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Single-Shell Tank Retrieval Sequence and Double-Shell Tank Space Evaluation

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Single-Shell Tank Retrieval Sequence and Double-Shell Tank Space Evaluation

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RPP-8554
Revision 2

Single-Shell Tank Retrieval Sequence and Double-Shell Tank Space Evaluation

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EXECUTIVE SUMMARY

This report proposes an updated single-shell tank (SST) waste retrieval sequence for the *River Protection Project System Plan*, Rev. 2 Target Case, updated for fiscal year (FY) 2003. This report also evaluates two bounding cases that illustrate the range of future double-shell tank (DST) space needs and satisfies the requirements of the *Hanford Federal Facility Agreement and Consent Order* (TPA) Milestones M-45-02L, *Submit Annual Updates to SST Retrieval Sequence Document*; M-46-00J, *Double-Shell Tank Space Evaluation*; and supports M-46-01J, *Concurrence of Additional Tank Acquisition.*

The SST retrieval sequence utilizes the balanced tank selection rationale as outlined in Milestone M-45-02L to establish a proposed order for tank retrieval and retrieval dates projected by computer modeling for SSTs at the Hanford Site. The criteria given in the TPA require a tank retrieval selection rationale based on:

- Maximizing risk reduction through the retrieval of
  - Mobile, long-lived radionuclides
  - Potential airborne contaminants
  - Principle non-radiological hazardous constituents
- In a manner which is sensitive to
  - Waste Treatment Plant (WTP) requirements
  - Infrastructure constraints
- And considering
  - DST space
  - DST waste compatibility.

Existing DST space is limited until the WTP begins operation, and any new DST that might be constructed would not be available until a similar timeframe. Therefore, maximizing risk reduction while staying within the existing tank space is a complex undertaking. This document provides the Office of River Protection's (ORP) current retrieval sequence and working schedule, which meets near-term constraints, fully utilizes the planned WTP processing

capabilities, utilizes additional supplemental treatment capability, and completes the mission by 2028.

Section 5.0 includes the DST space evaluation. For this year, two cases were selected to portray the range of DST space required to support the ORP's current planning approach. The first case meets both the waste treatment and mission completion milestones. The second case meets all interim TPA milestones, along with the overall completion milestones. Both cases employ a balanced risk reduction logic (developed for Revision 1 of this report and described in Appendix C), for selecting the SST retrieval sequence. An initial set of 26 tanks is established for both cases to maximize risk reduction within the available near-term DST space, while setting the stage for successful WTP startup, and future required tank farm closures. For the remaining SSTs, a groundwater risk list per unit volume is generated, with all of the SST farms ordered by groundwater risk ranking. An airborne risk list per unit volume is also generated, with the SST farms ordered by long-term airborne contamination risk ranking. During the course of the retrieval, the Hanford Tank Waste Operations Simulator model selects from each of the two lists the available, highest risk tank farm, accounting for the infrastructure in place. Among those two tank farms, the model then selects the tank that best balances the feed to the high-level waste (HLW) and low-activity waste (LAW) melters, to allow steady or continual operation of the WTP. Once selected, SST retrievals within the farm are timed to occur as space within the DSTs will allow.

The Target Case (Case 1) is a minor update of the *River Protection Project System Plan*, Rev. 2 Target Case. This case assumes tank space savings of approximately 7.3 million gallons are implemented and no new DSTs are built. Waste retrieval facilities and SST farm upgrades are assumed available according to the current baseline schedule. This case uses a longer time to reach full capacity, consistent with U.S. Department of Energy experience at other sites, but still completes processing of both the HLW and LAW waste by December 31, 2028. Additional LAW treatment capacity was provided by the addition of supplemental treatment technologies starting on January 31, 2011, which provide the treatment capacity needed to process all LAW by December 31, 2028. Within the specified assumptions for each of the two cases, WTP pretreatment was used to its full capacity. Some low-curie wastes were routed directly to

Supplemental Treatment, since that waste had previously been treated to remove cesium and strontium.

Case 1 completes SST retrieval by 2026 and meets the 2028 End-of-Waste Processing Milestone (M-62-00) by the addition of supplemental LAW treatment, while still fully utilizing the processing capacity in the WTP. The FY 2003 SST retrieval sequence shows an improvement in risk reduction performance over previous sequence submittals (Figures 4-1 through 4-6).

The TPA Compliant Case (Case 2) completes SST retrieval by 2018 and uses a more aggressive facility ramp-up to the same full capacity treatment rate used in Case 1. Case 2 also assumes that all waste must be pretreated before LAW immobilization by the WTP or treated by Supplemental Treatment.

The TPA Compliant Case (Case 2) meets the interim and final milestones included in TPA Milestone M-45-05, which calls for retrieving all waste from remaining SSTs by September 30, 2018; and M-45-00, which calls for completion of SST closure by 2024. It should be noted that although this case required completion of SST retrieval by 2018, the case was not constrained to meet predecessor target milestones for retrieval or farm closure. In this case, 21 additional DSTs are required to meet Milestone M-45-05 (SST retrieval by September 30, 2018). The first three new DSTs could be required as early as FY 2011.

The waste contained in these 21 additional DSTs contains approximately 11,000 metric tons of waste sodium. Alternatively, the ORP could avoid construction of these tanks by providing increased capacity in either the WTP or additional non-WTP Supplemental Treatment.

Cases 1 and 2 show that Milestone M-62-00 can be met, if the projected WTP capacity and ramp-up of processing rates are achieved, and if adequate supplemental waste processing facilities are provided.

The existing TPA milestones affecting tanks C-104, C-106, S-102, S-103, S-105, S-106, and S-112, are met for individual tank retrieval actions in both projection cases.

This document establishes the groundwork for the upcoming negotiation associated with the SST retrieval schedule milestones (M-45-00C and M-45-06-T20A). The cases illustrated in this

document show that the balanced risk reduction approach outlined in the TPA can be used to produce an SST retrieval sequence that maximizes risk reduction in the near term, provides balanced feed to the WTP to assure its full utilization, and minimizes the construction of new DSTs, while meeting the important overall completion of the treatment mission.

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TERMS

AMS	Articulating Mast System
BBI	Best-Basis Inventory
CH2M HILL	CH2M HILL Hanford Group, Inc.
DOE	U.S. Department of Energy
DST	Double-Shell Tank
FEIS	Final Environmental Impact Statement
FY	Fiscal Year
HLW	High-Level Waste
HTWOS	Hanford Tank Waste Operations Simulator
IMAP	*Integrated Mission Acceleration Plan*
Kgal	Kilogallon (1,000 gallons)
LAW	Low-Activity Waste
LLW	Low-Level Waste
Mgal	Million Gallons
MRS	Mobile Retrieval System
MT	Metric Ton
MTG	Metric Tons of Glass
ORP	Office of River Protection
PUREX	Plutonium-Uranium Extraction Plant
RPP	River Protection Project
SpG	Specific Gravity
SST	Single-Shell Tank
Tri-Party Agreement or TPA	*Hanford Federal Facility Agreement and Consent Order*
TRU	Transuranic
WIPP	Waste Isolation Pilot Plant
WTP	Waste Treatment Plant
TFCOUP	*Tank Farm Contractor Operation and Utilization Plan*

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1.0 INTRODUCTION

This report documents the proposed single-shell tank (SST) waste retrieval sequence for the River Protection Project (RPP), updated for fiscal year (FY) 2003, along with the basis for evaluating future double-shell tank (DST) space needs and waste transfers through FY 2028. The SST retrieval sequence identifies the proposed retrieval order (sequence) and retrieval dates projected by computer modeling for SSTs at the Hanford Site. In addition, the tank selection criteria, rationale, reference retrieval methods, and risk reduction performance are discussed. The DST space evaluation describes the DST utilization for the current U.S. Department of Energy (DOE) technical strategy, along with the potential need to build additional DSTs to meet future SST waste retrieval scenarios. This document presents the results of two projection cases in order to satisfy the requirements of the *Hanford Federal Facility Agreement and Consent Order* (also referred to as the Tri-Party Agreement [TPA]) (Ecology et al. 1996) and its Milestones M-45-02 and M-46-00, and providing the technical foundation for M-46-01 as defined in Figure 1-1.

Figure 1-1. Tri-Party Agreement Milestones M-45-02, M-46-00, and M-46-01.

M-45-02	SUBMIT ANNUAL UPDATES TO SST RETRIEVAL SEQUENCE DOCUMENT. THIS PROVIDES FOR AN ANNUAL UPDATE OF A SST RETRIEVAL SEQUENCE DOCUMENT THAT WILL DEFINE THE TANK RETRIEVAL SEQUENCE, SELECTION CRITERIA AND RATIONALE, REFERENCE RETRIEVAL METHOD(S) FOR EACH TANK, AND THE ESTIMATED RETRIEVAL SCHEDULES. THE RETRIEVAL SEQUENCE DOCUMENT WILL DETAIL RETRIEVAL METHODOLOGIES TO BE EMPLOYED AND ESTIMATED WASTE VOLUMES TO BE GENERATED DURING RETRIEVAL (TO BE TRANSFERRED TO THE DSTs OR OTHER AVAILABLE SAFE STORAGE). THE REPORT WILL ALSO DETAIL TANK SELECTION RATIONALE BASED ON THE PRIMARY OBJECTIVE OF MAXIMIZING RISK REDUCTION THROUGH THE RETRIEVAL OF MOBILE, LONG-LIVED RADIONUCLIDES OR POTENTIAL AIRBORNE CONTAMINANTS AND PRINCIPLE NON RADIOLOGICAL HAZARDOUS CONSTITUENTS IN A MANNER WHICH IS SENSITIVE TO WASTE TREATMENT FACILITY REQUIREMENTS AND INFRASTRUCTURE CONSTRAINTS. THE SEQUENCING WILL ALSO TAKE IN CONSIDERATION DOUBLE-SHELL TANK (DST) SPACE AND DST WASTE COMPATIBILITY WHEN SELECTING THE SST RETRIEVAL SEQUENCE. THE ANNUAL UPDATES WILL BE SUBMITTED TO ECOLOGY FOR APPROVAL AS AGREEMENT PRIMARY DOCUMENTS.	9/30/2000 and annually thereafter.
M-46-00	DOUBLE-SHELL TANK SPACE EVALUATION. A TANK VOLUME PROJECTION REPORT SHALL BE SUBMITTED ON AN ANNUAL BASIS TO ECOLOGY AND EPA. THIS REPORT SHALL INCLUDE DISCUSSIONS COVERING ALL ASSUMPTIONS THAT FORM THE BASIS OF THE PROJECTION. THE REPORT SHALL INCLUDE OR SHALL BE ACCOMPANIED BY DOE'S PLANS FOR ACQUISITION OF ADDITIONAL TANKS BASED ON THE TANK VOLUME PROJECTION.	9/30/1999 and annually thereafter.
M-46-01	CONCURRENCE OF ADDITIONAL TANK ACQUISITION. THE THREE PARTIES SHALL MEET TO ESTABLISH NEW MILESTONES, IF REQUIRED, FOR ACQUISITION OF ADDITIONAL TANKS.	11/30/1999 and annually thereafter.

The two projection cases were considered to provide an evaluation of DST space requirements over a range of schedule and process scenarios. Operating assumptions for the two cases were established in July 2003. Tank retrievals, facility schedules, waste generation reductions, and DST space requirements to meet the 2018 TPA retrieval milestone (Ecology et al. 1996; WHC 1996a; WHC 1996b) are discussed in relation to tank space availability. Assumptions for the two projection cases are provided in Appendix A.

Case 1 (Target Case) completes waste treatment in 2028, and includes tank space options to save approximately 7.3 million gallons (Mgal) of space. Case 1 is not constrained to complete SST retrievals by 2018. Single-shell tank retrieval occurs in a risk-based sequence, within existing DST capacity, at a rate that supports treatment processing. Case 1 is based on the *River Protection Project System Plan*, Rev. 2 Target Case (DOE 2003).

Case 2 (TPA Compliant) is constrained to finish SST retrieval by 2018, completes waste treatment in 2028, and includes tank space options to save approximately 7.3 Mgal of space. New DSTs are assumed to be built as required to achieve this milestone. Single-shell tank retrieval occurs in a risk-based sequence, within existing DST capacity, at a rate that supports treatment processing. Case 2 is also based on DOE (2003). Table 1-1 is a comparison of the main assumptions and results for each projection case.

Both cases use a balanced risk-reduction SST sequence, combined with infrastructure availability and balanced Waste Treatment Plant (WTP) feed constraints. Modeling of the assumptions for Cases 1 and 2 utilizes an estimate of the risk per tank farm, per unit volume. The SST retrieval risk-based sequences were designed using criteria prioritizing highest risk tank farms first while considering DST space and DST waste compatibility. The retrieval sequences considered both airborne and groundwater pathways in evaluating risk rankings for each tank or tank farm. The criteria and logic for these sequences are discussed in Section 3.0. The modeling also incorporated the near-term retrieval activities included in the Tri-Party Agreement Milestone M-45-00A. The relative risks for near-term retrievals included in the sequence modeling are summarized in Table 4-1. A detailed description of the scenarios and defining assumptions can be found in Appendices A and B, and in the *Tank Farm Contractor Operation and Utilization Plan, Rev. 4B* (TFCOUP) (Numatec 2003).

Table 1-1. Summary of DST Space Use Projections (Assumptions and Results).*

	Case 1 Target Case	Case 2 TPA Compliant
Brief description	Balanced Risk-based SST Retrieval within Existing DST Capacity Waste feed delivery and treatment match the RPP System Plan, Rev. 2 Target Case (DOE 2003). Process low cesium waste through non-WTP supplemental LAW treatment facility.	Balanced Risk-based SST Retrieval completed to meet 09/30/2018 TPA Milestone Waste feed delivery and treatment assumes an increase in effective pretreatment capacity provided by either expansion of WTP or provided as part of supplemental treatment. All tank waste for supplemental treatment will be pretreated to remove radionuclides before immobilization and disposal
DST space-saving options incorporated	Approximately 7.3 Mgal	Approximately 7.3 Mgal
LAW vitrification ramp-up	From - To MTG/day 03/01/10 - 01/31/11 3.4 02/01/11 - 12/31/11 18.0 01/01/12 - 12/31/12 24.0 01/01/13 - 12/31/28 28.8	From - To MTG/day 03/01/ 0 - 01/31/11 3.4 02/01/ 1 - 12/31/28 28.8
Supplemental LAW processing ramp-up	From - To MT Na/yr (net) 01/31/11 - 12/31/28 (2840-LAW Vit rate)	From - To MT Na/yr (net) 01/31/ 1 - 12/31/28 (3000-LAW Vit rate)
Complete waste treatment	By 12/31/2028	By 12/31/2028
ILAW Na_2O loading	Based on the Gimpel Rule	Based on the Gimpel Rule
TRU treatment start	10/28/2004	10/28/2004
HLW vitrification ramp-up	From - To MTG/d (net) 05/17/10 - 01/31/11 0.69 02/01/11 - 12/31/11 3.0 01/01/12 - 12/31/12 4.0 01/01/13 - 12/31/28 5.0	From - To MTG/d (net) 05/17/ 0 - 01/31/11 0.69 02/01/ 1 - 12/31/28 5.0
SST retrieval Complete retrieval Wastes evaporated	To support completion of waste processing by end of 2028 and as DST space allows. Until start of WTP	Complete by 09/30/2018. Until 2018
Maximum number of simultaneous retrievals	7	Not Restricted
Number of additional DSTs required beyond the existing 28 tanks	None	21

* Differences in assumptions among the projection cases have been highlighted.

DOE 2003, *River Protection Project System Plan*, ORP-11242, Rev. 2, U. S. Department of Energy, Office of River Projection, Richland, Washington.

Notes:

DST = double-shell tank.
HLW = high-level waste.
ILAW = immobilized low-activity waste.
LAW = low-activity waste.
Mgal = million gallons.
MTG = metric tons of glass.
Na = sodium.
RPP = River Protection Project.
SST = single-shell tank.
TPA = Tri-Party Agreement.
TRU = transuranic.
WTP = Waste Treatment Plant.

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2.0 METHODOLOGY FOR EVALUATING DOUBLE-SHELL TANK SPACE REQUIREMENTS

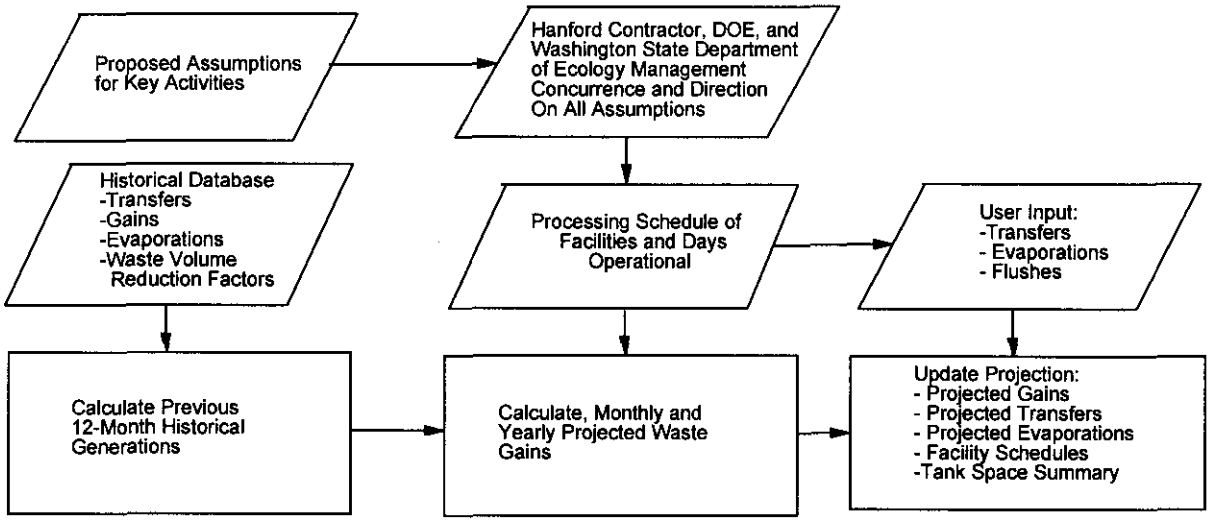
Completion of the RPP mission is dependent upon the availability and efficient use of DST space. The DST space evaluation process projects the DST space utilization, based on specific assumptions for the generation of wastes, the composition of wastes, and the operation of tank farms and waste processing facilities. Two projection cases are considered to provide an evaluation of DST space requirements over a range of schedule and process scenarios. The assumptions for these two cases capture the engineering inputs or bases supplied by the facilities, based on their future operational plans (determined by Tri-Party Agreement milestones, DOE directives, budget, etc.). The Hanford Tank Waste Operations Simulator (HTWOS) model is used to simulate the operation of the tank farm system within the constraints of the assumptions for the two cases.

The remaining principal activities contributing waste volume to the DST system are interim stabilization and retrieval of wastes in SSTs. The projected waste volumes received from interim stabilization are reviewed annually and are incorporated into all DST space evaluation cases. A balanced risk-based priority for the retrieval of waste from the SSTs has been adopted as a result of changes to the Tri-Party Agreement negotiated in August 2000 (Milestone M-45-02) (see Figure 1-1). The process for developing the SST retrieval sequence with the resulting schedule and projected waste volumes are provided in Section 3.0. The balanced risk-based SST retrieval sequence is incorporated into all DST space evaluation cases. An earlier SST strategy to retrieve low-volume tanks first was evaluated in Revision 1 of this document.

2.1 PROCESS DESCRIPTION

The work process for updating the DST space evaluation is shown in Figure 2-1. New assumptions based on current planning are proposed for key activities, then reviewed with stakeholders to obtain concurrence. After concurrence is obtained, the new assumptions are used to establish the processing schedules for various facilities. The processing schedules are then used along with user input for near-term operations to identify needed transfers, to plan for waste evaporation, and to estimate flush water quantities. In parallel, the database of historical transfer data is updated to include operations performed within the last twelve months. The updated historical data are used with the processing schedule data to project monthly and yearly waste volume gains to the DST system. The projected waste gains are combined with the transfer plans to project the DST space demand as a function of time.

Figure 2-1. Methodology of Waste Volume Projection.



Waste composition data are used to calculate the waste volume reduction factors and to determine waste segregation requirements (based on of chemical, radionuclide, or heat content) as part of identifying needed transfers, planning for waste evaporation, and estimating flush water quantities. The waste volume reduction factor (Cruzen et al. 1988) is defined as the percent of water (by volume) that can be removed from a waste stream by evaporation for storage.

The DST space evaluation utilizes outputs from the HTWOS, which incorporates the case-specific assumptions and is designed to model the actual activities within the tank farms. The waste transfers into the DST system begin with the waste being sent to a dilute receiver tank. The contents are then sampled (sampling and analysis require 90 days), and transferred to the 242-A Evaporator feed tank (Tank AW-102) for evaporation. After dilute waste is concentrated in the 242-A Evaporator, it is sent to a slurry receiver tank (Tank AW-106) as double-shell slurry feed and then transferred to another DST for storage. The concentrated waste will be eventually treated for disposal through the WTP.

The high-level waste (HLW) fraction will be processed at the WTP, immobilizing the HLW fraction into a glass matrix for disposal. It is anticipated that the separation of tank waste will generate a LAW supernate stream that may be pretreated to remove radionuclides, and later sent to LAW vitrification for immobilization and final disposal.

Two cases were defined for this years' projection through the discussions with the stakeholders identified in Figure 2-1. Both projection cases assume that supplemental treatment facilities will be added to support LAW waste treatment in parallel to the LAW treatment capacity currently planned for the WTP. In Case 1, portions of the waste sent to the WTP undergo supplemental LAW treatment processes; some of the low-cesium SST wastes are retrieved to a new facility

(bypassing the DSTs), where they are immobilized without pretreatment; and TRU solids are retrieved, dried, and packaged for shipment to the Waste Isolation Pilot Plant (WIPP). Within the WTP, the pretreatment process and LAW melter are operated at their capacities, with the pretreatment system being operated at a higher sodium processing rate than the LAW melter. The excess pretreated sodium not incorporated into LAW glass is treated by a supplemental treatment process.

In Case 2, portions of the waste sent to the WTP undergo supplemental LAW treatment processes; some of the SST wastes are retrieved to a new facility (bypassing the DSTs), where they are pretreated and immobilized, with the separated radionuclides being incorporated into the HLW glass; and TRU solids are retrieved, dried, and packaged for shipment to WIPP. As was done in Case 1, the pretreatment process and LAW melter are operated at their capacities, with the pretreatment system being operated at a higher sodium processing rate than the LAW melter. Both the sodium processing rate and the LAW vitrification rate are higher for Case 2 than for Case 1 (see Table A-1). The excess pretreated sodium not incorporated into LAW glass is treated by a supplemental treatment process. For Case 2, all of the pretreatment capability available in the WTP is utilized before implementing pretreatment in the supplemental treatment facility that receives waste directly from the SSTs.

2.2 MODELING ASSUMPTIONS

Section 2.2.1 describes the HTWOS model. Section 2.2.2 describes the tank spare-space allocations required by DOE Order 435.1, *Radioactive Waste Management*.

2.2.1 Model Description

The HTWOS model is a computerized dynamic simulation that models the operation of the tank farm systems in the 200 East and 200 West Areas. The HTWOS model simulates feed retrieval and staging activities for each projection case providing a common assumption basis for all activities, as well as accounting for operational conflicts. Tank farm operational constraints and physical equipment capacities are modeled. The average treatment capacity and production schedule for the WTP are also modeled. The model provides an integrated, life-cycle model of the performance of the RPP mission as planned.

The HTWOS model is a chemical/radionuclide, component-based model that maintains a mass balance of liquid and solid components in tanks as waste is moved through the system. The original inventory is derived from the best-basis inventory (BBI) maintained by CH2M HILL. The HTWOS model predicts waste transfers, using partitioning factors to predict the composition of the waste as it is retrieved from the tanks and delivered to the waste treatment facility. It also applies glass-formulation rules to predict the amount and composition of glass product produced. The availability and capacities for various systems and processes can be set to determine a processing schedule for waste retrieval and treatment. A more detailed description of the HTWOS modeling assumptions and the BBI can be found in Appendix B.

2.2.2 Tank Spare-Space and Emergency Space Allocations

DOE Order 435.1 requires that emergency space be reserved to store waste in case a leak should occur in a DST or any HLW facility. In compliance with DOE Order 435.1, emergency space of approximately 4,542 m^3 (1.2 Mgal), was reserved to store waste in case of a leak in a DST. The WTP emergency return space is considered as part of the emergency space allocation. A total of 4,542 m^3 (1.2 Mgal) of space has been reserved for emergency, WTP emergency return, and contingency space.

Due to accelerated SST waste retrieval plans, it will not be possible to keep one single tank empty for spare space. The plan is to maintain 1.2 Mgal of distributed spare space available at all times. Currently, Tank AP-108 is the selected designated receiver tank for emergency transfers for all DSTs (Reberger 2003). However, other multiple tanks will be utilized for emergency pumping if Tank AP-108 is full. This emergency pumping will be done in accordance to the *Double-Shell Tank Emergency Pumping Guide* (Reberger 2003). Alternatively, if Tank AP-108 is full, the contents could be emptied to either the evaporator feed tank or another receiver tank.

3.0 SINGLE-SHELL TANK RETRIEVAL SEQUENCE

3.1 TANK SELECTION CRITERIA AND RATIONALE

The Milestone M-45-02L requires that the SST retrieval sequence selection be based on an approach that maximizes risk reduction while being sensitive to WTP and infrastructure requirements and considering DST space and waste compatibility. For FY 2003, a composite measure of tank relative risk for both airborne and groundwater contamination was used to sort the SSTs. In addition, infrastructure issues, the need to provide balanced LAW and HLW feeds to the WTP, DST space, and waste compatibility were factored into the retrieval prioritization process. The SSTs with specified Tri-Party Agreement retrieval and closure milestones were prioritized to assure that the milestone dates were achieved.

The FY 2003 relative risk ranking employs the same logic as used in FY 2002. The risk rankings are the same for Cases 1 and 2; however, the retrieval sequence may differ between these two cases. This is because the cases differ in waste treatment rates, causing differences in retrieval timing. If the timing differs, tank retrieval can be affected by adjusting the timing of upgrades and outages, which impact the ability to transfer waste.

3.1.1 Technical Approach

Currently, there is not full agreement on tank waste risk assessment methodology, risk assessment scenarios, and related land use; as a result no generally accepted quantitative risk values that might result from various SST retrieval sequences is available. In general, the risk to the environment posed by the tank waste is a long-term issue. The difference in quantitative risk over the next 10,000 years between a tank retrieved in 2004 and the same tank retrieved in 2018 is not significant. What is significant is that waste which has already leaked into the environment and the extent of retrieval for any given tank. These quantitative considerations are being addressed in the closure planning risk assessment and the upcoming closure environmental impact statement. As these efforts progress, the additional quantitative risk information will be incorporated into the model for use in future revisions of this document.

The FY 2003 revision of this document continues with relative risk reduction of various retrieval sequences, based on unit risk factors. While the relative risk reduction does show differences between retrieval scenarios, the extent to which this risk reduction is meaningful remains uncertain, pending completion and acceptance of the ongoing risk assessment activities discussed earlier.

The relative risk ranking for SSTs was developed using risk factors from the *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (FEIS), DOE/EIS-0189, Volume 3, Appendix D "Anticipated Risk" to approximate the human health and environmental impacts of exposure to certain chemicals and radionuclides. Reduction in the long-term risk of unretrieved waste to the public and the environment was the major concern in formulating the relative risk ranking used in developing the current retrieval sequence. Three risk parameters are included in the risk-based evaluation of the SSTs. These parameters are groundwater, airborne, and chemical risk. There are two types of long-term risk concerns that are incorporated into HTWOS modeling: (1) protection of the groundwater and

(2) protection from airborne contamination. Within the FEIS, four exposure scenarios are applicable for the calculation of both the groundwater and the chemical risks. These scenarios pertain to the different ways that a person might be exposed to hazardous tank waste. The scenarios are labeled Industrial, Native American, Recreational Shore Line User and Land User, and Residential Farmer. Each scenario has a different factor for each analyte based on alternative pathways for human interaction. A comparison of the tank rankings using each of the four scenarios showed that although there may be some minor shuffling of tanks, there was no significant difference in the sequence using any particular scenario when considering all factors in tank prioritization.

The Industrial scenario was chosen for groundwater and chemical risk ranking because it was determined to be the most likely end-use scenario for 200 Area Plateau facilities. The Industrial scenario involves mainly indoor activities that include consumption of groundwater, although outdoor activities (e.g., soil contact) are included. The groundwater radionuclide and chemical unit risk factors used in ranking apply only to the water ingestion and absorption components of the scenario.

The airborne contamination risk factors are based on a fifth scenario – that of an intruder dose, which assumes that a person drills into the top of a tank. Two subsets of this scenario, driller and post-driller, are available for calculation. The post-driller subset was used because of the number of people involved and the time span concerned. The post-well drilling resident lives on land over which exhumed waste has been spread, grows vegetables on it, consumes some of the vegetables, ingests small amounts of contaminated soil each day, inhales suspended radionuclides, and has external exposure. In this scenario, the dominant pathway for the isotopes of concern is inhalation and external dose, which are components of airborne exposure (Rittman 1994).

The risk factors used to calculate the airborne, groundwater, and chemical risks are found in Tables D.2.1.21, D.2.1.23, and D.7.3.1 of the FEIS. These factors, along with sample calculations, are listed in Appendix C of this document.

3.1.2 Risk Parameters

The contaminants of concern for groundwater protection are long-lived, mobile radionuclides and mobile, non-carcinogenic chemicals. According to results documented in the FEIS, these contaminants are carbon-14, selenium-79, technetium-99, iodine-129, and uranium-238 for mobile radionuclides with very long half-lives; and nitrate, nitrite, and chromium for mobile, non-carcinogenic chemicals. These radionuclides and chemicals are found primarily in the saltcake tanks. The waste in the saltcake tanks often looks and acts very much like coarse table salt exposed to moisture (i.e., the waste dissolves easily in liquids and moves with the water). A simplifying assumption is made that 100% of the chemicals and radionuclides listed above are mobile. When more information becomes available, this assumption can be modified.

The contaminants of concern for airborne contamination are the long-lived, alpha-emitting radioactive elements, primarily plutonium. These materials are found predominantly in the sludge tanks. Sludge, which contains most of the metals, often looks like fine mud and dries very hard. Sludge tends to be insoluble in most liquids.

The information in the July 1, 2002, BBI (the primary source for inventory data) and supplemental adjustments for historical transfers through May 2003 and updated waste volume projections (see Appendix B for more information on the BBI), was modified to reflect a post-saltwell-pumping liquid inventory to account for a decrease in tank risk after the removal of saltwell liquor. Modifying the data in this way reflects the as-retrieved inventory situation. Using the modified inventory, airborne, groundwater, and chemical relative risk values were calculated for each tank. Two separate lists ordering the tank farms by decreasing airborne and groundwater risk value per unit volume of waste became the basis for sequencing the SST waste retrievals for FY 2007 and beyond, using the HTWOS model. Appendix B details the use of and background information on the HTWOS model.

3.1.2.1 Relative Groundwater Risk

The analytes used to calculate the groundwater relative risk comprise mobile, long-lived radionuclides, specifically carbon-14, selenium-79, technetium-99, iodine-129, and uranium-238. The relative groundwater risk from a particular radionuclide is calculated as the product of the analyte activity and its associated risk factor. The relative overall tank farm risk is based on the total activity per unit volume of waste for each tank farm.

3.1.2.2 Relative Airborne Risk

Airborne relative risk is calculated similarly to the groundwater risk (i.e., the product of the analyte activity and its associated risk factor). The analytes used to calculate the airborne risk comprise uranium and TRU and other isotopes, specifically americium, curium, niobium, neptunium, plutonium, tin, thorium, and uranium-238. The relative overall tank farm risk is based on the total activity per unit volume of waste for each tank farm.

3.1.2.3 Relative Chemical Risk

The analytes used to determine the relative chemical risk are NO_2^-, NO_3^-, and CrO_4^{-2}. The risk for each analyte is calculated by multiplying its weight inventory per unit volume of waste by a specific risk factor. The overall relative risk for a tank is calculated by summing the relative risks for each analyte. The chemical risk results are displayed for informational purposes and are not used for prioritizing tank retrievals. As in the case of groundwater risk, the chemical risk ranking is relative. Chemical risk factors are given in units of g/mL in groundwater, with the ranking determined by the product of the risk factor and the entire tank farm inventory.

3.1.3 Risk Reduction Performance Criteria and Assumptions

The FY 2003 SST retrieval sequence shows an improvement on risk reduction performance over previous sequence submittals. The performance improvement was derived from the prioritization of early tank retrievals to meet Tri-Party Agreement milestones, optimizing DST space utilization, and improved WTP treatment capacities. Processing of all SST and DST waste by 2028 is required for Cases 1 and 2. A full discussion of risk reduction performance is provided in Section 4.0.

3.1.4 Tank Selection Basis

For both Cases 1 and 2, an SST retrieval sequence was developed with a primary objective of maximizing risk reduction while incorporating the goal of tank farm closures. Two ranking lists were prepared based on the risk posed by each tank farm, based on either airborne or groundwater risk per unit volume of waste. The model subsequently chooses which tank to retrieve based on the priority of the tank farm. However, other constraints, such as the number of simultaneous retrievals allowed in a tank farm and the requirement that the WTP feed to the HLW and LAW melters are balanced, may drive the model to select a tank from a different tank farm. This is the same risk basis used to determine SST retrieval sequences for Cases 3 and 3b in FY 2002 (RPP-8554, Rev. 1). The logic employed to determine the final SST retrieval sequence for both cases is explained in Sections 3.1.5 and 3.1.6.

3.1.5 Logic to Select Early Retrieval Tanks

The logic to select the early SSTs for retrieval is based on the requirements of Tri-Party Agreement Milestone M-45-02L. Seven tanks (C-104, C-106, S-102, S-103, S-105, S-106, and S-112) were chosen because previous evaluations identified these tanks as higher risk and; therefore, Tri-Party Agreement milestones were established for their retrieval. Eight tanks were selected to continue retrieval of SSTs to fit within existing DST space and to provide WTP feed (C-201, C-202, C-203, C-204, U-201, U-202, U-203, and U-204). Eleven tanks were retrieved for TRU or Low-Level Waste (LLW) Packaging (T-104, T-110, T-111, T-201, T-202, T-203, T-204, B-201, B-202, B-203, and B-204). These tanks require little or no DST space. Selection of these 26 tanks allows progress on SST retrieval while being consistent with the Milestone M-45-02L objective of maximizing risk reduction, considering WTP requirements, infrastructure, DST space and waste compatibility.

3.1.6 Tank Selection Logic

Two ranking lists were prepared based on the risk posed by each tank farm, based on either airborne or groundwater risk per unit volume of waste. The model subsequently chooses which tank to retrieve based on the priority of the tank farm. The logic used to sequence tanks using both the airborne and groundwater risk ranking lists are provided below, and are illustrated in Figure 3-1:

1. Use two lists, ranking tank farms by decreasing groundwater and airborne risk.

2. Waste may be retrieved simultaneously from up to seven tanks for Case 1. Limitations on simultaneous transfers from specific tank farms or quadrants are given in Table A-1. These limits are removed for Case 2 to enable all 149 SSTs to be retrieved by 2018.

3. Waste from multiple SSTs will be mixed in the staging tanks to increase incidental blending.

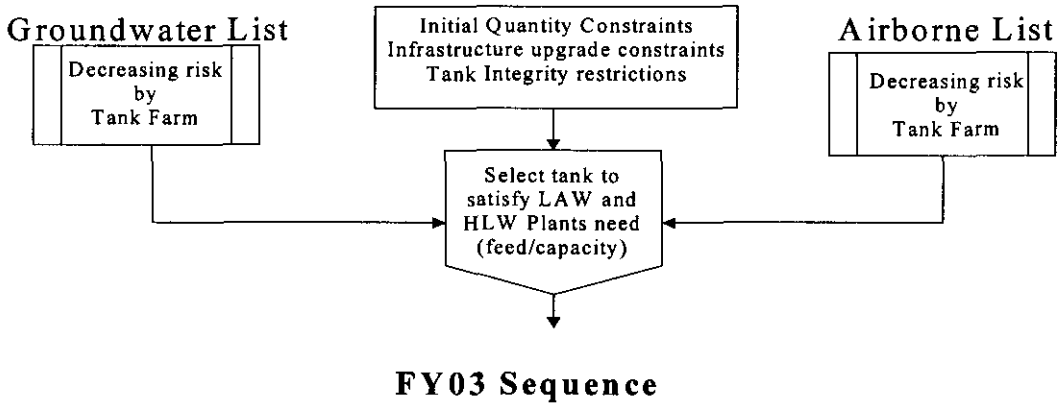
In each list, the HTWOS model selects the first available tank (availability is determined by factors such as project date constraints and infrastructure requirements). The model then chooses one tank between the two using one additional selection criterion. This selection criterion

incorporates a balance between retrieval of sludge (HLW tanks) and retrieval of saltcake (LAW tanks). The HTWOS model preferentially chooses the tank that will bring the ratio of

$$\frac{\text{cumulative projected LAW glass fraction}}{\text{cumulative projected HLW glass fraction}}$$

closest to 0.5. Maintaining this ratio near 0.5 prevents process outages in the LAW and HLW vitrification facilities through the balance of mission. This ratio is based on previous HTWOS modeling scenarios. Preferential retrieval was given to the projected HLW glass fraction to prevent significant outages in the HLW melter. The improvement achieved by implementing retrieval balancing was evaluated and described in Table 4-7 of the FY 2002 report (RPP-8554, Rev. 1).

Figure 3-1. Logic Used for Tank Selection.



3.2 SINGLE-SHELL TANK WASTE RETRIEVAL AND TRANSFER SYSTEM

3.2.1 Single-Shell Tank Farm Background

The SST farms consist of 149 tanks grouped in 12 tank farms (six in the 200 East Area and six in the 200 West Area). To retrieve waste from the SSTs, a waste transport system and receiver must be available within the pumping constraints of the SST transfer system. Some of the SST farms are in close proximity to DST farms and; therefore, waste from these SSTs can be retrieved directly into available DSTs. For retrieving waste from the remote SST farms, the current plan requires the construction of interim receiver facilities, referred to as waste receiver facilities, to stage the waste for transport to the DST system. The current waste receiver strategy is summarized in Table 3-1. The SST waste transfer plan is depicted graphically in Figure 3-2.

Table 3-1. Designated Receivers and Quadrants of Single-Shell Tank Farms.

Quadrant	Designated Receiver	Single-Shell Tank Farms
NW	NW WRF (six 570-m^3 [150,000-gal] tanks)	T, TX
	SY Tank Farm (modeled as SY-102)	TY
NE	NE WRF (six 570-m^3 [150,000-gal] tanks)	B, BX, BY
SW	SY Tank Farm (modeled as SY-102)	SX
	SW WRF (two 570-m^3 [150,000-gal] tanks)	U
	SY Tank Farm (modeled as SY-101)	S
SE	Tank AY-102, Tank AY-101	A, AX, C

Notes:

NE = Northeast.
NW = Northwest.
SE = Southeast.
SW = Southwest.
WRF = Waste Receiver Facility.

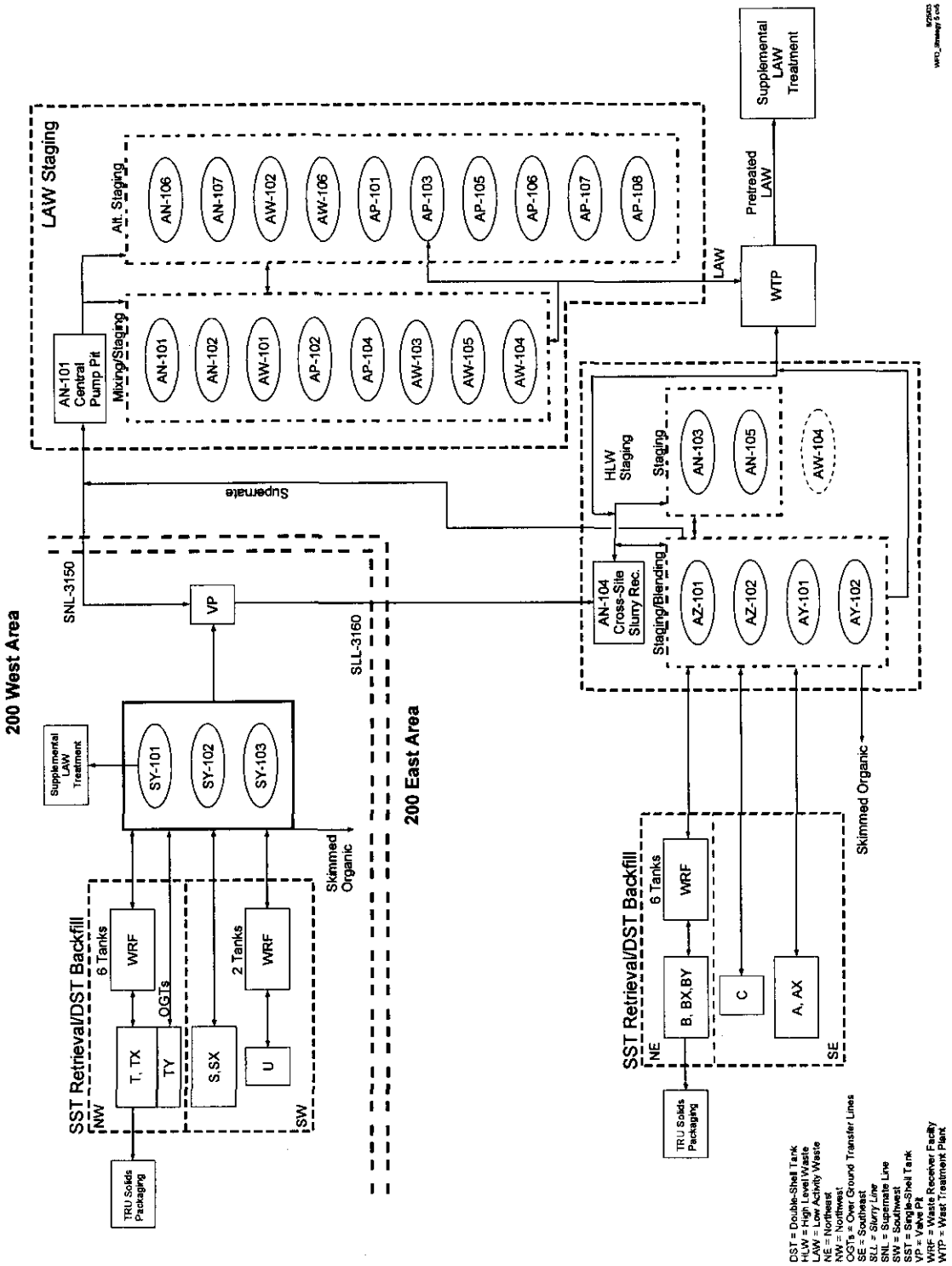
3.2.2 Retrieval Technologies

The SST Retrieval Program, and its predecessor organizations, have reviewed and evaluated numerous technologies for potential application to retrieve SST waste (RPP-6947, *Hanford Tank Initiative/Acquire Commercial Technology for Retrieval Report and Database*). Of the many systems and potential configuration options evaluated, the only system with recent experience in retrieval of SSTs is the traditional approach, "past-practice sluicing." This system, last applied in the retrieval of Tank C-106 in FY 1999, has been modified for the retrieval of S-112, S-102, and other tanks.

To evaluate the potential for cost and/or performance improvements, the program has elected to test and deploy several alternative technologies in "near-term" retrieval applications committed to in Milestone M-45-00A of the Tri-Party Agreement. Sections 3.2.2.1 through 3.2.2.4 are brief descriptions of the modified sluicing system and the alternative technology systems that are scheduled for deployment in the early SSTs planned as retrieval or technology demonstration projects under the Milestone M-45-00C negotiated agreement and low-volume 200-series tanks.

The current HTWOS model applies specific assumptions for the length of retrieval for each of the first 26 SSTs according to the type of retrieval technology used. The technologies assumed to be employed are those described below. Retrieval rates for the remaining SSTs are the same as used in the TFCOUP (Numatec 2002).

Figure 3-2. Single-Shell Tank Waste Transfer Plan for the Case 1.



3.2.2.1 Modified Sluicing

Modified sluicing is the introduction of a liquid, typically recycled supernatant or water, through a nozzle(s) at moderate pressures and volumes, into the waste matrix to dissolve or break apart and suspend the solids materials into the sluicing fluid for subsequent transport out of the tank. The sluicing liquid is introduced through a nozzle or nozzles inserted through risers on the perimeter of the tank. The slurry is retrieved from the tank by a pump that is lowered through an available riser near the center of the tank. Controlled addition of the solvent and coordinated removal of the liquid is planned to minimize the volume of liquid present in the tank and to reduce the potential for leakage. A similar system proved effective in the retrieval of Tank C-106, retrieving an estimated 97% of the solids in the tank (RPP-6696, *Data to Support C-106 Waste Retrieval Determination*). Modifications to this system are expected to improve retrieval performance and reduce the potential for leakage.

The retrieval rate algorithms for sluicing are given in Table A-35 of the TFCOUP (Numatec 2002).

3.2.2.2 Mobile Retrieval System

Sludge or mixed saltcake and sludge waste retrieval can be accomplished by installing a centrally located articulating mast system (AMS) in the tank and, through a separate riser, a small (sometimes collapsible) remote-operated tracked in-tank vehicle (crawler). In a mobile retrieval system (MRS) approach, fluid may be added to the waste in the immediate vicinity of the pump or vacuum removal device (which may be mounted on the crawler or on the articulated mast.) The system is operated to remove the resulting waste slurry out of the tank at a rate determined to minimize free-liquid accumulation. This approach reduces the amount of freestanding liquids in the tank and thereby reduces the potential for leaks during retrieval. In the most common applications, the vehicle also serves as a platform to mount other tools that can be used to dislodge compacted wastes or wastes adhering to sidewalls or appendages. For the SST application, the sluicing fluid may be supernatant or water. The articulated mast was added to the system design to enhance system effectiveness and flexibility as a result of lessons learned at Oak Ridge National Laboratory during the retrieval of the Gunite Tanks. This method currently is planned for use in Tank C-104 (HNF-2944).

The Crawler System (or in-tank vehicle) contains a slurry pump that operates at an average retrieval rate of 40 gpm of slurry containing 30 volume % solids (Crass 2000). Dilution water is added outside the tank to dilute the slurry to 10 wt% solids, making it suitable for transfer. When the volume of waste in the tank falls below 50,000 gal, the transfer rate decreases. The retrieval rate algorithms for the MRS are given in Table A-35 of the TFCOUP (Numatec 2002).

3.2.2.3 Vacuum System

A vacuum system will be used as the waste retrieval approach for all of the 200-series tanks. The vacuum is introduced to the tank waste by means of an AMS that has a horizontal reach of 15 feet and rotational capabilities of 360 degrees. This system is identical to the AMS and vacuum system design for Tank C-104 and used in the MRS design.

Air is mixed at the 3-inch suction port of the AMS enabling the required vertical lift of the waste to the topside receiver tank. The AMS is 33 feet in length in the retracted position, and can extend to greater than 40 feet in length. It will be deployed through and attached to standard 12-inch riser flanges that are available in all of the 200-series tanks. In addition, 4-inch risers are available for in-tank camera viewing and control of the AMS.

The retrieval rate algorithms for Vacuum System operations are given in *Hanford Tank Waste Operations Simulator (HTWOS) Model Run Results for the Propose Baseline Change Request (BCR) Case* (RPP-15588). When the vacuum system is applied to TRU tanks (T-200s and B-200s) the TRU Packaging system is rate-limiting, which therefore determines the retrieval rate.

3.2.3 Infrastructure Requirements

Infrastructure requirements are also used to establish the tank retrieval sequence. The HTWOS model takes into account the availability of infrastructure according to established and planned tank farm projects. For the timeframe beyond these projects, the infrastructure is assumed to be available. The model projections predict when retrievals will be needed, allowing projects to be planned to provide infrastructure by the need dates.

The following types of infrastructure hardware are required to functionally support pumping of solutions/slurries from SSTs.

- Tank-related retrieval systems:
  - In-tank hardware and support systems;
  - Monitoring and control systems for leak detection, mitigation, and retrieval control;
  - Jumper/pit upgrades, confinement systems, maintenance features; and
  - In-farm piping to waste receiver DSTs (including waste receiver facilities).
- Waste receiver facilities:
  - Facility features including instrumentation, control systems, ventilation, and personnel features.
- New transfer lines (temporary aboveground lines or newly installed lines):
  - Connections from SST farms to DSTs or waste receiver facilities; and
  - Connections from waste receiver facilities to DST receivers.

3.2.4 Tank Integrity

Issues regarding tank integrity, such as reliability of liners, thermal cycling, and interim stabilization, are being investigated. Sixty-seven of the SSTs are known or suspected to have leaked. All of the SSTs have exceeded their original design lives and continue to degrade. Tank

integrity is being addressed through routine measurements of surface levels, interstitial liquid levels, liquid observation wells in selected tanks, tank dome surveys, and in-tank video inspections. Efforts are underway through the Interim Stabilization Program to remove all of the pumpable liquids from the SSTs to minimize the potential for leakage losses to the vadose zone. Interim Stabilization Program saltwell pumping activities are planned for completion by the end of FY 2004 under the terms and conditions of the Interim Stabilization Consent Decree (Ecology/DOE 1999).

3.3 SINGLE-SHELL TANK RETRIEVAL SEQUENCE DESCRIPTION AND SCHEDULE

3.3.1 Retrieval Sequence and Schedule

The HTWOS model is used to develop the SST retrieval sequence and predict the dates when SST retrievals are completed. The selection of the SST retrieval sequence is based on the logic provided in Sections 3.1.4, 3.1.5, and 3.1.6.

In 2010, WTP operations phase is initiated. The effective production capacity of the HLW and LAW glass plants are assumed to ramp-up from 2010 through 2013. On March 1, 2010, it is assumed that the LAW melters will have a total operating capacity of 3.4 metric tons of glass (MTG) per day, and the HLW melters will have a total operating capacity of 0.69 metric tons (MT)/day. By January of 2013, it is assumed that the LAW melters will have ramped up to a total operating capacity of 28.8 MTG/day, and the HLW melters will have ramped up to a total operating capacity of 5.0 MT/day.

Under these constraints, SST waste retrieval is projected to be completed in FY 2026. Processing of both LAW and HLW is projected to be completed in 2028 for Case 1. The projected retrieval sequence and timing for this scenario are presented in Figure 3-3. The SST waste retrieval data associated with Figure 3-3, including the timing, duration, and quantity of waste retrieved, are presented in Table 3-2.

Retrieval sequence and schedule for Case 2 are presented in Table 3-3. Under Case 2, SST waste retrieval is completed in FY 2018. Processing of both LAW and HLW is projected to be completed in 2028.

The first 34 tanks sequenced are the same in both Case 1 and Case 2. Time differences in the Case 2 sequence are driven by the availability of additional DST space, WTP requirements for balanced LAW and HLW feed, and reduced SST retrieval infrastructure constraints.

Table 3-2. Single-Shell Tank Retrieval/Case 1 Sequence Data. (4 Sheets)

Tank	Retrieval Start Date	Retrieval Duration (days)	Retrieval End Date	Retrieved Liquid Vol. (gal)	Retrieved Solids Vol. (gal)	Total Retrieved Vol. (gal)	Groundwater Risk Ranking	Airborne Risk Ranking
C-106	3/25/2003	221	11/1/2003	168,117	1,783	169,900	127	66
S-112	9/20/2003	78	12/7/2003	1,995,047	4,853	1,999,900	21	29
C-201	12/2/2003	1	12/3/2003	9,549	351	9,900	148	107
C-202	12/12/2003	1	12/13/2003	9,552	349	9,900	147	119
S-102	12/19/2003	90	3/18/2004	2,091,480	8,420	2,099,900	40	70
C-203	12/22/2003	2	12/24/2003	29,215	685	29,900	144	128
C-204	12/29/2003	2	12/31/2003	29,457	443	29,900	145	146
T-201	9/25/2004	10	10/5/2004	27,929	2,971	30,900	141	103
T-202	10/6/2004	7	10/13/2004	19,790	1,111	20,900	143	131
T-203	10/13/2004	17	10/30/2004	34,955	1,946	36,900	142	124
B-201	10/28/2004	10	11/7/2004	26,205	3,695	29,900	139	100
T-204	11/1/2004	12	11/13/2004	34,669	2,232	36,900	138	130
B-202	11/27/2004	10	12/7/2004	27,166	1,734	28,900	135	126
S-105	12/1/2004	287	9/14/2005	1,888,856	1,044	1,889,900	25	38
B-203	12/27/2004	18	1/14/2005	48,714	3,186	51,900	136	120
T-111	1/9/2005	184	7/12/2005	499,974	29,926	529,900	72	62
B-204	1/26/2005	17	2/12/2005	48,003	2,897	50,900	137	117
S-103	2/1/2005	192	8/12/2005	1,326,617	3,283	1,329,900	34	64
S-106	2/17/2005	311	12/25/2005	2,054,417	5,483	2,059,900	22	97
T-110	5/1/2005	220	12/7/2005	336,832	13,907	350,739	110	109
C-104	10/3/2005	185	4/6/2006	736,736	58,898	795,634	2	2
U-201	11/8/2005	1	11/9/2005	39,161	739	39,900	134	148
U-202	11/18/2005	1	11/19/2005	29,277	623	29,900	146	147
U-203	11/28/2005	1	11/29/2005	29,386	514	29,900	149	149
U-204	12/8/2005	1	12/9/2005	28,870	1,031	29,900	140	145
T-104	12/20/2005	132	5/1/2006	295,853	21,047	316,900	112	76
C-111	12/15/2006	24	1/8/2007	104,243	11,657	115,900	89	65
C-101	12/19/2006	26	1/14/2007	153,035	22,865	175,900	69	41
C-110	12/23/2006	31	1/23/2007	343,588	12,312	355,900	90	104
C-108	12/28/2006	24	1/21/2007	240,265	8,635	248,900	126	136
C-109	4/15/2008	24	5/9/2008	305,928	11,972	317,900	83	101
C-112	5/15/2008	28	6/12/2008	361,785	15,115	376,900	24	51
U-101	5/13/2010	4	5/17/2010	141,027	5,002	146,029	124	135
U-102	5/14/2010	988	1/26/2013	695,074	11,991	707,065	44	48
TY-102	12/6/2010	26	1/1/2011	307,911	1,989	309,900	117	137
TY-103	1/6/2011	30	2/5/2011	292,222	17,678	309,900	46	84
S-109	2/10/2011	1331	10/3/2014	2,565,354	4,546	2,569,900	17	88
C-107	5/29/2011	184	11/29/2011	529,203	45,697	574,900	65	5
BY-101	4/2/2012	177	9/26/2012	1,254,677	25,160	1,279,837	9	94
BY-102	4/3/2012	429	6/6/2013	900,539	15,715	916,255	43	89
BY-103	4/4/2012	999	12/29/2014	1,185,786	20,805	1,206,591	19	79
BY-104	4/5/2012	197	10/19/2012	1,075,774	10,850	1,086,624	12	75
BY-105	4/6/2012	1040	2/10/2015	1,373,004	34,844	1,407,848	35	44
U-103	9/26/2012	213	4/27/2013	1,078,562	8,915	1,087,477	26	63

Table 3-2. Single-Shell Tank Retrieval/Case 1 Sequence Data. (4 Sheets)

Tank	Retrieval Start Date	Retrieval Duration (days)	Retrieval End Date	Retrieved Liquid Vol. (gal)	Retrieved Solids Vol. (gal)	Total Retrieved Vol. (gal)	Groundwater Risk Ranking	Airborne Risk Ranking
C-102	9/26/2012	454	12/24/2013	1,041,787	38,113	1,079,900	75	4
AX-102	10/19/2012	6	10/25/2012	58,612	1,288	59,900	119	58
AX-104	10/28/2012	422	12/24/2013	229,406	3,494	232,900	78	14
TY-101	1/26/2013	12	2/7/2013	204,517	35,383	239,900	106	91
TY-104	2/18/2013	22	3/12/2013	83,713	6,187	89,900	85	116
TY-105	3/20/2013	34	4/23/2013	440,247	19,654	459,900	64	125
TY-106	5/5/2013	2	5/7/2013	24,500	5,401	29,900	111	142
SX-101	5/6/2013	925	11/17/2015	3,599,412	10,488	3,609,900	55	24
SX-106	5/11/2013	921	11/18/2015	1,777,141	12,760	1,789,900	10	45
U-104	6/6/2013	142	10/26/2013	404,102	13,984	418,086	108	81
U-105	10/26/2013	716	10/12/2015	910,560	10,143	920,702	3	11
TX-116	10/8/2014	1211	1/31/2018	1,588,437	33,530	1,621,967	32	47
U-106	12/29/2014	328	11/22/2015	398,121	2,037	400,158	61	26
BY-106	2/10/2015	263	10/31/2015	1,329,737	12,531	1,342,268	11	105
C-103	5/25/2015	290	3/10/2016	1,340,475	49,425	1,389,900	80	3
AX-103	5/25/2015	556	12/1/2016	717,601	2,299	719,900	58	20
U-107	10/19/2015	443	1/4/2017	2,190,226	9,674	2,199,900	23	28
BY-107	10/31/2015	404	12/8/2016	845,425	12,431	857,855	36	115
BY-108	11/18/2015	232	7/7/2016	512,737	13,740	526,477	30	110
BY-109	11/22/2015	440	2/4/2017	677,416	15,298	692,715	52	98
U-108	11/24/2015	224	7/5/2016	914,774	20,465	935,239	8	30
C-105	3/13/2016	805	5/27/2018	1,581,389	58,511	1,639,900	53	7
BY-110	7/10/2016	239	3/6/2017	1,010,337	12,795	1,023,131	18	90
U-109	7/10/2016	313	5/19/2017	797,377	12,377	809,754	47	111
AX-101	12/4/2016	937	6/29/2019	1,824,334	5,567	1,829,900	99	55
BY-111	12/14/2016	194	6/26/2017	995,259	24,669	1,019,928	38	82
U-110	1/12/2017	493	5/20/2018	889,470	32,275	921,746	54	67
BY-112	2/6/2017	223	9/17/2017	1,230,982	22,280	1,253,261	33	86
TX-101	3/6/2017	24	3/30/2017	503,561	17,668	521,229	86	35
TX-102	3/30/2017	101	7/9/2017	592,480	5,746	598,226	48	59
U-111	6/3/2017	347	5/16/2018	605,072	9,215	614,287	39	56
TX-103	6/26/2017	198	1/10/2018	399,017	3,809	402,827	63	71
TX-104	12/8/2017	9	12/17/2017	114,195	5,771	119,966	100	99
TX-105	12/17/2017	599	8/8/2019	1,608,146	16,975	1,625,121	4	17
TX-106	12/22/2017	470	4/6/2019	984,870	4,320	989,191	27	39
TX-113	2/5/2018	1719	10/21/2022	2,016,570	16,455	2,033,025	1	85
TX-107	4/19/2018	7	4/26/2018	88,381	1,094	89,474	102	52
TX-108	5/5/2018	148	9/30/2018	352,943	3,761	356,704	67	73
TX-109	5/20/2018	165	11/1/2018	395,951	9,210	405,161	79	77
U-112	5/23/2018	31	6/23/2018	272,961	9,952	282,913	122	138
TX-110	10/21/2018	496	2/29/2020	1,260,919	14,429	1,275,348	16	25
TX-111	3/21/2019	189	9/26/2019	963,994	11,604	975,598	28	36
TX-112	3/23/2019	657	1/8/2021	1,780,225	18,153	1,798,378	5	15
TX-114	4/19/2019	536	10/6/2020	1,481,594	15,165	1,496,759	13	23

Table 3-2. Single-Shell Tank Retrieval/Case 1 Sequence Data. (4 Sheets)

Tank	Retrieval Start Date	Retrieval Duration (days)	Retrieval End Date	Retrieved Liquid Vol. (gal)	Retrieved Solids Vol. (gal)	Total Retrieved Vol. (gal)	Groundwater Risk Ranking	Airborne Risk Ranking
BX-101	6/29/2019	27	7/26/2019	274,585	10,743	285,328	123	72
BX-102	7/27/2019	43	9/8/2019	669,697	25,167	694,864	131	33
TX-115	8/25/2019	509	1/15/2021	1,546,692	15,928	1,562,620	6	19
TX-118	10/7/2019	354	9/25/2020	662,112	7,324	669,436	49	1
BX-103	1/16/2020	29	2/14/2020	240,160	9,916	250,075	113	18
BX-104	1/20/2020	135	6/3/2020	786,186	29,764	815,950	7	50
BX-105	2/16/2020	112	6/7/2020	299,052	11,419	310,471	77	102
BX-106	5/26/2020	107	9/10/2020	260,906	10,032	270,938	105	95
BX-107	6/10/2020	229	1/25/2021	883,531	35,782	919,313	71	96
BX-108	9/6/2020	4	9/10/2020	90,570	3,967	94,537	101	133
BX-109	9/15/2020	159	2/21/2021	248,983	10,452	259,435	56	132
BX-110	9/24/2020	133	2/4/2021	598,659	9,723	608,382	59	108
BX-111	9/29/2020	182	3/30/2021	513,033	7,781	520,814	60	123
A-101	2/22/2021	1830	2/26/2026	1,131,713	17,908	1,149,621	91	46
S-101	3/6/2021	46	4/21/2021	1,293,341	42,864	1,336,205	42	32
BX-112	3/28/2021	39	5/6/2021	337,641	13,034	350,675	107	92
A-102	3/30/2021	6	4/5/2021	64,475	2,077	66,551	70	42
A-103	4/8/2021	1121	5/3/2024	834,286	3,856	838,142	57	57
B-101	5/6/2021	40	6/15/2021	254,145	6,753	260,898	96	13
S-104	5/7/2021	57	7/3/2021	1,404,519	47,289	1,451,808	62	34
B-102	6/15/2021	10	6/25/2021	62,421	1,953	64,374	128	143
B-103	6/25/2021	18	7/13/2021	114,974	3,789	118,763	116	114
B-104	7/3/2021	159	12/9/2021	473,030	9,783	482,813	87	106
SX-102	7/6/2021	236	2/27/2022	1,099,869	4,618	1,104,487	45	49
B-105	11/14/2021	122	3/16/2022	706,594	8,492	715,087	93	118
B-106	12/9/2021	22	12/31/2021	141,915	5,471	147,386	81	127
B-107	2/24/2022	32	3/28/2022	331,508	14,981	346,489	95	68
SX-103	3/2/2022	278	12/5/2022	1,453,891	3,601	1,457,492	15	27
S-107	3/14/2022	330	2/7/2023	943,960	30,533	974,493	50	8
SX-104	3/14/2022	318	1/26/2023	1,090,069	11,373	1,101,442	29	12
B-108	3/20/2022	59	5/18/2022	238,784	8,987	247,771	120	141
B-109	3/28/2022	58	5/25/2022	356,480	14,439	370,918	73	122
B-110	5/20/2022	44	7/3/2022	337,677	14,917	352,594	109	78
B-111	5/25/2022	39	7/3/2022	282,591	11,548	294,139	68	74
B-112	7/20/2022	17	8/6/2022	55,689	2,306	57,995	115	144
T-101	8/6/2022	21	8/27/2022	305,616	13,169	318,785	84	93
T-102	8/27/2022	16	9/12/2022	242,315	9,154	251,469	103	121
TX-117	10/26/2022	1094	10/24/2025	1,262,321	16,998	1,279,320	37	43
S-108	5/5/2023	241	1/1/2024	2,572,375	7,525	2,579,900	14	22
SX-105	8/16/2023	230	4/2/2024	866,533	5,521	872,054	41	21
T-103	8/20/2023	7	8/27/2023	155,758	5,945	161,704	121	69
SX-107	8/20/2023	94	11/22/2023	579,567	20,325	599,893	94	54
T-105	8/27/2023	36	10/2/2023	362,299	13,012	375,311	92	83
S-110	9/12/2023	284	6/22/2024	1,120,805	16,591	1,137,396	20	37

Table 3-2. Single-Shell Tank Retrieval/Case 1 Sequence Data. (4 Sheets)

Tank	Retrieval Start Date	Retrieval Duration (days)	Retrieval End Date	Retrieved Liquid Vol. (gal)	Retrieved Solids Vol. (gal)	Total Retrieved Vol. (gal)	Groundwater Risk Ranking	Airborne Risk Ranking
T-106	10/2/2023	3	10/5/2023	109,370	4,275	113,644	125	129
T-107	11/25/2023	48	1/12/2024	528,633	19,561	548,193	31	87
SX-108	11/25/2023	228	7/10/2024	173,901	3,745	177,646	97	10
A-104	5/6/2024	344	4/15/2025	239,238	8,796	248,033	114	16
S-111	6/18/2024	165	11/30/2024	760,165	31,518	791,682	51	112
T-108	6/22/2024	3	6/25/2024	37,358	1,384	38,741	132	139
T-109	6/22/2024	21	7/13/2024	124,800	1,468	126,267	130	140
T-112	6/25/2024	24	7/19/2024	111,072	4,282	115,354	129	113
SX-109	6/25/2024	179	12/21/2024	1,096,677	35,050	1,131,727	66	40
SX-110	11/19/2024	25	12/14/2024	267,158	8,904	276,062	104	80
A-105	4/18/2025	307	2/19/2026	213,923	7,913	221,836	74	6
SX-111	4/24/2025	104	8/6/2025	576,384	20,038	596,422	88	53
SX-112	8/7/2025	108	11/23/2025	401,489	14,029	415,518	98	61
SX-113	11/14/2025	12	11/26/2025	193,814	7,164	200,978	118	134
SX-114	11/29/2025	22	12/21/2025	602,611	20,060	622,671	82	60
SX-115	2/15/2026	6	2/21/2026	16,498	621	17,119	133	31
A-106	2/22/2026	25	3/19/2026	368,909	12,526	381,434	76	9

Table 3-3. Single-Shell Retrieval Sequence for Case 2. (4 Sheets)

Tank	Retrieval Start Date	Retrieval Duration (days)	Retrieval End Date	Retrieved Liquid Vol. (gal)	Retrieved Solids Vol. (gal)	Total Retrieved Vol. (gal)
C-106	3/25/2003	221	11/1/2003	168,117	1,783	169,900
S-112	9/20/2003	78	12/7/2003	1,995,047	4,853	1,999,900
C-201	12/2/2003	1	12/3/2003	9,549	351	9,900
C-202	12/12/2003	1	12/13/2003	9,552	349	9,900
S-102	12/19/2003	90	3/18/2004	2,091,480	8,420	2,099,900
C-203	12/22/2003	2	12/24/2003	29,215	685	29,900
C-204	12/29/2003	2	12/31/2003	29,457	443	29,900
T-201	9/25/2004	10	10/5/2004	27,929	2,971	30,900
T-202	10/6/2004	7	10/13/2004	19,790	1,111	20,900
T-203	10/13/2004	17	10/30/2004	34,955	1,946	36,900
B-201	10/28/2004	10	11/7/2004	26,205	3,695	29,900
T-204	11/1/2004	12	11/13/2004	34,669	2,232	36,900
B-202	11/27/2004	10	12/7/2004	27,166	1,734	28,900
S-105	12/1/2004	287	9/14/2005	1,888,856	1,044	1,889,900
B-203	12/27/2004	18	1/14/2005	48,714	3,186	51,900
T-111	1/9/2005	184	7/12/2005	499,974	29,926	529,900
B-204	1/26/2005	17	2/12/2005	48,003	2,897	50,900
S-103	2/1/2005	192	8/12/2005	1,326,617	3,283	1,329,900

Table 3-3. Single-Shell Retrieval Sequence for Case 2. (4 Sheets)

Tank	Retrieval Start Date	Retrieval Duration (days)	Retrieval End Date	Retrieved Liquid Vol. (gal)	Retrieved Solids Vol. (gal)	Total Retrieved Vol. (gal)
S-106	2/17/2005	311	12/25/2005	2,054,417	5,483	2,059,900
T-110	5/1/2005	220	12/7/2005	336,832	13,907	350,739
C-104	10/3/2005	185	4/6/2006	736,736	58,898	795,634
U-201	11/8/2005	1	11/9/2005	39,161	739	39,900
U-202	11/18/2005	1	11/19/2005	29,277	623	29,900
U-203	11/28/2005	1	11/29/2005	29,386	514	29,900
U-204	12/8/2005	1	12/9/2005	28,870	1,031	29,900
T-104	12/20/2005	132	5/1/2006	295,853	21,047	316,900
C-111	12/15/2006	24	1/8/2007	104,243	11,657	115,900
C-101	12/19/2006	26	1/14/2007	153,035	22,865	175,900
C-110	12/23/2006	31	1/23/2007	343,588	12,312	355,900
C-108	12/28/2006	24	1/21/2007	240,265	8,635	248,900
C-109	4/15/2008	24	5/9/2008	305,928	11,972	317,900
C-112	5/15/2008	28	6/12/2008	361,785	15,115	376,900
U-101	5/13/2010	4	5/17/2010	141,027	5,002	146,029
U-102	5/14/2010	86	8/8/2010	695,074	11,991	707,065
U-103	8/11/2010	146	1/4/2011	1,078,562	8,915	1,087,477
TY-102	12/6/2010	26	1/1/2011	307,911	1,989	309,900
TY-103	1/6/2011	30	2/5/2011	292,222	17,678	309,900
U-104	1/7/2011	10	1/17/2011	404,102	13,984	418,086
SX-101	1/20/2011	142	6/11/2011	3,599,412	10,488	3,609,900
S-109	2/10/2011	659	11/30/2012	2,565,354	4,546	2,569,900
C-107	4/28/2011	184	10/29/2011	529,203	45,697	574,900
SX-106	6/14/2011	132	10/24/2011	1,777,141	12,760	1,789,900
U-105	10/27/2011	127	3/2/2012	910,560	10,143	920,702
U-106	3/5/2012	55	4/29/2012	398,121	2,037	400,158
C-102	3/11/2012	64	5/14/2012	1,041,787	38,113	1,079,900
AX-102	3/11/2012	6	3/17/2012	58,612	1,288	59,900
AX-104	3/20/2012	8	3/28/2012	229,406	3,494	232,900
AX-103	3/31/2012	70	6/9/2012	717,601	2,299	719,900
BY-101	4/2/2012	102	7/13/2012	1,254,677	25,160	1,279,837
BY-102	4/3/2012	185	10/5/2012	900,539	15,715	916,255
BY-103	4/4/2012	229	11/19/2012	1,185,786	20,805	1,206,591
U-107	5/2/2012	115	8/25/2012	2,190,226	9,674	2,199,900
C-103	5/17/2012	152	10/16/2012	1,340,475	49,425	1,389,900
AX-101	6/12/2012	1115	7/2/2015	1,824,334	5,567	1,829,900
BY-104	7/13/2012	78	9/29/2012	1,075,774	10,850	1,086,624
U-108	8/28/2012	130	1/5/2013	914,774	20,465	935,239
U-109	9/19/2012	162	2/28/2013	797,377	12,378	809,754
TY-101	9/29/2012	12	10/11/2012	204,517	35,383	239,900
TY-104	10/5/2012	22	10/27/2012	83,713	6,187	89,900
TY-105	10/14/2012	386	11/4/2013	440,247	19,654	459,900
C-105	10/19/2012	626	7/7/2014	1,581,389	58,511	1,639,900
TY-106	10/30/2012	2	11/1/2012	24,500	5,401	29,900
BY-105	11/22/2012	176	5/17/2013	1,373,004	34,844	1,407,848

Table 3-3. Single-Shell Retrieval Sequence for Case 2. (4 Sheets)

Tank	Retrieval Start Date	Retrieval Duration (days)	Retrieval End Date	Retrieved Liquid Vol. (gal)	Retrieved Solids Vol. (gal)	Total Retrieved Vol. (gal)
TX-116	12/5/2012	606	8/3/2014	1,588,437	33,530	1,621,967
U-110	3/3/2013	32	4/4/2013	889,470	32,275	921,746
U-111	4/7/2013	92	7/8/2013	605,072	9,215	614,287
BY-106	4/28/2013	182	10/27/2013	1,329,737	12,531	1,342,268
BY-107	5/21/2013	201	12/8/2013	845,425	12,431	857,855
U-112	7/11/2013	22	8/2/2013	272,961	9,952	282,913
BY-108	12/11/2013	37	1/17/2014	512,737	13,740	526,477
TX-101	1/17/2014	28	2/14/2014	503,561	17,668	521,229
BY-109	1/20/2014	47	3/8/2014	677,416	15,298	692,715
TX-102	2/16/2014	98	5/25/2014	592,480	5,746	598,226
TX-103	3/8/2014	63	5/10/2014	399,017	3,809	402,827
BY-110	3/11/2014	69	5/19/2014	1,010,337	12,795	1,023,131
TX-104	5/10/2014	8	5/18/2014	114,195	5,771	119,966
TX-105	5/19/2014	222	12/27/2014	1,608,146	16,975	1,625,121
BY-111	5/22/2014	137	10/6/2014	995,259	24,669	1,019,928
TX-106	5/27/2014	478	9/17/2015	984,870	4,320	989,191
TX-107	5/27/2014	7	6/3/2014	88,381	1,094	89,474
TX-108	6/3/2014	188	12/8/2014	352,943	3,761	356,704
BY-112	8/2/2014	201	2/19/2015	1,230,982	22,280	1,253,261
TX-113	8/8/2014	854	12/9/2016	2,016,570	16,455	2,033,025
TX-109	11/8/2014	68	1/15/2015	395,951	9,210	405,161
TX-110	11/11/2014	199	5/29/2015	1,260,919	14,429	1,275,348
TX-111	12/14/2014	248	8/19/2015	963,994	11,604	975,598
TX-112	1/25/2015	546	7/24/2016	1,780,225	18,153	1,798,378
TX-114	1/27/2015	476	5/17/2016	1,481,594	15,165	1,496,759
BX-101	7/2/2015	27	7/29/2015	274,585	10,743	285,328
BX-102	7/30/2015	39	9/7/2015	669,697	25,167	694,864
TX-115	8/9/2015	226	3/22/2016	1,546,692	15,928	1,562,620
BX-103	8/19/2015	34	9/22/2015	240,160	9,916	250,075
TX-118	9/13/2015	178	3/9/2016	662,112	7,324	669,436
BX-104	9/25/2015	27	10/22/2015	786,186	29,764	815,950
BX-105	10/25/2015	25	11/19/2015	299,052	11,419	310,471
BX-106	11/22/2015	19	12/11/2015	260,906	10,032	270,938
BX-107	12/15/2015	41	1/25/2016	883,531	35,782	919,313
BX-108	12/29/2015	4	1/2/2016	90,570	3,967	94,537
BX-109	1/2/2016	37	2/8/2016	248,983	10,452	259,435
BX-110	1/7/2016	99	4/15/2016	598,659	9,723	608,382
BX-111	1/30/2016	40	3/10/2016	513,033	7,781	520,814
BX-112	2/9/2016	52	4/1/2016	337,641	13,034	350,675
S-101	3/9/2016	83	5/31/2016	1,293,341	42,865	1,336,205
S-104	3/10/2016	38	4/17/2016	1,404,519	47,289	1,451,808
A-101	4/15/2016	877	9/9/2018	1,131,713	17,908	1,149,621
SX-102	4/30/2016	238	12/24/2016	1,099,869	4,618	1,104,487
A-102	5/17/2016	6	5/23/2016	64,475	2,077	66,551
A-103	5/26/2016	189	12/1/2016	834,286	3,856	838,142

Table 3-3. Single-Shell Retrieval Sequence for Case 2. (4 Sheets)

Tank	Retrieval Start Date	Retrieval Duration (days)	Retrieval End Date	Retrieved Liquid Vol. (gal)	Retrieved Solids Vol. (gal)	Total Retrieved Vol. (gal)
B-101	5/31/2016	36	7/6/2016	254,145	6,753	260,898
SX-103	6/3/2016	93	9/4/2016	1,453,891	3,601	1,457,493
B-102	7/9/2016	10	7/19/2016	62,421	1,953	64,374
B-103	7/22/2016	18	8/9/2016	114,974	3,789	118,763
B-104	8/12/2016	34	9/15/2016	473,030	9,783	482,813
S-107	9/7/2016	32	10/9/2016	943,960	30,533	974,493
B-105	9/18/2016	52	11/9/2016	706,594	8,492	715,087
SX-104	10/12/2016	75	12/26/2016	1,090,069	11,373	1,101,442
B-106	10/23/2016	22	11/14/2016	141,915	5,471	147,386
B-107	10/28/2016	29	11/26/2016	331,508	14,981	346,489
B-108	11/10/2016	23	12/3/2016	238,784	8,987	247,771
B-109	11/14/2016	30	12/14/2016	356,480	14,439	370,918
A-104	12/4/2016	131	4/14/2017	239,238	8,796	248,034
B-110	12/6/2016	42	1/17/2017	337,677	14,917	352,594
TX-117	12/14/2016	551	6/18/2018	1,262,321	16,998	1,279,320
SX-105	12/29/2016	117	4/25/2017	866,533	5,521	872,054
SX-107	1/1/2017	51	2/21/2017	579,568	20,325	599,893
B-111	1/20/2017	36	2/25/2017	282,591	11,548	294,139
S-108	2/24/2017	264	11/15/2017	2,572,375	7,525	2,579,900
T-101	2/25/2017	21	3/18/2017	305,616	13,169	318,785
B-112	2/28/2017	17	3/17/2017	55,689	2,306	57,995
T-102	3/21/2017	16	4/6/2017	242,315	9,154	251,469
A-105	4/17/2017	19	5/6/2017	213,923	7,913	221,837
A-106	5/9/2017	505	9/26/2018	368,909	12,526	381,434
SX-108	6/29/2017	89	9/26/2017	173,901	3,745	177,646
T-103	7/18/2017	7	7/25/2017	155,758	5,945	161,704
T-105	7/30/2017	27	8/26/2017	362,299	13,012	375,311
T-106	8/29/2017	3	9/1/2017	109,370	4,275	113,644
T-107	9/4/2017	32	10/6/2017	528,633	19,561	548,193
S-110	9/29/2017	148	2/24/2018	1,120,805	16,591	1,137,396
T-108	10/6/2017	3	10/9/2017	37,358	1,384	38,741
T-109	10/9/2017	18	10/27/2017	124,800	1,468	126,267
T-112	10/27/2017	24	11/20/2017	111,072	4,282	115,354
SX-109	11/18/2017	36	12/24/2017	1,096,677	35,050	1,131,727
SX-110	12/27/2017	25	1/21/2018	267,158	8,904	276,062
S-111	1/26/2018	67	4/3/2018	760,165	31,518	791,682
SX-111	3/1/2018	58	4/28/2018	576,384	20,038	596,423
SX-112	5/1/2018	26	5/27/2018	401,489	14,029	415,518
SX-113	5/30/2018	12	6/11/2018	193,814	7,164	200,978
SX-114	6/14/2018	22	7/6/2018	602,611	20,060	622,671
SX-115	7/10/2018	6	7/16/2018	16,498	622	17,119

3.3.2 Limitations on Single-Shell Tank Retrieval Sequence and Schedule

Some practical limitations within the Hanford Site tank waste system will drive the SST retrieval sequence and schedule. These limitations are discussed below. Infrastructure limitations are reflected in the HTWOS model, as it accounts for established and planned tank farm projects. Near-term project assumptions are shown in Table A-1. Beyond these projects, infrastructure is assumed to be in place as needed. The projected need dates for transfers provide information that will allow additional projects to be timed accordingly.

- Limited physical space is available in the tank farms for simultaneously performing construction and retrieval operations.
- Available piping between tanks within a farm and between tank farms restricts the number of simultaneous waste transfers that can be made. The presence of contaminated soil greatly increases the cost of adding more transfer lines to overcome this limitation.
- The layout of the farms on the Hanford Site restricts the number of simultaneous transfers that can be made because of the logistics requirements for operating within a tank farm to effectively monitor and control waste transfers.
- The ability to transfer waste across the site is constrained by the availability of the SY Farm tanks, the availability of Tank AN-104 to receive slurry transfers, and the lack of space in the 200 West Area in which to separate liquids from insoluble solids to enable transfer of supernatants to Tank AN-101.
- Single-shell tank waste can be transferred to DSTs only with the proper equipment. The use of DSTs to store retrieved SST waste may be constrained by the equipment installed in the DST. In the current plans, not all DSTs are being equipped with the two mixer pumps. Mixer pumps may be needed to mobilize insoluble solids that may be present in some SST waste.

3.3.3 Retrieval Waste Generation

For most of the tanks, it is assumed that enough water will be added to the SST waste to result in a sodium concentration of 5 *M* or an insoluble solids loading of 10 wt%, whichever requires the larger water addition (Numatec 2002). Solutions or slurries that meet these two criteria can be transferred reliably within the existing waste transfer system, with limited or no crystallization and/or solids settling. Additional liquid will be added outside the tank to dilute solutions and slurries so the waste can be transferred from the SSTs to the DSTs and, ultimately, to the WTP. The amount of water that needs to be added to retrieve and transport waste from a specific SST to a waste receiver facility tank or DST depends on the composition of waste in that SST.

Retrieval of the approximately 31.7 Mgal of SST waste will produce an estimated 99.0 Mgal of retrieved waste because of the addition of retrieval and transport liquids. This is nearly a three-fold volume increase. The amount of water needed to retrieve and transport the waste from a specific SST can be adjusted when better information becomes available about the waste, the specific transfer routes, and transport phenomena.

3.3.4 Double-Shell Tank Space Utilization

Available DST space was filled with retrieved SST waste to the maximum extent possible without violating spare-space and near-term feed delivery requirements and within known limitations of the DSTs and associated piping systems. Figure 3-4 shows the liquid volume in each of the 28 DSTs for the duration of the mission. The projected DST space needs for Case 1 are evaluated (Section 5.4.1) and depicted in Figure 5-5. The available DST space is not fully utilized over the entire mission because of bottlenecks created by cross-site slurry-transfer tank allocations.

An estimated 4.4 Mgal of DST storage capacity is needed for the waste retrieved from the seven SSTs designated in Tri-Party Agreement Milestone M-46-21. Additional DST capacity will be needed to store other SST waste retrieved before WTP full-scale operations, scheduled to begin in 2011. The DST space saving efforts specifically identified by the Milestone, as well as other ongoing efforts, are addressed in Section 5.3.

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Figure 3-3. Single-Shell Tank Retrieval/Case 1 Sequence and Schedule.

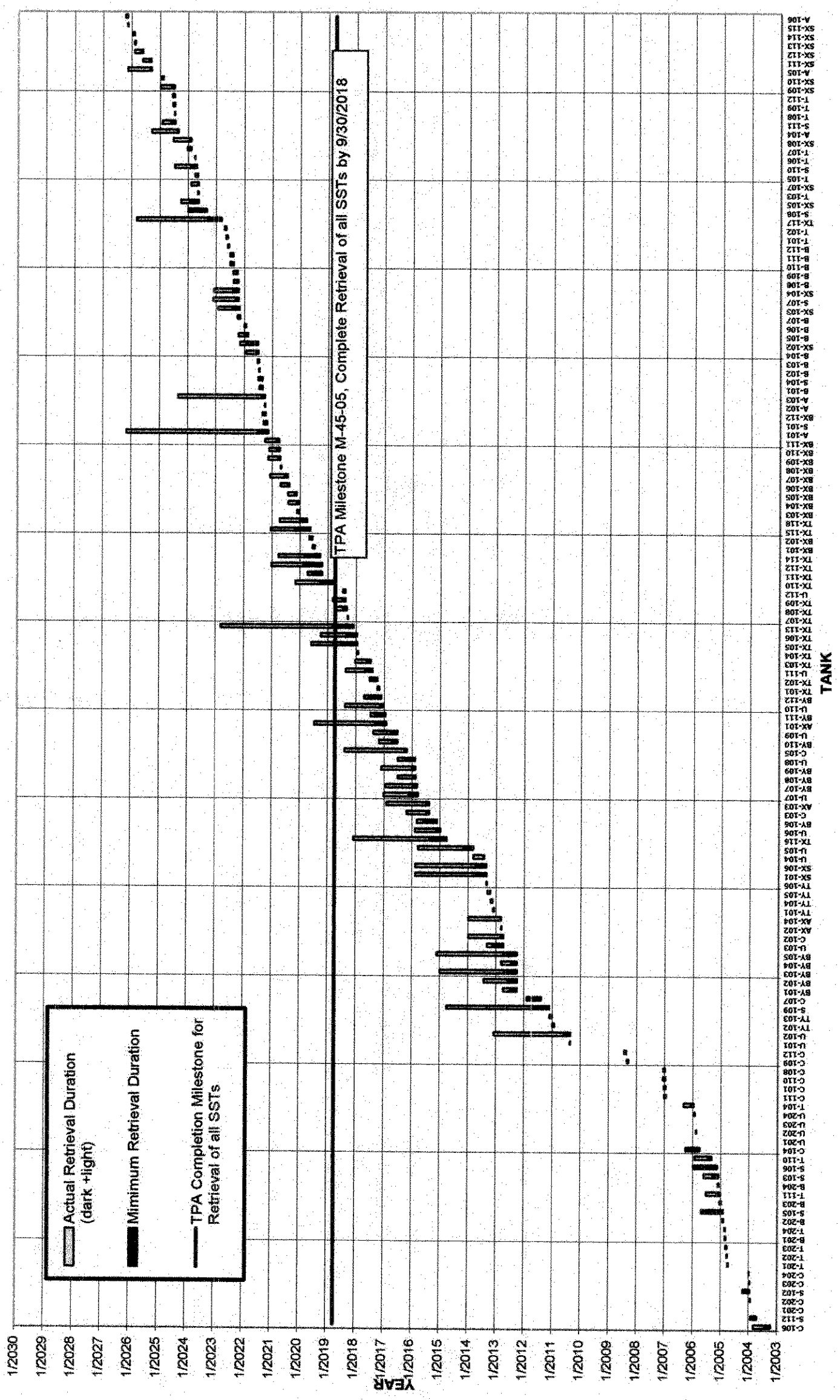
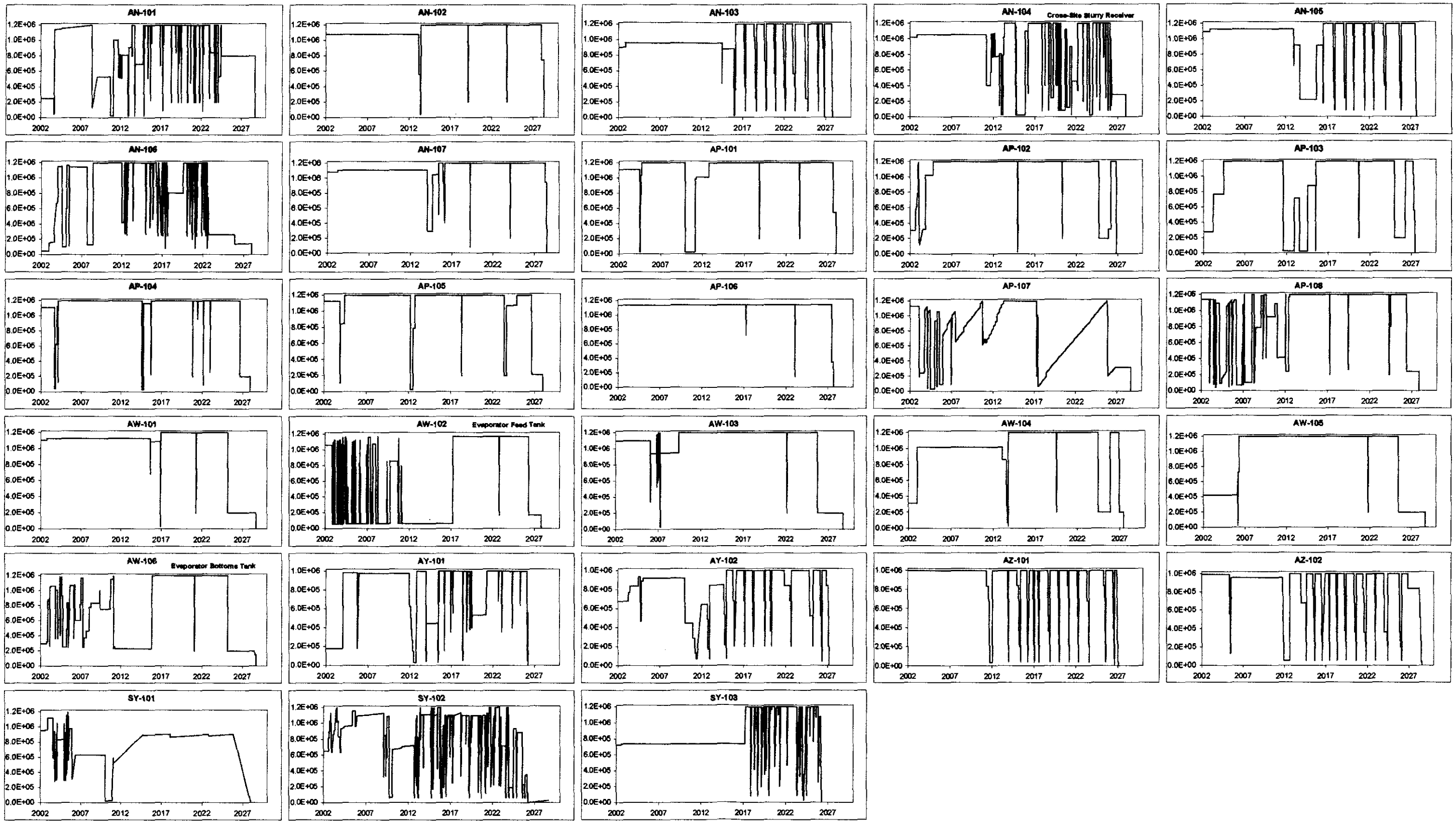


Figure 3-4. Case 1 Individual Double-Shell Tank Volume Plots (gallons).



4.0 RISK REDUCTION RESULTS FROM SINGLE-SHELL TANK RETRIEVAL SEQUENCE

The tank retrieval sequences for both cases have been prioritized to meet the objective of closure of tanks and tank farms. Consideration in the sequence also was given to maximizing risk reduction through retrieval of the mobile, long-lived radionuclides, and the long-lived alpha-emitting radioactive elements of concern. Other factors contributing to the retrieval sequence include WTP requirements, infrastructure constraints, and suitability for technology demonstration deployments provided for in Milestone M-45-00A. While not used as a tank selection criterion for modeling these cases, the results also were compared to risk reduction of the mobile, non-carcinogenic chemicals.

The relative risks of the identified contaminants for each of the SSTs selected for near-term retrieval are depicted in Table 4-1. Entries in the table are the relative risk for each tank divided by the sum of relative risks for all tanks. Appendix C contains relative risk data.

4.1 RELATIVE RISK RESULTS FOR CASE 1

To assess performance of this retrieval order, several key parameters were selected as success measures. Plots of the risk parameters for Case 1 are shown in Figures 4-1 through 4-6.

An ideal risk reduction curve for each parameter (airborne, groundwater, and chemical risk) is included in the risk versus volume retrieved figures. The ideal risk reduction curve was developed by sequencing tanks in the order that gave the maximum risk reduction for the waste volume retrieved, with no DST space or infrastructure constraints.

Based on the above selection rationale and the risk-reduction performance depicted in Figures 4-1 through 4-6, the SST retrieval order for Case 1 is considered to meet the objectives in Tri-Party Agreement Milestone M-45-02L for long-term risk reduction. A discussion of the risk reduction plots is provided below.

When the current sequence is compared to the SST retrieval sequence from FY 2002, a decrease in the rate of reduction of airborne risk (versus volume retrieved) is observed until near the end of the mission. The FY 2003 airborne risk versus time shows an early reduction in risk compared to FY 2002; however, the reduction curves are similar for the last quarter of the mission. The groundwater risk (versus volume retrieved) reduction curve for FY 2003 shows similar risk reduction throughout the mission compared to FY 2002. Groundwater risk versus time for FY 2003 showed an improvement over FY 2002. The chemical risk versus volume retrieved for FY 2003 showed a slight increase compared to FY 2002. The chemical risk versus time for FY 2003 was reduced as compared to FY 2002.

The large decrease in the rate of airborne risk reduction versus volume retrieved compared to FY 2002, Figure 4-1, is partially a result of tank selection focusing on tank farm closure, with less emphasis on the individual tank risk ranking. However, the rate of airborne risk reduction versus time shown in Figure 4-4 increases in the FY 2003 retrieval sequence is, in part, due to accelerated SST retrieval.

4.2 RELATIVE RISK RESULTS FOR CASE 2

Plots of the risk parameters for Case 2 risk reduction versus both volume retrieved and time are shown in Figures 4-7 through 4-12. A comparison in the risk-reduction performance for both Case 1 and Case 2 shows similar results in the risk-reduction performance. That is, risk reduction versus volume retrieved for Case 2, is comparable to equivalent types of risk reduction for Case 1. As expected, Case 2 projections indicating a large increase in the rate of risk reduction versus time compared to Case 1 is a direct result of accelerating SST retrieval to complete by 2018 (see Figures 4-10 through 4-12).

Table 4-1. Relative Risks for SSTs Selected for Near-Term Retrieval.

Tank	Groundwater Risk %	Airborne Risk %	Chemical Risk %	Volume (Kgal)
C-106	0.032	0.274	0.011	14
S-112	1.586	0.708	2.658	614
C-201	0.0001	0.083	0.0005	1
C-202	0.0002	0.043	0.001	1
S-102	1.074	0.231	0.987	439
C-203	0.0003	0.022	0.001	3
C-204	0.0002	0.001	0.001	2
T-201	0.001	0.091	0.106	31
T-202	0.001	0.018	0.054	21
T-203	0.001	0.028	0.106	37
B-201	0.001	0.099	0.089	30
T-204	0.001	0.020	0.133	37
B-202	0.005	0.024	0.065	29
S-105	1.471	0.587	2.294	406
B-203	0.002	0.041	0.126	52
T-111	0.443	0.313	0.637	447
B-204	0.002	0.050	0.129	51
S-103	1.200	0.291	1.112	238
S-106	1.584	0.109	3.102	455
T-110	0.078	0.077	0.296	370
C-104	2.489	10.899	0.274	259
U-201	0.006	0.0001	0.004	5
U-202	0.0002	0.0001	0.004	5
U-203	0.0001	0.0001	0.003	5
U-204	0.001	0.001	0.001	4
T-104	0.075	0.205	0.269	317
TOTAL:	**10.053%**	**14.213%**	**12.464%**	**3,873**

Figure 4-1. Case 1 Airborne Risk Reduction Versus Volume Retrieved.

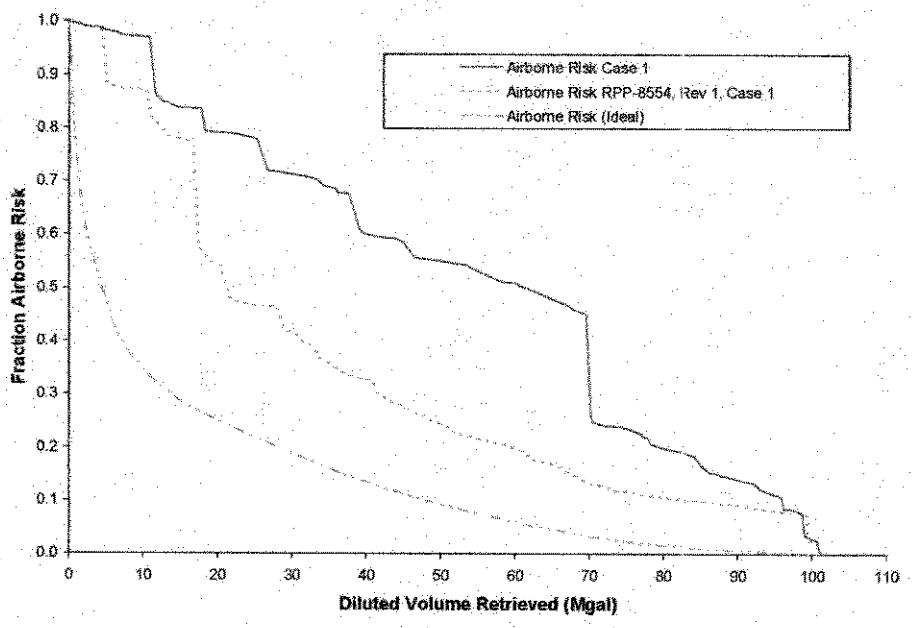


Figure 4-2. Case 1 Groundwater Risk Reduction Versus Volume Retrieved.

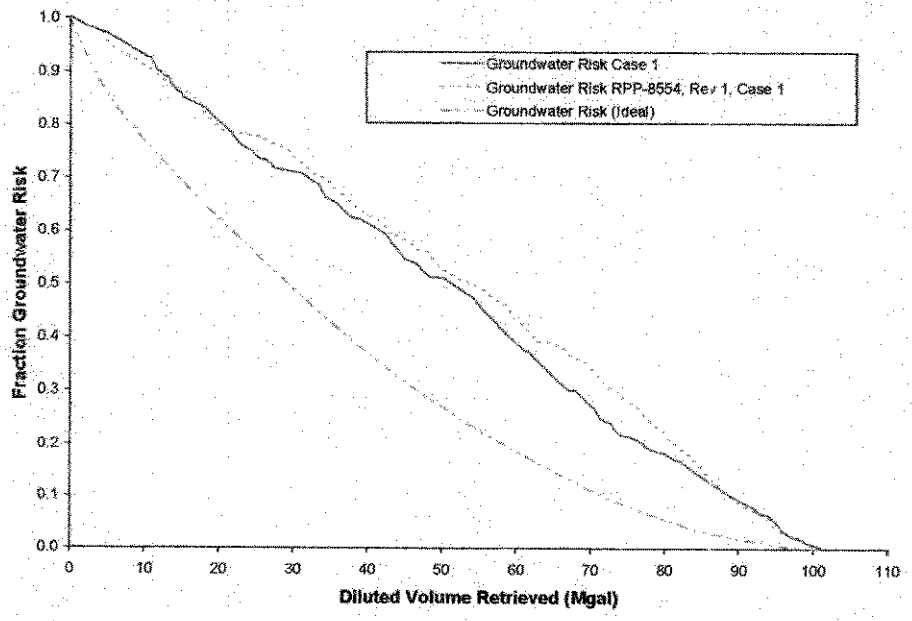


Figure 4-3. Case 1 Chemical Risk Reduction Versus Volume Retrieved.

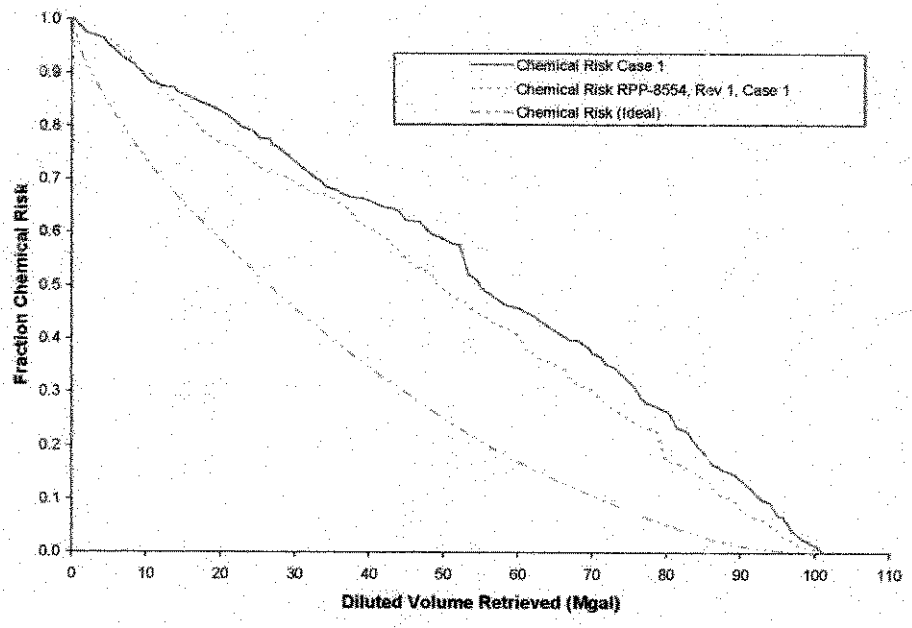


Figure 4-4. Case 1 Airborne Risk Reduction Over Time.

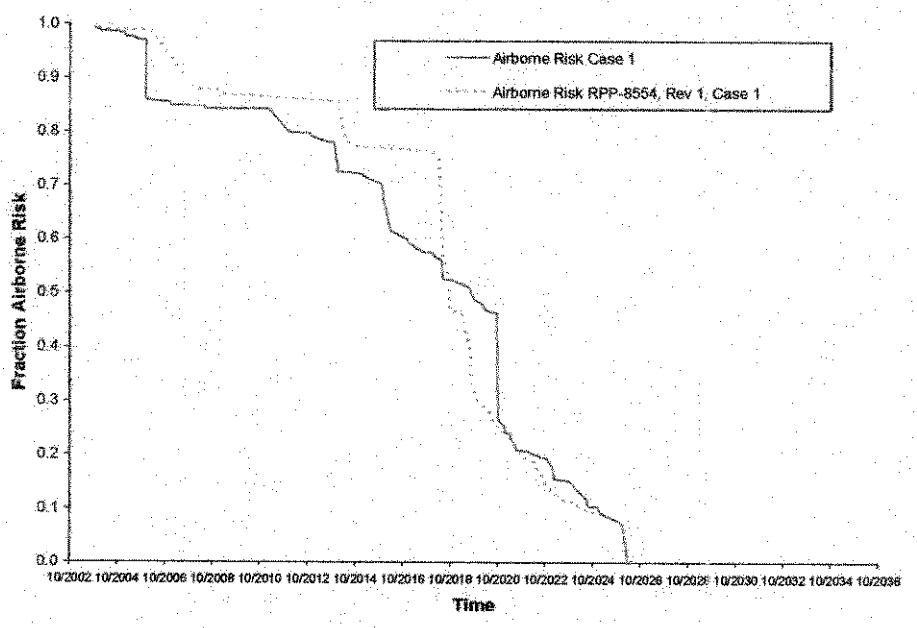


Figure 4-5. Case 1 Groundwater Risk Reduction Over Time.

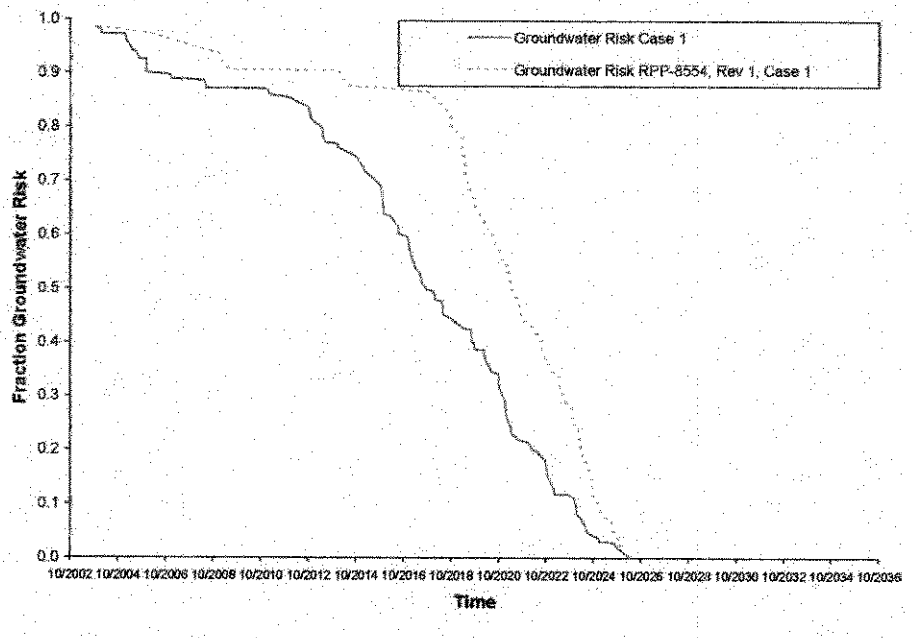


Figure 4-6. Case 1 Chemical Risk Reduction Over Time.

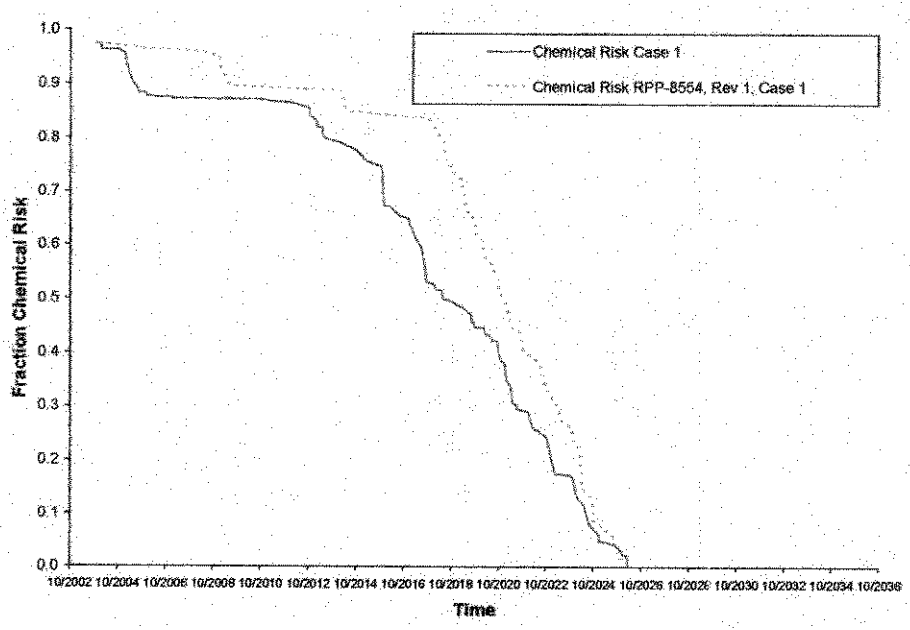


Figure 4-7. Case 2 Airborne Risk Reduction Versus Volume Retrieved.

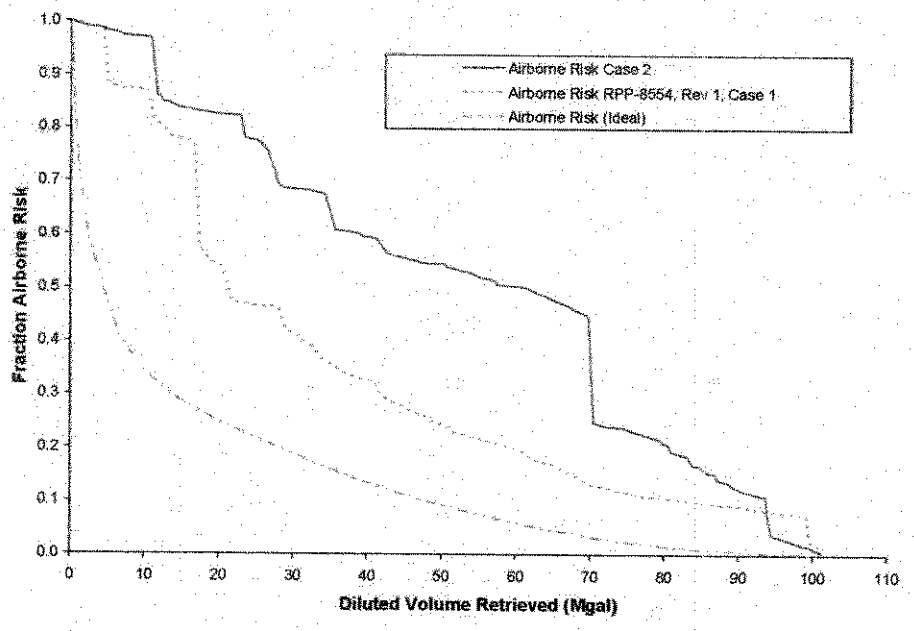


Figure 4-8. Case 2 Groundwater Risk Reduction Versus Volume Retrieved.

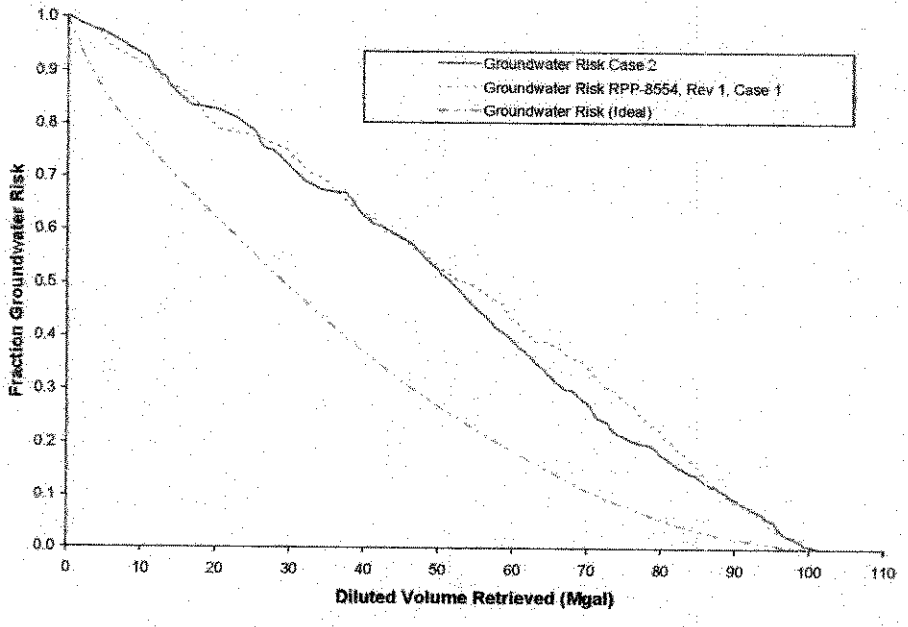


Figure 4-9. Case 2 Chemical Risk Reduction Versus Volume Retrieved.

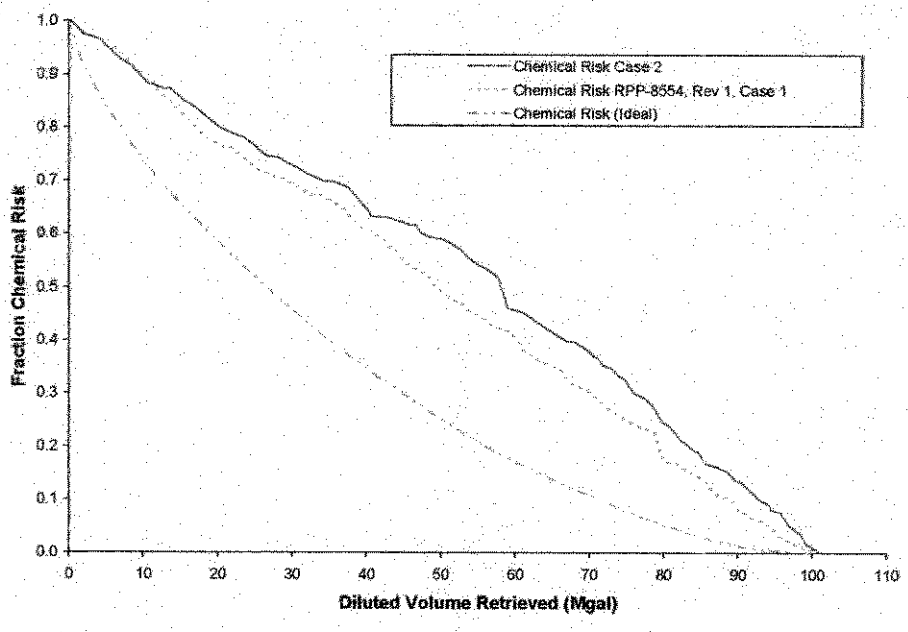


Figure 4-10. Case 2 Airborne Risk Reduction Over Time.

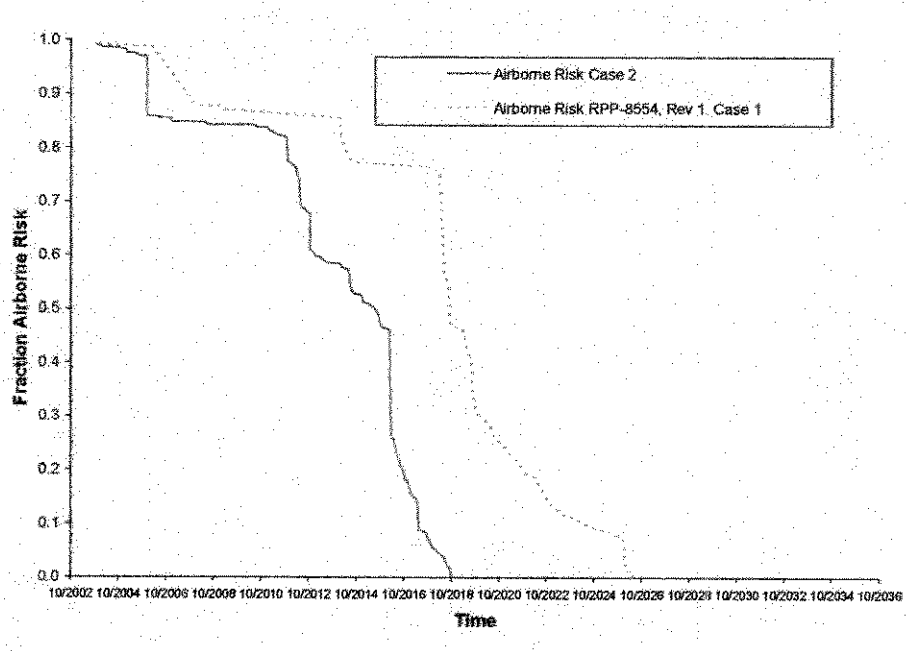


Figure 4-11. Case 2 Groundwater Risk Reduction Over Time.

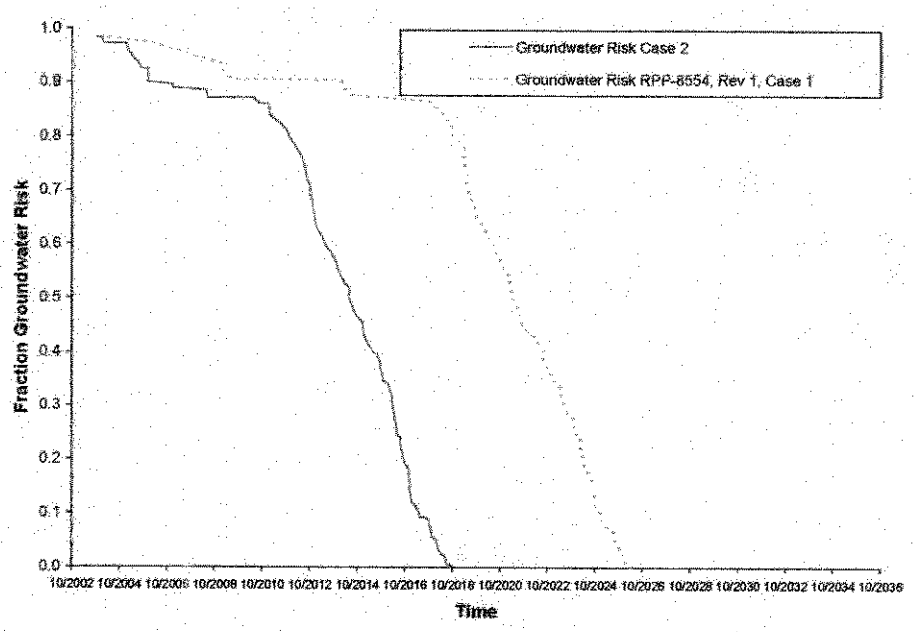
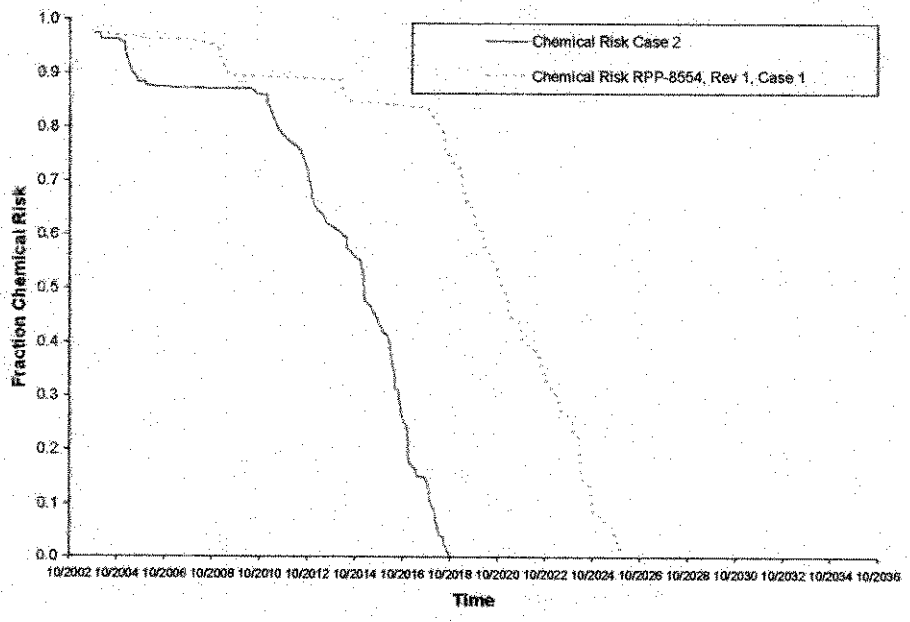


Figure 4-12. Case 2 Chemical Risk Reduction Over Time.



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5.0 DOUBLE-SHELL TANK SPACE EVALUATION

5.1 DOUBLE-SHELL TANK SPACE EVALUATION ASSUMPTIONS AND CONSTRAINTS

The two projection cases were evaluated to consider a range of operational assumptions that determine the impact of changes in the SST retrieval and waste treatment schedule on DST needs. A complete listing of assumptions for the two projections is presented in Appendix A. For FY 2003, Case 1 projection incorporates a risk-based SST retrieval sequence that completes waste vitrification in 2028 and maintains waste volumes within existing DST capacity. The Case 2 projection also incorporates a risk-based SST retrieval sequence that completes SST retrieval by September 30, 2018. The Case 2 projection determines the amount of new DST capacity needed to retrieve all SSTs by 2018. In this projection, about 25 Mgal of new DST space is needed. The assumptions and results are summarized in Table 1-1 and in Sections 5.1.1 through 5.1.2, with a more comprehensive list provided in Appendix A.

In all projection cases, Interim Stabilization is complete in 2004 to meet the Consent Decree (Ecology/DOE 1999) milestone and non-tank farm facility waste generations are based on values provided from facility management. Volumes used for each sequence were calculated based on tank inventory and composition information representative of July 1, 2002 (April 2002 for Tank S-112) with adjustments for historical transfers through May 31, 2003.

5.1.1 Projection Case 1 Assumptions and Results Summary

The following are the assumptions and results summary for Projection Case 1:

- Based on the RPP System Plan, Rev. 2 Target Case (DOE 2003), updated for this study;
- Incorporates a risk-based retrieval sequence;
- Not constrained to retrieve waste by 2018, but completes waste processing in 2028;
- Maintains waste volumes within existing DST capacity;
- Uses WTP processing assumptions based on operations as proposed in the RPP System Plan, Rev. 2 Target Case (DOE 2003) and updated for this study;
- Incorporates tank space options to save a total of approximately 7.3 Mgal of space. The options used and their related space savings are shown below:
  - Increasing the fill limit for existing DSTs. This option fills 23 DSTs to 1.2 Mgal (represents a depth of 436 inches in the tank) and fills the evaporator feed tank (AW-102) to 1.17 Mgal. Raising the fill limit for 24 DSTs creates an additional 1.4 Mgal of storage space.

  - Some of the existing wastes stored in DSTs could be concentrated to a higher specific gravity (SpG). Concentrating these wastes to a SpG of 1.47, rather than only concentrating to 1.37, saves an additional 2.6 Mgal of DST space.
  - Decreasing the space allocated for emergency, WTP return, and contingency space from 2.28 Mgal to 1.2 Mgal was used to save an additional 1.08 Mgal.
  - Bypass DSTs for Selected SST Retrievals saves and additional 1.4 Mgal.
  - Use Restricted Tank Space saves an additional 0.84 Mgal.
- Completes SST waste retrieval in March 19, 2026.

A detailed description of the development of the SST retrieval sequence is provided in Section 3.0. The actual SST retrieval sequence for Case 1 is also provided in Section 3.0.

5.1.2 Projection Case 2 Assumptions and Results Summary

The following are the assumptions and results summary for Projection Case 2:

- Based on the RPP Project System Plan, Rev. 2 Target Case (DOE 2003) and updated for this study;
- Incorporates a risk-based retrieval sequence;
- Complies with Tri-Party Agreement Milestone M-45-05, which calls for retrieving all waste from remaining SSTs by September 30, 2018;
- Calculates the required new DST capacity to retrieve all SSTs by September 30, 2018;
- Uses WTP processing assumptions based on operations as proposed in the RPP System Plan, Rev. 2 Target Case (DOE 2003) and updated for this study. Assumes an aggressive WTP capacity ramp-up after 2011, to complete processing by 2028;
- Incorporates tank space options to save a total of 7.3 Mgal of space. The options used and their related space savings are the same as described above for Case 1.
- The Enhanced WTP Operations processing schedule and WTP processing rates result in completion of waste processing in 2028.

The retrieval sequence, the schedule, and volume information for Case 2 SST waste retrieval is provided in Section 3.0.

5.2 ACTUAL WASTE GENERATION COMPARED TO MANAGEMENT LIMITS

New average monthly waste generation targets have been established for this projection with waste generations being reduced by the facilities (references and discussion in Appendix E). Table 5-1 presents a comparison of the previous limits established for each facility, the newly

established target rates for this projection, and the actual average monthly waste generation rate for the period October 2001 through September 2002. Terminal cleanout was completed at B Plant in 1998, and no additional waste will be received from this facility. Terminal cleanout at the Plutonium-Uranium Extraction Plant (PUREX) facility was completed, but the facility could be sending approximately 5 Kgal/year of collected condensate to the tank farms.

Table 5-1. Comparison of Average Monthly Waste Generation Rates (Kgal/month).

Facility	Management Limit From WHC-SD-WM-ER-029, Rev. 20 (64 Kgal/month)	Facility Target for FY 2003	Average Monthly Facility Generations (10/2001 - 09/2002)
Tank farms	10.0	10.0	2.7
WESF/B Plant	23.0	0.0	0.0
PUREX	15.0	0.42	0.0
T Plant	6.0	1.38	0.0
222-S Laboratory	5.0	0.83	0.0
300 Area	5.0	0.0	0.0
400 Area	0.0	0.0	0.0
TOTAL	64.0	12.63	2.7

Notes:

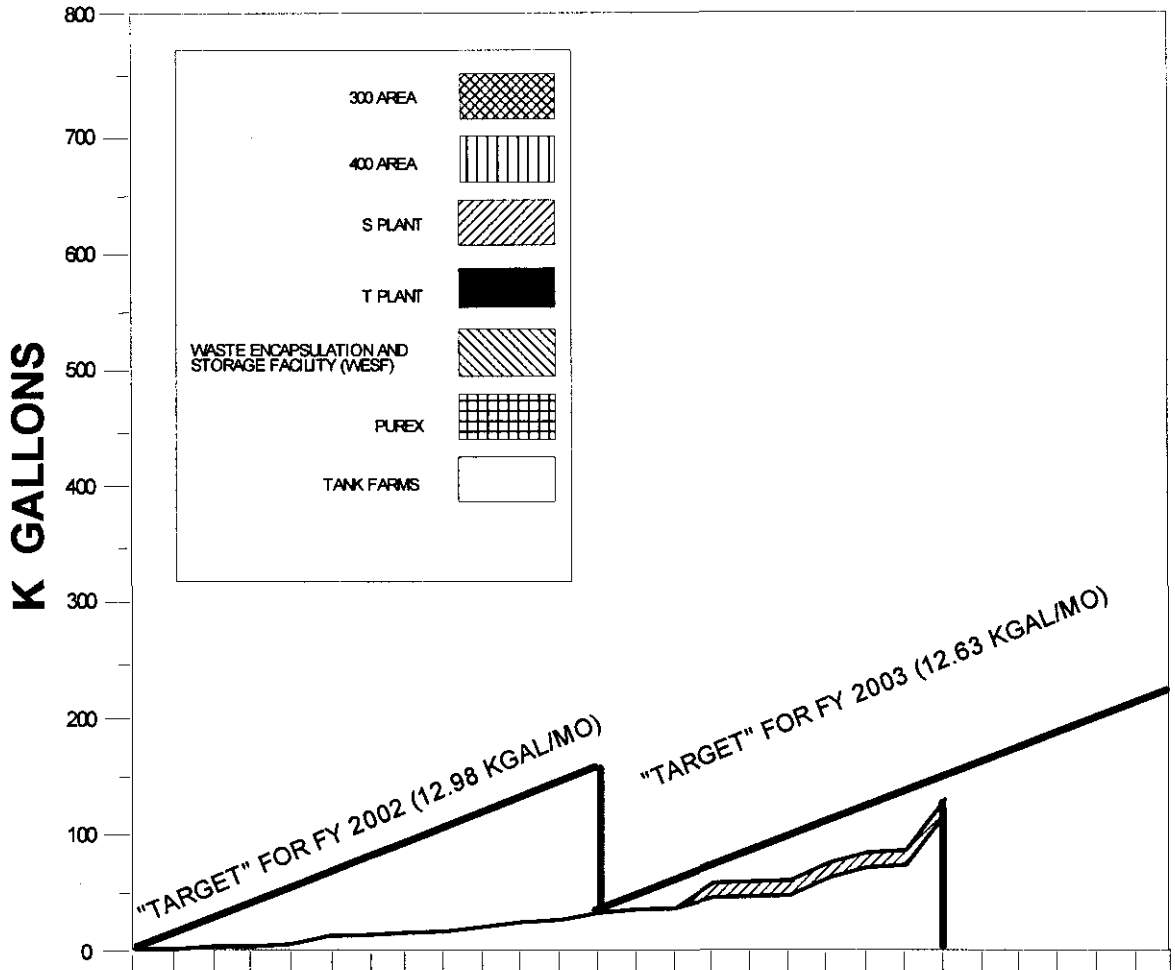
Monthly total does not include terminal cleanout volumes or saltwell liquid pumping.

PUREX = Plutonium-Uranium Extraction Plant.
WESF = Waste Encapsulation and Storage Facility.

Waste generation estimates for the completion of SST interim stabilization are based on the estimated remaining liquid, the saltwell pumping schedule, and the flushing and dilution requirements. A comparison of actual volumes to projected volumes is shown in Figure 5-3, with a more comprehensive discussion provided in Appendix E. All waste generators are at or below their new waste generation target for the period October 2001 through September 2002.

The total average monthly facility generations are 2.7 Kgal in FY 2002, down from 4.12 Kgal in FY 2001 and 6.3 Kgal in FY 2000. The total of the facility targets for FY 2003 are also lower than in FY 2001, by 0.35 Kgal/month. Targets were reduced for T Plant and the 300 Area. The volumes of waste entering the DST space for October 2001–September 2002 are compared graphically to the various targets or projected generations in Figures 5-1 through 5-4. The inactive miscellaneous underground storage tank wastes included in Figure 5-4 will be retrieved with SST waste, but have been included here since they are not included in SST retrieval tables.

Figure 5-1. Monthly Facility Generations.



FY2003 TARGET		10/01	11/01	12/01	1/02	2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03	9/03	10/03	11/03	12/03
300 AREA	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
400 AREA	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
S PLANT	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0						
T PLANT	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
WESF	0.0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
PUREX	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
TANK FARMS	10.0	0	3	0	2	7	1	2	1	4	4	2	6	3	1	9	1	1	15	9	2	44						
TOTAL	12.63	0	3	0	2	7	1	2	1	4	4	2	6	3	1	22	1	1	15	9	2	44						

NOTE: THIS GRAPHIC DEPICTS CONTRIBUTIONS FROM FACILITY GENERATIONS; TERMINAL CLEAN-OUT AND SWL PUMPING ARE NOT SHOWN

Figure 5-2. Comparison of Monthly Average Waste Generation to Target Rate.

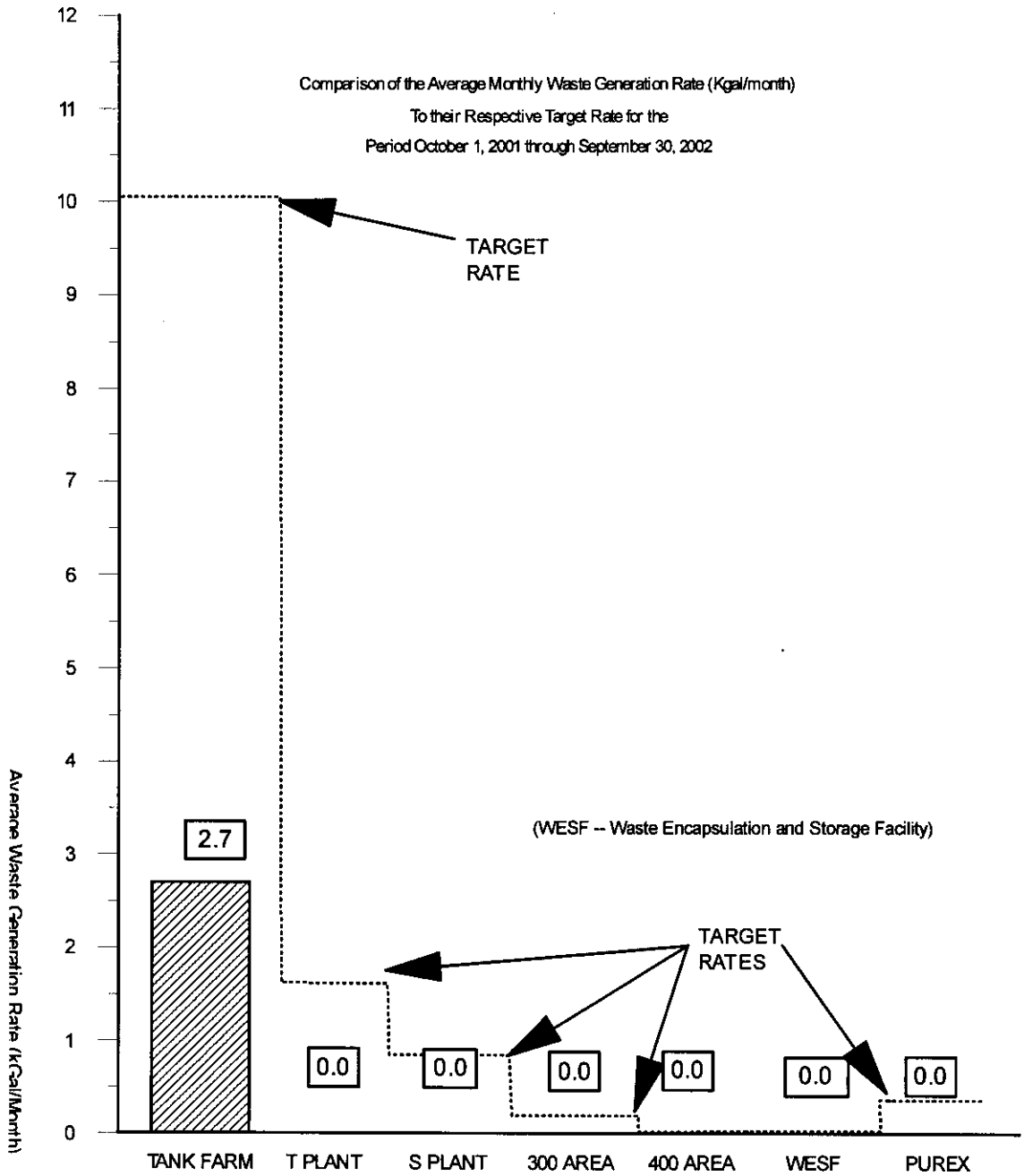
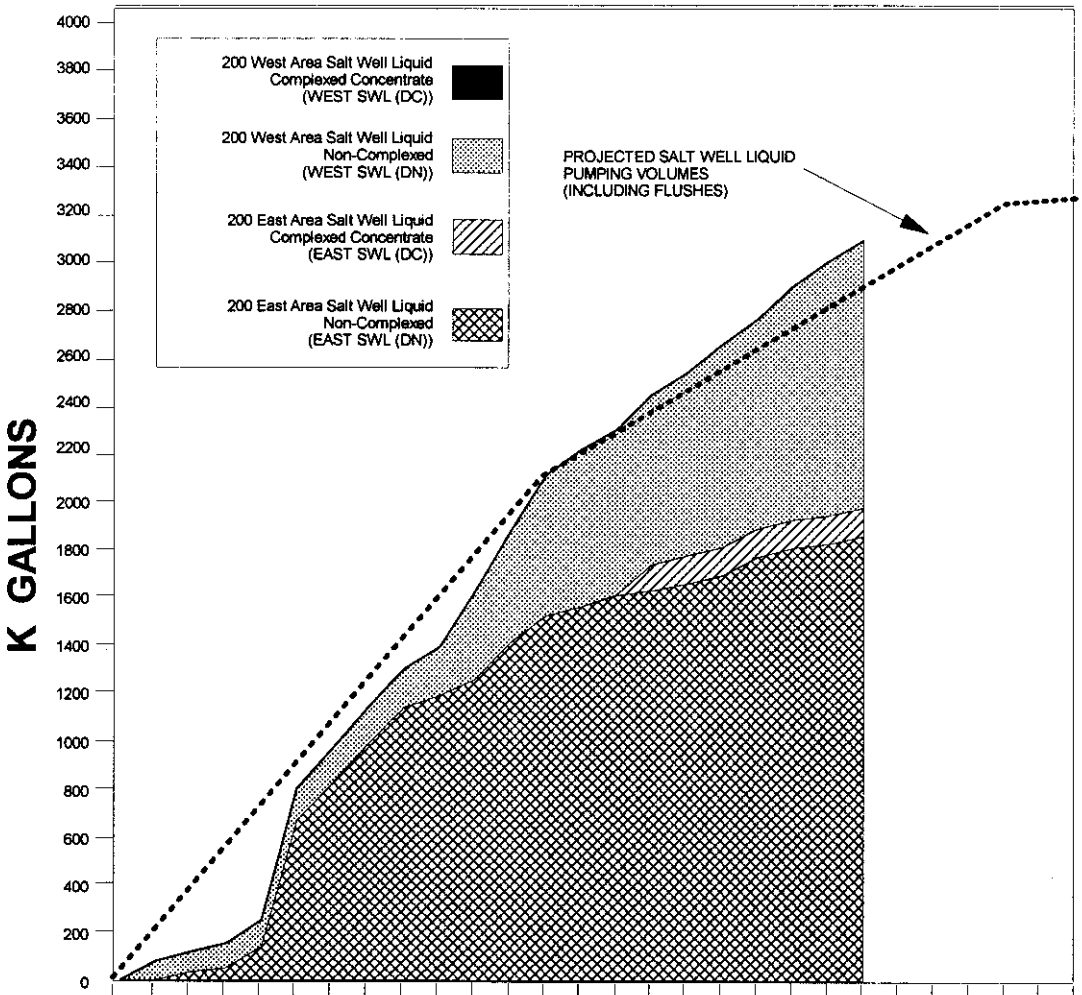


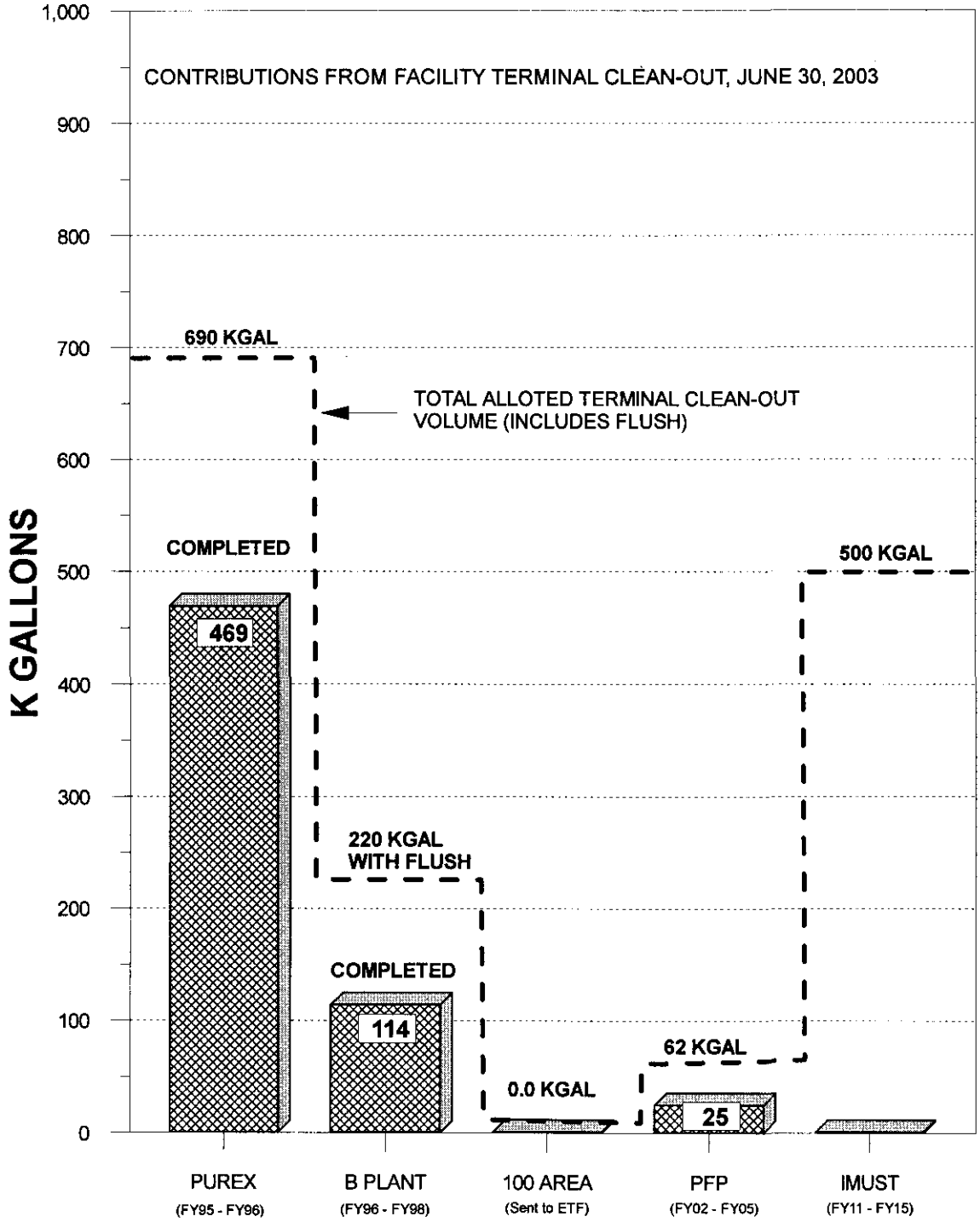
Figure 5-3. Monthly Contributions from Saltwell Liquid Pumping.



	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
WEST SWL (DC)	62	55	32	14	2	12	42	22	33	37	9	10	0	0	0	0	0	0	0	0	0						
WEST SWL (DN)	160	176	97	41	18	10	22	0	0	0	0	23	77	6	15	8	23	10	7	7	45						
EAST SWL (DC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
EAST SWL (DN)	0	0	0	0	0	22	8	0	0	36	0	0	0	41	17	90	525	156	161	153	50						

FY 2002 FY 2003

Figure 5-4. Contributions from Facility Terminal Cleanout.



5.3 SPACE-SAVING ALTERNATIVES

5.3.1 Background

Waste volume projections have shown that sufficient DST space is one of several factors important to SST waste retrieval. Tri-Party Agreement Milestone M-46-21 ["Complete Implementation of Double Shell Tank Space Optimization Study Recommendations (Tank Space Options Report, Document No. RPP-7702, April 12, 2001)"] recognizes the significance in carefully utilizing the DST space. This Milestone was approved in 2003 with the expressed purpose of:

> "*...creating sufficient double-shell tank storage space to accommodate the Parties' waste retrieval and closure demonstrations at tanks S-112, S-102, C-104, S-105, S-106 S-103 and C-106. Such actions shall include, but are not limited to, concentrating wastes to a higher specific gravity and raising allowable tank levels.*"

Current estimates indicate that approximately 4.4 Mgal of DST storage capacities are needed for the waste retrieved from the seven SSTs designated in Milestone M-46-21 (see Table 5-2). The DST space-saving efforts specifically identified by the Milestone, as well as other ongoing efforts, are addressed below.

Table 5-2. Needed DST Space for Tri-Party Agreement Single-Shell Tank Retrieval.

Single-Shell Tank	Current Volume (Kgal)	Retrieved Volume (Kgal, estimate)	DST Stored Volume (Kgal, estimate)
S-112	614	2,000	1,191
S-102	439	2,100	488
C-104	259	750	750
S-105	406	1,890	751
S-106	455	2,060	789
S-103	238	1,330	404
C-106	36	350	44
Total	2,447	10,480	4,417

In 2001, the Tank Space Options Report (Boyles et al. 2001) presented options that were reviewed for the purpose of alleviating a DST waste storage capacity shortfall. Eight options were identified that had the potential for increasing DST waste storage capacity an additional 5 to 10 Mgal. The study reflected a qualitative analysis conducted to identify promising options. The study pointed out that implementing the options would require more study to establish feasibility, enhance cost estimates, and understand the operational impacts. During preparation of the *Integrated Mission Acceleration Plan* (IMAP) (RPP-13678), the options identified in the

Tank Space Options Report (Boyles et al. 2001) were revisited. During the 2 years between preparation of the Tank Space Options Report and the IMAP, several significant changes have occurred: SST retrieval plans had accelerated, the WTP schedule and capacity were modified, and supplemental treatment of SST waste was being considered. The IMAP recognized that DST space represented a significant risk to accelerating the RPP mission and several DST space savings options were targeted for action to support SST waste retrieval and closure. The IMAP recommended space-saving options were:

1. Increased DST fill height (Section 5.3.1.1);
2. Maintain reserve emergency space compliant with DOE Order 435.1 (Section 5.3.1.2);
3. Concentrate supernatant waste to 1.41 SpG (Section 5.3.1.3);
4. Bypass DSTs for retrieval of selected SST waste to supplemental processing (Section 5.3.1.4);
5. Concentrate supernatant waste to maximum SpG (Section 5.3.1.3);
6. Use restricted DST space (Section 5.3.1.5); and
7. Retrieve and package DST TRU waste (Section 5.3.1.6).

Engineering and field efforts are underway to implement the DST space-savings options. Status and technical background for each of the seven IMAP alternatives are provided in the following sections.

5.3.1.1 Increase Double-Shell Tank Fill Height

For DSTs located in the AN, AP, AW, and SY Tank Farms, the normal tank fill height is 416 inches (1,144 Kgals), as currently established in *Operating Specifications for Double-Shell Storage Tanks* (OSD-T-151-00007). Fill height exceptions have been approved for AP-102, SY-102, and AW-102 by specific process direction. The existing 416-inch operating limit provides a 6-inch margin below the design basis waste level limit of 422 inches. The 422-inch limit was based on seismic calculations performed in the 1980s, when 422 inches was the maximum waste level used in the calculations. In addition, fill heights for tanks in AY and AZ Tank Farms are constrained by design to 364 inches each (1,001 Kgals).

The feasibility of increasing the fill height is being evaluated as part of the DST Integrity Project. The feasibility assessment includes evaluation of the design and construction codes and standards as well as consideration of the integrity of the primary and secondary shells. The maximum theoretical operating fill height is currently considered to be 460 inches. This fill height is the elevation where double-containment ends and the tank inner shell and outer shell meet. The final recommended fill height is anticipated to be lower than this value due to constraints such as:

- Regulatory requirements for double containment,
- Head-space volume for flammable gas dilution,
- Safety considerations for tank internal spray mist settling,
- Hanging or protruding equipment into the vapor space,

- Seismic limitations, and
- Operating margin for volume measurement uncertainty.

Following recommendation for fill height changes, implementation of increased fill height is scheduled to begin in FY 2004.

For modeling available DST space, it has been assumed that 23 DSTs are capable of holding 1.2 Mgal (436 inches) each, and the evaporator feed tank (AW-102) is capable of holding 1.17 Mgal (425 inches). Raising the fill limit for 24 DSTs creates an additional 1.4 Mgal of storage space.

5.3.1.2 Maintain Reserve Emergency Space Compliant with DOE Order 435.1

DOE Order 435.1 requires that space equivalent to the largest single vessel in a waste storage or processing system is available for emergency waste storage. Through FY 2002, 2.28 Mgal of tank space had been reserved for emergency storage. The 2.28 Mgal had historical roots derived from separate tank space needed for aging and non-aging waste. With discontinued operation of PUREX, the need for maintaining separate space for both aging and non-aging waste is no longer necessary. Later, separate emergency space was set aside for WTP and tank farm waste. In FY 2003, an agreement was reached between the Office of River Protection (ORP), the Tank Farm Contractor, and the WTP Contractor on Interface Control Document 19 (Pennington 2003) to maintain just 1.1 Mgal of distributed DST space for emergency storage. The emergency capacity may need to increase to approximately 1.2 Mgal when the DST fill height is raised. In May 2003, Reberger (2003) was updated and issued. These actions are complete and have allowed 1.08 Mgal of DST space to be available for SST retrieval.

5.3.1.3 Concentrate Existing Supernatant Waste to a Higher Density

In recent years, tank waste concentration in the 242-A Evaporator was limited to a SpG of 1.41 g/mL. This SpG limit reduced the potential that flammable gas could become trapped in the stored waste and result in periodic flammable gas release events. In actual practice, evaporator campaigns have stopped short of this limit to ensure that waste was not concentrated above this SpG limit.

Recently, modeling tools have been developed that can better predict the potential for creating flammable gas conditions from the solids and concentrated supernatant within a tank (Barker and Hedengren 2003). Tank-by-tank assessments may allow higher waste concentration. For example, laboratory work conducted for the second FY 2003 evaporator campaign (03-02) showed that a final density of 1.47 g/mL was acceptable for that waste and the associated storage conditions. The evaporator campaign was operated at this higher SpG target. For modeling these cases, some of the existing wastes are concentrated up to 1.47 SpG thereby saving an additional 2.6 Mgal of DST space through FY 2006 or 3.4 Mgal through FY 2018.

5.3.1.4 Bypass Double-Shell Tanks for Selected Single-Shell Tank Retrievals

Direct retrieval of SST waste to supplemental waste processing will bypass the DST system and thereby avoid the need for additional DST space. Technologies and flow sheets are currently

being developed for supplemental processing units to handle both TRU and LLW tank waste. It is envisioned that the supplemental treatment units would be located such that retrieved SST waste would be directly transferred to the processing units. Single-shell tank waste scheduled for accelerated retrieval could go directly to supplemental treatment. In the modeling, it is assumed that approximately 1.4 Mgal of SST waste bypasses the DST system. Sending the waste from four B-200 series tanks, four T-200 series tanks, T-104, T-110 and T-111 directly to transuranic-contact handled and LLW treatments effectively eliminates the need for the DST system to store this waste.

5.3.1.5 Use "Restricted" Space in Waste Treatment Plant Staged Feed Tanks

Currently, 13 DSTs contain waste feed that has been designated as staged waste feed for the WTP. These wastes have been sampled, for testing and analysis by the WTP contractor to assess pretreatment and vitrification processes. The ORP has directed the Tank Farm Contractor to maintain the waste in these tanks under configuration control (Boston 2000). This "restricted" space consists of available tank freeboard above the waste that has already been characterized as feed for the WTP. Concentrating and/or backfilling these tanks could potentially affect the existing characterization of the WTP feed. These tanks require ORP approval before receipt of additional waste. It should be noted that some of the available space is also restricted from use by flammable gas considerations; tanks AN-103, AN-104, AN-105 and SY-103. Current modeling assumptions include the ability to concentrate the existing waste and use approximately 839 Kgal of "restricted" tank space.

5.3.1.6 Retrieve and Package Double-Shell Tank Transuranic Waste

Processing the TRU wastes currently stored in DSTs and separately disposing the material at WIPP before startup of the WTP could make DST space available for SST waste retrieval. In addition, it allows the supernatant to be concentrated and consolidated with other waste. As currently envisioned, the solids of Tanks AW-103, AW-105, and SY-102 would be retrieved and packaged for disposal at WIPP. This option would require remote TRU handling capability for wastes contained in these tanks. This option has a high degree of technical risk and detailed plans are still being developed for this option.

5.3.2 Summary

Modeled space-saving options contributing to the gains in available DST space are summarized in Table 5-3. The amount of tank space saved is an estimate based on current information. The actual amount of space that will be saved depends upon the ability to manage constraints of the waste, tank preparations for WTP, and interfaces with supplemental processes.

Table 5-3. Space-Saving Options Summary for Case 1 through FY 2006.

Option	Estimated Double-Shell Tank Space Gained
Increase DST fill height	1.4 Mgal (estimated)
Reduce emergency reserve space to 1.2 Mgal	1.08 Mgal
Concentrate supernatant to higher density	2.6 Mgal (estimated through FY 06)
Bypass DSTs for TRU/LLW SST retrievals	1.4 Mgal (space avoidance through FY 06)
Use restricted tank space	0.84 Mgal (after concentration)
Retrieve and package DST TRU	TBD
Approximate total	7.3 Mgal

Notes:

DST = double-shell tank.
FY = fiscal year.
LLW = low-level waste.
Mgal = million gallons.
SST = single-shell tank.
TBD = to be determined.
TRU = transuranic.

5.4 DOUBLE-SHELL TANK SPACE USE PROJECTIONS

A summary of the major case assumptions is presented in Table 1-1. Detailed assumptions are provided in Appendix A. Case 1 does not require construction of new DST storage capacity. Case 2, which retrieves SSTs by 2018, does require construction of new DST storage capacity. In this subset, 21 additional DSTs are needed.

The results of a waste volume projection can be used to forecast tank space needs versus time, forecast the evaporator operation, forecast the needed LAW processing and disposal rates and HLW processing and storage, analyze tank space issues for aging and non-aging waste tanks, predict tank use, or determine the need and schedule for retrievals and cross-site transfers. To predict tank space needs, a graphic is produced showing tank count versus time, compared to the available space. Generations and evaporations for the near term (through 2003) are modeled on a monthly basis, whereas the remainder of the projection is typically modeled on an annual basis.

All projection cases assume that dilute waste will be evaporated to double-shell slurry feed in the year that it is produced, provided an evaporator is operational. In later parts of the projections when tank space becomes tight because of processing needs and/or the amount of SST wastes being retrieved, the evaporator is assumed to operate yearly even if volumes are small, to minimize waste storage needs. Long-range projection graphics for the two projection cases are presented in Sections 5.4.1, 5.4.2, and 5.4.3. Tank space requirement graphics have been included for the two projections. Short-range graphics, tank use graphics, and evaporator waste volume reduction data have been included for the Case 1 projection.

Other assumptions in the projections that impact tank space are listed below.

- It was assumed that the Tank Farm Contractor will need to use Tanks AN-101, AN-106, AN-104, and AN-105 for waste management during the same time frame that Project W-211 is preparing them for use as intermediate feed staging tanks. The baseline

plan assumes that Project W-211 activities will be completed while the tanks are storing waste. If the tanks had to be emptied before the Project W-211 activities began, the impact would be over 3 Mgal.

- Some DSTs will reach the end of their design life before completion of the RPP Mission. In these projection cases, it was assumed that no tanks fail. Emergency space would be used if a failure/loss of a DST should occur. Such a failure reduces the space available for the return of waste streams to the tank farms and also could impact waste feed delivery and processing. Technology development and demonstration activities are underway to interrogate DST integrity and seal any leaks that might occur.

- The two projections assumed that evaporator capacity would be available on an annual basis from FY 2001 through 2019 (the model accommodates evaporator outages and associated tank-farm upgrades). A reduction in evaporation capacity during years when space is tight or when waste receipts are high could result in a tank space shortage. After 2019, the projection shows that the evaporator is not needed. The WTP will have eight years of operating experience, will have treated a sufficient volume of waste to make space available, and the assumed total treatment rate allows retrieval to move on an aggressive schedule. Time is available between startup and 2019 to review the need for evaporator operations as treatment progresses.

Appendix F lists all the gains, losses, and transfers for the two projections through FY 2004.

5.4.1 Projection Case 1 Results

The SST retrieval sequence for FY 2003 and the body of this report are based on the Case 1 projection that incorporates a risk-based SST retrieval sequence to fit existing DST capacity. The Case 1 projection has extended retrieval durations or delayed the start of additional SST retrieval starts to prevent overfilling available space. The Case 1 projection incorporates 7.3 Mgal of tank space options. Tank space needs for the Case 1 projection are shown in Figure 5-5 (no new DST capacity is required). In past depictions of allocated space, the evaporator operational space and emergency space were included in the available space category within the HTWOS model and only the emergency space was shown separately on the diagram. Because of the increased demands on DST space, the evaporator operational space is now carried as a separate category in the model. At no time does the projected waste volume exceed the total capacity minus the emergency space allocation. For the short period of times when the waste volume plus space allocations exceed the total capacity, it is expected that DST space would be reallocated from one of the operational categories (e.g., moving Evaporator Operational Space to the Emergency Tank Volume category).

The retrieval sequence and risk reduction curves for Case 1 are shown in Section 4.0.

A spreadsheet summarizing the waste generations, evaporator waste volume reduction, and processing requirements for the Case 1 projection is included in Table 5-4. The near-term tank use, evaporator, and cross-site transfer information for Case 1 are shown in Tables 5-4 through 5-9.

Figure 5-5. Double-Shell Tank Space Requirements for the Case 1 Projection.

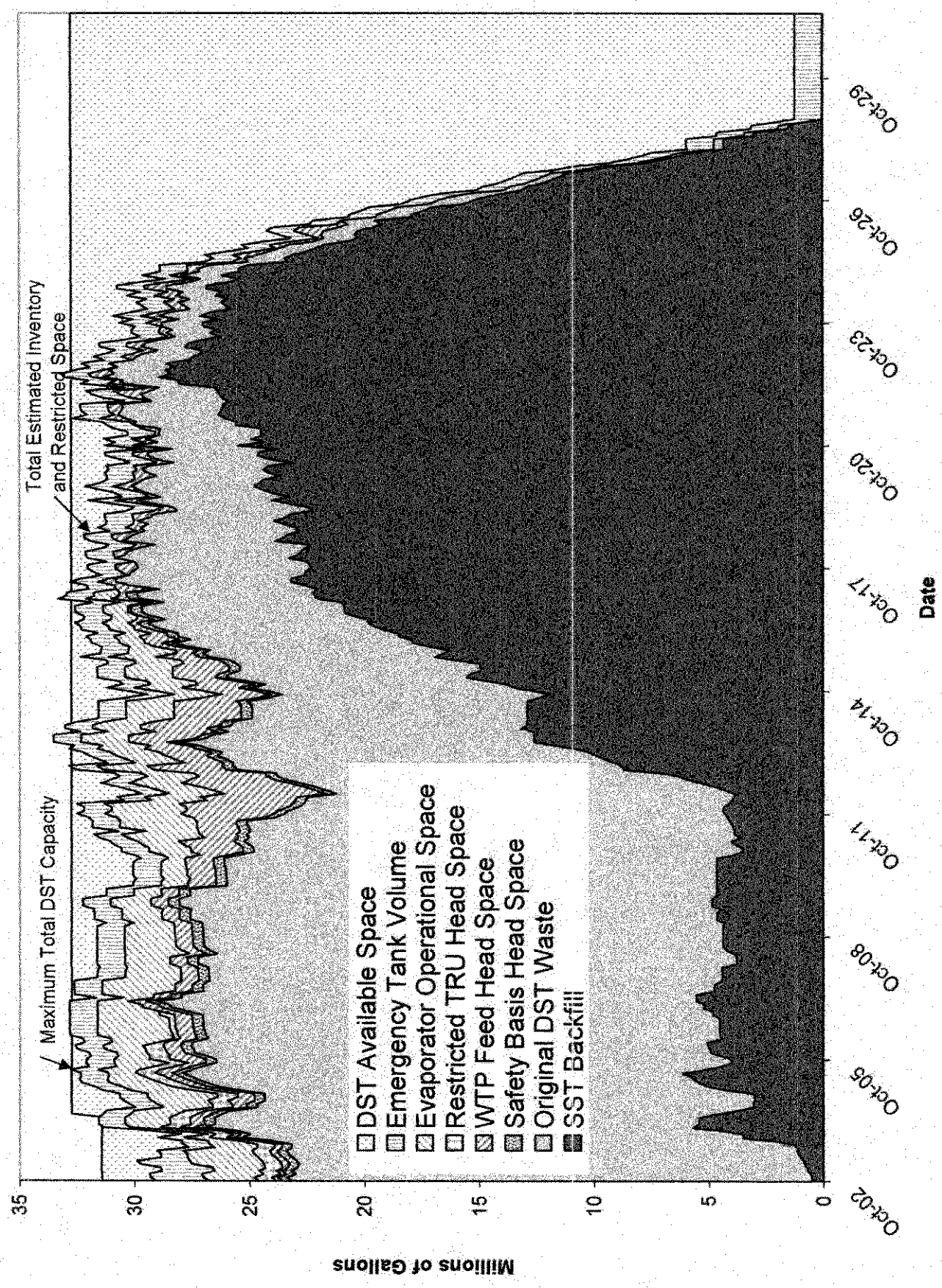


Table 5-4. Spreadsheet of Waste Additions and Reductions (Kgal) for Case 1.

FISCAL YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
STARTING INVENTORY	20924	23146	23992	24327	26469	27043	26767	27015	27588	25463	23493	23853	25909	24140	26712	26335	30280
SPACE UTILIZATION																	
Spare Space/WTP Emergency Return	1140	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
Restricted Space	1411	3038	3427	2919	2350	2282	1141	1002	1477	1966	2563	1346	2188	327	57	57	57
Priority/Operational Space	651	1469	1671	1157	1561	1196	1736	1906	2532	3286	2665	2318	2808	2782	3447	811	2829
NEW WASTE ADDITIONS																	
S Plant/WSCF	0	10	10	10	10	10	10	10	10	10	10	10	10	8	10	8	10
T Plant	0	15	15	14	8	5	3	3	3	3	3	3	3	3	3	3	3
300/400 Areas	0	0	15	15	29	11	5	4	4	0	0	0	0	0	0	0	0
Flushes	38	43	37	22	17	9	5	5	5	27	45	34	5	7	22	13	5
SWL Pumping	*2108*	*977*	*144*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Tank Farms	32	100	170	120	170	120	170	120	165	120	120	120	120	120	120	120	120
SST Retrieval	0	994	3450	5280	1242	897	1794	0	0	1557	4043	6067	2351	6851	4072	9610	3522
PFP	0	11	15	11	0	0	0	0	0	0	0	0	0	0	0	0	0
Inventory	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retrieval Water	39	272	60	23	100	65	6	5	0	306	0	7	5	8	7	5	11
Everything Else	0	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pretreatment Dilution	0	0	0	0	0	335	0	0	0	0	0	0	0	22	414	0	0
Wash Water	0	3	4	2	103	877	0	1041	1	48	4	6	3	4	22	8	26
PUREX	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
IMUST	0	0	0	0	0	0	0	0	0	100	100	100	100	100	0	0	0
NEW WASTE ADDITIONS TOTAL	2222	2456	3925	5502	1684	2334	1998	1193	193	2176	4330	6352	2602	7128	4675	9772	3702
TOTAL WASTE BEFORE EVAP	23146	25602	27917	29829	28153	29377	28765	28208	27781	27639	27823	30205	28511	31268	31387	36107	33982
EVAPORATOR WVR	0	-1610	-3590	-3360	-1110	-2610	-1750	-620	-670	-1480	0	0	0	0	0	0	0
CUM EVAPORATOR WVR	0	-1610	-5200	-8560	-9670	-12280	-14030	-14650	-15320	-16800	-16800	-16800	-16800	-16800	-16800	-16800	-16800
Low Activity Waste Outflow	0	0	0	0	0	0	0	0	-1172	-1172	-1805	-3204	-1984	-2027	-2665	-2000	-2000
High Level Waste Outflow	0	0	0	0	0	0	0	0	-476	-1494	-2165	-1092	-2387	-2529	-2387	-3827	-4466
EVAP AND OUTFLOWS TOTAL:	0	-1610	-3590	-3360	-1110	-2610	-1750	-620	-2318	-4146	-3970	-4296	-4371	-4556	-5052	-5827	-6466
NET INVENTORY CHANGE	2222	846	335	2142	574	-276	248	573	-2125	-1970	360	2056	-1769	2572	-377	3945	-2764
END OF YEAR INVENTORY	23146	23992	24327	26469	27043	26767	27015	27588	25463	23493	23853	25909	24140	26712	26335	30280	27516
TOTAL CAPACITY	26348	29699	30625	31745	32154	31445	31092	31696	30672	29945	30281	30773	30336	31021	31039	32348	31602
% of DST CAPACITY IN USE	84	91	94	97	98	96	95	97	94	91	93	94	93	95	95	99	97

Table 5-5. Projected Tank Use on September 2004. (2 Sheets)

Tank	Liquid (Kgal)	Solids (Kgal)	Total (Kgal)	Comment/Projected Use for Tank as of September 2004
AP-101	1200	0	1200	DSSF; first LAW feed tank in all projections.
AP-102	1002	23	1025	DSSF inventory; used to store concentrated waste beginning in FY 2003.
AP-103	1200	0	1200	CC/SL; received concentrated waste beginning FY 2003. Second LAW feed tank in all projections.
AP-104	1200	0	1200	CC; stores concentrated waste.
AP-105	1176	22	1198	Used to retrieve S-112 and S-102 waste, then refilled with DSSF in FY 2004.
AP-106	1140	0	1140	Received CP from AP-102 in FY 2001.
AP-107	28	4	32	DN/DC; used to receive cross-site SST retrieval waste from SY-101 and to stage dilute for evaporation.
AP-108	174	23	197	Used to receive cross-site SST retrieval waste from tanks SY-102 and SY-101, and to stage dilute for evaporation.
AN-101	1144	0	1144	Filled with DSSF when AN Farm becomes available in September 2003.
AN-102	944	134	1078	CC (TRU) inventory; (NCAW supernates are second and third sources).
AN-103	500	459	959	DSS inventory.
AN-104	608	445	1053	DSSF inventory; fourth LAW tank to be processed.
AN-105	588	538	1126	DSSF inventory.
AN-106	28	74	102	DN/SL; used to retrieve C-106 in FY 2003; receives cross-site SST retrieval waste from SY-101 and stages dilute for evaporation.
AN-107	873	233	1106	CC (TRU)/SL inventory.
AW-101	732	396	1128	DSSF/SL inventory.
AW-102	28	33	61	Evaporator feed tank; tank level will vary.
AW-103	787	313	1100	DSSF/PD solids; DSSF will be added to tank in FY 2007 and beyond.
AW-104	797	223	1020	DSSF/SL; will be refilled w/ DSSF started in FY 2003.
AW-105	159	263	422	DSSF/PD solids; projected refill w/ DSSF in FY 2006.
AW-106	623	223	846	Evaporator slurry receiver tank; tank level will vary as concentrated waste is added and removed.
AZ-101	919	52	971	NCAW/SL; second HLW feed tank in all projection cases.

Table 5-5. Projected Tank Use on September 2004. (2 Sheets)

Tank	Liquid (Kgal)	Solids (Kgal)	Total (Kgal)	Comment/Projected Use for Tank as of September 2004
AZ-102	885	105	990	NCAW/SL; supernates are blended with S-Farm wastes. Filled with DSSF in FY 2005. Third HLW feed tank in all projection cases.
AY-101	854	128	982	Emergency space; used to retrieve S-102 and C-104 waste beginning in FY 2003. First HLW feed tank in all projections.
AY-102	627	171	798	Received additional solids from C-106 in FY 2003; fourth HLW feed tank in all projection cases.
SY-101	569	268	837	CC/SL inventory; will be used for SST retrieval starting September 2003.
SY-102	773	191	964	DN/PT inventory; 200 West Area saltwell liquid and dilute receiver; will be used for SST retrieval and S-112 buffer starting September 2003.
SY-103	400	342	742	CC/SL inventory.

Notes:

CC = complexant concentrate waste.
CC/SL = complexant concentrate/ solids.
CC(TRU) = complexant concentrate transuranic waste.
CP = concentrated phosphate waste.
DN = dilute non-complexed waste.
DN/DC = dilute non-complexed waste/dilute complexed waste.
DN/PD = dilute non-complexed waste/PUREX decladding sludge.
DN/PT = dilute non-complexed waste/PFP TRU solids.
DN/SL = dilute non-complexed waste/solids.
DSS = double-shell slurry.
DSSF = double-shell slurry feed.
DSSF/SL = double-shell slurry feed/solids.
HLW = high-level waste.
LAW = low-activity waste.
NCAW/SL = neutralized current acid waste/solids.
PD = PUREX decladding sludge.
PUREX = Plutonium-Uranium Extraction Plant.
SST = single-shell tank.
TRU = transuranic.

Table 5-6. Evaporator Waste Volume Reduction and Liquid Effluent Retention Facility Additions for the Case 1 Projection.

Fiscal Year	Evaporator Waste Volume Reduction (Kgal)	Condensate to Liquid Effluent Retention Facility (Kgal)
2003	1,610	1,860
2004	3,590	4,130
2005	3,360	3,860
2006	1110	1,280
2007	2,610	3,000
2008	1,750	2,010
2009	620	720
2010	670	780
2011	1,480	1,700
2012	0	0
2013	0	0
2014	0	0
2015	0	0
2016	0	0
2017	0	0
2018	0	0

Table 5-7. Case1-Target-Case Evaporator Campaign Schedule.

Campaign	Start Date	Staging Tank (Staging Date to AW-102)	Original Waste Source	Waste Feed Type	Feed Volume (Kgal)	Waste Volume Reduction (Kgal)	Slurry Receiver Tank for Concentrated Waste (Final Storage Tank)
03-03	6/29/2003	AP-108 (6/12/2003)	AP-102	DN	1060	392	AP-108 (AN-101)
03-04	8/14/2003	SY-101 (7/16/2003)	SY-101	DN	520	136	AP-108 (AN-101-full)
04-01	10/30/2003	AP-105 (9/3/2003)	AP-105	DC	1020	280	AW-106 (AP-105)
04-02	12/5/2003	AP-104 (11/17/2003)	AP-104	DN	1070	430	AP-104
04-03	2/14/2004	AP-107 (1/29/2004)	AP-102 to AP-107 – 2/6/2003 SY-101 to AP-107 – 9/22/2003 (SWL and S-112)	DN	1100	420	AW-106 (AP-105 - full)
04-04	5/22/2004	AP-108 (2/28/2004)	SY-101 to AP-108 – 10/2/2003 (S-112)	DN	950	360	AW-106 (AP-103 – full), (AP-104 – full)
04-05	6/16/2004	AP-107 (5/29/2004)	SY-101 to AP-105 – 10/13/2003 (S-112) SY-101 to AP-105 – 12/22/2003 (S-102) AP-105 to AP-107 – 2/5/2004	DN	1100	530	AW-106 (AP-101)
04-06	7/14/2004	AP-101 (6/24/2004)	AP-101	DN	1090	330	AP-101
04-07	7/28/2004	AN-106 (7/20/2004)	AN-101 to AN-106 – 7/30/2003 C-106 to AN-106 – 10/18/2003 SY-101 to AN-106 – 1/15/2004 (S-102)	DN	1050	860*	AW-106 (AP-101)
04-08	9/24/2004	AY-102 (9/2/2004)	AY-102	DN	500	390*	AW-106 (AY-102-full), (AP-102-full)

Notes:

* High waste volume reduction requires multiple passes and use of Tank AW-106. Tank AW-106 must be cleaned-out before use.

DC = dilute complexed waste.
DN = dilute non-complexed waste.
DN/DC = dilute non-complexed/dilute complexed waste.

Table 5-8. Cross-Site Transfer Schedule for Case 1 Projection Through FY 2004.

Date for Cross-Site Transfer	Receiver Tank	Volume (Kgal, approximate)	Comments
December 2002	SY-102 to AP-102	400	DN/DC—saltwell liquid and DN
July 2003	SY-101 to AW-102	530	DC—SY-101 waste
September 2003	SY-101 to AP-107	800	DN/DC—saltwell liquid and DN (waste retrieved from S-112)
October 2003	SY-101 to AP-108	700	DN/DC—saltwell liquid and DN (waste retrieved from S-112)
October 2003	SY-101 to AP-105	600	DN (waste retrieved from S-112)
December 2003	SY-101 to AP-105	500	DN (waste retrieved from S-102)
December 2003	SY-101 to AY-101	750	DN (waste retrieved from S-102)
January 2004	SY-101 to AN-106	500	DN (waste retrieved from S-102)

Notes:

DN = dilute non-complexed waste.
DN/DC = dilute non-complexed/dilute complexed waste.

Aging Waste Tank Space for Case 1

Since no recently discharged fuel will be reprocessed at Hanford, only two of the four aging waste tanks (Tanks AZ-101 and AZ-102) are required to store existing aging waste. Radioactivity of the remaining aging waste is far below historical levels and little special operations are required for safe storage.

Waste from Tank C-106 was retrieved to Tank AY-102 in FY 1999, with the remainder planned for retrieval into Tank AY-102 and Tank AN-106 in FY 2003. Tank AY-101 will be used to retrieve the SST wastes from Tank S-102 and Tank C-104 starting in FY 2004.

In FY 2004, Tank AY-101 is used as a receiver tank for cross-sited Tank SY-101 waste during the retrieval of Tank S-102. This dilute waste is then staged through the evaporator and stored in AP-Farm, before Tank C-104 retrieval. In FY 2006, Tank AY-101 is used to receive Tank C-104 wastes, and is designated as the fourth HLW feed tank to WTP. The supernates from Tank AZ-102 are blended with saltcake SST retrieval waste, evaporated, and then returned to Tank AZ-102. Tank AZ-102 is topped-off with additional concentrated evaporator waste.

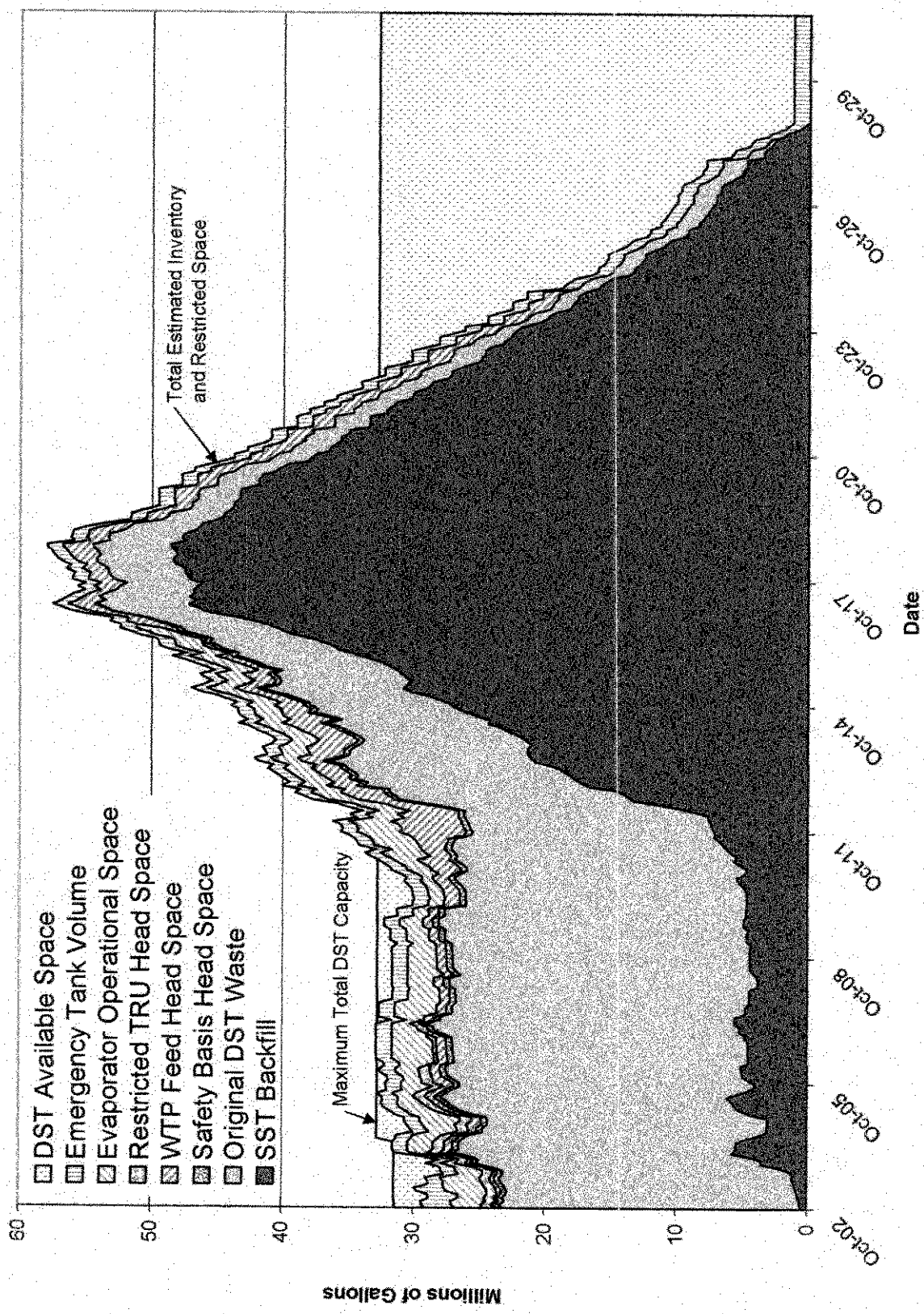
Table 5-9. Number of New Double-Shell Tanks to be Constructed and Funding Required ($M) to Meet Space Needs for Case 2.

Fiscal Year	Update Number of Tanks and Cost for Case 2 2018 Retrieval	
	New Double-Shell Tanks	Funding Required ($M)
2002	--	0
2003	--	0
2004	--	0
2005	--	0
2006	--	0
2007	--	18
2008	--	80
2009	--	160
2010	--	212
2011	3	214
2012	4	242
2013	1	303
2014	3	247
2015	6	98
2016	4	3
2017	--	--
2018	--	--
TOTALS	21	$1,575

5.4.2 Projection Case 2 Results

The objective of Case 2 was to estimate the number of new tanks needed if all SST retrieval is to complete in 2018 to assure meeting the TPA requirement of completing SST retrieval by September 30, 2018, and SST farm closure by September 30, 2024. The projected tank space needs for the Case 2 projection are shown in Figure 5-6. The projected tank space needs for the Case 2 projection exceed existing DST capacity by 3 tanks in FY 2011, by up to 7 tanks in FY 2012, by up to 11 tanks in FY 2014, and by up to a maximum of 21 additional tanks by FY 2018. The retrieval sequence and risk reduction curves for Case 2 are shown in Section 3.0. Options to reduce the tank space shortage for Case 2 are listed in Section 5.3 and include adjusting the SST retrieval schedule to match available space, increasing the waste treatment rates, and/or building additional DST space.

Figure 5-6. Double-Shell Tank Space Requirements for the Case 2 Projection.



5.4.3 Summary of Short-Range Projection Results for Case 1

This section provides an interpretation of detailed short-range projection results, applicable to projection Case 1, which is based on RPP System Plan, Rev. 2 Target Case (DOE 2003). These figures are intended to be used for near-term planning. This section presents certain information in the form of graphics. A number of these graphics show 12 months of historical operations and 24 months of projected operations. Most of the vertical axes represent thousands of gallons of waste generated. (The short-range graphics do apply to Case 2 for the near term, but the acceleration of SST retrieval will change long-range assumptions.)

In the computer simulation, facility waste streams are routed to a receiver tank. A tank fill graphic shows the filling of the receiver tank and is on the same page as the facility waste generation graph of the waste stream it receives. The tank fill graphic shows the rate at which a specific tank is filled with waste. Usually when a receiver tank is full, waste is transferred to a holding tank. This waste is either evaporated or stored for future disposal. For every transfer out of a tank, there is a corresponding receipt of the same volume into another tank or facility. For each evaporation out of a tank there is a corresponding receipt of the more concentrated waste in the receiving tank and an increase in the condensate from the 242-A Evaporator being sent to the Liquid Effluent Retention Facility.

The accuracy of this projection is directly related to the facility-supplied assumptions. Some of the major assumptions are listed below.

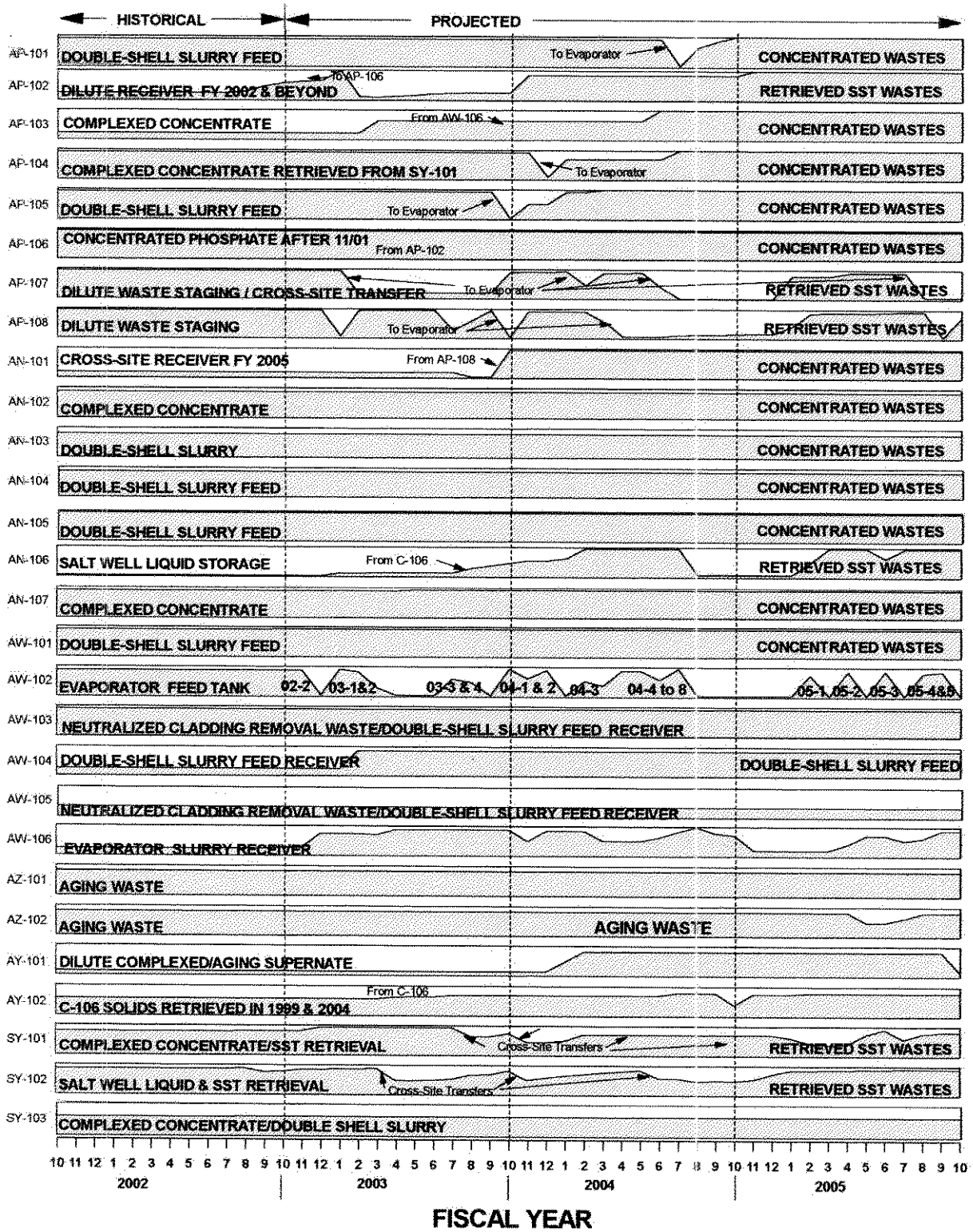
- Process operating schedules define the planned dates of plant operations or deactivation activities. These assumptions are consistent with the RPP program planning. Volumes and schedules for the various Hanford facilities for the two projection cases are presented in Appendix E.

- Plant waste generation assumptions define the volume and type of waste that will be generated by the plants. These assumptions result from an analysis of recent waste generation history and future plans specified by the plants. Most waste stream volumes are projected based on historical data and/or facility-supplied operating schedules. Section 5.2 includes a comparison of actual waste receipts to the facility waste generation targets for October 2001 to September 30, 2002.

Tank roles and waste routings define the use of tanks in the system. For example, a tank will be designated to act as the receiver of the PUREX facility miscellaneous waste (Tank AP-107), while other tanks will store concentrated waste.

Figure 5-7 shows the role of each tank for a period of four years. Note that if there are several transfers in or out of a tank in one month, no fluctuation in the tank level may appear. This is because the graphic program plots tank levels as of the last day of the month, and changes occurring during the month are not shown. The projected tank inventories and tank space usage for both Case 1 and Case 2 projections, as of September 2004, are included in Table 5-5.

Figure 5-7. Tank Levels During the Short-Range Projection for Case 1.



Non-Aging Tank Space

In later parts of the projections when tank space becomes tight because of processing needs and/or the amount of SST wastes being retrieved, the evaporator is assumed to operate yearly to minimize waste storage needs and to decrease the volume of retrieved SST waste. Tank space pinches occurring between FY 2003 and FY 2018 (see Figure 5-5) are caused by a combination of factors, including the following.

- Saltwell liquid pumping (SST interim stabilization) volumes are pumped by the end of FY 2004 and two tanks in the 200 East Area are available to receive saltwell liquid;
- The number of intermediate staging tanks used to stage wastes for Initial Phase processing (Tanks AN-101, AN-102, AN-105, AP-104, and AP-101);
- The large volume of SST waste retrieved beginning in FY 2003; and
- The decision not to consolidate neutralized current acid waste solids, which have increased the DST space needs from 2001 and beyond.

Figures 5-5 through 5-12 show the detailed operation of all the DST waste tanks for the Case 1 projection during the near term.

5.4.4 Evaporator Waste Volume Reduction and Liquid Effluent Retention Facility Condensate

Schedule and operational considerations presented in Appendix E result in the following evaporator waste volume reduction and Liquid Effluent Retention Facility condensate production volumes for the Case 1 projection. The ratio of process condensate sent to the Liquid Effluent Retention Facility for every gallon of waste volume reduction for Evaporator Campaigns 94-1, 94-2, and 95-1 was 1.29, 1.24, and 1.26, respectively (Guthrie 1996). The evaporator seal water and demister spray upgrade could reduce future process condensate production to 1.15 gal of condensate/gallon of waste volume reduction, which would lower the value used for future projections. The two projections used a value of 1.15 gal of condensate/gallon of waste volume reduction (Bowman 2000 and Flyckt 2002) to project future condensate production recorded in Table 5-6. The waste sources, campaign schedule, and concentrated waste receiver tanks used in the Case 1 projection are summarized in Table 5-7. Table 5-7 shows evaporator campaigns through the FY 2004. Cross-site transfers through FY 2004 are shown in Table 5-8.

See Figure 5-8 for dilute receiver tanks, evaporator waste volume reduction, and the 242-A Evaporator operating schedules for the Case 1 projection.

Figure 5-8. Case 1 Dilute Receiver Tanks and 242-A Evaporator Operations.

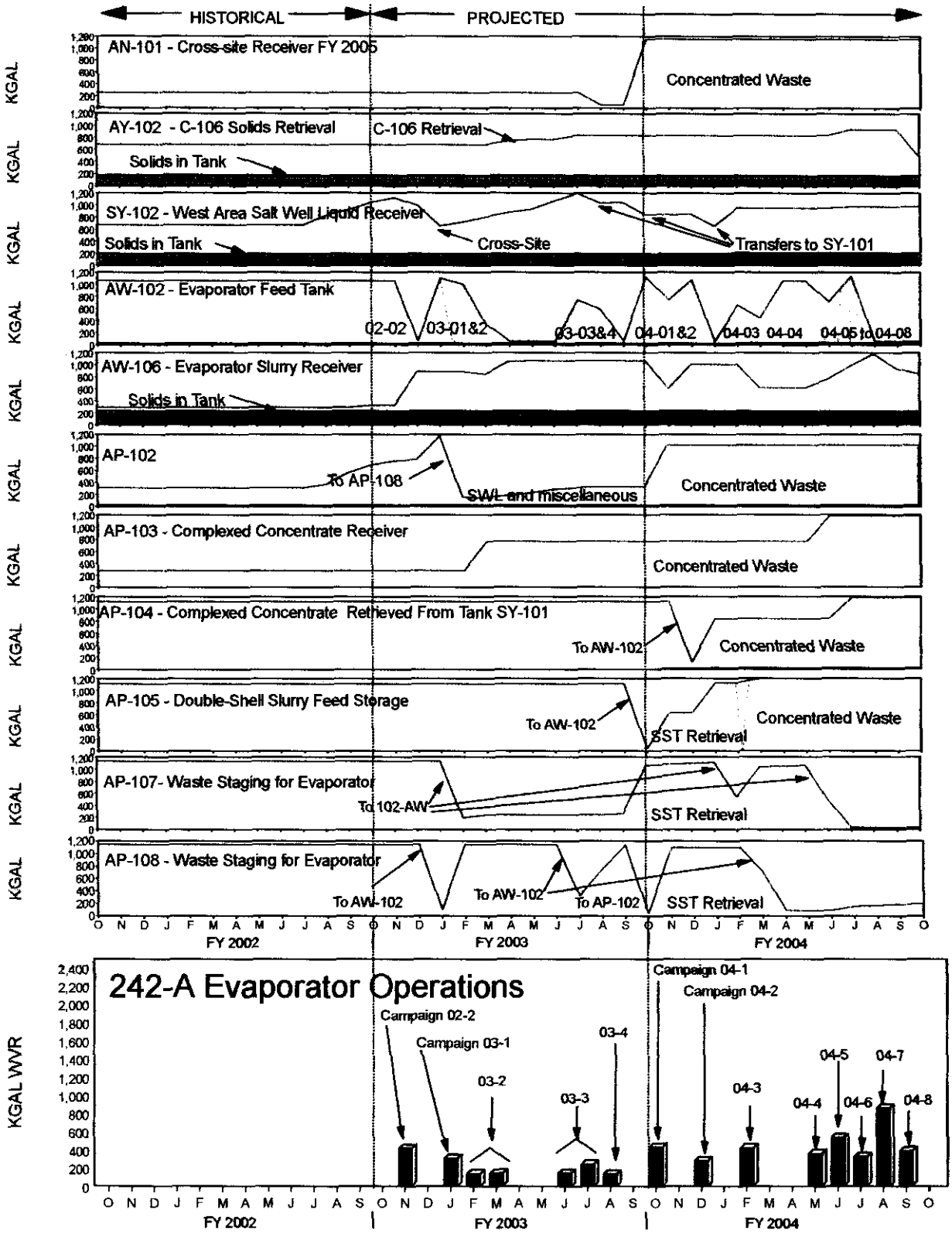


Figure 5-9. Case 1 West Area Waste Generations and SY Tank Levels.

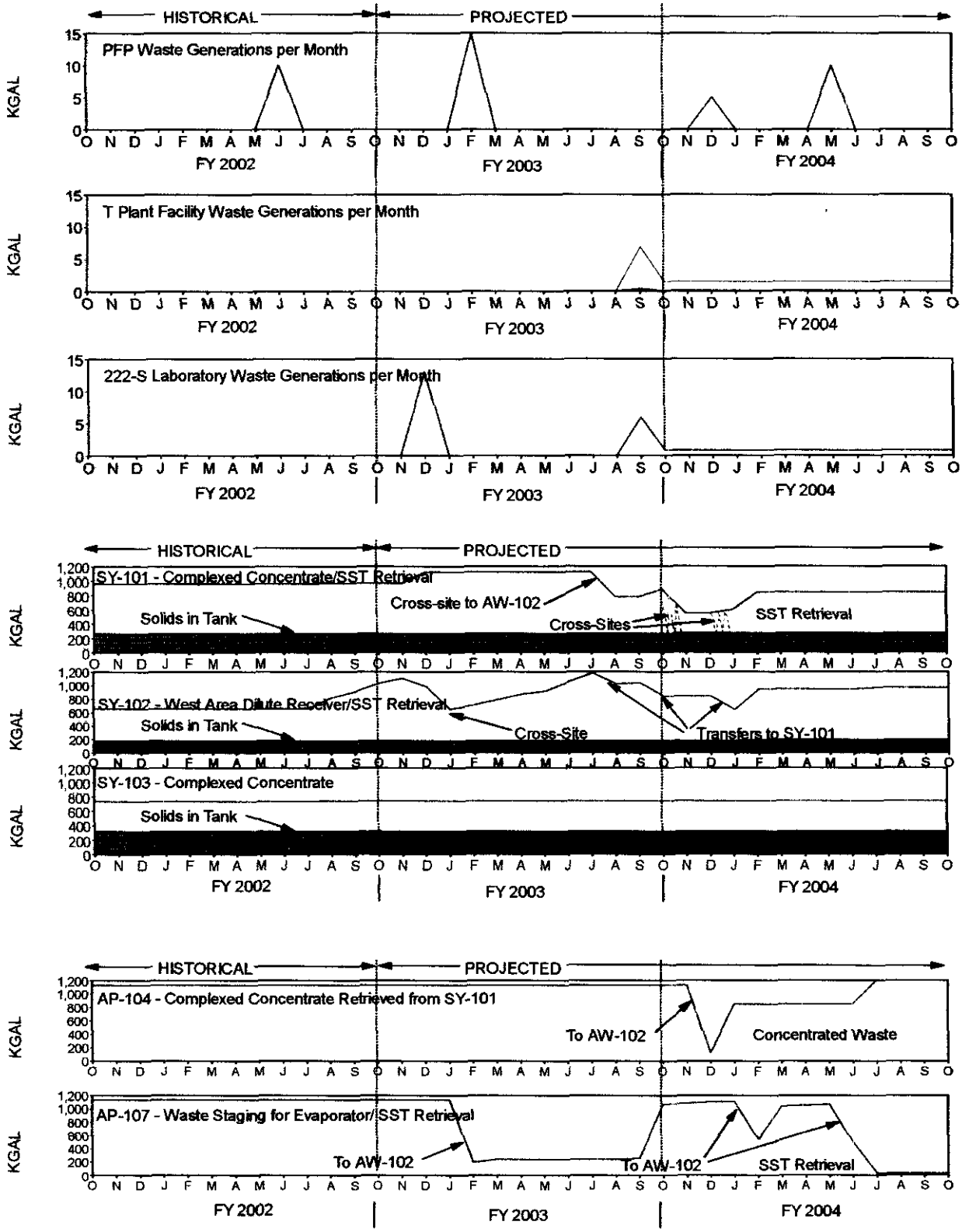


Figure 5-10. Case 1 AN Farm Tank Levels.

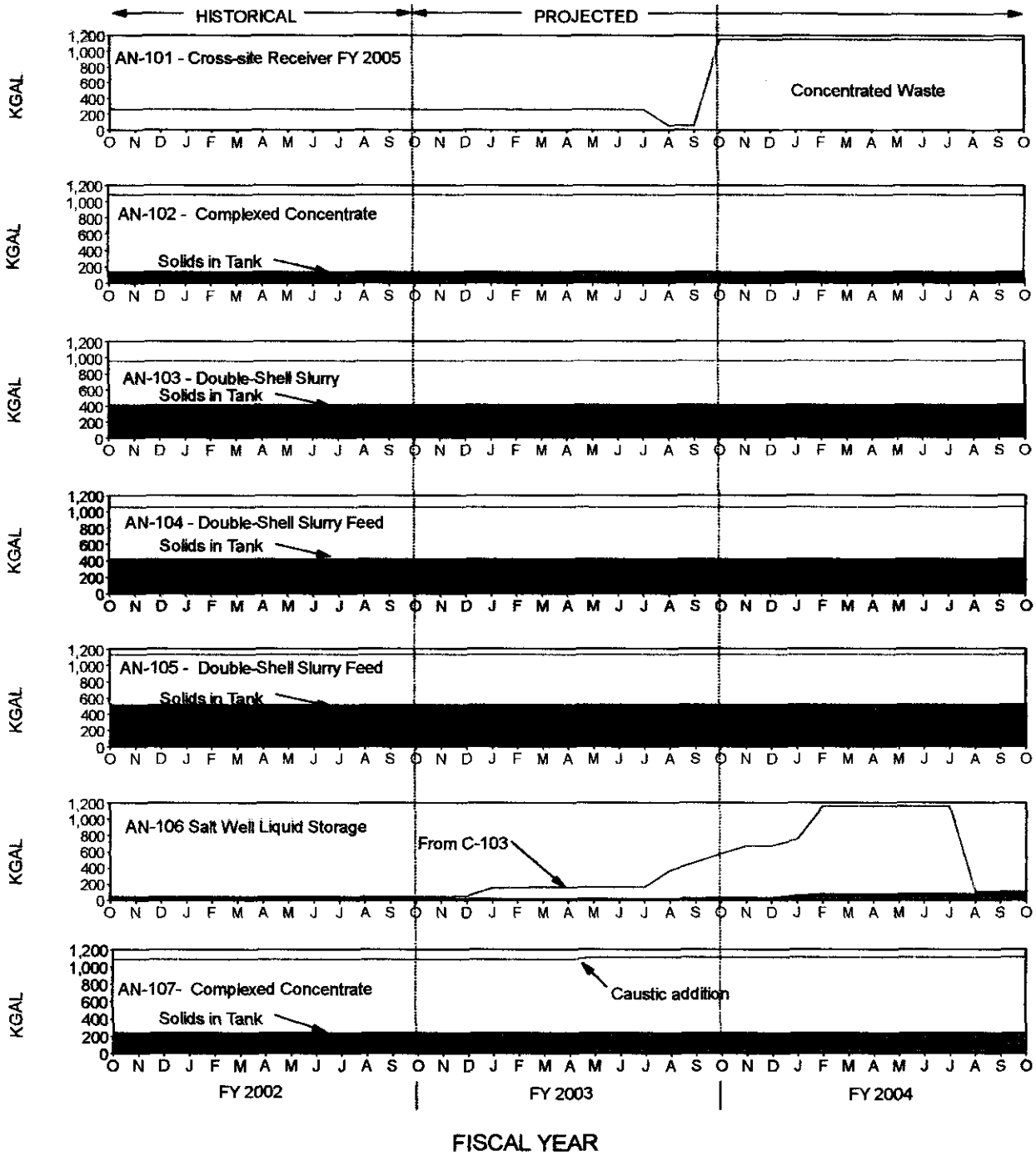


Figure 5-11. Case 1 AP Farm Tank Levels.

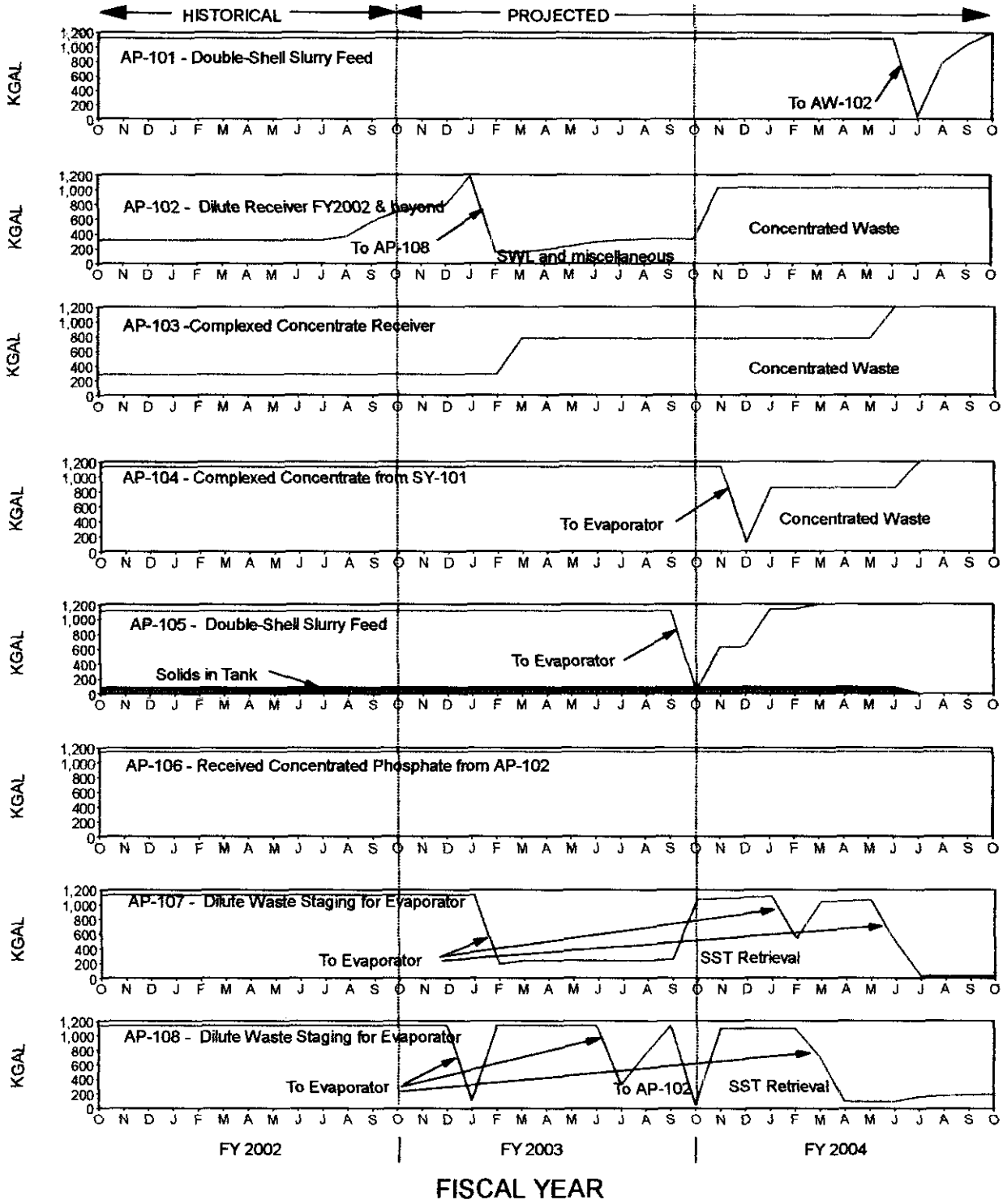
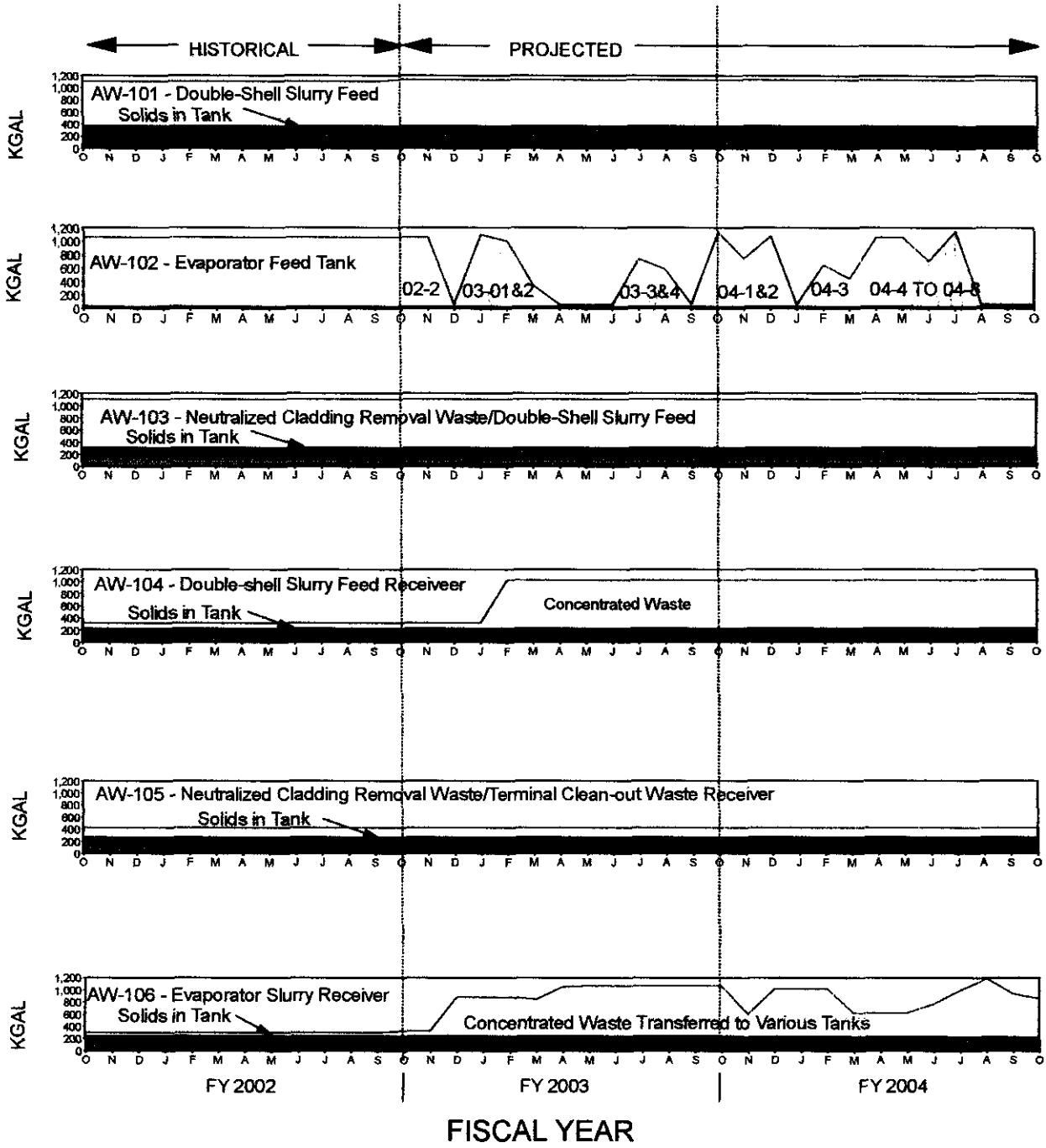


Figure 5-12. Case 1 AW Farm Tank Levels.



There should be sufficient Liquid Effluent Retention Facility and DST space for storage of Hanford facilities-generated waste and condensates between FY 2003 and the end of 2018, provided the following:

- The 242-A Evaporator schedule is achieved;
- The amount of condensate sent to the Liquid Effluent Retention Facility does not grossly exceed the 1.15 gal condensate/gallon waste volume reduction factor;
- Facilities stay within their respective generation limits;
- No unexpected waste receipts are received in the DSTs;
- Tank farm outages due to construction projects do not prohibit timely evaporator support; and
- Basin 42 must be emptied to 3 feet at least once every 365 days (Bowman 2003).

5.5 PROJECTED TANK NEEDS

This section describes the projected tank needs for both cases. It also provides a discussion on the cost estimate for additional DSTs.

5.5.1 Case 1 Projected Tank Needs

The Case 1 projection will conduct all retrieval activities within the existing DST capacity. For Case 1, no new DSTs are needed.

5.5.2 Case 2 Projected Tank Needs

The Case 2 projection, which retrieves all SSTs by 2018, exceeds DST capacity. For this subset, 21 new DSTs are needed.

5.5.3 Cost Estimates for Additional Double-Shell Tanks

Cost estimates for building new DSTs were completed during 1993-1994 to support new tank construction (Project W-236A). Discussions about current estimates with some of the W-236A staff members resulted in a rough estimate of around $75 million in 2003 dollars to build a simplified version of the tank designed seven years ago for project W-236A. Project W-236A estimated six years from design to construction complete (assumes expense funding). The time to complete construction could be accelerated to five years if a lower confidence schedule were adopted (e.g., 50% confidence the project would be completed within the designated cost and schedule versus the 80% confidence).

For projection Case 2, which retrieves SSTs by 2018, the total cost using year 2003 dollars would be on the order of $1.575 billion to build the 21 tanks needed by 2018. To calculate total

cost for the job on a yearly cost basis, the Project W-236A construction and cost schedule was used to calculate year 1 (8%), year 2 (25%), year 3 (35%), year 4 (31%), and year 5 (1%).

The cost and schedule presented represent only the costs to design and procure new tanks (capital line item). The schedule represents the standard times for performing conceptual designs, title II design, and construction based on Project W-236A. It assumes that funding for this will be obtained when requested. In recent experience, it may take several years to obtain the authorization and funding necessary for a line item of this magnitude. The costs do not reflect the life-cycle costs of the additional tanks. Specifically, additional costs would be incurred for the following items:

- Readiness review/acceptance of the new tanks;
- Operations of the new tank farms (it is assumed that the tanks would be grouped in farms, rather than built on an 'as needed' basis as presented, to minimize operational expenses). These expenses include added surveillances and maintenance of the new tank farm facilities;
- Cleanout of the new tank systems at the end of their use;
- Closure of the new tank systems, assuming clean closure cannot be achieved; and
- Post-closure monitoring of the new tank systems.

These additional costs likely will exceed the initial cost of construction of the new tanks. The intent in this section is to present a general feel for the number of new tanks and relative construction costs associated with them. Should the decision be made to build new tanks, a complete life-cycle cost estimate will be performed to assess the optimum number and grouping (e.g., number of new farms) that may be needed before proceeding with design.

For projection Case 2, the first three new tanks are required to be available for use by the end of FY 2011 (Table 5-9); therefore, funding would be needed to start this project by the start of FY 2005. It is expected that the funding request would start in FY 2004, which would allow design to start by FY 2006 to meet the construction complete schedule of 2011. The Project staff needs to start planning for this new work in one fiscal year.

6.0 CONCLUSIONS

6.1 SINGLE-SHELL TANK RETRIEVAL SEQUENCE

6.1.1 Single-Shell Tank Risk-Sequence Benefits

The FY 2003 retrieval sequence using airborne and groundwater risk factors continue the improved approach developed in FY 2002 for Revision 1 of this document. The enhanced basis for risk measures is as follows.

- The FY 2000 sequence was determined solely on technetium-99 inventory, while the FY 2001, FY 2002, and FY 2003 sequences distinguish between long-lived mobile radionuclides (carbon-14, selenium-79, technetium-99, iodine-129, and uranium-238) and airborne contaminants of concern (isotopes of americium, curium, niobium, neptunium, plutonium, tin, uranium, and other TRU).
- The increased groundwater and airborne risk reduction in early years resulted in a good approximation of the ideal risk reduction curves (Figures 4-1 through 4-6).

6.1.2 Single-Shell Tank Assumption-Based Benefits for the Target Case (Case 1)

Changing assumptions in the HTWOS model yielded the following results for the overall retrieval sequence.

- Retrieval of all SSTs is completed by March 19, 2026.
- Risk reduction in airborne and groundwater radionuclides and chemical contamination is improved over the FY 2002 sequence.
- Processing of all SST and DST waste is completed by the end of 2028.
- Allowing HTWOS to choose between high airborne-risk and high groundwater-risk tanks enabled a better balance of feeds to keep both the HLW and LAW melters running.

6.2 DOUBLE-SHELL TANK SPACE EVALUATION

A delay in the start date of the WTP and decreases in the processing rates for WTP have impacted the amount of space in DSTs that will be available for SST retrieval. The delay in the start of LAW processing and the lower waste treatment rates have decreased the space available for SST retrieval. The retrieval and dilution of Tank SY-101 in FY 2000 to resolve the safety issue further decreased the space available for SST retrieval. To complete retrieval of all SSTs by 2018, case 2 exceeds available space in FY 2011-2018, and requires approximately 21 new DSTs.

Options to reduce the tank space shortage include adjusting the SST retrieval schedule to match available space, increasing the waste treatment rates, including development of supplemental

treatment technologies, and/or building additional DST space. Costs and schedule estimates to build the additional tanks have been included in Table 5-9.

The projected tank space shortage in Case 2 may be avoided by a combination of the following options:

- Accelerate the treatment of waste (accelerate supplemental treatment and increase its capacity);
- Increase the processing rate of the WTP;
- Delay retrieval of SST wastes (would require changing the assumption that all SSTs are retrieved by September 30, 2018);
- Allow addition of wastes to early feed-tank headspace; and
- Construct new DSTs.

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APPENDIX A

ASSUMPTIONS MATRIX AND SCENARIO DEFINITIONS FOR 2003 SINGLE-SHELL TANK RETRIEVAL SEQUENCE AND DOUBLE-SHELL TANK SPACE EVALUATION

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A1.0 ASSUMPTIONS MATRIX

Table A-1 is the assumptions matrix for the projection cases. Differences in assumptions among the cases have been highlighted in the table.

A2.0 HTWOS MODEL SCENARIO AND SOFTWARE CHANGE SUMMARY FORMS

Table D-1 is the software change summary form for the SST retrieval case.

A3.0 REFERENCE

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Differences in assumptions among the projection cases have been highlighted.

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1** **Target Case**	**Case 2** **TPA-Compliant Case**	**Comments**
Brief Description	**Risk-based SST Retrieval within Existing DST Capacity** Based on RPP System Plan, Rev. 2 Target Case with updated waste volume projections and historical transfer data. SST Retrieval Sequence complies with M-45-00B milestone to retrieve high risk tanks early. Retrieves first 26 SSTs identified in "Integrated Mission Acceleration Plan," with the exception of U-107. SST retrieval completed as space in the existing DSTs will allow. Waste feed delivery and treatment rates are consistent with those established for CH2M Hill's current baseline; processing completed in 2028. Process low Cs waste through non-WTP supplemental LAW treatment facility. Tank space options: • Re-evaporate waste to 1.47 SpG. • Use of WTP feed restricted space. • Increase tank fill limits. • Evaporate SST retrieved waste until WTP starts. • Decrease emergency space to 1.2 Mgal. Salt well liquid pumping complete in 2004 to meet Consent Decree milestones.	**Risk-based SST Retrieval with Added DST Capacity** Based on RPP System Plan, Rev. 2 Target Case with updated waste volume projections and historical transfer data. SST Retrieval Sequence complies with M-45-00B milestone to retrieve high risk tanks early. Retrieves first 26 SSTs identified in "Integrated Mission Acceleration Plan," with the exception of U-107. SST retrieval completed by 9/30/2018 and closure of SST tank farms by 9/30/2024. Waste feed delivery and treatment rates are consistent with those established for CH2M Hill's current baseline; processing completed in 2028. All waste feed to supplemental treatment will be pretreated to remove radionuclides before immobilization and disposal. Tank space options: • Re-evaporate waste to 1.47 SpG. • Use of WTP feed restricted space. • Increase tank fill limits. • Evaporate SST retrieved waste until WTP starts. • Decrease emergency space to 1.2 Mgal. • Determine additional needed DST capacity. Salt well liquid pumping complete in 2004 to meet Consent Decree milestones.	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1** **Target Case**	**Case 2** **TPA-Compliant Case**	**Comments**
Major Technical Assumptions			
BBI data represents tank compositions and inventory as of	July 1, 2002 with adjustments for historical transfers through 5/31/2003.	July 1, 2002 with adjustments for historical transfers through 5/31/2003.	
Mission Summary Diagram -Schedule float -Transfer window	 Schedule float external to the model Two months	 Schedule float external to the model Two months	
Non-Tank Farm Facility Generations			
Total Limit	18-59 Kgal/year	18-59 Kgal/year	
PUREX Yearly Rate	 5 Kgal/year	 5 Kgal/year	
B Plant Yearly Rate	 No wastes anticipated	 No wastes anticipated	
WESF Yearly Rate	 No wastes anticipated	 No wastes anticipated	
222-S Laboratory Yearly Rate Flush for misc. waste WVRF	 10 Kgal/year 22% 99%	 10 Kgal/year 22% 99%	
T Plant Yearly Rate (FY 2003) Yearly Rate (FY 2003 on) Flush for misc. waste WVRF	 17 Kgal/year 3 to 14 Kgal/year 22% 99%	 17 Kgal/year 3 to 14 Kgal/year 22% 99%	
300 Area Yearly Rate Flush for misc. waste WVRF	 0 to 30 Kgal/year 44% 94%	 0 to 30 Kgal/year 44% 94%	
400 Area Yearly Rate	 No wastes anticipated	 No wastes anticipated	
WSCF Yearly Rate	 No wastes anticipated	 No wastes anticipated	
PFP Stabilization Dates Total volume Flush WVRF	 2003-2005 37 Kgal total 22% 81%	 2003-2005 37 Kgal total 22% 81%	
100 Area 100-N Volume, Kgal ---------- 100-K Basin Cleanout Volume, Kgal ---------- 105-F & 105-H Basin Volume, Kgal	 No wastes anticipated ---------- No wastes anticipated ---------- No wastes anticipated	 No wastes anticipated ---------- No wastes anticipated ---------- No wastes anticipated	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	Case 1 Target Case	Case 2 TPA-Compliant Case	Comments
Tank Farm Waste Generations			
Tank Farms			
Yearly Rate	120 Kgal/year	120 Kgal/year	
WVRF	99%	99%	
IMUST Wastes			
Total Volume (2011-15)	500 Kgal total	500 Kgal total	
Chemical Addition, Kgal			
Tank AN-102 (FY 2003)	AN-102--20.0 (19 M NaOH) + flush	AN-102--20.0 (19 M NaOH) + flush	
Tank AN-106 (FY 2003) add during retrieval of C-106	AN-106--20.0 (19 M NaOH) + flush	AN-106--20.0 (19 M NaOH) + flush	
Tank AN-107 (FY 2003)	AN-107--24.0 (19 M NaOH) + flush	AN-107--24.0 (19 M NaOH) + flush	
Tank AW-105 (FY 2003)	AW-105--10.0 (19 M NaOH) + flush	AW-105--10.0 (19 M NaOH) + flush	
SST Interim Stabilization			
Total Volume remaining	~0.38 Mgal on 4/1/2003	~0.38 Mgal on 4/1/2003	
Volume remaining without tanks S-102 & S-112	~0.27 Mgal on 4/1/2003	~0.27 Mgal on 4/1/2003	
West Area Receiver	Tank SY-102	Tank SY-102	
Pumping Completion, FY	2004	2004	
Dilution/Flush for Pumping	28-275%	28-275%	
WVRF, non-complexed	~47%	~47%	
WVRF, complexed	~10%	~10%	
DST Space Management			
Evaporator			
242-A Shutdown	2019	2019	
New Evaporator Available	No new evaporator capacity available after 2019.	No new evaporator capacity available after 2019.	
Outage Date (total months)	2003 (3), 2004 (4) 2005 (6), 2006 (3)	2003 (3), 2004 (4) 2005 (6), 2006 (3)	
Training Vol. (bi-yearly)	50 Kgal	50 Kgal	
Average Evaporation Rate	500 Kgal/month	500 Kgal/month	
Modeled Evaporation Limit	1.47 g/ml	1.47 g/ml	
LERF Basin 42 capacity	7.8 Mgal	7.8 Mgal	
Basin 42 cleanout requirement	Empty to 3 ft. at least once every 365 days	Empty to 3 ft. at least once every 365 days	
Time to cleanout Basin 42	60 days to sample and empty	60 days sample and empty	
Gal. Condensate/gal. WVR	1.15	1.15	
Modeled Characterization Time	3 months minimum	3 months minimum	
Yearly evaporation of waste	Yes	Yes	
SST Wastes Evaporated	Until start of WTP	Until 2018	
Effluent Treatment Facility			
Total treatment capacity	24 Mgal/year	24 Mgal/year	
Rate for evaporator condensate	5 Mgal/year	5 Mgal/year	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1** **Target Case**	**Case 2** **TPA-Compliant Case**	**Comments**
Total Emergency Space/WTP Return and Contingency Space Emergency Space LAW or HLW Return Space Contingency space	1.2 Mgal Total 1.2 Mgal Part of emergency space None	1.2 Mgal Total 1.2 Mgal Part of emergency space None	
Waste Segregation/DST Solids Total DST solids Store DSSF in NCRW tanks Store DSSF on NCAW solids Segregate Complexed wastes	~4.6 Mgal Not until solids removed. Yes If Possible	~4.6 Mgal Not until solids removed Yes If Possible	
Loss of DST Space Number tanks removed from service through the Initial Quantity Number tanks removed from service in enhanced WTP operations	None No DST failures or replacements assumed	None No DST failures or replacements assumed	
Tank Space Options Incorporated (M-45-12-T01 options)	• Raising tank fill limits will add up to 1.4 Mgal beginning 6/1/04. • Further concentration of waste will save up to 2.6 Mgal (1.47 SpG). • Use of WTP feed restricted space; savings to be determined by the model. • Decreasing emergency space to 1.2 Mgal will save 1.08 Mgal. • Total space savings incorporated will be determined by the model.	• Raising tank fill limits will add up to 1.4 Mgal beginning 6/1/04. • Further concentration of waste will save up to 2.6 Mgal (1.47 SpG). • Use of WTP feed restricted space; savings to be determined by the model. • Decreasing emergency space to 1.2 Mgal will save 1.08 Mgal. • Total space savings incorporated will be determined by the model. • Determine additional DST capacity needed to support completion of SST waste retrieval by 9/30/2018 and closure of SST tank farms by 9/30/2024.	
Major Project Assumptions			
241-A-A Pit work (W-314)	3/1/2004 - 1/12/2005	3/1/2004 - 1/12/2005	
AN Farm Outage (W-314)	10/1/2001 - 3/12/2004	10/1/2001 - 3/12/2004	
AP Farm Outage (W-314)	5/15/2003 - 3/1/2005	5/15/2003 - 3/1/2005	
Cross-site line outage connects cross-site to AN farm (W-314)	1/1/2004 - 4/30/2004	1/1/2004 - 4/30/2004	
Cross-site to AP farm (W-211)	1/1/2004 -4/30/2004	1/1/2004 -4/30/2004	
AW Farm Outage (W-314)	12/2/2002 - 8/9/2004	12/2/2002 - 8/9/2004	
SY Farm Outage (W-314)	11/1/2002 - 5/30/2004	11/1/2002 - 5/30/2004	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1** **Target Case**	**Case 2** **TPA-Compliant Case**	**Comments**
244-S Outage (W-314) - 222-S direct routed to SY farm after 9/30/2004 - PFP can no longer use 244-S after 6/30/2005 (waste from 244-TX is now routed through 244-S)	4/10/2003 - 9/30/2004	4/10/2003 - 9/30/2004	
AY Farm Electrical and Instrumentation Upgrades	12/23/2002 - 12/08/2003	12/23/2002 - 12/08/2003	
AZ Farm Electrical and Instrumentation Upgrades	1/09/2003 - 10/10/2003	1/09/2003 - 10/10/2003	
WTP LAW Feed Delivery			
LAW Feed Delivery Sequence and Envelope Designation	Source Tank (Envelope) AP-101 (A) 1-3 tanks from AP Farm (A) AN-104 (A) AN-102 (C) AN-105 (A) AN-107 (C) SY-101 (A) AN-103 (A) AW-101 (A) SST retrieval wastes	Source Tank (Envelope) AP-101 (A) 1-3 tanks from AP Farm (A) AN-104 (A) AN-102 (C) AN-105 (A) AN-107 (C) SY-101 (A) AN-103 (A) AW-101 (A) SST retrieval wastes	
First LAW Delivery	Start date 12/1/2009	Start date 12/1/2009	
Compliance Verification Sampling	• 270 days to certify a feed batch (HTWOS will adjust to maintain WTP operation). • Cannot complete certification more than 720 days before delivery. • Backup tanks do not need to be recertified after 720 days if contents have not changed.	• 270 days to certify a feed batch (HTWOS will adjust to maintain WTP operation). • Cannot complete certification more than 720 days before delivery. • Backup tanks do not need to be recertified after 720 days if contents have not changed.	
WTP LAW Waste Treatment and Immobilization Plant			
LAW Pretreatment Ramp Up	From - To MT Na/yr (net) 12/1/09-1/31/11 based on melter 2/1/11-12/31/28 2840	From - To MT Na/yr (net) 12/1/09-1/31/11 based on melter 2/1/11-12/31/28 3000	TPA Compliant case assumes increase in effective pretreatment capacity provided by either expansion of WTP or provided as part of Supplemental Treatment.
Backup Feed Strategy	Identify one tank as backup. No rolling backup required.	Identify one tank as backup. No rolling backup required.	
WTP Feed Tanks	WTP provides space	WTP provides space	
LAW Feed Receipt Tank Usage	1.5 Mgal Total Capacity;	1.5 Mgal Total Capacity;	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1** **Target Case**	**Case 2** **TPA-Compliant Case**	**Comments**
	be capable of receiving 1 Mgal without interruption while feeding out of the remaining 0.5 Mgal	be capable of receiving 1 Mgal without interruption while feeding out of the remaining 0.5 Mgal	
Pretreated NCAW Receipt Tanks	WTP provides space	WTP provides space	
Entrained Solid Receipt Tanks	WTP provides space	WTP provides space	
WTP Returns	No returns to DST system, except for emergency returns.	No returns to DST system, except for emergency returns.	
Pretreatment Durations	• The difference between delivery date and facility ramp up date for first LAW batch and first two HLW batches. • One month for remainder of batches.	• The difference between delivery date and facility ramp up date for first LAW batch and first two HLW batches. • One month for remainder of batches.	
LAW Pretreatment Capacity	~7.78 MT Na/day	~8.22 MT Na/day (3000 MT Na/year)	The pretreatment facility operating rate may need to be increased to complete processing by 12/31/2028.
LAW Melter Capacity	28.8 MTG/d	28.8 MTG/d	
LAW Vitrification Ramp Up	From - To MTG/day 3/1/10-1/31/11 3.4 2/01/11-12/31/11 18.0 1/01/12-12/31/12 24.0 1/01/13-12/31/28 28.8	From - To MTG/day 3/1/10-1/31/11 3.4 2/01/11-12/31/28 28.8	
Complete Waste Treatment	By 12/31/2028	By 12/31/2028	
LAW Waste Treatment Model for Sulfate	20 % of SO_4 in melter feed goes to Supplemental LAW treatment.	20 % of SO_4 in melter feed goes to Supplemental LAW treatment.	
ILAW Na_2O Loading	Based on the Gimpel rule (Rev. 4) for calculating the concentration of SO_3 in glass.	Based on the Gimpel rule (Rev. 4) for calculating the concentration of SO_3 in glass.	
WTP Supplemental LAW Processing			
Supplemental LAW Processing Ramp-Up	From - To MT Na/yr (net) 1/31/11-12/31/28 (2840-LAW Vit rate)	From - To MT Na/yr (net) 1/31/11-12/31/28 (3000-LAW Vit rate)	
Product and Packaging	Three sets of product assumptions will be used outside of the HTWOS model to estimate product mass, volume, and packaging. Bulk-Vitrification • 20 wt% waste Na_2O loading • Glass density 2.6 MT/m^3 • Package holds 30 MT glass Steam Reformer • 19.8 wt% waste Na_2O loading • Product density 1.0 MT/m^3 • Package holds 2.3 m^3	Three sets of product assumptions will be used outside of the HTWOS model to estimate product mass, volume, and packaging. Bulk-Vitrification • 20 wt% waste Na_2O loading • Glass density 2.6 MT/m^3 • Package holds 30 MT glass Steam Reformer • 19.8 wt% waste Na_2O loading • Product density 1.0 MT/m^3 • Package holds 2.3 m^3	Product estimates will be made for all 3 technologies being considered for supplemental treatment.

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1** **Target Case**	**Case 2** **TPA-Compliant Case**	**Comments**
	Cast Stone • Product volume 1.4 times the feed volume at 5 M Na • Product density 1.5 MT/m^3 • Package holds 3.625 m^3	Cast Stone • Product volume 1.4 times the feed volume at 5 M Na • Product density 1.5 MT/m^3 • Package holds 3.625 m^3	
WTP HLW Feed Delivery			
HLW Feed Delivery Sequence and Retrieval Efficiency	Source Tank / Retrieval Efficiency AY-102 90% AZ-101 90% AZ-102 80% C-104/AY-101 100%/100% C-107/AY-102 100%/100% AW-104 100% Continue with HLW solids made available from SST retrieval.	Source Tank / Retrieval Efficiency AY-102 90% AZ-101 90% AZ-102 80% C-104/AY-101 100%/100% C-107/AY-102 100%/100% AW-104 100% Continue with HLW solids made available from SST retrieval.	
First HLW Delivery of AY-102 starts	12/15/2009	12/15/2009	
Compliance Verification Sampling	Allow 270 days to complete feed compliance verification.	Allow 270 days to complete feed compliance verification.	
Contingency Feed	Identify sufficient feed sources to provide 20% extra.	Identify sufficient feed sources to provide 20% extra.	
Backup Feed Strategy	Identify one tank as backup. No rolling backup required.	Identify one tank as backup. No rolling backup required.	
WTP HLW Treatment and Immobilization Plant			
Initiate HLW Vitrification Services (full capacity)	Included in ramp up.	Included in ramp up.	
HLW Vitrification Ramp-Up	From - To / MTG/d (net) 5/17/10-1/31/11 0.69 2/1/11-12/31/11 3.0 1/1/12-12/31/12 4.0 1/1/13-12/31/28 5.0	From - To / MTG/d (net) 5/17/10-1/31/11 0.69 2/1/11-12/31/28 5.0	
Method for Estimating HLW Waste Oxide Loading	Glass Properties Model	Glass Properties Model	
HLW Feed Receipt Tank Usage	Sufficient space to receive 160,000 gallons (600 m^3) of HLW feed without interruption.	Sufficient space to receive 160,000 gallons (600 m^3) of HLW feed without interruption.	
HLW WTP Process Model	• Water wash factors in TWINS on 9/30/2001 will be used to partition waste into solid and liquid phases during retrieval and staging. • All high level solids batches and entrained solids will be caustic leached (caustic leach factors from TWINS on 9/30/2001).	• Water wash factors in TWINS on 9/30/2001 will be used to partition waste into solid and liquid phases during retrieval and staging. • All high level solids batches and entrained solids will be caustic leached (caustic leach factors from TWINS on 9/30/2001).	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	Case 1 Target Case	Case 2 TPA-Compliant Case	Comments
Supplemental Sludge Packaging			
Supplemental Sludge Packaging	• TRU packaging facility will be available for operations on 10/1/2004 and will begin packaging 10/28/2004. • Wastes from T-200 and B-200 series SSTs will be retrieved and processed through supplemental TRU/LLW packaging between 9/25/04 and 7/12/05 without impact to DST space. • Wastes from T-111 and T-110 SSTs will be retrieved and processed through supplemental TRU/LLW packaging in FY 2005 and 2006 without impact to DST space.	• TRU packaging facility will be available for operations on 10/1/2004 and will begin packaging 10/28/2004. • Wastes from T-200 and B-200 series SSTs will be retrieved and processed through supplemental TRU/LLW packaging between 9/25/04 and 7/12/05 without impact to DST space. • Wastes from T-111 and T-110 SSTs will be retrieved and processed through supplemental TRU/LLW packaging in FY 2005 and 2006 without impact to DST space.	
Supplemental sludge packaging process for AW-103/AW-105 and SY-102	• Deliver consolidated AW-103/-105 solids and then SY-102 solids to Supplemental Sludge Packaging process in FY 2007 through 2009. • Washed solids are assumed to be contact handled for packaging in 55 gal Drums	• Deliver consolidated AW-103/-105 solids and then SY-102 solids to Supplemental Sludge Packaging process in FY 2007 through 2009. • Washed solids are assumed to be contact handled for packaging in 55 gal Drums	Current ORP baseline has deferred RH-TRU consolidation to post 2006.
SST Retrieval			
Number of SSTs Retrieved	149	149	
Retrievable Sludge Volume	9.8 Mgal	9.8 Mgal	
Retrievable Saltcake Volume	21.5 Mgal	21.5 Mgal	
Early Retrieval Sequence and Minimum Retrieval Durations in days (d)--Exact start dates and durations will be determined by the model.	**C-106:** Target FY 2003. **S-112:** Target FY 2003. **S-102:** Target FY 2004. **C-201:** Target FY 2004. **C-202:** Target FY 2004. **C-203:** Target FY 2004. **C-204:** Target FY 2004. **T-201:** Target FY 2004. **T-202:** Target FY 2004. **T-203:** Target FY 2005. **B-201:** Target FY 2005. **T-204:** Target FY 2005. **B-202:** Target FY 2005. **S-105:** Target FY 2005 **B-203:** Target FY 2005. **T-111:** Target FY 2005. **B-204:** Target FY 2005. **S-103:** Target FY 2005.	**C-106:** Target FY 2003. **S-112:** Target FY 2003. **S-102:** Target FY 2004. **C-201:** Target FY 2004. **C-202:** Target FY 2004. **C-203:** Target FY 2004. **C-204:** Target FY 2004. **T-201:** Target FY 2004. **T-202:** Target FY 2004. **T-203:** Target FY 2005. **B-201:** Target FY 2005. **T-204:** Target FY 2005. **B-202:** Target FY 2005. **S-105:** Target FY 2005 **B-203:** Target FY 2005. **T-111:** Target FY 2005. **B-204:** Target FY 2005. **S-103:** Target FY 2005.	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1** **Target Case**	**Case 2** **TPA-Compliant Case**	**Comments**
	S-106: Target FY 2005. **T-110:** Target FY 2005. **C-104:** Target FY 2006. **U-201:** Target FY 2006. **U-202:** Target FY 2006. **U-203:** Target FY 2006 **U-204:** Target FY 2006. **T-104:** Target FY 2006. Continues risk based sequence; C-farm is retrieved next based on risk and need to supply feed to the WTP.	**S-106:** Target FY 2005. **T-110:** Target FY 2005. **C-104:** Target FY 2006. **U-201:** Target FY 2006. **U-202:** Target FY 2006. **U-203:** Target FY 2006 **U-204:** Target FY 2006. **T-104:** Target FY 2006. Continues risk based sequence; C-farm is retrieved next based on risk and need to supply feed to the WTP.	
SST TPA Milestone Dates	**M-45-00B**: Complete "near term" SST waste retrieval activities, 9/30/2006. **M-45-03C**: Complete full scale saltcake waste retrieval technology demonstration at single-shell tank S-112, 9/30/05.. **M-45-03F**: Complete full scale sludge/hard heel, confined sluicing and robotic technologies, waste retrieval demonstration at tank C-104, 9/30/2007. **M-45-05A**: Complete initial waste retrieval from tank S-102, 9/30/06. **M-45-05G-T01**: Complete S-105, S-106, and S-103 waste retrieval, 10/31/2009. **M-45-05L-T01**: Complete full scale C-106 waste retrieval, 11/01/2003. **M-045-05**: Retrieve waste from all remaining single-shell tanks, 9/30/2018. **M-045-00**: Complete closure of all single shell tank farms, 9/30/2024. Retrieval completed to support completion of waste processing by end of 2028 and as available DST space allows.	**M-45-00B**: Complete "near term" SST waste retrieval activities, 9/30/2006. **M-45-03C**: Complete full scale saltcake waste retrieval technology demonstration at single-shell tank S-112, 9/30/05.. **M-45-03F**: Complete full scale sludge/hard heel, confined sluicing and robotic technologies, waste retrieval demonstration at tank C-104, 9/30/2007. **M-45-05A**: Complete initial waste retrieval from tank S-102, 9/30/06. **M-45-05G-T01**: Complete S-105, S-106, and S-103 waste retrieval, 10/31/2009. **M-45-05L-T01**: Complete full scale C-106 waste retrieval, 11/01/2003. **M-045-05**: Retrieve waste from all remaining single-shell tanks, 9/30/2018. **M-045-00**: Complete closure of all single shell tank farms, 9/30/2024. Retrieval completed by 9/30/2018.	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1** **Target Case**	**Case 2** **TPA-Compliant Case**	**Comments**
Basis for Rest of SST Retrieval Sequence	Risk based sequencing using groundwater and airborne measures to prioritize Retrievals, considering WTP processing and DST Space. Use the requirement to keep the processing plants operating to balance between the groundwater risk measure and the airborne risk measure.	Risk based sequencing using groundwater and airborne measures to prioritize Retrievals, considering WTP processing and DST Space. Use the requirement to keep the processing plants operating to balance between the groundwater risk measure and the airborne risk measure.	
WRF Availability Dates	B WRF: 10/1/2009 T WRF: 10/1/2009 U WRF: 10/1/2009	B WRF: 10/1/2009 T WRF: 10/1/2009 U WRF: 10/1/2009	Current ORP baseline replaces U WRF with over ground transfer lines
The maximum number of simultaneous retrievals is determined by the most limiting condition(s) resulting from application of the following constraints:	Retrieval and transfer systems can support a maximum of 6 simultaneous retrievals for the B, BX, BY, T, TX and TY farms. Retrieval and transfer systems can support a maximum of 2 simultaneous retrievals in each tank farm for the A, AX, C, S, SX, and U farms. Retrieval and transfer systems can support a maximum of 6 simultaneous retrievals in each quadrant: SE - A, AX, and C farms NE - B, BX, and BY farms SW - S, SX, and SY farms NW - T, TX, and TY farms Retrieval and transfer systems can support a maximum of 7 simultaneous retrievals in all the tank farms. The waste from up to two SSTs may be retrieved to one DST at one time. The waste from only one SST may be retrieved into one WRF tank at a time.	Retrieval and transfer systems can support a maximum of 6 simultaneous retrievals for the B, BX, BY, T, TX and TY farms. Retrieval and transfer systems can support a maximum of 2 simultaneous retrievals in each tank farm for the A, AX, C, S, SX, and U farms. Retrieval and transfer systems can support a maximum of 6 simultaneous retrievals in each quadrant: SE - A, AX, and C farms NE - B, BX, and BY farms SW - S, SX, and SY farms NW - T, TX, and TY farms Retrieval and transfer systems can support a maximum of 7 simultaneous retrievals in all the tank farms. The waste from up to two SSTs may be retrieved to one DST at one time. The waste from only one SST may be retrieved into one WRF tank at a time.	

Table A-1. Assumption Matrix for the 2003 Single-Shell Retrieval Sequence and Double–Shell Tanks Space Evaluation. (All years are fiscal years) (11 Sheets)

Projection Case	**Case 1 Target Case**	**Case 2 TPA-Compliant Case**	**Comments**
Slurry Transfer Limitations	Stage solids through AZ, AY, and AN farms. After retrieving HLW solids from AP and AW farms, no HLW solids will be staged in AP or AW farm tanks.	Stage solids through AZ, AY, and AN farms. After retrieving HLW solids from AP and AW farms, no HLW solids will be staged in AP or AW farm tanks.	
Cs and Sr Capsule Processing			
Cs and Sr Capsule Processing Start Date	RL will dispose of the cesium and strontium capsules – do not process into HLW glass.	RL will dispose of the cesium and strontium capsules – do not process into HLW glass.	
Storage and Disposal			
ILAW Package Assumptions	Each package holds 2.31 m^3 (610 gallon) of ILAW	Each package holds 2.31 m^3 (610 gallon) of ILAW	
ILAW Glass Density	2.6 MT/m3	2.6 MT/m3	
ILAW Package Net Mass	6.0 MT	6.0 MT	
ILAW Facility Availability Dates (Project W-520)	Determined by HTWOS model	Determined by HTWOS model	
IHLW Canister Assumptions	Each canister holds 1.185 m^3 (300 gallon) of IHLW	Each canister holds 1.185 m^3 (300 gallon) of IHLW	
IHLW Glass Density	2.7 MT/m^3	2.7 MT/m^3	
IHLW Canister Net Mass	3.2 MT	3.2 MT	
IHLW Facility Availability Dates (Project W-464)	Determined by HTWOS model	Determined by HTWOS model	

Notes:

BBI = Best-Basis Inventory.
Enhanced WTP Operations = period following Initial Phase processing.
DST = double-shell tank.
HLW = high-level waste.
IHLW = immobilized high-level waste.
ILAW = immobilized low-activity waste.
IMUST = inactive miscellaneous underground storage tanks.
LAW = low-activity waste.
LERF = Liquid Effluent Retention Facility.
MAI = Mission Acceleration Initiative.
MTG/d = metric tons glass/day.
NCAW = neutralized current acid waste.
NCRW = neutralized cladding removal waste.
PUREX = Plutonium-Uranium Extraction Plant.
SR = Steam Reforming.
TCO = Terminal Clean-Out.
TBD = to be determined.
TBE = to be established.
TOE = Total Operating Efficiency.
TPA = Tri-Party Agreement (*Hanford Federal Facility Agreement and Consent Order*).
WESF = Waste Encapsulation and Storage Facility.
WTP = Waste Treatment Plant.
WSCF = Waste Sampling and Characterization Facility.
WVR = waste volume reduction.
WVRF = waste volume reduction factor.

Ecology, EPA, and DOE, 1996, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

APPENDIX B

HANFORD TANK WASTE OPERATIONS SIMULATOR MODEL DESCRIPTION

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B1.0 HANFORD TANK WASTE OPERATION SIMULATOR MODELING ASSUMPTIONS

B1.1 BEST-BASIS INVENTORY

The double-shell tank (DST) volumes used in all projections are based on HNF-EP-0182-182, *Waste Tank Summary Report for Month Ending May 31, 2003*. The inventory information for radiological and nonradiological hazardous constituent content is based on best-basis inventory data maintenance tool (BBIM), obtained in July of 2002, as shown below. The BBIM contains information on more analytes than is generally available in the BBI. BBI information is supplemented by additional data in preparing the initial inventory input to the Hanford Tank Waste Operations Simulator (HTWOS) model. The input compositions are provided in the *Double- and Single-Shell Tank Inventory Input to the HTWOS Model - 2003A Update*, RPP-17790.

Table B-1. Initial Inventory Input to HTWOS.

Tank	BBIM Download Date	Effective Date[1]
Double-shell tanks	10-16-2002	07-01-2002
AN-107	10-16-2002	07-03-2002[2]
Single-shell tanks	10-16-2002	07-01-2002

Notes:

[1]Per TWINS, the effective date represents a data cut-off date. It indicates to users that newer sample data or transactions occurring after this date have not been considered as part of the best basis assessment.

[2]Tank AN-107 has an inventory effective date of 07-03-2002, as reported in the BBI. This is the only double-shell tank with an effective date later than 07-01-2002. Therefore, with the exception of AN-107, the double-shell inventory has an effective date of 07-01-2002.

BBIM = best-basis inventory data maintenance tool.
BBI = best-basis inventory.
TWINS = Tank Waste Information Network System.

The initial inventory accounts for tank transfers through July 1, 2002, with the HTWOS model accounting for subsequent actual and planned transfers. The initial inventory transfers occurring between July 1, 2002, and May 31, 2003, were input manually into the model.

Other data modifications are necessary for final input into the HTWOS. The methods used to make the modifications are documented in *HTWOS Model Inventory Input Preparation*, TFC-ENG-CHEM-D-38.

Specific adjustments include the following:

- For DSTs, data are compiled in two sets, one for liquids, which include supernatant only, and one for solids. The solids set includes solid phases and any liquids associated with solid phases. If data are available only as a whole tank total, a split into phases is estimated. Chemical cesium is estimated based on the isotopic content of cesium-137,

and cesium-137 and specific ratios. Chemical strontium is calculated by subtracting strontium-90 from the BBI chemical strontium value. Chemical uranium is calculated by subtracting isotopic uranium from the BBI uranium-total value. Free hydroxide and bound hydroxide are calculated using several methods which incorporate charge balances, sample data, BBI data, and predictive equations. The method chosen depends on the data that are available.

- For single-shell tanks (SSTs), data are also compiled in two sets. The liquid data set includes the sum of the supernatant and all liquids associated with the solid phases (including "salt cake liquids," for example). The solid phase data set is just the solid portion. Cesium, strontium, and hydroxide are calculated using similar methods as the DST inventory. For those tanks that will be salt well pumped, the data are adjusted as needed so the inventory has at least enough liquid phase waste to match the projected volume to be pumped. (For some tanks this means numerically transferring some material from the solids to the liquids phase.) Total inventories are not changed. This information represents the initial inventory.

  A separate spreadsheet calculation is also performed to estimate the volume of water required to retrieve the waste. This spreadsheet starts with the inventory remaining after salt well pumping, and applies the wash factors to the solid phase of the inventory. Two water additions are then estimated, one to reach a 5 molar sodium solution in the liquids, and the other to reach a 10 wt% solids slurry. [Density changes occurring with water addition are included by using the density correlation in Appendix I the of the *Tank Farm Contractor Operation and Utilization Plan* (TFCOUP) (Numatec 2003).] The larger required volume of water is retained for further use in HTWOS. The reason for applying the wash factors to the SST data is that significant amounts of water will be added during retrieval. The additions will be used to mobilized SST waste constituents.

Application of Wash Factors by the HTWOS Model

The HTWOS model uses SST data that have already had water wash factors applied. For DSTs, HTWOS models the partition of the solids phases (solids and associated liquid) so that the total aqueous phase has a single composition, and the solids reported are for "dry solids." This partition uses thermodynamic data and does not exactly replicate the solid/liquid phase data presented by the BBI, although the total inventory remains the same. In general, water wash factors were developed based on analysis of centrifuged solids, which are wet. Therefore, the product of the HTWOS solid/liquid partition is not suitable for direct application of wash factors, but it does represent the expected as-delivered, unwashed composition of high-level waste (HLW) solids from DSTs. HTWOS compares the original solids mass with the partitioned mass for each constituent and computes a revised wash factor. The revised wash factors are used for DST solids to complete the wash step in the Waste Treatment Plant (WTP) portion of the HTWOS model.

The as-delivered partition compositions identified in Figure B-1 show that the SSTs have had 100% of the water wash factor applied, since this is a reasonable approximation of the dissolution that will occur during retrieval. Only a portion of each water wash factor is applied to analytes in DST solids in order to reach the as-delivered composition, since DSTs will not require as much water for retrieval. The as-delivered compositions are reported in Numatec

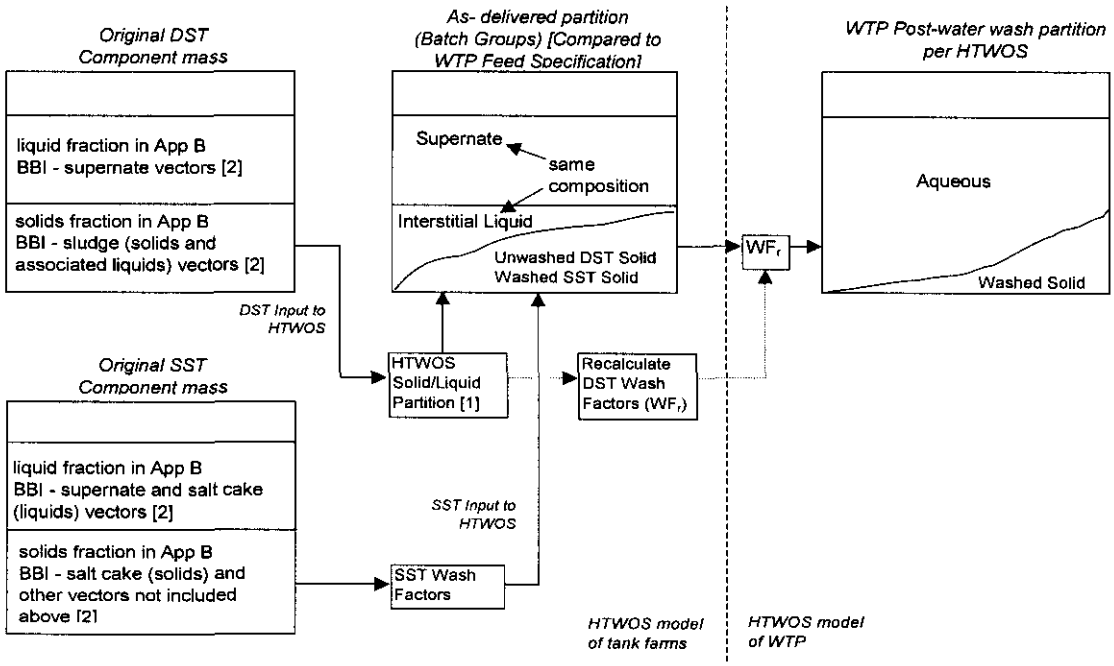
(2003) and are compared to the WTP contract feed specifications. The solids have not been washed in the WTP at this point.

The HTWOS extends the model through the WTP, and applies the balance of the DST wash factors in the WTP water wash step. The TFCOUP also publishes the post-water wash composition. At this point, all water wash factors have been applied.

The BBI is a detailed source for tank content information. The BBI is generated by scientists and engineers at the Hanford Site and in the National Laboratory System and provides their best estimate of the contents of the tank waste. Process knowledge and actual sample data are used to generate the BBI. The BBI has been extensively peer-reviewed by experts across the nation. Staff from the Washington State Department of Ecology and the U.S. Environmental Protection Agency have been involved in these reviews and have required public access to the data. The BBI is posted in a relational database on the Tank Waste Information Network System (TWINS) and is accessible for review at http://twins.pnl.gov:8001/. The BBI is updated routinely as new laboratory data are obtained. While the BBI is updated on a regular basis, generally quarterly, the inventory data used for the HTWOS model is updated annually to ensure consistency of output throughout the fiscal year.

Figure B-1. Initial Quantity HLW Sludge Partitioning in HTWOS.

There are two routes to post-wash partition: DST sludge x HTWOS partition x modified wash factor to washed solids, and SST sludge x wash factor to washed solids.



[1] Partition assumes supernate and interstitial liquids have the same composition, and that the solids density is 3 kg/L.

[2] Vectors are sources of characterization data, including samples and estimates. Inputs to HTWOS are compiled from BBI and other data (vectors).

B1.2 SINGLE-SHELL TANK RETRIEVAL RATES

The HTWOS model uses available data for technology-specific retrieval rates for all SST retrievals. The complete modeling basis for retrieval rates is documented in ORP-11242, Rev. 2, *River Protection Project System Plan.*

B1.3 WASTE TREATMENT PLANT ASSUMPTIONS

The U.S. Department of Energy, Office of River Protection, provided the key interface assumptions listed in Table B-2 regarding Initial Quantity vitrification operations dates. These assumptions were provided as the basis for the integrated baseline schedule as detailed in HNF-SD-WM-SP-012, Rev. 4.

Table B-2. Waste Treatment Plant Assumptions.

Assumption	Date
Ready to deliver first LAW batch	October 1, 2009
Ready to deliver first HLW batch	October 15, 2009
Start LAW facility hot commissioning	December 1, 2009
Start HLW facility hot commissioning	December 15, 2009
Start LAW full-scale production	January 1, 2013
Start HLW full-scale production	January 1, 2013

Notes:

Full-scale production refers to complete construction of facility and full-scale production initiated. Facility hot commissioning implies the ability to receive waste and start processing.

HLW = high-level waste.
LAW = low-activity waste.

B1.4 REFERENCES

HNF-EP-0182-182, 2003, *Waste Tank Summary Report for Month Ending May 31, 2003*, CH2M HILL Hanford Group, Inc., Richland, Washington.

ORP-11242, 2003, *River Protection Project System Plan*, Rev. 2, CH2M HILL Hanford Group, Inc., Richland, Washington.

Numatec, 2003, *Tank Farm Contractor Operation and Utilization Plan*, HNF-SD-WM-SP-012, Rev. 4B, prepared by Numatec Hanford Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

TFC-ENG-CHEM-D-38, 2003, *HTWOS Model Inventory Input Preparation,* CH2M HILL Hanford Group, Inc., Richland, Washington.

APPENDIX C

SINGLE-SHELL TANK RISK FACTORS, CALCULATIONS, AND RANKINGS

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C1.0 FINAL ENVIRONMENTAL IMPACT STATEMENT UNIT RISK FACTORS

Table C-1 lists, by analyte, the groundwater, airborne, and chemical unit concentration risk factors from DOE/EIS-0189, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*: Groundwater Factors, Table D.2.1.23; Airborne Factors, Table D.7.3.1; Chemical Factors, Table D.2.1.21.

Table C-1. Risk Factors.

Analyte	Groundwater Factor Risk/[Ci/mL][1]	Airborne Factor mrem/Ci exhumed[2]	Chemical Factor Risk/[g/mL)][3]
14-C	5.23 E+06	--	--
129-I	9.33 E+08	--	--
79-Se	3.22 E+07	--	--
99-Tc	7.11 E+06	--	--
238-U	2.84 E+08	2.51 E+02	--
241-Am	--	6.45 E+02	--
242m-Am	--	6.94 E+02	--
243-Am	--	1.29 E+03	--
243-Cm	--	7.42 E+01	--
244-Cm	--	9.80 E+00	--
245-Cm	--	1.05 E+03	--
246-Cm	--	7.25 E+02	--
247-Cm	--	1.81 E+03	--
248-Cm	--	2.60 E+03	--
94-Nb	--	5.54 E+03	--
237-Np	--	1.67 E+03	--
236-Pu	--	1.04 E+02	--
238-Pu	--	2.82 E+02	--
239-Pu	--	6.96 E+02	--
240-Pu	--	6.91 E+02	--
241-Pu	--	2.21 E+01	--
242-Pu	--	6.60 E+02	--
244-Pu	--	1.83 E+03	--
126-Sn	--	6.93 E+03	--
232-Th	--	1.07 E+04	--
NO_2^-	--	--	9.92 E+03
NO_3^-	--	--	6.20 E+03
CrO_4^{-2}	--	--	3.31 E+06

Notes:

[1]Risk for isotopes is defined as the increased probability of the exposed receptor contracting a cancer (incidence) or dying from cancer (fatality). The groundwater risk factors are expressed in terms of risk per unit concentration of isotope in the groundwater. The data are based on the groundwater pathway of the Industrial exposure scenario in the environmental impact statement. Units used in the environmental impact statement were clarified by Strenge (2002).

[2]The airborne unit risk factors are expressed in terms of mrem per Ci of isotope exhumed by well drilling. The data are based on the post-well driller intruder scenario of the environmental impact statement. This scenario includes airborne exposure as well as ingestion. However, the dominant pathway is from air exposure. The conversion factor between dose (mrem) and risk (cancer probability) is a constant. Therefore the relative ranking in units of mrem and risk is the same.

[3]Risk for chemicals is defined as the Hazard Index, which is the ratio of average daily intake to a reference dose. The chemical risk factors are expressed in terms of risk per (g/ml) concentration of chemical in the groundwater. The data are based on the groundwater pathway of the Industrial exposure scenario in the environmental impact statement. Units used in the environmental impact statement were clarified by Strenge (2002).

Strenge, D.L., 2002, *Re: Unit Risk Factors for the TWRS EIS*, e-mail, Dennis L. Strenge, PNNL, to Julie Reddick, DMJMH+N, July 22, 2002.

C2.0 SAMPLE CALCULATIONS

i	=	analyte
AF_i	=	analyte airborne dose factor [mrem/Ci exhumed]
GF_i	=	analyte groundwater risk factor [risk/(Ci/mL)]
CF_i	=	analyte chemical risk factor [Risk/(g/mL)]
C_i	=	analyte inventory (Ci)
K_i	=	analyte inventory (kg)

C2.1 Relative Groundwater Risk

$$\text{Groundwater Relative Risk} = \sum_{i={}^{14}C\ldots{}^{238}U} (GF_i \cdot C_i)$$

C2.3 Relative Airborne Risk

$$\text{Airborne Relative Risk} = \sum_{i={}^{238}U\ldots{}^{232}Th} (AF_i \cdot C_i)$$

C2.3 Relative Chemical Risk

$$\text{Chemical Relative Risk} = \sum_{i=NO_2^-\ldots CrO_4^-} (CF_i \cdot K_i)$$

Note: The analyte inventories are assumed to be proportional to the concentrations that would be found in the groundwater and in the exhumed waste. This is a reasonable assumption given that the isotopes of interest in the groundwater are soluble and mobile, and that exhumed material contains tank waste. The calculation does not result in a number that represents actual risk, since the groundwater concentrations and amounts exhumed were not needed and were not used. Rather, the results provide a relative risk ranking to distinguish the inventories in each single-shell tank (SST).

C3.0 SINGLE-SHELL TANK RISK RANKINGS

Table C-2 lists the risk ratings for the SST waste volume as of June 30, 2001 (except for Tank S-112, which is as of April 8, 2002).

Table C-2. Tank Risk Rankings. (5 Sheets)

Risk Rankings - Prepared from Best Basis Inventory 12/2001

SST Tank	Waste Volume July 2001 [kgal]	Ground Water Risk [mrem/mL]	Ground Water Rank	Percent Ground Water Risk	Airborne Risk [mrem]	Airborne Rank	Percent Airborne Risk	Chemical Risk [kg/mL]	Chemical Rank	Percent Chemical Risk
A-101	8.77E+02	3.82E+08	91	0.20%	4.16E+05	46	0.50%	3.06E+10	16	1.57%
A-102	4.10E+01	9.03E+08	70	0.48%	4.54E+05	42	0.54%	5.44E+09	76	0.28%
A-103	3.71E+02	1.43E+09	57	0.77%	3.05E+05	57	0.36%	1.04E+10	57	0.53%
A-104	2.80E+01	1.22E+08	114	0.07%	8.57E+05	16	1.02%	3.31E+08	135	0.02%
A-105	3.70E+01	8.01E+08	74	0.43%	3.34E+06	6	3.99%	1.81E+09	108	0.09%
A-106	1.25E+02	7.57E+08	76	0.40%	1.50E+06	9	1.79%	1.15E+10	54	0.59%
AX-101	6.62E+02	2.65E+08	99	0.14%	3.54E+05	55	0.42%	1.99E+10	37	1.02%
AX-102	3.00E+01	1.01E+08	119	0.05%	2.93E+05	58	0.35%	8.72E+08	121	0.04%
AX-103	1.12E+02	1.40E+09	58	0.75%	7.83E+05	20	0.94%	8.26E+09	65	0.42%
AX-104	8.00E+00	7.22E+08	78	0.39%	9.05E+05	14	1.08%	1.12E+08	140	0.01%
B-101	1.13E+02	2.95E+08	96	0.16%	9.43E+05	13	1.13%	2.93E+09	92	0.15%
B-102	3.20E+01	2.98E+07	128	0.02%	2.40E+03	143	0.00%	7.39E+08	124	0.04%
B-103	5.90E+01	1.07E+08	116	0.06%	4.39E+04	114	0.05%	1.42E+09	116	0.07%
B-104	3.71E+02	4.86E+08	87	0.26%	7.02E+04	106	0.08%	6.70E+09	71	0.34%
B-105	1.58E+02	3.50E+08	93	0.19%	3.88E+04	118	0.05%	7.99E+09	66	0.41%
B-106	1.17E+02	6.61E+08	81	0.35%	1.95E+04	127	0.02%	1.62E+09	111	0.08%
B-107	1.65E+02	3.03E+08	95	0.16%	2.06E+05	68	0.25%	1.87E+09	106	0.10%
B-108	9.40E+01	9.76E+07	120	0.05%	2.49E+03	141	0.00%	8.20E+08	122	0.04%
B-109	1.27E+02	8.22E+08	73	0.44%	2.71E+04	122	0.03%	5.21E+09	79	0.27%
B-110	2.46E+02	1.85E+08	109	0.10%	1.66E+05	78	0.20%	4.97E+09	82	0.26%
B-111	2.37E+02	9.38E+08	68	0.50%	1.79E+05	74	0.21%	5.02E+09	81	0.26%
B-112	3.30E+01	1.09E+08	115	0.06%	1.69E+03	144	0.00%	1.47E+09	113	0.08%
B-201	2.90E+01	2.16E+06	139	0.00%	8.32E+04	100	0.10%	1.72E+09	110	0.09%
B-202	2.70E+01	9.15E+06	135	0.00%	2.01E+04	126	0.02%	1.27E+09	117	0.07%
B-203	5.10E+01	3.94E+06	136	0.00%	3.43E+04	120	0.04%	2.45E+09	95	0.13%
B-204	5.00E+01	3.52E+06	137	0.00%	4.14E+04	117	0.05%	2.52E+09	94	0.13%
BX-101	4.30E+01	8.84E+07	123	0.05%	1.90E+05	72	0.23%	4.85E+08	130	0.02%
BX-102	9.60E+01	1.82E+07	131	0.01%	5.17E+05	33	0.62%	4.49E+08	133	0.02%
BX-103	7.10E+01	1.35E+08	113	0.07%	7.99E+05	18	0.95%	5.47E+08	128	0.03%
BX-104	9.30E+01	3.74E+09	7	2.00%	3.89E+05	50	0.46%	1.00E+10	58	0.52%

Table C-2. Tank Risk Rankings. (5 sheets)

Risk Rankings - Prepared from Best Basis Inventory 12/2001

SST Tank	Waste Volume July 2001 [kgal]	Ground Water Risk [mrem/mL]	Ground Water Rank	Percent Ground Water Risk	Airborne Risk [mrem]	Airborne Rank	Percent Airborne Risk	Chemical Risk [kg/mL]	Chemical Rank	Percent Chemical Risk
BX-105	5.10E+01	7.35E+08	77	0.39%	7.97E+04	102	0.10%	1.55E+10	47	0.80%
BX-106	3.80E+01	2.19E+08	105	0.12%	9.16E+04	95	0.11%	9.58E+09	61	0.49%
BX-107	3.45E+02	8.77E+08	71	0.47%	9.13E+04	96	0.11%	7.75E+09	68	0.40%
BX-108	2.60E+01	2.30E+08	101	0.12%	9.19E+03	133	0.01%	6.98E+08	125	0.04%
BX-109	1.93E+02	1.57E+09	56	0.84%	1.41E+04	132	0.02%	2.07E+09	101	0.11%
BX-110	2.07E+02	1.25E+09	59	0.67%	6.83E+04	108	0.08%	2.25E+10	32	1.16%
BX-111	1.62E+02	1.20E+09	60	0.64%	2.48E+04	123	0.03%	9.85E+09	60	0.51%
BX-112	1.65E+02	2.03E+08	107	0.11%	1.03E+05	92	0.12%	4.38E+09	85	0.23%
BY-101	3.87E+02	3.60E+09	9	1.92%	9.18E+04	94	0.11%	1.98E+10	38	1.02%
BY-102	2.77E+02	1.97E+09	43	1.05%	1.07E+05	89	0.13%	1.09E+10	56	0.56%
BY-103	4.00E+02	3.06E+09	19	1.63%	1.64E+05	79	0.20%	2.37E+10	28	1.22%
BY-104	3.26E+02	3.55E+09	12	1.90%	1.76E+05	75	0.21%	2.94E+10	19	1.51%
BY-105	5.03E+02	2.20E+09	35	1.17%	4.32E+05	44	0.52%	1.30E+10	52	0.67%
BY-106	5.62E+02	3.57E+09	11	1.91%	7.33E+04	105	0.09%	1.47E+10	50	0.76%
BY-107	2.66E+02	2.14E+09	36	1.14%	4.29E+04	115	0.05%	4.86E+09	83	0.25%
BY-108	2.28E+02	2.38E+09	30	1.27%	6.07E+04	110	0.07%	3.08E+09	90	0.16%
BY-109	2.90E+02	1.61E+09	52	0.86%	8.85E+04	98	0.11%	9.30E+09	62	0.48%
BY-110	3.98E+02	3.09E+09	18	1.65%	1.05E+05	90	0.13%	2.70E+10	22	1.39%
BY-111	4.59E+02	2.05E+09	38	1.09%	1.50E+05	82	0.18%	1.51E+10	48	0.78%
BY-112	2.91E+02	2.26E+09	33	1.21%	1.15E+05	86	0.14%	1.12E+11	1	5.77%
C-101	8.80E+01	9.18E+08	69	0.49%	4.57E+05	41	0.55%	1.46E+09	115	0.08%
C-102	3.16E+02	7.86E+08	75	0.42%	3.67E+06	4	4.39%	3.05E+09	91	0.16%
C-103	1.98E+02	7.04E+08	80	0.38%	5.56E+06	3	6.64%	2.36E+09	96	0.12%
C-104	2.63E+02	4.66E+09	2	2.49%	9.12E+06	2	10.90%	5.32E+09	77	0.27%
C-105	1.32E+02	1.60E+09	53	0.86%	2.46E+06	7	2.94%	1.50E+09	112	0.08%
C-106	4.80E+01	6.03E+07	127	0.03%	2.29E+05	66	0.27%	2.20E+08	138	0.01%
C-107	2.57E+02	1.03E+09	65	0.55%	3.54E+06	5	4.23%	3.68E+09	88	0.19%
C-108	6.60E+01	6.05E+07	126	0.03%	6.72E+03	136	0.01%	9.53E+08	120	0.05%
C-109	6.60E+01	6.17E+08	83	0.33%	8.20E+04	101	0.10%	6.24E+08	127	0.03%
C-110	1.78E+02	4.17E+08	90	0.22%	7.56E+04	104	0.09%	2.06E+09	103	0.11%
C-111	5.70E+01	4.25E+08	89	0.23%	2.41E+05	65	0.29%	4.83E+08	131	0.02%

Table C-2. Tank Risk Rankings. (5 sheets)

Risk Rankings - Prepared from Best Basis Inventory 12/2001

SST Tank	Waste Volume July 2001 [kgal]	Ground Water Risk [mrem/mL]	Ground Water Rank	Percent Ground Water Risk	Airborne Risk [mrem]	Airborne Rank	Percent Airborne Risk	Chemical Risk [kg/mL]	Chemical Rank	Percent Chemical Risk
C-112	1.04E+02	2.76E+09	24	1.48%	3.79E+05	51	0.45%	9.66E+08	119	0.05%
C-201	2.00E+00	2.73E+05	148	0.00%	6.93E+04	107	0.08%	9.40E+06	149	0.00%
C-202	1.00E+00	2.84E+05	147	0.00%	3.63E+04	119	0.04%	1.40E+07	148	0.00%
C-203	5.00E+00	5.43E+05	144	0.00%	1.82E+04	128	0.02%	2.28E+07	145	0.00%
C-204	3.00E+00	3.50E+05	145	0.00%	4.21E+02	146	0.00%	1.47E+07	147	0.00%
S-101	4.27E+02	2.00E+09	42	1.07%	5.44E+05	32	0.65%	5.46E+10	5	2.81%
S-102	4.92E+02	2.01E+09	40	1.07%	1.93E+05	70	0.23%	1.92E+10	40	0.99%
S-103	2.37E+02	2.25E+09	34	1.20%	2.44E+05	64	0.29%	2.16E+10	34	1.11%
S-104	2.94E+02	1.12E+09	62	0.60%	5.10E+05	34	0.61%	1.66E+10	43	0.85%
S-105	4.56E+02	2.75E+09	25	1.47%	4.91E+05	38	0.59%	4.46E+10	10	2.29%
S-106	4.55E+02	2.96E+09	22	1.58%	9.08E+04	97	0.11%	6.03E+10	4	3.10%
S-107	3.76E+02	1.63E+09	50	0.87%	1.57E+06	8	1.87%	2.54E+10	25	1.30%
S-108	4.32E+02	3.48E+09	14	1.86%	7.26E+05	22	0.87%	6.38E+10	3	3.28%
S-109	5.33E+02	3.22E+09	17	1.72%	1.11E+05	88	0.13%	2.99E+10	18	1.54%
S-110	3.90E+02	2.99E+09	20	1.60%	4.96E+05	37	0.59%	4.88E+10	9	2.51%
S-111	5.01E+02	1.63E+09	51	0.87%	5.47E+04	112	0.07%	3.80E+10	12	1.95%
S-112	5.23E+02	2.97E+09	21	1.59%	5.92E+05	29	0.71%	5.17E+10	8	2.66%
SX-101	4.29E+02	1.57E+09	55	0.84%	6.78E+05	24	0.81%	8.07E+10	2	4.15%
SX-102	5.14E+02	1.92E+09	45	1.02%	3.89E+05	49	0.46%	5.39E+10	6	2.77%
SX-103	5.18E+02	3.24E+09	15	1.73%	6.08E+05	27	0.73%	5.27E+10	7	2.71%
SX-104	4.46E+02	2.39E+09	29	1.27%	9.62E+05	12	1.15%	4.41E+10	11	2.27%
SX-105	4.84E+02	2.00E+09	41	1.07%	7.27E+05	21	0.87%	2.54E+10	24	1.31%
SX-106	3.97E+02	3.60E+09	10	1.92%	4.30E+05	45	0.51%	3.69E+10	13	1.90%
SX-107	1.02E+02	3.36E+08	94	0.18%	3.60E+05	54	0.43%	7.87E+09	67	0.41%
SX-108	8.70E+01	2.93E+08	97	0.16%	1.08E+06	10	1.30%	1.57E+10	46	0.81%
SX-109	2.49E+02	1.01E+09	66	0.54%	4.65E+05	40	0.56%	2.36E+10	29	1.21%
SX-110	6.20E+01	2.19E+08	104	0.12%	1.57E+05	80	0.19%	5.12E+09	80	0.26%
SX-111	1.22E+02	4.30E+08	88	0.23%	3.70E+05	53	0.44%	9.96E+09	59	0.51%
SX-112	1.08E+02	2.73E+08	98	0.15%	2.62E+05	61	0.31%	6.34E+09	74	0.33%
SX-113	3.10E+01	1.02E+08	118	0.05%	8.62E+03	134	0.01%	9.88E+07	141	0.01%
SX-114	1.65E+02	6.45E+08	82	0.34%	2.87E+05	60	0.34%	1.48E+10	49	0.76%

Table C-2. Tank Risk Rankings. (5 sheets)

SST Tank	Waste Volume July 2001 [kgal]	Ground Water Risk [mrem/mL]	Ground Water Rank	Percent Ground Water Risk	Airborne Risk [mrem]	Airborne Rank	Percent Airborne Risk	Chemical Risk [kg/mL]	Chemical Rank	Percent Chemical Risk
SX-115	1.20E+01	1.50E+07	133	0.01%	5.66E+05	31	0.68%	3.44E+08	134	0.02%
T-101	1.02E+02	5.81E+08	84	0.31%	9.18E+04	93	0.11%	4.03E+09	87	0.21%
T-102	3.20E+01	2.24E+08	103	0.12%	3.04E+04	121	0.04%	7.67E+08	123	0.04%
T-103	2.70E+01	9.61E+07	121	0.05%	2.04E+05	69	0.24%	4.51E+08	132	0.02%
T-104	3.17E+02	1.40E+08	112	0.08%	1.71E+05	76	0.20%	5.22E+09	78	0.27%
T-105	9.80E+01	3.62E+08	92	0.19%	1.46E+05	83	0.17%	3.15E+09	89	0.16%
T-106	2.10E+01	7.39E+07	125	0.04%	1.76E+04	129	0.02%	6.28E+08	126	0.03%
T-107	1.73E+02	2.37E+09	31	1.27%	1.12E+05	87	0.13%	1.96E+09	105	0.10%
T-108	4.40E+01	1.65E+07	132	0.01%	4.80E+03	139	0.01%	2.46E+08	136	0.01%
T-109	5.80E+01	1.90E+07	130	0.01%	2.65E+03	140	0.00%	2.21E+08	137	0.01%
T-110	3.69E+02	1.47E+08	110	0.08%	6.41E+04	109	0.08%	5.76E+09	75	0.30%
T-111	4.46E+02	8.28E+08	72	0.44%	2.62E+05	62	0.31%	1.24E+10	53	0.64%
T-112	6.70E+01	1.95E+07	129	0.01%	5.22E+04	113	0.06%	2.20E+09	98	0.11%
T-201	2.90E+01	1.83E+06	141	0.00%	7.62E+04	103	0.09%	2.05E+09	104	0.11%
T-202	2.10E+01	9.72E+05	143	0.00%	1.48E+04	131	0.02%	1.06E+09	118	0.05%
T-203	3.50E+01	1.64E+06	142	0.00%	2.33E+04	124	0.03%	2.07E+09	102	0.11%
T-204	3.80E+01	2.28E+06	138	0.00%	1.66E+04	130	0.02%	2.58E+09	93	0.13%
TX-101	8.70E+01	5.07E+08	86	0.27%	5.06E+05	35	0.61%	6.67E+09	72	0.34%
TX-102	2.17E+02	1.72E+09	48	0.92%	2.90E+05	59	0.35%	1.14E+10	55	0.59%
TX-103	1.57E+02	1.06E+09	63	0.57%	1.93E+05	71	0.23%	7.47E+09	69	0.38%
TX-104	6.50E+01	2.59E+08	100	0.14%	8.84E+04	99	0.11%	4.30E+09	86	0.22%
TX-105	6.09E+02	4.60E+09	4	2.46%	8.50E+05	17	1.02%	3.02E+10	17	1.56%
TX-106	3.41E+02	2.63E+09	27	1.41%	4.90E+05	39	0.59%	1.84E+10	41	0.95%
TX-107	3.60E+01	2.28E+08	102	0.12%	3.72E+05	52	0.44%	2.15E+09	100	0.11%
TX-108	1.34E+02	1.01E+09	67	0.54%	1.79E+05	73	0.21%	6.56E+09	73	0.34%
TX-109	3.84E+02	7.06E+08	79	0.38%	1.69E+05	77	0.20%	6.90E+09	70	0.36%
TX-110	4.62E+02	3.23E+09	16	1.73%	6.59E+05	25	0.79%	2.33E+10	30	1.20%
TX-111	3.70E+02	2.46E+09	28	1.31%	5.05E+05	36	0.60%	1.77E+10	42	0.91%
TX-112	6.49E+02	4.51E+09	5	2.41%	8.97E+05	15	1.07%	3.22E+10	15	1.66%
TX-113	6.53E+02	4.88E+09	1	2.61%	1.25E+05	85	0.15%	1.60E+10	45	0.82%
TX-114	5.35E+02	3.49E+09	13	1.86%	7.15E+05	23	0.85%	2.53E+10	26	1.30%

Table C-2. Tank Risk Rankings. (5 sheets)

Risk Rankings - Prepared from Best Basis Inventory 12/2001

SST Tank	Waste Volume July 2001 [kgal]	Ground Water Risk [mrem/mL]	Ground Water Rank	Percent Ground Water Risk	Airborne Risk [mrem]	Airborne Rank	Percent Airborne Risk	Chemical Risk [kg/mL]	Chemical Rank	Percent Chemical Risk
TX-115	5.68E+02	4.09E+09	6	2.18%	7.93E+05	19	0.95%	2.87E+10	20	1.48%
TX-116	6.31E+02	2.28E+09	32	1.22%	4.16E+05	47	0.50%	1.45E+10	51	0.75%
TX-117	6.26E+02	2.11E+09	37	1.13%	4.52E+05	43	0.54%	1.62E+10	44	0.83%
TX-118	2.86E+02	1.69E+09	49	0.90%	1.61E+07	1	19.23%	2.31E+10	31	1.19%
TY-101	1.18E+02	2.03E+08	106	0.11%	1.05E+05	91	0.13%	2.10E+10	36	1.08%
TY-102	6.40E+01	1.03E+08	117	0.06%	6.44E+03	137	0.01%	1.85E+09	107	0.10%
TY-103	1.62E+02	1.89E+09	46	1.01%	1.45E+05	84	0.17%	4.84E+09	84	0.25%
TY-104	4.30E+01	5.75E+08	85	0.31%	4.16E+04	116	0.05%	1.46E+09	114	0.08%
TY-105	2.31E+02	1.04E+09	64	0.56%	2.31E+04	125	0.03%	2.33E+09	97	0.12%
TY-106	2.10E+01	1.41E+08	111	0.08%	2.48E+03	142	0.00%	1.35E+08	139	0.01%
U-101	2.50E+01	7.45E+07	124	0.04%	7.78E+03	135	0.01%	1.76E+09	109	0.09%
U-102	2.93E+02	1.92E+09	44	1.03%	3.90E+05	48	0.47%	1.94E+10	39	1.00%
U-103	4.18E+02	2.69E+09	26	1.44%	2.48E+05	63	0.30%	2.61E+10	23	1.34%
U-104	1.22E+02	1.96E+08	108	0.10%	1.55E+05	81	0.19%	8.44E+09	64	0.43%
U-105	3.53E+02	4.64E+09	3	2.48%	1.05E+06	11	1.25%	2.25E+10	33	1.16%
U-106	1.72E+02	1.18E+09	61	0.63%	6.34E+05	26	0.76%	8.87E+09	63	0.46%
U-107	4.08E+02	2.96E+09	23	1.58%	5.96E+05	28	0.71%	2.48E+10	27	1.28%
U-108	4.68E+02	3.62E+09	8	1.93%	5.82E+05	30	0.70%	3.27E+10	14	1.68%
U-109	3.92E+02	1.77E+09	47	0.95%	5.99E+04	111	0.07%	2.14E+10	35	1.10%
U-110	1.86E+02	1.57E+09	54	0.84%	2.26E+05	67	0.27%	2.17E+09	99	0.11%
U-111	3.29E+02	2.04E+09	39	1.09%	3.21E+05	56	0.38%	2.81E+10	21	1.44%
U-112	4.90E+01	8.87E+07	122	0.05%	6.22E+03	138	0.01%	5.42E+08	129	0.03%
U-201	5.00E+00	1.07E+07	134	0.01%	6.10E+01	148	0.00%	8.35E+07	142	0.00%
U-202	5.00E+00	3.18E+05	146	0.00%	6.26E+01	147	0.00%	7.20E+07	143	0.00%
U-203	3.00E+00	2.72E+05	149	0.00%	5.97E+01	149	0.00%	6.19E+07	144	0.00%
U-204	3.00E+00	1.84E+06	140	0.00%	7.86E+02	145	0.00%	2.26E+07	146	0.00%

C4.0 REFERENCE

DOE/EIS-0189, 1996, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, U.S. Department of Energy, Washington, D.C.

APPENDIX D

ADDITIONAL DOUBLE-SHELL TANK SPACE EVALUATION MODELING ASSUMPTIONS

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Table D-1. Software Change Summary Form for Projection Cases 1 and 2.

Case Name/Scenario Identifier	FY 2003 Operational Waste Volume Projection Cases 1 & 2
Objective: Update the OWVP projections and document with the latest inventory and assumptions. Updated assumptions will serve as a basis for the OWVP, SST Retrieval, and TFCO & UP projections.	
Scenario Change Summary - This section is focused on changes in key assumptions or key inputs to the model.	
1. Incorporate the yearly update of waste generations, salt well liquid pumping volumes, and other assumptions into the OWVP projections. The assumption changes listed below will be used as the basis for OWVP Case 1 and 2. a. Table A-1 Assumption Matrix for the 2003 Single-shell Retrieval Sequence and Double-shell Tanks Space Evaluation. b. Waste Generation (Kgal/month) Spreadsheet for the 2003 OWVP. c. Double-Shell Tank Transfers thru 6/2005 to Support the 2003 OWVP. d. Salt Well Volumes and Flushes Updated for the 2003 OWVP Projections. e. Historical Transfers from 6/1/2002 through 5/31/2003. 2. Case 1 (Target Case) will use essentially the same treatment rate as that used for RPP System Plan, Rev. 2 Target Case (processing completed in 2028); will use a risk based approach to retrieve SST wastes to support the treatment schedule as space within the DSTs will allow; and will incorporate 7.3 Mgal of space savings. 3. Case 2 (TPA Compliant Case) will use an increase in effective pretreatment capacity provided by either expansion of WTP or provided as part of Supplemental Treatment; will use a risk based approach to retrieve all SST wastes by 9/30/2018 and closure of SST tank farms by 9/30/2024; and will incorporates 7.3 Mgal of space savings. 4. All OWVP projections will start with the DST inventory on 7/1/2002. Transfers and tank usage will be updated based on information available thru 5/31/2003 (Tables D-3 and D-5). 5. W-314 project assumptions: a. 244-A by pass will not interfere with the cross-site transfer of waste needed to support salt well liquid pumping and retrieval milestones. b. Cross-site line and master pump shutdown (MPS) outage will occur from 1/1/2004 to 4/30/2004. c. Other project assumptions and outage dates are listed in the assumption matrix (Table A-1) 6. Wastes in tank SY-101 will be transferred to tank AW-102 in 7/2003 for evaporation. After evaporation the concentrated waste will be transferred to tank AN-101. 7. The accelerated retrieval of tank C-106 will start in FY 2003. The next SST tanks to be retrieved are S-112, S-102, C-200s; T-200s; B-200s; and S-105. Dates for starting these tanks are listed in the assumption matrix (table A-1).	
Software Change Summary - This section is focused on changes in the HTWOS model functionality. Reference the item in the Scenario Change Summary section when an assumption change leads to a model function change.	
Requestor Information - For reporting modeling status and resolving issues.	
Requestor/Contact: J. O. Honeyman Signed Copy on file	
Reference for Request: TPA milestones M-045-02L, *Submit Annual Updates to SST Retrieval Sequence Document*, and M-046-00J, *Double-Shell Tank Space Evaluation*, both due by 9/30/2003.	
Deliverable(s): Analyzed HTWOS model results to support preparation of RPP-8554, Rev. 2	
Due Date: (Format the presentation of due dates to correspond with deliverables section.) As needed to support the schedule to deliver the final report by 9/23/2003.	
Change Approval	
Team Lead: J. N. Strode Signed Copy on file	**Manager:** N. Kirch Signed Copy on file
Customer: J. O. Honeyman Signed Copy on file	

Table D-2. Waste Generation (Kgal/yr) Spreadsheet for FY 2003.

Percent Flush to Apply is Shown at the Bottom of the Table.										
OWVP02WGX1						37349				
TOTAL=PUREX+ PFP+222-S+ T PLANT+ WESF+ 300+ 400										
									TOTAL	
									Non-Tank	
	PUREX	PFP	222-S	T PLANT	TANK	WESF	300	400	Farms	
	Baseline	Baseline	Baseline	Baseline	FARM		Baseline	Baseline	Generations	
Fiscal	Case	Case	Case	Case			Case	Case		
Year	(Kgal/yr)	(Kgal/yr)	(Kgal/yr)	(Kgal/yr)	(Kgal/yr)	(Kgal/yr)	(Kgal/yr)	(Kgal/yr)	(Kgal/yr)	
2003	5.00	11.10	10.00	16.50	120.00	0.00	0.00	0.00	42.60	
2004	5.00	14.79	10.00	13.50	120.00	0.00	15.16	0.00	58.45	*
2005	5.00	11.10	10.00	10.50	120.00	0.00	15.02	0.00	51.61	
2006	5.00	0.00	10.00	7.50	120.00	0.00	30.04	0.00	52.54	
2007	5.00		10.00	4.70	120.00	0.00	9.49	0.00	29.19	
2008	5.00		10.00	3.00	120.00	0.00	4.00	0.00	22.00	
2009	5.00		10.00	3.00	120.00	0.00	4.00	0.00	22.00	
2010	5.00		10.00	3.00	120.00	0.00	4.00	0.00	22.00	
2011	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	*
2012	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2013	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2014	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2015	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2016	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2017	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2018	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2019	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2020	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2021	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2022	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2023	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2024	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2025	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2026	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2027	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
2028	5.00		10.00	3.00	120.00	0.00	0.00	0.00	18.00	
TOT(Kgal)	130.00	36.98	260.00	115.70	3120.00	0.00	81.71	0.00	624.39	
Total is in kgal summed over all years										
RANGE =			18.0	-	58.5	Kgal/yr without Tank Farms				
RANGE =			138.0	-	178.5	Kgal/yr with Tank Farms				
% FLUSH	0		22	22	0	0	44	44		

Table D-3a. Double-Shell Tank Transfers—Case1-Target Case. (4 Sheets)

No.	Transfer or Event	Approximate Date	Reason for Transfer	Project and Other Interactions
2EEVAP6	**Evap Campaign 03-03**	**~6/29/2003**	Evaporates waste from AP-108; slurries directly to AP-108 and transfers to AN-101 later.	
2ETR001026 A1T	SY-101 to AW-102 (530 kgal)	~7/16/2003	Frees up space in SY-101 to support SST retrieval. Stages dilute waste for next evaporator campaign.	
	SY-102 to SY-101 (178 kgal)	~7/25/2003	Frees up space in SY-102 to support Interim Stabilization; provides buffer needed to keep S-112 retrieval batch within specifications.	
2EXFER0032	AN-101 to AN-106 (200 kgal)	~7/30/2003	Remove dilute from AN-101 so tank can be used to store concentrated waste.	
	Assume Phase-2 of the C-106 retrieval to AN-106 begins on 8/4/2003.			
2EEVAP5	**Evap Campaign 03-04**	**~8/14/2003**	Evaporates waste from SY-101; slurries directly to AP-108.	**Product should go to tanks without solids.**
2EXFER0040	AP-105 to AW-102 (1 Mgal)	~9/3/2003	Stages dilute waste for next evaporator campaign.	
2EXFER0031	AP-108 to AN-101 (1 Mgal)	~9/8/2003	Concentrated waste in AP-108 is moved into AN-101 to allow AP-108 to be used for SST retrieval.	
	Assume S-112 retrieval starts on 9/20/2003. Evaporator Campaign delayed to handle cross-sites from SY-101.			
2ETR001072	SY-101 to AP-107 (800 kgal)	~9/22/2003	SY-101 full; supports SST retrieval (first S-112 waste transfer). Tops off AP-107.	**Larger transfer volume needed to minimize number of cross-sites. Assume transfer and receipt of waste from S-112 occur simultaneously.**
	SY-102 to SY-101 (200 kgal)	~9/29/2003	Frees up space in SY-102 to support Interim Stabilization; provides buffer needed to keep S-112 retrieval batches 2 & 3 within specifications.	
2ETR001073	SY-101 to AP-108 (1 Mgal)	~10/2/2003	SY-101 full; supports SST Retrieval (second S-112 waste transfer). Tops off AP-108.	
2EXFER0042	SY-101 to AP-105 (600 kgal)	~10/13/2003	Supports S-112 retrieval.	

Table D-3a. Double-Shell Tank Transfers—Case1-Target Case. (4 Sheets)

No.	Transfer or Event	Approximate Date	Reason for Transfer	Project and Other Interactions
2EXFER0020	AW-106 to AP-102 (700 kgal)	~10/24/2003	Cleans out AW-106 before next evaporator campaign. Must leave space in AP-102 for SWL pumping.	**Takes jumper change in 02A pit. Potential increase in dose to W-211 workers in 02A & 02D pits.**
2EEVAP104	**Evap Campaign 04-01**	**~10/30/2003**	Evaporates waste from AP-105 to a higher specific gravity; slurries to AW-106.	**This activity supports TPA Milestone M-46-21.**
2EXFER0041	AP-104 to AW-102 (1 Mgal)	~11/17/2003	Stages dilute waste for next evaporator campaign.	
	Assume C-201 retrieval starts on 12/2/2003			
2EEVAP105	**Evap Campaign 04-02**	**~12/5/2003**	Evaporates waste from AP-104 to a higher specific gravity; slurries directly to AP-104.	**This activity supports TPA Milestone M-46-21.**
	Assume C-202 retrieval starts on 12/12/2003			
	SY-102 to SY-101 (200 kgal)	~12/17/2003	Frees up space in SY-102 to support Interim Stabilization; provides buffer needed to keep S-112 retrieval batches within specifications.	**The need for this transfer and subsequent transfers of this type is being verified – 6/12/2003.**
	Assume S-102 retrieval starts on 12/19/2003			
2EXFER0043	SY-101 to AP-105 (500 kgal)	~12/22/2003	SY-101 full; supports SST retrieval of S-102. Tops off AP-105.	
	Assume C-203 retrieval starts on 12/22/2003			
	Assume C-204 retrieval starts on 12/29/2003			
2EXFER0044	SY-101 to AY-101 (750 Kgal)	~12/30/2003	Supports S-102 retrieval. Tops off AY-101.	
2EXFER0045	SY-101 to AN-106 (500 Kgal)	**~1/15/2004**	Supports S-102 retrieval.	
	SY-101 to SY-102 (300 Kgal)	~1/23/2004	This transfer will be mandatory if S-102 volume exceeds 2.1 Mgal. Additional cross-sites could be needed.	**OPD device in SYA valve pit.**
2EXFER0025	AP-107 to AW-102 (1 Mgal)	~1/29/2004	Stages dilute waste for next evaporator campaign.	
2EXFER0050	AP-105 to AP-107	~2/5/2004	Cleans out AP-105 to receive concentrated waste.	

Table D-3a. Double-Shell Tank Transfers—Case1-Target Case. (4 Sheets)

No.	Transfer or Event	Approximate Date	Reason for Transfer	Project and Other Interactions
	(1 Mgal)		Tops off AP-107.	
2E4AP3AW	AW-106 to AP-105 (670 Kgal)	~2/10/2004	Concentrated waste is transferred back to original tank.	
2EEVAP107	**Evap Campaign 04-03**	**~2/14/2004**	Evaporates waste from AP-107; slurries directly to AP-105, and the remainder to AW-106. Tops off AP-105.	
2EXFER0033	AP-108 to AW-102 (1 Mgal)	~2/28/2004	Stages dilute waste for next evaporator campaign.	
	Cross-Site outage occurs 2/18/2004 – 5/22/2004			
	MPS outage occurs 2/18/2004 – 5/22/2004 – no DST transfers or Evaporator Campaigns during MPS outage			
	Evap Campaign 04-04	**~5/22/2004**	Evaporates waste from AP-108; slurries directly to AW-106.	
	AW-106 to AP-103 (430 kgal)	~5/26/2004	Increased fill limit. Tops off AP-103.	
	AP-107 to AW-102 (1 Mgal)	~5/29/2004	Stages dilute waste for next evaporator campaign. Cleans out AP-107 to receive concentrated waste from AN-101.	
	AW-106 to AP-104 (400 kgal)	~6/4/2004	Increased fill limit. Tops off AP-104.	
	Evap Campaign 04-05	**~6/16/2004**	Evaporates waste from AP-107; slurries to AW-106.	**High WVR requires multiple passes and use of AW-106.**
	AP-101 to AW-102 (1 Mgal)	~6/24/2004	Stages dilute waste for next evaporator campaign. Creates additional space to store concentrated waste.	
	Evap Campaign 04-06	**~7/14/2004**	Evaporates waste from AP-101; slurries directly to AP-101.	
	AN-106 to AW-102 (1 Mgal)	~7/20/2004	Stages dilute waste for next evaporator campaign.	
	Evap Campaign 04-07	**~7/28/2004**	Evaporates waste from AN-106; slurries to AW-106.	**High WVR requires multiple passes and use of AW-106.**

Table D-3a. Double-Shell Tank Transfers—Case1-Target Case. (4 Sheets)

No.	Transfer or Event	Approximate Date	Reason for Transfer	Project and Other Interactions
	AW-106 to AP-101 (250 kgal)	~8/14/2004	Cleans out AW-106 before next evaporator campaign.	
	AY-102 to AW-102 (500 kgal)	~9/2/2004	Stages dilute waste for next evaporator campaign. Concentrates AY-102 supernates.	
	AW-106 to AP-101 (170 kgal)	~9/24/2004	Cleans out AW-106 before next evaporator campaign. Tops off AP-101.	
	Evap Campaign 04-08	**~9/24/2004**	Evaporates waste from AY-102; slurries to AW-106.	**High WVR requires multiple passes and use of AW-106.**
	Assume T-201 retrieval starts on 9/25/2004.			
	AW-106 to AP-102 (180 kgal)	~10/2/2004	Cleans out AW-106 before next evaporator campaign. Increase fill limit. Tops off AP-102.	
	AW-106 to AY-102 (500 kgal)	~10/4/2004	Returns AY-102 waste to original tank. Tops off AY-102.	
	Assume T-202 retrieval starts on 10/6/2004.			
	Assume T-203 retrieval starts on 10/13/2004.			
	Assume B-201 retrieval starts on 10/28/2004.			
	Assume T-204 retrieval starts on 11/1/2004.			
	Assume B-202 retrieval starts on 11/27/2004.			
	Assume S-105 retrieval starts on 12/1/2004.			
	SY-101 to AP-107 (900 Mgal)	~12/7/2004	Supports S-105 retrieval. Tops off AP-107.	
	Assume B-203 retrieval starts on 12/27/2004.			
	SY-101 to AP-108 (800 Mgal)	~12/30/2004	Supports S-105 retrieval.	

Table D-3b. Case1-Target-Case Evaporator Campaign Schedule.

Campaign	Start Date	Staging Tank (Staging Date to AW-102)	Original Waste Source	Waste Feed Type	Feed Volume (Kgal)	Waste Volume Reduction (Kgal)	Slurry Receiver Tank for Concentrated Waste (Final Storage Tank)
03-03	6/29/2003	AP-108 (6/12/2003)	AP-102	DN	1060	392	AP-108 (AN-101)
03-04	8/14/2003	SY-101 (7/16/2003)	SY-101	DN	520	136	AP-108 (AN-101-full)
04-01	10/30/2003	AP-105 (9/3/2003)	AP-105	DC	1020	280	AW-106 (AP-105)
04-02	12/5/2003	AP-104 (11/17/2003)	AP-104	DN	1070	430	AP-104
04-03	2/14/2004	AP-107 (1/29/2004)	AP-102 to AP-107 – 2/6/2003 SY-101 to AP-107 – 9/22/2003 (SWL and S-112)	DN	1100	420	AW-106 (AP-105 - full)
04-04	5/22/2004	AP-108 (2/28/2004)	SY-101 to AP-108 – 10/2/2003 (S-112)	DN	950	360	AW-106 (AP-103 – full), (AP-104 – full)
04-05	6/16/2004	AP-107 (5/29/2004)	SY-101 to AP-105 – 10/13/2003 (S-112) SY-101 to AP-105 – 12/22/2003 (S-102) AP-105 to AP-107 – 2/5/2004	DN	1100	530	AW-106 (AP-101)
04-06	7/14/2004	AP-101 (6/24/2004)	AP-101	DN	1090	330	AP-101
04-07	7/28/2004	AN-106 (7/20/2004)	AN-101 to AN-106 – 7/30/2003 C-106 to AN-106 – 10/18/2003 SY-101 to AN-106 – 1/15/2004 (S-102)	DN	1050	860*	AW-106 (AP-101)
04-08	9/24/2004	AY-102 (9/2/2004)	AY-102	DN	500	390*	AW-106 (AY-102-full), (AP-102-full)

Notes:

DC = dilute complexed waste.
DN = dilute non-complexed waste.
DN/DC = dilute non-complexed/dilute complexed waste.

* High waste volume reduction requires multiple passes and use of Tank AW-106. Tank AW-106 must be cleaned-out before use.

Table D-4. Saltwell Volumes and Flushes Updated for the 2003 OWVP Projections. (4 Sheets)

SWL0602AA.XLS 6/18/2002 Updated flush factors through 5/31/2003.
SWL UPDATE INFO FROM DAVE VLADIMIROFF ON ~6/14/2002.
HISTORICAL VOLUMES THRU 5/31/2003

200 EAST AREA

TANK	VOL. (KGAL) FROM REFR 1	% FLUSH	PUMP EFFIC %	WASTE TYPE	RETRIEVE TO TANK	RETRIEVE ORIGIN NAME	MO VOL (KGAL) 9/99	10/99	11/99	12/99	1/00	2/00	3/00	4/00	5/00	6/00
A-101		0.4		DN			0	0	0	0	0	0	0	0	3	4
AX-101		0.4		DN			0	0	0	0	0	0	0	0	0	0
BY-105		1.50		DN			0	0	0	0	0	0	0	0	0	0
BY-106		1.13		DN			0	0	0	0	0	0	0	0	0	0
C-103		0.6		DC			0	0	0	0	0	0	0	0	0	0
106-AN (C-103)							0	0	0	0	0	0	0	0	0	0
FLUSH							0	0	0	0	0	0	0	0	0	0
102-AP (BY FARM)							0	0	0	0	0	0	0	0	0	0
FLUSH							0	0	0	0	0	0	0	0	0	0
102-AP (A-101,AX-101)							0	0	0	0	0	0	0	0	3	4
FLUSH							0	0	0	0	0	0	0	0	1	1
TOT W/O FLUSH							0	0	0	0	0	0	0	0	3	4
TOT WITH FLUSH							0	0	0	0	0	0	0	0	5	5

200 WEST AREA

TANK	VOL. (KGAL) FROM REFR 1	% FLUSH	PUMP EFFIC %	WASTE TYPE	RETRIEVE TO TANK	RETRIEVE ORIGIN NAME	MO VOL (KGAL) 9/99	10/99	11/99	12/99	1/00	2/00	3/00	4/00	5/00	6/00
S-101		0.4		DN			0	0	0	0	0	0	0	0	0	0
S-102		2.17		DN			3	3	3	3	3	3	3	3	3	3
S-103		0.73		DN			3	3	3	3	0	0	0	0	0	0
S-106		0.31		DN			12	13	12	13	1	0	0	0	0	0
S-107		0.4		DN			0	0	0	0	0	0	0	0	0	0
S-109		0.4		DN			0	0	0	0	0	0	0	0	0	0
S-111		0.26		DN			0	0	0	0	0	0	0	0	0	0
S-112		0.4		DN			0	0	0	0	0	0	0	0	0	0
SX-101		1.26		DN			0	0	0	0	0	0	0	0	0	0
SX-102		0.6		DN			0	0	0	0	0	0	0	0	0	0
SX-103		1.24		DN			0	0	0	0	0	0	0	0	0	0
SX-104		0.4		DN			0	0	0	0	0	0	0	0	0	0
SX-105		1.43		DN			0	0	0	0	0	0	0	0	0	0
SX-106		0.96		DN			10	10	10	7	0	0	0	0	0	0
T-104		0.28		DN			0	0	0	0	0	0	0	0	0	0
T-110		0.28		DN			0	0	0	0	0	0	0	0	0	0
U-102		2.97		DC			0	0	0	0	3	7	7	7	7	7
U-103		1.54		DC			2	13	13	13	13	13	13	13	5	0
U-105		1.22		DC			0	0	0	8	13	12	13	12	13	12
U-106		1.65		DC&TRU			0	0	0	0	0	0	0	0	0	0
U-107		0.4		DN			0	0	0	0	0	0	0	0	0	0
U-108		0.4		DN			0	0	0	0	0	0	0	0	0	0
U-109		1.96		DC			0	0	0	0	0	0	6	9	10	9
U-111		0.4		DN			0	0	0	0	0	0	0	0	0	0
DN-SWL							29	30	29	26	4	3	3	3	3	3
FLUSH							23	24	23	20	8	7	7	7	7	7
DC-SWL							2	13	13	21	29	31	40	42	34	29
FLUSH							3	21	20	30	44	54	71	74	63	54
TOT W/O FLUSH							31	43	42	48	33	34	43	45	38	32
TOT WITH FLUSH							56	87	85	98	85	95	121	126	108	93
							31									
GRAND TOTAL W/O FLUSH							31	43	42	48	33	34	43	45	41	36
GRAND TOTAL WITH FLUSH							56	87	85	98	85	95	121	126	113	98
							9/99	10/99	11/99	12/99	1/00	2/00	3/00	4/00	5/00	6/00

Table D-4. Saltwell Volumes and Flushes Updated for the 2003 DST Projections. (4 Sheets)

7/00	8/00	9/00	10/00	11/00	12/00	1/01	2/01	3/01	4/01	5/01	6/01	7/01	8/01	9/01	10/01	11/01	12/01	1/02
4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57
1	8	0	0	0	0	0	0	10	3	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	3	3	0
0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	9	8	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	12	11	0
0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	14	14	0
4	11	0	0	0	0	0	0	10	3	0	0	0	0	0	0	0	0	57
2	5	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	33
4	11	0	0	0	0	0	0	10	3	0	0	15	0	0	0	12	11	57
6	16	0	0	0	0	0	0	14	5	0	0	35	0	0	0	26	25	90
		23												28				
		32												54				

7/00	8/00	9/00	10/00	11/00	12/00	1/01	2/01	3/01	4/01	5/01	6/01	7/01	8/01	9/01	10/01	11/01	12/01	1/02
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	6	17	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	19	0	0	0	0	0	0	0	0	10	3	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
0	0	0	1	18	16	14	11	11	9	8	28	0	0	7	3	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	44	35	45	13	6	7	2	0	2	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	7	4	4	4	4	3	3	3	2	2	0	3	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	13	17	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
10	9	5	5	4	4	2	0	0	0	0	1	4	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	47	41	64	42	40	21	13	11	10	8	28	0	0	16	16	2	9	4
7	69	52	73	46	52	28	16	14	13	10	35	0	0	20	11	2	3	1
22	29	26	18	8	8	5	3	3	2	2	0	7	2	1	0	0	0	0
47	60	50	37	20	19	14	8	8	7	7	0	15	5	2	0	0	0	0
26	76	67	81	51	48	27	16	14	13	10	28	7	2	17	16	2	9	4
80	204	170	191	116	119	68	40	35	33	27	63	22	7	39	27	5	12	5
		526												312				
30	87	67	81	51	48	27	16	23	16	10	28	22	2	17	16	14	20	62
86	220	170	191	116	119	68	40	49	38	27	63	57	7	39	27	31	36	96
7/00	8/00	9/00	10/00	11/00	12/00	1/01	2/01	3/01	4/01	5/01	6/01	7/01	8/01	9/01	10/01	11/01	12/01	1/02

Table D-4. Saltwell Volumes and Flushes Updated for the 2003 DST Projections. (4 Sheets)

					--->---PROJECTED------->													
2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03
159	45	56	68	3	30	25	15	12	10	8	7	5	4	3	3	2	2	2
144	35	61	40	15	9	5	3	2	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	14	13	10	9	7	6	5	4	4	3	3	2	2	2
0	0	0	0	0	11	13	10	9	7	6	5	4	3	3	2	2	1	1
0	0	0	0	0	0	13	42	19	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	13	42	19	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	8	25	11	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	25	26	21	18	14	12	10	8	7	6	5	4	3	3
0	0	0	0	0	34	34	27	23	19	16	13	10	9	8	6	5	4	4
304	80	117	108	18	39	30	18	14	11	8	7	5	4	3	3	2	2	2
222	76	44	45	7	16	12	7	6	4	3	3	2	2	1	1	1	1	1
304	80	117	108	18	65	69	81	51	25	20	17	13	11	9	8	6	5	4
526	156	161	153	26	114	122	140	91	49	40	33	25	23	18	15	12	11	9
							921											
							1,539											
					--->---PROJECTED------->													
2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03
0	0	0	0	3	12	10	8	7	5	5	4	2.9	2.73	2	2	2	1	1
0	0	0	2	5	5	5	4	4	4	4	4	3	4	3	3	3	3	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	11	8	5	4	4	4	3	2.6	2.56	2	2	2	2	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	7	3	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
0	0	0	0	0	0	2	13	11	9	7	6	5	4	4	3	2	2	2
0	0	0	0	6	8	7	6	5	4	4	3	2	2	2	2	1	1	1
0	0	0	0	9	9	8	7	6	5	5	4	4	4	3	3	2	2	2
0	0	0	0	2	2	2	2	2	2	2	2	1	2	2	2	1	2	2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	14	20	13	10	8	6	5	4	3	2	2	1	1	0	0
0	0	0	1	16	18	13	10	9	7	6	5	3	3	3	2	2	1	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	12	11	9	6	5	4	3	2	2	1	1	0	0	0	0
22	7	3	4	70	98	78	73	64	52	46	40	31	30	26	23	20	18	16
1	3	4	4	44	58	48	44	40	34	31	27	22	22	19	18	16	15	13
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	7	3	4	70	98	78	73	64	52	46	40	31	30	26	23	20	18	16
23	10	7	8	115	156	126	117	103	86	77	67	53	52	45	40	35	32	29
							387											
326	87	120	112	88	163	147	154	115	78	67	57	44	42	35	31	26	23	20
549	166	168	161	140	270	248	257	194	135	117	100	78	75	63	56	48	43	38
2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03

Table D-4. Saltwell Volumes and Flushes Updated for the 2003 DST Projections. (4 Sheets)

9/03	10/03	11/03	12/03	1/04	2/04	3/04	4/04	5/04	6/04	7/04	8/04	9/04	CROSS CHECK TOTAL (KGAL)	TANK	5/1/2002 VOL REMAING (KGAL)
1	1	0	0	0	0	0	0	0	0	0	0	0	533	A-101	201
0	0	0	0	0	0	0	0	0	0	0	0	0	338	AX-101	73
1	1	1	0	0	0	0	0	0	0	0	0	0	102	BY-105	88
1	0	0	0	0	0	0	0	0	0	0	0	0	101	BY-106	77
0	0	0	0	0	0	0	0	0	0	0	0	0	74	C-103	74
0	0	0	0	0	0	0	0	0	0	0	0	0	106-AN (C-103)		
0	0	0	0	0	0	0	0	0	0	0	0	0	FLUSH		
2	1	1	0	0	0	0	0	0	0	0	0	0	102-AP (BY FARM)		
3	2	1	0	0	0	0	0	0	0	0	0	0	FLUSH		
1	1	0	0	0	0	0	0	0	0	0	0	0	102-AP (A-101,AX-101)		
0	0	0	0	0	0	0	0	0	0	0	0	0	FLUSH		
3	2	1	0	0	0	0	0	0	0	0	0	0	TOT W/O FLUSH		
7	4	2	0	0	0	0	0	0	0	0	0	0	TOT WITH FLUSH		
173												3			
332												6			

9/03	10/03	11/03	12/03	1/04	2/04	3/04	4/04	5/04	6/04	7/04	8/04	9/04	CROSS CHECK TOTAL (KGAL)	TANK	5/1/2002 VOL REMAING (KGAL)
1	0	0	0	0	0	0	0	0	0	0	0	0	68	S-101	68
3	3	2	2	1	0	0	0	0	0	0	0	0	110	S-102	71
0	0	0	0	0	0	0	0	0	0	0	0	0	14	S-103	0
0	0	0	0	0	0	0	0	0	0	0	0	0	50	S-106	0
1	1	1	1	1	0	0	0	0	0	0	0	0	58	S-107	58
0	0	0	0	0	0	0	0	0	0	0	0	0	34	S-109	0
3	3	3	3	3	3	3	3	3	3	3	3	3	127	S-111	85
1	1	1	1	0	0	0	0	0	0	0	0	0	74	S-112	74
1	1	0	0	0	0	0	0	0	0	0	0	0	87	SX-101	55
2	2	1	1	1	1	1	1	1	1	1	0	0	87	SX-102	85
1	2	1	1	1	1	1	1	1	1	1	1	1	169	SX-103	43
0	0	0	0	0	0	0	0	0	0	0	0	0	0	SX-104	0
0	0	0	0	0	0	0	0	0	0	0	0	0	153	SX-105	0
0	0	0	0	0	0	0	0	0	0	0	0	0	38	SX-106	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	T-104	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	T-110	0
0	0	0	0	0	0	0	0	0	0	0	0	0	87	U-102	0
0	0	0	0	0	0	0	0	0	0	0	0	0	99	U-103	0
0	0	0	0	0	0	0	0	0	0	0	0	0	88	U-105	0
0	0	0	0	0	0	0	0	0	0	0	0	0	39	U-106	0
0	0	0	0	0	0	0	0	0	0	0	0	0	98	U-107	87
1	0	0	0	0	0	0	0	0	0	0	0	0	101	U-108	100
0	0	0	0	0	0	0	0	0	0	0	0	0	78	U-109	0
0	0	0	0	0	0	0	0	0	0	0	0	0	56	U-111	56
14	12	10	10	8	5	5	5	5	5	5	4	4	DN-SWL		1,295
12	11	10	9	7	3	3	3	3	3	3	2	2	FLUSH		
0	0	0	0	0	0	0	0	0	0	0	0	0	DC-SWL		
0	0	0	0	0	0	0	0	0	0	0	0	0	FLUSH		
14	12	10	10	8	5	5	5	5	5	5	4	4	TOT W/O FLUSH		
26	23	20	19	14	8	8	8	8	8	8	7	6	TOT WITH FLUSH		
380												78			
17	14	11	10	8	5	5	5	5	5	5	4	4	GRAND TOTAL W/O FLUSH		
33	27	22	19	14	8	8	8	8	8	8	7	6	GRAND TOTAL WITH FLUSH		
9/03	10/03	11/03	12/03	1/04	2/04	3/04	4/04	5/04	6/04	7/04	8/04	9/04			

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
AY-101							182
	LOSS	101AY	UNKN	8/1/02	8/31/02	-1	181
	LOSS	101AY	UNKN	10/1/02	10/31/02	-1	180
	LOSS	101AY	UNKN	1/1/03	1/31/03	-1	179
AY-102							667
	LOSS	102AY	UNKN	6/1/02	6/30/02	-3	664
	GAIN	WATER	102AY	7/11/02	7/11/02	5	669
	GAIN	WATER	102AY	8/20/02	8/20/02	6	675
	GAIN	WATER	102AY	9/25/02	9/25/02	3	678
	LOSS	102AY	UNKN	10/1/02	10/31/02	-4	674
	GAIN	WATER	102AY	11/1/02	11/1/02	3	677
	GAIN	WATER	102AY	12/10/02	12/10/02	4	681
	GAIN	WATER	102AY	1/24/03	1/24/03	5	686
	GAIN	WATER	102AY	2/27/03	2/27/03	3	689
	LOSS	102AY	UNKN	3/1/03	3/31/03	-2	687
	TRANSFER	106C	102AY	4/1/03	4/30/03	18	705
	GAIN	WATER	102AY	4/2/03	4/30/03	11	716
	GAIN	WATER	102AY	4/3/03	4/30/03	5	721
AZ-101							990
	GAIN	WATER	101AZ	6/10/02	6/10/02	6	996
	GAIN	INST	101AZ	6/15/02	6/15/02	5	1001
	LOSS	101AZ	UNKN	7/1/02	7/31/02	-1	1000
	LOSS	101AZ	UNKN	8/1/02	8/31/02	-7	993
	GAIN	INST	101AZ	9/7/02	9/7/02	4	997
	LOSS	101AZ	UNKN	10/1/02	10/31/02	-2	995
	LOSS	101AZ	UNKN	11/1/02	11/30/02	-1	994
	LOSS	101AZ	UNKN	1/1/03	1/31/03	-1	993
	LOSS	101AZ	UNKN	2/1/03	2/28/03	-2	991
	LOSS	101AZ	UNKN	3/1/03	3/31/03	-1	990
	LOSS	101AZ	UNKN	4/1/03	4/30/03	-2	988
AZ-102							994
	LOSS	102AZ	UNKN	6/1/02	6/30/02	-1	993
	LOSS	102AZ	UNKN	7/1/02	7/31/02	-1	992
	GAIN	INST	102AZ	8/22/02	8/22/02	2	994
	LOSS	102AZ	INST	9/7/02	9/7/02	-3	991
	LOSS	102AZ	UNKN	10/1/02	10/31/02	-1	990
	LOSS	102AZ	UNKN	11/1/02	11/30/02	-1	989
	LOSS	102AZ	UNKN	12/1/02	12/31/02	-1	988
	LOSS	102AZ	UNKN	3/1/03	3/31/03	-1	987

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
SY-101							966
	GAIN	UNKN	101SY	8/1/02	8/31/02	1	967
	LOSS	101SY	UNKN	10/1/02	10/31/02	-2	965
	TRANSFER	102SY	101SY	11/7/02	11/7/02	40	1005
	GAIN	WATER	101SY	11/7/02	11/7/02	1	1006
	TRANSFER	102SY	101SY	11/13/02	11/14/02	113	1119
	GAIN	UNKN	101SY	12/1/02	12/31/02	1	1120
	LOSS	101SY	UNKN	3/1/03	3/31/03	-1	1119
SY-102							601
	GAIN	STWAT	102SY	6/1/02	6/30/02	21	622
	TRANSFER	108U	102SY	6/1/02	6/30/02	3	625
	TRANSFER	107U	102SY	6/1/02	6/30/02	11	636
	TRANSFER	111U	102SY	6/2/02	6/30/02	10	646
	TRANSFER	244-TX	102SY	6/18/02	6/18/02	10	656
	GAIN	WATER	102SY	6/18/02	6/18/02	4	660
	TRANSFER	111U	102SY	7/1/02	7/31/02	26	686
	GAIN	STWAT	102SY	7/1/02	7/31/02	54	740
	TRANSFER	108U	102SY	7/1/02	7/31/02	7	747
	TRANSFER	107U	102SY	7/1/02	7/31/02	48	795
	TRANSFER	102SX	102SY	7/1/02	7/31/02	14	809
	TRANSFER	103SX	102SY	7/1/02	7/31/02	4	813
	TRANSFER	102S	102SY	7/1/02	7/31/02	1	814
	TRANSFER	111S	102SY	7/1/02	7/31/02	2	816
	TRANSFER	101S	102SY	7/2/02	7/31/02	6	822
	TRANSFER	111U	102SY	8/1/02	8/31/02	14	836
	TRANSFER	108U	102SY	8/1/02	8/31/02	11	847
	TRANSFER	102S	102SY	8/1/02	8/31/02	1	848
	GAIN	STWAT	102SY	8/1/02	8/31/02	34	882
	LOSS	102SY	UNKN	8/1/02	8/31/02	-5	877
	TRANSFER	103SX	102SY	8/1/02	8/31/02	2	879
	TRANSFER	107U	102SY	8/1/02	8/31/02	17	896
	TRANSFER	101S	102SY	8/1/02	8/31/02	3	899
	TRANSFER	102SX	102SY	8/1/02	8/31/02	15	914
	GAIN	STWAT	102SY	9/1/02	9/30/02	44	958
	LOSS	102SY	UNKN	9/1/02	9/30/02	-4	954
	TRANSFER	103SX	102SY	9/1/02	9/30/02	1	955
	TRANSFER	102SX	102SY	9/1/02	9/30/02	9	964
	TRANSFER	108U	102SY	9/1/02	9/30/02	10	974
	TRANSFER	107U	102SY	9/1/02	9/30/02	5	979
	TRANSFER	111S	102SY	9/1/02	9/30/02	7	986
	TRANSFER	111U	102SY	9/2/02	9/30/02	17	1003
	TRANSFER	107S	102SY	9/2/02	9/30/02	14	1017
	TRANSFER	107S	102SY	9/2/02	9/30/02	19	1036

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
SY-102	TRANSFER	112S	102SY	9/2/02	9/30/02	2	1038
(cont'd)	GAIN	STWAT	102SY	10/1/02	10/31/02	28	1066
	TRANSFER	102SX	102SY	10/1/02	10/31/02	4	1070
	TRANSFER	101S	102SY	10/1/02	10/23/02	16	1086
	TRANSFER	112S	102SY	10/6/02	10/10/02	5	1091
	TRANSFER	111U	102SY	10/10/02	10/19/02	5	1096
	TRANSFER	108U	102SY	10/10/02	10/19/02	5	1101
	TRANSFER	102S	102SY	10/12/02	10/15/02	1	1102
	TRANSFER	107S	102SY	10/14/02	10/17/02	2	1104
	TRANSFER	111U	102SY	11/1/02	11/29/02	8	1112
	TRANSFER	108U	102SY	11/1/02	11/29/02	11	1123
	TRANSFER	107U	102SY	11/1/02	11/29/02	1	1124
	TRANSFER	111S	102SY	11/1/02	11/29/02	3	1127
	GAIN	STWAT	102SY	11/1/02	11/30/02	11	1138
	LOSS	102SY	UNKN	11/1/02	11/30/02	-6	1132
	TRANSFER	102SY	101SY	11/7/02	11/7/02	-40	1092
	TRANSFER	102SY	101SY	11/13/02	11/14/02	-113	979
	TRANSFER	111U	102SY	12/1/02	12/31/02	4	983
	GAIN	STWAT	102SY	12/1/02	12/31/02	6	989
	LOSS	102SY	UNKN	12/1/02	12/31/02	-10	979
	TRANSFER	108U	102SY	12/1/02	12/31/02	4	983
	TRANSFER	111S	102SY	12/1/02	12/31/02	4	987
	TRANSFER	107U	102SY	12/3/02	12/21/02	10	997
	TRANSFER	107U	102SY	12/3/02	12/21/02	1	998
	TRANSFER	102SY	102AP	12/9/02	12/19/02	-362	636
	TRANSFER	1RTS	102SY	12/15/02	12/15/02	13	649
	TRANSFER	107S	102SY	12/29/02	12/31/02	1	650
	TRANSFER	111U	102SY	1/1/03	1/4/03	1	651
	GAIN	STWAT	102SY	1/1/03	1/31/03	25	676
	TRANSFER	107S	102SY	1/1/03	1/30/03	10	686
	TRANSFER	111S	102SY	1/1/03	1/25/03	8	694
	TRANSFER	108U	102SY	1/1/03	1/30/03	7	701
	GAIN	STWAT	102SY	1/2/03	1/31/03	3	704
	TRANSFER	107U	102SY	1/3/03	1/21/03	6	710
	TRANSFER	101S	102SY	1/16/03	1/24/03	5	715
	TRANSFER	102SX	102SY	1/30/03	1/30/03	1	716
	TRANSFER	111U	102SY	2/1/03	2/27/03	1	717
	GAIN	UNKN	102SY	2/1/03	2/28/03	1	718
	TRANSFER	102SX	102SY	2/1/03	2/27/03	30	748
	TRANSFER	108U	102SY	2/1/03	2/27/03	1	749
	TRANSFER	107U	102SY	2/1/03	2/27/03	3	752
	TRANSFER	111S	102SY	2/1/03	2/27/03	6	758
	TRANSFER	107S	102SY	2/1/03	2/27/03	7	765
	GAIN	STWAT	102SY	2/2/03	2/28/03	34	799

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
SY-102	TRANSFER	244-TX	102SY	2/27/03	2/27/03	15	814
(cont'd)	GAIN	UNKN	102SY	3/1/03	3/31/03	3	817
	GAIN	WATER	102SY	3/6/03	3/25/03	2	819
	GAIN	STWAT	102SY	3/3/03	3/31/03	13	832
	GAIN	SWLIQ	102SY	3/6/03	3/25/03	14	846
	TRANSFER	101S	102SY	4/1/03	4/30/03	12	858
	TRANSFER	107S	102SY	4/1/03	4/30/03	9	867
	TRANSFER	111S	102SY	4/1/03	4/30/03	6	873
	TRANSFER	101SX	102SY	4/1/03	4/30/03	1	874
	TRANSFER	102SX	102SY	4/1/03	4/30/03	7	881
	TRANSFER	107U	102SY	4/1/03	4/30/03	7	888
	TRANSFER	108U	102SY	4/1/03	4/30/03	6	894
	GAIN	STWAT	102SY	4/3/03	4/30/03	49	943
SY-103							740
	GAIN	UNKN	103SY	6/1/02	6/30/02	1	741
	GAIN	UNKN	103SY	7/1/02	7/31/02	1	742
	LOSS	103SY	UNKN	8/1/02	8/31/02	-1	741
	LOSS	103SY	GAINS	9/3/02	9/4/02	-3	738
	LOSS	103SY	UNKN	11/1/02	11/30/02	-2	736
	LOSS	103SY	UNKN	12/1/02	12/31/02	-1	735
	GAIN	UNKN	103SY	3/1/03	3/31/03	1	737
	LOSS	103SY	UNKN	4/1/03	4/30/03	-2	735
AW-101							1127
	GAIN	UNKN	101AW	6/1/02	6/30/02	1	1128
	LOSS	101AW	UNKN	7/1/02	7/31/02	-1	1127
	GAIN	UNKN	101AW	9/1/02	9/30/02	1	1128
	LOSS	101AW	UNKN	2/1/03	2/28/03	-1	1127
AW-102							1062
	GAIN	UNKN	102AW	7/1/02	7/31/02	2	1064
	GAIN	UNKN	102AW	10/1/02	10/31/02	1	1065
	GAIN	WATER	102AW	10/4/02	10/28/02	1	1066
	EV	DC590	102AW	11/14/02	11/22/02	-1019	47
	EV	DC590	102AW	11/14/02	11/22/02	602	649
	GAIN	DSSF	102AW	11/23/02	11/23/02	4	653
	GAIN	WATER	102AW	11/24/02	11/30/02	29	682
	TRANSFER	102AW	106AW	11/25/02	11/25/02	-602	80
	LOSS	102AW	UNKN	12/2/02	12/31/02	-1	79
	GAIN	WATER	102AW	12/3/02	12/7/02	1	80
	TRANSFER	108AP	102AW	12/16/02	12/16/02	871	951
	TRANSFER	108AP	102AW	12/26/02	12/26/02	3	954
	GAIN	WATER	102AW	1/1/03	1/31/03	1	955

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
AW-102	TRANSFER	108AP	102AW	1/2/03	1/2/03	167	1122
(cont'd)	EV	DN715	102AW	1/16/03	1/16/03	-1072	50
	EV	DN715	102AW	1/16/03	1/16/03	766	816
	TRANSFER	102AW	104AW	1/17/03	1/17/03	-762	54
	GAIN	WATER	102AW	1/18/03	1/18/03	24	78
	TRANSFER	107AP	102AW	1/30/03	1/30/03	489	567
	TRANSFER	107AP	102AW	2/1/03	2/4/03	447	1014
	GAIN	WATER	102AW	2/17/03	2/26/03	1	1015
	EV	DN860	102AW	2/25/03	2/25/03	-985	30
	EV	DN860	102AW	2/25/03	2/25/03	848	878
	TRANSFER	102AW	106AW	2/26/03	2/27/03	-267	611
	EV	DN764	102AW	3/1/03	3/5/03	-611	0
	EV	DN764	102AW	3/1/03	3/5/03	467	467
	TRANSFER	102AW	106AW	3/6/03	3/6/03	-419	48
	GAIN	WATER	102AW	3/5/03	3/7/03	37	85
	GAIN	WATER	102AW	4/16/03	4/30/03	9	94
AW-103							1100
	GAIN	UNKN	103AW	8/1/02	8/31/02	1	1101
	LOSS	103AW	UNKN	10/1/02	10/31/02	-1	1100
AW-104							313
	LOSS	104AW	UNKN	10/1/02	10/31/02	-1	312
	LOSS	104AW	UNKN	1/1/03	1/31/03	-1	311
	TRANSFER	102AW	104AW	1/17/03	1/17/03	762	1073
	GAIN	WATER	104AW	1/18/03	1/18/03	3	1076
	LOSS	104AW	UNKN	2/1/03	2/28/03	-1	1075
	LOSS	104AW	UNKN	3/1/03	3/31/03	-1	1074
AW-105							424
	LOSS	105AW	UNKN	12/1/02	12/31/02	-1	423
	LOSS	105AW	UNKN	2/1/03	2/28/03	-1	422
AW-106							294
	GAIN	WATER	106AW	9/11/02	9/26/02	1	295
	LOSS	106AW	UNKN	10/1/02	10/31/02	-1	294
	GAIN	WATER	106AW	10/3/02	10/3/02	1	295
	LOSS	106AW	UNKN	11/1/02	11/30/02	-1	294
	TRANSFER	102AW	106AW	11/25/02	11/25/02	602	896
	LOSS	106AW	UNKN	12/1/02	12/31/02	-1	895
	LOSS	106AW	UNKN	1/1/03	1/31/03	-1	894
	GAIN	UNKN	106AW	2/1/03	2/28/03	2	896
	TRANSFER	106AW	103AP	2/18/03	2/18/03	-615	281
	TRANSFER	102AW	106AW	2/26/03	2/27/03	267	548

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
AW-106	LOSS	106AW	UNKN	3/1/03	3/31/03	-2	546
(cont'd)	TRANSFER	102AW	106AW	3/6/03	3/6/03	419	965
	LOSS	106AW	UNKN	4/3/03	4/30/03	-1	964
AN-101							252
	GAIN	UNKN	101AN	6/1/02	6/30/02	1	253
	LOSS	UNKN	101AN	1/1/03	1/31/03	-1	252
AN-102							1077
	GAIN	WATER	102AN	9/4/02	9/18/02	1	1078
	LOSS	102AN	UNKN	12/1/02	12/31/02	-1	1077
	GAIN	INST	102AN	1/9/03	1/9/03	2	1079
	LOSS	102AN	UNKN	3/1/03	3/31/03	-1	1078
	LOSS	102AN	UNKN	3/1/03	3/31/03	-2	1076
AN-103							958
	GAIN	UNKN	103AN	7/1/02	7/31/02	1	959
	GAIN	WATER	103AN	8/14/02	8/22/02	1	960
	LOSS	103AN	UNKN	9/1/02	9/30/02	-1	959
	LOSS	103AN	UNKN	10/1/02	10/31/02	-1	958
	GAIN	INST	103AN	1/9/03	1/9/03	1	959
AN-104							1053
	LOSS	104AN	UNKN	6/1/02	6/30/02	-1	1052
	GAIN	UNKN	104AN	7/1/02	7/31/02	1	1053
	GAIN	UNKN	104AN	9/1/02	9/30/02	1	1054
	LOSS	104AN	UNKN	1/1/03	1/31/03	-1	1053
AN-105							1127
	GAIN	UNKN	105AN	9/1/02	9/30/02	1	1128
	LOSS	105AN	UNKN	11/1/02	11/30/02	-1	1127
	LOSS	105AN	UNKN	4/3/03	04/30/03	-2	1125
AN-106							38
	GAIN	NAOH	106AN	6/5/02	6/6/02	8	46
	GAIN	STWAT	106AN	11/1/02	11/29/02	1	47
	GAIN	UNKN	106AN	11/1/02	11/30/02	1	48
	TRANSFER	103C	106AN	11/2/02	11/30/02	3	51
	GAIN	STWAT	106AN	12/1/02	12/30/02	2	53
	GAIN	UNKN	106AN	12/1/02	12/31/02	1	54
	LOSS	106AN	UNKN	12/1/02	12/31/02	-1	53
	TRANSFER	103C	106AN	12/2/02	12/31/02	31	84
	TRANSFER	103C	106AN	12/2/02	12/31/02	72	156
	TRANSFER	103C	106AN	1/1/03	1/30/03	5	161

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
AN-106	GAIN	STWAT	106AN	1/1/03	1/30/03	1	162
(cont'd)	TRANSFER	103C	106AN	2/1/03	2/28/03	2	164
AN-107							1083
	GAIN	WATER	107AN	7/2/02	7/23/02	1	1084
	LOSS	107AN	UNKN	11/1/02	11/30/02	-1	1083
	LOSS	107AN	UNKN	2/1/03	2/28/03	-2	1081
	GAIN	NA0H	107AN	4/15/03	4/23/03	24	1105
	GAIN	WATER	107AN	4/16/03	4/23/03	1	1106
AP-101							1113
	GAIN	UNKN	101AP	9/1/02	9/30/02	1	1114
	LOSS	101AP	UNKN	11/1/02	11/30/02	-1	1113
	LOSS	101AP	UNKN	2/1/03	2/28/03	-1	1112
	LOSS	101AP	UNKN	3/1/03	3/31/03	-1	1111
AP-102							1121
	TRANSFER	101AX	102AP	6/1/02	6/30/02	29	1150
	LOSS	102AP	UNKN	6/1/02	6/30/02	-3	1147
	GAIN	STWAT	102AP	6/1/02	6/30/02	21	1168
	TRANSFER	102AP	107AP	6/3/02	6/3/02	-76	1092
	TRANSFER	102AP	107AP	6/14/02	6/14/02	-783	309
	GAIN	STWAT	102AP	7/1/02	7/31/02	25	334
	TRANSFER	101A	102AP	7/1/02	7/31/02	35	369
	TRANSFER	101AX	102AP	7/1/02	7/31/02	5	374
	TRANSFER	101AX	102AP	7/1/02	7/31/02	2	376
	GAIN	WATER	102AP	7/16/02	7/16/02	2	378
	GAIN	STWAT	102AP	8/1/02	8/31/02	42	420
	GAIN	WATER	102AP	8/1/02	8/31/02	1	421
	LOSS	102AP	UNKN	8/1/02	8/31/02	-1	420
	GAIN	STWAT	102AP	8/1/02	8/1/02	20	440
	TRANSFER	101A	102AP	8/1/02	8/31/02	36	476
	TRANSFER	101AX	102AP	8/1/02	8/31/02	10	486
	TRANSFER	244-BX	102AP	8/12/02	8/12/02	16	502
	TRANSFER	244-BX	102AP	8/23/02	8/23/02	18	520
	TRANSFER	244-BX	102AP	8/26/02	8/26/02	18	538
	TRANSFER	244-BX	102AP	9/1/02	9/1/02	11	549
	GAIN	STWAT	102AP	9/1/02	9/30/02	24	573
	GAIN	UNKN	102AP	9/1/02	9/30/02	1	574
	TRANSFER	101A	102AP	9/1/02	9/30/02	21	595
	TRANSFER	101AX	102AP	9/1/02	9/30/02	1	596
	TRANSFER	244-BX	102AP	9/2/02	9/2/02	8	604
	TRANSFER	244-BX	102AP	9/3/02	9/3/02	9	613
	TRANSFER	244-BX	102AP	9/6/02	9/6/02	10	623

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
AP-102	TRANSFER	244-BX	102AP	9/17/02	9/17/02	8	631
(cont'd)	TRANSFER	244-BX	102AP	9/25/02	9/25/02	8	639
	TRANSFER	101AX	102AP	10/1/02	10/31/02	4	643
	TRANSFER	101A	102AP	10/1/02	10/31/02	9	652
	LOSS	102AP	UNKN	10/1/02	10/31/02	-2	650
	GAIN	STWAT	102AP	10/1/02	10/31/02	19	669
	TRANSFER	244-BX	102AP	10/3/02	10/3/02	18	687
	TRANSFER	101AX	102AP	11/1/02	11/30/02	9	696
	TRANSFER	101A	102AP	11/1/02	11/29/02	5	701
	GAIN	STWAT	102AP	11/1/02	11/30/02	24	725
	LOSS	102AP	UNKN	11/1/02	11/30/02	-1	724
	TRANSFER	101A	102AP	12/1/02	12/29/02	2	726
	TRANSFER	101AX	102AP	12/1/02	12/31/02	3	729
	GAIN	STWAT	102AP	12/1/02	12/31/02	14	743
	LOSS	102AP	UNKN	12/1/02	12/31/02	-1	742
	GAIN	WATER	102AP	12/9/02	12/19/02	7	749
	GAIN	WATER	102AP	12/9/02	12/19/02	22	771
	TRANSFER	102SY	102AP	12/9/02	12/19/02	362	1133
	TRANSFER	244-BX	102AP	12/30/02	12/30/02	15	1148
	GAIN	STWAT	102AP	1/1/03	1/31/03	8	1156
	TRANSFER	101AX	102AP	1/1/03	1/14/03	3	1159
	TRANSFER	102AP	108AP	1/6/03	1/6/03	-1051	108
	TRANSFER	101AX	102AP	2/1/03	2/28/03	1	109
	TRANSFER	101A	102AP	2/1/03	2/28/03	8	117
	GAIN	UNKN	102AP	2/1/03	2/28/03	2	119
	GAIN	STWAT	102AP	2/2/03	2/28/03	24	143
	TRANSFER	102AP	107AP	2/6/03	2/6/03	-50	93
	TRANSFER	244-BX	102AP	2/19/03	2/19/03	19	112
	TRANSFER	101AX	102AP	3/1/03	3/31/03	2	114
	TRANSFER	101A	102AP	3/1/03	3/31/03	14	128
	LOSS	102AP	UNKN	3/1/03	3/31/03	-2	126
	GAIN	STWAT	102AP	3/3/03	3/31/03	44	170
	TRANSFER	244-BX	102AP	3/19/03	3/19/03	13	183
	TRANSFER	101A	102AP	4/1/03	4/30/03	5	188
	TRANSFER	101AX	102AP	4/1/03	4/30/03	3	191
	GAIN	STWAT	102AP	4/2/03	4/30/03	34	225
	TRANSFER	244-BX	102AP	4/3/03	4/30/03	3	228
AP-103							281
	GAIN	WATER	103AP	10/3/02	10/23/02	1	282
	TRANSFER	106AW	103AP	2/18/03	2/18/03	615	897
	LOSS	103AP	UNKN	3/1/03	3/31/03	-2	895

Table D-5. Historical Transfers* from 6/1/2002 through 4/30/2003. (9 Sheets)

Tank	Gain, Loss, Transfer, or Evaporations	From or Source Tank	To or Receipt Tank	Start Date	End Date	Transaction Volume (Kgal)	Tank Volume (Kgal)
AP-104							1106
	LOSS	104AP	UNKN	11/1/02	11/30/02	-1	1105
	LOSS	104AP	UNKN	1/1/03	1/31/03	-1	1104
	LOSS	104AP	UNKN	3/1/03	3/31/03	-1	1103
AP-105							1131
	GAIN	UNKN	105AP	8/1/02	8/31/02	1	1132
	LOSS	105AP	UNKN	11/1/02	11/30/02	-1	1131
	LOSS	105AP	UNKN	1/1/03	1/31/03	-1	1130
	LOSS	105AP	UNKN	4/1/03	4/30/03	-1	1129
AP-106							1140
	LOSS	106AP	UNKN	12/1/02	12/31/02	-1	1139
	LOSS	106AP	UNKN	3/1/03	3/31/03	-1	1138
AP-107							273
	LOSS	107AP	UNKN	6/1/02	6/30/02	-1	272
	TRANSFER	102AP	107AP	6/3/02	6/3/02	76	348
	TRANSFER	102AP	107AP	6/14/02	6/14/02	783	1131
	LOSS	107AP	UNKN	7/1/02	7/31/02	-2	1129
	GAIN	WATER	107AP	7/24/02	7/24/02	1	1130
	LOSS	107AP	UNKN	8/1/02	8/31/02	-2	1128
	LOSS	107AP	UNKN	9/1/02	9/30/02	-1	1127
	LOSS	107AP	UNKN	10/1/02	10/31/02	-2	1125
	LOSS	107AP	UNKN	11/1/02	11/30/02	-2	1123
	LOSS	107AP	UNKN	12/1/02	12/31/02	-1	1122
	LOSS	107AP	UNKN	1/1/03	1/31/03	-3	1119
	TRANSFER	107AP	102AW	1/30/03	1/30/03	-489	630
	GAIN	UNKN	107AP	2/1/03	2/28/03	1	631
	TRANSFER	107AP	102AW	2/1/03	2/4/03	-447	184
	TRANSFER	102AP	107AP	2/6/03	2/6/03	50	234
	LOSS	107AP	UNKN	3/1/03	3/31/03	-1	233
AP-108							1135
	LOSS	108AP	UNKN	6/1/02	6/30/02	-1	1134
	GAIN	WATER	108AP	9/24/02	9/24/02	1	1135
	LOSS	108AP	UNKN	10/1/02	10/31/02	-1	1134
	LOSS	108AP	UNKN	12/1/02	12/31/02	-2	1132
	TRANSFER	108AP	102AW	12/16/02	12/16/02	-871	261
	TRANSFER	108AP	102AW	12/26/02	12/26/02	-3	258
	LOSS	108AP	UNKN	1/1/03	1/31/03	-1	257
	TRANSFER	108AP	102AW	1/2/03	1/2/03	-167	90
	TRANSFER	102AP	108AP	1/6/03	1/6/03	1051	1141
	LOSS	108AP	UNKN	2/1/03	2/28/03	-1	1140
	LOSS	108AP	UNKN	4/1/03	4/30/03	-1	1139

*Transactions have been summarized to reduce the number of records and still explain net inventory changes.

APPENDIX E
GENERAL FACILITY DESCRIPTIONS

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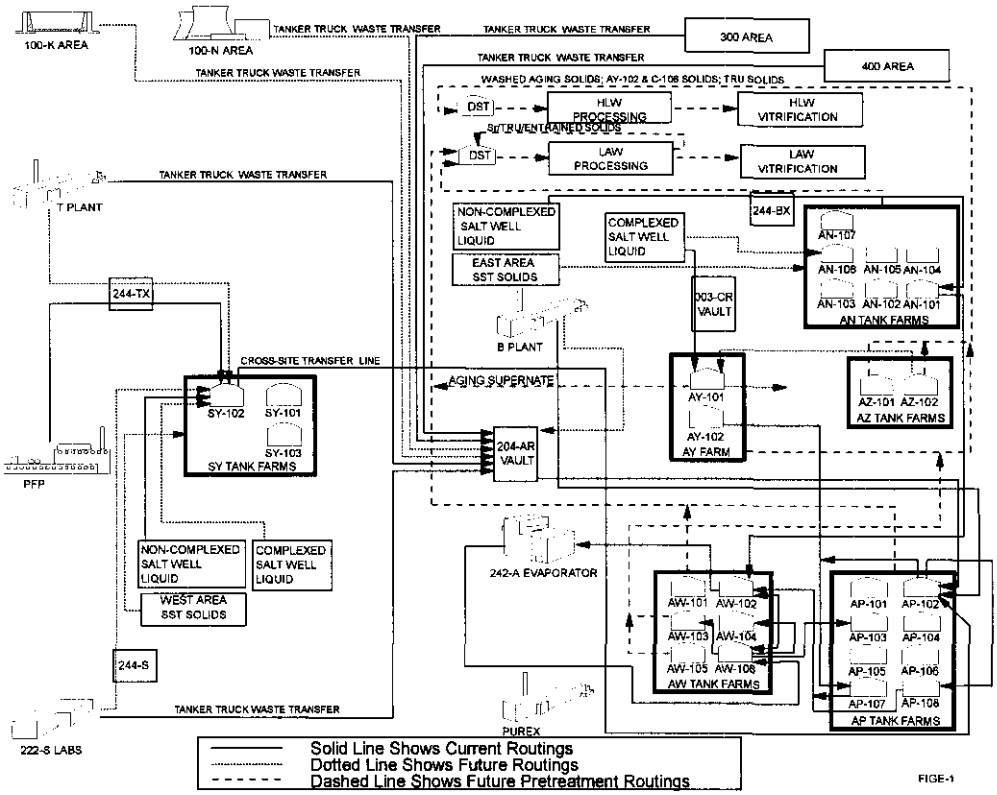
E1.0 SINGLE-SHELL TANKS

Figure E-1. Simplified Schematic of Current and Planned Routings.



E2.0 DOUBLE-SHELL TANKS

Information in this appendix briefly describes the facilities and projects pertinent to the Case 1 (Target Case) projection and includes facility operating dates, waste generation volumes, waste volume reduction factors, flushes, and other pertinent assumptions. Assumptions unique to the Case 2 projection are described in Section 5.1. This information has been summarized for each of the projection cases in the Assumptions Matrix, which is in Table A-1. The spreadsheet for the waste generation projection (Table D-2) lists the waste generations for each year for facilities that presented a range of waste generation rates (e.g., T Plant varied from 3 to 17 Kgal/year during the period from fiscal year 2003 through 2028). Some waste additions to double-shell tanks (DST) require a flush after the transfer has been completed. If a flush is required, it is reported in the following sections and in Table A-1.

E2.1 B PLANT/WASTE ENCAPSULATION AND STORAGE FACILITY

B Plant was constructed in 1945 to recover plutonium by the bismuth phosphate process. B Plant deactivation was completed in FY 1998 and B Plant will not be sending any future waste to tank farms (McGuire 2000).

The Waste Encapsulation and Storage Facility's current mission is to receive and store the cesium and strontium capsules manufactured at the Waste Encapsulation and Storage Facility safely and in compliance with all applicable rules and regulations (Powell 2003). Based on facility input, no wastes were projected for the Waste Encapsulation and Storage Facility (Powell 2003). If the integrity of a capsule is lost, up to 90 Kgal of waste could be transferred to the tank farms. For all projection cases the Waste Encapsulation and Storage Facility is not expected to be sending any waste to the tank farms.

E2.2 242-A EVAPORATOR AND LIQUID EFFLUENT RETENTION FACILITY

The 242-A Evaporator was restarted on April 15, 1994. The 242-A Evaporator's mission is to concentrate dilute tank farm waste. To understand the projection model for the 242-A Evaporator, understanding the waste flow during evaporator operation and the simulation model is necessary. During operation, waste from the dilute holding tanks is transferred into the evaporator feed tank (Tank AW-102). Waste in the feed tank then is transferred to the 242-A Evaporator for boil-down. Major assumptions for the evaporator operation are listed as follows:

- Because of the time required to sample and stage waste, the evaporator is operated in discrete campaigns (Powell 2003).
- Approximately three months is required from the time a holding tank is filled with dilute waste before the waste can be evaporated (Von Bargen 1995). This period allows time for sampling and analysis in accordance with the Evaporator data quality objective (DQO), documentation, and facility preparation. Some of the projected evaporator campaigns included two tanks of dilute waste for evaporation in a single campaign.
- Previous projections assumed that the 242-A Evaporator would require a 1-year outage for maintenance and or upgrades every 10 years based on a 10-year design life of the

242-A Evaporator (Miskho 1990). The 242-A Evaporator is currently undergoing life-extension upgrades to allow operation through 2019 (Powell 2003). The upgrades for FY 2003 were completed by June 2003. It is estimated that remaining upgrades will require six months each during FY 2004 and 2005 and approximately three months in FY 2006. The outages will not generally have to be in single blocks of time. At the request of the Liquid Waste Processing Facilities, this document will supply projected annual campaign schedules to assist in the scheduling of upgrade activities.

- The desired waste volume reduction for each 242-A Evaporator campaign is determined by boil-down studies, computer simulation, and/or process control sampling. The concentration of waste increases after each pass through the Evaporator until it reaches a concentration level consistent with engineering studies. The waste volume projection model of the 242-A Evaporator operation used in these projections cases produced double-shell slurry feed with a specific gravity of 1.47 (concentrated waste with a specific gravity of 1.36 to 1.47 have been produced in recent campaigns). After about 50 percent of the volume evaporates, the concentrated waste is transferred to the evaporator receiver tank (Tank AW-106). If additional evaporation is required, the waste in Tank AW-106 is transferred back to the evaporator feed tank (Tank AW-102). At the end of a campaign, the waste is in Tank AW-106. At a later date, the concentrated waste is transferred from Tank AW-106 to another DST holding tank.
- The Liquid Effluent Retention Facility Basin 42 has a 7.8-million-gal storage capacity for storing evaporator process condensate (Powell 2003). The basins must be cleaned out to a minimum heel once every 365 days (Bowman 2003).
- The ratios of process condensate sent to the Liquid Effluent Retention Facility for every gallon of waste volume reduction for Evaporator Campaigns 99-1 and 00-1, was 1.15 and 1.14, respectively. This projection used a value of 1.15 gal of condensate per gallon of waste volume reduction (Powell 2003).
- The maximum monthly waste volume reduction during Evaporator operation should be approximately 1,400 Kgal/month based on the steam boiler capacity (Powell 2003).
- An average evaporation rate of 330 Kgal/month was used in this simulation, taking into consideration the following:
  - The 242-A Evaporator historical processing rates
  - Down time between campaigns
  - Waste characterization
  - Staging and tank transfers.
- The simulation used in this projection evaporates all dilute waste to a concentrated interim storage form in the same year that a tank has been filled. Historically, dilute waste was concentrated to near the aluminate boundary, which would produce concentrated waste with a specific gravity ranging from 1.3 to 1.67. However, it has been noted that DSTs formerly on the Flammable Gas Watch List (i.e., tanks with safety concerns related to hydrogen build up) have specific gravities greater than 1.4 (Reynolds 1994). The Flammable Gas Watch List has been closed (Roberson 2001). However, the tank farm authorization basis maintains flammability controls over the tanks based on assigning them to flammability facility groups. To avoid creating

conditions that will put additional tanks on the Flammable Gas Facility Group Lists, all future waste concentrations will be limited to a specific gravity of 1.47 and a flammable gas study will be completed for each campaign before processing.

- The waste volume reductions achieved by the 242-A Evaporator since its restart in 1994 are summarized in Table E-1.
- Evaporator flushing after each campaign is projected to add 35 Kgal/campaign. Actual flushes for Campaigns 97-1, 99-1, and 00-1 were 30, 31, and 33 Kgal/campaign, respectively.
- Evaporator certification training runs before evaporator operation will add approximately 50 Kgal to tank farms and 50 Kgal to the Liquid Effluent Retention Facility and will occur biyearly (Guthrie 1997). The training run in April 1995 added 57 Kgal to DSTs.

Table E-1. Historical Evaporator Campaigns Since the 1994 Restart.[1]

Campaign	Start Date	Waste Source	Waste Feed Type	Approximate Waste Volume Reduction (Mgal)
94-01	4/94	AW-102, AW-106, and AP-103	dilute non-complexed	2.42
94-02	9/94	AW-102, AW-106, AP-101, AP-107, and AP-108	dilute non-complexed	2.79
95-01	6/95	AW-102, AW-106, AP-107, and AP-108	dilute non-complexed	2.16
96-01	5/96	SY-102, AW-105, & AY-102	dilute non-complexed	1.12
97-01	3/97	AN-101	dilute non-complexed	0.4
97-02	9/97	AY-101 and AN-106	dilute complexed	0.7
99-01	7/99	AY-102 and AP-108	dilute non-complexed	0.82
00-01	4/00	AP-107 and AP-108	dilute non-complexed	0.68
01-01	3/01	AW-104	dilute non-complexed	0.68
02-02	11/02	AP-107	dilute non-complexed	0.42
03-01	1/03	AP-108	dilute non-complexed	0.31
03-02	2/03	AP-107	dilute non-complexed	0.28
03-03	6/03	AP-108	dilute non-complexed	0.50

Notes:
[1] No evaporator campaign in fiscal year 1998 and 2002 (cold runs completed).

E2.3 GROUT

No additional grout vaults are scheduled to be poured at the Hanford Site. River Protection Project (RPP) planning requires that all tank waste be separated into low-activity and high-activity fractions and each fraction be immobilized into waste forms suitable for ultimate disposal. Tanks originally designated and set aside as grout feed tanks were used for other purposes.

E2.4 EFFLUENT TREATMENT FACILITY

The Effluent Treatment Facility started operation in November 1995 to process the stored evaporator condensate from the Liquid Effluent Retention Facility, newly generated evaporator condensate, and aqueous waste water containing low specific radioactivity (Wagner 1996). Treated effluent is discharged to the State-Approved Land Disposal Site, north of the 200 West Area. This site was chosen to allow tritium to decay away before migrating groundwater reaches the Columbia River. The Effluent Treatment Facility does not remove tritium because no feasible production-scale tritium removal technology presently exists. Because the Effluent Treatment Facility has a capacity to treat 24 Mgal/year, including 7.8 Mgal/year of condensate from the evaporator (Bowman 2000), Effluent Treatment Facility capacity should not limit future evaporator operations. The Effluent Treatment Facility should not send any waste streams to DSTs.

E2.5 PLUTONIUM FINISHING PLANT

The Plutonium Finishing Plant (PFP) is a facility in the 200 West Area that houses the processes and supporting operations for the following (Durnil 2003):

- Stabilization of plutonium residues by muffle furnace calcination
- Water washing chloride from plutonium bearing material before muffle furnace calcination
- Shipping, receiving, and storage of special nuclear materials
- Analytical and plutonium process support laboratories
- Effluent treatment facilities for wastewater and radioactive liquid waste streams.

An environmental impact statement (EIS) was issued for public comment in November 1995 covering the PFP facility stabilization and clean out. The waste volume projections are based on the preferred alternatives identified in the EIS for facility cleanout and stabilization. Based on current PFP operations, the magnesium hydroxide precipitation process and the laboratories are the only liquid waste generators. The magnesium hydroxide precipitation process removes plutonium from process feeds and the laboratories generate an intermittent waste stream based on analytes used in routine laboratory procedures.

Waste volumes for the baseline planning case were developed from existing production schedules. All projection cases projected that PFP stabilization and clean out would generate 37 Kgal of additional waste from 2003 through 2005 (Durnil 2003). The waste volume reduction factor to evaporate PFP waste to double-shell slurry feed is 81 percent (Sederburg 1995). Flush volumes for PFP stabilization waste streams is 22 percent (flushes of waste transfer lines from PFP to Tank 244-TX, from Tank 244-TX to Tank 244-S, and from Tank 244-S to Tank SY-102).

The percent solids experienced in past PFP waste generations are as follows (Barrington 1991):

- % Solids in Plutonium Reclamation Facility waste 3.5%
- % Solids in Remote Mechanical C Line waste 4.4%
- % Solids in laboratory waste 4.5%.

E2.6 Plutonium Uranium Extraction facility

The Plutonium Uranium Extraction (PUREX) Facility was used to separate irradiated N Reactor fuel into plutonium nitrate, uranyl nitrate hexahydrate, neptunium nitrate, and waste products. The main processing operations involved dissolution of cladding and irradiated fuel, solvent extraction, and conversion of plutonium nitrate to plutonium oxide. Acid recovery, solvent treatment systems, and off-gas treatment supported the major processes.

The PUREX deactivation was completed in FY 1997 and the waste transfer system has been deactivated. However, condensate is collected in the PUREX main stack catch tank (216-A-TK-2) and the Number 2 Filter catch tank (V11-1). This accumulation could result in approximately 5 Kgal of dilute waste being transferred to tank farms once per year (Eiholzer 1997).

All projection cases projected 5 Kgal/year of waste additions from PUREX. Based on the average waste composition presented for PUREX waste, the waste volume reduction factor for evaporation of PUREX waste to double-shell slurry feed is 99 percent (Sederburg 1995). Flush volumes for PUREX waste streams are 10 percent.

E2.7 222-S Laboratory

The 222-S Laboratory is a dedicated laboratory facility that currently provides analytical chemistry services in support of Hanford Site processing plants and tank characterization. Emphasis at the laboratory is on supporting the waste management processing plant, environmental monitoring programs, tank farms, the 242-A Evaporator, the Waste Encapsulation Storage Facility, the Plutonium Finishing Plant (PFP), and research activities. Most of the radioactive liquid waste generated at the laboratory complex originates from analytical activities performed within the 222-S Laboratory in support of tank characterization (Roosendaal 2003). Radioactive and radioactive hazardous (mixed) waste generated by the 222-S Laboratory is discharged to the 219-S Waste Handling Facility. Dilute, noncomplexed waste currently is being transferred via pipeline to Tank SY-102. The projected waste generation rate for the 222-S Laboratory was 10 Kgal/year for FY 2003 through 2028 for all projection cases (Roosendaal 2003). Based on the waste composition presented for 222-S Laboratory waste, the waste volume reduction factor for evaporation of 222-S Laboratory miscellaneous waste to double-shell slurry feed is 99 percent (Sederburg 1995). The flush volume for 222-S Laboratory waste streams is 22 percent.

E2.8 SALTWELL LIQUID PUMPING

- Saltwell liquid pumping will occur for SSTs containing 50,000 gal or more of drainable interstitial liquid. Pumping is scheduled to stop when the output rate decreases to 0.05 gal per minute. Saltwell liquid pumping assumptions for all projection cases are as follows: For the 2001 projection cases, the pumpable saltwell liquid volume remaining as

of June 1998 was estimated to be 4.0 Mgal (Field and Vladimiroff 1999). Saltwell liquid pumping that has occurred since June 1998 and recently revised porosity estimates, have resulted in a remaining pumpable liquid estimate of 0.38 Mgal (including S-112 and S-102) as of April 1, 2003 (Conner 2003). Approximately 0.5 Mgal of saltwell liquid (without flush) had been pumped in FY 2003 through June 30, 2003. For all projection cases, all saltwell liquid was assumed to be pumped from FY 2003 through the end of FY 2004 to meet the Consent Decree milestones. Projected saltwell liquid pumping volumes are based on the pumping sequence obtained from the latest project plan and updated through June 14, 2002 (Vladimiroff 2002). Historical pumping volumes and the projected pumping volumes for all projection cases are presented in Table E-2. The waste volume reduction factor for evaporation of dilute noncomplexed saltwell liquid to double-shell slurry feed is 47 percent (Sederburg 1995). The waste volume reduction factor for evaporation of dilute complexed saltwell liquid to complexant concentrate waste is 10 percent (Sederburg 1995).

- The actual dilution and flush used for saltwell liquid pumping in FY 2002 was approximately 74 percent. The projected total volume of dilution and flush liquid added from 2003 through 2004 would be approximately 0.28 Mgal. The waste volume reduction factor used for this flush is 99 percent (Sederburg 1995).
- Pumping saltwell liquid in the 200 West Area presents special problems because of the limited tank space available. Tank SY-101 is full of complexed waste designated as a feed to the WTP. Tank SY-103 contains complexed waste and is designated as a Flammable Gas Facility Group 1 Tank. Addition of waste to a SY-103 requires verification that the minimum time to reach 25% of the lower flammability limit for the tank vapor space, assuming the loss of primary ventilation, will remain greater than seven days. Additions to waste designated as feed to the WTP is prohibited without written approval from ORP (Fowler 2002). Before closure of the Watch List in August of 2001, Tank SY-103 was a Flammable Gas Watch List Tank. Additions to Watch List Tanks were prohibited. Additions to SY-103 are no longer prohibited, but are restricted, as described above. Therefore, Tank SY-102 was designated as the West Area saltwell-liquid receiver for saltwell liquid.

Table E-2. Saltwell Pumping Schedule for All Projections. (Kgal)

Fiscal Year	East Area		West Area		Total
	DN	DC	DN	DC	
Historical Saltwell Liquid Pumping from 1989 to 2002					
1989	55	0	0	17	72
1990	44	0	0	0	44
1991	227	0	0	0	227
1992	121	0	0	0	121
1993	1	0	37	0	38
1994	189	0	32	0	221
1995	194	105	18	0	317
1996	22	0	218	0	240
1997	23	0	140	0	163
1998	0	0	98	0	98
1999	1	0	872	22	895
2000	82	0	327	800	1,209
2001	66	0	547	330	943
2002	1,517	0	591	0	2,108
1989-2002 Total	2,542	105	2,880	1,169	6,696
Projected Saltwell Liquid Pumping from 2003 to 2004 (without flush)					
2003	154	69	380	0	603
2004	3	0	78	0	81
2003-2004 Total	157	69	458	0	684
Grand Total	2,699	174	3,338	1,169	7,380

Notes:

DC = dilute complexed waste.
DN = dilute non-complexed waste.

E2.9 SINGLE-SHELL TANK WASTE RETRIEVAL

The waste volume projection values for SST retrieval assume 99 percent retrieval by volume of all waste estimated in each SST. A dilution factor of approximately three is found to be necessary to remove the waste and transfer it to the DST system, based on the assumption that SST waste will be retrieved at a 5 molar sodium concentration or 10wt% solids concentration, plus the water additions needed for pumping. This dilution factor is typical of the factor from previous sluicing activities (in both DSTs and SSTs). Also, the dilution factor is not unreasonable for other retrieval options under consideration, in that this level of dilution is required for pumping most of the SST waste in the present piping system. Hence even a retrieval system that adds little water to the tank likely would dilute the waste when it was sent from the waste collection system via the piping system to the DSTs.

The 99-percent retrieval rate is based on the goal established in the M-45 series of the Tri Party Agreement of retrieving 99-percent or more of the waste from the SST system. The Tri-Party Agreement requires the SST waste to be retrieved to the limits of the technology applied. The Tri-Party Agreement includes a formal process for DOE to request a change to this limit based on demonstrations of technology and retrieval performance risk assessments. Demonstrations are planned and will be evaluated for both saltcake and sludge-type SSTs. Once these demonstrations are completed, a more accurate retrieval effectiveness value can be selected.

The retrieval and transfer of the majority of Tank C-106 solids to Tank AY-102 was completed in FY 1999. Approximately 194 Kgal of solids were retrieved into Tank AY-102. Retrieving the remainder of the waste from the SSTs will consist of retrieving approximately 9.8 Mgal of sludge and 21.3 Mgal of saltcake (HNF-EP-0182-182, 2003). Dilution of these solids for retrieval and processing results in a total retrieved volume of approximately 99 Mgal. Saltcake would be diluted to 5 M sodium and sludge will be diluted to 10 weight-percent solids. A further assumption is that all solids will be removed from the SSTs.

Case 2 is meant to project DST needs based on established Tri-Party Agreement milestones (Consent Decree milestones for saltwell liquid pumping), RPP planning, and the most realistic operational assumptions (described in Section 3.0 of this document). The near-term SST retrieval schedule for all projections is based on retrieving waste from Tanks S-112, S-102, and C-104 by the end of FY 2006. Details of these retrievals are as follows:

- Waste from Tank S-112 would be retrieved by September 30, 2005, to satisfy Tri-Party Agreement Milestone M-45-03C (saltcake dissolution demonstration).
- Waste from Tank S-102 would be retrieved by September 30, 2006, to satisfy Tri-Party Agreement Milestone M-45-05A (first full-scale retrieval).
- Waste from Tank C-104 would be retrieved by September 30, 2006, to satisfy Tri-Party Agreement Milestone M-45-03I (robotic technology demonstration).
- In addition, new milestones proposed for retrieval of waste in Tanks C-106, S-105, S-106, and S-103 are included in all early retrieval sequences.

The remaining SST retrieval sequence for each case is based on the risk based selection process. For Cases 1 and 2, tanks are ranked based on risk per tank. The timing for each retrieval sequence is linked to the availability of DST space, which is affected by the assumed rates of WTP and supplemental treatment processing.

The SST retrieval sequence, durations, and volumes for Cases 1 and 2 are shown in Section 3.0.

E2.10 T PLANT

The T Plant's primary mission is decontamination and treatment of radiologically and chemically contaminated waste and equipment located throughout the Hanford Site (McDonald 1997).

T Plant also provides inspection and repackaging services to various Hanford Site facilities. The 2706-T Low-Level Decontamination Facility (where equipment with low-level contamination is decontaminated) is an approved decontamination facility that commenced operation in September 1994. Limited 221-T canyon decontamination activities (primarily tank farms long-length contaminated equipment) were initiated in 1995.

T Plant has adopted decontamination techniques (ice blasting and CO_2 decontamination systems) that have reduced liquid waste generations from those reported previously. Dilute, non-complexed wastes collected at T Plant during decontamination, repackaging, or condensate collection, currently are being transported to the 204-AR waste unloading facility via tanker truck. This waste contains approximately 5 volume percent solids (McDonald 1997). Projected T Plant waste generations were based on a combination of anticipated work loads and actual observed generation rates. T Plant tank systems have been determined to contain *Toxic*

Substances Control Act (TSCA)-regulate polychlorinated biphenyls (PCB) in the solids. The liquid fraction is at or below detection limits (Barmettlor 2001). Negotiations are in progress with the U. S. Environmental Protection Agency and the Washington State Department of Ecology on TSCA applicability to the DSTs. This projection assumes that T Plant waste is transferred to the DST system. Based on information supplied by T Plant engineers (Barmettlor 2001), the projected volume for T Plant is 17 Kgal in FY 2003 decreasing to 3 Kgal/ year by FY 2008. The exact waste volume generation projected for each year is shown in Table D-2. All projection cases use the same generation rates. The waste volume reduction factor for evaporation of T Plant miscellaneous waste to double-shell slurry feed is 99 percent (Sederburg 1995). Flush volumes for T Plant waste streams are 22 percent.

E2.11 TANK FARMS

Currently, 28 DSTs are used to receive, store, and evaporate the liquid waste generated at the Hanford Site facilities to an interim waste form. The interim waste form (e.g., double-shell slurry feed) is stored in tank farms awaiting processing and treatment for final disposal. Tank Farm waste generation sources and operational considerations are listed in Sections E2.11.1 E2.11.2 for the aging and non-aging waste tanks. Tank Farm waste generations are primarily from line, cross-site, and air-lift circulator flushes.

E2.11.1 Double-Shell Tanks for Aging Waste

Four of the DSTs (AY and AZ farms) are designated as aging waste tanks and were designed to store high-heat waste (e.g., neutralized current acid waste or waste containing high-heat loads caused by the presence of strontium-90 or cesium-137). The aging waste tanks are equipped with condensers and air-lift circulators. The condensers handle the vapors from primary tank vent systems when hot liquid is present. Condensates are collected in catch tanks (e.g., Tank AZ-151) and returned either to an aging waste tank or to a dilute receiver tank. The air-lift circulators aid in suspending neutralized current acid waste solids and in heat removal. Air-lift circulators require periodic flushing (approximately once a week) to prevent clogging when they are operating. When the air-lift circulators are not operating, flushing is less frequent.

The following assumptions for aging waste tank operation are used in all projection cases.

- Aging waste tanks can be used for storing dilute non-aging waste.
- No additional aging waste will be produced by the Hanford Site facilities. However, certain waste containing high levels of -90 or cesium-137may require storage in aging waste tanks because of their radioactivity. Any HLW returns to DSTs from the WTP, after the initial phase of WTP operations, will be stored in three aging waste tanks.
- All SST solids retrieved from Tank C-106 were stored in aging waste Tank AY-102 in FY 1999 because of their high heat content.
- Tank AY-102 was designated as the 200 East Area dilute receiver for noncomplexed waste through mid FY 1996. Tank AY-102 currently is being used to store the solids retrieved from Tank C-106. This is currently the first HLW batch to WTP.

E.2.11.2 Double-Shell Tanks for Non-Aging Waste

The remaining 24 DSTs are called non-aging waste tanks and, in accordance with applicable operational and waste segregation policies, are used to store waste that does not contain high-heat loads. The following assumptions apply to non-aging waste tank operation.

- Caustic will be added to three non-aging waste tanks in FY 2003 to mitigate low caustic conditions in the tanks. Table E-3 summarizes those additions (Carothers 2003).
- Current operational tank use for this projection is summarized in Table E-4. Projected tank use is covered in Section 5.

  The TRU solids in Tank SY-102 will be retrieved starting in FY 2009. The neutralized cladding removal waste solids in Tank AW-105 were combined with the solids in Tank AW-103 in this projection in FY 2006.
- Flushes are generated during the receipt of waste transfers either from tanker trucks or after tank-to-tank transfers. Percent flushes are included with the facility waste volume generation assumptions.
- Tank AP-107 currently is receiving tanker truck shipments via the 204-AR waste unloading facility from T Plant and the 300 Area.
- Tank AP-102 will be used to receive all A, AX, and BY farm saltwell liquids in the 200 East Area. Tank AP-107 will be used to receive BY farm transfers (transferred through the 244-BX DCRT) beginning in mid FY 2003. Tank SY-102 will receive saltwell liquid in the 200 West Area. Tank AN-106 will be used to receive saltwell liquid from Tank C-103.
- Waste from PFP is transferred through the 244-TX double-contained receiver tank to Tank SY-102. Wastes from the 222-S Laboratory are transferred through the 244-S double-contained receiver tank to Tank SY-102.

Table E-3. Caustic Additions for Fiscal Year 2003.

Tank	Caustic Addition (Kgal)	Date
Tank AN-107	24 Kgal of 19 M NaOH plus flush	To be completed in FY 2003
Tank AN-106	20 Kgal of 19 M NaOH plus flush added as part of C-106 retrieval.	To be completed in FY 2003
Tank AN-102	20 Kgal of 19 M NaOH plus flush	To be completed in FY 2003

Notes:

FY = fiscal year.
Kgal = kilogallon.

Table E-4. Current Operational Tanks and Use.

Operation	Designated Tank
Evaporator Feed Tank	Tank AW-102
Evaporator Receiver Tank	Tank AW-106
200 East Dilute Receiver Tank	Tank AP-102 & Tank AP-107 (FY 2003-2028)
200 West Dilute Receiver Tank	Tank SY-102 (FY 2003-2028)
200 East Saltwell Liquid Receivers	Tank AP-102 & Tank AP-107
200 West Saltwell Liquid Receiver	Tank SY-102
Waste Treatment Plant Feed Tanks	Waste treatment plant supplies feed tanks
Intermediate Staging Tanks	Tanks AN-101, AN-102, AN-105, AP-104, AP-101
Entrained Solids Return Waste	Waste treatment plant supplies space
Dilute Feed Staging/SST Retrieval	Tanks AP-107, AP-108, AP-105, AN-106, AY-101

Notes:

FY = fiscal year.

Projected waste generations for tank farms were based on a combination of previously observed waste generation rates, anticipated operational needs, and the following chemical additions.

- **Tank Farm Water Additions to DSTs**. Tank Farms waste generation rates and flushing activities generally increase with the restart of the 242-A Evaporator because of the additional waste transfers. The 242-A Evaporator was restarted in April 1994. From April 1994 through May 1995, the average monthly waste generation rate for tank farms was 10.92 Kgal/month. The average monthly waste generation rate for tank farms during FY 2000, 2001, and 2002 was 6.3, 3.7, and 2.7 Kgal/month, respectively. The target rate set for waste generated from tank farms was 10 Kgal/month. All projection cases estimated that tank farms would generate 10 Kgal/month or 120 Kgal/year to cover transfer line and air-lift circulator flushes and chemical additions. The waste volume reduction for evaporation of these flushes to double-shell slurry feed was 99 percent (Sederburg 1995).

- **Cross-Site Transfers**. All projection cases assumed the cross-site transfer line would continue to be available to allow cross-site transfer of saltwell liquid, facility generations, DST solids from Tanks SY-101 and SY-102, and/or SST solids. All waste containing solids is assumed to be transferred cross site via the new line, which has inline pumps to Tank AN-104. Without operable cross-site lines many of the Tri-Party Agreement (and/or Consent Decree) milestones involving 200 West Area waste could not be met. Near term cross-site transfers are shown in Table 5-8.

All projection cases assumed that approximately 35 Kgal of water would be needed to flush after each cross-site transfer. During 2003-2004, several cross-site transfers are needed to accommodate the volume of saltwell liquid being pumped, waste retrieved from tank S-112 and S-102, and tank SY-101 waste. The waste volume reduction for evaporation of these flushes to double-shell slurry feed was 99 percent (Sederburg 1995). The projected tank fill limits and considerations are as follows:

- Initial Tank Fill Limits For Case 1 (Bosquet 2003):
  - AY, AZ Tanks: 1001 Kgal
  - Tank AW-102: 1125 Kgal
  - All other DSTs: 1144 Kgal
- The special tank fill considerations used to simulate tank transfers in this projection are
  - Tank SY-102, 1,144 Kgal maximum operational fill limit;

    The drawdown level is 358 Kgal until TRU solids have been removed. The minimum practical drawdown level is 578 Kgal. The 578 Kgal minimum was used in the projection models.
  - Tank AW-102, 1,125 Kgal maximum.
  - Tank AY-102, start transfer at 900 Kgal.
  - Dilute receivers are projected to be pumped down to 28 Kgal above solids.

E2.12 URANIUM OXIDE FACILITY

Deactivation of the Uranium Oxide (UO_3) Facility is complete and, therefore, no waste will be sent to DSTs.

E2.13 WASTE SAMPLING AND CHARACTERIZATION FACILITY

The Waste Sampling and Characterization Facility was activated in FY 1994. This projection assumed that the Waste Sampling and Characterization Facility would send its waste to the Effluent Treatment Facility and not to DSTs (Vogt 2002).

E2.14 100 AREA

E2.14.1 100-N Basin

The 100-N Basin was constructed in 1963 to receive irradiated fuel assemblies discharged from the N Reactor for inspection, storage, and preparation for shipment. In 1988 the N Reactor was placed in a "cold standby" status (shut down but capable of being restarted). In 1989 all nuclear fuel was removed from N Basin and transferred to K Basin. In 1991 DOE directed Westinghouse Hanford Company to begin deactivation activities. Deactivation of the N Basin was assumed to not send any waste to DSTs; instead, waste would be transferred to the Environmental Restoration Disposal Facility (Logan 1998).

E2.14.2 100-K Basin

Fuel handling operations have resulted in some cladding damage to N-Reactor fuel. Subsequent fuel oxidation resulted in fuel and fission products accumulating in fuel canisters and in the 100-K Basin where the fuel handling occurred. Aluminum oxide, iron oxide, concrete grit, and other debris have accumulated and mixed with the fuel corrosion products to form sludge on the basin floor. Approximately 430 Kgal of water and sediment (approximately 98 Kgal of sediment) will need to be removed. Based on the latest studies, the waste from the 100-K Basin cleanout will not be sent to DSTs (Jones 2000). The sludge would be sent to T Plant for interim storage. Final treatment and disposal of the sludge would be coordinated with that of other TRU waste at the Site (Jones 2000). The sludge will not be sent to tank farms.

E2.14.3 105-F and 105-H Basins

Plans to clean out the 105-F and 105-H Basins are being reviewed and the cleanout date is uncertain because of funding uncertainties. Based on the latest studies, the waste from 105-F and 105-H basin cleanout will be sent to the Effluent Treatment Facility and will not be sent to DSTs (Griffin 2001).

E2.15 300 AREA

Facilities in the 300 Area are used primarily for research and development activities or for analytical support. Waste from the Pacific Northwest National Laboratory facilities will be collected at the Radioactive Liquid Waste Tank and then transferred to the DSTs. Liquid waste collected in 300 Area will be shipped to the 204-AR waste unloading facility via a tanker truck (LR-56) because Hanford Site rail service has been discontinued.

The 324 Facility projected that it would not be sending any liquid waste to tank farms (Erickson 2001). The 325 Facility projected that it would send 1 to 4 Kgal/year to tank farms for the baseline case (Waller 2001). The 327 Facility projected that it would send 0 to 26 Kgal/year to tank farms (Hoober 2001). The 340 Facility projected that it would send a total of 20 Kgal which were assumed to occur in FY 1006-2010 at a rate of 4 Kgal/year (Powell 2003). Facilities in the 300 Area sent 15 Kgal of waste (including flush) to DSTs (~1.3 Kgal/month) in FY 1998 and no waste in FYs 1999, 2000, 2001, or 2002. Based on the facility inputs, all projection cases estimated that 0 to 30 Kgal/year of miscellaneous waste would be sent from 300 Area Facilities to tank farms. See Table D-2 for a listing of the volume of waste projected for each year for 300 Area facilities. Based on the chemical composition supplied for 300 Area waste streams, the waste volume reduction factor for evaporation of 300 Area miscellaneous waste to double-shell

slurry feed is 94 percent (Sederburg 1995). Flush volume for 300 Area waste streams is 44 percent.

E2.16 400 AREA

The 400 Area contains three major facilities (Dillhoff 1997). These are the Fast Flux Test Facility, the Maintenance and Storage Facility, and the Fuel and Material Examination Facility. Radioactive liquid waste is generated primarily in conjunction with the removal of residual sodium from reactor components or with decontamination activities. Approximately 11 Kgal of waste were received from the 400 Area in FY 1994-1995 (~0.5 Kgal/month). The 400 Area facilities send their radioactive waste to the Effluent Treatment Facility in the 200 Area (Dahl 1999). All projection cases projected that no waste would be sent from the 400 Area facilities to tank farms.

E2.17 WASTE PROCESSING

Final details of waste treatment and vitrification will not be developed until later in the process; the following assumptions are subject to change. The following schedule was developed to allow completion of all waste processing by the end of 2028. The waste treatment schedule used for the projections varies by case and is presented in the following sections.

WTP Initial Phase Schedule. The facility startup schedule is shown in Table E-5.

Table E-5. Facility Startup Schedule for Case 1 and Case 2.

Activity	Case 1	Case 2
Ready to deliver first LAW batch	10/01/09	10/01/09
Ready to deliver first HLW batch	10/15/09	10/15/09
Start LAW facility hot commissioning	12/01/09	12/01/09
Start HLW facility hot commissioning	12/15/09	12/15/09
Start pretreatment facility services	02/01/11	02/01/11
LAW vitrification services	03/01/10 (3.4 MTD) 02/01/11 (18.0 MTD) 01/01/12 (24.0 MTD) 01/01/13 (28.8 MTD)	03/01/10 (3.4 MTD) 02/01/11 (28.8 MTD)
HLW vitrification services	05/17/10 (0.69 MTD) 02/01/11 (3.0 MTD) 01/01/12 (4.0 MTD) 01/01/13 (5.0 MTD)	05/17/10 (0.69 MTD) 02/11/11 (5.0 MTD)
Supplemental LAW treatment operated in conjunction with the WTP	01/31/11 (2,840 MT Na/yr – LAW Vitrification rate)	01/31/11 (3,000 MT Na/yr – LAW Vitrification rate)
Supplemental TRU treatment	10/28/04 through 09/30/09	10/28/04 through 09/30/09
Mission Acceleration Initiative Supplemental Treatment of 5 M sodium low Cs supernate from SSTs	N/A	N/A

Intermediate Feed Staging Tanks. Tanks AN-101, AN-102, AN-105, AP-104, AP-101, and AP-103 were used for intermediate staging of waste by the tank farm contractor in all cases (RPP-15588).

Waste Treatment Plant Feed Tanks. Waste from the intermediate feed staging tanks will be transferred to feed tanks that will be built by the waste treatment plant contractor (Taylor 1999).

High-Level Waste Treatment and Immobilization in WTP. Processing of tank waste sludge through FY 2013 would involve sludge in Tanks AY-102 (includes C-106 solids), AZ-101, AZ-102, AY-101 (includes C-104 solids), C-107 (retrieved to AY-102), and AW-104. Starting in FY 2014, sludge processing involves waste retrieval from SSTs.

In projections before 2001, the assumption was that all neutralized current acid waste solids and the C-106 solids would be combined into one aging waste tank (Tank AZ-102) and that all

neutralized current acid waste supernatant liquids would be concentrated in one aging waste tank (Tank AZ-101). Since then, studies have been completed that looked at numerous sludge washing and combination options (Powell 1996). The alternatives for consolidating high-heat sludge have been reviewed by a decision board consisting of Hanford Site contractor management, a DOE representative, and a representative from the Washington State Department of Ecology. The decision board concluded that consolidating all the high-heat sludge into a single tank would require modifying the tank farm safety basis. The preliminary decision reached was to not consolidate all the high-heat sludge into a single tank.

Low-Activity Waste Treatment. The current DOE strategy calls for a demonstration of LAW treatment and immobilization at a rate dependent on the type of waste being processed. Envelope A feed typically is double-shell slurry feed, double-shell slurry, or dilute non-complexed waste. Envelope B feed is untreated neutralized current acid waste supernatant liquid. Envelope C feed typically is complexant concentrate waste. The LAW and HLW treatment ramp up rates used for all cases are listed in Section E2.17, above. Incorporation of low activity waste in glass is assumed according to the "Gimpel Rule" for Cases 1 and 2. The Gimpel rule provides an estimate of the amount of SO_3 that can be tolerated in LAW glass. Table E-6, below, shows the processing schedule, sequence of waste processed, and the approximate sodium quantity processed for the reference projection case (Case 1).

Storage of Separated TRU and Entrained Solids. For all projection cases, the entrained solids and TRU elements removed from LAW waste by the waste treatment plant were not returned to tank farms.

Table E-6. Projected LAW Processing Schedule for the Case 1 Projection.

Tank	Waste Type	Envelope	Delivered Volume With Solids (Kgal)	Approximate Quantity of Sodium Delivered (MT Na)	Existing of Future Waste	Modeled Delivery Range
AP-101	DSSF	A	1172	876	Existing	12/1/2009
AP-103	CC	B or C	1172	910	Future	8/5/2011
AP-105	DSSF	B or C	1172	1038	Future	3/13/2012
AN-104	DSSF	A	1415	844	Existing	9/9/2012 - 12/5/2012
AN-102	CC	C	1438	874	Existing	3/1/2013 - 5/12/2013
AN-105	DSSF	A	1389	845	Existing	7/10/2013 – 9/5/2013
AN-107	CC	C	900	703	Existing	1/9/2014
SY-101 (AP-104)	CC	A	1171	927	Existing	7/23/2014
AP-102	DSSF	A	1172	871	Future	11/23/2014
AN-103	DSS	A	1712	1040	Existing	6/23/2015 – 12/4/2015
AW-101	DSSF	A	1807	1095	Existing	6/7/2016 – 11/18/2016
AP-106	CP	A	1000	395	Future	3/19/2017
AP-108	DSSF	B or C	1000	515	Future	3/22/2017
AP-105	DSSF	B or C	1000	443	Future	4/4/2018

Note:

CC = complexant concentrate waste.
CP = concentrated phosphate waste.
DSS = double-shell slurry.
DSSF = double-shell slurry feed.

E2.19 WATCH LIST/SAFETY

The Watch List has been closed (Rasmussen 2001). However, removal of the Watch List designation alone does not allow use of all the headspace in former Watch List tanks. The existing waste in a Watch List tank may require dilution and/or treatment before the waste can be added. The feasibility of adding saltwell liquid to Tank SY-103 was stopped when it was determined that adding additional liquid might increase the likelihood of a flammable gas release event.

Tank SY-101 Remediation. Increases in the waste level in Tank SY-101 led to a need to remediate the flammable gas buildup in the tank by retrieving and diluting the waste rather than relying on mitigation of the gas buildup by use of a mixer pump. Tank SY-101 was diluted in FY 2000 and a portion of the diluted waste was transferred to Tank AP-104 to serve as contingency LAW feed. Tank SY-101 was removed from the watch list (Huntoon 2001).

Tank SY-103 Retrieval. For Case 1, the waste in Tank SY-103 will be diluted to approximately 7 M sodium and transferred to Tank AN-101 before treatment. The transfer to Tank AN-101 will occur in FY 2018.

All projection cases assume that timely permission is obtained to remove waste from the former watch list tanks used as LAW feed sources. All cases assume that the authorization basis is amended to support all activities related to Initial Phase activities (LAW feed staging and delivery, HLW feed staging and delivery, etc.).

E.2.20 EMERGENCY SPACE/LAW AND HLW RETURN

Emergency space is space reserved in case of a leak in a double-shell tank in accordance with DOE Order 435.1. Contingency space has historically been set aside to account for possible inaccuracies in the Waste Volume Projection (WVP) software when projecting waste generations and/or waste volume reduction factors.

In revision 25 of the Operational Waste Volume Projection (OWVP) document (HNF-SD-WM-ER-029, FY 1999), 2.28 Mgal of emergency space was reserved in case of a double-shell leak per DOE Order 435.1. In revision 26 (FY 2000) of the OWVP document, the emergency space was reduced to 1.14 Mgal. The tank farm contractor also has been requested to provide the capability to receive up to the equivalent of one tank volume of either LAW or HLW return from the waste treatment plant on an emergency basis (Taylor 1999) as part of the emergency space. In this document 1.2 Mgal of total space was reserved for emergency space and for either LAW or HLW returns. This emergency space could exist within an empty DST or be distributed primarily within the waste receiver tanks (AP-102, AP-107, AP-108, and SY-102).

E.2.21 WASTE SEGREGATION

Waste segregation and compatibility are requirements of DOE Order 435.1 (DOE 1999) and *Washington Administrative Code* (WAC) 173-303-395, "Dangerous Waste Regulations." The overriding purpose of waste segregation and compatibility are to ensure the safety of waste storage and tank farms operations; to minimize future processing costs; and to comply with DOE Order 435.1 and WAC 173-303-393. Waste types that typically are segregated include

- **Phosphate Waste**. Dilute phosphate or concentrated phosphate.

- **Waste Containing High Organic Concentrations**. Dilute complexed or complexant concentrate waste.
- **TRU-Containing Waste**. Neutralized cladding removal waste or PFP solids.
- **Watch List Tank Waste**. Included to prevent inadvertent commingling with other types of waste. Controls are in place to maintain safe operation of former watch list tanks. These controls may restrict waste transfers.
- **Pretreated Waste Streams**.
- **Washed Neutralized Current Acid Waste Solids**, etc.
- **Concentrated Interim Waste Types**. For example, double-shell slurry feed or double-shell slurry need to be separated from dilute waste to prevent the need to re-concentrate.
- **Waste Exhibiting Exothermic Reactions**.
- **Characterized Waste**. Waste that has been characterized and designated as feed for the waste treatment plant are segregated by feed envelope type.

All projections assume that current waste segregation practices are observed (if possible) with the exception of salt well liquid pumping in 200 West Area as discussed in Section 3.8. Waste segregation practices are summarized in Table E-7. For all projection cases, noncomplexed and complexed saltwell liquid waste in the 200 East Area were mixed for evaporation purposes beginning in FY 2002. The DOE has allowed the commingling of noncomplexed and complexed saltwell liquid waste as necessary to allow the stabilization of SSTs (Kinzer 1998).

Table E-7. Waste Compatibility Matrix.

Source Waste Type	Receiver Waste Type							
	DN	DSSF	DC	CC	(PD) NCRW	PT	NCAW	CP
DN	X	X	X	X	X	X	X	X
DSSF	X	X						
DC			X	X*				
CC			X*	X				
(PD) NCRW Solids	X				X	X		
(PT) PFP Solids	X				X	X		
NCAW							X	
CP								X

(*) Adding CC to DC is permitted but would not ordinarily be done. The volume of combined waste which would need to be evaporated would be increased, resulting in increased evaporation costs.

CC = complexant concentrate waste
CP = concentrated phosphate waste
DC = dilute complexed waste
DN = dilute non-complexed waste
DSSF = double-shell slurry feed
NCAW = neutralized current acid waste
NCRW = neutralized cladding removal waste
PD = PUREX decladding sludge
PT = PFP TRU solids

E2.22 LOSS OF DOUBLE-SHELL TANK SPACE

The RPP key planning assumptions (Barrett 2000) have acknowledged that DSTs will reach the end of their design life and could fail at the rate of one for each 5 years past their design life. While failure is possible, this study does not remove any DSTs from service for the purposes of modeling. Any new DSTs identified as needed are required for storage space and not for replacement. The assumption is that additional DST space will be built to replace tanks removed from service in time to meet the failure without a loss of overall space.

E2.23 NEW DOUBLE-SHELL TANK CONSTRUCTION ASSUMPTIONS

All projection cases assume that 28 DSTs will be available and then determine whether additional DSTs will be needed by the end of FY 2018. The results of this determination are presented in Section 5. For additional information on DST construction, see Section 5.6.

E2.24 DOUBLE-SHELL TANK SOLIDS VOLUMES

Solids volumes in the DSTs as of May 31, 2003, are shown in Table E-8 (HNF-EP-0182-182, 2003). Tanks with no solids level listed either have not been measured or have a minimal solids volume. The total DST solids used for this projection was approximately 4.6 Mgal.

Table E-8. Double-Shell Tank Solids Levels (Kgal).

Tank	Solids	Tank	Solids	Tank	Solids	Tank	Solids
AY-101	96	AN-101	-	AP-101	-	AP-108	-
AY-102	171	AN-102	134	AP-102	23	AW-101	396
AZ-101	52	AN-103	459	AP-103	-	AW-102	30
AZ-102	105	AN-104	445	AP-104	-	AW-103	313
SY-101	275	AN-105	538	AP-105	89	AW-104	223
SY-102	145	AN-106	17	AP-106	-	AW-105	263
SY-103	342	AN-107	234	AP-107	-	AW-106	239

Note:
Solids volumes as of 5/31/2003.

E2.25 INACTIVE MISCELLANEOUS UNDERGROUND STORAGE TANK WASTES

Approximately 500 Kgal of waste are projected to be received from inactive miscellaneous underground storage tanks between FYs 2011 and 2015 (Wacek 1996).

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APPENDIX F
WASTE TRANSFER REQUIREMENTS

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Table F-1. Acronyms Used in Transfer Lists.

Acronym	Meaning
242-A	242-A Evaporator
244-BX	244-BX double contained receiver tank
244-CR	244-CR double contained receiver tank
34L87	300 Area lab waste
EVAPF	Evaporator flush and tank farm water
PXTCO	PUREX terminal cleanout wastes
SPN87	S Plant dilute non-complexed
TAL88	T Plant supernate
TNS88	T Plant solids
WASH-CAUSTIC	Caustic added to tanks
WATER	Flush or dilution water
WESF	WESF wastes
ZNL87	Combined PFP waste stream (no TRUEX)

Table F-2. Transactions for Fiscal Year 2003. (4 Sheets)

From	To	Start Date	End Date	Liquid Volume (Kgal)	Solid Volume (Kgal)	Dilution Water (Kgal)
244-BX	AP-102	10/03/02	10/03/02	18	0	0
WATER	AP-102	10/20/02	10/20/02	34	0	0
S-112	SY-102	10/31/02	10/31/02	5	0	0
U-111	SY-102	10/31/02	10/31/02	5	0	0
U-108	SY-102	10/31/02	10/31/02	5	0	0
S-107	SY-102	10/31/02	10/31/02	2	0	0
S-102	SY-102	10/31/02	10/31/02	1	0	0
A-101	AP-102	10/31/02	10/31/02	9	0	0
AX-101	AP-102	10/31/02	10/31/02	4	0	0
S-101	SY-102	10/31/02	10/31/02	16	0	0
SX-102	SY-102	10/31/02	10/31/02	4	0	0
S-111	SY-102	10/31/02	10/31/02	0	0	0
WATER	AN-104	10/31/02	10/31/02	33	0	0
WATER	SY-102	10/31/02	10/31/02	34	0	0
WATER	SY-101	10/31/02	10/31/02	2	0	0
WATER	AN-105	10/31/02	10/31/02	31	0	0
WATER	AN-103	10/31/02	11/01/02	55	0	0
U-107	SY-102	11/01/02	11/01/02	1	0	0
AX-101	AP-102	11/01/02	11/01/02	9	0	0
S-111	SY-102	11/01/02	11/01/02	3	0	0
U-111	SY-102	11/01/02	11/01/02	8	0	0
U-108	SY-102	11/01/02	11/01/02	11	0	0
A-101	AP-102	11/01/02	11/01/02	5	0	0
SPN87	SY-102	11/01/02	11/01/02	3	0	0
TAL88	AP-102	11/01/02	11/01/02	1	0	0
EVAPF	AP-102	11/01/02	11/01/02	10	0	0
PXTCO	AP-102	11/01/02	11/01/02	5	0	0
C-103	AN-106	11/02/02	11/02/02	3	0	0
WATER	SY-102	11/02/02	11/02/02	1	0	0
WATER	AP-102	11/02/02	11/02/02	0	0	0
WATER	AP-102	11/02/02	11/02/02	1	0	0
SY-102	SY-101	11/07/02	11/07/02	153	0	0
AW-102	242-A	11/07/02	11/12/02	1003	0	0
242-A	AW-106	11/07/02	11/12/02	537	0	0
242-A	LERF	11/07/02	11/12/02	465	0	0
WATER	AW-106	11/26/02	11/26/02	20	0	0
S-111	SY-102	12/01/02	12/01/02	4	0	0
AX-101	AP-102	12/01/02	12/01/02	3	0	0
U-108	SY-102	12/01/02	12/01/02	4	0	0
A-101	AP-102	12/01/02	12/01/02	2	0	0
EVAPF	AP-102	12/01/02	12/01/02	10	0	0
WATER	C-103	12/01/02	12/01/02	33	0	0
U-111	SY-102	12/01/02	12/01/02	4	0	0
TAL88	AP-102	12/01/02	12/01/02	1	0	0
WATER	AP-102	12/02/02	12/02/02	0	0	0
C-103	AN-106	12/02/02	12/02/02	103	0	0

Table F-2. Transactions for Fiscal Year 2003. (4 Sheets)

From	To	Start Date	End Date	Liquid Volume (Kgal)	Solid Volume (Kgal)	Dilution Water (Kgal)
U-107	SY-102	12/03/02	12/03/02	11	0	0
SY-102	AP-102	12/09/02	12/10/02	362	0	0
WASH-WATER	AP-108	12/15/02	12/15/02	1	0	0
AP-108	AW-102	12/15/02	12/20/02	1041	0	0
S-107	SY-102	12/29/02	12/29/02	1	0	0
244-BX	AP-102	12/30/02	12/30/02	15	0	0
C-103	AN-106	01/01/03	01/01/03	5	0	0
U-111	SY-102	01/01/03	01/01/03	1	0	0
AX-101	AP-102	01/01/03	01/01/03	3	0	0
S-107	SY-102	01/01/03	01/01/03	10	0	0
S-111	SY-102	01/01/03	01/01/03	8	0	0
U-108	SY-102	01/01/03	01/01/03	7	0	0
TAL88	AP-102	01/01/03	01/01/03	1	0	0
WATER	SY-102	01/01/03	01/01/03	25	0	0
EVAPF	AP-102	01/01/03	01/01/03	10	0	0
WATER	AP-102	01/02/03	01/02/03	0	0	0
U-107	SY-102	01/03/03	01/03/03	6	0	0
AP-102	AP-108	01/06/03	01/11/03	1041	0	0
AW-102	242-A	01/06/03	01/11/03	1041	0	0
242-A	AW-104	01/06/03	01/11/03	705	0	0
242-A	LERF	01/06/03	01/11/03	336	0	0
S-101	SY-102	01/16/03	01/16/03	5	0	0
WASH-WATER	AP-107	01/27/03	01/27/03	1	0	0
SX-102	SY-102	01/30/03	01/30/03	1	0	0
AP-107	AW-102	01/27/03	01/31/03	940	0	0
U-107	SY-102	02/01/03	02/01/03	3	0	0
AX-101	AP-102	02/01/03	02/01/03	1	0	0
U-111	SY-102	02/01/03	02/01/03	0	0	0
A-101	AP-102	02/01/03	02/01/03	8	0	0
S-107	SY-102	02/01/03	02/01/03	7	0	0
U-108	SY-102	02/01/03	02/01/03	1	0	0
C-103	AN-106	02/01/03	02/01/03	2	0	0
S-111	SY-102	02/01/03	02/01/03	6	0	0
SPN87	SY-102	02/01/03	02/01/03	3	0	0
EVAPF	AP-102	02/01/03	02/01/03	10	0	0
SX-102	SY-102	02/01/03	02/01/03	30	0	0
TAL88	AP-102	02/01/03	02/01/03	1	0	0
WATER	SY-102	02/02/03	02/02/03	34	0	0
WATER	SY-102	02/02/03	02/02/03	1	0	0
WATER	AP-102	02/02/03	02/02/03	0	0	0
AP-102	AP-107	02/06/03	02/06/03	50	0	0
WASH-WATER	AW-106	02/08/03	02/08/03	1	0	0
AW-106	AW-102	02/08/03	02/08/03	131	0	0
WASH-WATER	AW-106	02/18/03	02/18/03	1	0	0
244-BX	AP-102	02/19/03	02/19/03	19	0	0
AW-106	AP-103	02/18/03	02/20/03	486	0	0

Table F-2. Transactions for Fiscal Year 2003. (4 Sheets)

From	To	Start Date	End Date	Liquid Volume (Kgal)	Solid Volume (Kgal)	Dilution Water (Kgal)
AX-101	AP-102	03/01/03	03/01/03	2	0	0
A-101	AP-102	03/01/03	03/01/03	14	0	0
EVAPF	AP-102	03/01/03	03/01/03	10	0	0
TAL88	AP-102	03/01/03	03/01/03	1	0	0
WATER	AP-102	03/02/03	03/02/03	0	0	0
AW-102	242-A	02/25/03	03/02/03	1071	0	0
242-A	AW-106	02/25/03	03/02/03	785	0	0
242-A	LERF	02/25/03	03/02/03	286	0	0
WATER	SY-102	03/06/03	03/06/03	49	0	0
WATER	SY-102	03/06/03	03/06/03	29	0	0
244-BX	AP-102	03/19/03	03/19/03	13	0	0
C-106	AY-102	03/25/03	03/25/03	49	1	0
WATER	AY-102	03/31/03	03/31/03	15	0	0
WATER	AN-106	04/01/03	04/01/03	5	0	0
A-101	AP-102	04/01/03	04/01/03	5	0	0
AX-101	AP-102	04/01/03	04/01/03	2	0	0
S-111	SY-102	04/01/03	04/01/03	6	0	0
SX-102	SY-102	04/01/03	04/01/03	7	0	0
U-107	SY-102	04/01/03	04/01/03	7	0	0
U-108	SY-102	04/01/03	04/01/03	6	0	0
S-101	SY-102	04/01/03	04/01/03	12	0	0
SX-101	SY-102	04/01/03	04/01/03	1	0	0
S-107	SY-102	04/01/03	04/01/03	9	0	0
WATER	AW-106	04/01/03	04/01/03	15	0	0
WASH-CAUSTIC	AN-107	04/01/03	04/01/03	26	0	0
TAL88	AP-102	04/01/03	04/01/03	1	0	0
EVAPF	AP-102	04/01/03	04/01/03	10	0	0
WATER	AY-102	04/01/03	04/01/03	28	0	0
WATER	AP-102	04/02/03	04/02/03	0	0	0
WATER	AP-102	04/15/03	04/15/03	28	0	0
EVAPF	AP-102	05/01/03	05/01/03	10	0	0
SPN87	SY-102	05/01/03	05/01/03	3	0	0
TAL88	AP-102	05/01/03	05/01/03	1	0	0
WATER	SY-102	05/02/03	05/02/03	1	0	0
WATER	AP-102	05/02/03	05/02/03	0	0	0
244-BX	AP-102	05/05/03	05/05/03	1	0	0
U-107	SY-102	05/01/03	05/05/03	5	0	1844
244-BX	AP-102	05/05/03	05/05/03	18	0	0
ZNL87	SY-102	06/01/03	06/01/03	11	0	0
TAL88	AP-102	06/01/03	06/01/03	1	0	0
EVAPF	AP-102	06/01/03	06/01/03	10	0	0
WATER	AY-102	06/01/03	06/01/03	67	0	0
WATER	SY-102	06/02/03	06/02/03	2	0	0
WATER	AP-102	06/02/03	06/02/03	0	0	0
244-BX	AP-102	06/10/03	06/10/03	13	0	0
A-101	AP-102	05/01/03	06/10/03	19	0	7697

Table F-2. Transactions for Fiscal Year 2003. (4 Sheets)

From	To	Start Date	End Date	Liquid Volume (Kgal)	Solid Volume (Kgal)	Dilution Water (Kgal)
WASH-WATER	AP-108	06/12/03	06/12/03	1	0	0
S-111	SY-102	06/01/03	06/12/03	29	0	11600
AP-108	AW-102	06/12/03	06/17/03	1060	0	0
TAL88	AP-102	07/01/03	07/01/03	1	0	0
EVAPF	AP-102	07/01/03	07/01/03	10	0	0
WATER	AP-102	07/02/03	07/02/03	0	0	0
SX-102	SY-102	05/01/03	07/03/03	23	0	9200
244-BX	AP-102	07/03/03	07/03/03	3	0	0
SX-101	SY-102	05/01/03	07/03/03	29	0	38280
AW-102	242-A	06/29/03	07/04/03	1060	0	0
242-A	AP-108	06/29/03	07/04/03	668	0	0
242-A	LERF	06/29/03	07/04/03	391	0	0
SY-101	AW-102	07/16/03	07/18/03	524	0	0
SY-102	SY-101	07/25/03	07/25/03	178	0	0
AN-101	AN-106	07/30/03	07/31/03	200	0	0
SPN87	SY-102	08/01/03	08/01/03	3	0	0
TAL88	AP-107	08/01/03	08/01/03	1	0	0
EVAPF	AP-107	08/01/03	08/01/03	10	0	0
WATER	SY-102	08/02/03	08/02/03	1	0	0
WATER	AP-107	08/02/03	08/02/03	0	0	0
OXALIC-ACID	C-106	08/03/03	08/03/03	30	0	0
S-107	SY-102	05/01/03	08/16/03	14	0	5600
S-101	SY-102	05/01/03	08/16/03	39	0	15600
AW-102	242-A	08/14/03	08/16/03	521	0	0
242-A	AP-108	08/14/03	08/16/03	385	0	0
242-A	LERF	08/14/03	08/16/03	136	0	0
C-106	AN-106	08/04/03	08/16/03	50	0	0
OXALIC-ACID	C-106	08/18/03	08/18/03	30	0	0
C-106	AN-106	08/19/03	08/31/03	50	0	0
EVAPF	AP-107	09/01/03	09/01/03	10	0	0
TAL88	AP-107	09/01/03	09/01/03	1	0	0
WATER	AP-107	09/02/03	09/02/03	0	0	0
OXALIC-ACID	C-106	09/02/03	09/02/03	30	0	0
WASH-WATER	AP-108	09/08/03	09/08/03	1	0	0
AP-104	AW-102	09/03/03	09/08/03	1067	0	0
U-108	SY-102	06/01/03	09/13/03	43	0	17200
AP-108	AN-101	09/08/03	09/13/03	1091	0	0
C-106	AN-106	09/03/03	09/15/03	50	0	0
OXALIC-ACID	C-106	09/17/03	09/17/03	30	0	0
SY-101	AP-107	09/22/03	09/27/03	800	0	0
SY-102	SY-101	09/29/03	09/30/03	200	0	0
C-106	AN-106	09/18/03	09/30/03	50	0	0

Table F-3. Transactions for FY 2004. (4 Sheets)

From	To	Start Date	End Date	Liquid Volume (Kgal)	Solid Volume (Kgal)	Dilution Water (Kgal)
TNS88	AP-107	10/01/03	10/01/03	1	0	0
EVAPF	AP-107	10/01/03	10/01/03	10	0	0
TAL88	AP-107	10/01/03	10/01/03	1	0	0
34L87	AP-107	10/01/03	10/01/03	1	0	0
WATER	AP-107	10/02/03	10/02/03	0	0	0
WATER	AP-107	10/02/03	10/02/03	0	0	0
WATER	AP-107	10/02/03	10/02/03	1	0	0
OXALIC-ACID	C-106	10/02/03	10/02/03	30	0	0
SY-101	AP-108	10/02/03	10/11/03	1048	2	0
C-106	AN-106	10/03/03	10/15/03	50	0	0
SY-101	AP-104	10/13/03	10/17/03	583	2	0
OXALIC-ACID	C-106	10/17/03	10/17/03	30	0	0
S-112	SY-101	09/20/03	10/20/03	1995	5	0
WASH-WATER	AW-106	10/24/03	10/24/03	1	0	0
AW-106	AP-102	10/24/03	10/27/03	700	0	0
SPN87	SY-102	11/01/03	11/01/03	3	0	0
TAL88	AP-107	11/01/03	11/01/03	1	0	0
PXTCO	AP-107	11/01/03	11/01/03	5	0	0
34L87	AP-107	11/01/03	11/01/03	1	0	0
EVAPF	AP-107	11/01/03	11/01/03	10	0	0
C-106	AN-106	10/20/03	11/01/03	50	0	0
WATER	SY-102	11/02/03	11/02/03	1	0	0
WATER	AP-107	11/02/03	11/02/03	0	0	0
WATER	AP-107	11/02/03	11/02/03	1	0	0
WATER	AP-107	11/02/03	11/02/03	1	0	0
AW-102	242-A	10/30/03	11/04/03	1070	0	0
242-A	AW-106	10/30/03	11/04/03	646	0	0
242-A	LERF	10/30/03	11/04/03	424	0	0
AP-105	AW-102	11/17/03	11/22/03	1016	0	0
34L87	AP-107	12/01/03	12/01/03	1	0	0
TAL88	AP-107	12/01/03	12/01/03	1	0	0
EVAPF	AP-107	12/01/03	12/01/03	10	0	0
WATER	AP-107	12/02/03	12/02/03	0	0	0
WATER	AP-107	12/02/03	12/02/03	1	0	0
C-201	AN-106	12/02/03	12/03/03	10	0	0
AW-102	242-A	12/05/03	12/10/03	1016	0	0
242-A	AP-105	12/05/03	12/10/03	736	0	0
242-A	LERF	12/05/03	12/10/03	280	0	0
C-202	AN-106	12/12/03	12/13/03	10	0	0
SY-102	SY-101	12/17/03	12/18/03	200	0	0

Table F-3. Transactions for FY 2004. (4 Sheets)

From	To	Start Date	End Date	Liquid Volume (Kgal)	Solid Volume (Kgal)	Dilution Water (Kgal)
C-203	AN-106	12/22/03	12/24/03	29	1	0
SY-101	AP-104	12/22/03	12/24/03	500	1	0
C-204	AN-106	12/29/03	12/31/03	29	0	0
TAL88	AP-107	01/01/04	01/01/04	1	0	0
EVAPF	AP-107	01/01/04	01/01/04	10	0	0
34L87	AP-107	01/01/04	01/01/04	1	0	0
WATER	AP-107	01/02/04	01/02/04	0	0	0
WATER	AP-107	01/02/04	01/02/04	1	0	0
SY-101	AY-101	12/30/03	01/03/04	797	3	0
SY-101	AN-106	01/12/04	01/14/04	398	2	0
S-102	SY-101	12/19/03	01/24/04	2091	8	0
SY-101	SY-102	01/23/04	01/24/04	299	1	0
SPN87	SY-102	02/01/04	02/01/04	3	0	0
TAL88	AP-107	02/01/04	02/01/04	1	0	0
34L87	AP-107	02/01/04	02/01/04	1	0	0
EVAPF	AP-107	02/01/04	02/01/04	10	0	0
WATER	SY-102	02/02/04	02/02/04	1	0	0
WATER	AP-107	02/02/04	02/02/04	1	0	0
WATER	AP-107	02/02/04	02/02/04	0	0	0
AP-107	AW-102	01/29/04	02/03/04	1100	0	0
WASH-WATER	AP-104	02/05/04	02/05/04	1	0	0
AP-104	AP-107	02/05/04	02/10/04	1000	0	0
AW-106	AP-104	02/10/04	02/13/04	646	0	0
AW-102	242-A	02/14/04	02/17/04	689	0	0
242-A	AP-104	02/14/04	02/17/04	423	0	0
242-A	LERF	02/14/04	02/17/04	266	0	0
AW-102	242-A	02/20/04	02/22/04	411	0	0
242-A	AW-106	02/20/04	02/22/04	252	0	0
242-A	LERF	02/20/04	02/22/04	158	0	0
WASH-WATER	AP-108	02/28/04	02/28/04	1	0	0
TAL88	AP-107	03/01/04	03/01/04	1	0	0
EVAPF	AP-107	03/01/04	03/01/04	10	0	0
34L87	AP-107	03/01/04	03/01/04	1	0	0
WATER	AP-107	03/02/04	03/02/04	1	0	0
WATER	AP-107	03/02/04	03/02/04	0	0	0
AP-108	AW-102	02/28/04	03/04/04	1000	0	0
EVAPF	AP-107	04/01/04	04/01/04	10	0	0
34L87	AP-107	04/01/04	04/01/04	1	0	0
TAL88	AP-107	04/01/04	04/01/04	1	0	0
WATER	AP-107	04/02/04	04/02/04	1	0	0
WATER	AP-107	04/02/04	04/02/04	0	0	0

Table F-3. Transactions for FY 2004. (4 Sheets)

From	To	Start Date	End Date	Liquid Volume (Kgal)	Solid Volume (Kgal)	Dilution Water (Kgal)
34L87	AP-107	05/01/04	05/01/04	1	0	0
SPN87	SY-102	05/01/04	05/01/04	3	0	0
TAL88	AP-107	05/01/04	05/01/04	1	0	0
EVAPF	AP-107	05/01/04	05/01/04	10	0	0
WATER	SY-102	05/02/04	05/02/04	1	0	0
WATER	AP-107	05/02/04	05/02/04	1	0	0
WATER	AP-107	05/02/04	05/02/04	0	0	0
AW-102	242-A	05/22/04	05/26/04	941	0	0
242-A	AW-106	05/22/04	05/26/04	576	0	0
242-A	LERF	05/22/04	05/26/04	364	0	0
WASH-WATER	AW-106	05/26/04	05/26/04	1	0	0
AW-106	AP-103	05/26/04	05/28/04	432	0	0
ZNL87	SY-102	06/01/04	06/01/04	15	0	0
TAL88	AP-108	06/01/04	06/01/04	1	0	0
EVAPF	AP-108	06/01/04	06/01/04	10	0	0
34L87	AP-108	06/01/04	06/01/04	1	0	0
WATER	AY-102	06/01/04	06/01/04	67	0	0
EVAPF	AP-108	06/01/04	06/01/04	50	0	0
WATER	SY-102	06/02/04	06/02/04	3	0	0
WATER	AP-108	06/02/04	06/02/04	0	0	0
WATER	AP-108	06/02/04	06/02/04	1	0	0
AP-107	AW-102	05/29/04	06/03/04	1044	0	0
WASH-WATER	AW-106	06/04/04	06/04/04	1	0	0
WATER	AY-102	06/05/04	06/05/04	30	0	0
AW-106	AP-105	06/04/04	06/05/04	351	0	0
AW-102	242-A	06/16/04	06/21/04	1103	0	0
242-A	AW-106	06/16/04	06/21/04	573	0	0
242-A	LERF	06/16/04	06/21/04	530	0	0
WASH-WATER	AP-101	06/24/04	06/24/04	1	0	0
AP-101	AW-102	06/24/04	06/29/04	1083	0	0
TAL88	AP-108	07/01/04	07/01/04	1	0	0
EVAPF	AP-108	07/01/04	07/01/04	10	0	0
34L87	AP-108	07/01/04	07/01/04	1	0	0
WATER	AP-108	07/02/04	07/02/04	1	0	0
WATER	AP-108	07/02/04	07/02/04	0	0	0
AW-102	242-A	07/14/04	07/19/04	1083	0	0
242-A	AP-101	07/14/04	07/19/04	754	0	0
242-A	LERF	07/14/04	07/19/04	329	0	0
WASH-WATER	AN-106	07/20/04	07/20/04	1	0	0
AN-106	AW-102	07/20/04	07/25/04	1052	0	0
AW-102	242-A	07/25/04	07/30/04	1052	0	0

Table F-3. Transactions for FY 2004. (4 Sheets)

From	To	Start Date	End Date	Liquid Volume (Kgal)	Solid Volume (Kgal)	Dilution Water (Kgal)
242-A	AW-106	07/25/04	07/30/04	197	0	0
242-A	LERF	07/25/04	07/30/04	855	0	0
SPN87	SY-102	08/01/04	08/01/04	3	0	0
TAL88	AP-108	08/01/04	08/01/04	1	0	0
EVAPF	AP-108	08/01/04	08/01/04	10	0	0
34L87	AP-108	08/01/04	08/01/04	1	0	0
WATER	SY-102	08/02/04	08/02/04	1	0	0
WATER	AP-108	08/02/04	08/02/04	0	0	0
WATER	AP-108	08/02/04	08/02/04	1	0	0
WASH-WATER	AW-106	08/14/04	08/14/04	1	0	0
AW-106	AP-101	08/14/04	08/15/04	250	0	0
TAL88	AP-108	09/01/04	09/01/04	1	0	0
34L87	AP-108	09/01/04	09/01/04	1	0	0
EVAPF	AP-108	09/01/04	09/01/04	10	0	0
WATER	AP-108	09/02/04	09/02/04	1	0	0
WATER	AP-108	09/02/04	09/02/04	0	0	0
AY-102	AW-102	09/02/04	09/04/04	467	0	0
WASH-WATER	AW-106	09/24/04	09/24/04	1	0	0
AW-106	AP-101	09/24/04	09/24/04	168	0	0
AW-102	242-A	09/24/04	09/27/04	467	0	0
242-A	AW-106	09/24/04	09/27/04	82	0	0
242-A	LERF	09/24/04	09/27/04	385	0	0

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