Pollution Prevention Project

Radioactive Liquid Waste Treatment Facility (RLWTF)

Influent Boundary Condition Assessment

Revision 2.0

LA-UR-05-9001
November 2005

Prepared For:
Los Alamos National Laboratory
Pollution Prevention/Waste Minimization
Engineering Support to the RLWTF Upgrades Project

Prepared By:
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335 Central Park Square
Los Alamos, NM 87544

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LIST OF ABBREVIATIONS/ACRONYMS

BTF	Beryllium Treatment Facility
CLEAR	Chloride Extraction for Actinide Recovery
CMR	Chemistry and Metallurgy Research
CMR-R	Chemistry and Metallurgy Research - Replacement
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ESA	Engineering Sciences and Applications Group
FWO	Facility Waste Operations
ft	feet/foot
FY	fiscal year
GSAF	generator set-aside fund
LANL	Los Alamos National Laboratory
LLW	low-level waste
LPY	liters per year
M	molar
MOX	mixed oxide fuel
MPF	Modern Pit Facility
NARS	Nitric Acid Recycle System
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
P2	Pollution Prevention Program
PEIS	Programmatic Environmental Impact Statement
PMDS	Project Management Deployed Services
ppy	pits per year
RLW	radioactive liquid waste
RLWCS	Radioactive Liquid Waste Collection System
RLWTF	Radioactive Liquid Waste Treatment Facility
RRES	Risk Reduction and Environmental Stewardship
SWS	Sanitary Waste System
TA	technical area
TDS	total dissolved solids
TRU	transuranic
WAC	waste acceptance criteria
WM	waste minimization

EXECUTIVE SUMMARY

The Radioactive Liquid Waste Treatment Facility (RLWTF) is located at Los Alamos National Laboratory (LANL) Technical Area (TA) 50. The facility has been in operation since 1963 and treats industrial, low-level, and transuranic waste water generated by multiple TAs, divisions, and organizations which support LANL missions. The RLWTF has treated low-level waste (LLW) water with peak volumes in the late 1960's of 63,000,000 liters per year (LPY) and more recent volumes in the early 1990's of 20,000,000 to 23,000,000 LPY. Currently, the RLWTF is 17 years beyond its original design life of 25 years and is operating with infrastructure and equipment that can no longer be repaired. LANL is in the process of developing a conceptual design for the continuation of radioactive liquid waste (RLW) treatment capability at LANL.

This Influent Boundary Condition Assessment report provides volume, radiological constituent, and chemical/mineral constituent boundaries for the conceptual design effort and is intended to serve as the preliminary influent design basis for a new facility that will maintain RLW treatment capability at LANL. Development of these boundaries included analysis of historical analytical data and operational knowledge dating back 5 to 12 years, and a scope that encompassed future LANL mission activities and pollution prevention/waste minimization projects anticipated to take place upstream from the RLWTF.

Radioactive Liquid Waste Treatment Facility (RLWTF) Influent Boundary Condition Assessment

1.0 INTRODUCTION

The Environmental Stewardship Division (ENV) Pollution Prevention Program (P2) and the Nuclear Waste Infrastructure Services (NWIS) Radioactive Liquid Waste (RLW) Group have been working in cooperation with representatives from Project Management Deployed Services (PMDS) to develop the justification, requirements, and boundary conditions for the continuation of RLW treatment capability at Los Alamos National Laboratory (LANL). The purpose of this report is to provide boundary conditions for future RLW operations that encompass pollution prevention/waste minimization (P2/WM), anticipated mission changes/impacts, and current operational knowledge.

The Radioactive Liquid Waste Treatment Facility (RLWTF) located at LANL Technical Area (TA) 50 has been in operation since 1963. It is currently 17 years beyond its original design life of 25 years and is using electrical infrastructure and equipment that can no longer be repaired or replaced. The RLWTF cannot meet current authorization basis criteria for a Hazard Category 2 nuclear facility, and fails current International Building Code requirements. This limits flexibility of operations to meet regulatory requirements and response to system failures as they occur. These features also make the RLWTF vulnerable to major system failures that could shut down the capability for both low-level waste (LLW) and transuranic (TRU) waste water treatment. Such a shut down in operations represents a single point of failure for all nuclear, environmental, and research and development operations that generate RLW at LANL. Three specific examples of single point failures and operational limitations at the RLWTF include:

- Fiscal Years (FY) 03 and 04 - The mixed oxide fuel (MOX) program at TA-55 began discharging 6-7 Molar nitric acid to TA-50-66. This acid requires an equivalent amount of sodium hydroxide to neutralize it in TA-50-1, Room 60, which generates a significant amount of heat. Currently, the cooling jacket on the neutralization tank is not operational. This limits the amount of acid that can be neutralized to the cooling capacity of the tank during a single operational shift.

- September 2003 - The caustic influent tank (2,800 gallons), in place since 1983, began leaking at a welded seam that prevented the tank from being filled beyond the 80 percent level (840 gallons). Currently, the RLWTF cannot accept caustic TRU waste discharges from TA-55 until the tank is replaced. This has shut down all TA-55 production activities that produce caustic waste.

- November 2002 - The caustic waste line began to leak in the TA-50-201 vault. This leak shut down operations at TA-55 until the installed spare RLW line, from TA-55 to TA-50-201, could be connected.

1.1 Problem

LANL must retain the capability to treat industrial, LLW and TRU liquid waste streams that vary in volume, radioactivity, and chemical/mineral content on a daily basis. These influent characteristics are influenced by multiple groups and organizations in support of LANL missions.

1.2 Scope

This report analyzes influent data from the existing RLWTF to develop boundary conditions to be used for the conceptual design of future RLWTF operations at LANL. It includes consideration of the potential impact associated with the implementation of P2/WM projects upstream from the existing RLWTF and takes a detailed look at the mission changes associated with the following LANL projects:

- Chemistry and Metallurgy Research–Replacement (CMR-R) Project
- Chemistry and Metallurgy Research (CMR) Decommissioning
- Expanded Pit Production at TA-55
- Modern Pit Facility (MPF)
- Other Proposed Projects (e.g., TA-55 Infrastructure Reinvestment Project, Radioisotopic Thermal Generator Operations, Radiography Operations, Newly Generated TRU Facility)

The boundary conditions proposed in this report will serve as the preliminary influent design basis for a new RLWTF and will be updated as detailed engineering studies are conducted prior to the completion of the conceptual design.

2.0 BACKGROUND

The RLWTF is located at TA-50 on approximately 15 acres of U.S. Department of Energy (DOE) controlled land, south of the Los Alamos Town site. TA-50 is located on the northeast corner of the intersection of Pajarito Drive and Pecos Road, on the mesa bounded by Mortandad Canyon to the north and Two-Mile Canyon to the south. Mesa-top elevations on the site range from approximately 7,250 to 7,280 feet (ft) above mean sea level. Figure 1 shows the location of TA-50 with respect to the LANL site boundary and relative to the other TAs. Figure 2 provides the facilities and structures associated with the RLWTF. The nearest point of unrestricted public access to TA-50, outside the LANL site boundary, is the Royal Crest Trailer Park, 3,770-ft north of TA-50. Additional residential areas of Los Alamos and White Rock are within a 10-mile radius of TA-50 and together have a population of approximately 18,800.

2.1 Process Map/Description

The existing RLWTF has been in operation at LANL since 1963. Historically, the plant has treated as much as 63 million liters per year (LPY) of industrial, LLW, and TRU waste water sent to the facility through an industrial collection system that connects sources (e.g., drains, equipment) located at TA-3, 35, 59, 48, 55, and 50, and includes trucked waste from TA-15, 16, 54, and 21. These sources include drains, tanks, and equipment from facilities that house processes and laboratories which perform electroplating, material fabrication, material dissolutions, and other analytical and experimental actinide chemistry processes. These processes generate industrial (e.g., non-radiological acids and bases, cooling, equipment) waste, LLW, and acid/caustic TRU waste water that is treated at the RLWTF and discharged to a National Pollutant Discharge Elimination System (NPDES) permitted outfall in Mortandad Canyon.

The industrial waste and LLW streams are discharged by the generators to the Radioactive Liquid Waste Collection System (RLWCS) where they are commingled and staged at the TA-50 influent storage tanks prior to being fed into the main plant as depicted in Figure 3. The main plant treats RLW using a chemical precipitation clarifier, tubular ultra-filter, ion exchange, reverse osmosis, and electro-dialysis reversal systems that produce a concentrated (high total dissolved solids [TDS]) waste stream that is fed to an evaporator. This system is generally capable of removing 99.99 percent of the radionuclides in the waste stream and produces approximately 180 drums of solid LLW for disposal at TA-54 each year.

Caustic and acid TRU waste water is discharged to the RLWTF directly from TA-55 through dedicated pipelines that segregate these waste streams into two storage tanks located at TA-50-66. These TRU waste streams are treated as a segregated/dedicated operation in TA-50-1, in Room 60 as depicted in Figure 4. Caustic waste is fed from TA-50-66 into the neutralization tank for pH adjustment and is then pumped into the decant tank. Acid waste is neutralized separately and then pumped into the clarifier for removal of high activity constituents. The overflow from the clarifier is pumped into the decant tank. Neutralized waste from the decant tank is fed directly to the evaporator. Sludge from the decant tank is concentrated, solidified in a cementation unit. This waste stream has a very high

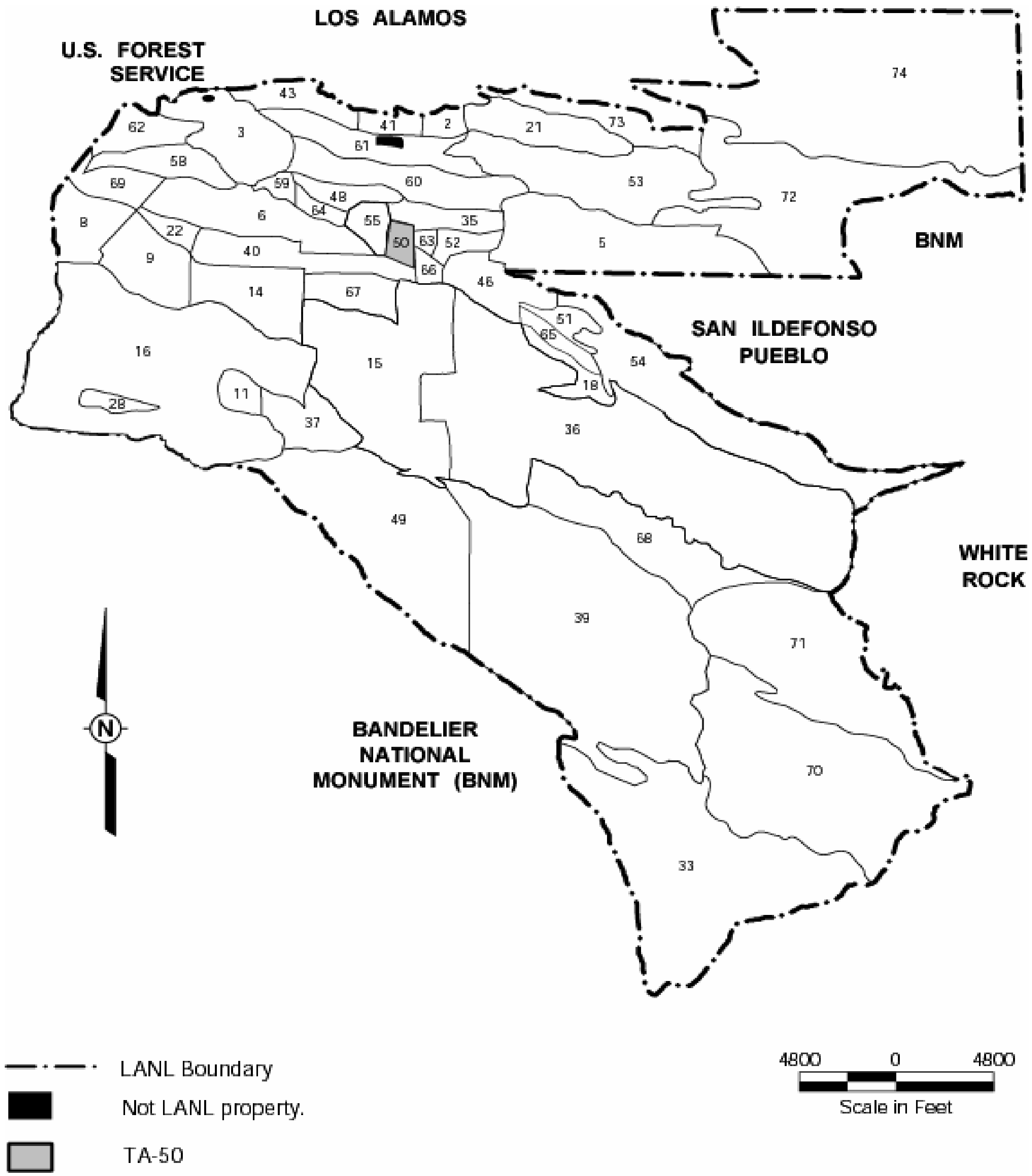


Figure 1
Location Map of Technical Area (TA) 50 at LANL

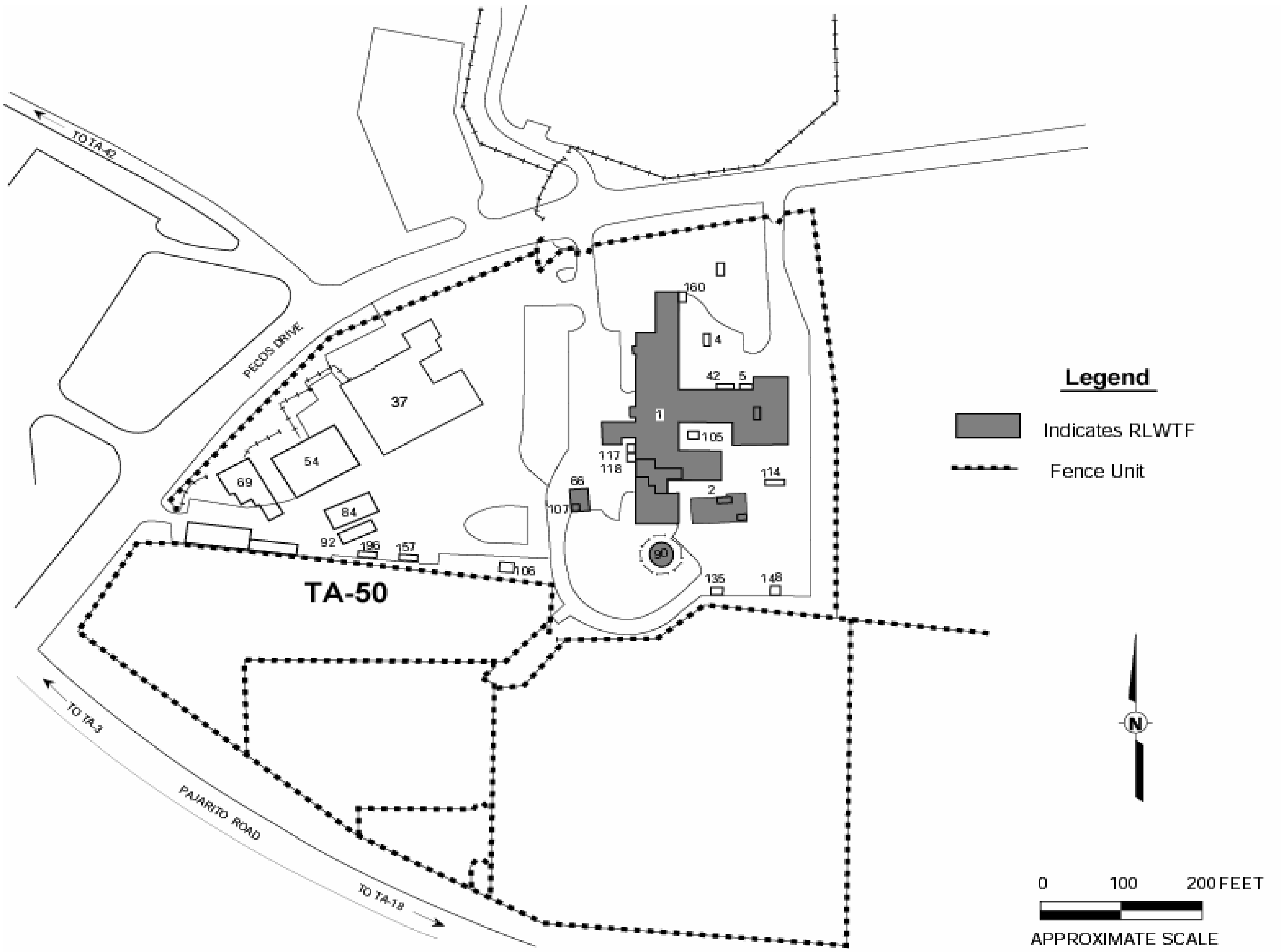


Figure 2
Location of Facilities and Structures Associated with RLWTF

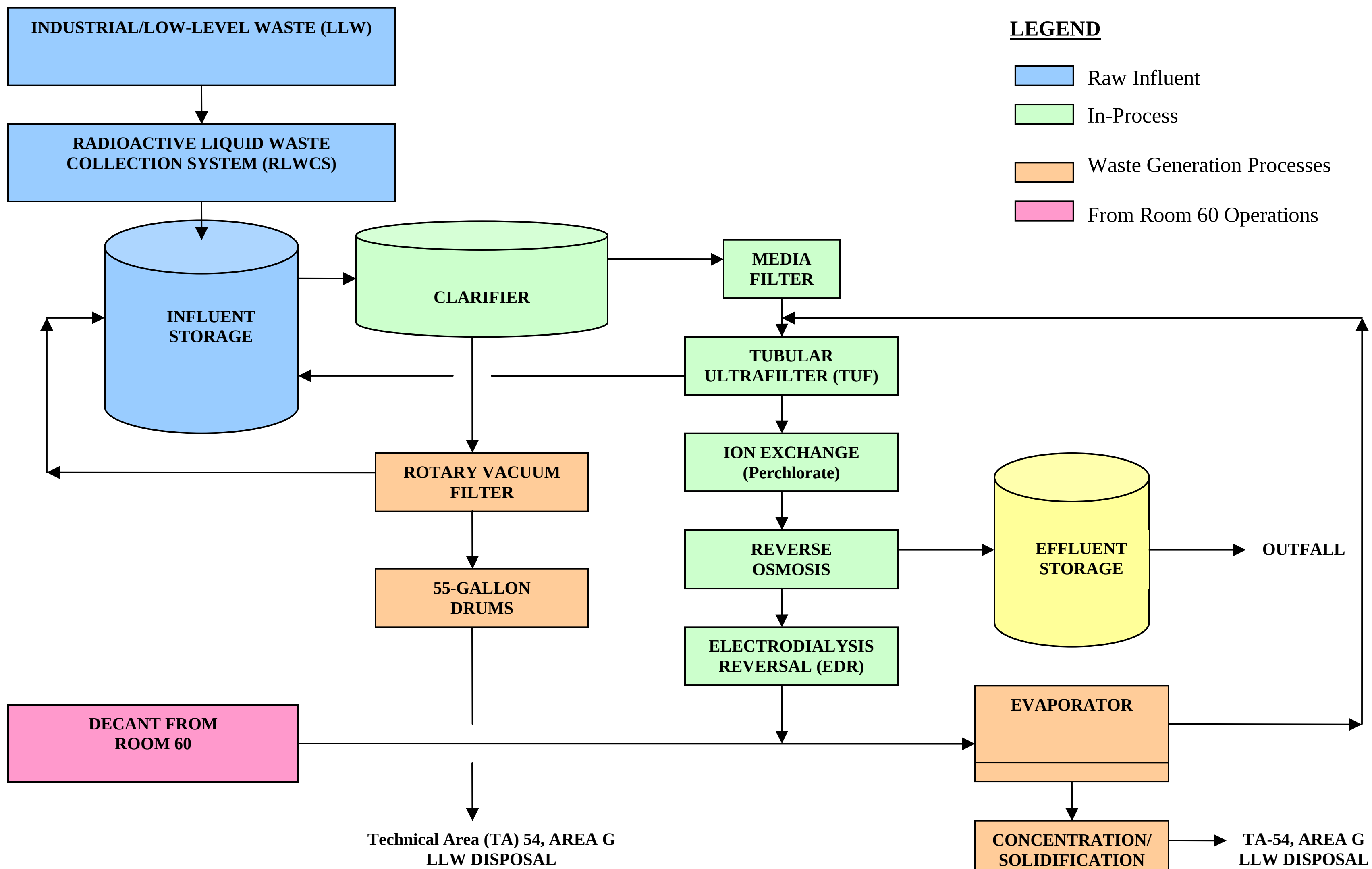


Figure 3
Radioactive Liquid Waste Treatment Facility Industrial/Low-Level Waste Process Flow Diagram

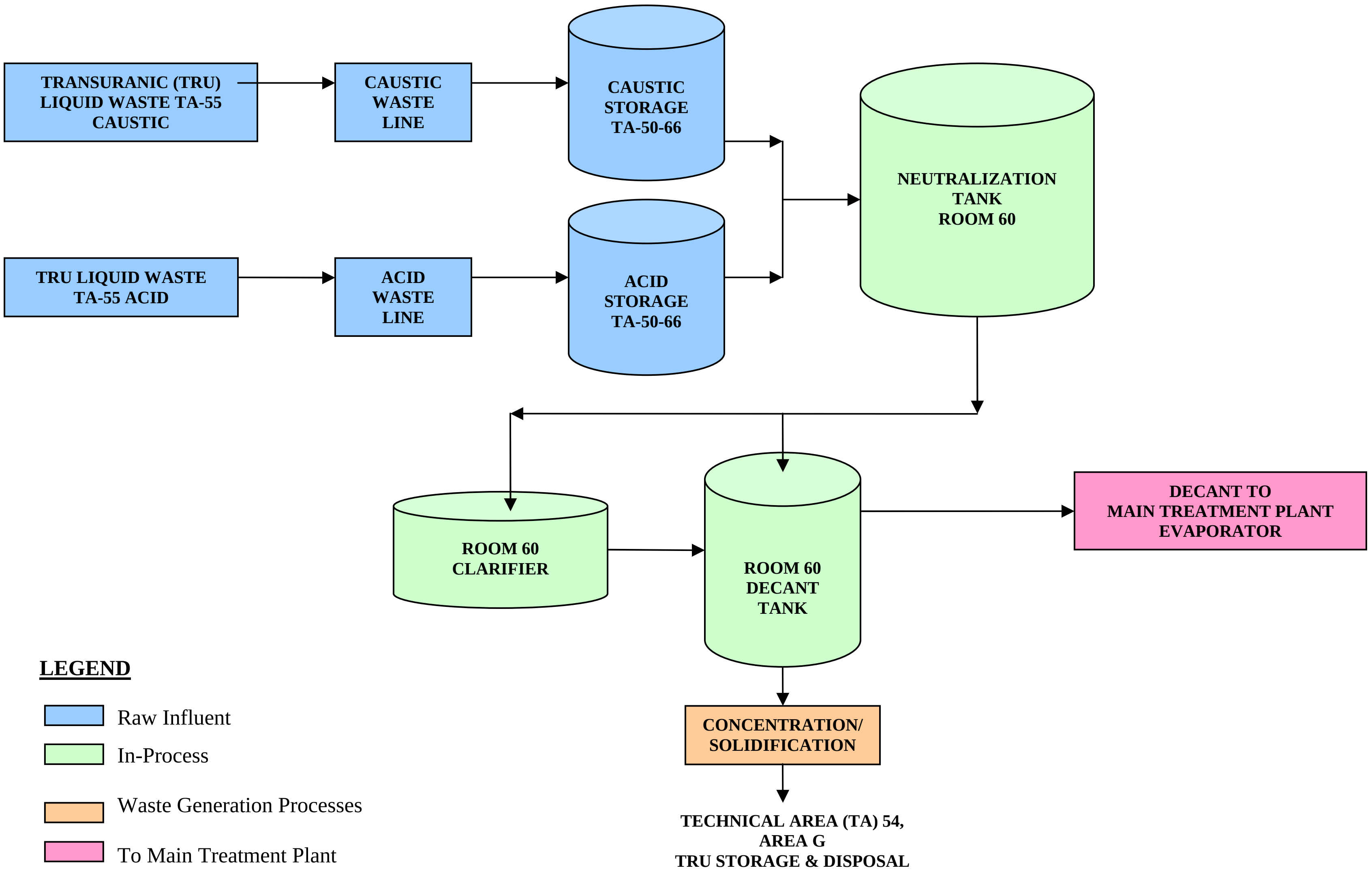


Figure 4
Radioactive Liquid Waste Treatment Facility Transuranic Waste Process Flow Diagram

TDS and is concentrated with nitrate and tritium. These factors make the evaporator the best available technology to prevent nitrate from discharge to the environment in excess of the current New Mexico Groundwater (NMGW) requirement. Room 60 is the primary source of rate-limiting and single-point failure issues at the RLWTF. The caustic waste stream has a high concentration of chlorides that is corrosive to stainless steel tanks. The acid waste stream currently has a very high normality that generates a significant amount of heat when neutralized.

2.2 Drivers (Regulatory, Safety, Performance Measure)

The influent received by the RLWTF is required to meet the Waste Acceptance Criteria (WAC) unless a waste exemption form has been approved. Tables 1 and 2 provide the WAC for radiological and chemical/mineral constituents to be discharged in the LLW and TRU waste influent.

Table 1
Waste Acceptance Criteria for the Low-Level Waste Stream [a]

Constituent	Waste Acceptance Criteria [a]
Radiological Contaminants (nCi/L)	
Summation of Gross Alpha, Beta, or Gamma	500
Americium-241, Neptunium-237, Plutonium-238, Plutonium-239, Plutonium-240, Uranium-234	100
Arsenic-74, Beryllium-7, Cerium-141, Cobalt-57, Cobalt-58, Europium-152, Manganese-52, Manganese-54, Rubidium-83, Scandium-46, Scandium-48, Selenium-75, Tin-113, Strontium-85, Strontium-89, Vanadium-48, Yttrium-88	100
Iodine-133, Sodium-22, Rubidium-84	50
Zinc-65	40
Cobalt-60	20
Tritium (reactor-produced)	20
Cesium-134, Cesium-137, Cobalt-56	10
Strontium-90	5
Uranium-235, Uranium-238	1
Radium-226+Radium-228	0.5
Thorium-232	0.11
Tritium (accelerator-produced)	0
Chemical Contaminants (mg/L)	
Total Suspended Solids	10,000
Perchlorate	0.500
Chemical Oxygen Demand	125
Barium	<100
Zinc	100
Aluminum, Boron	50
Total Toxic Organics	25
Copper	10
Nitrate-Nitrogen	9.4 (g/day)
Ammonia – Nitrogen, Cobalt	5
Arsenic, Chromium, Lead, Silver	<5
Beryllium, Chlorine (Free), Fluoride, Vanadium	1
Cadmium, Selenium	<1
Cyanide	0.5
Mercury	<0.2

a. Tables 3.1 and 3.2, *LANL Waste Acceptance Criteria*, PLAN-WASTEMGMT-002, Los Alamos National Laboratory, Los Alamos, New Mexico.

g/day = grams per day.
mg/L = milligrams per liter.
nCi/L = nanocuries per liter.

Table 2
Waste Acceptance Criteria for the Transuranic Waste Stream [a]

Constituent	Caustic Waste Acceptance Criteria [a]	Acid Waste Acceptance Criteria [a]
Radiological Contaminants (nCi/L)		
Gross Alpha	4,500,000	100,000
Gross Beta	750,000	20,000
Gross Gamma	270,000	6000
Americium-241	750,000	16,700
Tritium (reactor produced)	20	20
Plutonium-238	750,000	16,700
Plutonium-239	750,000	16,700
Radium-226	0.15	0.15
Neptuniun-237	50	10
Uranium-234	2,250,000	50,000
Uranium-235	100	60
Uranium-238	10	6
Chemical Contaminants (mg/L)		
Total Suspended Solids	10,000	10,000
Perchlorate	0.5	0.5
Chemical Oxygen Demand	125	125
Barium	< 100	< 100
Zinc	100	100
Aluminum, Boron	50	50
Total Toxic Organics	25	25
Ammonia-Nitrogen, Copper, Nitrate-Nitrogen	10	10
Arsenic, Chromium, Lead, Silver	< 5	< 5
Cobalt	5	5
Beryllium, Chlorine (Free), Vanadium	1	1
Cadmium, Selenium	< 1	< 1
Cyanide	0.5	0.5
Mercury	< 0.2	< 0.2

a. Tables 1.1, 1.2 and 1.3, *Waste Acceptance Criteria for the RLWTF Room 60 Pretreatment Plant*, PLAN-RLW-013, R.0, Los Alamos National Laboratory, Los Alamos, New Mexico.

mg/L = milligrams per liter.
nCi/L = nanocuries per liter.

The RLWTF treatment processes generate both a solid waste stream and a liquid effluent that are subject to further regulation depending on disposition. The solid waste streams consist of 55-gallon drums of cemented TRU waste generated in Room 60 and 55-gallon drums of LLW generated by the main plant clarifier and evaporator. The TRU waste drums are transferred to TA-54 for storage and eventually shipped to the Waste Isolation Pilot Plant for disposal. The LLW drums are transferred to TA-54 and buried in the LLW disposal pits at Area G. Liquid distillate is generated by the evaporator and is retreated through the LLW process. Prior to discharge, to Mortandad Canyon, the effluent is sampled to ensure that it meets the requirements of the *New Mexico Water Quality Control Commission Regulations (New Mexico Administrative Code 20.6.2.3103), NPDES Permit, NM0028355, Outfall 051 – Radioactive Liquid Waste Treatment Facility* (TA-50), and *Radiation Protection of the Public and Environment,* Chapter 3, "Derived Concentration Guidelines for Air and Water." Tables 3 and 4 below summarize these requirements for radiological and chemical/mineral constituents, respectively.

Table 3
Regulatory Limits for Radiological Constituents in Effluent Discharged by the RLWTF

Constituent(s)	Limit (nCi/L)	Requirement(s) [a]
Americium-241, Neptunium-237, Plutonium-239	0.03	DOE O 5400.5 - DCG
Plutonium-238	0.04	DOE O 5400.5 - DCG
Thorium-232	0.05	DOE O 5400.5 - DCG
Radium -226 & Radium 228	0.03 0.20	NPDES (Daily Max) [b, c] DOE O 5400.5 - DCG
Uranium-234	0.50	DOE O 5400.5 - DCG
Uranium-235, Uranium-238	0.60	DOE O 5400.5 - DCG
Strontium-90	1	DOE O 5400.5 - DCG
Cesium-134	2	DOE O 5400.5 - DCG
Cesium-137	3	DOE O 5400.5 - DCG
Zinc-65	9	DOE O 5400.5 - DCG
Cobalt-56, Cobalt-60, Iodine-133, Sodium-22, Praseodymium-84	10	DOE O 5400.5 - DCG
Europium-152, Manganese-52, Rubudium-83, Scandium-46, Scandium-48, Selenium-75, Strontium-89, Vanadium-48	20	DOE O 5400.5 - DCG
Yttrium-88	30	DOE O 5400.5 - DCG
Arsenic-74, Barium-133, Zirconium-89	40	DOE O 5400.5 - DCG
Cobalt-58, Manganese-54, Tin-113	50	DOE O 5400.5 - DCG
Cerium-141	53	DOE O 5400.5 - DCG
Niobium-95	60	DOE O 5400.5 - DCG
Strontium-85	70	DOE O 5400.5 - DCG
Zirconium-88	100	DOE O 5400.5 - DCG
Cobalt-57	200	DOE O 5400.5 - DCG
Beryllium-7	1000	DOE O 5400.5 - DCG
Tritium (reactor-produced)	20 2000	NPDES (Daily Max) [b, c] DOE O 5400.5 - DCG

a. *Radiation Protection of the Public and Environment*, Chapter 3, "Derived Concentration Guidelines for Air and Water," DOE O 5400.5, U.S. Department of Energy, Washington D.C, 1993.
b. NPDES Permit, NM0028355, Outfall 051 – Radioactive Liquid Waste Treatment Facility (TA-50), December 2000.
c. NMED establishes groundwater standards in New Mexico Administrative Code 20.6.2.3103 for 46 parameters.

DCG = Derived Concentration Guideline.
DOE = U.S. Department of Energy.
nCi/L = nanocuries per liter.
NMED = New Mexico Environment Department.
NPDES = National Pollutant Discharge Elimination System.

Table 4
Regulatory Limits for Chemical/Mineral Constituents in Effluent Discharged by the RLWTF

Constituent(s)	Limit (mg/L)	Requirement(s) [a, b]
Aluminum	5.0	NPDES (Daily Max) NMWQC Standard
Arsenic	0.368 0.1	NPDES (Daily Max) NMWQC Standard
Barium	1.0	NMWQC Standard
Boron	5.0 0.75	NPDES (Daily Max) NMWQC Standard
Cadmium	0.05 0.01	NPDES (Daily Max) NMWQC Standard
Chloride	250	NMWQC Standard
Cobalt	1.0 0.05	NPDES (Daily Max) NMWQC Standard
Chemical Oxygen Demand	125	NPDES (Daily Max)
Copper	1.393 1.0	NPDES (Daily Max) NMWQC Standard
Cyanide	0.2	NMWQC Standard
Fluoride	1.6	NMWQC Standard
Iron	1.0	NMWQC Standard
Lead	0.524 0.05	NPDES (Daily Max) NMWQC Standard
Mercury	0.00077 0.002	NPDES (Daily Max) NMWQC Standard
Nickel	0.2	NMWQC Standard
Nitrate-N	10.0	NMWQC Standard
pH	6.0 – 9.0	NPDES (Daily Max) NMWQC Standard
Selenium	0.005 0.05	NPDES (Daily Max) NMWQC Standard
Silver	0.05	NMWQC Standard
Sulfate	600	NMWQC Standard
Total Dissolved Solids	1000	NMWQC Standard
Total Chromium	2.68 0.05	NPDES (Daily Max) NMWQC Standard
Total Suspended Solids	45	NPDES (Daily Max)
Total Toxic Organics	1.0	NPDES (Daily Max)
Uranium	5.0	NMWQC Standard
Vanadium	0.01	NPDES (Daily Max) NMWQC Standard
Zinc	8.75 10.0	NPDES (Daily Max) NMWQC Standard

a. NPDES Permit, NM0028355, Outfall 051 – Radioactive Liquid Waste Treatment Facility (TA-50), December 2000.
b. NMED establishes groundwater standards in 20.6.2.3103, New Mexico Administrative Code for 46 parameters.

mg/L = milligrams per liter.
NMWQC = New Mexico Water Quality Commission.
NPDES = National Pollutant Discharge Elimination System.
NMED = New Mexico Environment Department.

3.0 INFLUENT CHARACTERISTICS

The following sections provide descriptions of the influent characteristics for the industrial/LLW and TRU waste streams discharged to the RLWTF from 1994 to 2005. This information is intended to demonstrate the variability of each waste stream.

3.1 Low-Level Waste

The existing RLWTF has treated LLW waste water since 1963 with peak volumes in the late 1960's of 63,000,000 LPY and more recent volumes in the early 1990's of 20,000,000 to 23,000,000 LPY. The annual raw influent volume data for the LLW stream from 1994 to 2005 is presented in Table 5 and Figure 5, respectively.

Table 5
Low-Level Waste Raw Influent Volume 1994 to 2005

Calendar Year [a]	Raw Influent Volume (Liters)
1994	21,291,787
1995	19,015,592
1996	15,336,465
1997 [b]	16,298,612
1998 [c]	22,307,291
1999 [d]	20,464,536
2000	17,857,966
2001	13,558,873
2002	11,986,052
2003	12,156,083
2004 [e]	8,418,000 [g]
2005 [f]	7,879,880 [h]

a. Fax transmittal, To: Jennifer Griffin, From Pete Worland, Date: April 23, 2004, Subject: Influent Data for FYs 94, 95, 96, 00, 01, 02, and 03.
b. *RLWTF Annual Report for 1997*, 50-RLWTF-1997 Annual Report, December 1998.
c. *RLWTF Annual Report for 1998*, Annual Report-RLW-1998, August 1999.
d. *RLWTF Annual Report for 1999*, Annual Report-RLW-1999, September 2000.
e. *RLWTF Annual Report for 2004*, Annual Report-RLW-2004, May 2005.
f. The volume for 2005 is estimated based upon existing flow meter data and typical flow projections for Oct – Dec.
g. On July 16, 2004 the LANL director shut down operations laboratory wide to reassess health and safety. This shut down lowered the volume received by the RLWTF for the last five months of 2004.
h. The LANL shut down continued to impact the RLWTF volume in 2005. This was due to several operations upstream not returning to full operational status until Summer 2005.

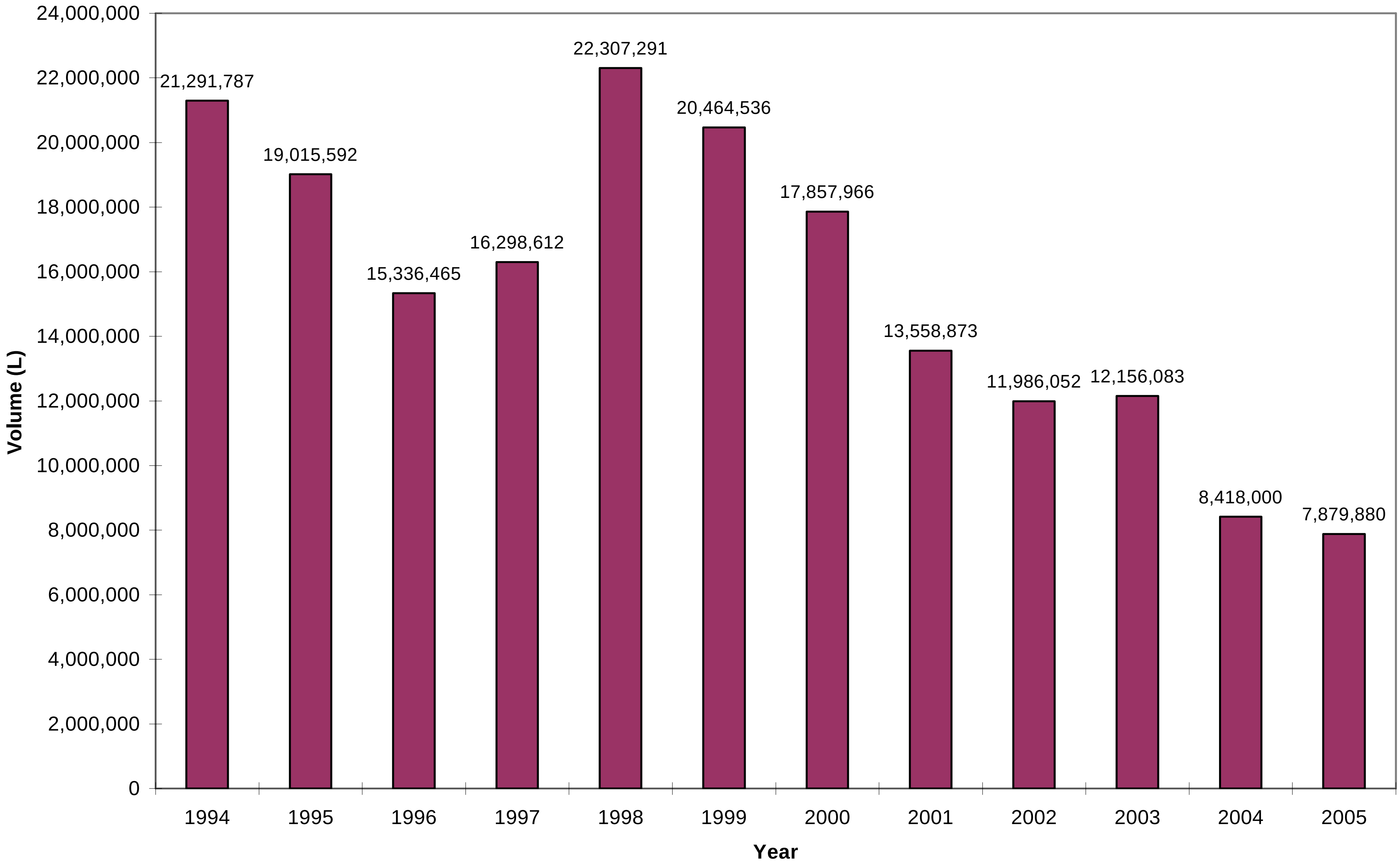


Figure 5
Low-Level Waste Raw Influent Volume from 1994 to 2005

In 1998, LANL mission activities began to decline and the RLWTF observed a reduction in volume (1999, 2000, and 2001). Reductions in volume continued in 2001 and 2002 due to the implementation of the P2/WM and CMR facility upgrade projects summarized in Table 6. These projects reduced the baseline volume to the facility by approximately 4,325,051 LPY.

Table 6
Volume Reductions due to Pollution Prevention and CMR Facility Upgrades 2001 to 2002

Project Description/Title [a]	Project Type	Volume (LPY)	Year(s)
TA-48-1 Boiler Blow Down	Pollution Prevention	2,154,297	2001
TA-21-420 Cooling Tower Blow Down	Pollution Prevention	1,490,076	2001
TA-3-29 Wing 7 Vacuum Pumps	CMR Upgrade	193,056	2002
TA-3-29 Wing 7 Cooling Water Evaporator	CMR Upgrade	462,672	2002
TA-3-29 Laboratory Condenser	CMR Upgrade	24,960	2002

a. *Alternative Discharge Strategy Report for Minimization of Waste Destined for Treatment at the RLWTF*, August 2003.

CMR = Chemistry and Metallurgy Research.
LPY = liters per year.

The LLW stream is contaminated with both radiological and chemical/mineral constituents that vary in concentration based on the LANL Mission activities at the generator sites. Table 7 provides the average concentration of key contaminates over the last five FYs.

Table 7
Average Contaminant Concentrations for the Low-Level Waste Stream [a]

Contaminant	Average Raw Monthly Composite Data				
	FY01	FY02	FY03	FY04	FY05
Radiological Concentration (nCi/L)					
Gross Alpha	34	176	134	66	59
Americium-241	4	64	60	35	23
Cesium-137	0.62	0.12	0.17	0.27	0.16
Plutonium-238	22	60	54	18	8
Plutonium-239	5	23	28	19	16
Uranium-234	0.16	0.38	0.74	0.44	0.36
Urnaium-235	0.03	0.37	0.004	0.001	0.001
Uranium-238	0.05	0.56	0.07	0.05	0.03
Strontium-90	0.06	0.06	0.08	0.05	0.09
Tritium (reactor-produced)	30	12	na	na	na
Gross Beta	5.5	6.5	8.4	0.29	2.3
Chemical/Mineral Concentrations (mg/L)					
Aluminum	0.16	0.96	1.0	0.81	0.08
Ammonia-N	3.5	6.2	4.2	5.3	5.1
Arsenic	0.01	0.02	0.01	0.01	0.01
Barium	0.05	0.55	0.08	0.08	0.08
Boron	0.03	0.03	0.04	0.03	0.03
Cadmium	0.006	0.003	0.004	0.004	0.007
Calcium	13	11	14	9	14
Chloride	26	26	22	41	27

Table 7 (continued)
Average Contaminant Concentrations for the Low-Level Waste Stream [a]

Contaminant	Average Monthly Composite Data				
	FY01	FY02	FY03	FY04	FY05
Chromium (total)	0.05	0.06	0.03	0.10	0.08
Cobalt	0.013	0.003	0.002	0.002	0.014
Chemical Oxygen Demand	46	97	206	159	121
Copper	0.47	0.51	0.80	0.46	0.39
Fluoride	0.82	0.92	0.57	1.20	0.45
Iron	1.9	2.1	1.3	2.4	3.4
Lead	0.06	0.12	0.08	0.11	0.08
Magnesium	3.4	4.0	4.1	2.8	2.8
Mercury	0.003	0.007	0.004	0.003	0.001
Nickel	0.10	0.18	0.18	0.07	0.23
Nitrate-N	5.8	5.8	3.9	7.8	8.4
Nitrite-N	na	0.32	0.71	0.87	0.29
Perchlorate	na	0.31	0.10	0.18	0.28
pH	7.1	7.0	7.0	7.1	6.9
Potassium	4.4	6.2	4.9	2.9	7.4
Selenium	0.01	0.04	0.00	0.01	0.00
Silicon	30	36	34	20	67
Sulfate	36	22	30	26	14
Total Dissolved Solids	218	136	196	314	196
Total Suspended Solids	12	47	28	21	14
Uranium	0.08	0.24	0.09	0.17	0.09
Vanadium	0.017	0.021	0.045	0.008	0.003
Zinc	0.17	0.65	0.16	0.14	0.25

a. Radioactive Liquid Waste Treatment Facility, Analytical Results for Raw Monthly Composite, 01-OCT-1999 to 23-Sep-2005, issued Friday, September 23, 2005, 2:25 pm.

3.2 Transuranic Waste

The TRU caustic and acid waste streams are generated at TA-55 and were segregated from the LLW stream in the 1980's to reduce corrosion in the piping and equipment at the RLWTF. Table 8 provides the last 12 years of volume data for each of the waste streams.

Table 8
Transuranic Caustic and Acid Waste Stream Influent Volumes [a]

Year	Caustic (Liters)	Acid (Liters) [b]
1994	0	9,074
1995	6851	20,761
1996	3,257	24,592
1997	11,058	45,746
1998	0	41,930
1999	7,930	40,364
2000	4,335	12,755
2001	8,670	14,094

Table 8 (continued)
Transuranic Caustic and Acid Waste Stream Influent Volumes [a]

Year	Caustic (Liters)	Acid (Liters) [b]
2002	1,684	14,062
2003	8,674	79,000
2004	6,129	30,730
2005	0	0

a. Fax transmittal, To: Jennifer Griffin; From: Pete Worland; Date: April 23, 2004.
b. The acid waste stream data is a treated volume because a significant quantity of sodium hydroxide is added to increase the pH.

The variability in the volume of these waste streams is solely dependent upon operations at TA-55 and is difficult to predict based on past volumes, as shown in Figures 6 and 7.

The caustic waste stream is generated as a result of pit production and has a volume based upon the feed materials utilized by operations. Acid waste is generated primarily by pit production and has a volume based upon the use of certain feed materials and implementation of other LANL mission activities. Table 9 summarizes the influent characteristics for the radiological component of the caustic and acid waste streams.

Table 9
Radiological Contaminant Concentrations for Transuranic Waste Streams [a]

Contaminant	Batch Data Concentrations (µCi/L)				
	2000	2001	2002	2003	2004
Caustic Waste Stream					
Gross Alpha	1,200	1,300	583	420	140
Americium-241	790	760	326	190	40
Plutonium-238	270	160	109	120	19
Plutonium-239	260	210	136	62	77
Plutonium-240	na	na	23	29	17
Tritium	na	na	2	na	na
Acid Waste Stream					
Gross Alpha	19	85	67	13	na
Americium-241	4	5	2	6	na
Plutonium-238	5	24	66	6	na
Plutonium-239	24	39	18	7	na
Plutonium-240	na	na	na	1	na
Tritium	na	0.044	0.025	na	na

a. Electronic Mail, May 23, 2005: TRU Influent and Effluent Influent, From: Karyn Wiemers (DMJM), To: Pete Worland (LANL) Ketra Clark (DMJM), John Garfield (DMJM), Jennifer Griffin (Shaw), and Sharon Burkhardt (DMJM).

µCi/L = microcuries per liter.

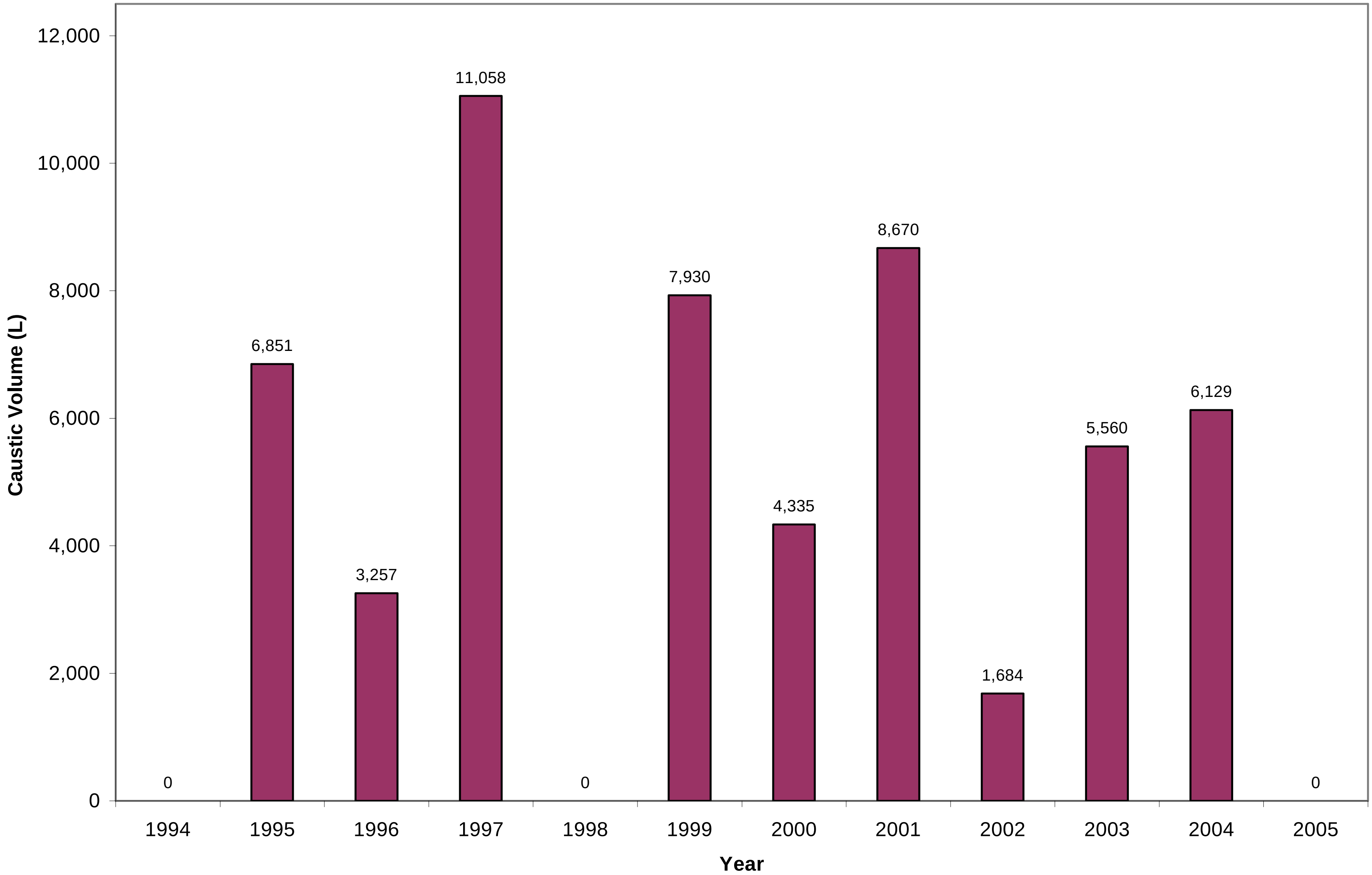


Figure 6
Caustic Waste Volumes from 1994 to 2005

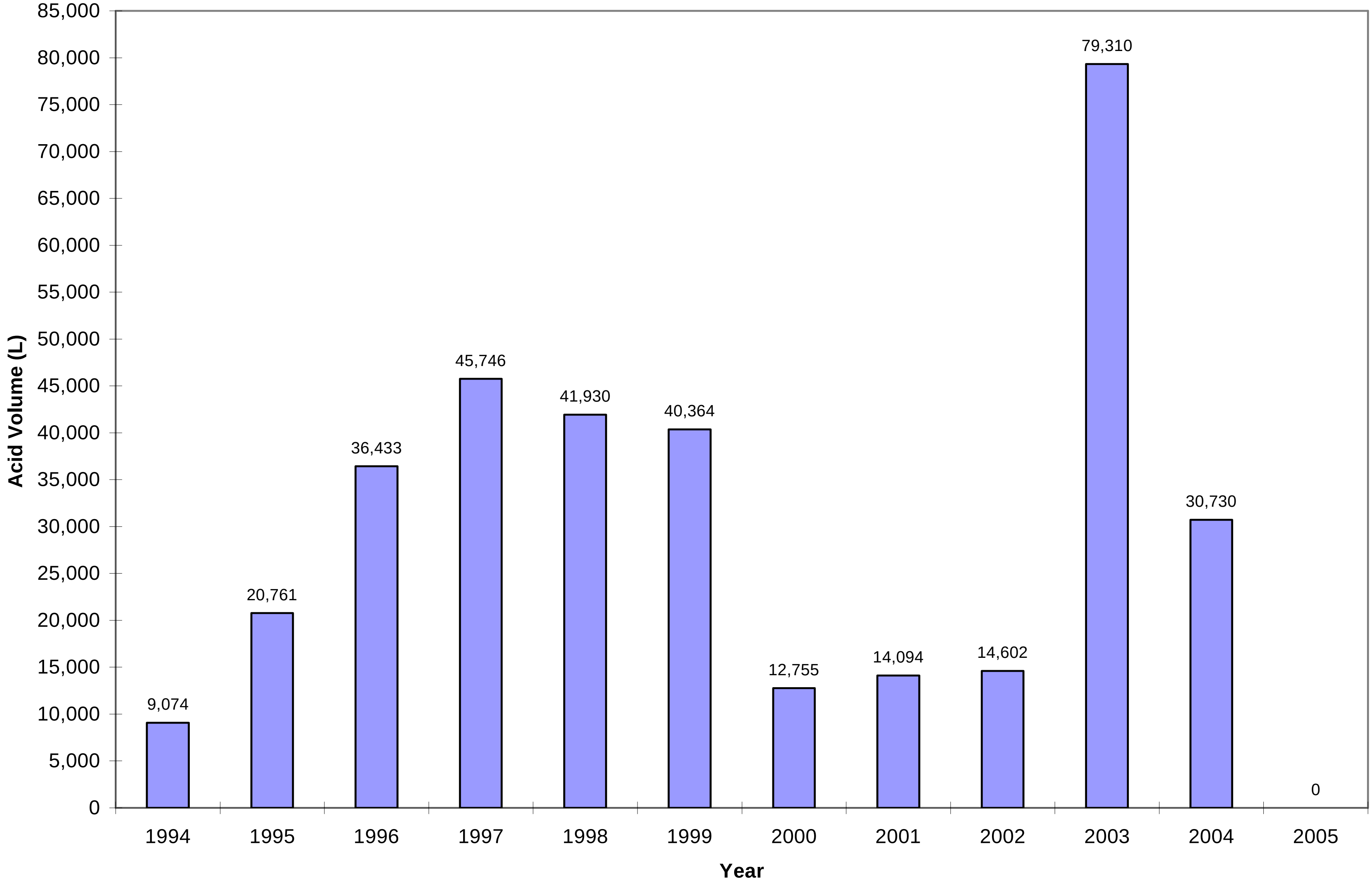


Figure 7
Acid Waste Volumes from 1994 to 2005

Chemical/mineral data for the TRU waste streams is limited to a few data points collected in 2003 and 2004. Table 10 summarizes those data.

Table 10
Chemical/Mineral Contaminant Concentrations for Transuranic Waste Streams [a]

Contaminant	Concentration (mg/L)
Caustic Waste Stream	
Barium	0.02
Cadmium	0.23
Chromium	3.60
Lead	0.16
Nitrate – N	794
pH (standard units)	7.42
Selenium	0.29
Silver	0.02
Acid Waste Stream	
Nitrate – N	25,719
Nitrite – N	14
Sulfate	284
Chloride	667
Normality (standard units)	4.36

a. Electronic Mail, May 23, 2005: TRU Influent and Effluent Influent, From: Karyn Wiemers (DMJM), To: Pete Worland (LANL) Ketra Clark (DMJM), John Garfield (DMJM), Jennifer Griffin (Shaw), and Sharon Burkhardt (DMJM).

mg/L = milligrams per liter.

4.0 PROGRAMS AND PROJECTS THAT IMPACT RLWTF WASTE STREAMS

The RLWTF waste streams are significantly impacted by changes in LANL mission activities and the implementation of P2/WM activities, as illustrated by the data provided in Section 3.0. The following sections provide descriptions of the activities and projects that are expected to impact the RLWTF waste streams in the next 5 to 10 years.

4.1 LANL Mission

The following sections provide brief descriptions of the major LANL mission-related projects that will impact RLWTF waste stream volumes.

4.1.1 Chemistry and Metallurgy Research-Replacement (CMR-R) Project

LANL is currently in the design phase to replace the CMR building (TA-3-29). The new facilities are proposed to consist of two separate buildings that will incorporate roughly 42,000 square ft of process area for analytical chemistry, material characterization, and metallurgy. The CMR-R is currently proposed for location near the Plutonium Facility at TA-55 on Pajarito Road and is scheduled for completion in 2012. The waste streams from the new CMR-R have not been fully identified or characterized, but should have a volume comparable to TA-55-4 on a square foot basis. The expected volumes include a LLW stream at approximately 1,748,250 LPY and a caustic TRU waste stream at 2,000 LPY. It is expected that CMR-R and CMR will overlap in operation by a couple of years as the older facility is decommissioned and the processes are relocated to the new buildings. The current volume of LLW being discharged from the CMR is approximately 2,078,436 LPY.

4.1.2 Increased Pit Production at TA-55

Increased pit production at TA-55 would involve expanding the current pit production capabilities of plutonium facilities in TA-55-4 from approximately 10 pits per year (ppy) to approximately 50 ppy without expanding the size of the building. To do this, a number of plutonium processing activities that are not related to pit production or stockpile certification would be relocated to other facilities or downsized and consolidated within TA-55-4. Table 11 summarizes the liquid waste volume projections associated with the project.

Table 11
Volume Projections for Increased Pit Production

Processing (ppy)	Caustic Volume (LPY)	Acid Volume (LPY)	Industrial/LLW (LPY)
10	15,000 [a, b, c]	7,154 [d]	844860 [e]
50	73,500	35,055	948,843

a. Electronic mail transmittal, To: Jennifer Griffin, From: Cynthia L. Kowalczyk, Date: October 25, 2005, Subject: Re: Comment Resolution Meeting – TA-50 RLWTF Boundary Conditions Assessment Report.
b. Electronic mail transmittal, To: Jennifer Griffin, Pete Worland, Bob Dodge, Bob McClenahan, Martin Price, Amanda Bean, Kent Abney; From: Cynthia L. Kowalczyk, Date: November 8, 2005, Subject: Re: Comment Resolution for TA-50 Caustic Waste Stream.
c. Electronic mail transmittal, To: Jennifer Griffin, Cynthia Kowalczyk, Pete Worland, Ron Nakaoka, Bob McClenahan, Martin Price, Amanda Bean, Kent Abney; From: Bob Dodge, Date: November 9, 2005, Subject: Re: Comment Resolution for TA-50 Caustic Waste Stream.
d. E-mail, To: Marty Price, From: Pete Worland, Date: January 21, 2004, Subject: TRU Volume Estimates Due to Increased Pit Production at TA-55.
e. White, Anne; Bachmeier, Craig; Scott, Jim; *Waste Volume Forecast*, LA-UR-03-4009, Los Alamos National Laboratory, Los Alamos, New Mexico.

LLW = low-level waste.
LPY = liters per year.
ppy = pits per year.

The RLWTF Room 60 operation is not currently capable of meeting this increased demand for treatment of caustic and acid TRU waste due to the limitations discussed in Sections 1.0 and 3.0 of this report.

4.1.3 Mixed Oxide Fuel Program

The MOX project is the largest nitric acid consuming process at TA-55. During operations in 2003 and 2004 this project discharged an additional 30,000 to 43,000 Liters (L) of highly concentrated acid TRU waste to the RLWTF, Room 60 operations. The project will resume in fiscal year 2006 with estimated discharges of approximately 21,000 LPY of acid TRU waste during 2006 through 2011.

4.1.4 Modern Pit Facility

The National Nuclear Security Administration has proposed to site, construct, and operate an MPF for the purpose of producing plutonium pits to support long-term national security needs. A range of pit production capacities and construction locations consistent with national security requirements are analyzed in the draft environmental Impact Statement for the Modern Pit Facility and the Draft Supplemental Programmatic Environmental Impact Statement (PEIS) on Stockpile Stewardship and Management for a Modern Pit Facility. Included among the reasonable alternatives for the MPF is construction at LANL. The estimated plant sizes for the MPF include 125, 250 and 450 ppy of production. These production rates are not anticipated to impact existing or future RLWTF operations. This facility will have treatment capability on-site and outside the existing infrastructure of LANL RLW treatment capability per the PEIS.

4.1.5 Other Proposed Projects

Sections 4.1.1 through 4.1.4 provide descriptions of those LANL Mission activities that have well developed scopes and calculated impacts to RLW impacts at LANL. However, there are several proposed activities that have not matured to the point where a volume impact to the RLWTF can be readily determined. These projects include the following:

- TA-55 Infrastructure Reinvestment Project: This project will revitalizes aging and obsolete facility and safety systems to ensure continuing support of the National Nuclear Safety Administrations Stockpile Stewardship mission. The project will include upgrades to the electrical, mechanical, safety, facility controls, and other selected systems to enable continued operations to satisfy mission objectives and programmatic milestones cost effectively for the next 30 to 40 years.

- Radioisotopic Thermal Generator Operations: These operations at TA-55 will be transferred to the Idaho National Laboratory. These operations contributed a small amount of activity to the TA-55 TRU effluent steam and the effect of this move should be negligible.

- Radiography Operations: This project is a future year line item which will move pit radiography from TA-8 to TA-55. The project is currently in the conceptual design phase and any RLW impacts will be assessed once the design concept is finalized.

- Newly Generated TRU Facility: This project is a future year line item which will construct a packaging facility for newly generated TRU waste from weapons manufacturing. This project is in pre-conceptual design and no RLW data is currently available.

4.2 Pollution Prevention/Waste Minimization (P2/WM)

The P2 group, in cooperation with the RLWTF, is attempting to reduce hydraulic loading on the existing facility by eliminating non-radioactive, off-specification, high-activity, and difficult waste streams from discharge to the RLWCS. This will allow the RLWTF to more efficiently process waste streams that are generated by upstream laboratory and process activities in support of the LANL mission. The following sections describe several projects either in progress or scheduled for execution during FY04 through FY08.

4.2.1 Nitric Acid Recovery System

The Nitric Acid Recovery System (NARS) was installed in 1997 and remains operational today. This process was designed to re-concentrate nitric acid from TA-55 processing operations to 12 to 15 molar (M) acid. NARS is a batch treatment system that treats to meet the feed requirements of TA-55 operations. It is designed to reduce the waste stream volume by approximately 68 percent and discharge low concentration nitric acid to the RLWCS. TA-55 typically generates 4,000 L per month of nitric acid waste that is directly discharged to the RLWTF. The sampling data on the NARS distillate indicates that it is free of radiological contamination with the exception of small amounts of tritium. Use of recycled acid at TA-55 from NARS is limited due to piping constraints and the age and size of the distillate storage tanks. Piping modifications are proposed so that other process areas at TA-55 can use recycled acid and new pencil tanks have been purchased to replace the aging tanks; however, scheduling conflicts at the division level for labor has delayed and or prevented these projects from moving forward. In addition, the largest nitric acid consuming process at TA-55, the MOX project, does not use recycled nitric acid due to concerns about purity. At this time, TA-55 personnel anticipate using recycled acid for at least some operations starting in 2006. NARS does not have the capacity to recycle all of the acid waste potentially generated at TA-55 (1,578 to 71,712 LPY). TA-55 has requested that the RLWTF Upgrades Project provide redundant treatment capability for the excess acid waste at the new RLW facility. This redundancy is currently provided by the Room 60 operations as described in Section 2.1.

4.2.2 Chloride Extraction for Actinide Recovery

The Chloride Extraction for Actinide Recovery (CLEAR) process was scheduled for implementation by the end of FY04 and is currently scheduled for implementation in FY07. This system was installed at

TA-55-4 ten years ago and has been awaiting authorization basis approval for use. The CLEAR process will replace the controlled hydroxide precipitation/filtration portion within the Experimental Chloride Extraction Line, which generates the caustic TRU waste stream treated by the RLWTF in Room 60. The process is expected to drop the activity of this waste stream by approximately 93 percent by reducing the amount of americium before the hydroxide is precipitated. The CLEAR process is expected to drop the activity of the caustic TRU waste stream below 100,000 nCi/L, however, the waste stream will still have a very high chloride and salt content. This will require that this waste stream be handled separately from the LLW waste stream discharged from TA-55. It is also important to note that an increase in production at TA-55 could result in identification of the CLEAR process glovebox as the rate limiting step or as a “single point of failure” along the production line. TA-55 has requested that the RLWTF Upgrades Project provide redundant treatment capability at the new RLW facility. This redundancy is currently provided by the Room 60 operations as described in Section 2.1.

4.2.3 Beryllium Technology Facility

The Beryllium Technology Facility (BTF) is located in Building 141 within the Sigma Complex at TA-3. It is designed to centralize all beryllium processing operations and is managed by the Material Science and Technology Division, Materials Technology: Metallurgy Group. The BTF has a laundry facility located in Room 108 that is used to remove beryllium particulate from the personal protective equipment used by operations personnel. The BTF laundry waste water discharge does not contain any radiological constituents and consists primarily of detergent and suspended beryllium particles. The detergent used by the BTF laundry contains surfactants that interfere with the process operations at the RLWTF (Generator Set-Aside Fund [GSAF] Proposal 452, October 2003). In FY05, a characterization and treatment study was conducted on this waste stream to determine if the BTF laundry wastewater could be discharged to the Sanitary Waste System (SWS). The results of this study indicated that the laundry wastewater meets the SWS WAC. The P2 group plans, in cooperation with the operating division/group of the BTF laundry facility, to apply for a waste profile form to the SWS and install the appropriate piping during FY06. This will eliminate the laundry wastewater discharge to the RLWCS by FY07. The volume reduction will be 475,000 to 950,000 LPY (GSAF Proposal 591, October 2005).

4.2.4 Engineering Sciences and Applications Group Evaporator

The Engineering Sciences and Applications Group (ESA) machine shop produces an estimated 208,197 LPY of wastewater from showers, hand-washing, and rinsing metal parts (GSAF Proposal 602, October 2005). The wastewater discharge contains trace radiological constituents, trace amounts of coolant, and metal particles such as uranium, steel, aluminum, and copper. Currently, the waste rinse water is collected in sumps and pumped to the RLWTF. However, the ESA machine shop is expecting to move to a location that is too far from the RLWTF to connect directly to the waste collection system. Designing the new building to incorporate a process for handling the waste on-site is preferred, as it is more cost effective than trucking the waste to the RLWTF. The P2 group plans, in cooperation with the operating division/group of the ESA machine shop, to execute a project to install an evaporator at TA-3-102. This evaporator will be used to demonstrate effectiveness and eliminate the wastewater discharge to the RLWCS by FY08. It will be moved to the new ESA facilities when construction of the ESA machine shop is complete.

4.2.5 TA-48 Duct Washing

TA-48-1 houses the analytical capability to support the Nevada Test Site testing effort. This capability includes the ability to perform complex analytical processes utilizing perchloric acid. When perchloric acid is fumed, it dries and can leave behind a perchlorate salt crystal in the hood and ductwork. This perchlorate salt crystal can be flammable and highly explosive when subjected to heat, impact, or reaction with other specific chemicals. The TA-48-1 *Hazard Control Plan for Perchlorate Work at TA-48, RC-1*, HCP-CFM-010, and *Perchloric Acid Operations*, C-INC-WI-1000, require that the hoods and ducting be washed down with water for a minimum of 10 minutes each time perchloric acid is fumed. The hazard control plan also requires that the ducting be washed down at least once a week, regardless of perchloric acid use, to prevent buildup of residual salt crystals in the ducting. This duct washing generates approximately 1,000,000 LPY of wash water that is discharged to the RWLCS. The P2 group plans, in cooperation with the operating division/group of TA-48 analytical operations and facility management, to execute a project that reduces and/or eliminates the discharge of duct wash water to the RLWCS. In FY04 and FY05 an engineering study was completed to segregate the duct work in TA-48-1, Room 421. This would dramatically reduce the duct wash down requirements for the building by 750,000 LPY (GSAF Proposal 590, October 2005). The 100 percent engineering package is complete and the project is ready for installation during FY06 pending funding. If the project is fully funded the volume reduction should impact the RLWTF in FY07.

4.2.6 TA-3 Electroplating Shop

The electroplating baths are located within the Sigma Complex at TA-3-66, on the northeast corner of the intersection of Diamond Drive and Pajarito Road. There are 15 baths in Room 100 arranged in four rows. The baths are heated and maintained at 200 degrees Fahrenheit using 15 pounds per square inch steam that flows through a 2-inch diameter loop within each bath basin. The steam is supplied to the building by the steam plant located at TA-3-22. The steam coils exit through the floor of each bath and release condensate to floor drains that are connected to a 6-inch collection manifold and two 1,000-gallon tanks in the basement of TA-3-66 (Room H7). Both tanks discharge to a lift station that carries the condensate to the RLWTF. The discharge of steam condensate is estimated at approximately 1,000,000 LPY (GSAF Proposal 592, October 2005). The P2 group plans, in cooperation with the operating division/group of the TA-3 electroplating shop and facility management, to execute a project that collects the condensate in a tank for proper disposal. This project will eliminate the continued discharge of steam condensate to the RLWCS and will likely be executed during FY07 through FY08.

5.0 PROJECTED IMPACTS TO RLWTF WASTE STREAM VOLUMES

The projects described in Section 4.0 will impact the RLWTF waste stream volumes. The following sections group the projects by waste stream.

5.1 Low-Level Waste Stream

There are a number of LANL mission activities and P2/WM projects scheduled for implementation in the next 5 to 10 years that will have significant impacts to the LLW stream volume. Table 12 provides the list of these projects, associated volume reduction or increase, and the expected year of implementation.

Table 12
LANL Mission and Pollution Prevention Projects that will Impact the Low-Level Waste Stream Influent Volume

Project Title	Volume (LPY)	Year of Implementation	Increase or Decrease
CMR-R Radiological Lab and Office [a]	811,688	2009	Increase
CMR-R Nuclear Facility [a]	936,563	2012	Increase
Increased Pit Production [b, c]	205,366	2007	Increase
CMR Decommission	2,078,436	2014	Decrease
TA-3-241 Beryllium Technology Facility [d]	475,000	2007	Decrease
TA-48 Duct Washing System [d]	750,000	2007	Decrease
TA-3-102 ESA Evaporator/102 Shops [d]	208,198	2008	Decrease
TA-3-66 Electroplating Shop [d]	1,000,000	2008	Decrease

a. Electronic mail transmitted, To: Louis, Jennifer Griffin, Pete Worland, From: Martin Price, Date: July 21, 2005, Subject: CMR-R, RLW Estimates.
b. White, Anne, Bachmeier, Craig, Scott, Jim, Waste Volume Forecast, LA-UR-03-2009, Los Alamos National Laboratory, Los Alamos, New Mexico.
c. Electronic mail transmitted, To: Jennifer Griffin, Bob Dodge, Marty Price, Victor Turner, From: Pete Worland, Date: September 29, 2005, Subject: LLW Volumes from TA-55.
d. FY06 Generator Set-Aside Fund Proposals 590, 591, 592, and 602.

The anticipated LLW operating volumes for 2006 through 2020 are provided in Figure 8 by the center (pink) line. This line is the total impact of LANL mission and P2/WM projects as summarized in Table 12.

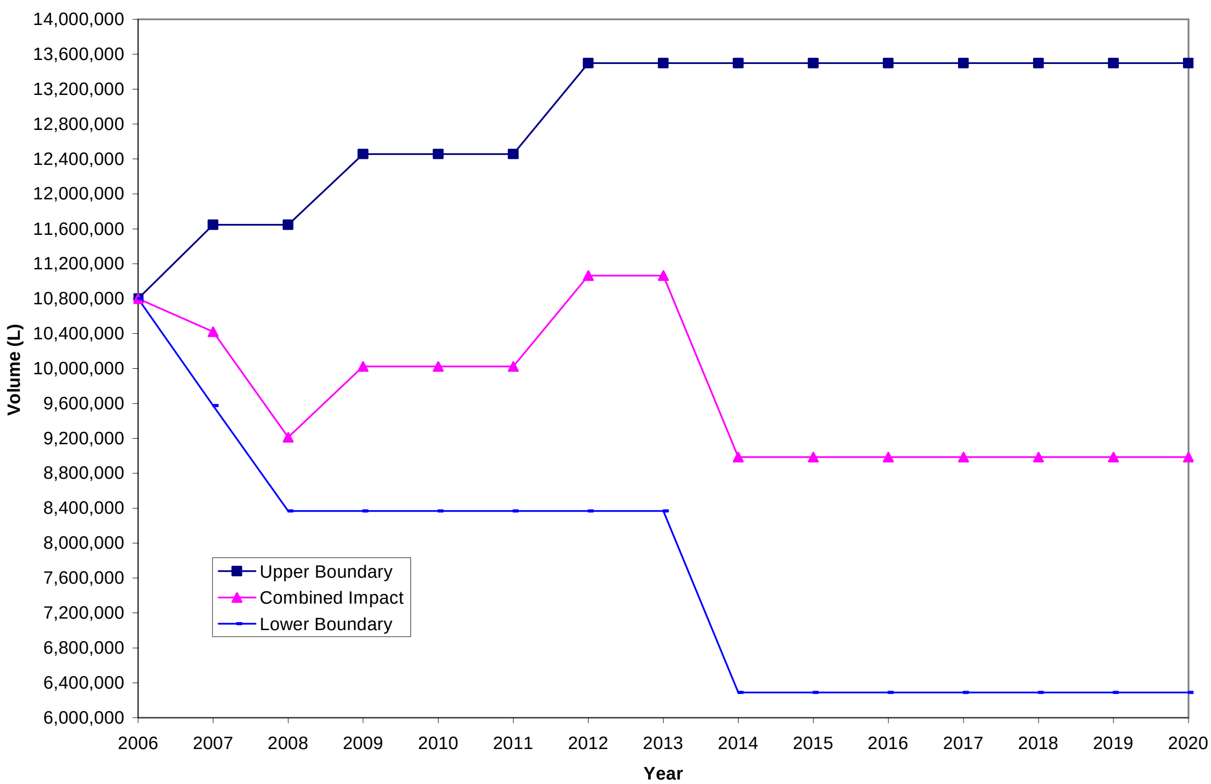


Figure 8
Project Low-Level Waste Volumes for 2006 to 2020

The upper (dark blue) line indicates the impact of LANL mission activities that will increase the LLW volume to the RLWTF. This line shows two peaks in 2009 and 2012 that correspond to start of the

CMR-R Radiological Laboratory and Office and the CMR-R Nuclear Facility, respectively. The second peak also reflects a potential increase in pit manufacturing form 10 to 50 ppy. LANL mission activities are expected to increase the LLW volume by nearly 2,000,000 LPY. The lower (blue) line indicates the impact of P2/WM activities and the decommissioning of the CMR at TA-3-29. The first drop in volume (2006 through 2008) is due to the implementation of four major P2/WM projects that are expected to lower the volume of LLW by 2,433,198 LPY. The second drop in volume (2013 through 2014) is due to the decommissioning of the CMR.

5.2 TRU Waste Stream

The RLWTF segregated the caustic and acid TRU waste streams from the main LLW influent in the early 1980's to prevent airborne contamination hazards in the TA-50-1 basement and deterioration of piping/equipment due to material incompatibility with the pH and chloride concentrations in the waste streams. The contaminant content and volume for both waste streams is dependent only on the mission activities/projects occurring at TA-55, Building 4. The mission importance of TA-55 and the cost to implement projects inside Building 4 have limited pollution prevention/waste minimization activities to the CLEAR and NARS processes as described in Section 4.2. There are three LANL mission activities/projects scheduled for implementation in the next 5 to 10 years that will have significant impacts to the volume of both TRU waste streams. Table 13 provides the list of these projects, associated volume reduction or increase, and the expected year of implementation.

Table 13
LANL Mission and Pollution Prevention Activities that will Impact the Transuranic Acid and Caustic Waste Stream Influent Volumes

Project Title	Volume (LPY)	Year of Implementation	Increase or Decrease
Acid Waste Stream			
Increased Pit Production [a]	35,055	2012	Increase
End of MOX Program at LANL [b]	21,000	2011	Decrease
NARS Process at TA-55	14,080	2006	Decrease
Caustic Waste Stream			
CMR-R Nuclear Facility [c]	2,000	2012	Increase
Increased Pit Production [d, e, f]	73,500	2012	Increase
CLEAR Process at TA-55	0	2007	Na

a. Electronic mail transmitted, To: Marty Price, From: Pete Worland, Date: September 21, 2005, Subject: Re: Pit Manufacturing Projections.
b. Electronic mail transmitted, To: Jennifer Griffin, From: Pete Worland, Date: July 26, 2005, Subject: TA-50 Caustic-Acid Dump Estimate for FY05 – FY07.
c. Electronic mail transmitted, To: Louis, Jennifer Griffin, Pete Worland, From: Martin Price, Date: July 21, 2005, Subject: CMR-R RLW Estimates.
d. Electronic mail transmittal, To: Jennifer Griffin, From: Cynthia L. Kowalczyk, Date: October 25, 2005, Subject: Re: Comment Resolution Meeting – TA-50 RLWTF Boundary Conditions Assessment Report.
e. Electronic mail transmittal, To: Jennifer Griffin, Pete Worland, Bob Dodge, Bob McClenahan, Martin Price, Amanda Bean, Kent Abney; From: Cynthia L. Kowalczyk, Date: November 8, 2005, Subject: Re: Comment Resolution for TA-50 Caustic Waste Stream.
f. Electronic mail transmittal, To: Jennifer Griffin, Cynthia Kowalczyk, Pete Worland, Ron Nakaoka, Bob McClenahan, Martin Price, Amanda Bean, Kent Abney; From: Bob Dodge, Date: November 9, 2005, Subject: Re: Comment Resolution for TA-50 Caustic Waste Stream.

The anticipated TRU caustic waste operating volumes for 2006 through 2020 are provided in Figure 9. This line accounts for the impact of LANL mission activities as summarized in Table 13. This waste stream does not currently have any P2/WM projects proposed that will reduce volume. It is anticipated to increase in volume by approximately 75,500 LPY due to increased pit production and the startup of the CMR-R Nuclear Facility in 2012.

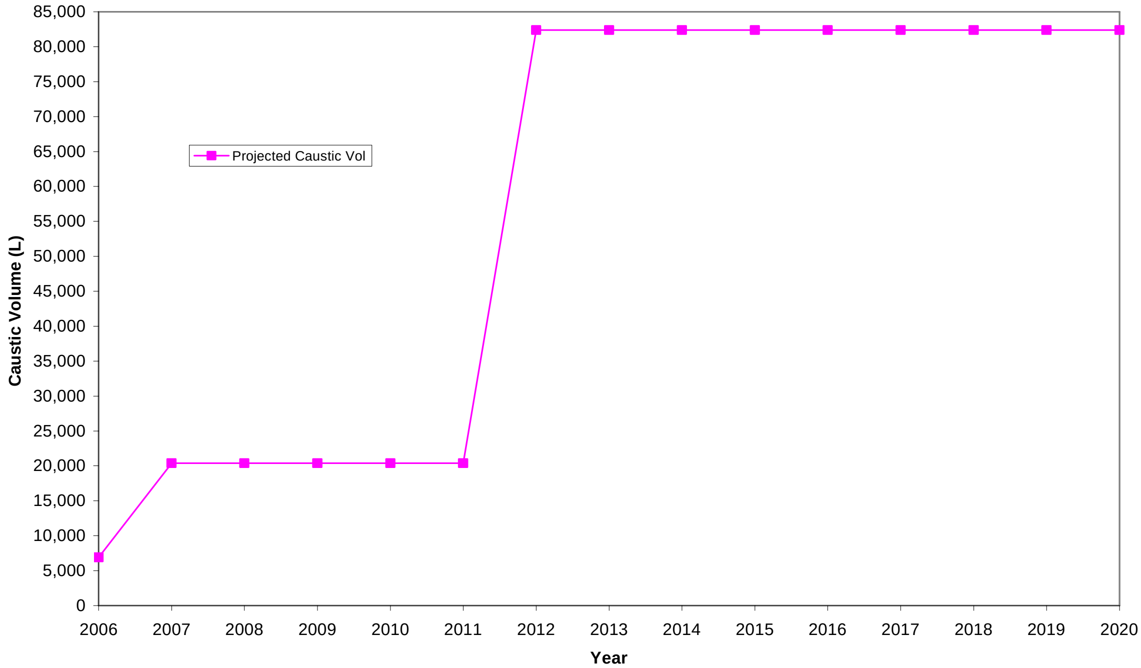


Figure 9
Transuranic Caustic Waste Influent Base, Minimum, and Maximum Volumes for 1994 to 2020

The anticipated TRU acid waste operating volumes for 2006 through 2020 are provided in Figure 10 by the center (pink) line. This line accounts for the impact of LANL mission and pollution prevention/waste minimization projects as summarized in Table 13.

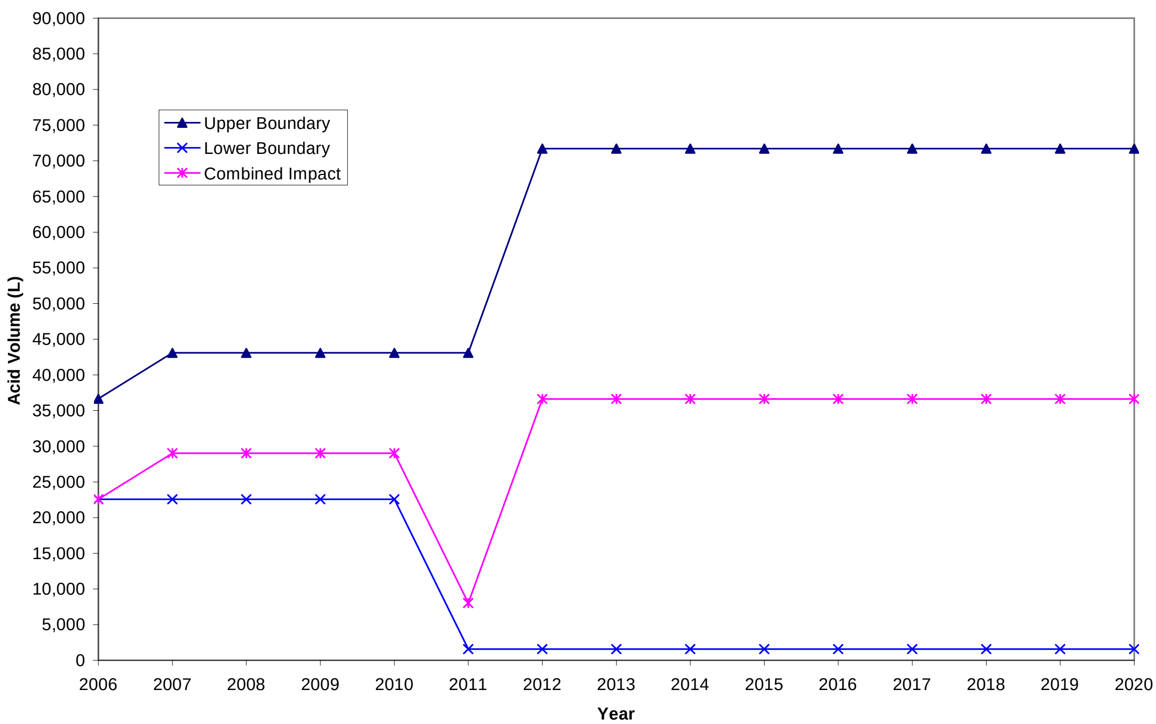


Figure 10
Transuranic Acid Waste Influent Base, Minimum, and Maximum Volumes for 1994 to 2020

The upper (dark blue) line indicates the impact of LANL mission activities that will increase the acid waste volume to the RLWTF. This line shows a peak in 2012 that corresponds to a potential increase in pit manufacturing from 10 to 50 ppy. This will increase the acid waste volume by 35,055 LPY. The lower (blue) line indicates the impact of the end of the MOX program at TA-55 (2011). This will drop the acid waste volume by 21,000 LPY.

6.0 PROPOSED BOUNDARY CONDITIONS

The following sections propose boundary conditions and a nominal design basis for the design and construction of a new RLWTF capability at LANL. These boundary conditions were developed taking into consideration the potential influence/impact associated with the execution of P2 projects upstream from the existing RLWTF and mission changes/increases as described in Section 6.0.

6.1 Influent Volume

The influent volume boundary conditions were calculated assuming that all P2 and mission changes/increases discussed in Sections 4.0 and 5.0 were implemented. Table 14 summarizes the overall impacts to the volume of each waste stream.

Table 14
Proposed Boundary Conditions and Nominal Design Basis for Influent Volume

Waste Stream	Boundary Conditions		Nominal Design Basis (LPY)
	Lower (LPY)	Upper (LPY)	
Low-Level/Industrial [a]	6,288,144	13,496,871	10,375,302
TRU Acid [b]	1,578	71,712	41,682
TRU Caustic [b]	1,684	82,391	42,088

a. *Low-Level Waste Influent Volume Boundary Conditions*, 116256-05-008, R.1, Shaw Environmental, Inc., Los Alamos, New Mexico, November 10, 2005.

b. *TRU Influent Boundary Conditions*, 116256-05-009, R.1, Shaw Environmental, Inc., Los Alamos, New Mexico, November 14. 2005.

The detailed calculations are provided in Appendices A and B as calculations 116256-05-008, R.1, *Low-Level Waste Influent Volume Boundary Conditions* and 116256-05-009, R.1, *TRU Influent Boundary Conditions*.

6.2 Low-Level Waste Stream Contaminants

The proposed influent boundary conditions and nominal design basis for the contaminants in the LLW stream were determined by calculating the average, minimum, maximum, and 90 percent confidence interval concentrations using raw influent data collected by the RWLTF during 2000, 2001, 2002, 2003, 2004, and 2005. The calculations included identification and deletion of outliers, plotting the frequency distribution to determine normality, adjustment to a normal distribution (if needed), and a statistical analysis to determine the 90 percent confidence interval. The calculated minimum and maximum results became the lower and upper boundary conditions and the 90 percent Confidence Interval became the recommended nominal design basis. Table 15 provides the results for the radiological contaminants.

Table 15
Proposed Boundary Conditions and Nominal Design Basis for the Low-Level Waste Stream

Contaminant	Boundary Conditions		Nominal Design Basis
	Lower	Upper	
Radiological Contaminants (nCi/L) [a]			
Gross Alpha	5.4	300	170 [c]
Americium-241	1.1	200	88
Cesium-137	0.0041	1	0.5
Plutonium-238	3.8	93	52
Plutonium-239	0.0054	56	29
Tritium	7.7	46	41
Uranium-234	0.0055	1.2	0.5
Uranium-235	0.00008	0.3	0.11
Uranium-238	0.0046	0.186	0.11
Chemical Contaminants (mg/L) [b, c]			
Aluminum	0.12	1.83	1.1
Ammonia-Nitrogen	0.56	10	8
Arsenic	0.008	0.06	0.03
Barium	0.01	0.055	0.05
Boron	0.042	2.91	0.59
Cadmium	0.001	0.008	0.006
Calcium	6.0	16.0	14
Chlorine	14	30	27
Chromium (total)	0.003	0.098	0.06
Cobalt	0.0008	0.009	0.004
COD	32	213	158
Copper	0.152	0.91	0.59
Fluoride	0.146	1.41	1.0
Iron	0.003	4	3
Lead	0.03	0.16	0.12
Magnesium	2	4	4
Mercury	0.0003	0.011	0.007
Nickel	0.02	0.386	0.22
Nitrate-Nitrogen	0.01	9.8	7
Nitrite-Nitrogen	0.01	1.06	0.8
Perchlorate	0.009	0.38	0.25
pH (pH units) [c]	6.01	8.22	7.7
Potassium	0.003	12	8
Selenium	0.05	0.093	0.06
Silicon	10	40	40
Sulfate	3.4	57	37
TDS	40	478	400
TSS	4	64	44
Uranium	0.0139	0.335	0.21
Vanadium	0.006	0.22	0.06
Zinc	0.02	0.25	0.2
Organic Contaminants (mg/L) [d]			
1,1,1-trichloroethane	0.0004	0.0090	0.0093
1,2,4-trimethylbenzene	0.0004	0.0033	0.0023
1,2-dichlorobenzene	0.0003	0.0015	0.0012
1,2-dichloroethane	0.0005	0.0010	0.0010
1,3-dichlorobenzene	0.0003	0.0010	0.0010
1,4-dichlorobenzene	0.0005	0.0012	0.0011
2-butanone	0.0003	0.0190	0.0128

Table 15 (continued)
Proposed Boundary Conditions and Nominal Design Basis for the Low-Level Waste Stream

Contaminant	Boundary Conditions		Nominal Design Basis
	Lower	Upper	
Organic Contaminants (mg/L) [d]			
2-chlorophenol	0.0020	0.0090	0.0094
2-nitrophenol	0.0020	0.0070	0.0060
4-methyl-2-pentanone	0.0010	0.0920	0.0390
4-nitrophenol	0.0020	0.0130	0.0104
Acetone	0.0120	1.2000	0.7544
Azobenzene	0.0020	0.0120	0.0042
Benzene	0.0004	0.0006	0.0005
Benzoic acid	0.0020	0.0930	0.0622
Benzyl alcohol	0.0010	0.0060	0.0051
Bis-(2ethylhexyl) phthalate	0.0020	0.0260	0.0153
Bromobenzene	0.0002	0.0017	0.0016
Bromodichloromethane	0.0002	0.0020	0.0016
Bromoform	0.0004	0.0050	0.0035
Bromomethane	0.0003	0.0064	0.0052
Butylbenzylphthalate	0.0009	0.0070	0.0055
Carbon disulfide	0.0003	0.0015	0.0015
chlorodibromomethane	0.0002	0.0006	0.0005
Chloroform	0.0002	0.0040	0.0023
Chloromethane	0.0002	0.0070	0.0041
Diethyl phthalate	0.0010	0.0040	0.0035
Di-N-octylphthalate	0.0010	0.0030	0.0027
Iodomethane	0.0009	0.0083	0.0063
Methylene Chloride	0.0003	0.0180	0.0097
Naphthalene	0.0005	0.0030	0.0023
N-nitrosodimethylamine	0.0023	0.0060	0.0052
N-nitroso-di-N-propylamine	0.0028	0.0091	0.0084
Phenol	0.0010	0.0190	0.0104
Pyridine	0.0010	0.0390	0.0170
Toluene	0.0003	0.0020	0.0013
Xylene (Total)	0.0008	0.0057	0.0046

a. 116256-05-006, *Nominal Design Basis Concentrations for Radiological Contaminants in the LLW Stream*, Shaw Environmental, Inc., Los Alamos, New Mexico, October 2005.

b. 116256-05-007, *Nominal Design Basis Concentrations for Chemical Contaminants in the LLW Stream*, Shaw Environmental, Inc., Los Alamos, New Mexico, October 2005.

c. 116256-05-001, *Nominal Design Basis Concentrations for Chemical Contaminants in the LLW Stream – Addendum*, Shaw Environmental, Inc., Los Alamos, New Mexico, October 2005.

d. 116256-05-003, *Nominal Design Basis Concentrations for Organic Contaminants in the LLW Stream*, Shaw Environmental, Inc., Los Alamos, New Mexico, October 2005.

nCi/L = nanocuries per liter

The detailed calculations are provided in Appendices C, D, E, and F as calculations 116256-05-006, *Nominal Design Basis Concentrations for Radiological Contaminants in the LLW Stream*, 116256-05-007, *Nominal Design Basis Concentrations for Chemical Contaminants in the LLW Stream*, 116256-05-001, *Nominal Design Basis Concentrations for Chemical Contaminants in the LLW Stream – Addendum*, and 116256-05-003, *Nominal Design Basis Influent Concentrations for Organic Contaminants in the LLW Stream*.

6.3 TRU Waste Stream Contaminants

The proposed influent boundary conditions and nominal design basis for the radiological contaminants in the TRU waste streams were determined by calculating the average, minimum, maximum, and 90 percent confidence interval concentrations using raw influent data collected by the RLWTF during 2000, 2001, 2002, 2003, and 2004. The calculations for the radiological contaminants included identification and deletion of outliers, plotting the frequency distribution to determine normality, adjustment to a normal distribution (if needed), and a statistical analysis to determine the 90 percent confidence interval. The calculated minimum and maximum results became the lower and upper boundary conditions and the 90 percent Confidence Interval became the recommended nominal design basis.

Table 16 provides the radiological contaminants, boundary conditions, and design basis for the caustic and acid waste streams.

Table 16
Proposed Boundary Conditions and Nominal Design Basis
for the Radiological Contaminants in the Transuranic Waste Streams[a]

Contaminant	Boundary Conditions (nCi/L)		Nominal Design Basis (nCi/L)
	Lower	Upper	
Caustic Waste Stream			
Gross Alpha	110,000	1,589,000	1,296,673
Americium-241	14,000	1,000,000	805,761
Plutonium-238	14,000	270,000	218,843
Plutonium-239	28,000	290,000	245,876
Plutonium-240	8,100	29,000	26,193
Uranium-235	0.35	11	11
Tritium	1,100	2,900	2,000
Acid Waste Stream			
Gross Alpha	5,600	62,600	50,777
Americium-241	1,200	7,000	5,862
Plutonium-238	2,400	12,000	9,885
Plutonium-239	3,900	41,000	32,412
Plutonium-240	1,100	2,600	2,618
Uranium-235	0.054	250	302
Tritium	20	44	31.3

a. 116256-05-002, *Nominal Design Basis Concentrations for Radiological Contaminants in the TRU Waste Stream, October 2005.*

nCi/L = nanocuries per liter

Table 17 adjusts the radiological boundary conditions and design basis for the caustic waste stream to account for implementation of the CLEAR process as described in Section 4.2.2.

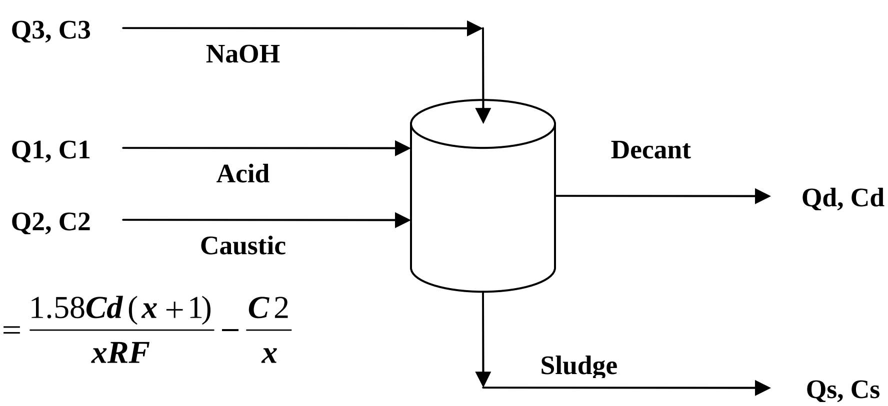
Table 17
Proposed Radiological Boundary Conditions and Nominal Design Basis for the Transuranic Caustic Waste Stream – with the CLEAR Process [a]

Contaminant	Boundary Conditions (nCi/L)		Nominal Design Basis (nCi/L)
	Lower	Upper	
Gross Alpha	7,700	111,230	90,767
Americium-241	980	70,000	56,403
Plutonium-238	980	18,900	15,319
Plutonium-239	1,960	20,300	17,211
Plutonium-240	567	2,030	1,834

a. Reduced by 93 percent as discussed in Section 4.2.2.

The detailed calculations for each waste stream are provided in Appendix G as calculations 116256-05-002, *Nominal Design Basis Concentrations for Radiological Contaminants in the TRU Waste Stream*.

The data for the chemical contaminants in the caustic and acid waste streams were insufficient to the level of analysis described in Section 6.2. Instead the raw influent data, data collected from the process tanks after pH adjustment, and evaporator feed data (i.e., Room 60 effluent data) were used to estimate concentration levels for contaminates using mass balance equations for a simplified flow diagram as shown in Figure 11.



$$C1 = \frac{1.58Cd(x+1)}{xRF} - \frac{C2}{x}$$

$$C2 = \frac{1.58Cd(x+1)}{RF} - xC1$$

RF = retention factor
x = volumetric ratio

Figure 11
Flow Diagram and Mass Balance Equations Used to Estimate Chemical Contaminant Concentrations

The detailed calculation is provided in Appendix H as 116256-05-005, *Nominal Design Basis Concentrations for Chemical Contaminants in the TRU Waste Stream*. Table 18 provides a summary of the results.

Table 18
Proposed Boundary Conditions and Nominal Design Basis for the Chemical Contaminants in the Transuranic Waste Stream

Contaminant	Boundary Conditions (mg/L) [a]		Nominal Design Basis (mg/L)
	Lower	Upper	
Caustic Waste Stream			
Ammonia-Nitrogen	0.007	110.9	69
Arsenic	0.09	0.27	0.20
Barium	0.010	0.053	0.024
Cadmium	0.043	0.59	0.231
Chloride	854	122,303 [b]	61,578 [c]
Chromium	0.4	5.4	3.6
Lead	0.10	0.24	0.16
Nitrate-Nitrogen	460	1,127	794
Nitrite-Nitrogen	0.023	97.6	31.1
pH *(standard units)*	4.8	7.8	6.8
Selenium	0.20	0.36	0.29
Silver	0.008	0.030	0.016
Sulfate	2,585	7,038	5,053
Acid Waste Stream			
Ammonia-Nitrogen	0.004	53	34.5
Arsenic	0.16	0.43	0.32
Barium	0.050	0.058	0.053
Chloride	72	1262	667
Nitrate-Nitrogen	877	43,300	25,719
Nitrite-Nitrogen	0.012	41.9	14
Selenium	0.72	1.01	0.75
Silver	0.006	0.11	0.05
Sulfate	203	365	284
pH	1	5.8	4.4

a. 116256-05-005, *Nominal Design Basis Concentrations for Chemical Contaminants in the TRU Waste Stream,* Shaw Environmental, Inc., Los Alamos, New Mexico, October 2005.
b. Value provided by Memorandum, To: Ron Nakaoka, From: Daniel Kathios, Subject: Assessment of Aqueous Waste Streams sent to TA-50 from the Los Alamos National Laboratory Plutonium Facility via the Caustic Waste Line, Date: July 27, 2005.
c. Revised to reflect impact of new chloride data provided in footnote b.

7.0 CONCLUSIONS

The boundary conditions proposed in this report are intended to serve as the preliminary influent design basis for a new and/or upgraded facility that will maintain RLW treatment capability at LANL. These conditions should not be utilized without consideration of future mission and P2 efforts outlined in Section 4.0. RLW treatment is an infrastructure issue at the Laboratory that must be considered from a systemic viewpoint. This will ensure that the most efficient methods are utilized for the proper treatment and disposal of RLW. It will also minimize the consequences to the environment due to future operations; prevent pollution; and foster sustainable use of natural resources.

8.0 REFERENCES

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APPENDIX A

116256-05-008, R.1, Low-Level Waste Influent Volume Boundary Conditions

APPENDIX B
116256-05-009, R.1, TRU Influent Boundary Conditions

APPENDIX C

116256-05-006, R.2, Nominal Design Basis Concentrations for Radiological Contaminants in the LLW Stream

APPENDIX D

116256-05-007, R.3, Nominal Design Basis Concentrations for Chemical Contaminants in the LLW Stream

APPENDIX E

116256-05-001, R.1, Nominal Design Basis Concentrations for Chemical Contaminants in the LLW Stream – Addendum

APPENDIX F

116256-05-003, R.1, Nominal Design Basis Influent Concentrations for Organic Contaminants in the LLW Waste Stream

APPENDIX G

116256-05-002, R.1, Nominal Design Basis Concentrations for Radiological Contaminants in the TRU Waste Stream

APPENDIX H

116256-05-005, R.1, Nominal Design Basis Concentrations for Chemical Contaminants in the TRU Waste Stream