APR 2 8 1995
(70) St. (36)

ENGINEERING DATA TRANSMITTAL

1. EDT 602398

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Waste Tank Process Engineering	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: W236-A (MWTF).	6. Cog. Engr.: Richard G. Brown	7. Purchase Order No.: NA
8. Originator Remarks: For review. Please send your comments (or "no comment") using an RCR by 3/16/95. Electronic copies appreciated.		9. Equip./Component No.: NA
		10. System/Bldg./Facility: NA
11. Receiver Remarks:		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date: March 16, 1995

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-W236A-ES-012	ALL	0	MWTF Path Forward Engineering Analysis Technical Task 3.3, Single Shell Tanks Liquid Contents	Q MSN	4 1,2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval	4. Review	1. Approved	4. Reviewed no/comment
	2. Release	5. Post-Review	2. Approved w/comment	5. Reviewed w/comment
	3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. RG Brown	Richard Brown				[signature]	4/12/95		1	1
1	1	Cog. Mgr. WB Barton	W B Barton	4/19/95							
		QA									
		Safety									
		Env.									
1	1	4/25/95 DB Engelman	VC Boyles for								

18. Richard G. Brown 4/12/95 Signature of EDT Originator Date	19. [signature] 4/26/95 Authorized Representative for Receiving Organization Date	20. [signature] 4/26/95 Cognizant Manager Date	21. DOE APPROVAL (if required) Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097^GMACPATH~GEF1000^G

BD-7400-172-1 (07/91)

INSTRUCTIONS FOR COMPLETION OF THE ENGINEERING DATA TRANSMITTAL

(USE BLACK INK OR TYPE)

BLOCK	TITLE	
(1)*	EDT	• Pre-assigned EDT number.
(2)	To: (Receiving Organization)	• Enter the individual's name, title of the organization, or entity (e.g., Distribution) that the EDT is being transmitted to.
(3)	From: (Originating Organization)	• Enter the title of the organization originating and transmitting the EDT.
(4)	Related EDT No.	• Enter EDT numbers which relate to the data being transmitted.
(5)*	Proj./Prog./Dept./Div.	• Enter the Project/Program/Department/Division title or Project/Program acronym or Project Number, Work Order Number or Organization Code.
(6)*	Cognizant Engineer	• Enter the name of the individual identified as being responsible for coordinating disposition of the EDT.
(7)	Purchase Order No.	• Enter related Purchase Order (P.O.) Number, if available.
(8)*	Originator Remarks	• Enter special or additional comments concerning transmittal, or "Key" retrieval words may be entered.
(9)	Equipment/Component No.	• Enter equipment/component number of affected item, if appropriate.
(10)	System/Bldg./Facility	• Enter appropriate system, building or facility number, if appropriate.
(11)	Receiver Remarks	• Enter special or additional comments concerning transmittal.
(12)	Major Assm. Dwg. No.	• Enter applicable drawing number of major assembly, if appropriate.
(13)	Permit/Permit Application No.	• Enter applicable permit or permit application number, if appropriate.
(14)	Required Response Date	• Enter the date a response is required from individuals identified in Block 17 (Signature/Distribution).
(15)*	Data Transmitted	
	(A)* Item Number	• Enter sequential number, beginning with 1, of the information listed on EDT.
	(B)* Document/Drawing No.	• Enter the unique identification number assigned to the document or drawing being transmitted.
	(C)* Sheet No.	• Enter the sheet number of the information being transmitted. If no sheet number, leave blank.
	(D)* Rev. No.	• Enter the revision number of the information being transmitted. If no revision number, leave blank.
	(E) Title or Description of Data Transmitted	• Enter the title of the document or drawing or a brief description of the subject if no title is identified.
	(F)* Impact Level	• Enter the appropriate Impact Level (Block 15). Also, indicate the appropriate approvals for each item listed, i.e., SQ, ESQ, etc. Use NA for non-engineering documents.
	(G) Reason for Transmittal	• Enter the appropriate code to identify the purpose of the data transmittal (see Block 16).
	(H) Originator Disposition	• Enter the appropriate disposition code (see Block 16).
	(I) Receiver Disposition	• Enter the appropriate disposition code (see Block 16).
(16)	Key	• Number codes used in completion of Blocks 15 (G), (H), and (I), and 17 (G), (H) (Signature/Distribution).
(17)	Signature/Distribution	
	(G) Reason	• Enter the code of the reason for transmittal (Block 16).
	(H) Disposition	• Enter the code for the disposition (Block 16).
	(J) Name	• Enter the signature of the individual completing the Disposition 17 (H) and the Transmittal.
	(K)* Signature	• Obtain appropriate signature(s).
	(L)* Date	• Enter date signature is obtained.
	(M)* MSIN	• Enter MSIN. Note: If Distribution Sheet is used, show entire distribution (including that indicated on Page 1 of the EDT) on the Distribution Sheet.
(18)	Signature of EDT Originator	• Enter the signature and date of the individual originating the EDT (entered prior to transmittal to Receiving Organization). If the EDT originator is the cognizant engineer, sign both Blocks 17 and 18.
(19)	Authorized Representative for Receiving Organization	• Enter the signature and date of the individual identified by the Receiving Organization as authorized to approve disposition of the EDT and acceptance of the data transmitted, as applicable.
(20)*	Cognizant Manager	• Enter the signature and date of the cognizant manager. (This signature is authorization for release.)
(21)*	DOE Approval	• Enter DOE approval (if required) by letter number and indicate DOE action.

*Asterisk denote the required minimum items check by Configuration Documentation prior to release; these are the minimum release requirements.

DISCLAIMER

SUPPORTING DOCUMENT

1. Total Pages ~~90~~ 91

2. Title	3. Number	4. Rev No.
Multi-Function Waste Tank Facility Path Forward Engineering Analysis Technical Task 3.3, Single-Shell Tank Liquid Contents	WHC-SD-W236A-ES-012	0

5. Key Words	6. Author
MWTF, TANKS, PATH FORWARD, W236A	Name: R. G. Brown/R. W. Mattichak R Mattichak Signature Organization/Charge Code 71310/ D4009

7. Abstract

8. RELEASE STAMP

OFFICIAL RELEASE
BY W-236A IMT
DATE APR 28 1995
STATION (36) CLERK (70)

A-6400-073 (08/94) WEF124

RELEASE AUTHORIZATION

Document Number:	WHC-SD-W236A-ES-012, Rev. 0
Document Title:	Multi-Function Waste Tank Facility Path Forward Engineering Analysis Technical Task 3.3, Single-Shell Tank Liquid Contents
Release Date:	April 28, 1995

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

V.L. Birkland — V.L. Birkland — April 28, 1995

A-6001-400.2 (09/94) WEF256

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MULTI-FUNCTION WASTE TANK FACILITY PATH FORWARD ENGINEERING ANALYSIS TECHNICAL TASK 3.3, SINGLE-SHELL TANK LIQUID CONTENTS

R. G. Brown
R. W. Mattichak

Westinghouse Hanford Company
Richland, Washington

This page intentionally left blank.

EXECUTIVE SUMMARY

The purpose of this study is to determine the quantities of liquid waste remaining in the unstabilized single-shell tanks (SST) and to determine the quantities of flush water produced from flushing salt well lines and transfer lines for interim double-shell tank (DST) storage.

To provide an accurate estimate of the waste liquid remaining in the salt cake and sludge waste tanks, a separate "projected porosity value" (see Glossary for definition) was calculated for the salt cake volume and the sludge volume. Recent waste characterization reports[1,2,3] compiled the historical data that were used for the salt cake, sludge, and supernatant volumes remaining within the waste tanks. A total of 25 salt cake tanks and 6 sludge tanks were selected to calculate the projected porosity values. The resultant average projected porosity value is 61% for salt cake tanks and 16% for sludge tanks.

It is emphasized that this study calculated the projected porosity value which should be used for projecting the quantities of total liquids that are remaining within the unstabilized waste tanks. These quantities include interstitial liquid plus the unidentified liquid (supernatant) that may be

---

[1]Gaddis, L. A., and W. W. Pickett, 1994, *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Areas*, WHC-SD-WM-ER-352, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[2]Gaddis, L. A., and W. W. Pickett, 1994, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Areas*, WHC-SD-WM-ER-349, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[3]Gaddis, L. A., and W. W. Pickett, 1995, *Historical Tank Content Estimate for the Northwest Quadrant of the Hanford 200 West Area*, WHC-SD-WM-ER-351, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

contained as a hidden pocket and/or layer between the salt cake layers, and has not been identified prior to salt well pumping. This is different from the 'uniform' salt cake porosity that is calculated after pumping has been initiated and does not include the supernatant liquids that are found. It accounts for the supernatant liquid separately. However, for predicting the total liquid to be pumped from the tank, both the interstitial liquid reflected in the salt cake true uniform porosity plus the hidden pockets of supernatant must be accounted for.

There has not been significant pumping experience with sludge tanks. Previous studies have suggested that a 'true' sludge material would be unpumpable. Pumping of tanks containing sludge has shown that some materials defined as sludge do have interstitial liquid flow properties similar to salt cake. However, large pockets or layers of hidden supernatant are not anticipated.

Results from this study indicate the following.

- Salt well pumping will produce 6.0 million gallons (Mgal) of waste liquid for interim storage in the DSTs. This is an increase of 1.0 Mgal of liquid waste over the January 13, 1995, position letter* projections using a 45% "uniform" salt cake porosity value and an increase of 1.8 Mgal over projections in

*Alumkal, W. T., 1995, *Multi-Function Waste Tank Facility - Decision Paper* (Letter 9550111 to T. R. Sheridan, U.S. Department of Energy-Headquarters), Westinghouse Hanford Company, Richland, Washington.

WHC-SD-WM-ER-029, *Operational Waste Volume Projection** using a 35% 'uniform' salt cake porosity value.

- Flushing of the salt well lines and transfer lines will generate an additional 1.6 Mgal of water that will require interim storage in the DSTs until waste volume reduction through the evaporator can be accomplished.

The salt well pumping and flush water will eventually be evaporated, which will reduce the volume of liquid for DST storage for final disposal. For volume reductions, see WHC-SD-WM-TI-690, *Waste Volume Reduction Factors for Potential 242-A Evaporator Feed* (Sederburg 1995).**

This study uses the actual total liquids removed and the field-calculated interstitial liquid remaining to be pumped from the actual data records for the waste salt cake and sludge within the SSTs that have been, or are being, pumped. The projected porosity value is defined as the volume percentage of total liquid (includes hidden pockets and/or layers of supernatant) within the total bulk salt cake volume, excluding the capillary held region and identified supernatant. The accuracy of the quantity of liquids to be pumped depends on an accurate determination of quantities and properties of the salt cake and sludge in the SSTs. The database used for this study relied on the actual data that were available; however, the data for the pumping of the

---

*Strode, J. N., 1994, *Operational Waste Volume Projection*, WHC-SD-WM-ER-029, Rev. 20, Westinghouse Hanford Company, Richland, Washington.

**Sederburg, J. P., 1995, *Waste Volume Reduction Factors for Potential 242-A Evaporator Feed*, WHC-SD-WM-TI-690, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

stabilized tanks (1980's) were not necessarily complete so assumptions were necessary. The recent pumping data obtained for the current pumping operations are more complete and support the 61% projected porosity value for salt cake tanks.

The salt cake database had varying salt cake porosities that ranged from 30% to 100%, with a 19.6% standard deviation. However, the database was not a normal distribution and the confidence of any one tank having a 61% salt cake porosity would be low.

The sludge database consisted of six tanks with total pumping of 71 kgal of liquids. The porosity values range from 11% to 23% with a standard deviation of 4.5%. Of the remaining liquids to be removed from the SSTs, the sludge tanks will contribute just over 5% (0.3 Mgal).

Inaccuracies in the solids measurements and the inability to accurately estimate supernate volumes contribute to the spread of the data and the high porosities exhibited by the salt cake database. The same range can be expected for the remaining tanks that require stabilization.

The flush water projection was based on the procedural requirements for the flushing of the salt well pumping equipment and system plus the transfer lines. This includes the transfer lines from the double-contained receiver tank to the DST for storage. The flush water projection did not include any transfer flush water between the 200 East and 200 West Area Tank Farms.

CONTENTS

LIST OF FIGURES

MULTI-FUNCTION WASTE TANK FACILITY PATH FORWARD ENGINEERING ANALYSIS TECHNICAL TASK 3.3, SINGLE-SHELL TANK LIQUID CONTENTS

1.0 INTRODUCTION

1.1 HISTORICAL BACKGROUND

Single-shell tanks (SST) were constructed between 1943 and 1964 to store liquid and solid wastes generated as a result of plutonium production and separation operations at the Hanford Site. Until 1980, the liquid radioactive chemical waste produced from defense activities was pumped initially to 149 SSTs for storage. In 1978, the interim stabilization program was implemented, and by 1981, the 149 SSTs were declared out of service and newly generated waste was contained in the double-shell tanks (DST). The purpose of the ongoing interim stabilization program is to remove pumpable liquid from the SSTs to minimize the risk to the environment in the event of a tank leak (Klem 1986).

In the late 1950's and throughout the 1960's, one method, or a combination of methods, was applied to leaking tanks to reduce the effect of the leaks: (1) the tank was isolated to prevent any further addition of waste to the tank, (2) diatomaceous earth was added to absorb the liquid waste, (3) sludge was air cooled, or (4) a combination of isolation and addition of diatomaceous earth was used. In the 1970's, the environmental impact of tank leaks was reduced by transferring supernatant to an evaporator where a large fraction of the water was removed. The remaining waste was returned to the tanks as saturated slurry which formed salt cake (Forney 1989). Generally, two types of solids exist in the SSTs: sludge and salt cake. Sludge results from the neutralization of chemical separation wastes, and salt cake results from thermal evaporation of aged chemicals and miscellaneous wastes (DeWeese 1988). For SSTs containing both types of solids, the salt cake layer is generally above the sludge. Liquid is present in SSTs as free-standing supernatant and/or as interstitial liquid existing in the void spaces of solid wastes.

The supernatant and interstitial liquid are removed from the SSTs by salt well pumping. In this method, the liquid is jet pumped through a salt well casing installed in the tanks. Salt well pumping continues until either a major pumping failure occurs and the tank meets the interim stabilization criteria, or the pumping rate decreases to 0.05 gpm. After the salt well liquor has been removed and has met the tank stabilization requirements, the tank is physically isolated to minimize the possibility of any future intrusion of liquid into the tank.

The liquid waste pumped from the SSTs is collected in a double-contained receiver tank (DCRT) and sent to a DST for interim storage. The liquid is ultimately sent to the evaporator for waste volume minimization and the resulting slurry from the evaporator is sent to DSTs for interim storage pending final disposal.

Since the interim stabilization process began in 1978, 108 SSTs have been classified as interim stabilized (as of March 1995). The bulk of the liquid remaining in the 41 unstabilized SSTs is interstitial liquid. The term 'porosity' (see Glossary for definition) is used to determine the volume fraction of drainable interstitial liquid in the waste solids. It has not in past practice included pockets or layers of liquid existing in different locations within the salt cake. An accurate porosity estimation method is needed to predict the volume of liquid waste remaining in the SSTs still requiring stabilization. The SST liquid volume and the volume of flush water required to transfer the waste are needed to project the DST storage capacity required to support the stabilization program.

1.2 BACKGROUND

Current waste volume projections assume a 35% salt cake porosity for a baseline case and a 45% salt cake porosity for an upper planning case in determining the interstitial liquid volumes (Strode 1994). Both cases use a 12.5% porosity for the sludge. By using 35% and 45% salt cake porosity waste volume projections, it is predicted that 4.2 and 5.0 million gallons (Mgal), respectively, of pumpable liquid waste remain in the SSTs.

Studies have been performed in the past to derive a 'uniform' salt cake porosity that could be used to predict the volume of interstitial liquid in the SSTs. Early laboratory experiments on synthetic salt cakes estimated a porosity between 30% and 35% (Handy 1975, Strachan 1975, Metz 1976). The porosity values used from these studies tend to give low estimates of the pumpable interstitial liquid. This is partly due to the lack of in-tank solids data available at the time, and because the synthetic salt cakes used in the laboratory experiments were of uniform density and did not have any liquid pockets or layers in them, which have been found to exist in actual salt cakes once pumping has begun. Interstitial liquid volume predictions are based on the volume as well as the porosity of the salt cake and sludge. Because of the inability to characterize the solids in the tank bottoms and the poor record keeping of tank transfers, it was extremely difficult to determine the tank contents (Anderson and Mudd 1990). Therefore, earlier predictions of pumpable waste remaining in the SSTs were low due to poor quality of available data.

Realizing this problem of inaccurate data, the Characterization Program recently compiled all known historical data relating to the Hanford Site 200 Area tanks. This compilation of data is represented in the waste characterization reports entitled *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Areas* (Gaddis and Pickett 1994a), *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Areas* (Gaddis and Pickett 1994b), and *Historical Tank Content Estimate for the Northwest Quadrant of the Hanford 200 West Area* (Gaddis and Pickett 1995). The information given in the waste characterization reports is considered to be the most accurate depiction of SST solid contents. Using this information to correct the solid volume data used for previous stabilization efforts of jet-pumped salt cake and sludge tanks, along with stabilization records of liquid waste (supernate and interstitial) removed from the tanks, provides a more accurate porosity value of the salt cake and sludge (Figures 1-1 and 1-2).

Figure 1-1. Porosity Values for Stabilized Single-Shell Salt Cake Tanks.

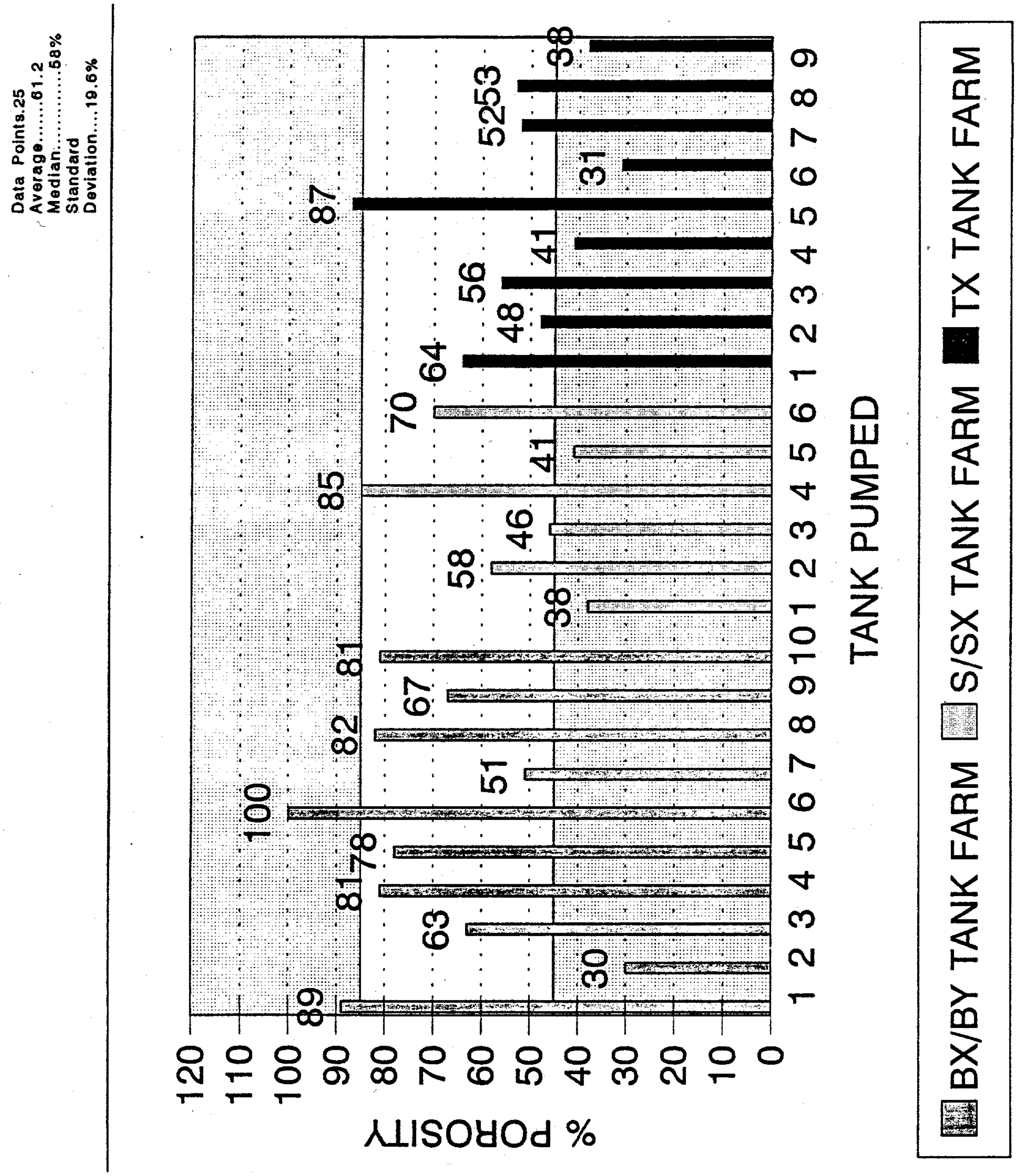
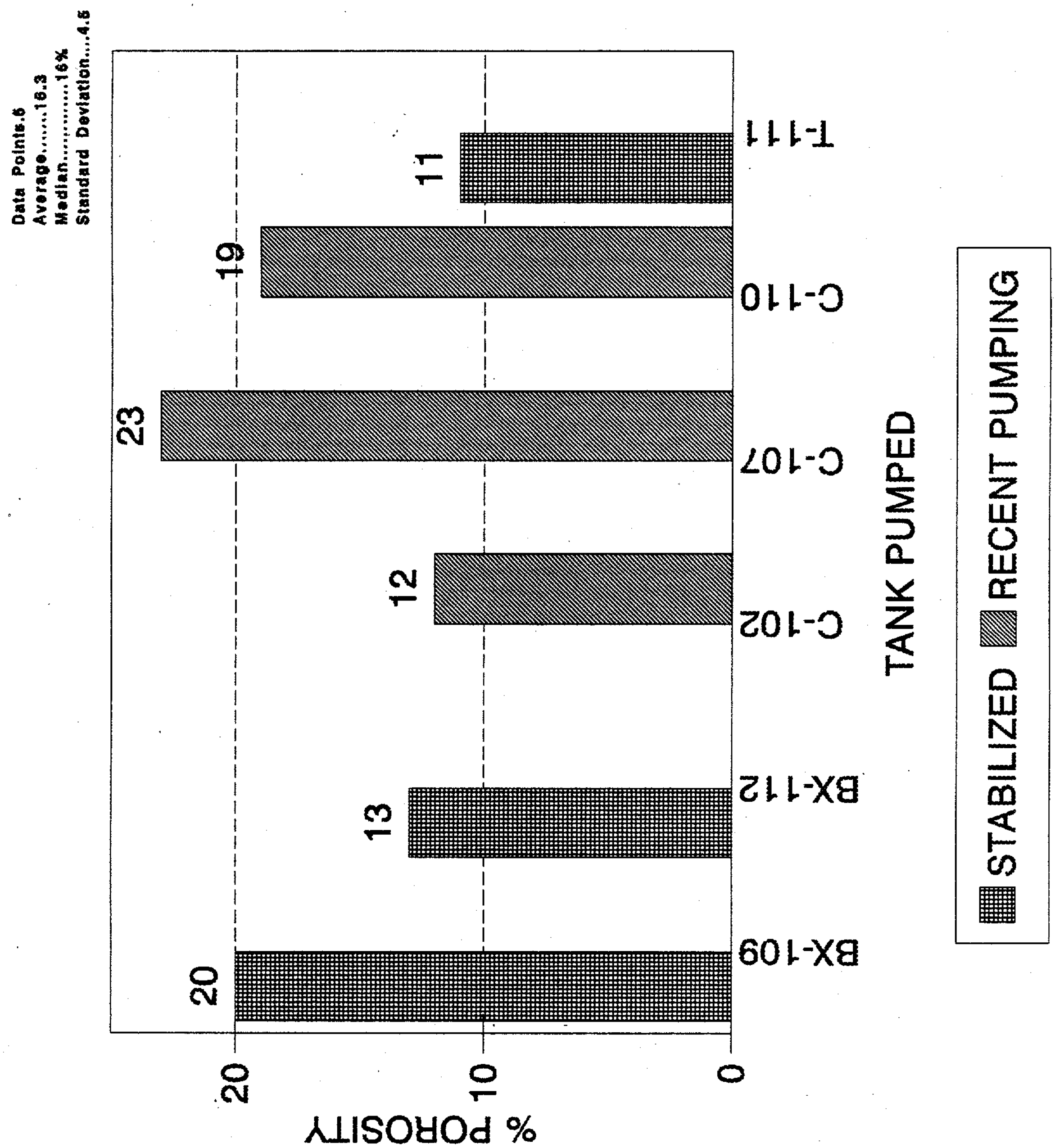


Figure 1-2. Porosity Values for Stabilized Single-Shell Sludge Tanks.



1.3 PURPOSE AND NEED

The Multi-Function Waste Tank Facility (MWTF) path forward tasks were initiated to provide information on the amount of additional safe storage capacity needed to meet the Tank Waste Remediation System's (TWRS) mission. Eight technical tasks were defined to provide a technical basis to determine the need for new tanks.

The purpose of this report is to respond to Task 3.3 in the internal memo, *Technical Tasks - Action Plan to Support the MWTF Path Forward* (Thompson 1994). This study determines (1) the quantity of liquid waste remaining in the SSTs that still requires stabilization, and (2) the quantity of flush water required to support the stabilization effort. As of March 27, 1995, 41 of the 149 SSTs on the Hanford Site still require stabilization. The majority of the SSTs remaining to be stabilized (27) are in the 200 West Area, and the other 14 are in the 200 East Area. Records for the SSTs that have been stabilized or partially pumped are examined in this report to gain insight into the pumping that remains.

This page intentionally left blank.

2.0 DISCUSSION

2.1 BASIS TO DETERMINE LIQUIDS REMAINING IN SSTs

One of the primary factors affecting the waste volume projections is how much liquid waste must be pumped from the SSTs. Porosity of the SST sludge and salt cake is one of the main factors affecting these projections.

An accurate estimate of the liquid waste remaining in the SSTs will require the following:

- An accurate solids classification for the SSTs. To provide consistent data between studies and recommendations on porosity, the same database needs to be used. This study identifies and updates the change in porosity values for the stabilized salt cake and sludge tanks using the data from the waste characterization reports.

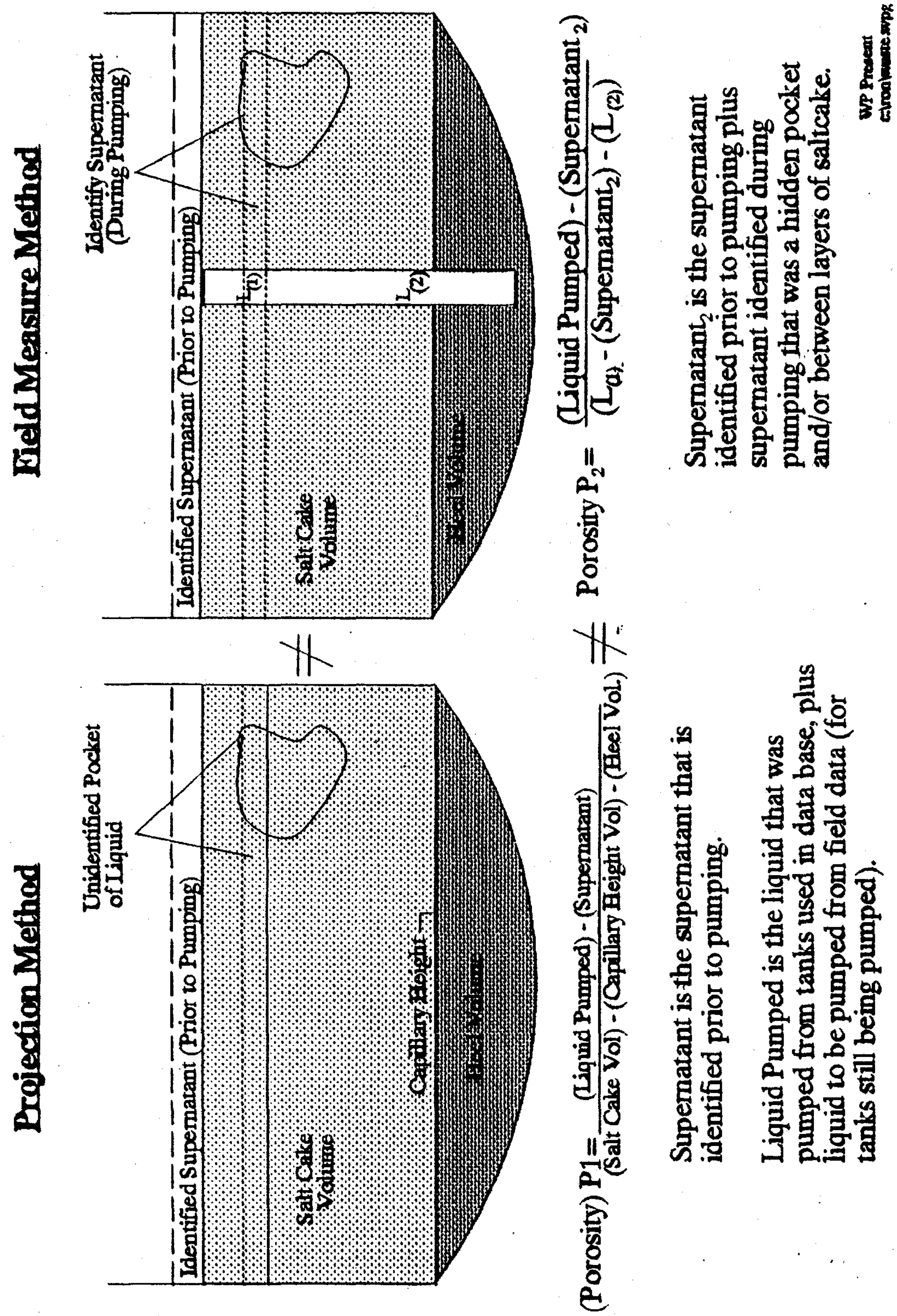
- Examination of the pumping data from the seven unstabilized, jet-pumped tanks in S Farms. Previous studies could not agree on a porosity value because of the variation of the solids classification used. This study used the pumping records for liquids pumped and calculated the porosity based on waste volume from the waste characterization reports.

- Examination of the pumping data for the jet pump prototypes and the other stabilized tanks.

- Using actual pumping data to update porosity values as new data become available. This study used the pumping data from the four SSTs that were actively pumped during 1994 and compares it to the updated stabilized tank porosities. The resulting data provide the most complete records on actual pumping quantities.

Current waste volume projections use the porosity value to calculate the quantity of liquid that will drain from a salt cake and/or sludge. The term porosity is used to describe the volume fraction of drainable interstitial liquid in waste solids (DeWeese 1988), excluding the capillary held region. The porosity values currently used tend to give low estimates of the actual pumpable liquid remaining (PLR) in the SSTs (see Appendix C). To predict the total pumpable volume of liquid remaining in a salt cake SST, three things have to be accounted for: (1) the supernatant above the salt cake, (2) interstitial liquid within the salt cake, and (3) the 'pockets' and/or 'layers' of liquid distributed throughout the salt cake. Therefore, the total pumpable volume of liquid waste in an SST would be the sum of the volume of interstitial liquid calculated using the projected porosity and known quantities of supernatant within the tank. The porosity value used in this study to predict the amount of interstitial liquid in a salt cake SST will be referred to as the 'projected porosity value.' This term accounts for the interstitial liquid held in the pores of the salt cake, as well as for the pockets and/or layers of liquid within the salt cake minus known quantities of supernate. Once pumping begins in an SST, actual field-measured data should be used to recalculate the 'actual' porosity value for that individual tank. Figure 2-1 depicts the two methods of calculating the porosity term.

Figure 2-1. Salt Cake Porosity.



The prediction of PLR in a sludge tank is somewhat less complicated, because sludge tanks do not have hidden pockets or layers of liquid in them. The porosity value used to determine the PLR in a sludge tank uses a true sludge porosity. For salt cake tanks, the porosity value used is more of a projection porosity because it has to account for the hidden liquid pockets and layers of liquid in the salt cake.

The limited pumping experience on sludge tends to suggest that 'true' sludges are unpumpable. Pumping of tanks containing sludge has shown that some materials defined as sludge will have interstitial liquid flow properties similar to salt cake. However, large pockets or layers of hidden supernatant are not anticipated. The liquids projection for the sludge tanks is just over 5% of the total, which is not very significant.

2.1.1 Assumptions Necessary for Data Interpretation

The following assumptions were used to determine the salt cake and sludge porosities:

- Waste volume data from the waste characterization reports
  - Once a tank becomes a bottoms receiver, any solids that accumulate are considered to be salt cake.
  - For salt cake accumulation, all reported solids are considered to be salt cake.
  - Solids were evenly distributed throughout the tank.
  - Complete settling of the sludge occurred and the solids settled in a pseudo-pancake formation.
  - The capacity of the tanks was never exceeded during transfers.
  - Cascades, tank transfers, and crib line effluents were normally free of particulates; therefore, the majority of solids were confined to their initial receiver tanks and were not cribbed or transferred extensively between tanks.
- Salt well pumping data from the last 5 years is more reliable than pumping data from previous years (due to better procedural control, better records, better instrumentation, and improved conduct of operations).
- Data are taken from field measurements to calculate liquids removed from salt cake/sludge for SSTs currently being pumped (i.e., pumping began in 1994 and is continuing in 1995).
- Actual field-measured data were used to calculate porosity for liquid waste removed.
- Existing methods and formulas were used to calculate pumpable liquid waste remaining in the SSTs.

- The data concerning pumpable liquid waste remaining in the SSTs that have been, or are being, actively pumped, are taken from the Hanlon report (Hanlon 1995) and have not been changed.

- The data obtained from the Tank Farm Operations are the most accurate.

2.1.2 Determination of Salt Cake and Sludge Porosities

In the waste characterization reports, the histories of the 149 SSTs were reviewed and tank layer models (TLM) were developed to confirm the classification of the solid wastes (Gaddis and Pickett 1994a, 1994b, and 1995). Using the solids volumes depicted in the TLMs, the salt cake porosities were recalculated for the 25 previously jet pump stabilized salt cake tanks and 6 stabilized sludge tanks. These calculations can be found in Appendix A. It should be noted that the SSTs from the TX Tank Farm were stabilized in the late 1970's to early 1980's. The TX Tank Farm consists of 18 SSTs. Of the 18 tanks, 16 are salt cake, and of these 16, 8 were assumed leakers. When the TX Tank Farm was stabilized, the major emphasis placed was on removing the liquid from the tanks to reduce environmental impact. The transfer records were not well maintained, and flush water volumes were not recorded regularly. Therefore, based on the lack of information on these tanks, and the fact that all of the TX tanks have been stabilized, the decision was made to use data from 9 of the 18 TX Tank Farm tanks for this study. See Appendix A for individual tank assessments.

The projected porosity value used to determine the pumpable liquid waste remaining in salt cake tanks for this study was calculated from data on the seven stabilized salt cake SSTs (BX-111, BY-101, BY-104, BY-107, BY-110 BY-111, and BY-112); data on the five S Tank Farm salt cake SSTs and one SX Tank Farm salt cake SST that have been pumped (SX-104, S-105 [stabilized], S-106, S-108, S-110 and S-112); data on the recent pumping of three tanks (BY-102, BY-103, and BY-109); and data on the nine stabilized TX Tank Farm salt cake SSTs (TX-102, TX-105, TX-106, TX-110, TX-111, TX-112, TX-113, TX-114, and TX-118). The porosity value used to determine the pumpable liquid waste remaining in sludge tanks for this study was calculated from data on the sludge tanks (three stabilized tanks, BX-109, BX-112, and T-111) and three tanks that have been previously pumped or are currently being pumped (C-102, C-107, and C-110). These tanks have been chosen as the primary database for this study because they are believed to represent the most current and accurate tank stabilization data available.

After the porosity values for each individual tank were calculated, the average was determined to be approximately 61% for salt cake tanks and 16% for sludge tanks (see Appendix B, Tables B-1 and B-2).

A comparison study was performed to verify the applicability of using the average porosity values determined. The study used the 25 stabilized salt cake tanks database and compared how 35%, 45%, and 61% salt cake porosity values predict the PLR in the SSTs with the actual volume of pumpable liquid initially in the stabilized SSTs. The initial volume of pumpable liquid in the SSTs was determined by adding the volume of liquid waste (both supernatant and interstitial) removed by pumping and the pumpable liquid estimated to be remaining in the tanks after pumping was completed. Also, the solids volumes used were the estimates used before pumping started. The results of this comparison show that 5.4 Mgal of pumpable liquid waste were initially contained in the 25 SSTs used for this study. The 35% salt cake porosity predicted that the volume of PLR in the SSTs was 3.5 Mgal, an underestimate of 1.9 Mgal. The 45% salt cake porosity predicted that the volume of PLR in the SSTs was 4.4 Mgal; this underestimates the actual volume of PLR by 1 Mgal. When using the 61% projection salt cake porosity, a prediction was made at 6.0 Mgal; this overshoots the actual volume by 605 kgal (see Appendix C, Table C-1).

A similar comparison was made using the sludge tanks. The results of this comparison show that the 12.5% sludge porosity underestimates the actual volume of PLR by 22 kgal. The 16% sludge porosity overestimates the actual volume of PLR by 13 kgal (see Appendix C, Table C-2).

2.1.3 PLR

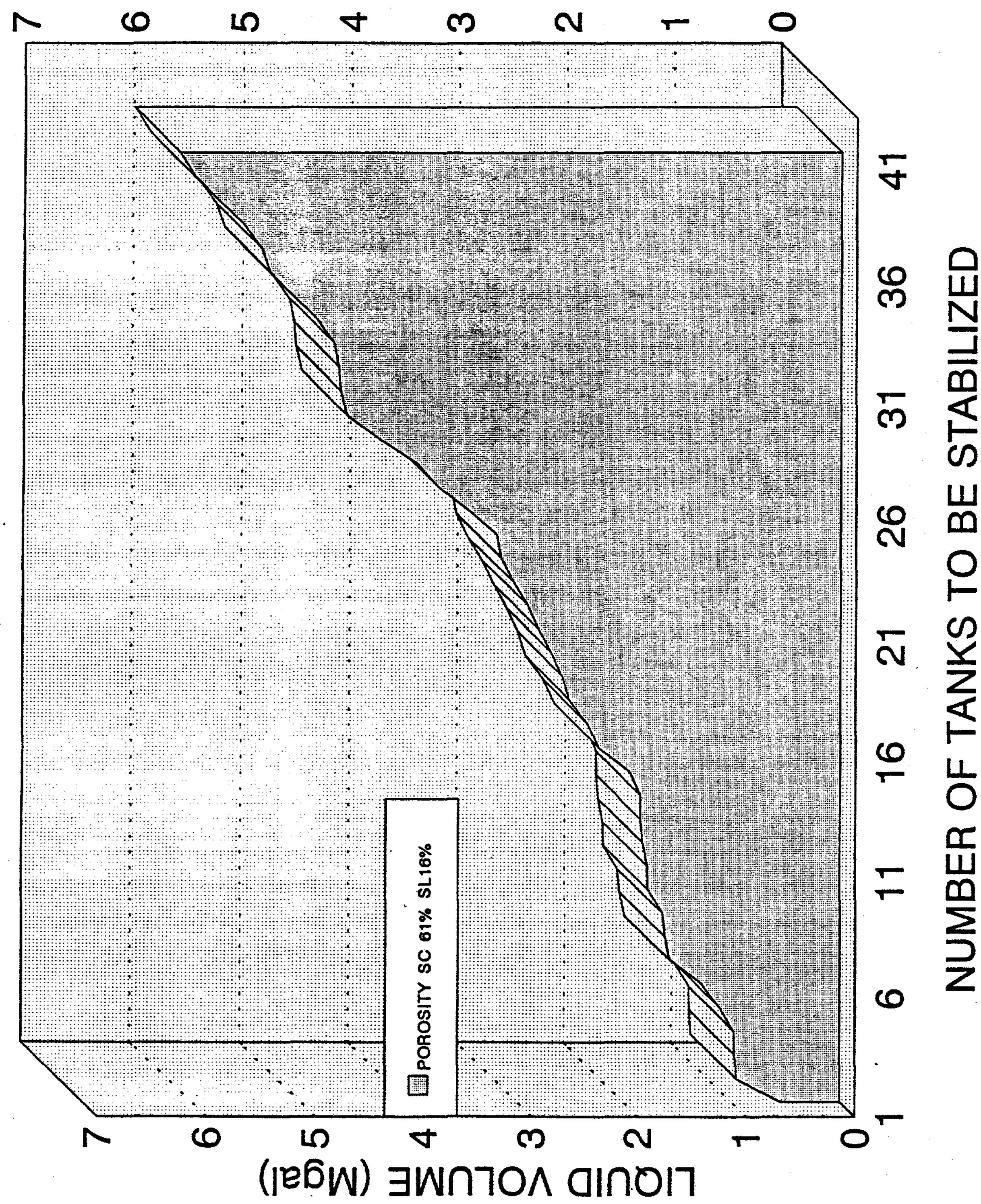
Based on the average projected porosity value of 61% for salt cake tanks and an average sludge porosity value of 16%, the baseline case indicates that the PLR in the SSTs is 6.0 Mgal (see Figure 2-2).

Compared to the 45% salt cake porosity used by the Hanlon report, an additional 1.0 Mgal of liquid will require storage capacity (see Appendix D, Table D-1).

Compared to the 35% salt cake porosity used by the operational waste volume projection, an additional 1.8 Mgal of liquid will require storage capacity (see Appendix D, Table D-1).

The 61% projected salt cake and 16% sludge porosities provide a good overall estimate of the liquid waste volume remaining in the SSTs. However, these porosity percentages are not exact and will not accurately estimate the volume of pumpable liquid waste remaining in each SST requiring stabilization. As the data show, the porosity value of the salt cake ranges from 30% to 100%, and the sludge porosity varies from 11% to 23%. Currently, there is no way to accurately predict the volume of liquid waste in each individual tank before pumping takes place. Inaccuracies in the solids measurements and the inability to accurately estimate supernatant volumes contribute to the spread of data and the high porosities exhibited by the database. It is emphasized that when the actual amounts of liquid recorded as pumped from the tanks are plugged into the equation, they give the salt cake structure a porosity which includes the pools and pockets/layers of liquid. This has the affect of increasing the salt cake porosity, in some cases over 100%, which is not physically possible. The error results because one key assumption is erroneous. <u>The salt cake is not a uniformly distributed structure</u>. It contains significant quantities of pools and layers of liquid (supernatant).

Figure 2-2. Liquid Waste Remaining in the Single-Shell Tanks.



2.2 BASIS TO DETERMINE FLUSH WATER REQUIREMENTS

Flush water requirements were determined by going through the operating procedures and by following the TWRS Daily Operating Reports to estimate the average number of pump shutdowns that occur during the stabilization of an SST.

From these data, the set of assumptions (see Section 2.2.1) was developed to estimate flush water that would be added to the DSTs. The flush water estimate includes the flushing for the salt well pumping equipment, transfer to the DCRT, and transfer to the DST for storage. The estimate excludes flush water that would be required to transfer between the 200 West and 200 East Area Tank Farms.

2.2.1 Flush Water Assumptions

The following assumptions were used to determine the amount of flush water required.

- Liquid waste is salt well pumped from an SST to a DCRT (20 kgal capacity).
- The salt well pumping system is flushed when the DCRT is filled.
- The salt well pumping system is flushed after downtime periods longer than 4 hours.
- The salt well system will experience two downtime periods longer than 4 hours for every 20 kgal of liquid removed from the SSTs.
- The salt well and DCRT systems will require 5.2 kgal of flush water for every 20 kgal of liquid removed from the SSTs.

2.3 SEGREGATION OF COMPLEX WASTE

Historically, complexed waste and transuranic (TRU) waste have been segregated for tank storage to minimize the amount of waste that requires more expensive disposal and to comply with U.S. Department of Energy (DOE) Orders. The DOE Order 5820.2a, *Radioactive Waste Management* (DOE 1988), states in Section I.3.b.(2)(e), "To the extent practical, waste shall be segregated by type (sludge, salt, high activity, and low activity) to make accessibility for future processing easier," and in Section II.3.e.(1), "Transuranic waste shall be segregated or otherwise clearly identified to avoid combining of transuranic waste streams with high-level waste or low-level waste." The Hanford Site has implemented this practice by segregating waste that was considered complex (>10 g/L total organic carbon) from TRU waste sludge (Reynolds 1995).

Processing problems in the evaporator are another reason for segregating complex waste from other waste types. The organic complexants interfere with the crystallization process resulting in extremely thick, viscous slurries. When complexed waste and noncomplexed waste are mixed, the noncomplexed waste cannot be evaporated to as low a volume as when it is alone. Therefore, there is a potential for a net loss of space in the tank farms by mixing complexed and noncomplexed waste. Complexed waste also adds to the complexity of pretreatment for final disposal. The pretreatment of waste before vitrification calls for a step that destroys the organic compounds and releases the TRU (Orme 1994). If complexed waste is not segregated but blended with other waste, there is a potential that more waste will have to go through the organic destruction process. This will add complexity and cost to the final disposal of the waste (Reynolds 1995).

An estimated 1.8 Mgal of potentially complexed waste remain to be pumped from the 200 East and 200 West Area SSTs. Table E-1 in Appendix E shows the breakdown of complexed versus noncomplexed SSTs in the Hanford Site 200 Areas. The division of complexed versus noncomplexed SSTs in the 200 West Area is from WHC-SD-W236A-015, *Waste Segregation Analysis for Salt Well Pumping in the 200 West Area* (Reynolds 1995).

3.0 RESULTS AND CONCLUSIONS

3.1 RESULTS

The waste characterization reports (Gaddis and Pickett 1994a, 1994b, and 1995) combine all historical data available for Hanford Site waste and provide a consistent base for all future porosity and liquid waste in SST studies. The comparison of the present 45% salt cake porosity value, adjusted for salt cake volumes using the waste characterization report values, does not accurately project the value of the PLR in the unstabilized SSTs. A projected porosity value must be used to account for the hidden pockets of liquid in the salt cakes.

Data obtained for pumping operations during the 1980's are based on best available data; however, data sources are extracted from early reports and cannot be verified. Data for the liquid waste pumped from the TX Tank Farm tanks consisted mainly of calculated amounts using engineering best judgement. Data from 7 of the 16 stabilized TX Tank Farm salt cake tanks were not used for the 31-tank study sample because the data were inaccurate.

The 31-tank study sample used to calculate the projected porosity value for salt cake/sludge tanks consisted of the salt cake/sludge tanks with the best retrievable data. The current pumping activity (1994/95) is the most reliable.

Flush water (1.6 Mgal) needs to be considered as part of the storage requirements, and will need interim storage space in the DST until it can be evaporated.

3.2 CONCLUSIONS

The projected PLR in the SSTs is 6.0 Mgal, based on the average projected salt cake porosity value of 61% and sludge porosity value of 16% derived from this study. A projected salt cake porosity value of 61% provides a good estimate for the overall volume of pumpable liquid waste remaining in the SSTs still requiring stabilization. However, the database had varying salt cake porosities that ranged from 30% to 100%, with a standard deviation of 19.6%. This implies that the confidence of any one tank having a salt cake porosity of 61% is low. However, when compared to a salt cake porosity of 45%, 61% projected salt cake porosity provided a better estimate of PLR in the 25-salt cake tank study sample used. With 5,484 kgal of pumpable liquid initially contained in the 25-salt cake study sample, a 45% salt cake porosity provides an estimate of 4,433 kgal, an underestimate of 941 kgal. A 61% projected salt cake porosity estimates the PLR to be 5979 kgal, an overestimate of just 605 kgal. Therefore, it is the recommendation of this report to use a 61% projected salt cake porosity to predict the volumes of pumpable liquid waste remaining in the SSTs containing salt cake solids still requiring stabilization.

This page intentionally left blank.

4.0 RECOMMENDATIONS

The following recommendations are made as a result of the study.

1. Use the Tank Characterization Database (TCD) as the official source for waste tank characterization data.

2. Update the TCD to show the liquids remaining within the SSTs, using the revised projected porosity values as determined by this report.

3. Reliable data on total liquid pumped from each SST should be recorded and the projected porosity value recalculated to give better determination for future liquid projections as tanks are pumped. The data should then be used to make annual revisions to the TCD.

This page intentionally left blank.

5.0 REFERENCES

Alumkal, W. T., 1995, *Multi-Function Waste Tank Facility - Decision Paper*, (Letter 9550111 to T. R. Sheridan, U.S. Department of Energy-Headquarters), Westinghouse Hanford Company, Richland, Washington.

Anderson, J. D., and O. C. Mudd, 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

DeWeese, G. C., 1988, *Observed Porosities of Single-Shell Tank Waste Salt Cakes and Sludge*, WHC-SD-WM-TI-328, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

DOE, 1988, *Radioactive Waste Management*, DOE Order 5820.2A, Westinghouse Hanford Company, Richland, Washington.

Forney, C. E., 1989, *Single-Shell Tank Waste Pumping Strategy*, WHC-SD-WM-TI-274, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Gaddis, L. A., and W. W. Pickett, 1994a, *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Areas*, WHC-SD-WM-ER-352, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Gaddis, L. A., and W. W. Pickett, 1994b, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Areas*, WHC-SD-WM-ER-349, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Gaddis, L. A., and W. W. Pickett, 1995, *Historical Tank Content Estimate for the Northwest Quadrant of the Hanford 200 West Area*, WHC-SD-WM-ER-351, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Handy, L. L., 1975, *Flow Properties of Salt Cake and Interstitial Liquid Removal/Immobilization Development Program*, ARH-C-6, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. M., 1995, *Waste Tank Summary Report for Month Ending December 31, 1994*, WHC-EP-0182-81, Issued Monthly, Westinghouse Hanford Company, Richland, Washington.

Klem, M. J., 1986, *Salt Well Pumping Strategy*, SD-WM-TI-274, Westinghouse Hanford Company, Richland, Washington.

Metz, W. P., 1976, *A Topical Report on Interstitial Liquid Removal from Hanford Salt Cakes*, ARH-CD-545, Westinghouse Hanford Company, Richland, Washington.

Orme, R. M., 1994, *TWRS Process Flowsheet*, WHC-SD-TI-613, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Reynolds, D. A., 1995, *Waste Segregation Analysis for Salt Well Pumping in the 200 West Area*, WHC-SD-W236A-015, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Sederburg, J. P., 1995, *Waste Volume Reduction Factors for Potential 242-A Evaporator Feed*, WHC-SD-WM-TI-690, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Strachan, D. M., 1975, *Permeability, Capillarity and Pore Volume of Synthetic Hanford Salt Cake*, ARH-ST-129, Westinghouse Hanford Company, Richland, Washington.

Strode, J. N., 1994, *Operational Waste Volume Projection*, WHC-SD-WM-ER-029, Rev. 20, Westinghouse Hanford Company, Richland, Washington.

Thompson, J. D., 1994, *Technical Tasks - Action Plan To Support The MWTF Path Forward* (Letter to L. F. Ermold, DRAFT), Westinghouse Hanford Company, Richland, Washington.

6.0 BIBLIOGRAPHY

Awadalla, N. G., 1994, *Position Paper, Need for Additional Waste Storage Capacity and Recommended Path Forward for Project W-236A, Multi-Function Waste Tank Facility*, WHC-SD-W236A-ER-011, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Joncus, S. J., 1983, *Guideline For Declaring Single-Shell Tanks Interim Stabilized Following Jet Pumping*, WHC-SD-RE-TI-099, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Jungfleisch, F. M., 1984, *Preliminary Estimation of the Waste Inventories in Hanford Tanks Through 1980*, SD-WM-TI-057, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Kirk, J. J., 1980, *Permeability, Porosity, and Capillarity of Hanford Waste Material and Its Limits of Pumpability*, RHO-CD-925, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Klem, M. J., 1988, *Technology Program Plan for Interim Stabilization of Single-Shell Tanks Between FY87 and FY96*, SD-WM-TPP-031, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Klem, M.J., 1990, *Single-Shell Tank Interim Stabilization Criteria Review*, WHC-SD-WM-DIC-005, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Larrick, A. P., 1994, *Project W-236A Multi-Function Waste Tank Facility Waste Feed Projections*, SD-W236A-TS-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Metz, W. P., and Ogren, W. E., 1976, *Criteria - Waste Tank Isolation and Stabilization*, ARH-CD-784, Westinghouse Hanford Company, Richland, Washington.

Molberg, T. P., 1991, *Jet Pump Duration To Stabilize Remaining Single-Shell Tanks* (Letter 77130-91-0112 to V. C. Boyles), Westinghouse Hanford Company, Richland, Washington.

Swaney, S. L., 1994, *Single Shell Tank Stabilization Record*, WHC-SD-RE-TI-178, Rev. 4, Westinghouse Hanford Company, Richland, Washington.

Tank Farm Process Engineering, 82/01/00 thru 86/12/00, *Waste Status Summary*, RHO-RE-SR-14, Issued Monthly, Westinghouse Hanford Company, Richland, Washington.

Weiss, R. L., 1986, *TY Tank Farm Waste Characterization Data*, RHO-WM-TI-1 P, Westinghouse Hanford Company, Richland, Washington.

This page intentionally left blank.

7.0 GLOSSARY

ABBREVIATIONS AND ACRONYMS

DCRT	double-contained receiver tank
DOE	U.S. Department of Energy
DST	double-shell tank
MWTF	Multi-Function Waste Tank Facility
PLR	pumpable liquid remaining
SST	single-shell tank
TCD	Tank Characterization Data
TLM	tank layer model
TRU	transuranic
TWRS	Tank Waste Remediation System

DEFINITIONS OF TERMS

Projection Porosity. A projection factor to determine liquids in waste tanks based on salt cake content.

This page intentionally left blank.

APPENDIX A

POROSITY CALCULATIONS

This page intentionally left blank.

Porosity BX-111 (STABILIZED 1995) Assumed Leaker

Total BX-111 Tank Inventory

	1980	1994
• Sludge	32 kgal	32 kgal
• Salt cake	179 kgal	179 kgal
• Supernatant	22 kgal	19 kgal
Total waste	233 kgal	230 kgal

Total liquid pumped (1995)	119.1 kgal
Total projected pumpable liquid remaining (PLR) (field data)	0.0 kgal
Total supernate removed	33.0 kgal
Total volume leaked	8.0 kgal

Based on data for 1980, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \text{ X } 100$$

$$P_{sc} = \frac{119.1 + 0 - 33}{179 - 82.5} \text{ X } 100$$

$$P_{sc} = 89\%$$

The pumping includes quantities of supernatant as hidden pockets/layer. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

As of March 1995, salt well pumping for BX-111 has been completed and was declared interim stabilized.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity BY-101 (STABILIZED 1984)

Total BY-101 Tank Inventory

	1977	1994
• Sludge	37 kgal	37 kgal
• Salt cake	402 kgal	350 kgal
• Supernatant	0 kgal	0 kgal
Total waste	439 kgal	387 kgal

Total liquid pumped (1977)	61.6 kgal
Total liquid pumped (1984)	35.8 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1977, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{97.4 + 0 - 0}{402 - 82.5} \times 100$$

$P_{sc} = 30\%$

The pumping includes quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-52 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity BY-102 (RECENT PUMPING)

Total BY-102 Tank Inventory

	1978	1994
• Sludge	29 kgal	29 kgal
• Salt cake	388 kgal	312 kgal
• Supernatant	0 kgal	0 kgal
Total waste	417 kgal	341 kgal

Total liquid pumped (1978 - 1979)	34.6 kgal
Total liquid pumped (1991 - 1994)	151.4 kgal
Total projected PLR (field data)	6.7 kgal
Total supernate removed	0.0 kgal

Based on data for 1978, salt cake volume, and total liquid pumped plus PLR (field data).

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^*} \times 100$$

$$P_{sc} = \frac{186 + 6.7 - 0}{388 - 82.5} \times 100$$

$$P_{sc} = 63\%$$

The pumping included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-76 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity BY-103 (RECENT PUMPING) Assumed Leaker

Total tank inventory

	1978	1994
• Sludge	9 kgal	9 kgal
• Salt cake	452 kgal	391 kgal
• Supernatant	0 kgal	0 kgal
Total waste	461 kgal	400 kgal

Total liquid pumped (1979)	84.4 kgal
Total liquid pumped (1987 - 1994)	78.5 kgal
Total projected PLR (field data)	137.0 kgal
Total supernate removed	0.0 kgal
Total volume leaked (greater than)	5.0 kgal

Based on data for 1978, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^*} \times 100$$

$$P_{sc} = \frac{162.9 + 137 - 0}{452 - 82.5} \times 100$$

$$P_{sc} = 81\%$$

The pumping included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-61 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity BY-104 (STABILIZED 1985)

Total BY-104 Tank Inventory

	1980	1994
• Sludge	150 kgal	150 kgal
• Salt cake	473 kgal	256 kgal
• Supernatant	11 kgal	0 kgal
Total waste	634 kgal	406 kgal

Total liquid pumped (1983 - 1984)	329.5	kgal
Total projected PLR (field data)	0.0	kgal
Total supernate removed (field data)	11.0	kgal

Based on data for 1980, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity } (P_{sc}) = \frac{\text{Lqd rmvd} + \text{PLR} - (\text{Sludge vol} - 66^{*}) \times P_{sl} - \text{supnate rmvd}}{\text{Volume of salt cake} - 82.5^{**}} \times 100$$

$$P_{sc} = \frac{329.5 + 0 - 24.4}{473 - 82.5} \times 100$$

P_{sc} = 78%

The pumping included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-217 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary height for sludge within tank.
**Constant--Compensates for capillary and unpumpable height within tank.

Porosity BY-107 (STABILIZED 1979) Assumed Leaker

Total BY-107 Tank Inventory

	1975	1994
• Sludge	117 kgal	117 kgal
• Salt cake	250 kgal	149 kgal
• Supernatant	0 kgal	0 kgal
Total waste	367 kgal	266 kgal

Total liquid pumped (1975)	153.1 kgal
Total liquid pumped (1976 - 1979)	56.4 kgal
Total PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal
Total volume leaked	15.1 kgal

The following formula has been used in the past (and is currently being used) to predict the amount of liquid that can be pumped from a salt cake structure. However, when the liquid was actually pumped out, the tank BY-107 and that ACTUAL amount of liquid pumped was plugged into the equation. That gave the salt cake structure a porosity of 120%, which is not physically possible. The error results because one key assumption is erroneous. The saltcake is not a uniformly distributed structure. It contains significant quantities of pools and layers of liquid (supernatant). In the case of tank BY-107, a volume of 101 kgal was attributed to salt cake but it really was liquid.

Based on data for 1975, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity } (P_{sc}) = \frac{\text{Lqd rmvd} + \text{PLR} - (\text{Sludge vol} - 66^{*}) \times P_{sl} - \text{supnate rmvd}}{\text{Volume of salt cake} - 82.5^{**}} \times 100$$

$$P_{sc} = \frac{209.5 + 0 - 8.16}{250 - 82.5} \times 100$$

$$P_{sc} = 120\%$$

*Constant--Compensates for capillary height for sludge within tank.
**Constant--Compensates for capillary and unpumpable height within tank.

Porosity BY-109 (RECENT PUMPING)

Total BY-109 Tank Inventory

	1984	1994
• Sludge	36 kgal	36 kgal
• Salt cake	397 kgal	387 kgal
• Supernatant	0 kgal	0 kgal
Total waste	433 kgal	423 kgal

Total liquid pumped (1991 - 1994)	117.4 kgal
Total projected PLR (field data)	43.2 kgal
Total supernate removed	0.0 kgal

Based on data for 1984, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$P_{sc} = \frac{117.4 + 43.2 - 0}{397 - 82.5} \times 100$$

$$P_{sc} = 51\%$$

The pumping included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-10 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity BY-110 (STABILIZED 1985)

Total BY-110 Tank Inventory

	1980	1994
• Sludge	190 kgal	190 kgal
• Salt cake	315 kgal	208 kgal
• Supernatant	3 kgal	0 kgal
Total waste	508 kgal	398 kgal

Total liquid pumped (1983 - 1984)	213.3 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	3.0 kgal

Based on data for 1980, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity } (P_{sc}) = \frac{\text{Lqd rmvd} + \text{PLR} - (\text{Sludge vol} - 66^{*}) \times P_{sl} - \text{supnate rmvd}}{\text{Volume of salt cake} - 82.5^{**}} \times 100$$

$$P_{sc} = \frac{213.3 + 0 - 22.8}{315 - 82.5} \times 100$$

P_{sc} = 82%

The pumping included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-107 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary height for sludge within tank.
**Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity BY-111</u> (STABILIZED 1995)

Total BY-111 Tank Inventory

	1977	1994
• Sludge	26 kgal	26 kgal
• Salt cake	589 kgal	433 kgal
• Supernatant	0 kgal	0 kgal
Total waste	615 kgal	459 kgal

Total liquid pumped (1978)	28.1 kgal
Total liquid pumped (1983 - 1984)	313.3 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed (field data)	0.0 kgal

Based on data for 1977, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - }82.5^{*}} \times 100$$

$$P_{sc} = \frac{341.4 + 0 - 0}{589 - 82.5} \times 100$$

$$P_{sc} = 67\%$$

The pumping included quantities of supernatant as hidden pockets/layer. A noticeable solids volume change (-156 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity BY-112</u> (STABILIZED 1984)

Total BY-112 Tank Inventory

	1976	1994
• Sludge	26 kgal	26 kgal
• Salt cake	284 kgal	274 kgal
• Supernatant	0 kgal	0 kgal
Total waste	310 kgal	290 kgal

Total liquid pumped (1976)	46.9 kgal
Total liquid pumped (1983 - 1984))	116.4 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed (field data)	0.0 kgal

Based on data for 1976, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$P_{sc} = \frac{163.3 + 0 - 0}{284 - 82.5} \times 100$$

P_{sc} = 81%

The pumping included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-10 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity S-105 (STABILIZED 1988)

Total S-105 Tank Inventory

	1975	1994
• Sludge	2 kgal	2 kgal
• Salt cake	539 kgal	454 kgal
• Supernatant	0 kgal	0 kgal
Total waste	541 kgal	456 kgal

Total liquid pumped (1975)	22.0 kgal
Total liquid pumped (1978)	114.3 kgal
Total projected PLR (field data)	18.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1975, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - }82.5^{*}} \times 100$$

$$P_{sc} = \frac{136.3 + 18 - 0}{539 - 82.5 - 55} \times 100$$

$$P_{sc} = 38\%$$

Major pump failure occurred in 1978 and pumping was halted. Analysis in 1988 determined that the stabilization criteria were met and S-105 was declared stabilized. The salt cake volume was adjusted to reflect the actual salt cake volume that was pumped.

The pumping includes quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-52 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity S-106 (PUMPING 1978 - 1980)

Total S-106 Tank Inventory

	1978	1994
• Sludge	32 kgal	32 kgal
• Salt cake	580 kgal	511 kgal
• Supernatant	0 kgal	0 kgal
Total waste	612 kgal	543 kgal

Total liquid pumped (1978 - 1980)	99.8 kgal
Total projected PLR (field data)	162.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1978, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$P_{sc} = \frac{(99.8 + 0 - 0}{580 - 82.5} + \frac{162 + 0 - 0)}{511 - 82.5} \times 100$$

$$P_{sc} = 58\%$$

The pumping occurred between 1978 and 1980, which included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-85 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

The present salt cake volume was used for the porosity calculation for the remaining liquid to be pumped at a later date.

*Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity S-108</u> (PUMPING 1978 - 1980)

Total S-108 Tank Inventory

	1978	1994
• Sludge	5 kgal	5 kgal
• Salt cake	665 kgal	599 kgal
• Supernatant	0 kgal	0 kgal
Total waste	670 kgal	604 kgal

Total liquid pumped (1978 - 1980)	151.6 kgal
Total projected PLR (field data)	105.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1978, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^*} \times 100$$

$$P_{sc} = \left(\frac{151.6 + 0 - 0}{665 - 82.5} + \frac{105 + 0 - 0}{599 - 82.5}\right) \times 100$$

$$P_{sc} = 46\%$$

The pumping occurred between 1978 and 1980, which included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-66 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant. The present salt cake volume was used for the porosity calculation for the remaining liquid to be pumped at a later date.

*Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity S-109</u> (PUMPING 1978 - 1980)

Total S-109 Tank Inventory

	1978	1994
• Sludge	13 kgal	13 kgal
• Salt cake	555 kgal	555 kgal
• Supernatant	127 kgal	0 kgal
Total waste	695 kgal	568 kgal

Total liquid pumped (1978 - 1980)	111 kgal
Total projected PLR (field data)	119 kgal
Total supernate removed	0 kgal

Based on data for 1978, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

DATA NOT USED

A large quantity of visible supernatant was pumped. After pumping, a visible change in solids volume has not occurred.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity S-110 (PUMPING 1979)

Total S-110 Tank Inventory

	1979	1994
• Sludge	113 kgal	113 kgal
• Salt cake	579 kgal	277 kgal
• Supernatant	0 kgal	0 kgal
Total waste	692 kgal	390 kgal

Total liquid pumped (1979)	185.9 kgal
Total projected PLR (field data)	103.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1979, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity } (P_{sc}) = \frac{\text{Lqd rmvd} + \text{PLR} - (\text{Sludge vol} - 66^{*}) \times P_{sl} - \text{supnate rmvd}}{\text{Volume of salt cake} - 82.5^{**}} \times 100$$

$$P_{sc} = \frac{(185.9 + 0 - 7.5}{579 - 82.5} + \frac{103 + 0 - 7.5)}{277 - 82.5} \times 100$$

$$P_{sc} = 85\%$$

The pumping occurred in 1979, which included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-302 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

The present salt cake volume was used for the porosity calculation for the remaining liquid to be pumped at a later date.

*Constant--Compensates for capillary height for sludge within tank.
**Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity S-111</u> (PUMPING 1976 - 1980)

Total S-111 Tank Inventory

	1976	1994
• Sludge	139 kgal	139 kgal
• Salt cake	484 kgal	447 kgal
• Supernatant	0 kgal	10 kgal
Total waste	623 kgal	596 kgal

Total liquid pumped (1976 - 1980)	3.3 kgal
Total projected PLR (field data)	134.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1976, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - }82.5^{*}} \times 100$$

DATA NOT USED

The quantity of liquid pumped is not sufficient to be meaningful for this study.

*Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity S-112</u> (PUMPING 1978 -1980)

Total S-112 Tank Inventory

	1978	1994
• Sludge	6 kgal	6 kgal
• Salt cake	667 kgal	631 kgal
• Supernatant	0 kgal	0 kgal
Total waste	673 kgal	637 kgal

Total liquid pumped (1978 - 1980)	125.1 kgal
Total projected PLR (field data)	112.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1978, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$P_{sc} = \frac{(125.1 + 0 - 0}{667 - 82.5} + \frac{112 + 0 - 0)}{631 - 82.5} \times 100$$

$$P_{sc} = 41\%$$

The pumping occurred between 1978 and 1980, which included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-36 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

The present salt cake volume was used for the porosity calculation for the remaining liquid to be pumped at a later date.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity SX-104 (PUMPING 1988 - 1989) Assumed Leaker

Total SX-104 Tank Inventory

	1980	1994
• Sludge	169 kgal	169 kgal
• Salt cake	544 kgal	445 kgal
• Supernatant	0 kgal	0 kgal
Total waste	713 kgal	614 kgal

Total liquid pumped (1988 - 1989)	113.2 kgal
Total projected PLR (field data)	195.0 kgal
Total supernate removed	0.0 kgal
Total liquid leaked	6.0 kgal

Based on data for 1980, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity } (P_{sc}) = \frac{\text{Lqd rmvd + PLR - (Sludge vol - 66}^{*}\text{) X } P_{sl} \text{- supnate rmvd}}{\text{Volume of salt cake - 82.5}^{**}} \text{ X 100}$$

$$P_{sc} = \frac{(113.2 + 0 - 16.5}{544 - 82.5} + \frac{195 + 0 - 16.5)}{445 - 82.5} \text{ X 100}$$

P_{sc} = 70%

The pumping occurred between 1988 and 1989, which included quantities of supernatant as hidden pockets/layer. A noticeable change in the solids volume (-99 kgal) occurred after removal of the liquid. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

The present salt cake volume was used for the porosity calculation for the remaining liquid to be pumped at a later date.

*Constant--Compensates for capillary height for sludge within tank.
**Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-102 (STABILIZED 1983)

Total TX-102 Tank Inventory

	1977	1980	1994
• Sludge	2 kgal	2 kgal	2 kgal
• Salt cake	453 kgal	332 kgal	215 kgal
• Supernatant	0 kgal	0 kgal	0 kgal
Total waste	455 kgal	334 kgal	217 kgal

Total liquid pumped (1977 - 1978)	93.6 kgal
Total liquid pumped (1980 - 1983)	94.4 kgal
Total projected PLR (field data)	4.5 kgal
Total supernate removed	0.0 kgal

Based on data for 1977 and 1980, salt cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$P_{sc} = \left(\frac{93.6 + 0 - 0}{453 - 82.5} + \frac{94.4 + 4.5 - 0}{332 - 82.5}\right) \times 100$$

$$P_{sc} = 64\%$$

The pumping campaigns occurred between 1973 and 1983, which included quantities of supernatant as hidden pockets/layer. Noticeable changes in the solids volume (-121 kgal) and (-117 kgal) occurred from removal of the liquid after each pumping campaign. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity TX-103</u> (STABILIZED 1983)

Total TX-103 Tank Inventory

	1980	1994
• Sludge TBP	3 kgal	3 kgal
• Salt cake	154 kgal	154 kgal
• Supernatant	0 kgal	0 kgal
Total waste	157 kgal	157 kgal

Total liquid pumped (1983)	68.3 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1980, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^*} \times 100$$

DATA NOT USED

A large quantity of visible supernatant was pumped. After pumping, a visible change in solids volume did not occur and the remaining salt cake was not pumped because it met the stabilization requirements.

*Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity TX-105</u> (STABILIZED 1983) Assumed Leaker

Total TX-105 Tank Inventory

	1977	1994
• Sludge	8 kgal	8 kgal
• Salt cake	601 kgal	601 kgal
• Supernatant	0 kgal	0 kgal
Total waste	609 kgal	609 kgal

Total liquid pumped (1977)	126.0 kgal
Total liquid pumped (1983)	121.5 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal
Total liquid leaked (average of 19 Tanks)	8.0 kgal

Based on data for 1977, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5*}} \text{ X } 100$$

$$P_{sc} = \frac{247.5 + 0 - 0}{601 - 82.5} \text{ X } 100$$

$$P_{sc} = 48\%$$

Did not include amount leaked

*Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity TX-106</u> (STABILIZED 1983)

Total TX-106 Tank Inventory

	1980	1994
• Sludge	123 kgal	148 kgal
• Salt cake	330 kgal	305 kgal
• Supernatant	0 kgal	0 kgal
Total waste	453 kgal	453 kgal

Total liquid pumped (1983)	134.6 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1980, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity } (P_{sc}) = \frac{\text{Lqd rmvd} + \text{PLR} - (\text{Sludge vol} - 66^{*}) \times P_{sl} - \text{supnate rmvd}}{\text{Volume of salt cake} - 82.5^{**}} \times 100$$

$$P_{sc} = \frac{134.6 + 0 - 9.1}{(330 - 25) - 82.5} \times 100$$

$$P_{sc} = 56\%$$

Salt cake volume was adjusted for calculating porosity value to compensate for the impenetrable layer of solids found at 4 1/2 ft from bottom during lancing operation (Swaney 1994).

*Constant--Compensates for capillary height for sludge within tank.
**Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-108 (STABILIZED 1983)

Total TX-108 Tank Inventory

	1977	1994
• Sludge	6 kgal	6 kgal
• Salt cake	75 kgal	128 kgal
• Supernatant	0 kgal	0 kgal
Total waste	81 kgal	134 kgal

Total liquid pumped (1977 - 1978)	37.1 kgal
Total liquid pumped (1983)	13.7 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1977, salt cake volume, and total liquid pumped

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

DATA NOT USED

The salt cake was pumped during primary stabilization (1977 to 1978) which removed liquid. A solids volume increase occurred before the final pumping for stabilization.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-109 (STABILIZED 1983)

Total TX-109 Tank Inventory

	1980	1994
• Sludge	0 kgal	383 kgal
• Salt cake	450 kgal	0 kgal
• Supernatant	0 kgal	0 kgal
Total waste	450 kgal	383 kgal

Total liquid pumped (1977)	226.0 kgal
Total liquid pumped (1982)	72.3 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed (field data)	0.0 kgal

Based on 1980 Projection

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^*} \times 100$$

DATA NOT USED

Tank is classified as sludge tank. The dip tubes are plugged and it is difficult to determine liquid levels. Values were measured using pump baseplate as reference. Data for this study are not meaningful.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-110 (STABILIZED 1983) Assumed Leaker

Total TX-110 Tank Inventory

	1977	1980	1994
• Sludge	37 kgal	37 kgal	37 kgal
• Salt cake	531 kgal	493 kgal	425 kgal
• Supernatant	0 kgal	0 kgal	0 kgal
Total waste	568 kgal	530 kgal	462 kgal

Total liquid pumped (1978 - 1981)	59.6 kgal
Total liquid pumped (1982)	115.4 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal
Total liquid leaked (average of 19 Tanks)	8.0 kgal

Based on data for 1977 and 1980, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5*}} \times 100$$

$$P_{sc} = \left(\frac{59.6 + 0 - 0}{531 - 82.5} + \frac{115.4 + 0 - 0}{493 - 82.5}\right) \times 100$$

$$P_{sc} = 41\%$$

Did not include amount leaked

*Constant-Compensates for capillary and unpumpable height within tank.

Porosity TX-111 (STABILIZED 1983)

Total TX-111 Tank Inventory

	1977	1994
• Sludge	43 kgal	43 kgal
• Salt cake	327 kgal	327 kgal
• Supernatant	33 kgal	0 kgal
Total waste	403 kgal	370 kgal

Total liquid pumped (1978)	148.5 kgal
Total liquid pumped (1982)	98.4 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed (field data)	33.0 kgal

Based on data for 1977, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$P_{sc} = \frac{246.9 + 0 - 33.0}{327 - 82.5} \times 100$$

$$P_{sc} = 87\%$$

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-112 (STABILIZED 1983)

Total TX-112 Tank Inventory

	1977	1994
• Sludge	24 kgal	24 kgal
• Salt cake	625 kgal	625 kgal
• Supernatant	0 kgal	0 kgal
Total waste	649 kgal	649 kgal

Total liquid pumped (1978)	48.1 kgal
Total liquid pumped (1982)	94.0 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1977, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$P_{sc} = \frac{142.1 + 0 - 0}{(625 - 89) - 82.5} \times 100$$

P_{sc} = 31%

Pumping was stopped because of major pump failure and tank met stabilization requirements. The salt cake was adjusted to compensate for the high final liquid level (62.5 in.).

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-113 (STABILIZED 1983) Assumed Leaker

Total TX-113 Tank Inventory

	1975	1994
• Sludge	183 kgal	183 kgal
• Salt cake	498 kgal	424 kgal
• Supernatant	0 kgal	0 kgal
Total waste	681 kgal	607 kgal

Total liquid pumped (1977)	214.3 kgal
Total liquid pumped (1982)	19.2 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal
Total liquid leaked (average of 19 Tanks)	8.0 kgal

Based on data for 1975, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity } (P_{sc}) = \frac{\text{Lqd rmvd} + \text{PLR} - (\text{Sludge vol} - 66^{*}) \times P_{sl} - \text{supnate rmvd}}{\text{Volume of salt cake} - 82.5^{**}} \times 100$$

$$P_{sc} = \frac{233.5 + 0 - 18.7}{498 - 82.5} \times 100$$

$P_{sc} = 52\%$

Did not include amount leaked.

*Constant--Compensates for capillary height for sludge within tank.
**Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-114 (STABILIZED 1983) Assumed Leaker

Total TX-114 Tank Inventory

	1975	1980	1994
• Sludge	62 kgal	62 kgal	62 kgal
• Salt cake	616 kgal	583 kgal	473 kgal
• Supernatant	0 kgal	0 kgal	0 kgal
Total waste	678 kgal	645 kgal	535 kgal

Total liquid pumped (1977)	164.5 kgal
Total liquid pumped (1982)	104.3 kgal
Total projected PLR (field data)	4.0 kgal
Total supernate removed	0.0 kgal
Total liquid leaked (average of 19 Tanks)	8.0 kgal

Based on data for 1975 and 1980, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \text{ X } 100$$

$$P_{sc} = \frac{(164.5 + 0 - 0}{616 - 82.5} + \frac{104.3 + 4.0 - 0)}{583 - 82.5} \text{ X } 100$$

$$P_{sc} = 53\%$$

Did not include amount leaked.

The pumping campaigns occurred between 1975 and 1983, which included quantities of supernatant as hidden pockets/layer. Noticeable changes in the solids volume (-33 kgal) and (-110 kgal) occurred from removal of the liquid after each pumping campaign. Salt cakes tend to form irregular surfaces, and occasionally floating crusts and/or pockets form above or around a layer of supernatant.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-115 (STABILIZED 1983) Assumed Leaker

Total TX-115 Tank Inventory

	1977	1994
• Sludge	8 kgal	8 kgal
• Salt cake	632 kgal	632 kgal
• Supernatant	0 kgal	0 kgal
Total waste	640 kgal	640 kgal

Total liquid pumped (1978)	10.7 kgal
Total liquid pumped (1983)	99.1 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal
Total liquid leaked (average of 19 Tanks)	8.0 kgal

Based on data for 1977, salt cake volume, and total liquid pumped

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - } 82.5^{*}} \times 100$$

DATA NOT USED

Records for liquids pumped in 1977 for primary stabilization are not consistent with amounts of liquids removed from other tanks.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-116 (STABILIZED 1983) Assumed Leaker

Total TX-116 Tank Inventory

	1976	1994
• Sludge	20 kgal	20 kgal
• Salt cake	611 kgal	611 kgal
• Supernatant	0 kgal	0 kgal
Total waste	631 kgal	631 kgal

Total liquid pumped (1977)	195.5 kgal
Total liquid pumped (1982)	23.9 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal
Total liquid leaked (average of 19 Tanks)	8.0 kgal

Based on data for 1976, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

DATA NOT USED

Diatomaceous earth and desiccant had been added to tank as an effort to control leaking.

A 15-in. spool piece was installed under the pump with 13 in. of solids in the salt well screen when pumping was shut down. Final liquid level was at 52 in.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-117 (STABILIZED 1983) Assumed Leaker

Total TX-117 Tank Inventory

	1977	1994
• Sludge	7 kgal	7 kgal
• Salt cake	619 kgal	619 kgal
• Supernatant	0 kgal	0 kgal
Total waste	626 kgal	626 kgal

Total liquid pumped (1977)	132.5 kgal
Total liquid pumped (1982)	54.3 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal
Total liquid leaked (average of 19 Tanks)	8.0 kgal

Based on data for 1977, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

DATA NOT USED

Diatomaceous earth and desiccant had been added to tank as an effort to control leaking.

The dip tubes were plugged and could not measure liquid level. Used measurements based on pump location.

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity TX-118 (STABILIZED 1983)

Total TX-118 Tank Inventory

	1980	1994
• Sludge	33 kgal	33 kgal
• Salt cake	314 kgal	314 kgal
• Supernatant	0 kgal	0 kgal
Total waste	347 kgal	347 kgal

Total liquid pumped (1983)	89.1 kgal
Total projected PLR (field data)	0.0 kgal
Total supernate removed	0.0 kgal

Based on data for 1980, salt cake volume, and total liquid pumped (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of salt cake - 82.5}^{*}} \times 100$$

$$P_{sc} = \frac{89.1 + 0 - 0}{314 - 82.5} \times 100$$

P_{sc} = 38%

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity BX-109 (STABILIZED 1990)

Total BX-109 Tank Inventory

	1990	1994
• Sludge	193 kgal	193 kgal
• Salt cake	0 kgal	0 kgal
• Supernatant	5 kgal	0 kgal
Total waste	198 kgal	193 kgal

Total liquid pumped	12.8 kgal
Total projected PLR (field data)	7.6 kgal
Total supernate removed	4.6 kgal

Based on data for 1990, sludge cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of sludge - 115.5*}} \times 100$$

$$P_{sc} = \frac{12.8 + 7.6 - 4.6}{193 - 115.5} \times 100$$

$$P_{sc} = 20\%$$

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity BX-112 (STABILIZED 1990)

Total BX-112 Tank Inventory

	1990	1994
• Sludge	164 kgal	164 kgal
• Salt cake	0 kgal	0 kgal
• Supernatant	1 kgal	1 kgal
Total waste	165 kgal	165 kgal

Total liquid pumped	4.1 kgal
Total projected PLR (field data)	2.1 kgal
Total supernate removed	0.0 kgal

Based on data for 1990, sludge cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of sludge - }115.5^{*}} \times 100$$

$$P_{sc} = \frac{4.1 + 2.1 - 0}{164 - 115.5} \times 100$$

P_{sc} =13%

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity C-102 (PUMPING)

Total C-102 Tank Inventory

	1991	1994
• Sludge	423 kgal	423 kgal
• Salt cake	0 kgal	0 kgal
• Supernatant	0 kgal	0 kgal
Total waste	423 kgal	423 kgal

Total liquid pumped	14.2 kgal
Total projected PLR (field data)	23.6 kgal
Total supernate removed	0.0 kgal

Based on data for 1991, sludge cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of sludge - 115.5}^{*}} \times 100$$

$$P_{sc} = \frac{14.2 + 23.6 - 0}{423 - 115.5} \times 100$$

$$P_{sc} = 12\%$$

*Constant--Compensates for capillary and unpumpable height within tank.

<u>Porosity C-107</u> (PUMPING)

Total C-107 Tank Inventory

	1991	1994
• Sludge	275 kgal	275 kgal
• Salt cake	0 kgal	0 kgal
• Supernatant	0 kgal	0 kgal
Total waste	275 kgal	275 kgal

Total liquid pumped	17.9 kgal
Total projected PLR (field data)	18.5 kgal
Total supernate removed	0.0 kgal

Based on data for 1991, sludge cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of sludge - 115.5}^{*}} \times 100$$

$$P_{sc} = \frac{17.9 + 18.5 - 0}{275 - 115.5} \times 100$$

$$P_{sc} = 23\%$$

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity C-110 (PUMPING) Assumed Leaker

Total C-110 Tank Inventory

	1991	1994
• Sludge	187 kgal	187 kgal
• Salt cake	0 kgal	0 kgal
• Supernatant	0 kgal	0 kgal
Total waste	187 kgal	187 kgal

Total liquid pumped	12.4 kgal
Total projected PLR (field data)	2.0 kgal
Total supernate removed	0.0 kgal
Total volume leaked	2.0 kgal

Based on data for 1991, sludge cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of sludge - 115.5}^*} \times 100$$

$$P_{sc} = \frac{12.4 + 2 - 0}{187 - 115.5} \times 100$$

$$P_{sc} = 19\%$$

*Constant--Compensates for capillary and unpumpable height within tank.

Porosity T-111 (STABILIZED 1995) Assumed Leaker

Total T-111 Tank Inventory

	1993	1995
• Sludge	453 kgal	446 kgal
• Salt cake	0 kgal	0 kgal
• Supernatant	0 kgal	0 kgal
Total waste	453 kgal	446 kgal

Total liquid pumped	9.6 kgal
Total projected PLR (field data)	29.1 kgal
Total supernate removed	0.0 kgal
Total volume leaked (less than)	1.0 kgal

Based on data for 1993, sludge cake volume, and total liquid pumped plus PLR (field data)

$$\text{Porosity}_{sc}\ (P_{sc}) = \frac{\text{Liquid removed + PLR - supernatant removed}}{\text{Volume of sludge - 115.5}^{*}} \times 100$$

$$P_{sc} = \frac{9.6 + 29.1 - 0}{453 - 115.5} \times 100$$

P_{sc} = 11%

*Constant--Compensates for capillary and unpumpable height within tank.

A1.0 REFERENCES

Swaney, S. L., 1994, *Single Shell Tank Stabilization Record*, WHC-SD-RE-TI-178, Rev. 4, Westinghouse Hanford Company, Richland, Washington.

A2.0 GLOSSARY

ABBREVIATIONS AND ACRONYMS

Lqd	liquid
rmvd	removed
supnate	supernatant
Vol	volume

APPENDIX B

SINGLE-SHELL TANK POROSITY DATABASE

This page intentionally left blank.

Table B-1. Single-Shell Tank Salt Cake Porosity Database.

TANK NO.	TOTAL WASTE (K gal)	SLUDGE (K gal)	SLTCAKE (K gal)	SUPER-NATANT (K gal)	TOT LIQUID PUMPED (K gal)	PUMPABLE LIQUID REMAIN (K gal)	TOT LIQUID SC/SL (K gal)	POROSITY VALUE %
BX-111	233	32	179	33	119.1	0	119.1	89
BY-101	439	37	402	0	97.4	0	97.4	30
BY-102	417	29	388	0	186	6.7	192.7	63
BY-103	461	9	452	0	162.9	137	299.9	81
BY-104	634	150	473	11	329.5	0	329.5	82
BY-107	367	117	250	0	209.5	0	209.5	100
BY-109	433	36	397	0	117.4	43.2	160.6	51
BY-110	508	190	315	3	213.3	0	213.3	90
BY-111	615	26	589	0	341.4	0	341.4	67
BY-112	310	26	284	0	163.3	0	163.3	81
S-105	541	2	539	0	136.3	18	154.3	38
S-106	612/543*	32	580/511*	0	99.8	162	261.8	58
S-108	670/604*	5	665/599*	0	151.6	105	256.6	46
S-110	692/390*	113	579/277*	0	185.9	103	288.9	90
S-112	673/637*	6	667/631*	0	125.1	112	237.1	41
SX-104	713/614*	169	544/445*	0	113.2	195	308.2	79
TX-102	455/334*	2	453/332*	0	188	4.5	192.5	64
TX-105	609	8	601	0	247.5	0	247.5	48
TX-106	453	123	330-25**	0	134.6	0	134.6	60
TX-110	568/530*	37	531/493*	0	175	0	175	41
TX-111	403	43	327	33	246.9	0	246.9	87
TX-112	649	24	625-89**	0	142.1	0	142.1	31
TX-113	681	183	498	0	233.5	0	233.5	56
TX-114	678/645*	62	616/583*	0	268.8	4	272.8	53
TX-118	347	33	314	0	89.1	0	89.1	38

* Waste Volume Updated

**Waste Volume Adjusted For Ending Liquid Level

Table B-2. Single-Shell Tank Sludge Porosity Database.

TANK NO.	TOTAL WASTE (K gal)	SLUDGE (K gal)	SLTCAKE (K gal)	SUPER-NATANT (K gal)	TOT LIQUID PUMPED (K gal)	PUMPABLE LIQUID REMAIN (K gal)	TOT LIQUID SC/SL (K gal)	POROSITY VALUE %
BX-109	193	193	0	0	12.8*	7.6	15.8	20
BX-112	165	164	0	1	4.1	2.1	6.2	13
C-102	423	423	0	0	14.2	23.6	37.8	12
C-107	275	275	0	0	17.9	18.5	36.4	23
C-110	187	187	0	0	12.4	2	13.9	19
T-111	453	453	0	0	9.6	29.1	38.7	11

* Includes 4.6 Kgal Supernatant

APPENDIX C

POROSITY PROJECTION COMPARISON

This page intentionally left blank.

Table C-1. Salt Cake Porosity Projection Comparison.

Tank#	Supernat * Vol (Kgal)	Sludge * Vol (Kgal)	Saltcake * Vol (Kgal)		PLR @ 35% (kgal)	PLR @ 45% (kgal)	PLR @ 61% (kgal)	Actual * PLR (kg
BX-111	22	32	179		56	65	81	86
BY-101	0	37	402		112	144	195	97
BY-104	11	150	473		158	197	263	341
BY-107	0	117	250		65	82	110	225
BY-110	3	190	315		100	123	165	213
BY-111	0	26	589		177	228	309	341
BY-112	0	26	284		71	91	123	163
S-105	0	2	539		160	205	278	154
TX-102	0	2	453		130	167	226	193
TX-105	0	8	601		181	233	316	248
TX-106	0	123	330		94	119	160	135
TX-110	0	37	531		157	202	274	175
TX-111	33	43	327		119	143	182	247
TX-112	0	24	625		190	244	331	142
TX-113	0	183	498		160	202	272	234
TX-114	0	62	616		187	240	325	273
TX-118	0	33	314		81	104	141	89
				TOTAL =	2196	2789	3752	3356
BY-102**	0	29	388		107	137	186	193
BY-103**	0	9	452		129	166	225	305
BY-109**	0	36	397		110	142	192	161
S-106**	0	32	580		174	224	303	262
S-108**	0	5	665		204	262	355	257
S-110**	0	113	579		180	229	310	289
S-112**	0	6	667		205	263	357	237
SX-104**	0	169	544		174	221	298	314
				TOTAL =	1283	1644	2227	2018
				TOTAL	3479	4433	5979	5374

The 35% porosity value under estimates the actual pumpable liquid volume by 1895 Kgals

The 45% porosity value under estimates the actual pumpable liquid volume by 941 Kgals.

The 61% porosity value over estimates the actual pumpable liquid volume by 605 Kgals

* Supernate, sludge, and salt cake volumes taken from pre-pumping estimates
** Indicates pumping started but not complete
*** Volume of liquid waste in tank before any pumping took place.
Determined by adding the volume of liquid waste removed to the volume of liquid waste estimated to be remaining.

Table C-2. Sludge Tank Porosity Projection Comparison.

Tank #	Supernat * Vol (Kgal)	Sludge * Vol (Kgal)	Saltcake * Vol (Kgal)	PLR @ 12.5%	PLR @ 16%	*Actual* *** *PLR*
BX-109	0	193	0	10	12	20
BX-112	1	164	0	7	9	6
C-102**	3	423	0	41	52	38
C-107**	0	275	0	20	26	36
C-110**	5	187	0	14	16	16
T-111	0	453	0	42	54	40
			TOTALS	134	169	156

The 12.5% sludge porosity under estimates the actual pumpable liquid volume by 22 kgals.

The 16% sludge porosity over estimates the actual pumpable liquid volume by 13 kgals.

* Supernate, sludge, and salt cake volumes taken from pre-pumping estimates
** Indicates pumping started but not complete
*** Volume of liquid waste in tank before any pumping took place.
Determined by adding the volume of liquid waste removed to the volume of liquid waste estimated to be remaining.

APPENDIX D

UNSTABILIZED SINGLE-SHELL TANK LIQUID INVENTORY

This page intentionally left blank.

Table D-1. Unstabilized Single-Shell Tank Liquid Inventory Comparisons.

TANK	TOTAL WASTE (K gal)	SLUDGE (K gal)	SALTCAKE (K gal)	SUPER-NATANT (K gal)	SC-63% SL-16% (K gal)	SC-35%** SL-12.5% (K gal)	SC-45%*** SL-12.5% (K gal)
A-101	953	3	950	0	547	304	390
AX-101	748	13	735	0	411	232	298
BX-106*	46	31	0	15	15	15	15
BY-102*	341	0	341	0	7	7	7
BY-103*	400	9	391	0	137	137	137
BY-105	503	166	337	0	176	132	169
BY-106	642	98	544	0	296	166	213
BY-109*	423	36	387	0	43	43	43
C-102*	423	423	0	0	24	24	24
C-103*	195	62	0	133	133	133	133
C-105	150	150	0	0	6	4	8
C-106	229	197	0	32	45	42	42
C-107*	275	275	0	0	19	19	19
C-110*	187	187	0	0	2	2	2
S-101	427	211	204	12	112	65	90
S-102	549	4	545	0	291	162	208
S-103	248	9	222	17	105	66	79
S-106*	547	32	511	4	168	168	168
S-107	376	212	150	14	80	30	52
S-108*	604	5	599	0	105	105	105
S-109*	568	13	555	0	119	119	119
S-110*	390	113	277	0	103	103	103
S-111*	596	139	447	10	134	134	134
S-112*	637	6	631	0	107	107	107
SX-101	456	403	52	1	47	98	124
SX-102	543	59	484	0	253	127	177
SX-103	652	112	539	1	296	192	211
SX-104*	614	169	445	0	195	195	195
SX-105	683	55	628	0	344	186	238
SX-106	538	6	476	61	309	195	233
T-104	445	442	0	3	55	44	44
T-107	180	171	0	9	18	16	16
T-110	379	376	0	3	45	36	36
U-102	374	43	313	18	163	99	122
U-103	468	32	423	13	228	132	166
U-105	418	32	349	37	205	130	157
U-106	226	26	185	15	80	51	61
U-107	406	90	285	31	162	128	156
U-108	468	26	415	24	233	64	174
U-109	463	48	396	19	217	147	160
U-111	329	26	303	0	139	77	99
TOTALS	18099	4510	13119	472	6172	4235	5034

*Field Data
** Waste Projection Data *** Hanlon Report Data

Table D-2. Unstabilized Single-Shell Tank Liquid Inventory.

TANK	TOTAL WASTE (K gal)	SLUDGE (K gal)	SLTCAKE (K gal)	SUPER-NATANT (K gal)	BASE SC-63% SL-16% (K gal)	FLUSH WATER (K gal)	TOTAL LIQUID to DST's (K gal)
A-101	953	3	950	0	547	142	689
AX-101	748	13	735	0	411	107	518
BX-106*	46	31	0	15	15	4	19
BY-102*	341	0	341	0	7	2	9
BY-103*	400	9	391	0	137	36	173
BY-105	503	166	337	0	176	46	222
BY-106	642	98	544	0	296	77	373
BY-109*	423	36	387	0	43	11	54
C-102*	423	423	0	0	24	6	30
C-103*	195	62	0	133	133	35	168
C-105	150	150	0	0	6	1	7
C-106	229	197	0	32	45	12	57
C-107*	275	275	0	0	19	5	24
C-110*	187	187	0	0	2	1	3
S-101	427	211	204	12	112	29	141
S-102	549	4	545	0	291	76	367
S-103	248	9	222	17	105	27	132
S-106*	547	32	511	4	168	44	212
S-107	376	212	150	14	80	21	101
S-108*	604	5	599	0	105	27	132
S-109*	568	13	555	0	119	31	150
S-110*	390	113	277	0	103	27	130
S-111*	596	139	447	10	134	35	169
S-112*	637	6	631	0	107	28	135
SX-101	456	403	52	1	47	12	59
SX-102	543	59	484	0	253	66	319
SX-103	652	112	539	1	296	77	373
SX-104*	614	169	445	0	195	51	246
SX-105	683	55	628	0	344	89	433
SX-106	538	6	476	61	309	80	389
T-104	445	442	0	3	55	14	70
T-107	180	171	0	9	18	5	23
T-110	379	376	0	3	45	12	56
U-102	374	43	313	18	163	42	206
U-103	468	32	423	13	228	59	287
U-105	418	32	349	37	205	53	258
U-106	226	26	185	15	80	21	100
U-107	406	90	285	31	162	42	205
U-108	468	26	415	24	233	61	294
U-109	463	48	396	19	217	56	273
U-111	329	26	303	0	139	36	175
TOTALS	18099	4510	13119	472	6172	1605	7777

*** Field Data**

APPENDIX E

BREAKDOWN OF COMPLEX/NONCOMPLEX UNSTABILIZED SINGLE-SHELL TANKS

This page intentionally left blank.

Table E-1. Complex/Noncomplex Single-Shell Tanks Requiring Stabilization.

Complex SSTs

East Area Tanks

Tank #	Liquid Volume (Kgal)
C-102 sl	24
C-107 sl	19
C-110 sl	2

East Area Complex Total = 45 Kgal

West Area Tanks

Tank #	Liquid Volume (Kgal)
S-102	282
S-111 *	134
SX-103 *	287
SX-106 *	301
U-103 *	221
U-105 *	200
U-106 *	78
U-107	158
U-111	135

West Area Complex Total = 1796 Kgal

Non-Complexed SSTs

East Area Tanks

Tank #	Liquid Volume (Kgal)
A-101	529
AX-101	398
BX-106 sl	15
BY-102	7
BY-103	137
BY-105	171
BY-106	287
BY-109	43
C-103 sl	133
C-105 sl	6
C-106 sl	45

East Area Non-complex Total = 1771 Kgal

West Area Tanks

Tank #	Liquid Volume (Kgal)
S-101	109
S-103	102
S-106	168
S-107	79
S-108	105
S-109	119
S-110	103
S-112	107
SX-101	47
SX-102	245
SX-104	195
SX-105	333
T-104 sl	55
T-107 sl	18
T-110 sl	45
U-102	159
U-108	227
U-109	210

West Area Non-complex Total = 2426 (Kgal)

East & West Complex Total = 1841 Kgal

East & West Non-complex Total = 4197 Kgal

Total SST Pumpable Liquid Waste = 6038 Kgal

*** = Suspected to be Complex**

This page intentionally left blank.