RECLAIM OPERATIONS	15APR94*	5MAY94	19SEP94	7OCT94	111
[illegible]00	15	15	0		TRANSPORT AND PAD STORAGE	18APR94	6MAY94	20SEP94	10OCT94	111
500	10	10	0		FINAL RINSE POND	25APR94	6MAY94	27SEP94	10OCT94	111
[illegible]00	5	5	0		DEBRIS REMOVAL	9MAY94	13MAY94	11OCT94	17OCT94	111
[illegible]M2	0	0	0		PUMPING COMPLETE	16MAY94	13MAY94	18OCT94	17OCT94	111
900	10	10	0		CLEANUP AND DEMOBILIZE	16MAY94	27MAY94	18OCT94	31OCT94	111
[illegible]M3	0	0	0		FINISH 94 ACTIVITIES	1NOV94	31OCT94*	1NOV94	31OCT94	0
1000	130	130	0		IN STORAGE	1NOV94	1MAY95	1NOV94	1MAY95	0
[illegible]00	90	90	0		DECANT CLEAR LIQUID	2MAY95	4SEP95	2MAY95	4SEP95	0
1200	100	100	0		CONSOLIDATE DENSIFIED WASTE	12SEP95	29JAN96	12SEP95	29JAN96	0

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR	TOTL FLT
M1	START PROJECT	1OCT93	30SEP93	0	116
100	RCRA PERMIT MODIFICATION	1OCT93	30DEC93	65	116
150	PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10FEB94	30	116
200	PURCHASE AND INSTALL CONTAINERS	4FEB94	7APR94	45	116
400	PROCESS HOOK-UP	11MAR94	7APR94	20	116
300	POND RECLAIM OPERATIONS	15APR94	5MAY94	15	111
800	TRANSPORT AND PAD STORAGE	18APR94	6MAY94	15	111
500	FINAL RINSE POND	25APR94	6MAY94	10	111
700	DEBRIS REMOVAL	9MAY94	13MAY94	5	111
M2	PUMPING COMPLETE	16MAY94	13MAY94	0	111
900	CLEANUP AND DEMOBILIZE	16MAY94	27MAY94	10	111
M3	FINISH 94 ACTIVITIES	1NOV94	31OCT94	0	0
1000	IN STORAGE	1NOV94	1MAY95	130	0
1100	DECANT CLEAR LIQUID	2MAY95	4SEP95	90	0
1200	CONSOLIDATE DENSIFIED WASTE	12SEP95	29JAN96	100	0



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 29JAN96

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

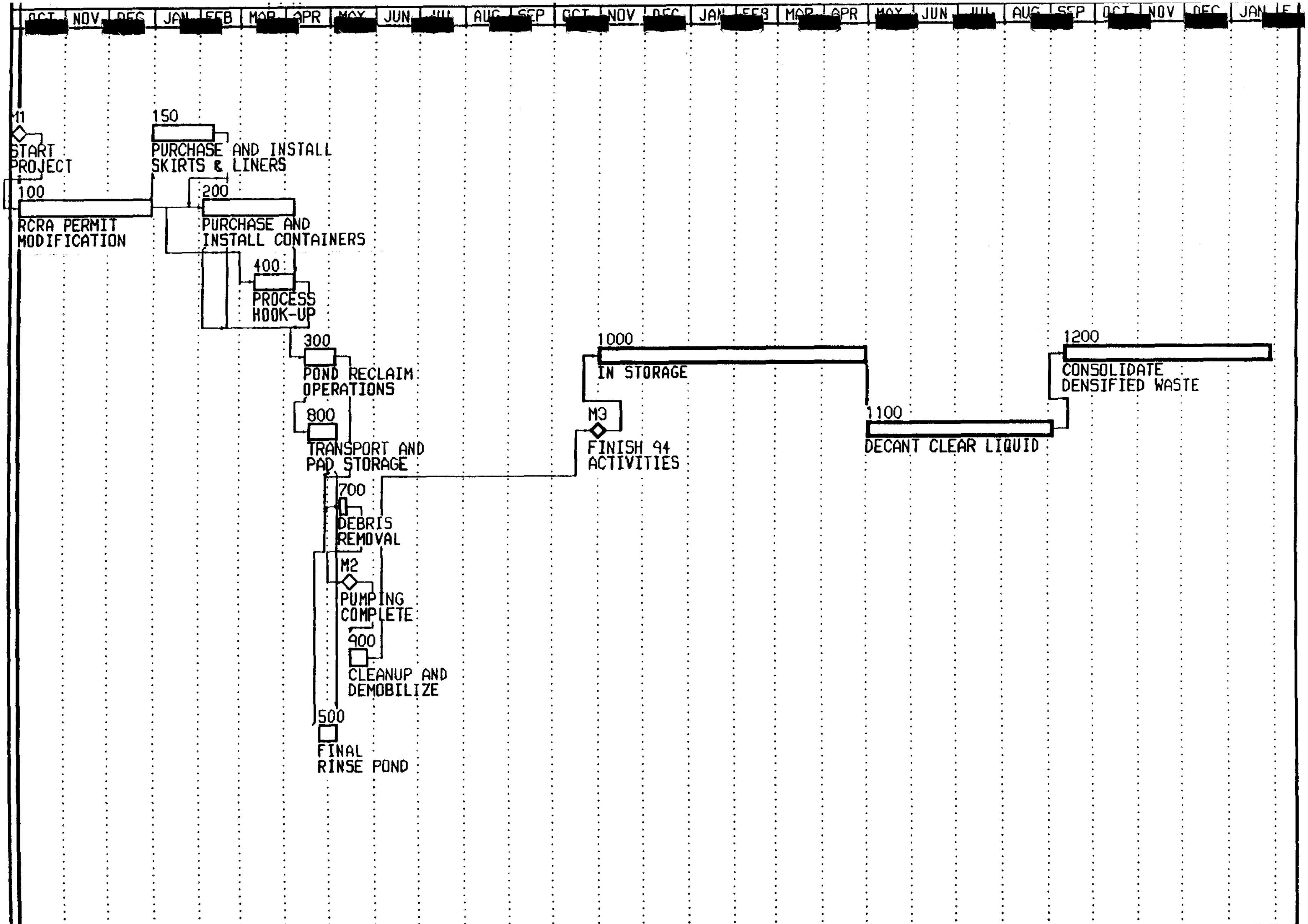
BP71

Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-B POND CONSOLIDATION OPTION 7.1

----PROJECT SCHEDULE----

Date	Revision	Checked	Approved



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 29JAN96

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Act Id
Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

EP71

Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-B POND CONSOLIDATION OPTION 7.1

PROJECT SCHEDULE

Date	Revision	Checked	Approved

Pond 207 – C Option #2

Material Transfer Options

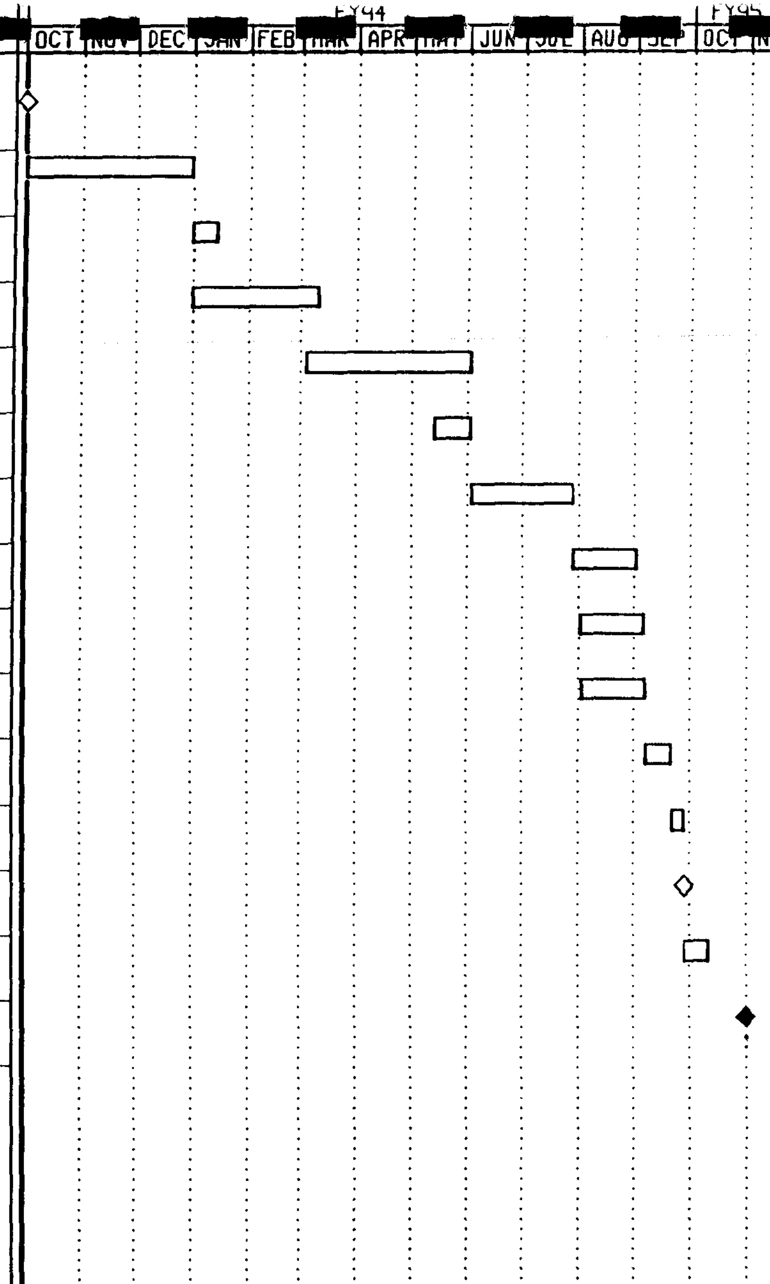
Item	Description	Unit	Qty	Unit Factors Mhrs.	Lab $	Mat.	Equip.	S/C	Costs Labor	Material	Equipt.	SubCont.	Total
	Pad Operations	EA	2	240	$91.00				$43,680	$0	$0	$0	$43,680
	Foremen	EA	1	240	$91.00				$21,840	$0	$0	$0	$21,840
	RAD Protection Equipment	EA	1	240	$89.00				$21,360	$0	$0	$0	$21,360
3c	Debris Removal												
	Journeymen	EA	6	40	$91.00		$4,368		$21,840	$0	$26,208	$0	$48,048
	Foremen	EA	1	40	$91.00		$728		$3,640	$0	$728	$0	$4,368
	RAD Protection Technician	EA	1	40	$89.00								
4	Demobilize												
	Journeymen	EA	6	80	$89.00		$6,408		$42,720	$0	$38,448	$0	$81,168
	Foremen	EA	2	80	$89.00		$2,136		$14,240	$0	$4,272	$0	$18,512
	Subtotal								$619,939	$20,700	$146,019	$0	$786,658

Item	Description	Unit	Qty	Mhrs.	Lab $	Mat.	Equip.	S/C	Labor	Material	Equipt.	SubCont.	Total
	M&O Contractors Costs												
1	EG&G Supervn. (1) @ $91/Hr (736Hr)	EA							$66,976				$66,976
5	EG&G Project Manag @ 15% of Labor	LOT							$92,991				$92,991
	Total M&O Contractor Costs								$159,967				$159,967
	Total Estimated Costs								$779,906	$20,700	$146,019	$0	$946,625
	Contingency @ 15% on Material, 25% on Balance of Costs								$194,976	$3,105	$36,505	$0	$234,586
	Escalation @ 4.4%/Year on Labor.								$42,895				$42,895
	Total Project Costs								$1,017,777	$23,805	$182,524	$0	$1,224,106

TS	PRIMAVERA PROJECT PLANNER	207-C POND - OPTION 2
DATE 23JUL93 RUN NO. 22 9:17	ROCKY FLATS SOLAR EVAPORATOR PONDS	START DATE 1OCT93 FIN DATE 31OCT94
CHEDULE REPORT - SORT BY ES, TF		DATA DATE 1OCT93 PAGE NO. 1

VITY	ORIG DUR	REM DUR	%	CODE	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL FLOAT
M1	0	0	0		START PROJECT	1OCT93*	30SEP93	21OCT93	20OCT93	14
00	65	65	0		RCRA PERMIT MODIFICATION	1OCT93	30DEC93	21OCT93	19JAN94	14
50	10	10	0		CIRCULATION HOOK-UP	31DEC93	13JAN94	9JUN94	22JUN94	114
150	50	50	0		PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10MAR94	20JAN94	30MAR94	14
200	65	65	0		PURCHASE AND INSTALL CONTAINERS	4MAR94	2JUN94	24MAR94	22JUN94	14
400	15	15	0		PROCESS HOOK-UP	13MAY94*	2JUN94	2JUN94	22JUN94	14
00	40	40	0		SALT CRYSTAL RECIRCULATION	3JUN94	28JUL94	23JUN94	17AUG94	14
900	25	25	0		RECLAIM TO POND SIDE	29JUL94	1SEP94	18AUG94	21SEP94	14
00	25	25	0		POND RECLAIM OPERATIONS	2AUG94*	5SEP94	22AUG94	23SEP94	14
800	25	25	0		TRANSPORT AND PAD STORAGE	3AUG94	6SEP94	23AUG94	26SEP94	14
00	10	10	0		RINSE POND	7SEP94	20SEP94	27SEP94	10OCT94	14
700	5	5	0		DEBRIS REMOVAL	21SEP94	27SEP94	11OCT94	17OCT94	14
M2	0	0	0		PUMPING COMPLETE	28SEP94	27SEP94	18OCT94	17OCT94	14
00	10	10	0		CLEANUP AND DEMOBILIZE	28SEP94	11OCT94	18OCT94	31OCT94	14
M3	0	0	0		FINISH 94 ACTIVITIES	1NOV94	31OCT94*	1NOV94	31OCT94	0

ACTIVITY [redacted]	ACTIVITY [redacted]SCR[redacted]N [redacted]	EARLY ST[redacted]	EARLY FI[redacted]	ORIG D[redacted]	TOTL FL[redacted]
M1	START PROJECT	1OCT93	30SEP93	0	14
100	RCRA PERMIT MODIFICATION	1OCT93	30DEC93	65	14
550	CIRCULATION HOOK-UP	31DEC93	13JAN94	10	114
150	PURCHASE AND INSTALL SKIRTS & LINERS	31DEC93	10MAR94	50	14
200	PURCHASE AND INSTALL CONTAINERS	4MAR94	2JUN94	65	14
400	PROCESS HOOK-UP	13MAY94	2JUN94	15	14
600	SALT CRYSTAL RECIRCULATION	3JUN94	28JUL94	40	14
900	RECLAIM TO POND SIDE	29JUL94	1SEP94	25	14
300	POND RECLAIM OPERATIONS	2AUG94	5SEP94	25	14
800	TRANSPORT AND PAD STORAGE	3AUG94	6SEP94	25	14
500	RINSE POND	7SEP94	20SEP94	10	14
700	DEBRIS REMOVAL	21SEP94	27SEP94	5	14
M2	PUMPING COMPLETE	28SEP94	27SEP94	0	14
1000	CLEANUP AND DEMOBILIZE	28SEP94	11OCT94	10	14
M3	FINISH 94 ACTIVITIES	1NOV94	31OCT94	0	0



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31OCT94

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

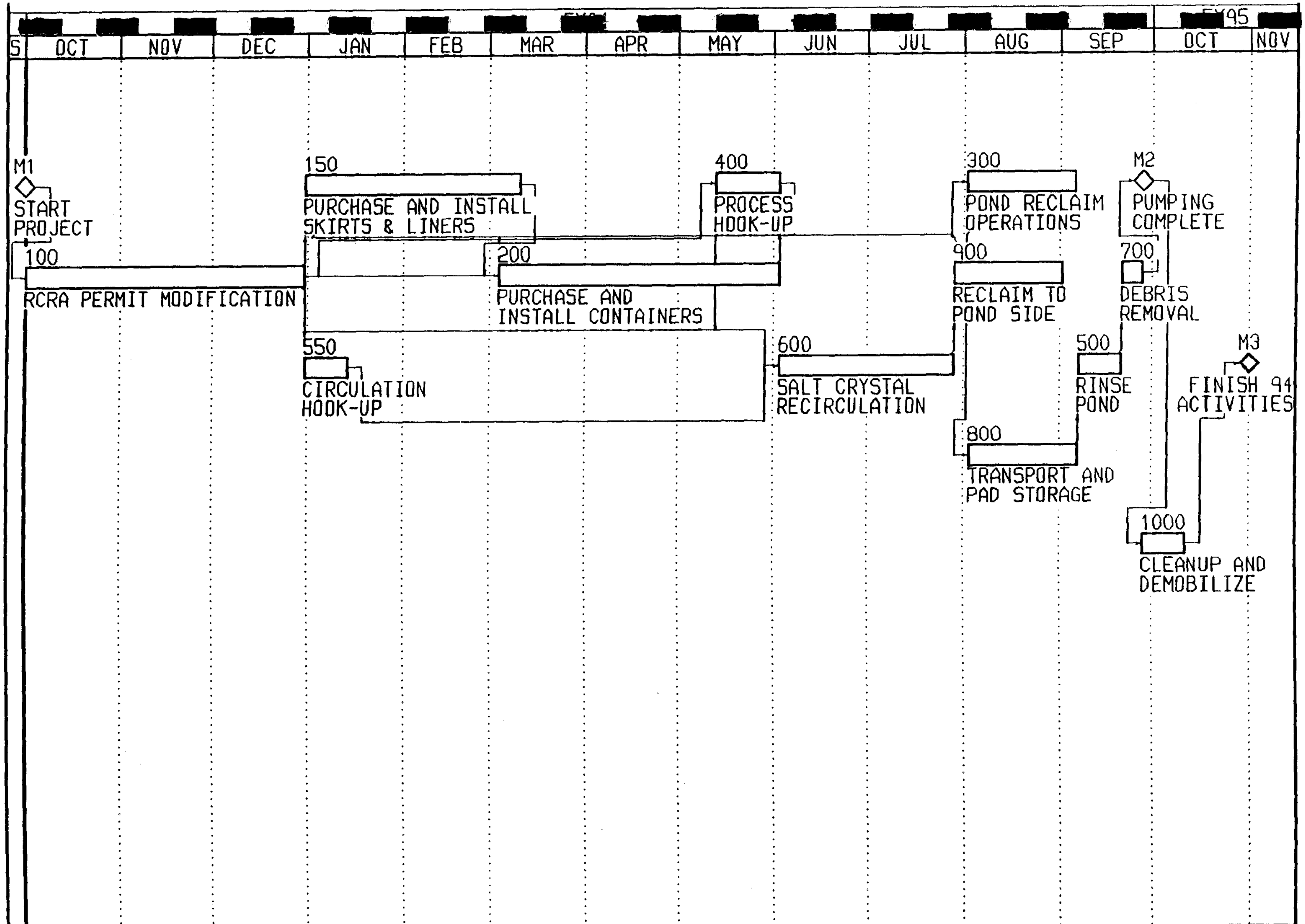
207C

Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-C POND OPTION 2

-----PROJECT SCHEDULE-----

Date	Revision	Checked	Approved



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31OCT94

(c) Primavera Systems, Inc.

act id

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

207C Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
207-C POND OPTION 2

----PROJECT SCHEDULE----

Date	Revision	Checked	Approved

Clarifier Option 3

	Material Transfer Options			Unit Factors					Costs				
Item	Description	Unit	Qty	Mhrs.	Lab $	Mat.	Equip.	S/C	Labor	Material	Equipt.	SubCont.	Total
	Direct and Indirect Costs												
1	Hook-up and Installation												
1b	Hook-up Labor												
	Journeymen	EA	4	80	$45.00		$1,440		$14,400	$0	$5,760	$0	$20,160
	Foremen	EA	1	80	$60.00		$480		$4,800	$0	$480	$0	$5,280
2b	Pumping												
	Journeymen	EA	4	120	$91.00		$4,368		$43,680	$0	$17,472	$0	$61,152
	Foremen	EA	1	120	$91.00		$1,092		$10,920	$0	$1,092	$0	$12,012
	RAD Protection Technician	EA	1	120	$89.00		$1,068		$10,680	$0	$1,068	$0	$11,748
2c	Additional Equipment and Material												
	Miscellaneous Equipment	EA	1	20	$48.00	$2,000	$96		$960	$2,000	$96	$0	$3,056
	3" Double Contained Pipe	LF	500	0	$48.00	$31	$2		$0	$15,500	$1,200	$0	$16,700
	Miscellaneous Bulk Material	LOT	1	40	$48.00	$1,200	$192		$1,920	$1,200	$192	$0	$3,312
3	Operations												
3a	Reclaim												
	Lance Operator	EA	2	80	$91.00				$14,560	$0	$0	$0	$14,560
	Pump Operator at Clarifier	EA	2	80	$91.00				$14,560	$0	$0	$0	$14,560
	Foreman	EA	1	80	$91.00				$7,280	$0	$0	$0	$7,280
3b	Pumping												
	Pump Operator at Pad	EA	3	120	$91.00				$32,760	$0	$0	$0	$32,760
	Pipe Line Operator	EA	1	104	$91.00				$9,464	$0	$0	$0	$9,464
	Foremen	EA	1	104	$91.00				$9,464	$0	$0	$0	$9,464
3c	Debris Removal												
	Journeymen	EA	3	16	$91.00		$874		$4,368	$0	$2,621	$0	$6,989
	Foremen	EA	1	16	$91.00		$291		$1,456	$0	$291	$0	$1,747

Clarifier Option 3

Material Transfer Options

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
4	Demobilize												
	Journeymen	EA	6	80	$90.00		$6,480		$43,200	$0	$38,880	$0	$82,080
	Foremen	EA	2	80	$90.00		$2,160		$14,400	$0	$4,320	$0	$18,720
	Subtotal								$238,872	$18,700	$73,472	$0	$331,044
	M&O Contractors Costs												
1	EG&G Project Man. @ 15% of Labor	LOT							$35,831				$35,831
	Total M&O Contractor Costs								$35,831				$35,831
	Total Estimated Costs								$274,703	$18,700	$73,472	$0	$366,875
	Contingency @ 15% on Material, 25% on Balance of Costs								$68,676	$2,805	$18,368	$0	$89,849
	Escalation @ 4.4%/Year on Labor.								$15,109				$15,109
	Total Project Costs								$358,487	$21,505	$91,840	$0	$471,832

LA S

PRIMAVERA PROJECT PLANNER — CLARIFIER - OPTION 3

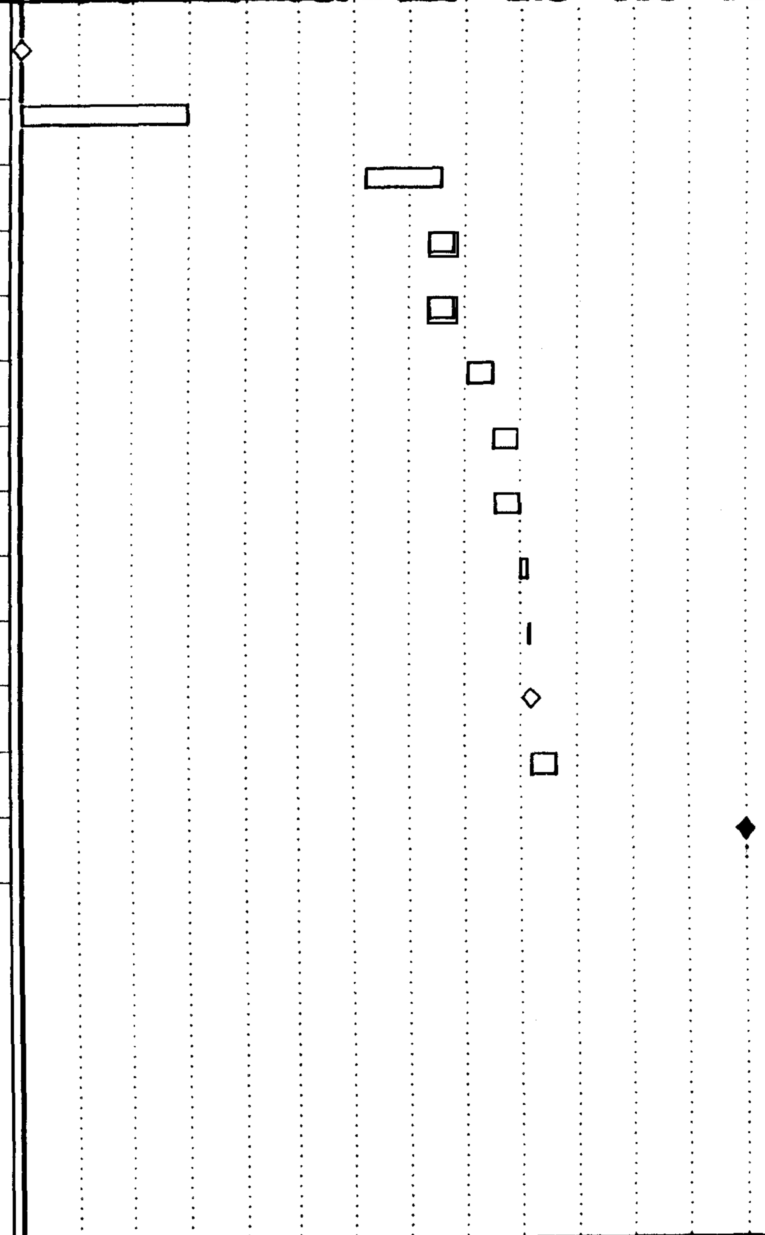
DATE 23JUL93 RUN NO. 12 — ROCKY FLATS SOLAR EVAPORATOR PONDS — START DATE 1OCT93 FIN DATE 31OCT94

9:08

SCHEDULE REPORT - SORT BY ES, TF — DATA DATE 1OCT93 PAGE NO. 1

ACTIVITY ID	ORIG DUR	REM DUR	%	CODE	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL FLOAT
M1	0	0	0		START PROJECT	1OCT93*	30SEP93	19APR94	18APR94	142
100	65	65	0		RCRA PERMIT MODIFICATION	1OCT93	30DEC93	19APR94	18JUL94	142
50	30	30	0		PURCHASE AND INSTALL SKIRTS & LINERS	7APR94*	18MAY94	19JUL94	29AUG94	73
200	10	10	0		PURCHASE AND INSTALL CONTAINERS	12MAY94*	25MAY94	23AUG94	5SEP94	73
00	10	10	0		PROCESS HOOK-UP	12MAY94*	25MAY94	23AUG94	5SEP94	73
600	10	10	0		SLUDGE RECLAIM	2JUN94	15JUN94	13SEP94	26SEP94	73
00	10	10	0		POND RECLAIM OPERATIONS	16JUN94*	29JUN94	27SEP94	10OCT94	73
800	10	10	0		TRANSPORT AND PAD STORAGE	17JUN94	30JUN94	28SEP94	11OCT94	73
00	2	2	0		WASH CLARIFIER	1JUL94	4JUL94	12OCT94	13OCT94	73
700	2	2	0		DEBRIS REMOVAL	5JUL94	6JUL94	14OCT94	17OCT94	73
M2	0	0	0		PUMPING COMPLETE	7JUL94	6JUL94	18OCT94	17OCT94	73
00	10	10	0		CLEANUP AND DEMOBILIZE	7JUL94	20JUL94	18OCT94	31OCT94	73
M3	0	0	0		FINISH 94 ACTIVITIES	1NOV94	31OCT94*	1NOV94	31OCT94	0

ACTIVITY [redacted]	ACTIVITY [redacted]SCR[redacted]N	EARLY ST[redacted]	EARLY FI[redacted]	ORIG D[redacted]	TOTL FL[redacted]
M1	START PROJECT	1OCT93	30SEP93	0	142
100	RCRA PERMIT MODIFICATION	1OCT93	30DEC93	65	142
150	PURCHASE AND INSTALL SKIRTS & LINERS	7APR94	18MAY94	30	73
200	PURCHASE AND INSTALL CONTAINERS	12MAY94	25MAY94	10	73
400	PROCESS HOOK-UP	12MAY94	25MAY94	10	73
600	SLUDGE RECLAIM	2JUN94	15JUN94	10	73
300	POND RECLAIM OPERATIONS	16JUN94	29JUN94	10	73
800	TRANSPORT AND PAD STORAGE	17JUN94	30JUN94	10	73
500	WASH CLARIFIER	1JUL94	4JUL94	2	73
700	DEBRIS REMOVAL	5JUL94	6JUL94	2	73
M2	PUMPING COMPLETE	7JUL94	6JUL94	0	73
900	CLEANUP AND DEMOBILIZE	7JUL94	20JUL94	10	73
M3	FINISH 94 ACTIVITIES	1NOV94	31OCT94	0	0



Plot Date 23JUL93
Data Date 1OCT93
Project Start 1OCT93
Project Finish 31OCT94

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

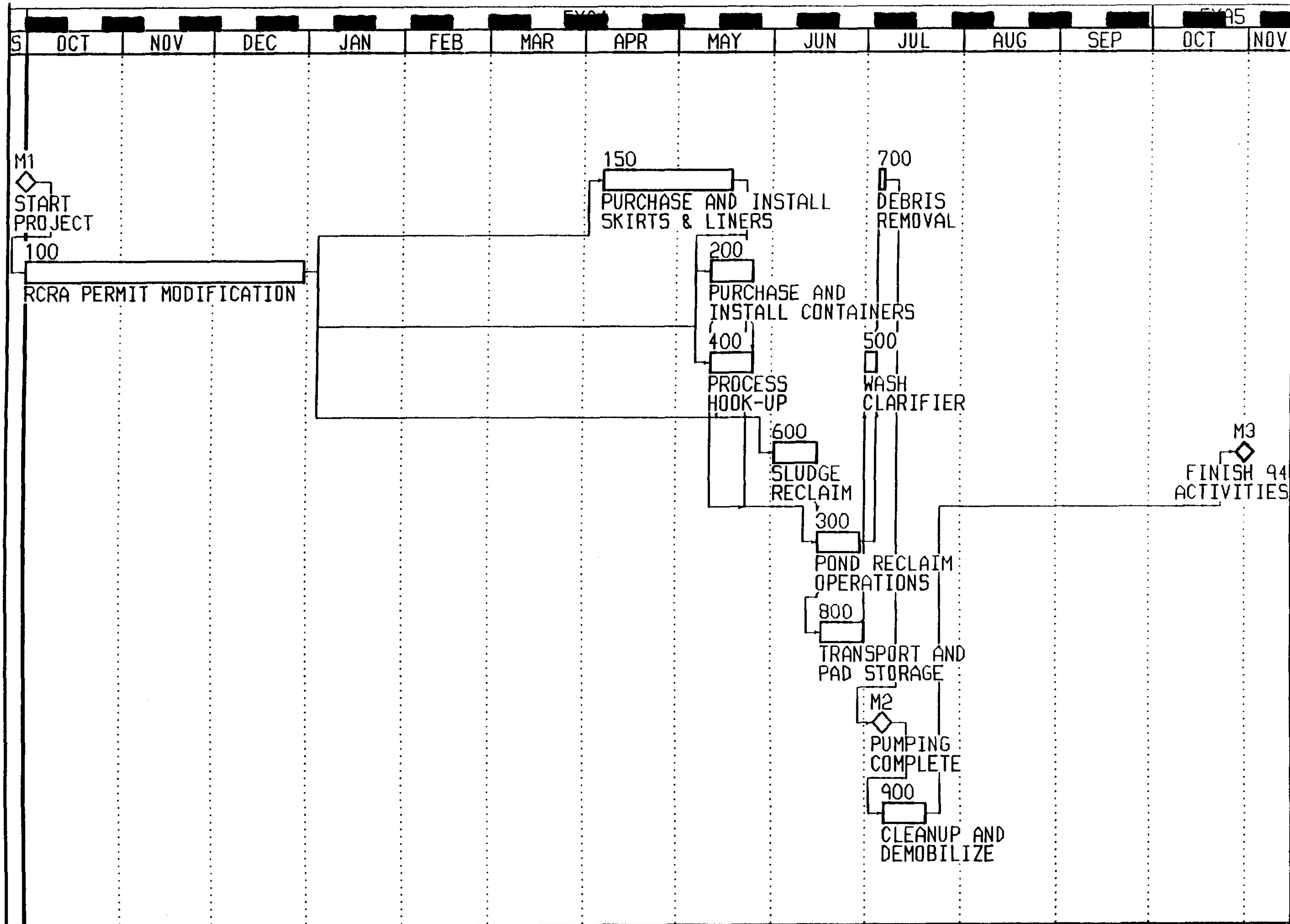
CLAR

Sheet 1 of 1

ROCKY FLATS PLANT
SOLAR EVAPORATOR PONDS
CLARIFIER OPTION 3

-----PROJECT SCHEDULE-----

Date	Revision	Checked	Approved



Plot Date	23JUL93
Data Date	1OCT93
Project Start	1OCT93
Project Finish	31OCT94

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- Activity Bar/Early Dates
- Critical Activity
- Progress Bar
- Milestone/Flag Activity

CLAR

Sheet 1 of 1

ROCKY FLATS PLANT

SOLAR EVAPORATOR PONDSDERNIZATION

CLARIFIER OPTION 3

-----PROJECT SCHEDULE-----

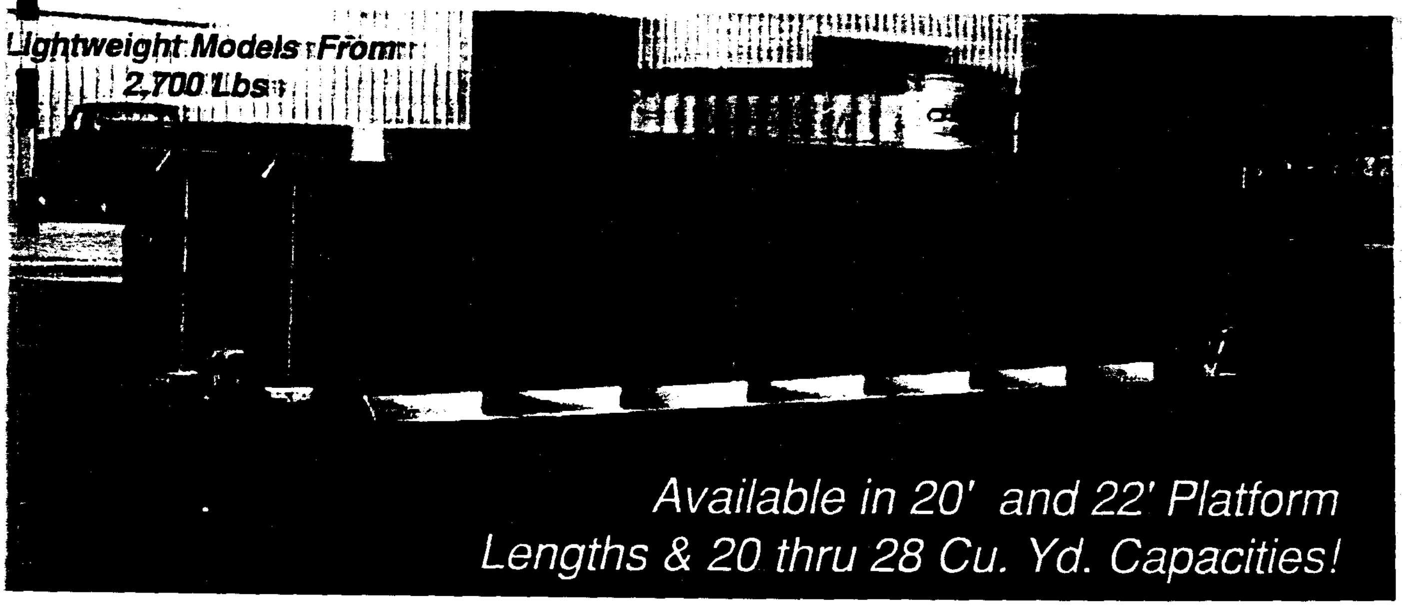
Date	Revision	Checked	Approved

APPENDIX J
Vender Information: Roll-Offs

BROTHERS EQUIPMENT CO.
4950 JACKSON ST
DENVER, COLO. 80216
PHONE: 303-399-7370

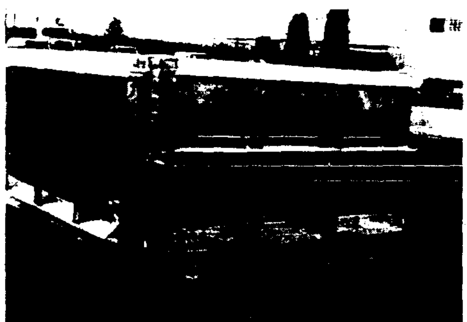
Galbreath
A Sudbury Company

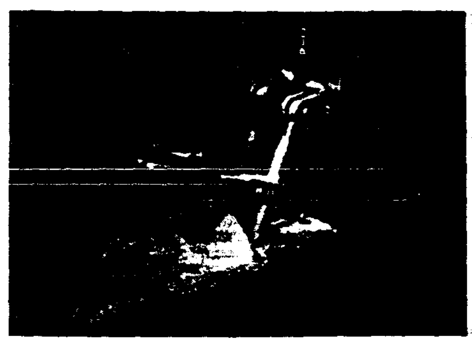
Roll-Off Aluminum Open Top
SLUDGE CONTAINERS
Top Hinged Rear Door Style



STANDARD FEATURES

/4" 5454-H34 aluminum floor.
5/32" 5454-H34 aluminum sides.
3-2"x6"x3/16" 6061-T6 aluminum side posts on 24" centers.
1/4" 5454-H34 aluminum bulkhead.
3/6" 5454-H34 aluminum tailgate.
1"6"x1/4" 6061-T6 extruded aluminum top rail.
3/6" 6061-T6 extruded aluminum piece rub rail and inside diagonal.
4" structural channel 6061-T6 cross members on 18" centers.
2"6061-T6 solid aluminum nose cone on 2"x6" 6061-T6 boxed aluminum channel long sills.
Steel hardware and wear points.
Rear discharge door gasketed with 1" neoprene rubber material.
All welds continuous- inside and outside.
Outside dirt shedders.
6-8" O.D. rear rollers.
Dog house style container hook-up standard.
A variety of options available.


3/16" aluminum tailgate with 1" neoprene gasket and four sludge locks provide leak resistant seal.


Standard ratchet type rear door closing system.


4" nose rollers with factory installed grease fittings. 2" solid nose cone on boxed channel long sills.

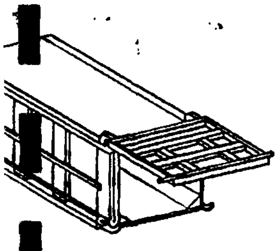

Standard 6-5/8" bolt-on rear rollers with grease fittings.

P. O. Box 220, Winamac, Indiana 46996 219/946-6631 FAX 219/946-4579

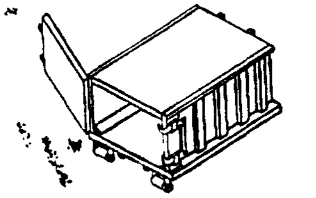
Galbreath

S A SUDBURY COMPANY

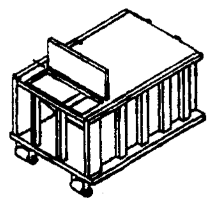
CLOSED TOP "CS" ROLL-OFF SLUDGE CONTAINER SPECIFICATIONS



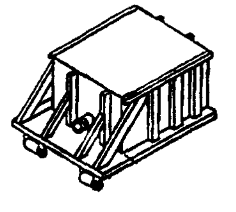
li[illegible]d Gasketed Rear Door [illegible]table Hinges, Ratchet [illegible]rs, Release Handle At Front re[illegible] Side.



Side Hinged, Gasketed Rear Door Adjustable Hinges and Latches, With Ratchet Binders.



Scow Type Rear With Gasketed Discharge
Door On Top, Spring-Assisted Opening, Ratchet Binder Closing.



Platform Mounted Valve Discharge Platform Extends 24" For Valve Installation. Capacity Same As Top And Side Hinged Models. Various Valve Sizes Available.

M[illegible]DEL [illegible]O.	INSIDE DIMENSIONS			RATED CAPACITY				SHIPPING WEIGHT	
				TOP & SIDE HINGED DOOR		SCOW TYPE		TOP & SIDE HINGED DOOR	SCOW TYPE
	L	H	W	YDS.	GALS.	YDS.	GALS.	LBS.	LBS.
CS1230	12'	30"	84"	7	1450	6	1225	5442	5542
C[illegible]236	12'	36"	84"	9	1750	7	1450	5655	5755
C[illegible]242	12'	42'	84"	10	2075	8	1650	5889	5989
CS1248	12'	48"	84"	12	2400	9	1825	6094	6194
CS1430	14'	30"	84"	8	1700	7	1475	5990	6090
C[illegible]436	14'	36"	84"	10	2075	9	1750	6223	6333
C[illegible]442	14'	42"	84"	12	2450	10	2000	6475	6575
CS1448	14'	48"	84"	14	2800	11	2250	6700	6800
CS1630	16'	30"	84"	10	1975	9	1750	6026	6126
C[illegible]636	16'	36"	84"	12	2375	10	2075	6275	6375
C[illegible]642	16'	42"	84"	14	2800	12	2375	6547	6647
CS1648	16'	48"	84"	16	3225	13	2650	6789	6889
CS1830	18'	30"	84"	11	2225	10	2000	6742	6842
C[illegible]836	18'	36"	84"	13	2700	12	2375	7007	7107
C[illegible]842	18'	42"	84"	16	3175	14	2750	7298	7398
CS1848	18'	48"	84"	18	3625	15	3075	7561	7661
CS2030	20'	30"	84"	12	2475	11	2250	7279	7379
C[illegible]2036	20'	36"	84"	15	3000	13	2675	7569	7669
C[illegible]2042	20'	42"	84"	17	3525	15	3100	7879	7979
CS2048	20'	48"	84"	20	4060	17	3500	8161	8261
CS2230	22'	30"	84"	14	2725	12	2525	8180	8280
C[illegible]2236	22'	36"	84"	16	3325	15	3000	8489	8589
C[illegible]2242	22'	42"	84"	19	3900	17	3475	8818	8918
CS2248	22'	48"	84"	22	4475	19	3900	9119	9219
CS2430	24'	30"	84"	15	3000	14	2775	8298	8398
C[illegible]2436	24'	36"	84"	18	3625	16	3300	8626	8726
C[illegible]2442	24'	42"	84"	21	4250	19	3825	8974	9074
CS2448	24'	48"	84"	24	4875	21	4325	9294	9394

Standard Features:

1/4" Floor, 3/16" Sides, 3 1/2" x 5 1/2" Side Stakes On 24" Centers, 7 Ga. Roof With 3" Channel Supports And Baffles As Required, 6" x 2" x 1/4" Rectangular Tubing Long Sills, 3" (4.1 Lb.) Structural Channel Cross Sills, Solid Steel Nose Cone, All Seams Continuously Welded Inside And Outside, All Inside Lower Corners Gusseted And Air Tested For Leaks. Rear Discharge Door Gasketed With 1" x 2 1/2" Neoprene Rubber. Painted Any Of Galbreath's 24 Standard Colors.

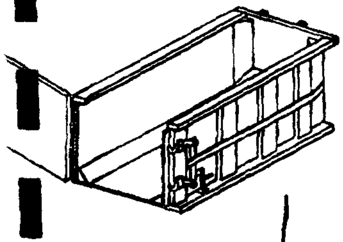
Galbreath

3', 4', 5', 6' high

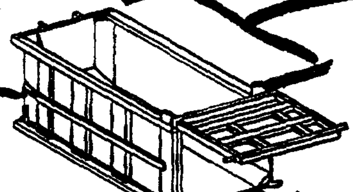
S A SUDBURY COMPANY

OPEN TOP "OS" ROLL-OFF SLUDGE CONTAINER SPECIFICATIONS

12', 14', 16', 18' 20', 22' & 24' Long



Side-Hinged Gasketed Rear Door Adjustable Hinges and Latches With Ratchet Binders.



Top Hinged Gasketed Rear Door. Adjustable Hinges, Ratchet Binders, Release Handle at Front Street Side.

MODEL NO.	INSIDE DIMENSIONS			RATED CAP. YDS.	SHIPPING WT. LBS.
	L	H	W		
OS1230	12'	30"	84"	7	3988
[illegible]1236	12'	36"	84"	9	4166
[illegible]1242	12'	42"	84"	10	4405
OS1248	12'	48"	84"	12	4607
[illegible]1254	12'	54"	84"	13	4808
[illegible]1260	12'	60"	84"	15	5057
OS1266	12'	66"	84"	17	5249
[illegible]1272	12'	72"	84"	18	5466
[illegible]1430	14'	30"	84"	8	4410
OS1436	14'	36"	84"	10	4636
[illegible]442	14'	42"	84"	12	4886
[illegible]448	14'	48"	84"	14	5108
OS1454	14'	54"	84"	16	5328
[illegible]460	14'	60"	84"	18	5597
[illegible]466	14'	66"	84"	19	5819
OS1472	14'	72"	84"	21	6046
[illegible]630	16'	30"	84"	10	4969
[illegible]636	16'	36"	84"	12	5217
OS1642	16'	42"	84"	14	5487
O[illegible]648	16'	48"	84"	16	5729
[illegible]654	16'	54"	84"	18	5968
OS1660	16'	60"	84"	20	6256
O[illegible]666	16'	66"	84"	22	6498
[illegible]672	16'	72"	84"	24	6744
OS1830	18'	30"	84"	11	5374
[illegible]836	18'	36"	84"	13	5641
[illegible]842	18'	42"	84"	16	5931
OS1848	18'	48"	84"	18	6192
[illegible]854	18'	54"	84"	20	6451
[illegible]860	18'	60"	84"	23	6768
[illegible]	18'	66"	84"	25	7121
[illegible]	18'	72"	84"	27	7286

MODEL NO.	INSIDE DIMENSIONS			RATED CAP. YDS.	SHIPPING WT. LBS.
	L	H	W		
OS2030	20'	30"	84"	12	5810
OS2036	20'	36"	84"	15	6097
OS2042	20'	42"	84"	17	6406
OS2048	20'	48"	84"	20	6687
OS2054	20'	54"	84"	23	6966
OS2060	20'	60"	84"	25	7294
OS2066	20'	66"	84"	28	7570
OS2072	20'	72"	84"	30	7860
OS2230	22'	30"	84"	14	6214
OS2236	22'	36"	84"	16	6521
OS2242	22'	42"	84"	19	6848
OS2248	22'	48"	84"	22	7148
OS2254	22'	54"	84"	25	7447
OS2260	22'	60"	84"	28	7795
OS2266	22'	66"	84"	31	8096
OS2272	22'	72"	84"	34	8406
OS2430	24'	30"	84"	15	6617
OS2436	24'	36"	84"	18	6943
OS2442	24'	42"	84"	21	7291
OS2448	24'	48"	84"	24	7612
OS2454	24'	54"	84"	27	7930
OS2460	24'	60"	84"	30	8297
OS2466	24'	66"	84"	34	8617
OS2472	24'	72"	84"	37	8942

7472 gal full

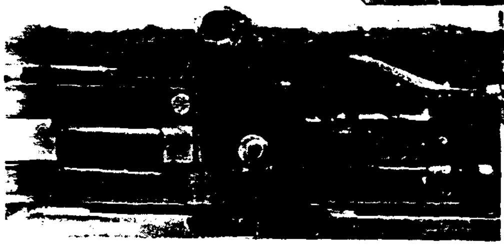
Standard Features:

1/4" Floor, 3/16" Sides, 3 1/2" x 5 1/2" Side Stakes On 24" Centers, 6" x 3" x 3/16" Rectantangular Tubing Top Cap, 6" x 2" x 1/4" Rectangular Tubing Long Sills, 3" (4.1 Lb.) Structural Channel Cross Sills, Solid Steel Nose Cone, All Seams Continuously Welded Inside And Outside, All Inside Corners Gusseted And Air Tested For Leaks, Rear Discharge Door Gasketed With 1" x 2 1/2" Neoprene Rubber, Painted Any Standard Galbreath Color.

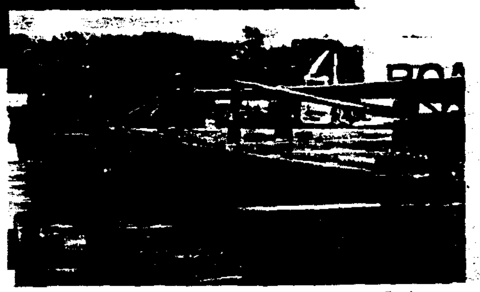
Sludge Top Rolling Lids

Galbreath
A Sudbury Company
Post Office Box 220
Winamac, Indiana 46996
219/946-6631

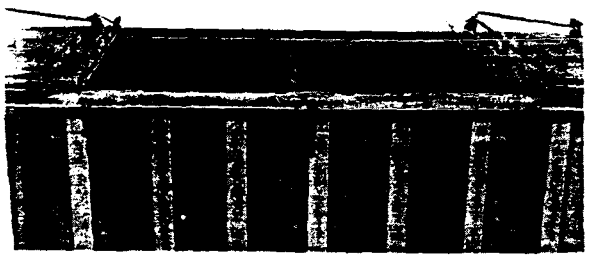
For Galbreath Roll-Off Sludge Containers



Lid Rides On Full Length Steel Rail By Way Of Four (4) 1½" x 4" Roller Bearing Steel Wheels With Track Scraper.



Removable Rubber Bumper Faced Stop On Both Ends Keeps Lids From Rolling Beyond The Track. Adjustable Truss Brace Allows Gasket To Be Tightened In The Center Part Of The Lid.



Lids In "Open" Position With 6" Center Divider.

Patent Applied For

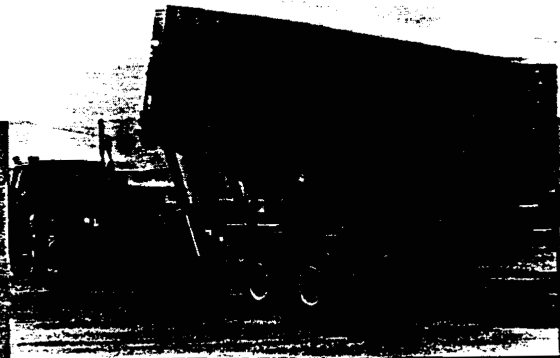
Sludge Top Rolling Lid Features

- One Easy Operating Ratchet Raises Or Lowers The Lid Allowing Clearance For The Lid To Be Rolled Or Compressing the Gasket To Form A Seal.
- Lid can Be Opened And Closed In Less Than A Minute Under Normal Conditions.
- Tightening Lid By Hand Is Normally Sufficient To Obtain A Leak Resistant Seal.
- Replaceable Nylon Side Bearings On Lids.
- Ten (10) Grease Fittings In Each Rolling Lid.
- Lid Opening Sizes Available In 60" x 80", 54" x 80", And 44" x 80" Spaced On Container Per User's Requirements With 6" Minimum Distance Required Between Lids.

Model "AT"
"The Legalizer"

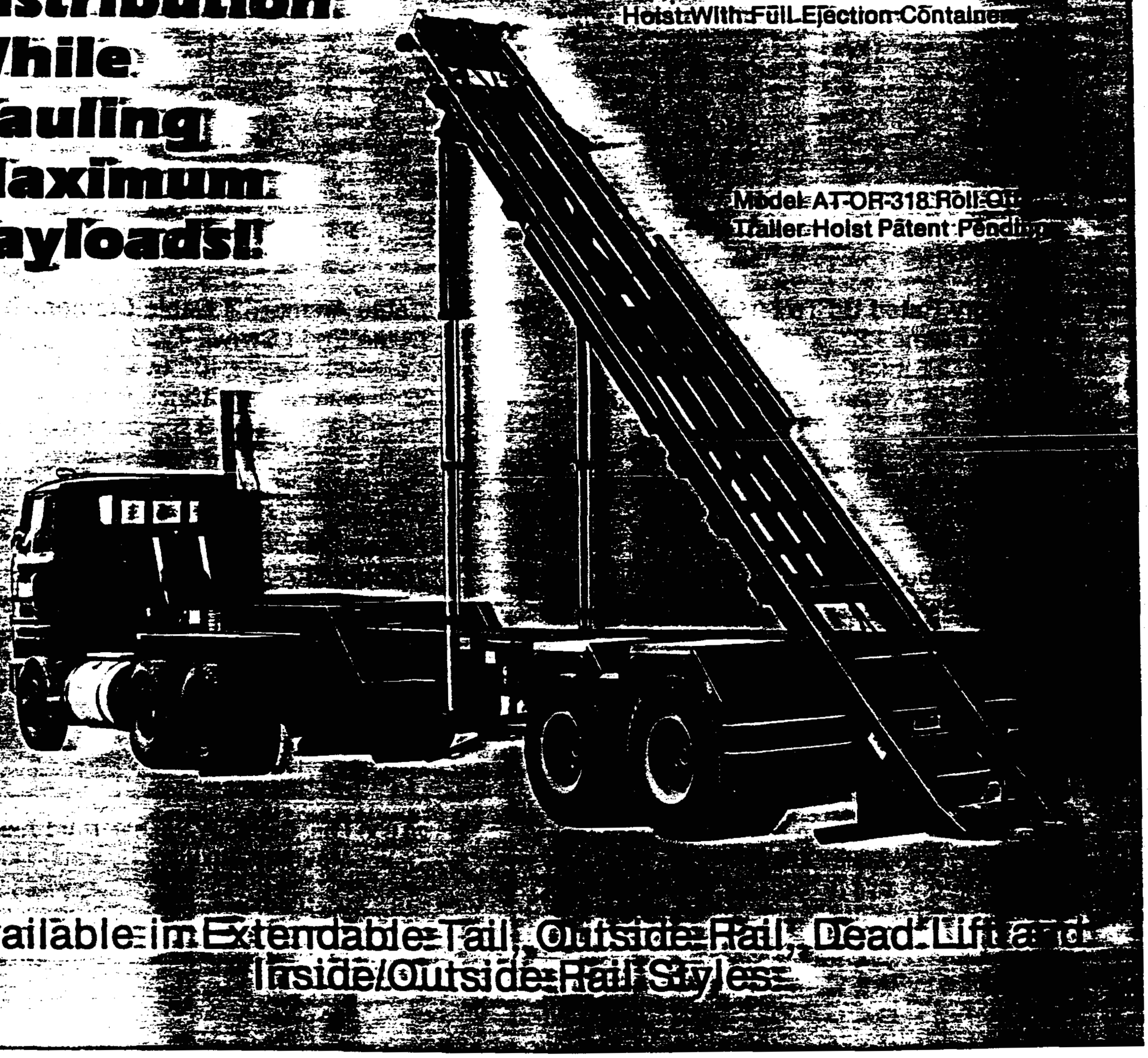
A SUDBURY COMPANY
Winamac, Indiana 46996
219/946-6631

Movable Front Trailer Roll-Off



Model AT-OR-318 Trailer Hoist With Full Ejection Container

Engineered To Provide Legal Weight Distribution While Hauling Maximum Payloads!

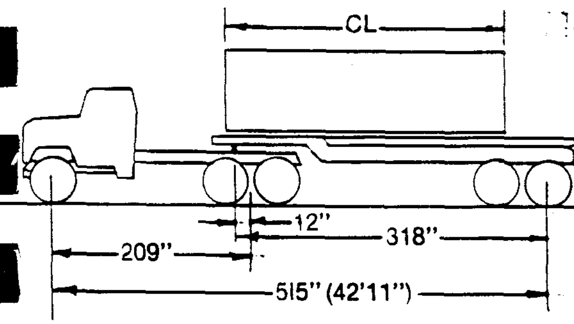


Model AT-OR-318 Roll-Off Trailer Hoist Patent Pending

Available in Extendable Tail, Outside Rail, Dead Lift and Inside/Outside Rail Styles

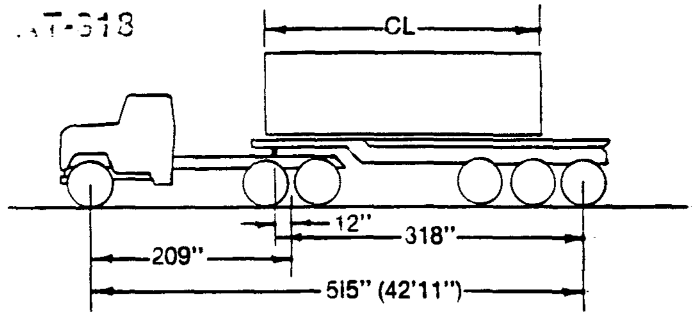
Load Distribution

MODEL AT-318



KING PIN REAR TOTAL

APPROX. WT. 6,700 LBS. + 11,300 LBS. = 18,000 LBS.



KING PIN REAR TOTAL

APPROX. WT. 6,700 LBS. + 12,300 LBS. = 19,000 LBS.

CONTAINER FORWARD				
	LIFTING CAPACITY		WEIGHT DIST.	
[illegible]	1400 PSI	1850 PSI	K.P.	REAR
20'	39.335#	44.288#	67.2%	32.8%
[illegible]	41.452#	46.670#	63.1%	36.9%
[illegible]	43.810#	49.325#	59.0%	41.0%
[illegible]	46.452#	53.000#	54.9%	45.1%
28'	49.432#	55.656#	50.8%	49.2%
30'	52.822#	59.472#	46.8%	53.2%

CONTAINER REARWARD				
	LIFTING CAPACITY		WEIGHT DIST.	
CL	1400 PSI	1850 PSI	K.P.	REAR
20'	59.256#	66.175#	40.3%	59.7%
22'	64.194#	72.275#	36.2%	63.8%
24'	70.029#	78.845#	32.1%	67.9%
26'	77.032#	86.730#	27.9%	72.1%
28'	85.592#	96.367#	23.9%	76.1%
30'	96.291#	108.412#	19.8%	80.2%

CONTAINER FORWARD				
	LIFTING CAPACITY		WEIGHT DIST.	
CL	1400 PSI	1850 PSI	K.P.	REAR
20'	39.335#	44.288#	64.2%	35.8%
22'	41.452#	46.670#	59.7%	40.3%
24'	43.810#	49.325#	55.2%	44.8%
26'	46.452#	53.000#	50.7%	49.3%
28'	49.432#	55.545#	46.3%	53.7%
30'	52.822#	59.472#	41.8%	58.2%

CONTAINER REARWARD				
	LIFTING CAPACITY		WEIGHT DIST.	
CL	1400 PSI	1850 PSI	K.P.	REAR
20'	59.256#	66.175#	34.7%	65.3%
22'	64.194#	72.275#	30.2%	69.8%
24'	70.029#	78.845#	25.7%	74.3%
26'	77.032#	86.730#	21.3%	78.7%
28'	85.592#	96.367#	16.8%	83.2%
30'	96.291#	108.412#	12.3%	87.7%

The cable line pull is 36,000 lbs. which at 45° will allow the 7" winch cylinders to load 49,000 lbs. When the hoist is lowered to 30°, a container weighing 69,000 lbs. can be loaded. Therefore, the Pull-On Capacity of this unit, when used as designed, will be in excess of 69,000 lbs.

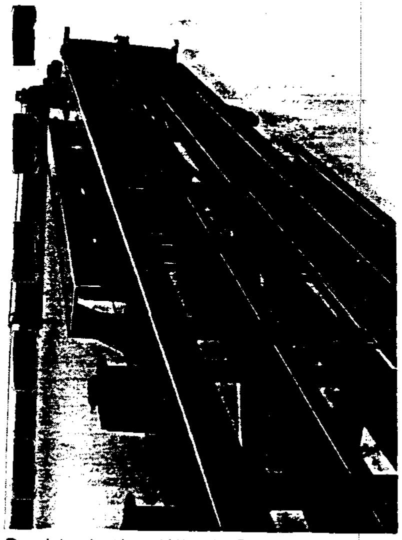
Specifications

- Factory Rated Up To 60,000 Lbs.
- Hoist Frame - 8" × 4" × 3/8" A500 Grade C Tubing.
- Operating Pressure - 1850 P.S.I. (2000 P.S.I. Max.)
- Automatic Spring Loaded Front Container Lock.
- Lift Cylinders - 6", 5", 4" Double Acting Telescopic.
- Lift Cylinder Shafts - 2½" Solid.
- Winch Cylinders - 7" Double Acting
- Movable Front Travel - 79"
- Cable - 7/8" EXIWRC.
- Cable Anchor - 4 Cable Clamps.
- Cable End - Swivel Type.
- Cable Sheaves - 10" O. D. × 2½" I. D. With Aluminum Bronze Bearings.
- Hydraulic Valve - 3 Spool/45 G. P. M. With Relief.
- Dump Angle - 50°
- Working Points - Greasable
- Recommended Container Lengths - 22' Through 30'
- Side Rollers - 4" O. D. Work Hardened Steel With Brass Bearings.

Options

- Side Mount or Bottom Mount Tire Carriers.
- Auxiliary Hydraulic Outlet At Rear With Four Spool Valve (Except for EX Series - Auxiliary Hydraulic Outlet At Rear For EX Series Uses Five Spool Valve.)
- 20,000 Lbs. Capacity Pusher Third Axle.
- Trailer Mounted Auxiliary Hydraulic Motor.

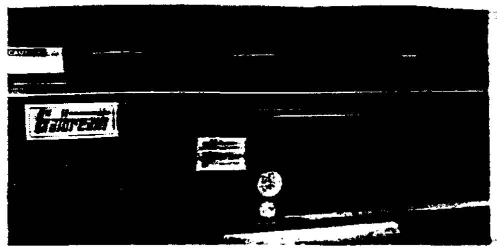
...ality Design Features



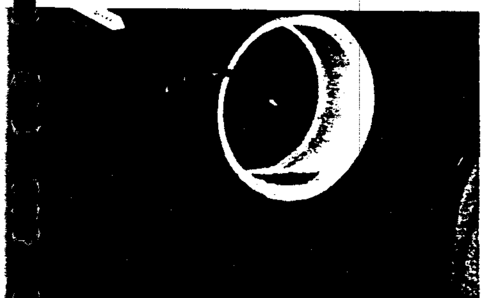
Double Acting Winch Cylinders And Rod Protectors.

Pneumatic Operated Front Locking Pins

Operating Instructions—Pressure Gauge—Air Valve—Lock-Out Bar & Pin With Control Handles

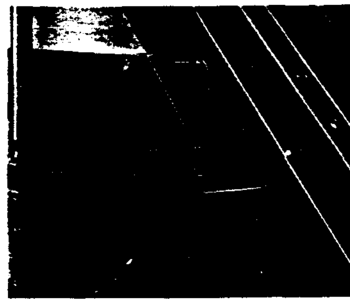


Hoist Prop In Use And Folded Away For Storage.



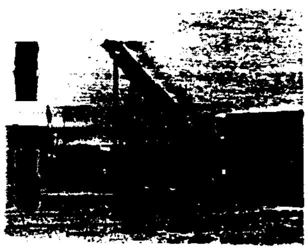
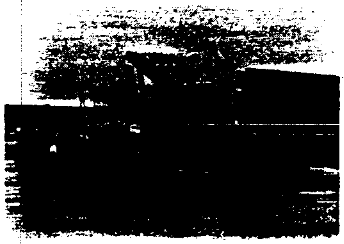
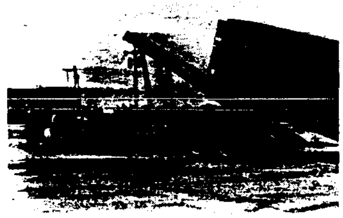
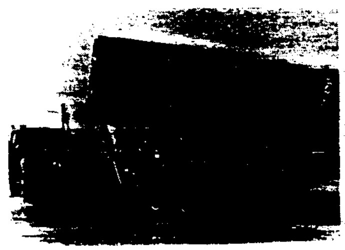
Optional Side Mounted Tire Carrier.

Heavy Duty Rear Hinge—Removable Fenders —Rear Bumper With Recessed Lights.



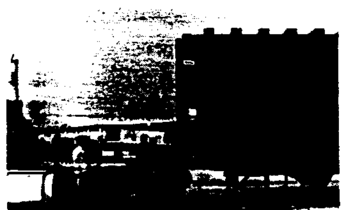
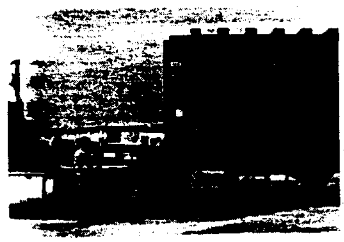
Surface Hardened Removable Side Rollers.

...e "Legalizer" In Operation

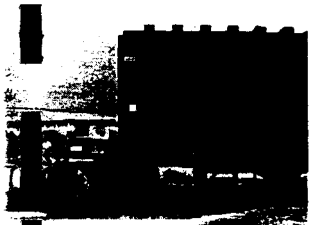
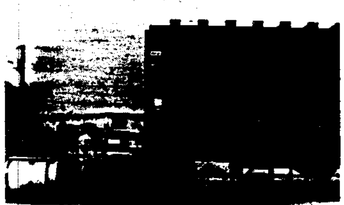
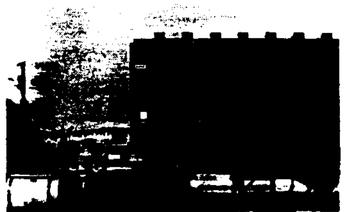





Container Is Loaded On Hoist As Any Standard Trailer Roll-Off.

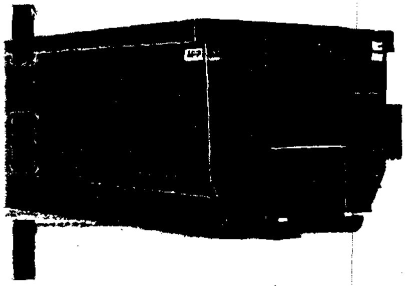


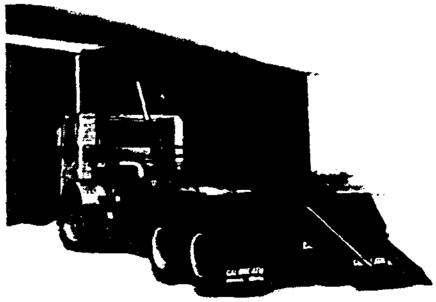
Container And Load Is Moved To Any of Seven Locked In Positions To Transfer Weight


From Trailer Axles To Tractor Axles - Thus Becoming The Legalizer.

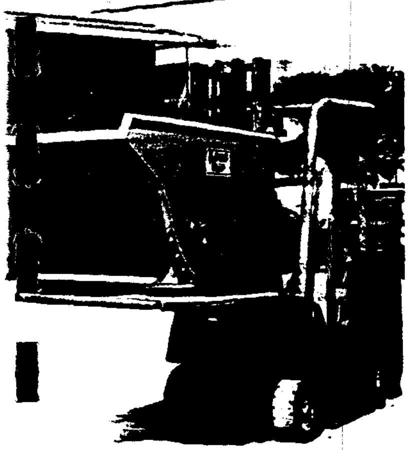


"T-Model" Tapered Side Roll Off Container.

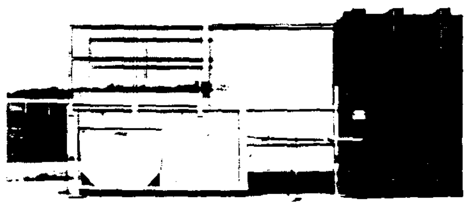


Galbreath 60,000 Lbs. Rated Capacity Extendable Tail Roll-Off Hoist.

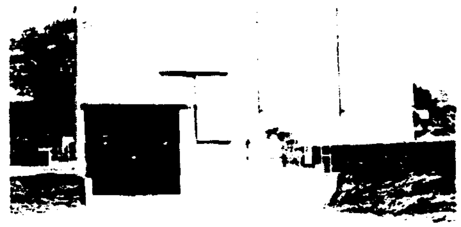
"OFE" Model Open Top Ejector Container.



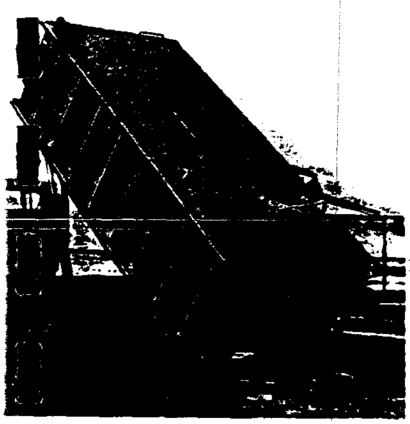
u d. Galbreath Self Dumping Hopper.



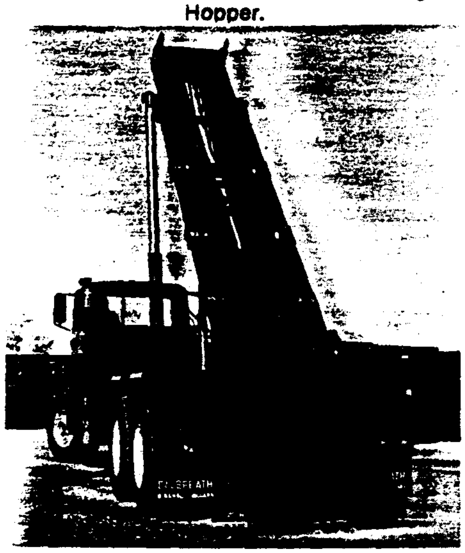
Galbreath Stationary Compactor With Optional Hand Rails And End Loading Hopper.



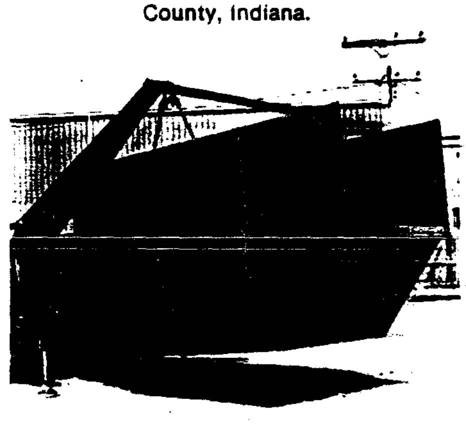
Galbreath Transfer Station—Pulaski County, Indiana.



b ath Single Axle Roll-Off Hoist With ow Type Sludge Container.



Galbreath 60,000 Lbs. Rated Capacity SIO Model Roll-Off Hoist.



Galbreath Square End Lugger Container.

WMA WEMI

ographs Used In This Brochure Are Illustrative

Because Galbreath, Incorporated is continually striving to improve their products through new and improved techniques and knowledge, we reserve the right to make any changes at any time without notice.

A SUDBURY COMPANY
st Office Box 220
/i amac, Indiana 46996
219/946-6631

Represented By

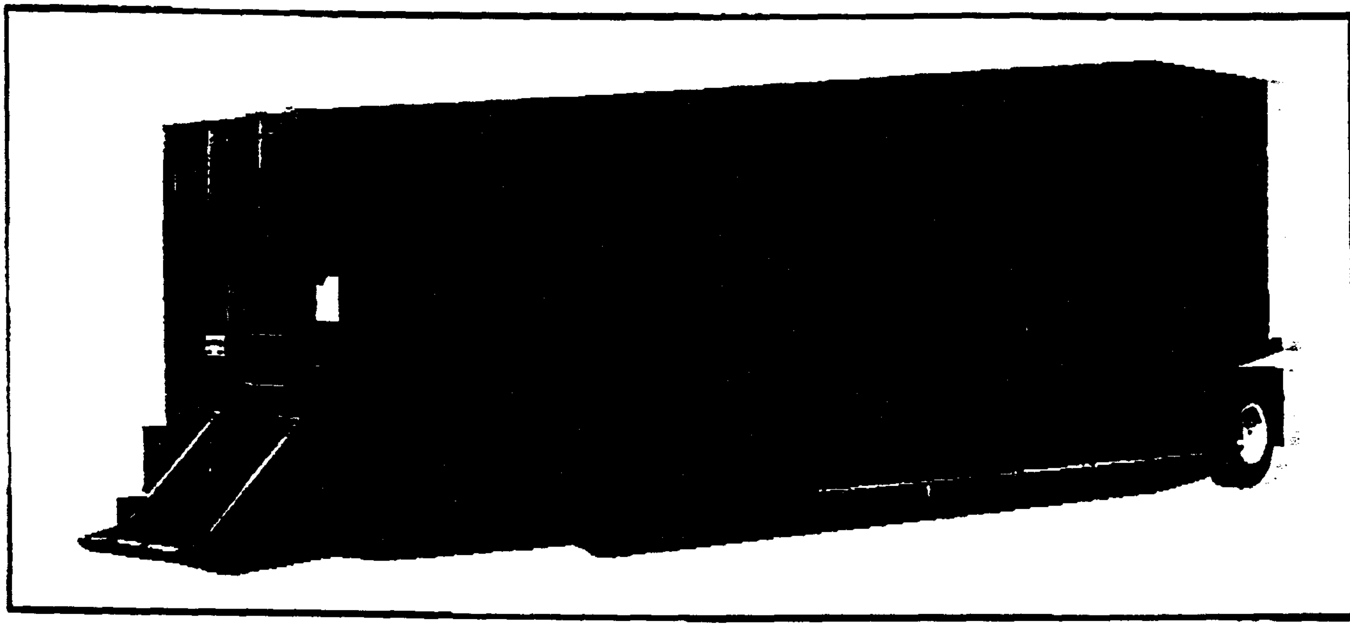
KOIS BROTHERS EQUIPMENT CO.
4950 JACKSON ST.
DENVER, COLO. 80216
PHONE: 303-399-7370

APPENDIX K
Vender Information: Mobile FRAC Tanks

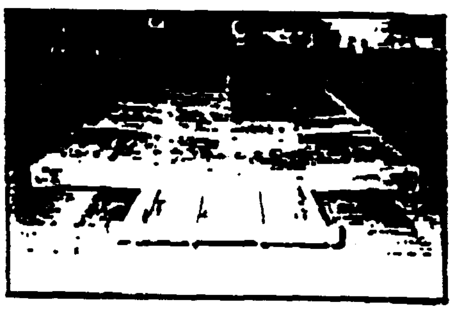
V.E. ENTERPRISES, INC.

MOBILE STORAGE TANKS

Frac Tanks

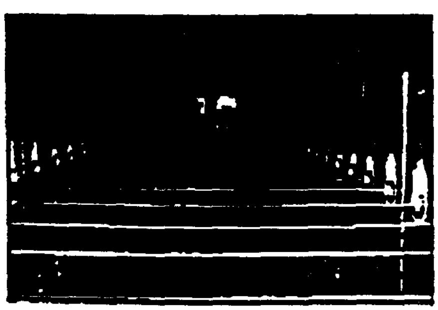


- FULL 500 BBL. CAPACITY
- BETTER DRAINAGE
- FASTER CLEANING
- STRONGEST CONSTRUCTION



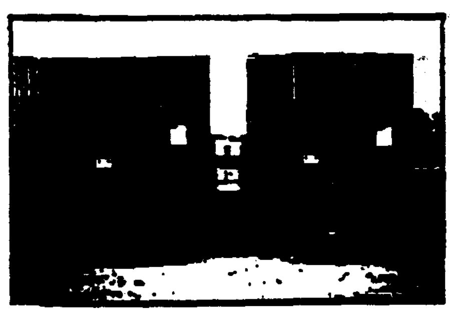
"V" Bottom

V.E.'s "V" bottom floor allows for full drainage and easy cleaning



Structural Integrity

Enough strength to hold a full load of 19 lb. mud. Internally reinforced with 46 - 3/4" rods. Optional "x" rod bracing for easy cleaning is available.



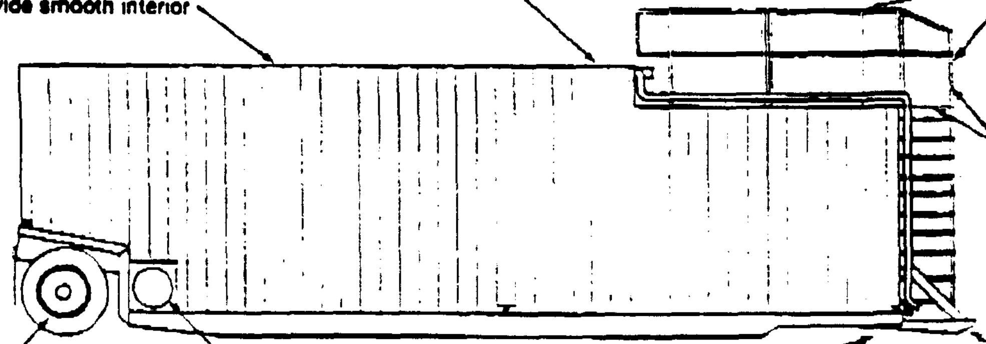
Options

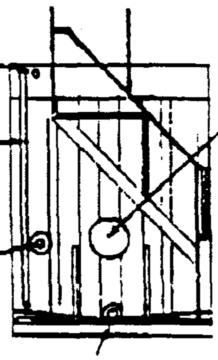
Choice of inside or outside manifold valves, lines, paint, inside coatings and/or other accessories.

V.E. ENTERPRISES • P. O. BOX 369 • SPRINGER, OKLAHOMA 73458 • (800) 234-2329

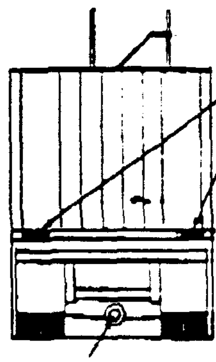
Single Step™ Features

- SPECIAL "DEEP WELL" CORRUGATION DESIGN ELIMINATES INTERNAL CROSS ROD BRACING
- LACK OF INTERNAL CROSS ROD BRACING AND LOCATING ROOF RAFTERS OUTSIDE ALLOWS FOR COST SAVINGS IN CLEANING, INTERNAL COATING, AND MAINTENANCE
- 1/4" A-36 STEEL FLOOR, SIDES, AND TOP SHEETS MEAN LONGER SERVICE LIFE FOR TANK
- "V" BOTTOM FLOOR ASSURES FAST AND EASY DRAINAGE
- DESIGNED FOR FLUID CAPACITIES UP TO 15 LBS. PER GALLON





FRONT VIEW



REAR VIEW

STANDARD SPECIFICATIONS

Length: Tank Only: 37'2"
Overall: 40'0"
Width: 8'6"
Height: 11'0"
Weight: 23,420 lbs. (Ready for Service)
Drain Valves: 4" w/4" Butterfly valve, front and rear
Stairway: Front stairway w/handrails
Front Manway: 18" Quick open w/hinge (round)
Side Manway: 18" Quick open w/hinge (round)
Tires: 9:00 X 20
Axle: 22,500 lb. Axle/Running gear
Suspension: Hutch 7700 or equivalent

OPTIONS

Paint: Your choice of color, design and graphics
Inside Coating: Per customer's specifications
Manifold: Inside or Outside
Material: Stainless Steel, Certified A-36
Fittings: Per customer's specifications
Valves: Per customer's specifications
Eductor Systems: Single, double, or 4-way
Compartments: Single or multiple
Wall Thickness: 3/16" for up to 11 lbs. per gallon
Wheels/Tires: "Budd" type hubs and wheels w/tires to match

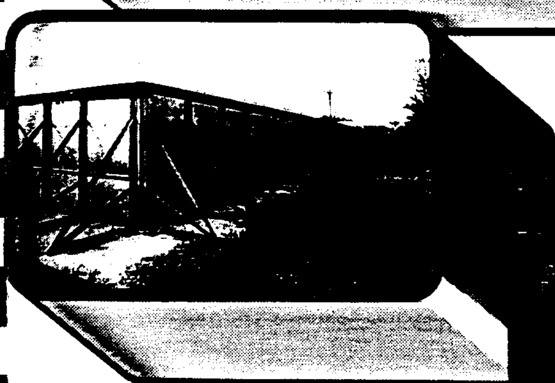
* Many other options are available on request and special design modifications are welcome.

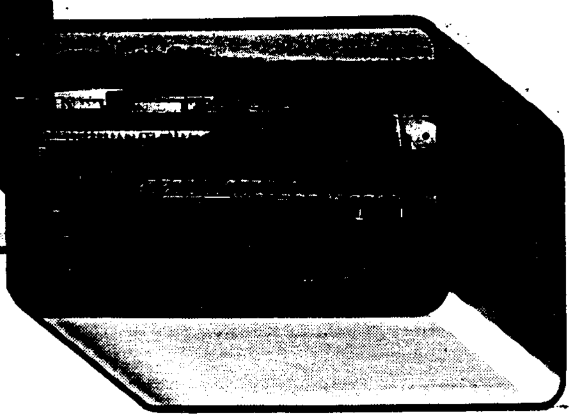
V.E. ENTERPRISES • P. O. BOX 369 • SPRINGER, OKLAHOMA 73458 • (800) 234-2329

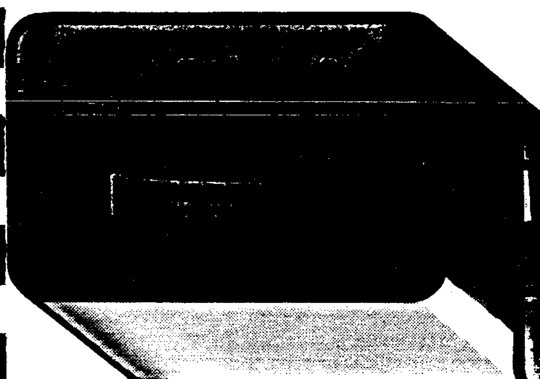
CATALOG 690

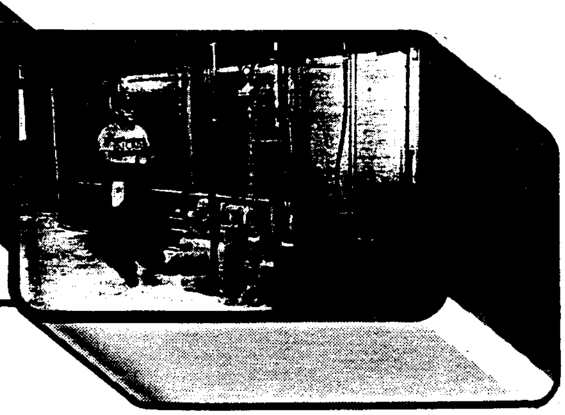
Engineered Containment Systems

Since 1970





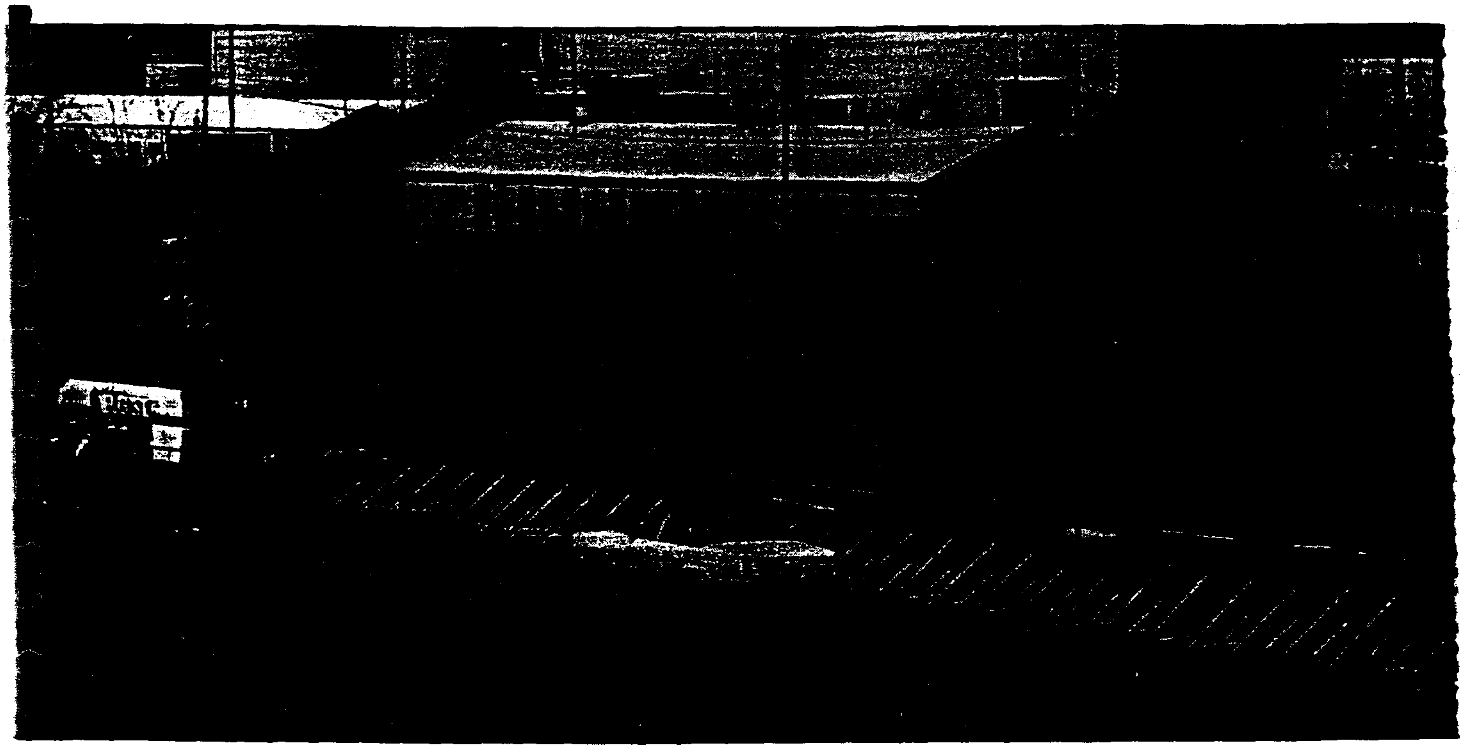




ModuTank Inc.

29-24 40th Ave., Long Island City, NY 11101 (718) 392-1112 FAX (718) 786-1008

ModuTank™ / EconoTank™



Low-cost, versatile, heavy-duty storage tanks in all modular capacities for environmental, industrial, commercial, agricultural and aquaculture applications. ModuTanks are economical alternatives to costly standard tanks, ponds or pits. Built for heavy-duty service to unlimited sizes, the modular facility is ideal for permanent or standby storage.

ST IN OVERALL COSTS – The -allon containment costs for any duTank or EconoTank size are below for virtually any equivalent storage h.

TALLATION SPEED – A typical 75' x k (200,000 gallons) can be com- installed by six unskilled laborers a supervisor in about eight hours, g simple hand tools only. An easily d step-by-step installation manual plied. All parts can be comfortably carried by one or two workers.

IEERED FOR SPECIFIC NEEDS o obligation, the ModuTank Inc. engi- ring service will consult with you on l containment needs and help the ModuTank for virtually any irement.

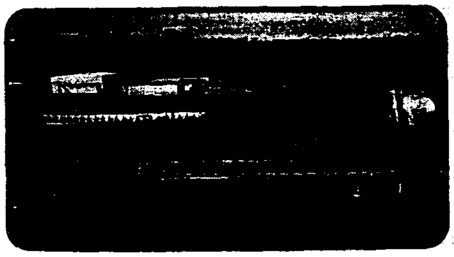
TANK COVERS – Floating covers ted from the same flexible mem- ne material as liners are optionally ble for creating totally enclosed s. Covers, buoyed up by flotation als, ride the fluid's surface and descend to the tank's bottom as it empties.

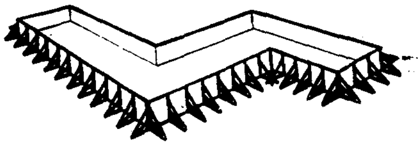
LINERS – A full range of premium quality flexible membrane liners is available, including XR-5, Hypalon, PVC, and 60 and 80 mil. HDPE compatible with most corrosive solutions handled by industry and hazardous materials encountered in environmental applications.

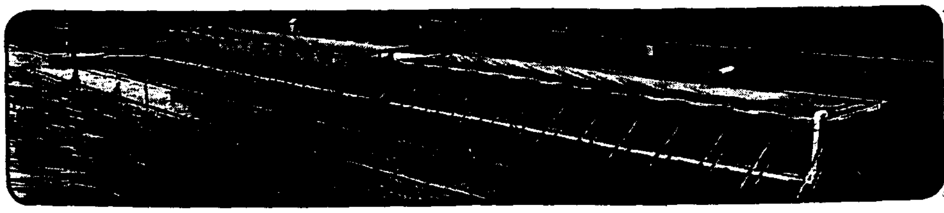
SEISMIC 4 DESIGN – A special ModuTank engineered to meet Universal Building Code Seismic 4 conditions is available. Its unique structural design has been certified by a registered professional engineer. Contact ModuTank Inc. for specifics.

PIPING – Inlet and outlet pipes can be installed through-the walls, over-the-top or through-the-bottom. Bottom drains, sumps and accessory fittings are available.

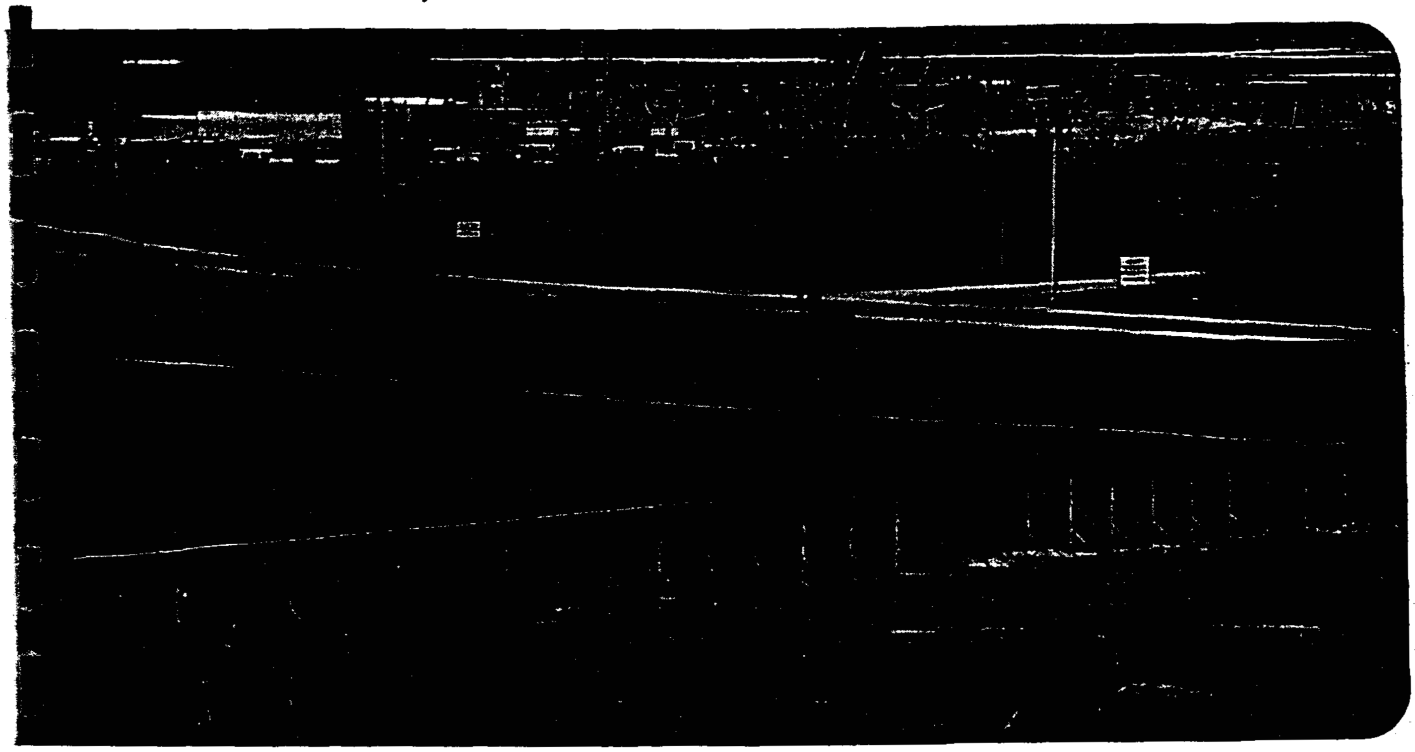
UNIQUE SHAPES – Virtually any shape utilizing right angles such as a "T" – "L" – "Cross" – etc. can be assembled from ModuTank's unique, modular components. This capability is especially useful for installations with special flow requirements or irregularly shaped sites.

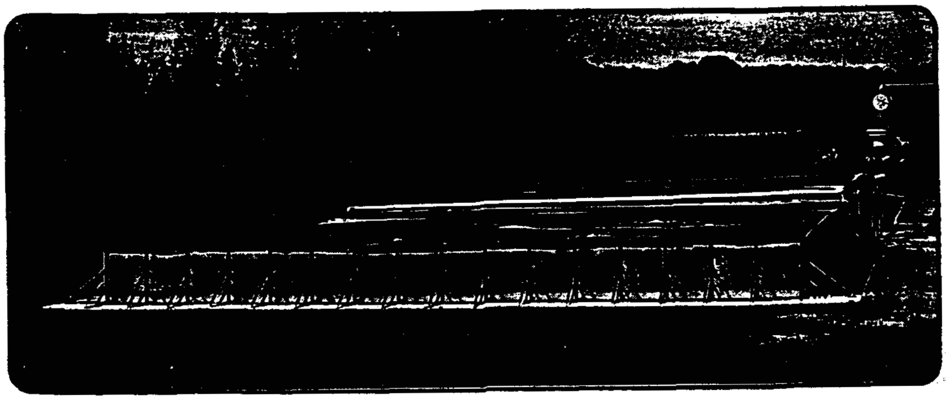






– UNLIMITED GALLONS, SEISMIC 4 VERSION AVAILABLE





…UTANK SPECIFICATIONS – Wall …els are 16 gauge galvanized steel. Sup…t frames are 2" x 2" x 1/8" and 2" x 2" …/16" steel angle, rails are 3" x 2" steel …; both are hot-dip galvanized after …rication. Stainless steel fasteners and …sion cable system are supplied. A …e of fitted liners and floating covers in …s gauges and materials is available.

…E RANGES – Any desired rectilinear …from 4' x 4' upward, based on 3'-9" …modules and 4'-9" maximum wall …ight.

TYPICAL MODUTANK SIZES

[illegible]

OTHER SIZES AVAILABLE

EconoTank™ **Low-cost, versatile, heavy-duty storage tanks in all modular capacities for short term (typically up to 18 months) use in environmental, industrial, commercial and agricultural applications. EconoTanks are economical alternatives to costly standard tanks, ponds or pits.**

LOWEST IN OVERALL COSTS Dollar-for-dollar, the per-gallon containment costs for any EconoTank size are below those for virtually any equivalent storage system. Additional cost savings can be realized through ModuTank Inc.'s buy-back of undamaged EconoTank steel panels and frames after their use.

ECONOTANK SPECIFICATIONS Wall panels are 16 gauge galvanized steel. *Support frames are 2" x 2" x 1/8" and 2" x 2" x 3/16" steel angle, rails are 3" x 2" steel angle; both are hot dip galvanized after fabrication. Tension cables are galvanized steel. A 20 mil. HDPE liner is standard.

BUY BACK PLAN For short term use applications, ModuTank Inc. offers a buy-back plan under which a substantial portion of the original purchase price is repaid to the purchaser upon the return of the tanks. Details on this cost savings plan will be furnished upon request.

***ModuTank Inc. reserves the right to furnish structurally sound previously installed steel components.**

APPENDIX L
Cost Estimate Detail Worksheets

[redacted] COS [redacted] IMA [redacted] DE [redacted] W [redacted] SHE [redacted]

Storage Option #1 (a)
Roll-Offs, Open Top Containers
With External Secondary Containment

#	Description	Unit	Qty	Unit Factors Mhr	Lab $	Mat.	Equip.	S/C	Costs Labor	Material	Equipt.	SubCont.	Total
1	14' Roll-Off Container	EA	235	8	$35.00	$7,608			$65,800	$1,787,880	$0	$0	$1,853,680
	Open Top, FOB Site												
2	External Secondary Containment	EA	5					$21,380	$0	$0	$0	$106,900	$106,900
3	Rental for Roll-Off Trailer Hoist	MTH	4				$4,000		$0	$0	$16,000	$0	$16,000
4	Support Pads for Tanks (4 per tank)	EA	940	4	$35.00	$150	$8		$131,600	$141,000	$7,520	$0	$280,120
	Subtotal												$2,256,700
	Costs per Tank												$9,603

Storage Option #1 (a)
Roll-Offs, Open Top Containers
With External Secondary Containment

#	Description	Unit	Qty	Unit Factors Mhr	Lab $	Mat.	Equip.	S/C	Costs Labor	Material	Equipt.	SubCont.	Total
1	24' Roll-Off Container	EA	150	8	$35.00	$9,166			$42,000	$1,374,900	$0	$0	$1,416,900
	Open Top, FOB Site												
2	External Secondary Containment	EA	8					$21,380	$0	$0	$0	$171,040	$171,040
3	Rental for Roll-Off Trailer Hoist	MTH	4				$4,000		$0	$0	$16,000	$0	$16,000
4	Support Pads for Tanks (4 per tank)	EA	600	4	$35.00	$150	$8		$84,000	$90,000	$4,500	$0	$178,500
	Subtotal												$1,782,440
	Costs Per Tank												$11,883

COST ESTIMATE DETAIL WORKSHEET

<u>Storage Option #2 (a)</u>

FRAC Tanks with External Secondary Containment

Item	Description	Unit	Qty	Unit Factors					Costs				
				Mhrs.	Lab $	Mat.	Equip.	S/C	Labor	Material	Equipt.	SubCont.	Total
1	21,000 US Gal. Mobile FRAC Tank	EA	54	8	$35.00	$17,000	$350		$15,120	$918,000	$18,900	$0	$952,020
2	Freight to Site	EA	54			$731			$0	$39,474	$0	$0	$39,474
3	External Secondary Containment	EA	6					$21,380	$0	$0	$0	$128,280	$128,280
4	Support Pads for Tanks (4 per tank)	EA	216	4	$35.00	$150	$8		$30,240	$32,400	$1,728	$0	$64,368
	Subtotal												$1,184,142
	Costs Per Tank												$21,929

Storage Option #3 (a.1)

Roll–Offs, Open Top Container with HDPE Liner

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
1	14' Roll–Off Container	EA	235	8	$35.00	$7,608			$65,800	$1,787,880	$0	$0	$1,853,680
	Open Top, FOB Site												
2	Rental for Roll–Off Trailer Hoist	MTH	4				$4,000		$0	$0	$16,000	$0	$16,000
3	Gundle Tank Lining – 60 Mil w/net	EA	235					$3,503	$0	$0	$0	$823,205	$823,205
	Subtotal												$2,692,885
	Costs Per Tank												$11,459

Storage Option #3 (a.2)

Roll–Offs, Open Top Container with HDPE Liner

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
1	24' Roll–Off Container	EA	150	8	$35.00	$9,166			$42,000	$1,374,900	$0	$0	$1,416,900
	Open Top, FOB Site												
2	Rental for Roll–Off Trailer Hoist	MTH	4				$4,000		$0	$0	$16,000	$0	$16,000
3	Gundle Tank Lining – 60 Mil w/net	EA	150					$3,503	$0	$0	$0	$525,450	$525,450
	Subtotal												$1,958,350
	Costs Per Tank												$13,056

[redacted]COS[redacted]IMA[redacted]E DE[redacted]L W[redacted]SHE[redacted]

Recommended Storage Option

Mixed Tanks and Linings

Item	Description	Unit	Qty	Unit Factors: Mhrs.	Lab $	Mat.	Equip.	S/C	Costs: Labor	Material	Equipt.	SubCont.	Total
	Direct Costs												
1	14' Roll–Off Container	EA	110	8	$35.00	$7,608			$30,800	$836,880	$0	$0	$867,680
	Open Top, FOB Site												
2	24' Roll–Off Container	EA	7	8	$35.00	$9,166			$1,960	$64,162	$0	$0	$66,122
	Open Top, FOB Site												
3	Gundle Tank Lining – 60 Mil w/net	EA	117					$3,503	$0	$0	$0	$409,851	$409,851
4	Rental for Roll–Off Trailer Hoist	MTH	4				$4,000		$0	$0	$16,000	$0	$16,000
5	Catwalks for roll–Offs	LF	854	0.6	$35.00	$85			$17,934	$72,590	$0	$0	$90,524
6	Isolating Valves	EA	97	3	$35.00	$300			$10,185	$29,100	$0	$0	$39,285
7	21,000 US Gal. Mobile FRAC Tank	EA	25	8	$35.00	$17,000	$350		$7,000	$425,000	$8,750	$0	$440,750
8	Support Pads for Tanks (4 per tank)	EA	100	4	$35.00	$150	$8		$14,000	$15,000	$800	$0	$29,800
9	External Secondary Containment	EA	1					$38,730	$0	$0	$0	$38,730	$38,730
10	Relocate Metal Containers	LOT	1	400	$35.00		$5,000		$14,000	$0	$5,000	$0	$19,000
11	Relocate Conveyor	EA	1	320	$35.00		$3,000		$11,200	$0	$3,000	$0	$14,200
12	Leak Detection	EA	117	6	$35.00	$500			$24,570	$58,500	$0	$0	$83,070
13	Fume Collection	EA	3	250	$35.00	$5,000			$26,250	$15,000	$0	$0	$41,250
	Total Direct Costs								$157,899	$1,516,232	$33,550	$448,581	$2,156,262

COST ESTIMATE DETAIL WORKSHEET

	Indirect Costs												Total
1	Productivity Factor @ 50% of Dl								$78,950				$78,950
2	General Conditions @ 10% of DL								$23,685				$23,685
3	Field Indirects @ 25% of DL								$59,212				$59,212
4	Contractors Overhead @12.34%								$39,457				$39,457
5	General And Administrative @ 9%								$32,328				$32,328
	Total Indirect Costs								$233,631				$233,631

	M&O Contractors Costs												Total
1	EG&G Supervision (1) @ $120/Hr.								$67,200				$67,200
2	H&S Field Rad Tech @ $89/Hr. (560 hr)								$49,840				$49,840
3	H&S Lab Technician @ $92Hr (280hr)								$25,760				$25,760
4	EG&G Project Manag @ 15% of Labor								$58,730				$58,730
	Total M&O Contractor Costs								$201,530				$201,530

Total Estimated Costs	$593,060	$1,516,232	$33,550	$448,581	$2,591,423
Contingency @ 15% on Material, 25% on Balance of Costs	$148,265	$227,435	$8,388	$112,145	$496,232
Escalation @ 4.4%/Year on Labor.	$32,618				$32,618
Total Project Costs	$773,943	$1,743,667	$41,938	$560,726	$3,120,274

Figure 1-2
750 Pad

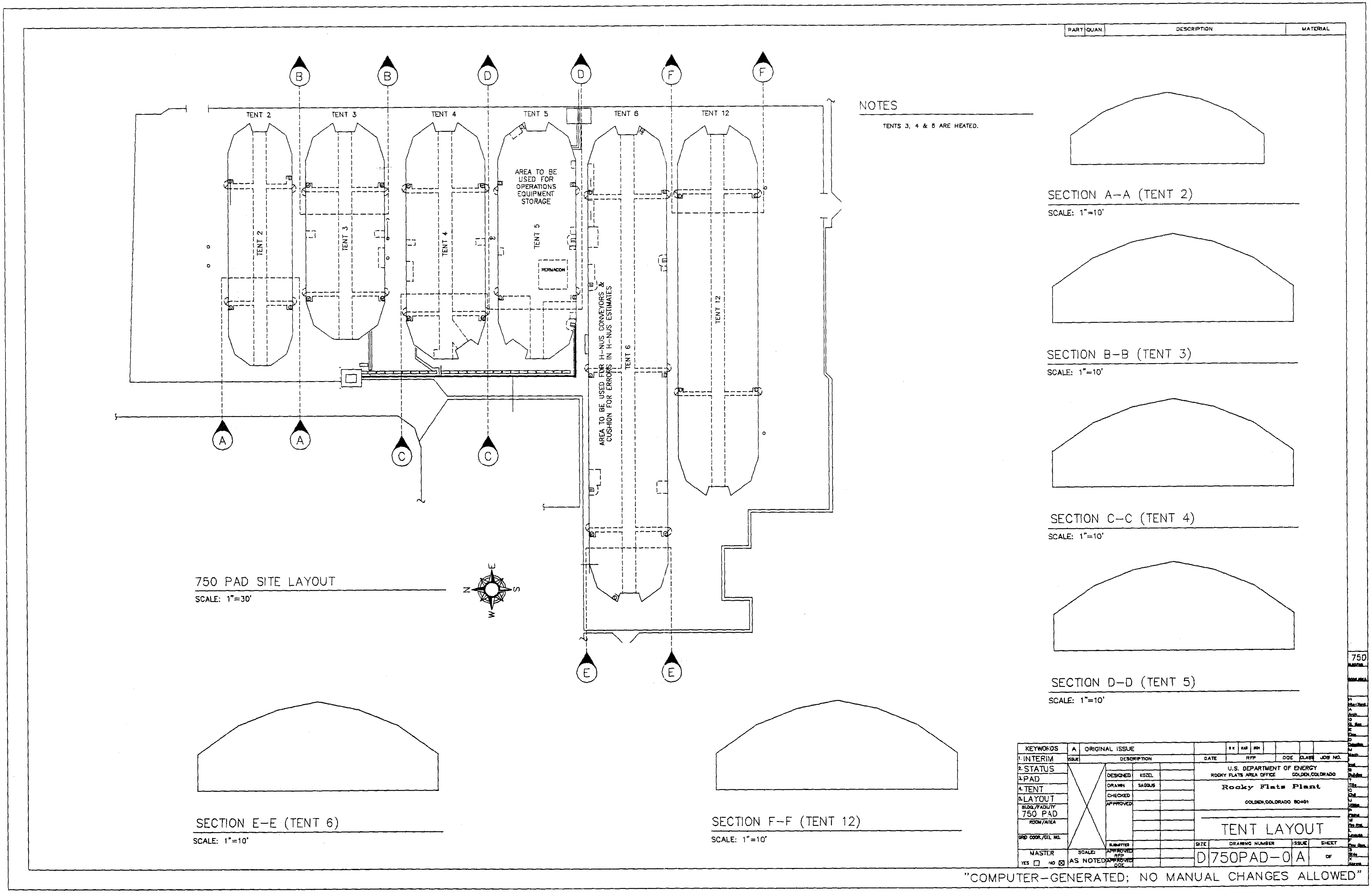


Figure 2-1
750 Pad Recommended Option Layout

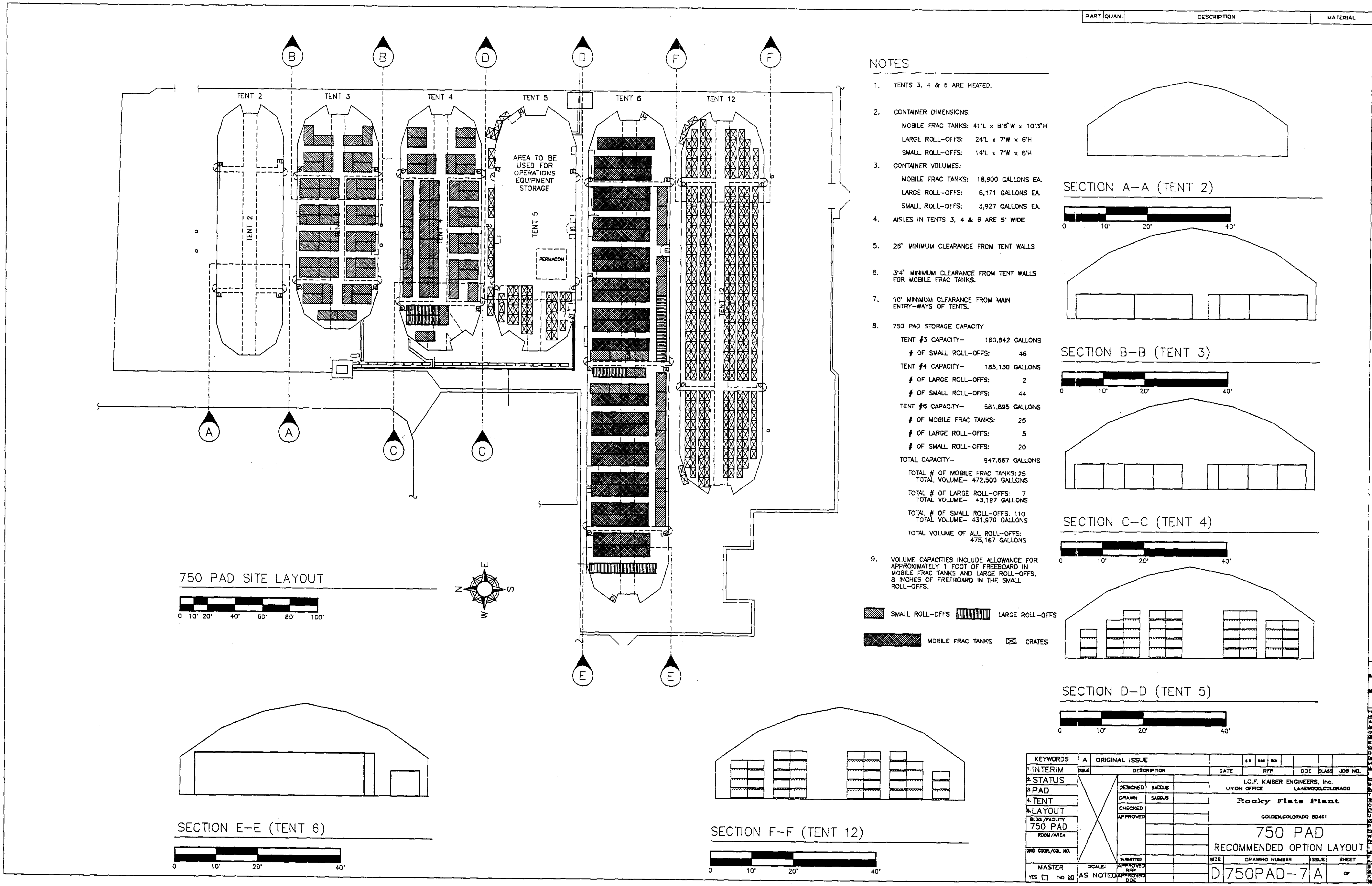


Figure 5-1
Roll-Off Layout

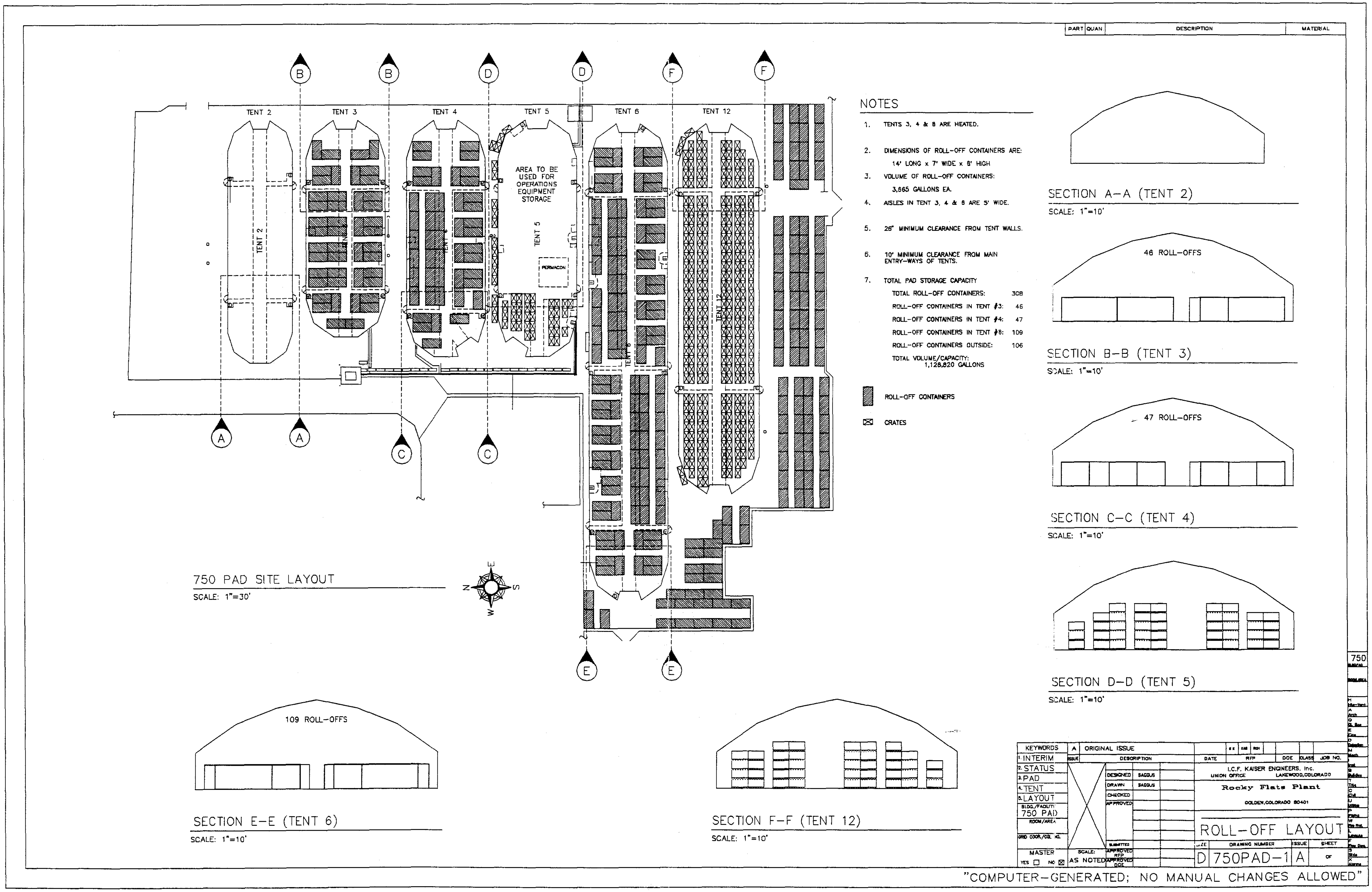


Figure 5-2
Mobile FRAC Tank Layout

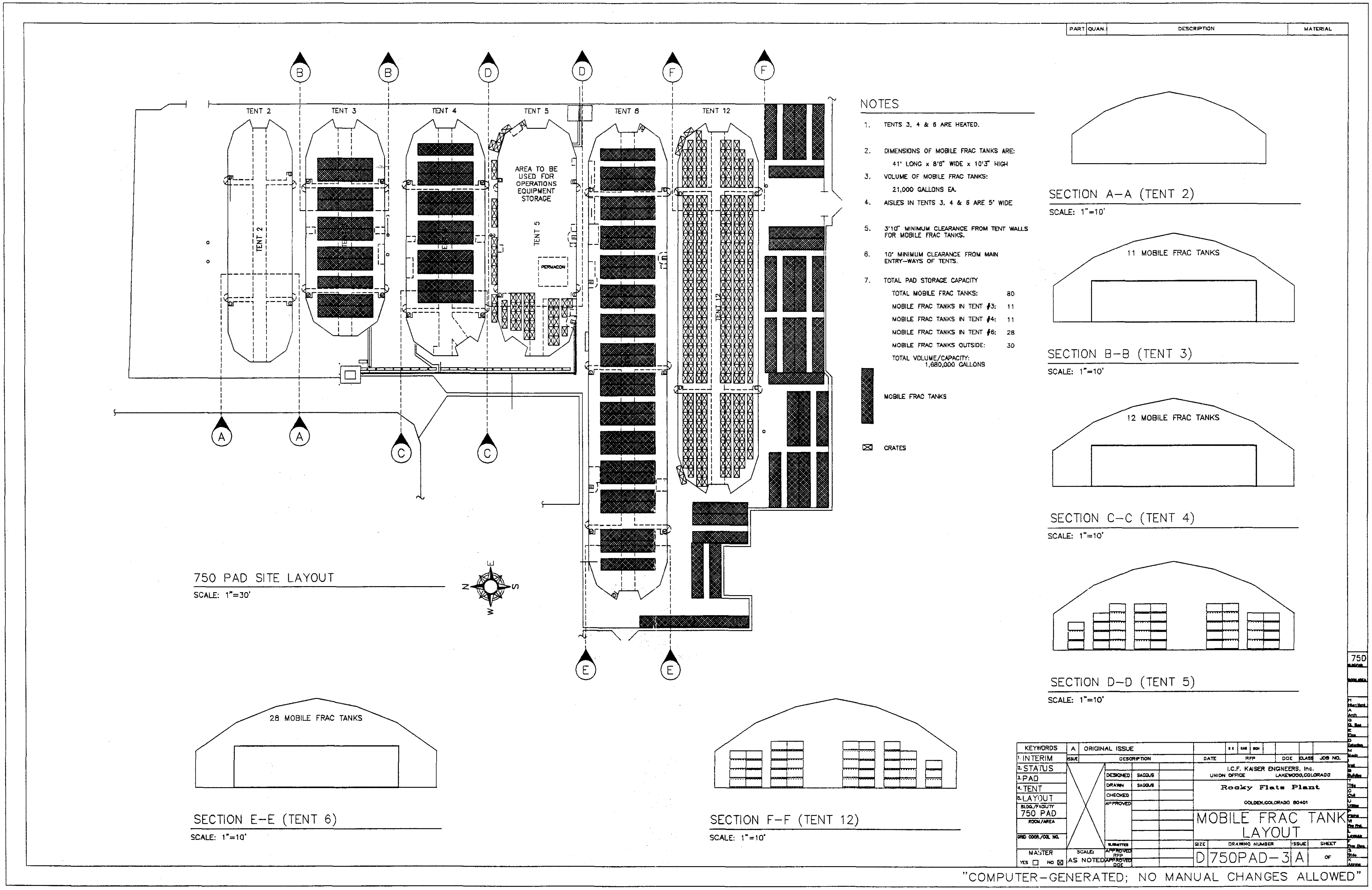


Figure 5-3
Drum Layout