GROUND WATER QUALITY DISCHARGE PERMIT UGW450005

STATEMENT OF BASIS

Low-Level and 11e.(2) Radioactive Waste Disposal Facility

EnergySolutions LLC
423 West 300 South, Suite 200
Salt Lake City, Utah 84101

March 20, 2012

Purpose

This Statement of Basis describes a proposed change to Ground Water Quality Discharge Permit No. UGW450005 (hereafter Permit) for the EnergySolutions' (hereafter Permittee) Low-Level and 11e.(2) radioactive waste, and mixed waste disposal facility located near Clive, Tooele County, Utah; in Township 1 South, Range 11 West, Section 32, Salt Lake Baseline and Meridian. These changes are related to a Permittee request to the Co-Executive Secretary of the Utah Water Quality Board for a revised ground-water monitoring well network at the Mixed Waste embankment in the southeastern area of Section 32. Mixed wastes operations are regulated by both the Utah Division of Solid and Hazardous Waste (DSHW) and the Utah Division of Radiation Control (DRC), with the DSHW regulating hazardous waste, and the DRC regulating radioactive waste and administrating the Permit. The Permittee requested the DSHW approve a Class 3 Modification to the State-issued RACA Part B Permit for on-going operations, and a northern expansion of the Mixed Waste embankment in a July 19, 2011 letter. The DSHW has evaluated the Permittee request and has finished a Public Comment Period concerning the request. New compliance monitoring wells are necessary to accommodate the expanded footprint of the modified Mixed Waste embankment. The Executive Secretary is proposing a modification of the Permit at this time to accommodate the Mixed Waster embankment expansion; specifically, the revised Mixed Waste ground-water monitoring well network. The construction and operation of the expanded Mixed Waste embankment will allow the Permittee to increase waste capacity at the embankment, and support operations at the Permittee's Clive facility. The Permittee's proposed monitoring well network is designed to verify regulatory compliance with the DRC administered Ground Water Quality Discharge Permit, and DSHW administered Mixed Waste Facility's Storage, Treatment, and Disposal Permit. The changes considered below, will be integrated into the next Permit modification, which will succeed the previous Permit modification, dated February 14, 2012 (see Attachment A for the redline/strikeout version of the Permit).

Compliance ground-water monitoring at the Clive facility is required by the Permit at all embankments, and is conducted at established intervals for specific parameters listed in the

Permit. Monitoring wells are essential elements in ground-water compliance monitoring to verify regulatory compliance, and provide early warning of any release from an embankment. Monitoring well locations are an important component in an embankment monitoring well network, and are based on a comprehensive evaluation process at the Clive facility. Therefore it is of considerable practical importance to quantify in the evaluation the physical properties of shallow aquifer materials and ground water flow, which are most influential for predicting the migration paths of a release from an embankment. Suitability of the monitoring network for compliance ground-water monitoring at the Mixed Waste embankment is evaluated by determining, within the embankment boundary, where a release would or would not be detected by a monitoring well network.

The Permittee used a monitoring efficiency software program to evaluation different potential impacts from contaminant ground-water migration paths, or plumes of indicator parameters, that exceeding applicable regulatory standards, released from the Mixed Waste embankment to the shallow aquifer. The modeling, in the context of this strategy, utilized an understanding of shallow aquifer material and the ground-water flow system to design a monitoring well network that would detect 95 percent or greater of any potential contaminant plumes released. The program provided an efficiency of a given monitoring well network in detecting a potential release from the expanded Mixed Waste embankment; this provides a method for quantifying the efficiency of the monitoring well network. Modeling was performed using iodine-129 and technetium-99. These radionuclides were selected because of their potential presence in Mixed Waste embankment waste, conservative transport characteristics, and long half-lives relative to the modeled time period of 500 years. These are reasonable and conservative surrogate contaminants and have been used in past well spacing evaluations. The Permittee evaluate the efficiency of numerous networks of well locations and spacing and the monitoring efficiencies for each model run provided a means of quantifying monitoring well networks for comparison.

The monitoring well spacing proposed for the expanded Mixed Waste embankment in the July 19, 2011 letter, had efficiencies over 96 percent, where 96 percent of a release from the Mixed Waste embankment would be detected by monitoring wells at the embankment boundary, and about 4 percent of a release from the embankment would not be detected. As with any analysis of contaminant migration, there is uncertainty in parameter values used in the Mixed Waste embankment modeling, which render questionable the precise values predicted from the model. In the present configuration of the model, as a deterministic tool, these uncertainties are addressed by use of conservative estimates of input parameter values to the models, where the use of conservative parameter values in the monitoring well network design increase the chances for detection of contamination. In adopting this approach, the predicted monitoring efficiencies would be expected to be conservative and provide adequate protection for any release from the Mixed Waste embankment. The DRC reviewed the July 19, 2011 well spacing evaluation in a November 7, 2011 memorandum, see Attachment B; and asked follow-up questions in a January 4, 2012 Request for Information Letter; the Permittee responded in a February 9, 2012 letter; and the DRC evaluated that response in a February 13, 2012 memorandum, see Attachment C. The DRC verified that the data going into, and the predictions produced by the model were sufficiently accurate, determined that conservative (protective) input parameter values were used to provide a protective well spacing at the expanded Mixed Waste embankment, and recommended the acceptance of the Mixed Waste embankment monitoring well network in the DRC memorandums dated November 7, 2011, and February 13, 2012 (for technical details see Attachment B and C). An acceptable monitoring well density or spacing decrees any uncertainty in the Mixed Waste embankment well spacing evaluation, so a high degree of confidence is provided by the well network

The Permittee's proposed Mixed Waste embankment monitoring well network consisted of one replacement monitoring well along the east side, one new monitoring well at the northeast corner, two new monitoring wells along the north side, and six existing Mixed Waste monitoring wells. The new well locations are within 90 feet of the edge of waste, which is consistent with ground-water flow and transport models, which defined the design basis for the facility, and required by the Permit, Part I.F.1.e. The spacing is also consistent with the spacing of existing embankments. The Executive Secretary is satisfied that the compliance monitoring well network is designed to verify regulatory compliance with the Permit, and will provide early warning of any potential releases from the Mixed Waste embankment. Thus, the Executive Secretary stipulates the Mixed Waste embankment well network as proposed in the Permittee's July 19, 2011 letter, with the following conditions:

1. All well screens shall fully penetrate the shallow unconfined aquifer.
2. The Permittee will conform to the well design, construction and reporting requirements and submit all documents conformant to Ground Water Permit No. UGW450005.
3. The Permittee will provide final well completion diagrams, including stratigraphic cross sections (with well geologic log data), casing depths and screened intervals.

Four new monitoring wells (GW-151, GW-152, GW-153, and GW154) are added to, and three monitoring wells (GW-130, GW-131, and GW-132) have been removed from Part I.F.1. b of the Permit, Compliance Monitoring Wells (see Attachment A). The removed compliance monitoring well (GW-130, GW-131, and GW-132) will continue to be compliance monitoring wells until their abandonment, see Part I.I.3 of Attachment A. The replacement wells will be approved by the Executive Secretary with the signing of this Permit modification.

Monitoring well I-30-100 will have to be abandoned due to the Mixed Waste embankment expansion; this is a deep aquifer monitoring well listed in Part I.F.1.d of the Permit. The Permittee proposed a new deep aquifer monitoring well, GW-153D, as its replacement. The new well would be about 300 feet to the east, and 250 feet to the north of monitoring well I-30-100. The new location is appropriate to characterize vertical gradients in the eastern portion of the Clive facility. The Executive Secretary finds this location acceptable; therefore, deep aquifer monitoring well I-3-100 has been removed from Part I.F.1.d and GW-153D has been added.

Background for parameters and wells to be listed in Table 1F of this Permit will be established with the completion of compliance item Part I.I.3, which require a Background Ground-Water Quality Report for any new Mixed Waste Compliance Well that will require additional evaluation to be included in the Ground Water Protection Level Exceptions for

Mixed Waster Wells. Exceptions have not been established for Ground Water Protection Levels (GWPLs) for the new Mixed Waste monitoring wells (GW-151, GW-152, GW-153, and GW154), so the universal GWPLs in Table 1E are applicable. The Permittee will establish Ground-Water Protection Levels, for parameters listed in Table 1E of this Permit, based on four quarters of evaluation to determine if background concentrations are within these GWPLs or warrant a request for exceptions status for ground-water protection levels for the new Mixed Waste wells. If additional evaluations is warranted, at a minimum, eight additional quarters of data collection and then statistical analysis will be done. More frequent monitoring is warranted during establishment of background conditions, to improve the characterization of ground-water quality. The Executive Secretary does not anticipate the background concentrations for any parameter listed in Table 1E to be greater than their respective ground water protection level, because the removed wells were subject to the universal GWPLs. As a result, compliance monitoring for these parameters will commence in the new Mixed Waste Embankment wells with their completion at a quarterly frequency

REFERENCES

EnergySolutions, July 19, 2011, (CD11-0198) Class 3 Modification with Temporary Authorization for Top of Waste and Radon Barrier - Mixed Waste Cell Extension and Cover: letter to Scott Anderson, Executive Secretary of Solid and Hazardous Waste Board from Sean McCandless of EnergySolutions.

DRC, November 7, 2011, EnergySolutions' Well Spacing Analyses for the Mixed Waste Embankment Expansion: Memorandum for Charles Bishop to John Hultquist.

DRC, January 4, 2012, Mixed Waste Embankment Extension, Well spacing analysis: Division of Radiation Control request for Information: letter from Charles Bishop of the DRC to Sean McCandless of EnergySolutions.

EnergySolutions, February 9, 2012, (CD12-0005) Mixed Waste Embankment Extension, Well Spacing Analysis: Response to the Division of Radiation Control (DRC) Request for Information: letter from Sean McCandless of EnergySolutions to Rusty Lundberg of the DRC.

DRC, February 13, 2012, EnergySolutions response to the Division of Radiation Controls' request for information concerning the Mixed Waste Embankment Extension, Well Spacing Analysis: Memorandum for Charles Bishop to John Hultquist.

Attachment A

Redline/ strikeout copy of
EnergySolutions Ground Water Quality Discharge Permit

Permit No. UGW450005

STATE OF UTAH
DIVISION OF WATER QUALITY
UTAH WATER QUALITY BOARD
P.O. BOX 16690
SALT LAKE CITY, UTAH 84116-0690

Ground Water Quality Discharge Permit

In compliance with the provisions of the
Utah Water Quality Act, Title 19, Chapter 5, Utah Code Annotated 1953, as amended,

EnergySolutions, LLC
423 West 300 South, Suite 200
Salt Lake City, Utah 84101

hereafter referred to as the "Permittee", is granted a Ground Water Quality Discharge Permit for a Low-Level Radioactive Waste and 11e.(2) Waste Disposal Facility in accordance with conditions set forth herein. This facility currently consists of five separate operable units: a Low-Activity Radioactive Waste (LARW) cell, an 11e.(2) Cell, a Mixed Waste cell, a Class A cell, and a Class A North cell, which are located at approximately latitude 40° 41' 18" North, longitude 113° 06' 54" West.

This modified Ground Water Quality Discharge Permit amends and supersedes all other Ground Water Discharge permits for this facility issued previously.

This modified permit shall become effective on ~~February 14, 2012~~
This permit and the authorization to operate shall expire at midnight, **June 8, 2013.**

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Co-Executive Secretary
Water Quality Board

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PART I. SPECIFIC PERMIT CONDITIONS

A. Ground Water Classification

Based on ground water quality data submitted by the permit applicant, ground water in the vicinity of the site is defined as Class IV, saline ground water.

B. Background Ground Water Quality

1. Background Quality from Existing Monitoring Wells

   Based on ground water quality samples collected through June 2006, the upper boundary of background ground water quality is defined as the mean concentration plus the second standard deviation for any contaminant in any individual well as determined by the Executive Secretary.

2. Determination and Revision of Background Ground Water Quality

   After submittal of additional ground water quality data, background ground water quality values may be revised by the Executive Secretary.

C. Ground Water Protection Levels

1. Ground Water Protection Levels, LARW Cell, Class A Cell, and Class A North Cell

   Based on the types of wastes to be received for disposal in the low-activity radioactive waste (LARW) facility, which include naturally occurring radioactive materials (NORM) and Class A low-level radioactive waste (LLRW), an evaluation of indicator isotopes and their mobility, and the Ground Water Quality Standards (GWQS); ground water protection levels (GWPL) are defined as either the GWQS or the Background Concentration, whichever is greater, as listed in Tables 1A and 1B of this Permit. In all cases, ground water quality in any compliance monitoring well at the LARW cell, Class A cell, and Class A North cell shall comply with the GWPLs found in Table 1A, unless other GWPLs have been cited on a well and contaminant-specific basis in Table 1B, below.

2 Ground Water Protection Levels, 11e.(2) Cell

   Based on the types of waste to be disposed of in the 11e.(2) cells, an evaluation of the Ground Water Quality Standards; GWPLs for inorganic, dissolved metals, and organic parameters are defined as either the GWQS or the Background Concentration, whichever is greater, as listed in Tables 1C and 1D of this Permit. In all cases, ground water quality in any compliance monitoring well at the 11e.(2) Disposal cells shall comply with the GWPLs found in Table 1C, unless other GWPLs have been cited on a well and contaminant-specific basis in Table 1D, below.

3. <u>Ground Water Protection Levels for Radiologic Parameters, Mixed Waste Cell</u>

Based on the type of waste to be disposed of in the Mixed Waste Cell, which includes low-level radioactive waste, an evaluation of indicater isotopes, and the Ground Water Quality Standards (GWQS); ground water protection levels (GWPL) defined as either the GWQS or the Background Concentration, whichever is greater as listed in Table 1E and 1F of this Permit. In all cases, ground water quality in any compliance monitoring well at the Mixed Waste Cell shall comply with the GWPLs found in Table 1E, unless other GWPLs have been cited on a well and radiologic parameter-specific basis in Table 1F, below.

4 <u>Revision of Ground Water Protection Levels</u>

After submittal of additional ground water quality data, the ground water protection levels may be revised by the Executive Secretary.

Table 1A: Ground Water Protection Levels (GWPL) – Universal to All LARW, Class A, Class A North, and Evaporation Pond Wells

Parameter	GWPL [1]	Parameter	GWPL [1]
Field and Inorganic Parameters (mg/l)		*Radiologic Parameters – Alpha Emitters [9] (pCi/l)*	
Cyanide	0.2		
Fluoride	4.0	Neptunium-237 [10]	7
Total Nitrate/Nitrite (as N)	10.0	Strontium-90	42
pH (units)	6.5 – 8.5	Thorium-230	83
Dissolved Metals (mg/l)		Thorium-232	92
Antimony	0.006	Uranium-233	26
Arsenic	NA [2]	Uranium-234	26
Barium	2.0	Uranium-235	27
Beryllium [3]	0.004	Uranium-236	27
Cadmium	0.005	Uranium-238	26
Chromium	0.1		
Copper	1.3	*Radiologic Parameters – Beta/Gamma Emitters [12] (pCi/l)*	
Lead	0.015	Carbon-14	3,200
Mercury	0.002	Iodine-129 [12]	21
Molybdenum	NA [2]	Technetium-99	3,790
Nickel [3]	0.10	Tritium	60,900
Selenium	0.05		
Silver	0.1	*Combined Radiologic Parameters (pCi/l)*	
Thallium	0.002		
Uranium – total [4]	0.03	Radium-226 + Radium-228 [13]	5
Zinc	5.0		
Organic Parameters (mg/l)			
Acetone [5]	0.7	1,2-Dichloroethane	0.005
Parameter	**GWPL [1]**	**Parameter**	**GWPL [1]**
2-Butanone [14]	4.0	Methylene Chloride [7]	0.005

Carbon Disulfide (5)	0.7	1,1,2-Trichloroethane (8)	0.005
Chloroform (6)	0.08	Vinyl Chloride	0.002

1. All ground water protection levels (GWPLs) derived from Ground Water Quality Standards (GWQS, see UAC R317-6-2), except as noted.
2. Due to naturally elevated concentrations of arsenic and molybdenum in the Class IV saline aquifer at Clive, Utah, these constituents are poor indicators of cell leakage and therefore will not be used as compliance parameters with ground water protection levels. However, the Permittee will continue to sample, analyze, and report arsenic and molybdenum data in all compliance monitoring wells at Permit and License renewal as a best management practice.
3. Beryllium and Nickel GWQS derived from EPA drinking water Maximum Contaminant Levels (MCL), as published in the July 17, 1992 Federal Register, Vol. 57, No. 138, pp. 31776 – 31849, Table 1.
4. Total uranium GWQS of 0.03 mg/l from EPA final MCL in National Primary Drinking Water Regulations Final Rule for Radionuclides (December 7, 2000 Federal Register, Vol. 65, No. 236, p. 76708).
5. GWQS for acetone, and carbon disulfide determined by DWQ staff from reference doses available in the technical literature, see August 8, 1994 DWQ Staff Report: Ground Water Quality Conditions and Proposed Revision to Ground Water Protection Levels, Envirocare of Utah Inc., Low-Level Radioactive Waste and 11e.(2) Waste Disposal Facility, near Clive, Tooele County, Utah, p. 3.
6. GWQS for chloroform derived from a 1998 EPA final drinking water MCL for total trihalomethane compounds in "Drinking Water Standards and Health Advisories", EPA 822-B-00-001, Summer 2000.
7. GWQS for methylene chloride derived from EPA drinking water MCL (ibid.).
8. GWQS for 1,1, 2-Trichloroethane from final EPA MCL in "Drinking Water Regulations and Health Advisories", EPA 822-B-96-002, October 1996.
9. All GWPL values for alpha-emitting radionuclides based on 1E-4 lifetime cancer mortality risk concentration levels provided in 1991 EPA draft MCL values for drinking water (July 18, 1991 Federal Register, Vol. 56, No. 138, pp. 33078-9, 33100-3, and Appendix C).
10. Neptunium-237, as determined by Total Radioactive Neptunium, EPA Method 907.0.
11. All GWPL values for beta/gamma emitting radionuclide parameters based on a 4 millirem/year equivalent dosage, as per 1991 EPA draft MCL values for drinking water (July 18, 1991 Federal Register, Vol. 56, No. 138, pp. 33078, 33103, and Appendix B).
12. Iodine-129, as determined by Total Radioactive Iodine, EPA Method 902.0.
13. GWQS of 5 pCi/l for combined radium-226 + radium-228 from final EPA MCL in National Primary Drinking Water Regulations Final Rule for Radionuclides (December 7, 2000 Federal Register, Vol. 65, No. 236, p. 76708).
14. GWQS for 2-Butanone (methyl ethyl ketone) derived from Life-time health advisory value in "2006 Edition of the Drinking Water Standards and Health Advisories", EPA 822-R-06-013, August 2006.

Table 1B: Ground Water Protection Level Exceptions[(1)] – LARW, Class A, Class A North, and Evaporation Pond Wells

Well ID	Parameter	GWPL [(2)]	Well ID	Parameter	GWPL [(2)]
Inorganic/Metal Parameters (mg/l)					
GW-94	Uranium – total	0.035	GW-105	Selenium	0.095
GW-95	Uranium – total	0.0320			
GW-100	Uranium – total	0.117	P3-95 SWC	Uranium – total	0.180
GW-24	Selenium	0.058			
Radiologic Parameters (pCi/l)					
GW-20	Ra-226+Ra-228	5.49	GW-100	Uranium-234	68.6
				Uranium-238	43.0
GW-24	Ra-226+Ra-228	5.81			
			GW-105	Ra-226+Ra-228	6.03
GW-29	Ra-226+Ra-228	5.59			
			GW-58	Uranium-234	31.2
GW-56R	Ra-226+Ra-228	5.31			
			GW-36	Uranium-234	36.4
GW-64	Ra-226+Ra-228	5.63			
			GW-112	Ra-226+Ra-228	6.72
GW-77	Ra-226+Ra-228	5.46			
			P3-95 SWC	Uranium-234	48
GW-84	Ra-226+Ra-228	6.01		Uranium-238	79
				Ra-226+Ra-228	7.63
GW-85	Ra-226+Ra-228	7.77			
			GW-66R	Ra-226 + Ra-228	5.47
GW-86	Ra-226+Ra-228	6.19			
GW-88	Ra-226+Ra-228	5.04			
GW-89	Ra-226+Ra-228	5.04			
GW-90	Ra-226+Ra-228	5.85			
GW-91	Ra-226+Ra-228	5.92			
GW-93	Ra-226+Ra-228	5.54			

1. Table 1B exceptions constitute specific wells and parameters determined to have natural background ground water quality concentrations above GWQS, or as otherwise specified below. Background concentration is defined as the mean concentration plus the second standard deviation for any contaminant in any individual well.
2. The number of significant figures used for all GWPLs determined by laboratory results previously reported by the Permittee.

Table 1C: Ground Water Protection Levels – Universal for all 11e.(2) Wells

Parameter	GWPL [(1)]	Parameter	GWPL [(1)]
Field and Inorganic Parameters [(2)] (mg/l)		*Organic Parameters – Specific to 11e.(2) (mg/l)*	
Cyanide	0.2	Acetone [(5)]	0.7
Fluoride	4.0	2-Butanone [(11)]	4.0
Total Nitrate/Nitrite (as N)	10.0	Carbon Disulfide [(5)]	0.7
pH (units)	6.5 – 8.5	Chloroform [(6)]	0.08
Dissolved Metals [(2)] (mg/l)		1,2-Dichloroethane	0.005
Antimony	0.006	Methylene Chloride [(7)]	0.005
Arsenic	NA [(3)]	Naphthalene [(8)]	0.02
Barium	2.0	Diethyl Phthalate [(9)]	5.0
Beryllium [(4)]	0.004	2-Methylnaphthalene [(10)]	0.004
Cadmium	0.005	Benzo(a)anthrancene	0.01
Chromium	0.1	Benzo(a)pyrene	0.01
Copper	1.3	Benzo(k)fluoranthene	0.01
Lead	0.015	Chlordane	0.002
Mercury	0.002	Chrysene	0.01
Molybdenum	NA [(3)]		
Nickel [(4)]	0.10		
Selenium	0.05		
Silver	0.1		
Thallium	0.002		
Uranium – total	0.03		
Zinc	5.0		
Combined Radiologic Parameters (pC/l)			
Radium-226+radium-228	5		
Radiologic Parameters (pC/l)			
Thorium-230	83		
Thorium-232	92		

1. All field, inorganic, dissolved metals, and organic indicator organic parameters and corresponding GWPLs for the 11e.(2) wells are equivalent to those for the LARW wells in Table 1A, above.
2. All ground water protection levels (GWPL) derived from Ground Water Quality Standards (GWQS, see UAC R317-6-2), except as noted.
3. Due to naturally elevated concentrations of arsenic and molybdenum in the Class IV saline aquifer at Clive, Utah, these constituents are poor indicators of cell leakage and therefore will not be used as compliance parameters with ground water protection levels. However, the Permittee will continue to sample, analyze, and report arsenic and molybdenum data in all compliance monitoring wells at Permit and License renewal as a best management practice.
4. Beryllium and Nickel GWQS derived from EPA drinking water Maximum Contaminant Levels (MCL), as published in the July 17, 1992 Federal Register, Vol. 57, No. 138, pp. 31776 – 31849, Table 1.
5. GWQS for acetone, and carbon disulfide determined by DWQ staff from reference doses available in the technical literature, see August 8, 1994 DWQ Staff Report: Ground Water Quality Conditions and Proposed Revision to Ground Water Protection Levels, Envirocare of Utah Inc., Low-Level Radioactive Waste and 11e.(2) Waste Disposal Facility, near Clive, Tooele County, Utah, p. 3.
6. GWQS for chloroform derived from a 1998 EPA final drinking water MCL for total trihalomethane compounds in “Drinking Water Standards and Health Advisories”, EPA 822-B-00-001, Summer 2000.
7. GWQS for methylene chloride derived from EPA drinking water MCL (ibid.).

8. Naphthalene GWQS derived from final EPA drinking water LHA (ibid.).
9. GWQS for diethyl phthalate based on draft EPA drinking water LHA (ibid.).
10. GWQS for 2-methylnaphthalene could not be located or determined, thanks to a lack of reference dosage information in the technical literature. Consequently, a detection monitoring approach has been taken and the GWPL set equal to the minimum achievable detection limit for the compound as a result of matrix interferences from high TDS content of Clive ground water. As health-based risk or other reference dosage information becomes available, the Executive Secretary may modify the Permit and set a GWQS for 2-methlynaphthalene.
11. GWQS for 2-Butanone (methyl ethyl ketone) derived from Life-time health advisory value in "2006 Edition of the Drinking Water Standards and Health Advisories", EPA 822-R-06-013, August 2006

Table 1D: Ground Water Protection Level Exceptions (1) – 11e.(2) Wells

Well ID	Parameter	GWPL (2)	Well ID	Parameter	GWPL (2)
Inorganic/Metal Parameters (mg/l)					
GW-19A	Cadmium	0.0074	GW-27	Uranium – total	0.039
	Selenium	0.077	GW-36	Uranium – total	0.058
GW-25	Uranium – total	0.146	GW-58	Uranium – total	0.046
GW-26	Uranium – total	0.037			

1. Table 1D exceptions constitute specific wells and parameters determined to have natural background ground water quality concentrations above GWQS, or as otherwise specified below. Background concentration is defined as the mean concentration plus the second standard deviation for any contaminant in any individual well.
2. The number of significant figures used for all GWPLs determined by data evaluation and review of analytical method sensitivity.

Table 1E: Ground Water Protection Levels Universal to All Mixed Waste Wells

Parameter	GWPL	Parameter	GWPL
Dissolved Metals (mg/l)			
Uranium – total (1)	0.03		
Radiologic Parameters (pCi/l)			
Alpha Emitters (2)		*Beta/Gamma Emitters (4)*	
		Carbon-14	3,200
Neptunium-237 (3)	7	Iodine-129 (5)	21
Strontium-90	42	Technetium-99	3,790
Thorium-230	83	Tritium	60,900
Thorium-232	92		
Uranium-233	26		
Uranium-234	26	*Combined Radiologic Parameters (pCi/l)*	
Uranium-235	27	Radium-226 + Radium-228 (6)	5
Uranium-236	27		
Uranium-238	26		

1. Total uranium GWQS of 0.03 mg/l from EPA final MCL in National Primary Drinking Water Regulations Final Rule for Radionuclides (December 7, 2000 Federal Register, Vol. 65, No. 236, p. 76708).
2. All GWPL values for alpha-emitting radionuclides based on 1E-4 lifetime cancer mortality risk concentration levels provided in 1991 EPA draft MCL values for drinking water (July 18, 1991 Federal Register, Vol. 56, No. 138, pp. 33078-9, 33100-3, and Appendix C).
3. Neptunium-237, as determined by Total Radioactive Neptunium, EPA Method 907.0.
4. All GWPL values for beta/gamma emitting radionuclide parameters based on a 4 millirem/year equivalent dosage, as per 1991 EPA draft MCL values for drinking water (July 18, 1991 Federal Register, Vol. 56, No. 138, pp. 33078, 33103, and Appendix B).
5. Iodine-129, as determined by Total Radioactive Iodine, EPA Method 902.0.
6. GWQS of 5 pCi/l for combined radium-226 + radium-228 from final EPA MCL in National Primary Drinking Water Regulations Final Rule for Radionuclides (December 7, 2000 Federal Register, Vol. 65, No.236,p.76708).

Table 1F: Ground Water Protection Level Exceptions (1) – Mixed Waste Wells

Well ID	Parameter	GWPL (2)	Well ID	Parameter	GWPL (2)

1. Table 1F exceptions constitute specific wells and parameters determined to have natural background ground water quality concentrations above GWQS, or as otherwise specified below. Background concentration is defined as the mean concentration plus the second standard deviation for any contaminant in any individual well.
2. The number of significant figures used for all GWPLs determined by laboratory results previously reported by the Permittee.

D. Best Available Technology (BAT) Design Standard

1. <u>Discharge Technology Performance Criteria</u>

Best available technology for the facility will incorporate discharge technology based on the use of earthen materials in both the bottom liner and final cover. However, under no circumstances shall the facility cause ground water at the compliance monitoring wells (Part I.F.1) to exceed the ground water protection levels in Part I.C for the following minimum periods of time:

Disposal Cell	Contaminant Group	Performance Standard*
LARW, Class A, and Class A North	Heavy metals Inorganics Organics Mobile and non-mobile Radionuclides	200 years 200 years 200 years 500 years
11e.(2)	Heavy metals Inorganics Organics	200 years 200 years 200 years
Mixed Waste	Mobile and non-mobile	500 years

* Said performance standards shall be measured from the following initial startup dates: 1988 [LARW Cell], 1992 [Mixed Waste Cell], 1994 [11e.(2) Cells], 2000 [Class A Cell], and 2005 [Class A North Cell]

If after review of any environmental monitoring data collected at the facility, the Executive Secretary determines that the ground water protection levels in Part I.C of the Permit may be exceeded at the compliance monitoring wells before completion of the above-minimum time periods, said potential shall constitute a violation of the Best Available Technology requirements of this Permit.

2. Authorized LARW Cell Engineering Design and Specifications

The best available technology design standard shall be defined by, and construction of the LARW facilities shall conform to the engineering plans summarized in Table 2A, below, and the specifications listed in the approved LLRW and 11e.(2) Construction Quality Assurance/Quality Control (CQA/QC) Plan (Radioactive Materials License No. 2300249 (the License), Condition 44):

For the LARW cell, this engineering design includes, but is not limited to, the following elements:

a) Cover System – shall include the following materials or as specified by the approved LLRW and 11e.(2) CQA/QC Plan (Radioactive Materials License, Condition 44), from the top down:

1) An 18-inch thick erosion barrier consisting of a 1.25-inch, or greater, average diameter rock material over the top-slope area, and a 4.5-inch, or greater average diameter rock material over the side-slope area, as specified on the approved engineering drawing number 9407-4,

2) A 6-inch thick upper filter zone consisting of sandy gravel material,

3) A 12-inch compacted thickness of sacrificial soil with a minimum Residual Moisture Content of 3.5% (by weight). Such Residual Moisture Content shall be the asymptotic value measured by ASTM Methods D-3152 and D-2325 at soil tensions above 15 bars. If the fines content (#200 sieve) of the sacrificial soil is greater than or equal to 15%, residual moisture content testing is not required,

4) A 6-inch lower filter zone consisting of sandy gravel material with a minimum permeability of 3.5 cm/sec,

5) A 2-foot thick clay radon barrier measured perpendicular to the slope. Said radon barrier will be divided into two layers:

i. An upper layer, 1 foot thick, with a field hydraulic conductivity of 5.0E-8 cm/sec or less, and

ii. A lower layer, 1 foot thick with a field hydraulic conductivity of 1.0E-6 cm/sec or less.

Top slope of the embankment shall be between 2% and 4%, as specified on the approved engineering drawings, and side slopes shall be no steeper than approximately 5:1. The outside toe of the clay radon barrier/liner shall extend outward and beyond the outermost edge of the waste layer and shall merge with the bottom clay liner.

b) Waste Layer – the waste layer shall not exceed a final thickness of 43 feet above the top of the bottom clay liner.

c) Clay Bottom Liner – the bottom clay liner shall be constructed below natural grade on slopes no greater than 0.12% north to south and 0.2% east to west. Final grade and elevation for the base of the clay liner will comply with the approved engineering design (Table 2A). This liner will be constructed after excavation of the site to the total design depth, followed by placement of imported clay materials, which meet the approved specifications for material and construction. The new clay liner shall be graded to prevent the accumulation of leachate over the existing 1-foot thick clay liner. The clay liner shall be a minimum of 2 feet thick, measured perpendicular to the slope, constructed in accordance with the approved LLRW and 11e.(2) CQA/QC Plan (Radioactive Materials License, Condition 44), and have a field hydraulic conductivity of 1.0E-6 cm/sec or less.

Table 2A: Approved LARW Cell Engineering Design Drawings

Drawing	Last Revision Date	Subject
9407-2, Rev. E	July 28, 1998	LARW Disposal Cell – Cell Location and Excavation Limits
9407-4, Rev. V	February 1, 2005	LARW Disposal Cell – LARW Cell Closure
9407-4A, Rev. L	May 16, 2003	LARW Disposal Cell – LARW Cell Closure
9407-4B, Rev. J	May 16, 2003	LARW Disposal Cell – LARW Cell Closure
9407-5, Rev. I	February 4, 1999	LARW Disposal Cell – Site Layout
9407-6, Rev. E	July 28, 1998	LARW Disposal Cell – Site Layout
9407-7, Rev. A	June 27, 1994	Drainage Plan – Plan View
9407-7A, Rev. A	June 27, 1994	Drainage Plan – Details
9407-8, Rev. C	October 16, 1998	LARW Disposal Cell Wedge Expansion Cross Section
03046-VO1, Rev. 0	May 16, 2003	LARW Disposal Cell – Radon Barrier Design Sections and Details
03046A-VO1 Rev. -	August 1, 2003	LARW Disposal Cell Closure – Plan and Details
03046A-VO2 Rev. 1	August 1, 2005	LARW Disposal Cell Closure – Sections and Details
03046A-VO3 Rev. -	August 1, 2003	LARW Disposal Cell – Radon Barrier Redesign Sections and Details

Table 2A: Approved LARW Cell Engineering Design Drawings

Drawing	Last Revision Date	Subject
03046A-VO4 Rev. -	August 1, 2003	LARW Disposal Cell – Radon Barrier Redesign Sections and Details
03046A-VO5 Rev. -	August 1, 2003	LARW Disposal Cell – Radon Barrier Redesign Section and Details
L9	July 21, 1993	Fence Details

3. 11e.(2) Disposal Cell Design

The best available technology design standard shall be defined by, and construction of the 11e.(2) cell shall conform to the approved engineering design summarized in Table 2B, below, and the specifications listed in the currently approved LLRW and 11e.(2) CQA/QC Plan

Table 2B: Approved 11e.(2) Cell Engineering Design Drawings

Drawing	Last Revision Date	Subject
9420-4, Rev. F	March 4, 2002	11e.(2) Disposal Cell, Layout
9420-5, Rev. D	February 21, 2002	11e.(2) Disposal Cell, Cross Sections
9420-6, Rev. D	December 21, 2002	11e.(2) Disposal Cell, Ditch Cross Sections

Said 11e.(2) cell engineering design shall include, but is not limited to, the following elements:

a) Cover System – shall include the following materials, as described from the top down:

1) Top-slope Area – the top-slope shall consist of the following materials, from the top down:

i) Riprap Erosion Barrier – a 12-inch thick layer of rock armor material with a particle size ranging from 0.75 to 4.50 inches in diameter with an average diameter between 1.125 and 3.0 inches.

ii) Filter Zone – a single 12-inch thick layer of granular material with a particle size ranging from 0.3125 to 3.0 inches in diameter (coarse sand to fine cobble) and a minimum hydraulic conductivity of 42 cm/sec.

iii) Upper Radon Barrier – a layer of clay material at least 12 inches thick with a field hydraulic conductivity of 5.0E-8 cm/sec or less.

iv) Lower Radon Barrier – a layer of clay material at least 3 feet thick with a field hydraulic conductivity of 1.0E-6 cm/sec or less.

The minimum slope for top-slope areas shall be 2.1%.

2) Side-slope Area – the side-slope area shall consist of the following materials, from the top down:

A. Riprap Erosion Barrier – an 18-inch thick layer of rock armor material with a particle size ranging from 2.0 to 16.0 inches in diameter with an average diameter between 4.5 and 8.0 inches.

B. Filter Zone – a single 12-inch thick layer of granular material with a particle size ranging from 0.3125 to 3.0 inches in diameter (coarse sand to fine cobble) and a minimum hydraulic conductivity of 42 cm/sec.

C. Upper Radon Barrier – a layer of clay material at least 12 inches thick with a field hydraulic conductivity of 5.0E-8 cm/sec or less.

D. Lower Radon Barrier – a layer of clay material at least 2.5 feet thick with a field hydraulic conductivity of 1.0E-6 cm/sec or less.

The slope for side-slope areas shall be approximately 20%.

b) 11e.(2) Waste Layer – the 11e.(2) waste shall not exceed a final thickness of 47 feet above the bottom clay liner.

c) Bottom Clay Liner – the clay liner will be constructed only after excavation of the site to the total design depth, followed by placement of imported clay materials which meet the approved specifications for material and construction. The clay liner shall be a minimum of 2 feet thick, measured perpendicular to the slope, and have a field hydraulic conductivity of 1.0E-6 cm/sec or less.

4. Final Authorized Class A and Class A North Cell Engineering Design and Specifications

The best available technology design standard shall be defined by, and construction of the Class A and Class A North facilities shall conform to the engineering plans summarized in Table 2C, below, and the specifications listed in the approved LLRW and 11e.(2) Construction Quality Assurance/Quality Control (CQA/QC) Plan (Radioactive Materials License, Condition 44):

For the Class A and Class A North cells, this engineering design includes, but is not limited to, the following elements:

a) Cover System – top-slope and side-slope areas shall include the following materials or as specified by the approved LLRW and 11e.(2) CQA/QC Plan (Radioactive Materials License, Condition 44), from the top down:

1) An 18-inch thick erosion barrier consisting of a 1.25-inch, or greater, average diameter rock material over the top-slope area, and a 4.5-inch, or greater average diameter rock material over the side-slope area, as specified on the approved engineering drawing number 9821-01,

2) A 6-inch thick upper (Type A) filter zone consisting of sandy gravel material,

3) A 12-inch compacted thickness of sacrificial soil with a minimum Residual Moisture Content of 3.5 % (by weight). Such Residual

Moisture Content shall be the asymptotic value measured by ASTM Methods D-3152 and D-2325 at soil tensions above 15 bars, If the fines content (#200 sieve) of the sacrificial soil is greater than or equal to 15%, residual moisture content testing is not required,

4) A 6-inch lower (Type B) filter zone consisting of sandy gravel material with a minimum permeability of 3.5 cm/sec,

5) A 2-foot thick clay radon barrier measured perpendicular to the slope. Said radon barrier will be divided into two layers:

i. an upper layer, 1 foot thick, with a field hydraulic conductivity of 5.0E-8 cm/sec or less, and

ii. a lower layer, 1 foot thick with a field hydraulic conductivity of 1.0E-6 cm/sec or less.

Top slope of the embankment shall be between 2% and 4%, as specified on the approved engineering drawings, and side slopes shall be no steeper than approximately 5:1. The outside toe of the clay radon barrier/liner shall extend outward and beyond the outermost edge of the waste layer and shall merge with the bottom clay liner.

b) Waste Layer – the waste layer shall not exceed a final thickness of 54 feet above the top of the bottom clay liner.

c) Clay Bottom Liner – the bottom clay liner shall be constructed below natural grade. Final grade and elevation for the base of the clay liner will comply with the approved engineering design (Table 2C). This liner will be constructed after excavation of the site to the total design depth, followed by placement of imported clay materials, which meet the approved specifications for material and construction. The clay liner shall be a minimum of 2 feet thick, measured perpendicular to the slope, constructed in accordance with the approved LLRW and 11e.(2) CQA/QC Plan (Radioactive Materials License, Condition 44), and have a field hydraulic conductivity of 1.0E-6 cm/sec or less.

Table 2C: Approved Class A and Class A North Cell Engineering Design Drawings

Drawing	Last Revision	Subject
Class A Disposal Embankment		
9821-01, Rev. .J	2/9/09	Class A Disposal Cell – Layout Plan and Cover Details
9821-02, Rev. D	2/9/09	Class A Disposal Cell – Cross Sections
9821-03, Rev. D	7/8/09	Class A Disposal Cell – Ditch Details
9821-04, Rev. A	7/25/00	Class A Disposal Cell – Updated Drainage System
Class A North Disposal Embankment		
04080-C01 Rev. 3	2/9/09	Class A North Disposal Cell – Layout Plan and Cover Details
04080-C02 Rev.4	7/8/09	Class A North Disposal Cell – Cross Sections
04080-C03 Rev. 3	7/8/09	Class A North Disposal Cell – Ditch Details
04080-C04, Rev 3	10/26/09	Class A North Embankment Proposed CWF & LC Area, Area & Haul Road Layout
08080-C06, Rev. 4	10/26/09	Class A North Embankment Proposed CWF Area, CWF Area

Table 2C: Approved Class A and Class A North Cell Engineering Design Drawings

		Plan and Details
08080-C06A	10/29/09	Class A North Embankment Proposed CWF area, CWF Area Plan and Details

5. Disposal Cell Location Restrictions

The LARW, 11e.(2), Class A, and Class A North disposal cells shall be restricted to the following locations in Section 32, Township 1 South, Range 11 West, SLBM, as specified on the currently approved engineering plans, drawings, and the approximate Latitude and Longitude Coordinates provided in Table 3 below:

Table 3: Authorized LARW, 11e.(2), Class A, and Class A North Disposal Cell Locations

Disposal Cell	Edge of Waste Position	Coordinates	
		Latitude	Longitude
LARW	NW Corner	40° 41' 11.382" N	113° 06' 51.318" W
	SW Corner	40° 40' 52. 908" N	113° 06' 51. 203" W
	SE Corner	40° 40' 52. 960" N	113° 06' 36. 734" W
	NE Corner	40° 41' 11.434" N	113° 06' 36. 848" W
11e.(2)	NW Corner	40° 41' 12. 590" N	113° 07' 24. 545" W
	SW Corner	40° 40' 55. 055" N	113° 07' 24. 761" W
	SE Corner	40° 40' 54. 845" N	113° 06' 55. 564" W
	NE Corner	40° 41'12.380" N	113° 06' 55.346" W
Class A	NW Corner	40° 41' 28. 061" N	113° 07' 24.735" W
	SW Corner	40° 41' 14. 230" N	113° 07' 24. 702" W
	SE Corner	40° 41' 14.191" N	113° 06' 55.369" W
	NE Corner	40° 41' 28.022" N	113° 06' 55.403" W
Class A North	NW Corner	40° 41' 38. 509" N	113° 07' 24. 752" W
	SW Corner	40° 41' 30. 527" N	113° 07' 24. 740" W
	SE Corner	40° 41' 30.550" N	113° 06' 57.211" W
	NE Corner	40° 41' 38. 532" N	113° 06' 57.222" W

This description does not include the Mixed Waste facility, located east of the LARW Cell, which is authorized under a separate State-issued Part B Permit from the Utah Division of Solid and Hazardous Waste.

6. Definition of LARW Waste

For purposes of this Permit, Low-Activity Radioactive Waste (LARW) is defined as radioactive wastes, which meet the definition of Class A Low-Level Radioactive Waste (LLRW) under the Utah Radiation Control Rules, UAC R313-15-1008, or are defined as Naturally Occurring and Accelerator Produced Radioactive Materials under the Utah Radiation Control Rules, UAC R313-12-3.

7. Definition of Mobile Waste

Any waste containing any of the following isotopes shall be considered a mobile waste and subject to special provisions or requirements under this Permit: aluminum-26, berkelium-247, calcium-41, californium-249, californium-250, carbon-14, chlorine-36, iodine-129, neptunium-237, rhenium-187, sodium-22, technetium-99, terbium-157, terbium-158, or tritium.

8. Definition of PCB/Radioactive Waste

For purposes of this Permit, PCB/Radioactive Waste to be accepted for disposal shall meet the criteria specified in R315-315-7(2)(a) or (3)(b)(i-vi) of the rules designated for disposal in a municipal or non-municipal non-hazardous landfill.

9. Definition of 11e.(2) Waste

For purposes of this Permit, 11e.(2) Waste is defined as "... tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content", as defined in Section 11e.(2) of the U.S. Atomic Energy Act of 1954, as amended.

10. Collection Lysimeters for Future Construction at the Class A and Class A North Cells

Future construction of the clay bottom liner of Class A and Class A North Cells shall include the installation of collection lysimeters below the bottom clay liner, in accordance with the CQA Plan for Collection Lysimeter Construction currently approved by the Executive Secretary and included herein as Appendix C. The Permittee shall also comply with the currently approved Operation, Maintenance and Closure Plan for Collection Lysimeters, also included herein as Appendix C. In addition, the Permittee shall comply with the following requirements:

a) Collection Lysimeter "As-Built" Report – within 30 days of completion of the construction of each lysimeter, the Permittee shall submit an "As-Built" Report for Executive Secretary approval.

b) Future Collection Lysimeter Construction Notification – the Permittee shall submit a notice of construction of additional lysimeters in the Class A and Class A North Cells. Said notice shall be submitted at least one week prior to construction in order to allow the Executive Secretary to inspect lysimeter construction.

c) Future Collection Lysimeter Construction – in addition to any design or construction requirements found in the currently approved Appendix C, the Permittee shall construct all future collection lysimeters in a manner that will allow the lysimeter to be operated in compliance with all performance standards mandated by Part I.E.11 or monitoring requirements dictated by Part I.F.6 of this Permit. Any changes to the approved design or construction specifications in Appendix C shall require prior Executive Secretary approval.

11. Future Modification of Disposal Cell Engineering Design or Specifications

Any change in the approved engineering design or specifications which causes a significant adverse effect to the infiltration performance of a disposal cell shall require prior submittal and Executive Secretary approval of infiltration and contaminant transport analysis of the proposed change. Said changes must be submitted to the Executive Secretary as a written request with the revised engineering drawings, specifications, ground water flow and contaminant transport models, or any other documentation deemed necessary by the Executive Secretary, at least 180 days prior to the effective date desired by the Permittee.

12. Final Authorized Engineering Design and Specifications for Waste and Wastewater Related Facilities

Best available technology design standards for related facilities at the disposal site shall be defined by, and construction conform to the engineering plans and specifications summarized in Table 5, below:

Table 5: Approved Engineering Design Drawings for Waste/Wastewater Related Facilities

Related Facility	Drawing No.	Last Revision	Subject / Title
Track 4 Railcar Decontamination Pad	T-100, Rev. 3	Aug. 14, 1999	Foundation
	T-101, Rev. 3	Aug. 16, 1999	Foundation Details
	9906-02, Rev. H	Feb 26, 2007	Wash Water System As-Built
	9906-02A, Rev. H	Feb. 26, 2007	Wash Water System As-Built
Class A North Containerized Waste Facility and Large Component Area Evaporation Basin	04080-C05, Rev. 5	September 8, 2011	Plan and Section
	04080-C06, Rev. 4	October 26, 2009	Class A North Embankment Proposed CWF Area, CWF Area Plan & Details
	08080-C06A, Rev. 1	October 26, 2009	Class A North Embankment Proposed CWF Area, CWF Area Plan & Details
1995 Evaporation Pond	9718-1, Rev. C	March 13, 2007	Facility Layout
	9504-3, Rev. E	Oct. 28, 1999	Storage Pond
	9504-3A, Rev. A	Oct. 28, 1999	Leak Detection System Details, As-Built
	9504-4, Rev. E	Oct. 28, 1999	Facility Details
	9718-4, Rev. A	Aug. 17, 1998	Piping Diagrams and Pump Station
	08007-C01, Rev. 1	June 26, 2008	1995 Evaporation Pond HDPE Repairs, New 60 mil HDPE Liner
1997 Evaporation Pond	9718-1, Rev. C	March 13, 2007	Facility Layout
	9718-2, Rev. D	Feb. 25, 1999	Evaporation and Storage Pond
	9718-2a, Rev. B	Feb. 25, 1999	Leak Detection System Details, As-Built
	9718-3, Rev. -	Sept. 17, 1997	Details
	9718-4, Rev. A	Aug. 17, 1998	Piping Diagrams and Pump Station
2000 Evaporation Pond	0009-00, Rev. A	July 10, 2000	Site Plan and Facility Layout
	0009-01, Rev.E	Feb. 22, 2008	Plan View
	0009-02, Rev. A	Jan. 29, 2001	Cross Sections
	0009-03, Rev. B	Jan. 29, 2001	Details
	0009-04, Rev. A	Jan. 29, 2001	Sump/Side Slope Cross-Section
	0009-05, Rev. A	Jan. 29, 2001	Leak Detection Details
	0009-06, Rev. A	Feb. 22, 2008	Water Transfer Piping Details
Mixed Waste Evaporation Pond	9802-1, Rev. D	Dec. 22, 1999	Facility Layout
	9802-2, Rev. F	Dec. 22, 1999	Water Storage Facility
	9802-3, Rev. D	Dec. 22, 1999	Facility Details As-Built
	9802-4, Rev. B	Dec. 4, 1998	Water Storage Facility
	9802-5, Rev. A	Dec. 22, 1999	Leak Detection System Details, As-Built

Table 5: Approved Engineering Design Drawings for Waste/Wastewater Related Facilities

Related Facility	Drawing No.	Last Revision	Subject / Title
	9803-2, Rev. -	Feb. 11, 1998	Storage Pad Drain Line As-Built
Box Washing Facility	9621-1, Rev. C	July 20, 1998	Site Plan As-Built Drawing
	9621-2, Rev. B	July 20, 1998	Foundation Plan As-Built Drawing
	9621-3, Rev. B	July 20, 1998	Elevation Views As-Built Drawing
	9621-4, Rev. B	July 20, 1998	Elevation Views As-Built Drawing
	9621-5, Rev. B	July 20, 1998	Wall Detail As-Built Drawing
Intermodal Unloading Facility	9705-1, Rev. A	July 31, 1998	Plan View
	9705-2, Rev. A	July 31, 1998	Cross Section Drawings
	9813-01, Rev. B	March 13, 2007	Layout
	9813-02, Rev. A	July 31, 1998	Layout (and Details)
	0701-G03, Rev. 1	June 8, 2007	Site Layout and Facility Legend
Railcar Rollover Facility	0221-01	March 26, 2002	Site Layout and Drain Line
	0221-02	March 26, 2002	Fabric Cover Frame Layout
	0221-03	March 26, 2002	Rollover Cover South Elevation
	0221-04, Rev. A	April 24, 2002	Cover Run-off Collection and Drainage
	07013-C0, Rev 0	March 31, 2008	Drainage repair plan
Rail Digging Facility	0107-01, Rev. B	April 25, 2002	Site Layout
	0107-02, Rev. B	April 19, 2002	Digging Track Plan
	0107-03, Rev. B	April 12, 2002	Track and Pad Details
	0107-04A, Rev. A	April 25, 2002	Excavator Ramp
Container Storage Pad	9514-1, Rev. C	March 13, 2007	Plan, Sections and Details
East Truck Unloading Facility	05023-C104, Rev. 9	April 26, 2007	New Site Layout
	05023-C301, Rev. 4	Sept. 22, 2005	Cross Sections
	05023-C401, Rev. 5	Dec. 12, 2005	Truck Unloading Area Plan View
	05023-C402, Rev. 5	De. 12, 2005	Truck Unloading Dock Plan View
	05023-C403, Rev. 7	April 26, 2007	Enlarged Dock Plan View
	05023-C501, Rev. 5	Dec. 12, 2005	Truck Unloading Area Details
	05023-C502, Rev. 4	Dec. 12, 2005	Truck Dock Details
	05023-C503, Rev. 4	Dec. 12, 2005	Truck Dock Details
	05023-S1, Rev. 1	Sept. 22, 2005	Concrete Container Holding Pad Safety Protection
Shredder Facility	05056-F13, Rev._	09/30/06	Shredder Facility; Outfeed Pad Plan and Pad Details (As-Constructed)
	05056-F13A, Rev._	09/30/06	Shredder Facility; Shredder Pad Plan (As-Constructed)
	05056-F13B, Rev._	09/30/06	Shredder Facility; Shredder Pad Details (As-Constructed)
	05056-L1, Rev. 6	09/06	Shredder Facility; Site Layout Plan (As-Built)
	05056-L2, Rev. 2	08/06	Shredder Facility; Containment Pad Water Management Layout Plan
	05056-C1, Rev. 10	09/06	Shredding Facility; Operating Pad Layout (As-Built)
	05056-C6, Rev. 4	09/06	Shredding Facility; Operating Pad – Sections and Details (As-Built)
	05056-C7, Rev 7	9/17/07	Shredding Facility; Catch Basin and Manhole Layouts (As-Built)
	05056-C8, Rev. 2	9/17/07	Shredding Facility; Drainage System Details
	05056-F1 thru -F14	Various	Details
Rotary Dump	05006-C1, Rev. 3	Oct 6, 2006	Heater Building; Plan sheet

Table 5: Approved Engineering Design Drawings for Waste/Wastewater Related Facilities

Related Facility	Drawing No.	Last Revision	Subject / Title
Facility	05006-C2, Rev. 5	Oct 6, 2006	Rotary Dump Building; Plan Sheet
	05006-C3, Rev. 3	November 10, 2011	Wash Building; Plan Sheet
	05006-C5, Rev. 3	Oct 6, 2006	Rotary Dump Building; Section A-A
	05006-C6, Rev. 2	Oct 6, 2006	Rotary Dump Building; Section B-B
	05006-C12, Rev. 1	Oct 6, 2006	Heater Building; Drainage Details and Sections
	05006-C7, Rev. 1	Oct 6, 2006	Rotary Dump Building; Section C-C
	05006-C8, Rev. 1	Oct 6, 2006	Rail Car Wash Building; Section D-D
	05006-C9, Rev. 1	Oct 6, 2006	Wash Building, Drainage Plan Sheet
	05006-F1, Rev. 2	Oct 6, 2006	Rotary Dump Facility; Heater, Rotary and Wash Buildings foundation Plan and Details
	05006-F2, Rev. 3	Oct 6, 2006	Rotary Dump Facility; Heater Building Foundation Plan and Details
	05006-F10, Rev. 4	Oct 6, 2006	Rotary Dump Facility; Rotary Dumper Building Foundation Plan and Details
	05006-F13, Rev. 1	Oct 6, 2006	Rotary Dump Facility; Rotary Dumper Building Foundation Plan and Details
	05006-F25, Rev. 3	Oct 6, 2006	Rotary Dump Facility; Rotary Dumper Building Foundation Plan and Details
	05006-F26, Rev. 3	Oct 6, 2006	Rotary Dump Facility; Rotary Dumper Building Foundation Plan and Details
	05006-F27, Rev. 3	Oct 6, 2006	Rotary Dump Facility; Rotary Dumper Building Foundation Plan and Details
	05006-P103, Rev. 1	Sept. 20, 2007	Rotary to NW Corner Pond
	05006-V1, Rev. 2	Dec 1, 2006	Rotary Dump Facility; Water Supply and Waste Water Flow Diagram
	05006-SL100. Rev. 6	Oct 6, 2006	Rotary Dump Building; Sediment Basin Liner Plan
	05006-SL101. Rev. 6	Oct 6, 2006	Rotary Dump Building; Sediment Basin Liner Sections
	05006-SL102. Rev. 6	Oct 6, 2006	Rotary Dump Building; Sediment Basin Liner Section
	05006-F5, Rev.	November 10, 2011	Wash Building Foundation Plan and Details
	05006-F9C, Rev. 3	6/11/08	Wash Building Foundation Details
Intermodal Container Wash Building	05008-G1, Rev. 4	May 19, 2006	Intermodal Container Wash Building; Map Layout and Index
	05008-C100, Rev. 2	May 19, 2006	Intermodal Container Wash Building; Facility Location Map
	05008-C101, Rev. 4	September 26, 2006	Intermodal Container Wash Building; Plan Sheet
	05008-C102, Rev. 2	May 19, 2006	Intermodal Container Wash Building; Section A-A
	05008-C103, Rev. 3	May 19, 2006	Intermodal Container Wash Building; Section B-B
	05008-SL100, Rev. 5	August 23, 2006	Intermodal Container Wash Building; Sediment Basin Liner Plan
	05008-SL101, Rev. 5	August 23, 2006	Intermodal Container Wash Building; Sediment Basin Liner Section A-A
	05008-SL102, Rev. 5	August 23, 2006	Intermodal Container Wash Building;

Table 5: Approved Engineering Design Drawings for Waste/Wastewater Related Facilities

Related Facility	Drawing No.	Last Revision	Subject / Title
			Sediment Basin Liner Section B-B
Decontamination Access Control Building	05015-G001, Rev. 1	February 23, 2006	Access Control Building; Map Layout and Index
	05015-C100, Rev. 1	February 23, 2006	Access Control Building; Facilities Location Map
	05015-C101, Rev. 2	February 23, 2006	Access Control Building; Floor Plan
	05015-C102, Rev. 2	February 23, 2006	Access Control Building; Elevations
	05015-C103, Rev. 3	February 23, 2006	Access Control Building, Typical Sections
	05015-C104, Rev. 0	February 23, 2006	Access Control Building, Site Layout and Gray Water Tank and Pipe
	05015-S100, Rev. 2	June 30, 2006	Access Control Building, 1000 Gallon Gray Water Tank
	05015-P100, Rev. 1	February 23, 2006	Access Control Building, Plumbing Plan
	05015-P101, Rev. 1	February 23, 2006	Access Control Building, Plumbing Details
East Side Drainage and Gray Water System Modifications	06007-G1, Rev. 5	2/26/07	East Side Drainage, Map Layout and Index
	06007-G2, Rev. 4	2/26/07	East Side Drainage, Notes and Specifications
	06007-C1, Rev. 5	2/26/07	East Side Drainage, General Site Plan
	06007-C2, Rev. 5	2/26/07	East Side Drainage, Storm Water Drainage Plan
	06007-C3, Rev. 7	2/1/2010	East Side Drainage, Intermodal Container Wash Facility Gray Water System Plan
	06007-C4, Rev. 6	3/12/08	East Side Drainage, Decon Access Control Gray Water System
	06007-D1, Rev. 7	6/10/09	East Side Drainage, Section and Details
	06007-P1, Rev. 4	2/26/07	East Side Drainage, Pipelines #4 and #5 Alignments and Profiles
	06007-SL1, Rev. 3	3/14/07	East Side Drainage, Storm Water Lift Sump Plan
	06007-SL2, Rev. 3	3/14/07	East Side Drainage, Storm Water Lift Sump Section
	06007-SL3, Rev. 3	3/14/07	East Side Drainage, Storm Water Lift Sump Section
	06007-V1, Rev. 3	2/26/07	East Side Drainage, Storm Water and Waste Flow Diagram

Table 5: Approved Engineering Design Drawings for Waste/Wastewater Related Facilities

Related Facility	Drawing No.	Last Revision	Subject / Title
	06007-P2, Rev. 4	2/22/08	Pipeline 4A and 5A Extension into the 1997 Pond
Northwest Corner Evaporation Pond			
	06021-C1, Rev 5	October 19, 2011	Northwest Corner Pond; General Site Plan and Profile
	06021-C2, Rev. 8	October 19, 2011	Northwest Corner Pond; Pond Plan View
	06021-C3, Rev.5	08/29/07	Northwest Corner Pond; Sections and Details
	06021-C4, Rev. 3	08/29/07	Northwest Corner Pond; Sections and Details
	06021-C5, Rev. 3	08/29/07	Northwest Corner Pond; Sump Plan, Sections, and Details
	06021-C6, Rev. 3	08/29/07	Northwest Corner Pond; Leak Detection System Sections and Details
	06021-C7, Rev. 3	09-17-07	Northwest Corner Pond Leak Detection System Sections and Details
	06021-C10, Rev. 2	October 19, 2011	Northwest Corner Pond; Water Transfer Facility; Plan & Details
	06021-C11, Rev. 1	October 19, 2011	Northwest Corner Pond; Water Transfer Facility; Plan & Details
11e.(2) Disposal Cell Temporary Diversion Ditch	9420-7D	10/15/09	Lift Section Details
DU Storage Building	088800, sheet 1of 10	8/19/10	Anchor Bolt Plan & Details
	088800, sheet 2 of 10	8/19/10	Anchor Bolt Reactions
	088800, sheet 3 of 10	8/19/10	Rigid Frame Elevation
	088800, sheet 4 of 10	8/23/10	Roof Framing
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	088800, sheet 9 of 10	8/19/10	Detail drawings
	088800, sheet 10 of 10	8/19/10	Detail drawings
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	10008 L02	8/12/10	Building Plan & Elevations
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	J10197 E2	8/24/10	Electrical installation Details, Wiring Diagrams and One-Line
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	J10197 M3	8/24/10	Specifications
	10008 C01	9/2/10	Site Ground Plan
	10335 S1	9/2/10	Foundation Plan and Footing Schedule
	10335 S2	9/2/10	Details
	10335 S3	9/2/10	Notes

13. Authorized Mixed Waste Cell Engineering Design and Specifications

The best available technology standards for the Mixed Waste Cell shall be defined by those requirements mandated by the Utah Division of Solid and Hazardous Waste State-issued Part B Permit, issued April 4, 2003 (as amended), hereafter State-issued Part B Permit. All Mixed Waste Cell engineering design and specifications shall comply with State-issued Permit, Module V.

14. DU Storage Building

The best available technology standards for the depleted uranium (DU) Storage Building shall be defined as the complete physical control and containment of DU within the building. For the purposes of this Permit, waste materials stored in the DU Storage Building will be exclusively limited to Savannah River Site DU material (waste stream 9021-33). The DU waste, in the DU Storage Building, is not subject to the 365-day storage requirement applicable to all other containerized waste in Part I.E.10.a.6 of this Permit.

E. BAT Performance and Best Management Practice Standards

1. Waste Restrictions

a) Reserved.

b) 11e.(2) Waste – any change effecting the non-radiologic content of the waste to be disposed of in the 11e.(2) Cell, including additional types or concentrations of non-radiologic contaminants, above and beyond those defined in Table 6 below, shall require prior approval from the Executive Secretary, after submittal of satisfactory technical justification to demonstrate that the requirements of Part I.D.1 of this Permit will be met.

c) Solid Waste Landfill Equivalency – PCB/Radioactive Waste shall only be disposed of as designated in the State-issued Part B Permit.

d) Mixed Waste, Class A, and Class A North Cells – waste to be disposed of in the Mixed Waste, Class A, and Class A North Cells shall be limited to wastes which meet the definition of Class A Low-Level Radioactive Waste (LLRW) under the Utah Radiation Control Rules, UAC R313-15-1008, or are defined as Naturally Occurring and Accelerator Produced Radioactive Materials under the Utah Radiation Control Rules, UAC R313-1

2. Prohibited Wastes

a) Hazardous Waste – the disposal of hazardous waste as defined by the Utah Hazardous Waste Management Rules (UAC R315-2-3) is prohibited in the Class A, Class A North, and 11e.(2) Disposal Cells. LLRW, or 11e.(2) waste that exceeds the regulatory concentration levels of the Toxic

b) Characteristic Leaching Procedure (TCLP) as defined in 40 CFR Part 261 Subpart C, Table 1 is prohibited, unless specifically authorized in Part I.E.5 of this Permit; Table 6, below; or with prior written approval from the Executive Secretary. Waste samples shall be collected in accordance with the currently approved Waste Characterization Plan (Radioactive Materials License, Condition 58); the Procedure for Certification of 11e.(2) Waste in the currently approved Appendix E of this Permit, and analyzed for those exclusive parameters listed in Table 6, below; or for PCB/Radioactive Waste, the currently approved State-issued Part B Permit.

Table 6: Maximum Allowable Concentrations in 11e.(2) Waste

Parameter	TCLP Leachate Regulatory Limit (mg/l)	Total Waste Concentration (mg/kg)
Volatile Organic Compounds		
Acetone	n/a	10.0
2-Butanone	200.0	10.0
Carbon Disulfide	n/a	10.0
Chloroform	6.0	10.0
1,1-Dichloroethane	0.5	10.0
Diethyl Phthalate	n/a	80.0
Methylene Chloride	n/a	70.0
2-Methylnaphthalene	n/a	80.0
Naphthalene	n/a	80.0
1,1,2-Trichloroethane	n/a	7.27
Vinyl Chloride	0.2	0.66

c) Liquid Waste – acceptance of liquids and liquid content of all wastes shall be in accordance with the Radioactive Materials License.

d) Chelating Agents – the disposal of any waste containing chelating agents shall be limited to the Mixed Waste Cell and is prohibited in the Class A, Class A North, and 11e.(2) Disposal Cells. The disposal of any waste in the Mixed Waste Cell containing chelating agents in excess of 22% by weight is prohibited.

3. Failure to Construct as per Approval

Failure to construct any portion of the facility in compliance with the approved engineering design and specifications or in a manner inconsistent with the LLRW and 11e.(2) CQA/QC Plan (Radioactive Materials License UT 2300249, Condition 44) shall be cause for the Executive Secretary to require excavation of the materials and remedial construction, retrofit of the embankment or any other mitigative action to prevent the release of pollutants to soil or ground water.

4. Unsaturated Soil Moisture Content Monitoring

The Permittee shall conduct soil moisture content monitoring to verify performance of the engineered containment systems for the LARW, 11e.(2), Class

A, and Class A North Disposal Cells in accordance with the requirements of Part 1.H.17 of this Permit and Radioactive Material License Condition 28. This monitoring shall consist of instrumentation, as approved by the Executive Secretary, installed in the Cover Test Cell.

The Permittee shall maintain and replace all soil moisture instrumentation as directed by the Executive Secretary.

The Executive Secretary reserves the right to require similar soil moisture content monitoring in the radon barrier at the 11e.(2) Cell. The Permittee shall install and make operational any soil moisture instrumentation in compliance with the schedule to be determined by the Executive Secretary.

5. Allowable Heavy Metal Waste Concentration Limits

Waste containing any of the following non-radionuclide metals: Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Mercury, Selenium, Silver, and Zinc can be disposed of in the Class A, Class A North, or 11e.(2) Cells at any concentrations.

6. Open Cell Time Limitation

For each open portion of any disposal cell, final cover construction shall be completed in accordance with the approved engineering plans and specifications (Part I.D.2 and 4) and the approved Construction Quality Assurance / Quality Control Plan requirements under the Radioactive Materials License on or before the end of 18 years after the date of initial placement of the first lift of any LLRW waste in that portion of the open cell. Final cover construction shall include but is not limited to completion of the following:

a. Riprap Layer
b. Type A Filter Layer
c. Sacrificial Soil Layer
d. Type B Filter Layer
e. Upper Radon Barrier Layer
f. Lower Radon Barrier Layer
g. Temporary cover layer
h. Settlement stand installation and all monitoring necessary to demonstrate waste platform is stable and ready for final cover construction.

Any modification of this 18 -year limitation shall require submittal of detailed justification including but not limited to ground water flow and contaminant transport modeling of open cell conditions or other technical information as necessary, and prior Executive Secretary approval. Said modeling report or other studies must be submitted in their entirety to the Executive Secretary 180 days prior to the expiration date of the respective 18-year open cell time limit. Failure to secure Executive Secretary approval prior to expiration of the 18 -year deadline shall not be cause for the Permittee to postpone construction of the cover of any cell in accordance with the currently approved engineering design and specifications in Part I.D.2 or 4 of this Permit.

7. General Stormwater Management Requirements

The Permittee shall contain all stormwater runoff at the Class A, Class A North, and 11e.(2) Disposal Cells which has contacted the waste (i.e., contact stormwater). The Permittee shall not begin pumpage or removal of stormwater that falls inside the restricted area that has not contacted the waste (i.e., non-contact stormwater) before beginning removal of contact stormwater. This includes runoff from waste disposed in excavated, below grade areas of the Class A, Class A North, and 11e.(2) Disposal Cells, additionally, and:

a) Within 24 hours of discovery of an accumulation of contact stormwater, the Permittee shall immediately begin pumpage and removal of said stormwater in accordance with the stormwater management schedule listed in Appendix J, BAT Performance Monitoring Plan.

b) The Permittee shall pump and remove contact stormwater in an uninterrupted manner until it is completely removed from said location. The Permittee may utilize equipment, which cannot be used at higher priority locations, at lower priority locations in accordance with stormwater management in Appendix J, BAT Performance Monitoring Plan. All contact stormwater accumulated and pumped shall be disposed of in the evaporation ponds only as explicitly approved by the Executive Secretary. However, contact stormwater from the Class A, Class A North, and 11e.(2) disposal cells may be used for minimal engineering and dust control purposes on the waste in the Class A and Class A North disposal cells and for dust suppression activities at the Shredder Facility.

c) Class A North Containerized Waste Facility and Large Component Evaporation Basin – precipitation that falls on the Class A North Containerized Waste Facility and Large Component Area shall be allowed to accumulate in an engineered evaporation basin constructed in accordance with the following conditions:

   1) The evaporation basin shall be constructed in accordance with the design specifications in engineering drawings listed in Table 5 for the Class A North Embankment and the requirements of the currently approved LLRW and 11e.(2) CQA/QC Plan.

   2) Fluid head in the evaporation basin shall not exceed a 1-foot level above the lowest point of the bottom clay liner of the basin. The occurrence of fluid levels above this 1-foot maximum allowable head limit shall constitute a violation of this Permit.

   3) The Permittee shall ensure that the physical integrity of the clay liner is not compromised by desiccation or freeze/thaw cycles by implementing quality assurance/quality control requirements in the currently approved LLRW and 11e.(2) CQA/QC Plan.

8. <u>11e.(2) Waste Management Requirements</u>

The Permittee shall manage the 11e.(2) Waste and related activities at the facility in accordance with all applicable requirements of the currently approved Radioactive Materials License, No. UT2300478, for the following activities and procedures:

a) Spill response and prevention

b) Runon and runoff containment

c) Decontamination of vehicles, equipment, and containers

d) Unloading procedures

e) Waste storage time limits

f) Stormwater/wastewater collection and disposal

g) Leaking waste shipments

In addition, the Permittee shall manage 11e.(2) waste storage and handling in compliance with the containment and spill prevention requirements of Part I.E.10.a of this Permit.

9. <u>11e.(2) Waste Storage</u>

Storage of 11e.(2) waste at the facility shall be explicitly limited to areas within the confines of the 11e.(2) Disposal Cells having completed and approved clay liner.

10. <u>LLRW Waste Management Performance Requirements</u>

The Permittee shall operate and maintain all facilities in compliance with the following performance requirements:

a) Contaminant Containment and Spill Prevention – the Permittee shall manage all site operations to:

1) Prevent contact of wastes with the ground surface.

2) Prevent spills of wastes or liquids contained therein from any contact with the ground surface or ground water.

3) Prevent contact of surface water or stormwater run-on with the waste.

4) Control any runoff, which may have contacted the waste from subsequent contact with the ground surface or ground water by means of approved engineering containment. Any accumulations of such contact runoff or leachates shall be removed and managed in accordance with Part I.E.7.

5) Prevent wind dispersal of wastes.

6) Minimize the time any waste is held in temporary storage without disposal in a disposal cell or embankment. In no case shall any waste be in temporary storage beyond 365 days after the date of waste entry into the controlled area. Once the waste is removed from temporary

storage and is in a disposal cell, the 365 day restriction is no longer relevant.

7) Identify all wastes held in storage by use of clear and legible placards, signs, or labels which identify the generator, waste stream number and dates that said waste or waste container both entered the controlled area and was placed into temporary storage.

8) Maintain all waste containers in a closed, strong tight and watertight condition.

9) All containers in storage shall be inspected daily.

10) Waste in bags shall be managed as bulk waste.

b) Containerized Waste Storage Pad and Other Waste Storage Areas – the Permittee shall operate and maintain waste containers, the asphalt surface of the Containerized Waste Storage Pad, and other storage surfaces used as a waste storage area, so as to prevent the discharge of stormwater or leachate to subsurface soils or ground water, by completing the following actions, as applicable:

1) Repair or otherwise seal and render impermeable any and all cracks, ruptures, damage, or porous areas found in the asphalt surface or other storage surfaces as soon as possible after discovery in accordance with the currently approved Appendix K of this Permit.

2) Fill any areas of subsidence and return the asphalt surface or other storage surfaces to its original design grade, permeability, and appearance, in order to prevent the impoundment of any storm water or leachate on the pad as soon as possible after discovery in accordance with the currently approved Appendix K of this Permit.

3) Prevent contact of waste with precipitation or stormwater by maintaining all containers in a closed and watertight condition.

4) Manage leaking containers in accordance with the Waste Characterization Plan and Radioactive Materials License.

5) Adequately operate and maintain any stormwater collection sump, pump, and pipeage to ensure containment and conveyance of stormwaters to the approved evaporation ponds.

c) Prohibition and Restrictions for Dry Active Waste Storage – dry active waste is defined as contaminated materials without soil-like texture or characteristics, and have a dry weight density of 70 pounds per cubic foot or less (e.g., contaminated paper, plastic, personal protective equipment, cloth, or other similar soft-type debris). Open-air storage of dry active waste is prohibited at the facility. All temporary storage of dry active waste shall be conducted either inside buildings or in watertight containers at the Containerized Waste Storage Pad or other approved storage areas. Dry active waste located within a disposal cell must be covered at the end of the working day with soil or soil-like waste material to prevent wind dispersal.

d) Intermodal Unloading Facility – the Permittee shall operate and maintain the LLRW Intermodal Unloading Facility to provide free draining conditions on both the unloading pad and in the stormwater drainage pipeline system.

e) Containerized Waste Management – the following locations are approved for management and storage of Class A waste received in containers (does NOT include waste received for disposal in the Containerized Class A Facility):

- Containerized Waste Storage Pad
- Intermodal Unloading Facility
- Railcar Rollover Facility
- East Truck Unloading Facility
- Decontamination Facilities (Box Wash, Rail Car Wash Track #2 and #4)
- Class A and Class A North Disposal Cells
- Shredder Facility
- Rotary Dump Facility

f) Bulk Waste Management – the following locations are approved for management and storage of bulk Class A waste:

- Intermodal Unloading Facility
- Railcar Rollover Facility
- East Truck Unloading Facility (raised dock area excluded)
- Decontamination Facilities (Box Wash, Rail Car Wash Track #2 and #4)
- Class A and Class A North Disposal Cells
- Rail Digging Facility (bulk waste transfer only, waste storage prohibited)
- Shredder Facility in accordance with the State-issued Part B Permit and the TSCA Coordinated Approval
- Rotary Dump Facility

11. <u>LARW, Class A, Class A North Cell Collection Lysimeters: Operation, Maintenance and Annual Inspection</u>

The Permittee shall operate and maintain all collection lysimeters in compliance with the currently approved Appendix C of this Permit. Said operation shall include at least an annual video log inspection of each collection lysimeter constructed at the LARW, Class A, and Class A North Cells. Each video inspection shall log the entire length of the drainage pipe to ensure proper operation and free drainage of each collection lysimeter. Failure to satisfactorily complete an annual video log inspection or a determination that free draining conditions no longer exist in a collection lysimeter shall constitute failure to maintain best available technology pursuant to Part I.G.4 of this Permit. Such failures shall be reported to the Executive Secretary in accordance with the requirements of Part I.H.8 of this Permit.

12. Stormwater Drainage Works Performance Criteria

All stormwater drainage works constructed and operated at the LARW, Class A, Class A North, and 11e.(2) facilities shall perform in accordance with the following criteria:

a) Seepage Control to Prevent Ground Water Mounding – all drainage works at the facility shall be constructed of either low-permeability clay liner materials or of an impermeable man-made conveyance in order to control and prevent any alteration of local natural ground water hydraulic gradients or velocities. This infiltration control shall address seepage during periods of storm water storage in the drainage system.

b) Free Drainage – all stormwater drainage works shall be free draining and under gravity conditions shall convey stormwater from the contributing facilities to an off-site location, except as follows:

1. The stormwater culvert at the southeast margin of the 11e.(2) cell, as found on the Permittee's engineering drawing 9420-7D as listed in Table 5 of this Permit. Said construction includes an engineered catch basin and lift station.

c) Temporary Stormwater Drainage Works – plans and specifications for any temporary stormwater drainage works shall be submitted for Executive Secretary review and approval prior to installation. As-Built reports shall be submitted for Executive Secretary approval within 30 days following installation. Prior to site closure, the Permittee shall remove all temporary stormwater drainage works (e.g., drainage grates, piping, ditches, etc. not approved under Part I.D.4) as part of the site Decontamination and Decommissioning Plan required under Radioactive Material License, Condition 74.

13. Reserved

14. Wastewater Management Requirements

The Permittee shall operate and maintain all wastewater storage, treatment, and disposal facilities in accordance with Best Available Technology requirements approved by the Executive Secretary, as follows:

a) 1995, 1997, 2000, Mixed Waste, and Northwest Corner Evaporation Ponds – the Permittee shall operate and maintain the 1995, 1997, 2000 , and Northwest Corner evaporation ponds and the Mixed Waste evaporation pond to prevent release of fluids to subsurface soils or groundwater, in accordance with the following requirements:

1) Leak Detection System Pumping and Monitoring Equipment Continuous Operation – the Permittee shall provide continuous operation of the leak detection system pumping and monitoring equipment, including, but not limited to, the submersible pump, pump controller, head/pressure transducer, and flow meter equipment approved by the Executive Secretary. Failure of any pumping or

monitoring equipment not repaired and made fully operational within 24 hours of discovery shall constitute failure of Best Available Technology and a violation of this Permit.

2) Maximum Allowable Daily Leakage Volumes – the Permittee shall measure the daily volume of all fluids pumped from the respective leak detection systems of the 1995, 1997, 2000, Mixed Waste, and Northwest Corner evaporation ponds. Under no circumstance shall the daily leak detection system flow volume, as determined pursuant to Part I.F. a.3, exceed the following limits:

i.	1995 Evaporation Pond:	162 gallons/day
ii.	1997 Evaporation Pond:	171 gallons/day
iii.	Mixed Waste Evaporation Pond:	171 gallons/day
iv.	2000 Evaporation Pond:	382 gallons/day
v.	Northwest Corner Evaporation Pond:	326 gallons/day

Daily leak detection system flow volumes in excess of these limits shall constitute failure of Best Available Technology and a violation of this Permit.

3) Maximum Allowable Head – the Permittee shall measure fluid head in the respective leak detection sumps of the 1995, 1997, 2000, the Mixed Waste, and Northwest Corner evaporation ponds by use of pressure transducer equipment approved by the Executive Secretary. Under no circumstance shall fluid head in the leak detection system sump exceed a 1-foot level above the lowest point in the lower flexible membrane liner. The occurrence of leak detection system fluid levels above this 1-foot limit shall constitute failure of Best Available Technology and a violation of this Permit.

4) 2-foot Minimum Vertical Freeboard Criteria – the Permittee shall operate and maintain at least 24 inches of vertical freeboard in the 1995, 1997, 2000, Mixed Waste, and Northwest Corner evaporation ponds to ensure total containment of fluids. This vertical distance shall be determined by use of a gauging station approved by the Executive Secretary. If at any time the Permittee operates the pond with less than 24 inches of vertical freeboard, such operation shall constitute failure of Best Available Technology and a violation of this Permit.

5) Ancillary equipment intended to facilitate evaporation shall be constructed and operated in accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit.

b) Box-Washing Facility – the Permittee shall operate and maintain the Box-Washing Facility to ensure:

1) Free draining conditions exist across the floor to the wastewater collection sumps.

2) The integrity of the concrete working surface to prevent discharge.

3) Water level is maintained below the collection sump grate.

4) Maintenance of a freeboard in each concrete wastewater storage tank (at or below three fourths full).

c) Rail Car Wash Facility – the Permittee shall operate and maintain the Rail Car Wash Facility on Track No. 4 in accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit.

15. <u>Filter Construction Settlement Performance Standards</u>

Cover system filter placement shall begin only after the Permittee demonstrates that 95% of the maximum consolidation has been achieved at the upper surface of the radon barrier. Any filter construction undertaken without this demonstration and prior Executive Secretary approval shall constitute a violation of this Permit.

16. <u>Mixed Waste Cell BAT Performance and Best Management Practice Standards</u>

Performance and best management practice standards for waste storage, and stormwater and wastewater storage, treatment, and disposal at the Mixed Waste Cell shall be defined by requirements mandated by the State-issued Part B Permit.

17. <u>Railcar Rollover Facility BAT Performance and Best Management Practice Standards</u>

The Permittee shall operate and maintain the railcar rollover facility to ensure the physical integrity and the asphalt ramps and concrete bay to prevent discharge to the subsurface. Daily inspections shall be documented to ensure compliance with the stormwater management requirements in Part I.E.7.

On an annual basis during the second quarter of each year, the Permittee shall remove all waste from the facility, pressure wash all surfaces to remove all foreign material, and inspect the entire concrete bay and asphalt ramps of the rollover facility. The Permittee shall repair or otherwise seal and render impermeable any and all cracks, ruptures, damage, or porous areas prior to resuming use of the facility. The Permittee shall submit a written notice of inspection to the Executive Secretary at least one week prior to the annual inspection to allow the Executive Secretary the opportunity to have a DRC representative present.

18. <u>Evaluation of Effect of Proposed Pumping Well(s)</u>

The Permittee will evaluate the effect of any proposed pumping well at the facility on the local ground water flow field and ground water monitoring. This evaluation will be undertaken with the use of analytical or numeric ground water flow models, which conform to the guidance provided to the Permittee by the Bureau of Radiation Control in the November 26, 1990 Notice of Deficiency, Comment WPC-1 K. The Permittee will submit the results of this evaluation and receive Executive Secretary approval before any construction of the withdrawal well.

19. Management of 2000 Evaporation Pond Waste Material

The Permittee shall dispose of all waste material generated during the everyday use and operation of the pond in the Class A or Class A North Cell only. Waste material includes, but is not limited to: sludge, soil contaminated from spills or releases, miscellaneous debris, and material or equipment repaired or replaced such as synthetic liner, pumps, piping, cables, floats, etc. All material associated with the final demolition of the pond, including underlying contaminated soil, must be disposed of in the Class A or Class A North Cell and is expressly prohibited from disposal in the 11e.(2) cell.

20. Shredder Facility

The Permittee shall operate and maintain the Shredder Facility:

a) In accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit.

b) To ensure the physical integrity of all concrete surfaces to prevent discharge to subsurface soils or ground water.

c) On an annual basis during the second quarter of each year, the Permittee shall remove all waste from the Shredder Facility, pressure wash all surfaces to remove all foreign material, and inspect all concrete surfaces. The Permittee shall repair or otherwise seal and render impermeable any and all cracks, ruptures, damage, or porous areas prior to resuming use of the facility. At least one week prior to the annual inspection the Permittee will submit written notice to allow the Executive Secretary the opportunity to have a DRC representative present.

d) To ensure that free draining conditions over the entire concrete pad to each of the seven catch basins, and to ensure the water level in each catch basin is below its respective grate.

e) To ensure wastewater level in Manhole #1 is maintained at or below the invert to the outlet pipe, and free draining conditions exist in the conveyance pipe to the Rotary Dump Sediment Basin.

21. Rotary Dump Facility

The Permittee shall operate and maintain the Rotary Dump Facility::

a) In accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit.

b) To ensure the physical integrity of all concrete surfaces to prevent discharge to subsurface soils or ground water.

c) On an annual basis during the second quarter of each year, the Permittee shall remove all waste from the Rotary Dump Facility and pressure wash all surfaces to remove all foreign material, and inspect all surface areas of the concrete access drives and concrete floor of the Rotary Dump Building. The Permittee shall repair or otherwise seal and render impermeable any and all cracks, ruptures, damage, or porous areas prior to resuming use of the facility. At least one week prior to the annual inspection, the Permittee shall submit written notice to allow the Executive Secretary the opportunity to have a DRC representative present.

d) To ensure that free draining conditions exist in all wastewater transfer pipes without release or discharge to subsurface soils or ground water.

e) To ensure the leak detection annulus of the sediment basin is free of fluids.

f) To ensure the water level in the sediment basin is below the level of the grate covering the pump sump.

g) The dual-walled pipe used to transfer fluids from the sediment basin is free draining, and the leak detection annulus within the secondary pipe is free of fluids.

22. <u>Intermodal Container Wash Building</u>

The Permittee shall operate and maintain the Intermodal Container Wash Building:

a) In accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit.

b) To ensure free draining conditions exist:

i. Within each wash bay and trench drain to the sediment basin, and

ii. From each boot wash station to the sediment basin.

c) To ensure the integrity of all concrete surfaces to prevent discharge of waste water to subsurface soils or ground water.

d) To ensure the sediment basin provides a total containment system and does not cause a direct or in-direct discharge to subsurface soils or ground water.

e) To ensure the water level in the sediment basin is always maintained below the grate located over the pump sump.

f) To ensure the leak detection annulus of the sediment basin is free of liquids.

g) To ensure the dual-walled pipe used to transfer fluids from the sediment basin is free draining, and the leak detection annulus within the secondary pipe is free of fluids.

23. Decontamination Access Control Building

The Permittee shall operate and maintain the Decontamination Access Control Building:

a) In accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit.

b) To ensure free draining conditions exist from the bootwash and all graywater lines (i.e., eyewash, emergency shower, respirator wash sink, etc.) to the underground wastewater collection tank located outside the southeast corner of the building.

c) To ensure the dual-walled leak detection annulus of the wastewater collection tank is maintained free of fluids.

d) To ensure the fluid level in the wastewater collection tank is maintained below the invert of the inlet pipe.

e) To ensure the dual-walled piping from the wastewater collection tank to the 1997 Evaporation Pond via the East Side Drainage System is free draining and the leak detection annulus within the secondary pipe remains free of fluids.

24. East Side Drainage Project

The Permittee shall operate and maintain the East Side Drainage Project:

a) In accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively, of the Permit.

b) To ensure the leak detection annulus of the dual-walled piping system is always maintained free of fluids, including the drip pans found inside manholes #1 and #2.

c) To ensure the fluid level in the 11 stormwater catch basins is always maintained below the level of their respective outlet pipes.

d) To ensure the stormwater, graywater, and wastewater piping throughout the entire East Side Drainage Project remains free draining at all times.

e) To ensure the fluid level in the stormwater lift sump is always maintained below the level of the inlet piping.

25. Horizontal Hydraulic Gradient Performance Standard

The Permittee shall operate the facility to prevent the shallow aquifer horizontal hydraulic gradient, based on fresh water equivalent ground water elevations, of any sub area, from exceeding the cell-specific Horizontal Hydraulic Gradient Limits specified in Part I.H.2.(d) of this Permit. Said performance standard for horizontal hydraulic gradient at the LARW Cell shall become effective after 1.5 years from the effective date of this Permit Modification.

The Permittee shall operate and maintain the stormwater culvert, catch basin, and lift station at the southeast margin of the 11e.(2) cell to transfer stormwater in an un-interrupted manner to the Southwest Pond, in accordance with a currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively, of this Permit.

26. Vertical Hydraulic Gradient Performance Standard

The Permittee shall maintain a neutral or upward hydraulic gradient in all nested or paired monitoring wells at the facility required by Part I.H.2[c] of this Permit. Said neutral hydraulic gradient is defined as equal freshwater elevation in both wells of the pair, pursuant to Part I.H.2(a) of this Permit. Upward hydraulic gradient is defined as a condition where the deeper well of the pair exhibits a higher or greater freshwater elevation than the shallow well. For well pair GW-19A and GW-19B, this performance standard shall become effective after completion of the shallow aquifer de-watering required by Part I.I.2 of this Permit.

27. DU Storage Building Performance Standard

The Permittee shall operate and maintain the DU Storage Building:

a) In accordance with the BAT Performance Monitoring Plan and BAT Contingency Plan, Appendices J and K, referenced in Part I.I.5 of this Permit.
b) To maintain the building floor at the approved design grade, and in a sound, undamaged, water tight physical condition.

c) To prevent physical contact of any DU waste material or liquids therein with the building’s asphalt floor.

d) To ensure the physical integrity of the building’s asphalt floor to contain and control any waste leakage due to container damage, degradation or spills.

e) To prevent any physical contact of any precipitation, run-on, or other water with the DU waste.

f) To ensure the physical integrity of the walls and roof of the building to prevent the contact of precipitation with the DU containers and waste therein.

g) To maintain all DU containers in a closed, strong tight and water tight condition.

h) To prevent the occurrence or presence of any water on the building floor at any time.

F. Compliance Monitoring

1. Compliance Monitoring Wells

Ground water monitoring wells used as compliance monitoring points shall meet the following requirements:

a) LARW, Class A, Class A North, and 11e.(2) Compliance Monitoring Wells – the following wells shall be sampled and analyzed for purposes of compliance monitoring

1) LARW Cell – existing wells GW-128, GW-16R, GW-20, GW-22, GW-23, GW-24, GW-29, GW-56R, GW-64, GW-77, GW-103, GW-104, and GW-105.

2) 11e.(2) Cell – existing wells GW-19A, GW-20, GW-24, GW-25, GW-26, GW-27, GW-28, GW-29, GW-36, GW-37*, GW-38R*, GW-57, GW-58, GW-60, GW-63, GW-126, GW-127 and piezometer PZ-1*. * Wells 37, 38R, and piezometer PZ-1 shall be monitored only for ground water elevations

3) Class A Cell – existing wells GW-81, GW-82, GW-83, GW-84, GW-85, GW-86, GW-88, GW-89, GW-90, GW-91, GW-92, GW-93, GW-94, GW-95, GW-99, GW-100, GW-101, and GW-102.

4) Class A North Cell – existing wells GW-106, GW-107, GW-108, GW-109, GW-110, GW-111, GW-112, GW-137, GW-138, GW-139, GW-140, and GW-141.

b) Mixed Waste Cell Compliance Monitoring Wells (radiologic contaminants only) – the following wells shall be sampled and analyzed for purposes of compliance monitoring:, ~~GW-130, GW-131, GW-132~~, GW-133, GW-134, GW-135, GW-136, I-1-30, GW-151, GW-152, GW-153, GW-154, and I-3-30*.

* Well I-3-30 shall be monitored only for ground water elevations.

c) Evaporation Pond Monitoring Wells – monitoring wells P3-95 NECR, P3-95 SWC, and P3-97 NECR shall be sampled and analyzed for purposes of compliance monitoring for the 1995 and 1997 Ponds, well GW-66R shall be sampled and analyzed for purposes of compliance monitoring for the Mixed Waste Pond, and wells GW-19A, GW-36, and GW-58 shall be sampled and analyzed for purposes of compliance monitoring for the 2000 Evaporation Pond in addition to the 11e.(2) cell. Monitoring well GW-129 shall be sampled and analyzed for purposes of compliance monitoring for the Northwest Corner Evaporation Pond.

d) Deep Aquifer Monitoring Wells– the Permittee shall monitor heads in all deep aquifer monitoring wells, including, but not limited to monitoring wells I-1-100, ~~I-3-100~~, GW-19B, GW-27D, ~~and~~ GW-139D, and GW-153D.

e) Well Construction Criteria – any ground water monitoring well used as a compliance monitoring point shall be:

1) Located hydrologically downgradient of waste disposal,

2) Completed exclusively in the uppermost aquifer,

3) Located as close as practicable to the waste and no more than 90 feet from edge of waste,

4) Constructed in conformance to guidelines found in the EPA RCRA Ground Water Monitoring Technical Enforcement Guidance Document, 1986, OSWER-9950.1.

f) Well Network Early Warning Requirement – any network of ground water monitoring wells used as points of compliance shall be adequately constructed, both in location and spacing, to provide early warning of a contaminant release from a waste embankment before the contaminant leaves the embankment's 100-foot wide buffer zone, as defined in Table 7, below. For purposes of this Permit, early warning shall be provided by a compliance monitoring well network with an inter-well spacing distance to be approved by the Executive Secretary.

g) Buffer-Zone Requirements– waste disposal is prohibited inside the buffer zone, as described in Tables 3 and 7 of this Permit.

Table 7: Buffer Zone Boundary Locations

Disposal Cell	Edge of Buffer Zone Position	Coordinates	
		Latitude	Longitude
LARW	NW Corner	40° 41' 12.366" N	113° 06' 52.622" W
	SW Corner	40° 40' 51.915" N	113° 06' 52.494" W
	SE Corner	40° 40' 51.976" N	113° 06' 35.429" W
	NE Corner	40° 41' 12.427" N	113° 06' 35.556" W
Class A	NW Corner	40° 41' 29.052" N	113° 07' 26.037" W
	SW Corner	40° 41' 13. 245" N	113° 07' 25. 996" W
	SE Corner	40° 41' 13.202" N	113° 06' 54.069" W
	NE Corner	40° 41' 29.008" N	113° 06' 54.109" W
Class A North	NW Corner	40° 41' 39. 496" N	113°0 7' 26.051" W
	SW Corner	40° 41' 29. 536" N	113° 07' 26.035" W
	SE Corner	40° 41' 29. 563" N	113° 06' 55.911" W
	NE Corner	40° 41' 39. 521" N	113° 06' 55.926" W
11e.(2)	NW Corner	40° 41' 13.587" N	113°0 7' 25.832" W
	SW Corner	40° 40' 54.077" N	113° 07' 26.070" W
	SE Corner	40° 40' 53.849" N	113° 06' 54.279" W
	NE Corner	40° 41' 13.359" N	113° 06' 54.037" W

h) Protection of Monitoring Network – all compliance monitoring wells must be protected from damage due to surface vehicular traffic or contamination due to surface spills. All monitoring wells shall be maintained in full operational condition for the life of this Permit.

The criteria for determining full operational condition are:

1) Accessibility – each well must be accessible for sampling and shall not be located in an area of standing water.

2) Casing Measuring Point – each well shall have a permanent surveyed reference point such as the top of the protective casing.

3) Physical Integrity – any physical disturbance to any well, which may alter the surveyed water level measuring point, is prohibited. In addition, all wells shall have an adequate surface seal around the well casing to prevent surface or storm water from entering the well.

4) Chemical Integrity – all well and sampling materials shall be constructed of inert materials to prevent the introduction of contaminants from leaching or corrosion.

5) Silt Content – if the measured water column of any well is less than 90% of the theoretical water column, the monitoring well shall be redeveloped prior to sampling.

Any well that becomes damaged beyond repair or is rendered unusable for any reason will be replaced by the Permittee within 90 days or as directed by the Executive Secretary.

i) Notification of Ground-water Monitoring Event

At least 30 calendar days prior to the annual Ground Water Monitoring event required under Part I.H.1, the Permittee will submit a written notice and schedule, with approximate dates the wells will be sampled, to the Executive Secretary to allow the DRC the opportunity to collect duplicate or split ground-water samples from the same wells at the same time as the Permittee's staff during a regularly scheduled sampling event for independent laboratory analysis.

2. <u>BAT Compliance Monitoring Points</u>

The Permittee shall inspect, sample, analyze, or otherwise monitor other points of compliance in order to confirm compliance with this Permit. These points or instruments shall include:

a) East Truck Unloading Area – including monitoring of free draining conditions to the stormwater collection troughs, water level in the collection troughs, and physical condition/integrity of all exposed asphalt and concrete surfaces.

b) LARW, Class A, and Class A North Cell Collection Lysimeters – all collection lysimeters constructed at the LARW, Class A, and Class A North Cells in accordance with the requirements of Part I.D.10 of this Permit.

c) LARW Containerized Waste Storage Pad – including monitoring of water in the stormwater collection sump and physical condition of containers on the pad.

d) 1995, 1997, 2000, Mixed Waste, and Northwest Corner Evaporation ponds – including monitoring of: 1) vertical freeboard at the water level gauging stations approved by the Executive Secretary, 2) operational status and required BAT performance parameters of all leak detection pump-back system equipment, including but not limited to, leak detection system pump, head pressure transducer, and flow meters required by Part I.E.14 of this Permit and approved by the Executive Secretary.

e) Intermodal Unloading Facility – including monitoring of free draining conditions at both the unloading pad and throughout the length of the contact stormwater drainage discharge pipeline that discharges to the 1995 and 1997 evaporation ponds.

f) Box-Washing Facility – including monitoring of free draining conditions, physical condition and integrity of concrete floor and floor sumps, sump pump in floor sump is operational, free drainage is maintained through the pipeline discharging wastewater into the concrete holding tanks, and water level in concrete holding tanks is maintained at or below three-quarters full.

g) Track No. 4 and Track No. 2 Rail Car Wash Facilities – including monitoring of free draining conditions and physical condition and integrity of rail bay concrete floor, floor sumps, conveyance pipe, Collected Water Receiver Tank, Filtered Water Storage Tank, and concrete secondary containment vault.

h) Rail Digging Facility – including monitoring of free draining conditions to the concrete collection basins and throughout the drainage system after the collection basins, and physical integrity of the asphalt and concrete surfaces.

i) Shredder Facility – including monitoring to determine:

1) Free draining conditions throughout the concrete surfaces to the seven catch basins,

2) Physical integrity of all concrete surfaces,

3) Water level at each catch basin and manhole, and

4) Free draining conditions of all wastewater transfer piping.

j) Rotary Dump Facility – including monitoring to determine:

1) Free draining conditions, physical condition, and integrity of all concrete surfaces,

2) Presence or absence of fluids in the Sediment Basin leak detection annulus,

3) Water level in the sediment basin,

4) Free draining conditions in all wastewater transfer piping, and

5) Presence or absence of fluids in the leak detection annulus within the secondary pipe of all dual-walled wastewater transfer piping systems.

k) Intermodal Container Wash Building – including monitoring to determine:

1) Free draining conditions, physical condition, and integrity of concrete floor and floor trenches,

2) Presence or absence of fluids in the sediment basin leak detection annulus,

3) Fluid level in the sediment basin, and

4) Presence or absence of fluids in the leak detection annulus within the secondary pipe of all dual-walled wastewater transfer piping systems.

l) Decontamination Access Control Building – including monitoring to determine:

1) Free draining conditions in all wastewater transfer piping,

2) Presence or absence of fluids in the gray water collection tank leak detection annulus,

3) Water level in the gray water collection tank, and

4) Presence or absence of fluids in the leak detection annulus within the secondary pipe of all dual-walled wastewater transfer piping systems.

m) East Side Drainage Project - including monitoring to determine the presence or absence of fluids in the leak detection annulus within the secondary piping of all dual-wall wastewater transfer systems. All dual-walled pressurized pipe connected to the East Side Drainage Project, that does not gravity drain to a leak detection port, including both primary and secondary piping, shall be pressure tested annually by an independent Professional Engineer registered in the State of Utah.

3. Future Modification of Compliance Monitoring Systems or Equipment

If at any time the Executive Secretary determines that additional systems, mechanisms or instruments are necessary to monitor ground water quality or Best Available Technology compliance at the facility, the Permittee shall submit within 30 days of receipt of notification, a plan and compliance schedule to modify the compliance monitoring equipment, for Executive Secretary approval. Any failure to construct the required compliance monitoring system or equipment in accordance with the approved plan and schedule shall constitute a violation of this Permit.

4. Compliance Monitoring Period

Monitoring shall commence upon issuance of this Permit, or upon:

a) Completion of each collection lysimeter in accordance with Part I.D. 10 of this Permit and

b) Completion of the soil moisture instrumentation required by Part I.E.4.

Thereafter, compliance monitoring shall continue through the life of the Permit.

5. Monitoring Requirements and Frequency

Measurements or analysis done for monitoring will be conducted in compliance with the requirements below, and reported to the Executive Secretary as per the requirements of Part I.H.

a) Water Level Measurements – water level measurements shall be made monthly in each monitoring well and piezometer listed in Part I.F.1. Measurements made in conjunction with annual ground water sampling shall be completed prior to any collection of ground water samples in accordance with the currently approved Water Monitoring Quality Assurance Plan in Appendix B of this Permit. These measurements will be made from a permanent single reference point clearly demarcated on the top of the well or surface casing. Measurements will be made to the nearest 0.01 feet.

b) Specific Gravity Measurements – ground water-specific gravity measurements shall be made annually in each monitoring well and piezometer in conjunction with each annual ground water quality sampling event.

c) Ground Water and Pore Water Quality Sampling and Analysis – except for arsenic and molybdenum, grab samples of ground water from compliance monitoring wells and pore water from lysimeters (as available) will be collected for chemical analysis on an annual basis, in conformance with Part II.A and B and the currently approved Water Monitoring Quality Assurance Plan in Appendix B of this Permit.

1) Ground/Pore Water Analytical Methods – methods used to analyze ground water samples must comply with the following:

i. Are methods cited in UAC R317-6-6.3A(13) or have been approved by the Executive Secretary in the currently approved Water Monitoring Quality Assurance Plan, Appendix B of this Permit, and

ii. Have detection limits which do not exceed the Ground Water Quality Standards or Protection Levels listed in Tables 1A and 1C of this Permit.

2) Analysis Parameters – the following analyses will be conducted on all samples collected for ground water monitoring:

i. Field Parameters – dissolved oxygen, pH, temperature, specific gravity, and specific conductance.

ii Laboratory Parameters – including:

- General Inorganic Parameters: Chloride, Sulfate, Carbonate, Bicarbonate, Sodium, Potassium, Magnesium, Calcium, bromide, iron, and total anions and cations
- General Radiologic Parameters: potassium-40, gross beta
- All Protection Level Parameters – individual analysis for all parameters found in Part I.C, Tables 1A, 1B, 1C, 1D, 1E, and 1F of this Permit

3) Arsenic and Molybdenum – arsenic and molybdenum samples will be collected for chemical analysis at the time of Permit renewal and reported with the application for Permit Renewal.

6. Collection Lysimeter Sampling

Collection lysimeter sampling shall be conducted in compliance with the currently approved Water Monitoring Quality Assurance Plan approved by the Executive Secretary, as provided in Appendix B of this Permit. Sample analysis shall conform to the requirements of Part I.F.5(c) of this Permit.

Water quality samples shall be collected within 24 hours of initial discovery of fluid. The priority of sample parameters shall conform to the currently approved Appendix C of this Permit, with special emphasis on selection of mobile and predominant contaminants found within the capture area of the lysimeter.

7. Modification of Monitoring or Analysis Parameters

If at any time the Executive Secretary determines the monitoring or analysis parameters to be inadequate, the Permittee shall modify all required monitoring parameters immediately after receipt of written notification from the Executive Secretary. Upon any change in the currently approved waste parameters defined in Conditions 6, 7, and 8 of the Utah Radioactive Material License UT 2300249, the Permittee shall revise the currently approved Water Monitoring Quality Assurance Plan in Appendix B.

8. Waste Characterization Monitoring

a) Class A Waste – all Class A waste received by the Permittee shall be fully characterized to determine its chemical and radiological constituents and the presence and concentration of any chelating agents both before shipment and emplacement for disposal, in accordance with the requirements of the currently approved Waste Characterization Plan in the Radioactive Material License UT 2300249, Condition 58 and for PCB/Radioactive Waste, in the currently approved State-issued Part B Permit . Said waste characterization shall include sampling and analysis of all contaminants authorized by Part I.E.1 and of those prohibited by Part I.E.2 of this Permit.

b) 11e.(2) Waste – all 11e(2) Waste received by the Permittee shall be fully characterized both before shipment and after arrival at the facility to identify any new non-radiologic contaminants not authorized by this Permit by Parts I.E.2 and I.E.5. Said waste characterization shall include sampling and analysis of all non-radiologic contaminants prohibited by Part I.E.2 of this Permit.

The Permittee shall maintain records of all Class A, and 11e.(2) Waste sampling and analysis on site.

9. <u>Waste Liquid Content Monitoring</u>

All wastes received shall be tested for liquids in accordance with the currently approved LLRW Waste Characterization Plan in the Radioactive Material License, Condition 58. In accordance with UAC R313-15-1008(2)(a)(iv), solid waste received for disposal shall contain as little free-standing and non-corrosive liquid as reasonably achievable, but shall contain no more free liquids than 1% of the volume of the waste. In the event that solid waste is received or observed to contain free liquids in excess of 1% by volume, the Licensee/Permittee shall immediately notify the Division of Radiation Control that the shipment(s) failed the requirements for acceptance.

10. <u>Post-Closure Monitoring</u>

Post-closure monitoring shall conform to the requirements of the currently approved Post-Closure Monitoring Plan in Appendix F of this Permit.

11. <u>On-Site Meteorological Monitoring</u>

The Permittee shall provide continuous monitoring of the following minimum meteorological parameters, in accordance with the currently approved Weather Station Monitoring Plan found in Appendix G of this Permit:

a) Wind direction and speed

b) Temperature

c) Daily Precipitation

d) Pan evaporation

The Permittee shall maintain records of this monitoring on site. The Permittee shall submit an annual meteorological report for the facility in compliance with the requirements of Part I.H.10 of this Permit.

12. <u>Containerized Waste Storage Areas: Leakage/Spill Monitoring and BAT Status</u>

The Permittee shall conduct daily inspections of the containerized waste storage areas in order to remediate any container leakage or spillage in accordance with the currently approved BAT Performance Monitoring Plan in Appendix J of this Permit . Said inspections shall also evaluate compliance with the Best Available Technology requirements of Part I.E.10 of this Permit. The Permittee shall maintain a written record of these inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

13. Evaporation Ponds Monitoring

a) 1995, 1997, 2000, Mixed Waste, and Northwest Corner Evaporation Pond Daily Monitoring – the Permittee shall conduct daily inspections of the 1995, 1997, 2000, Mixed Waste, and Northwest Corner evaporation ponds to determine compliance with the Best Available Technology requirements of Part I.E.14.a of this Permit, including:

1) Visual observation of pond water level, relative to pond spillway centerline, to evaluate pond freeboard compliance against BAT performance criteria.

2) Determination of operational status of leak detection system pump, pump controller, head/pressure transducer, and flow meter equipment.

3) Measurement of daily leak detection system flow volume. For BAT compliance monitoring purposes for the 1995, 1997, 2000, Mixed Waste, and Northwest Corner evaporation ponds, the Permittee shall calculate an average daily leakage volume across a consecutive 7-day period. The Permittee shall perform this calculation for each evaporation pond weekly.

4) Measurement of daily leak detection system head. For BAT compliance monitoring purposes for the 1995, 1997, 2000, Mixed Waste, and Northwest Corner evaporation ponds, the Permittee shall determine the maximum head limit to be measured by the approved head/pressure transducer construction that complies with the 1-foot BAT head performance standard of Part I.E.14.a.3. On a daily basis, the Permittee shall compare the daily measured head against the maximum head limit for each evaporation pond.

The Permittee shall maintain written records of the findings of these daily inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

b) 1995, 1997, 2000, Mixed Waste, and Northwest Corner Evaporation Pond Leak Detection System Pump Tests – the Permittee shall conduct a pump test of the evaporation pond's leak detection sump within 5 days of discovery that the average daily leak detection system flow volume (Part 1.F.2.d)exceeds the following limits:

1)	1995 Evaporation Pond:	155 gallons/day
2)	1997 Evaporation Pond:	160 gallons/day
3)	Mixed Waste Evaporation Pond:	160 gallons/day
4)	2000 Evaporation Pond:	355 gallons/day
5)	Northwest Corner Evaporation Pond:	300 gallons/day

Said pump test shall comply with the currently approved BAT Contingency Plan in Appendix K of this Permit.

c) Annual Monitoring – on an annual basis, the Permittee shall:

1) Collect water quality samples from fluids stored in the approved evaporation ponds.

2) Analyze said water samples for all ground water quality protection level parameters defined in Part I.F.5.c.2, above, including a complete gamma spectroscopic analysis.

Sampling and analyses at all evaporation ponds shall comply with the currently approved Water Monitoring Quality Assurance Plan in Appendix B of this Permit.

d) Annual Pump Inspection – on an annual basis, the Permittee shall remove the submersible pump from the leak detection system of the 1995, 1997, 2000, Mixed Waste, and Northwest Corner evaporation ponds and check both the winding resistance and insulation resistance. If either the winding resistance or insulation resistance is outside of the manufacturer specifications, the pump will be replaced and/or repaired with a pump that satisfies all manufacturer specifications within 24 hours. Within 30 days of completing the annual pump inspection, a bor-o-scope video inspection shall be performed to ensure the pump was correctly reinstalled.

14. Confined Aquifer Head Monitoring

The Permittee shall conduct monthly monitoring of water levels and annual specific gravity measurements in all wells completed in the deep confined aquifer, including, but not limited to: I-1-100, ~~I-3-100~~GW_153D, GW-19B, GW-139D, and GW-27D. Annual water levels and specific gravity measurements shall be made in conjunction with the annual ground water quality sampling event.

15. Mixed Waste Leachate Monitoring

On an annual basis, the Permittee shall collect representative samples of leachate from the Mixed Waste Cell leachate collection system (upper leachate collection access pipe) and analyze for radioactive contaminants. If no leachate is present during the annual sampling event, no sample is required. Said radioactive contaminants shall include:

a) All Ground Water Protection Level Parameters found in Tables 1E and 1F of this Permit

b) A complete gamma spectroscopic analysis to determine all other gamma-emitting radioisotopes that may be present

16. Intermodal Unloading Facility Monitoring

The Permittee shall conduct daily monitoring of the Intermodal Unloading Facility to determine and ensure free draining conditions exist both on the unloading pad and across the contact stormwater drainage pipeline that discharges to the 1995 and 1997 evaporation ponds. The Permittee shall maintain written records of the findings of these daily inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

17. Box-Washing Facility Monitoring

The Permittee shall conduct daily monitoring of the Box-Washing facility to demonstrate compliance with the Best Available Technology requirements of Part I.E.14.b of this Permit, including:

a) Free draining conditions

b) Physical integrity of concrete surfaces

c) Wastewater catch basin (sump) water level

d) Water level in wastewater storage tanks

e) Absence of discharge to the ground or ground water

The Permittee shall maintain written records of the findings of these daily inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

18. Rail Car Wash Facility Monitoring

The Permittee shall conduct daily monitoring of the Track No. 4 facility to demonstrate compliance with the Best Available Technology requirements of Part I.E.14.d of this Permit in accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit.

The Permittee shall maintain written records of the findings of these daily inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

19. Railcar Rollover Facility Monitoring

The Permittee shall conduct daily monitoring of the Railcar Rollover Facility to demonstrate compliance with the BAT Performance and Best Management Practice Standards of Parts I.E.7 and I.E.17 of the Permit in accordance with the currently approved BAT Performance Monitoring Plan and Contingency Plan in Appendices J and K, respectively, of this Permit.

20. Open Cell Time Limit Monitoring

The Permittee shall demonstrate compliance with the open cell time limitation requirements of Part I.E.6 of this Permit by observing and recording the following dates of completion for each working area in the Class A and Class A North cells:

a) Initial placement of waste on the first lift on the clay liner

b) Completion of construction of the clay radon barrier

The Permittee shall maintain written records of this monitoring on site. All monitoring records shall comply with the requirements of Part II.G of this Permit.

21. Reserved

22. BAT Performance Monitoring Plan

The Permittee shall demonstrate compliance with the BAT requirements and performance standards and Best Management Practices in Parts I.D and I.E of this Permit by implementing the most current BAT Performance Monitoring Plan approved by the Executive Secretary and provided in Appendix J of this Permit.

23. BAT Contingency Plan

In the event that BAT failure occurs at any facility, the Permittee shall implement the most current BAT Contingency Plan approved by the Executive Secretary and provided in Appendix K of this Permit to regain the BAT requirements and performance standards and Best Management Practices specified in Parts I.D and I.E of this Permit.

24. Stormwater Monitoring

The Permittee shall demonstrate compliance with stormwater removal requirements of Part I.E.7 of this Permit by maintaining daily written records for stormwater management activities:

a) Date, time, and location of discovery of stormwater accumulation

b) Date and time when stormwater removal activities were initiated at each location

c) Date and time when stormwater removal was completed at each location

d) First and last name(s) of all personnel involved with stormwater removal activities

e) Unique identity of locations of where stormwater was removed

f) Type of stormwater removed: contact or non-contact stormwater

g) Identify equipment used to remove contact and non-contact stormwater

h) Volumes of stormwater removed at each location

i) Location(s) where stormwater was disposed

25. Shredder Facility

The Permittee shall conduct daily monitoring of the Shredder Facility to demonstrate compliance with the Best Available Technology requirements of Part I.E.20 of this Permit in accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K of this Permit, respectively, including:

a) Free draining conditions

b) Physical integrity of concrete surfaces

c) Absence of discharge to the ground or ground water

The Permittee shall maintain written records of the findings of these daily inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

26. Rotary Dump Facility

The Permittee shall conduct daily monitoring of the Rotary Dump Facility to demonstrate compliance with the Best Available Technology requirements of Part I.E.21 of this Permit in accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K of this Permit, respectively, including:

a) Free draining conditions

b) Physical integrity of concrete surfaces

c) Water level in Sediment Basin sump

d) Presence of fluids in the Sediment Basin leak detection system

e) Absence of discharge to the ground or ground water

f) Absence of fluid in annular space between the primary and secondary pipes of the leak detection system for pressurized pipes

The Permittee shall maintain written records of the findings of these daily inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

27. Intermodal Container Wash Building

The Permittee shall conduct daily monitoring of the Intermodal Container Wash Building to demonstrate compliance with the Best Available Technology requirements of Part I.E.22 of this Permit in accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit, including:

a) Free draining conditions,

b) Physical integrity of concrete surfaces,

c) Water level in Settlement Basin,

d) Presence of fluids in the settlement basin leak detection system, and

e) Absence of discharge to the ground or ground water.

The Permittee shall maintain written records of the findings of these daily inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

28. Decontamination Access Control Building

The Permittee shall conduct daily monitoring of the Decontamination Access Control Building to demonstrate compliance with the Best Available Technology requirements of Part I.E.23 of this Permit in accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit, including:

a) Free draining conditions in all wastewater transfer piping,

b) Water level in the gray water collection tank,

c) Presence of fluids in the gray water collection tank leak detection annulus, and

d) Absence of discharge to the ground or ground water.

The Permittee shall maintain written records of the findings of these daily inspections on site. All daily inspection records shall comply with the requirements of Part II.G of this Permit.

29. <u>East Side Drainage Project</u>

The Permittee shall conduct daily monitoring of the East Side Drainage Project to demonstrate compliance with the Best Available Technology requirements of Part I.E.24 of this Permit in accordance with the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan in Appendices J and K, respectively of this Permit, including:

a) Free draining conditions in all wastewater transfer piping

b) Absence of fluids in the leak detection annulus within the secondary pipe of the dual-walled piping system, and

c) Absence of discharge to the ground or ground water.

30. <u>DU Storage Building Monitoring</u>

The Permittee shall conduct weekly visual monitoring of the DU Storage Building to determine compliance with the BAT performance standards defined in Part I.E.27. This shall include, but is not limited to:

a) Verification of the physical integrity of the building floor, walls, and roof.
b) Determination of physical integrity of each DU waste container.
c) Verification of the lack of any water in the building.

In addition, if the Permittee discovers any failure of a waste container, or the DU Storage Building to meet the requirements in Parts I.E.27 or I.F.30, of this Permit, the Permittee shall:

a) Complete all corrective actions needed to repair and abate the problem within 24-hours of discovery, and

b) Determine the root cause of the problem(s) and complete all necessary action to prevent future occurrences of said problem(s) within 5 calendar days of said discovery.

The Permittee shall maintain written records of all visual findings and corrective actions of this weekly inspection on site. All weekly inspection and corrective action records shall comply with the requirements of Part II.G of this Permit.

G. Non-Compliance Status. Ground Water Monitoring and Best Available Technology

1. Noncompliance with the Ground Water Protection Levels

Noncompliance with the ground water protection levels in Part I.C, Tables 1A, 1B, 1C, 1D, 1E, and 1F as applied to the compliance monitoring wells defined in Part I.F.1 of this Permit shall be defined as follows:

a) Monitoring for probable out-of-compliance shall be defined as any one sample in excess of the protection level in Tables 1A, 1B, 1C, 1D, 1E, or 1F of this Permit for any parameter from the same compliance monitoring well.

b) Out-of-Compliance Status –defined as two (2) consecutive samples in excess of the protection level in Tables 1A, 1B, 1C, 1D, 1E, or 1F of this Permit for any parameter from the same compliance monitoring well.

c) Other Methods to Determine Ground Water Quality Compliance Status – at the discretion of the Executive Secretary, other methods may be employed to determine the compliance status of the facility with respect to ground water quality data, including: 1) Trend and/or Spatial Analysis – analysis of any contaminant concentration trend through time in a single compliance monitoring point, and /or spatial analysis of the same from any group of compliance monitoring points.

2) EPA RCRA Statistical Methods – other applicable statistical methods may be used to determine out-of-compliance status, as defined in the EPA document "Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities", February 1989, or as amended.

2. Requirements for Ground Water Monitoring for Probable Out-of-Compliance Status

The Permittee shall evaluate the results of each round of ground water sampling and analysis to determine existence of probable out-of-compliance status as defined in Part I.G.1(a) of this Permit. Upon any determination that probable out-of-compliance status exists, the Permittee shall:

a) Notify the Executive Secretary of the probable out-of-compliance (POOC) status within 30 days of the initial detection.

b) Immediately implement a schedule of quarterly ground water sampling and analysis for the well(s)/parameter(s) of concern, consistent with the requirements Part I.F.5(b) and the currently approved Water Monitoring Quality Assurance Plan, Appendix B of this Permit. This quarterly sampling will continue until the compliance status can be determined by the Executive Secretary.

3. Requirements for Ground Water Out-of-Compliance Status

a) Notification and Accelerated Monitoring – the Permittee shall evaluate the results of each round of ground water sampling and analysis to determine existence of out-of-compliance status as defined in Part I.G.1(b) of this Permit. Upon any determination that an out-of-compliance status exists the Permittee shall:

1) Verbally notify the Executive Secretary of the out-of-compliance status within 24 hours, and provide written notice within 5 days of the detection and

2) Immediately implement an accelerated schedule of monthly ground water monitoring of the monitoring wells of concern for the parameters in question. This monitoring shall continue for at least 2 months or until the facility is brought into compliance, as determined by the Executive Secretary. At the discretion of the Executive Secretary, the Permittee may be required to sample and analyze for additional inorganic, organic, or radiochemical parameters in order to determine the compliance status of the facility.

b) Source and Contamination Assessment Study Plan – within 30 days of the verbal notice to the Executive Secretary required in Part I.G.3(a) of this Permit, the Permittee shall submit for Executive Secretary approval an assessment study plan and compliance schedule for:

1) Assessment of the source or cause of the contamination and determination of steps necessary to correct the source.

2) Assessment of the extent of the ground water contamination and any potential dispersion.

3) Evaluation of potential remedial actions to restore and maintain ground water quality and ensure that the ground water standards will not be exceeded at the compliance monitoring wells, and best available technology will be reestablished.

c) Contingency Plan – in the event that Out-of-Compliance status is determined as per Part I.G.1(b) or (c), and upon written notification from the Executive Secretary, the Permittee shall immediately implement the currently approved Contingency Plan in Appendix A of this Permit.

4. Definition and Requirements for Failure to Maintain Best Available Technology

a) Definition of Failure to Maintain Best Available Technology (BAT) Requirements – any violation of the BAT Design Standards in Part I.D, including design, design specifications, or construction requirements shall constitute failure to meet the best available technology requirements of this Permit. Any violation of the BAT Performance Standards in Parts I.D.1 or I.E shall also constitute failure to meet the best available technology requirements of this Permit

b) Requirements for Failure to Maintain Best Available Technology – in the event that the Permittee fails to maintain best available technology in accordance with Parts I.D and I.E, above, the Permittee shall:

1) Notify the Executive Secretary verbally within 24 hours of discovery of the BAT failure, and provide written notice within 5 days of discovery.

2) Submit within 5 days of discovery a complete written description of:

i. The cause of the BAT failure,

ii. Any measures taken by the Permittee to mitigate the BAT failure,

iii. Time frame of the discovery of the BAT failure and any mitigation measures were implemented, and

iv. Evidence to demonstrate that any discharge or potential discharge caused by the BAT failure did not and will not result in a violation of UAC 19-5-107.

c) BAT Contingency Plan – in the event that Out-of-Compliance status is determined as per Part I.G.4(a) or by daily implementation of the currently approved BAT Performance Monitoring Plan in Appendix J of this Permit, the Permittee shall immediately implement the currently approved BAT Contingency Plan in Appendix K of this Permit.

5. Affirmative Defense Relevant to Best Available Technology Failures

In the event that a compliance action is initiated against the Permittee for violation of Permit conditions relating to best available technology, the Permittee may affirmatively defend against that action by demonstrating the following:

a) The Permittee submitted notification according to UAC R317-6-6.13,

b) The failure was not intentional or caused by the Permittee's negligence, either in action or in failure to act,

c) The Permittee has taken adequate measures to meet permit conditions in a timely manner or has submitted to the Executive Secretary, for Executive Secretary approval, an adequate plan and schedule for meeting permit conditions, and

d) The provisions of UAC 19-5-107 have not been violated.

H. Reporting Requirements

Notwithstanding any other environmental monitoring and reporting required by the Radioactive Material License, the Permittee shall submit the following reporting information.

1. Ground-Water Monitoring

Monitoring required in Part I.F of this Permit, shall be reported according to the following schedule, unless modified by the Executive Secretary:

a) Routine Annual Monitoring

Time Period	Report Due By
January 1 thru December 31	March 1

b) Accelerated Monitoring

Monitoring required in Part I.G.2 and Part I.G.3 of this Permit, shall be reported on a semi-annual schedule according to the following schedule, unless modified by the Executive Secretary:

Time Period	Report Due By
1st (January thru June)	September 1
2nd (July thru December)	March 1

The Permittee shall include within the written report a summary table of wells, sampling dates, analytes, and any other constructive information concerning all wells in accelerated monitoring. A more detailed discussion of each analyte and associated well will also be provided in the report.

2. Water Level Measurements

The Permittee shall comply with the following ground water level reporting requirements:

a) General Requirements – monthly water level measurements from all ground water monitoring wells will be reported annually in both measured depth to ground water and saline ground water elevations above mean sea level. In addition, annual freshwater equivalent head elevations will be reported for each well and will be derived from annual ground water specific gravity measurements made in that well during each annual sampling event.

b) Maps and Diagrams Format – distribution of freshwater equivalent head shall be summarized on an annual basis in the form of monthly potentiometric maps of the uppermost aquifer for each water level measurement event, and shall be submitted with the annual monitoring report required by Part I.H.1

c) Vertical Hydraulic Gradient Reporting – on a monthly basis the Permittee shall calculate and provide summaries of head data for each intermediate / shallow aquifer nested well group, including but not limited to: I-1-30 / I-1-100, ~~I-3-30 / I-3-100~~GW-153 / GW153D, GW-19A / GW-19B, GW-27/GW-27D, and GW-139/GW-139D. Said summaries shall include measured water level depth, calculations of ground water level elevations, both saline and fresh water equivalents, in both the shallow and confined aquifers for each water level measurement event and include calculations of both the saline and fresh water equivalent vertical gradients (ft/ft) for each nested well group. These summaries shall be submitted with the annual monitoring report as required by Part I.H.1.

d) Horizontal Hydraulic Gradient Reporting – on a monthly basis the Permittee shall calculate the following and provide within the annual monitoring report as required by Part I.H.1:

1) A site-wide summary of maximum, minimum, and average horizontal hydraulic gradient for all wells located in Section 32 based on saline and fresh water equivalent ground water elevations and

2) Individual disposal cell summary of maximum, minimum, and average horizontal hydraulic gradient based on saline and fresh water equivalent ground water elevations for the Class A, Class A North LARW, 11e.(2), and Mixed Waste disposal facilities. Determination of these individual hydraulic gradients shall be made after division of each disposal cell into smaller sub-areas for purposes of hydraulic gradient comparisons through time, as approved by the Executive Secretary. On an individual cell basis, the Permittee shall identify the cell sub-areas where the monthly maximum, minimum, and average hydraulic gradients occurred, as summarized in the August 31, 2004 letter response from Envirocare of Utah Inc. to DRC comments regarding the 2003 2nd Semi-Annual Ground Water Report.

In the event that the average fresh water equivalent horizontal hydraulic gradient of any sub-area exceeds the cell-specific Permit limit listed below, the Permittee shall report and identify the sub-area in which the exceeded limit occurred within the annual ground water monitoring report required by Part I.H.1 of this Permit.

Disposal Cell	Fresh Water Equivalent Horizontal Hydraulic Gradient Limit
Class A	1.00E-3
Class A North	1.00E-3
LARW	9.67E-4
Mixed Waste	9.67E-4
11e.(2)	3.29E-3

3. Ground Water and Pore Water Quality Sampling

Reporting will include:

a) Field Data Sheets – or copies thereof, including the field measurements, required in Part I.F.5(c)(2) of this Permit, and other pertinent field data, such as:

1) Ground Water Monitoring – well name/number, date and time, names of sampling crew, type of sampling pump or bail, measured casing volume, volume of water purged before sampling, volume of water collected for analysis.

b) Results of Ground Water, Pore Water, and Surface Water Analysis – including date sampled, date received; and the results of analysis for each parameter, including: value or concentration, units of measurement, reporting limit (minimum detection limit for the examination), analytical method, the date of the analysis, counting error for each radiochemical analysis, and total anions and cations for each inorganic analysis.

c) Quality Assurance Evaluation – with every sampling report the Permittee shall include a quality assurance evaluation of the reported ground water and pore water data. Said report shall evaluate the sample collection techniques, sample handling and preservation, and analytical methods used in sampling with the objective of verifying the accuracy of the compliance monitoring results.

d) Electronic Data Files and Format – in addition to written results required for every sampling report, the Permittee shall provide an electronic copy of all laboratory results for ground water, pore water, and surface water quality sampling. Said electronic files shall consist of a Comma Separated Values (CSV) file format, or as otherwise approved by the Executive Secretary.

4. Spill Reporting

The Permittee shall report as per UAC 19-5-114, any spill or leakage of waste or waste liquids which come in contact with native soil or ground water in compliance with Part II.I of this Permit. For spills of solid waste greater than 100 kg, the spill must be reported to the Division of Radiation Control within 7 calendar days of discovery.

5. Post-Closure Monitoring

Reporting of post-closure monitoring shall comply with the requirements of the currently approved Post-Closure Monitoring Plan in Appendix F of this Permit.

6. Annual "As-Built" Report

The Permittee shall submit an annual "As-Built" Report to document interim construction of the Class A, Class A North, and 11e.(2) Disposal cells in compliance with the currently approved design and specifications and LLRW and 11e.(2) Construction Quality Assurance/Quality Control Plan (Radioactive Materials License, Condition 44). These reports will be submitted for the Executive Secretary's approval on or before December 1of each calendar year and will be prepared in accordance with the LLRW and 11e.(2) Construction Quality Assurance/Quality Control Plan..

7. <u>Waste Characterization Reporting</u>

In the event that a new contaminant is detected in any waste at the facility, which has not been authorized by Part I.E.1, or if concentrations of approved contaminants are detected above the limits established in Part I.E.2 of this Permit, the Permittee shall notify the Executive Secretary in writing within 7 calendar days from the date of discovery.

8. <u>Collection Lysimeter Reporting</u>

The Permittee shall provide a verbal report to the Executive Secretary within 24 hours of discovery of the presence of any fluid in the standpipe of the collection lysimeters. The Permittee shall provide a written report of the incident to the Executive Secretary within 7 calendar days of discovery. The Permittee shall provide a report of the annual video log survey of the lysimeter's drainpipe, as required by the currently approved Appendix C of this Permit, on or before December 31 of each calendar year.

9. <u>Reporting of Mechanical Problems or Discharge System Failures</u>

The Permittee shall verbally notify the Executive Secretary within 24 hours of initial discovery of any mechanical or discharge system failure that could affect the chemical characteristics or volume of the discharge. The Permittee shall submit a written report of the failure within 7 calendar days of said failure.

10. <u>Meteorological Reporting</u>

On or before March 1 of each calendar year, the Permittee shall submit an annual meteorological report for the previous meteorological year (January 1 to December 31) for Executive Secretary approval.

The objective of this report shall be to show that the meteorological assumptions made in the infiltration and unsaturated zone modeling used to support issuance of the Permit were conservative or representative of the actual conditions at the site. In addition, and in conjunction with an application for permit renewal, 180 days before expiration of the Permit, the Permittee shall submit a summary report of all meteorological data collected since issuance of the last Permit (minimum of 4 years of data). Said report shall compare the data observed against regional normal values, as available, and provide summary statistics of all meteorological data collected.

11. <u>Containerized Waste Storage Area Reporting</u>

The Permittee shall report the following events in accordance with the requirements of Part I.E.10:

a) Failure of sump pump or other equipment to provide removal of stormwater and free and uninterrupted drainage of the pad, and

b) Any container spill or leakage that may have caused a release to the subsurface soils or ground water via cracks or other damage to the asphalt surface.

12. Evaporation Ponds Reporting

a) Annual Water Quality Sampling –annual water quality samples collected and analyzed shall be reported in conjunction with the ground water quality monitoring report required by Part I.H.1 of this Permit.

b) 1995, 1997, 2000, Mixed Waste, and Northwest Corner Evaporation Pond Daily Monitoring – the Permittee shall report results of daily monitoring for the 1995, 1997, 2000, Mixed Waste, and Northwest Corner evaporation ponds as follows:

1) BAT Failure Reporting – the Permittee shall report the following monitoring requirements pursuant to Part I.G.4.b:

a) Failure to maintain the 24-inch vertical freeboard requirement of Part I.E.14.a.4,

b) Failure of operational status for leak detection system pump, pump controller, head/pressure transducer, and/or flow meter equipment, pursuant to Part I.E.14.a.1,

c) Daily average leak detection pumpage volumes in excess of the volume monitoring thresholds established in Part I.F.14.b, or the BAT performance standards listed in Part I.E.14.a.2, and

d) Daily leak detection sump head values in excess of the BAT performance standards established pursuant to Part I.E.14.a.3.

2) Leak Detection System Pump Test Reporting – within 15 calendar days of completion of any leak detection system pump test required by Part I.F.13.b of this Permit, the Permittee shall submit a written report for Executive Secretary approval to document equipment, methods, and results of said pump test.

c) Annual Pump Inspection – results of the annual pump inspection and bor-o-scope video inspection conducted in accordance with Part I.F.13.d shall be submitted for the Executive Secretary's approval as part of the 1st Semi-annual BAT Monitoring Report.

13. Annual Ground Water Usage Report

On or before March 1 of each calendar year the Permittee shall survey and report the location of all ground water withdrawals within at least a 1-mile radius of the facility boundary. The purpose of this report will be to locate all points near the facility where ground water is pumped or otherwise removed for any consumptive use, including domestic, agricultural, or industrial purposes. This report shall include a survey of water right appropriations found in the area of interest, identify the owners thereof, and disclose the physical location and depths of all such ground water withdrawals.

14. Reserved

15. Mixed Waste Cell Leachate Reporting

The Permittee shall report the results of Mixed Waste Leachate water quality sampling and analysis required by Part I.F.15 of this Permit with the annual ground water monitoring reports required by Parts I.H.1 and I.H.3.

16. BAT Non-Compliance Reporting Requirements

For all facilities subject to requirements under the currently approved BAT Performance Monitoring Plan and BAT Contingency Plan (Appendix J and K, respectively) the Permittee shall provide verbal notification to the Executive Secretary of any BAT failures that are not corrected within 24 hours. All such verbal notifications shall be followed-up with a written notification within 7 calendar days.

17. Annual Cover Test Cell Report

On or before March 1 of each calendar year the Permittee shall submit an annual report for Executive Secretary approval. The annual report shall detail the Permittee's progress in implementing the corrective action plan required under Radioactive Material License Condition 28, provide the data collected in the past year, analyze the data, and interpret the meaning of the data relative to the overall objective of the corrective action plan.

18. Reserved

19. Railcar Rollover Facility Reporting

The Permittee shall submit the daily inspection results required in Part I.E.7c.2 with each Semi-annual BAT Monitoring Report. The annual inspection and repair activities required under Part I.E.17 shall be submitted with the First Semi-annual BAT Monitoring Report of each calendar year. The annual inspection report shall document all inspection and repair activities including photographs of the condition of the surfaces both before and after repairs.

20. BAT Semi-annual Monitoring Report

The Permittee shall submit a semi-annual BAT monitoring report to document compliance with the BAT performance standards mandated by Part I.E of this Permit. The report shall provide results, calculations, and evaluations of daily BAT monitoring data required in Part I.F of this Permit, including but not limited to the following:

a) 1995, 1997, 2000, Mixed Waste, and Northwest Corner Evaporation Ponds – the Semi-annual BAT monitoring report shall:

   1) Include a quality assurance evaluation of all daily leak detection system flow volume and head data collected,

   2) Include results of daily flow and head monitoring of the leak detection sump at each pond,

3) Include results of weekly calculation of daily average flow volumes from the leak detection sump at each pond, pursuant to Part I.F.13.a.3 of this Permit,

4) Evaluate any apparent trends in daily flow and head monitoring with respect to the pond's ability to comply with the BAT performance standards mandated by Part I.E.14 of this Permit.

b) Stormwater Management – the BAT Semi-annual report shall include daily stormwater monitoring records generated pursuant to Part I.F.24.

c) Reporting Schedule – the BAT Semi-annual Monitoring Report shall be submitted for Executive Secretary approval in accordance with the following schedule:

Half	Report Due On
1st (January –June)	September 1
2nd (July-December)	March 1

*The Second Half Report shall include results of the required annual pressure tests for dual-walled pipe as identified in Part I.F.2.m.

21. Manifest Radioisotope Inventory Report

180 days prior to Permit expiration, the Permittee shall submit for Executive Secretary approval a summary report of activities for radioisotopes including, but not limited to Aluminum-26, Berkelium-247, Calcium-41, Californium 250, Chlorine-36, Rhenium-187, Terbium-157, and Terbium-158; as listed in the current Radioactive Materials License (UT#2300249) Condition 29.E. Said report will be generated from the Clive facility Manifest Inventory (Permittee's EWIS database). The report shall provide a comprehensive, inclusive, and systematic evaluation of all manifest inventory data available for these radioisotopes disposed at the LARW, Class A, Class A North, 11e.(2), Mixed Waste, and any other embankment (excluding the Vitro Embankment) at the Clive facility. The report shall consist of a table of these and all other radioisotopes, which have been disposed at the Permittee's Clive facility to date, and will include, but is not limited to: (1) total of individual radioisotopes activity (mCi), (2) radioisotope half-life (years, days, minutes, etc.), (3) distributions coefficients for each radioisotope (L/kg), and (4) the current overall average activity concentration of each radioisotope, determined by dividing each isotope's total individual inventoried activity disposed by the mass of the current waste (pCi/.gm) found in all embankments listed at the facility.

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22. Comprehensive Ground Water Quality Evaluation Report

180 days prior to Permit expiration, the Permittee shall submit for Executive Secretary approval a comprehensive ground water quality evaluation report for the site. In submittal of this report, the Permittee shall present a complete and

thorough evaluation of all ground water and vadose zone water quality data available for the LARW, Class A, Class A North, 11e.(2), and Mixed Waste facilities. Said report shall be similar to the September 1, 2004 Comprehensive Ground Water Quality Evaluation Report and shall include but not be limited to:

a) Graphs of temporal concentration trends for all compliance monitoring parameters and wells across the entire period of record, and an evaluation of parameter temporal relationships,

b) Number of water quality data available for each compliance parameter for each well,

c) Statistical tests of normality for each compliance parameter water quality data population, including univariate tests or equivalent,

d) Calculation of mean concentration and standard deviation on direct concentration values; for water quality parameter populations that fail the normality test, provide mean concentrations and standard deviations on transformed values that are normally distributed,

e) Calculation of mean concentration plus the second standard deviation for comparison with existing ground water protection levels to identify parameters that warrant an evaluation for ground water protection level adjustments based on natural variations in background concentrations, and

f) Isoconcentration maps of spatial concentration trends across Section 32 and an evaluation of facies and spatial relationships of water quality parameters that warrant an evaluation for ground water protection level adjustments based on section e) above.

23. Reserved

24. Revised Hydrogeologic Report

180 days prior to Permit expiration, the Permittee shall submit for Executive Secretary approval a revised hydrogeologic report for the disposal facility and surrounding area. In submittal of this report the Permittee shall provide a comprehensive and thorough description of hydrogeologic conditions at the facility current through the time of report submittal. This report will include, but is not limited to an evaluation of:

a) Ground-water hydraulics, including ground-water flow directions, velocities, and hydraulic gradients, in both the horizontal and vertical directions, and will include equipotential maps, cross-sections, and related calculations, and

b) An updated evaluation and reinterpretation of the site hydrogeology using all available data including new or additional data acquired since Executive

c) Secretary approval of the last revised hydrogeologic report dated September 1, 2004.

I. Compliance Schedule

1. Ground Water Institutional Control Plan

The Permittee shall submit a ground water institutional control plan for Executive Secretary approval at the time the site Decontamination and Decommissioning Plan required under Radioactive Materials License Condition 74 is submitted. In submittal of this plan the Permittee shall eliminate future inadvertent intrusion into potentially contaminated ground water at the disposal facilities and subsequent routes of exposure to the public and the environment. Said plan shall include at least one of the options listed in the July 27, 1998 Utah Division of Radiation Control Request for Information.

2. Groundwater Mound Dewatering Near Wells GW-19A/GW-19B

On or before January 15, 2010, the Permittee will submit a plan and schedule for Executive Secretary review and approval for long-term pumping of the shallow aquifer at or near monitoring well GW-19A. The purpose of this pumping is to eliminate any downward hydraulic gradient from the shallow to the intermediate aquifer at or near well GW-19A. If after review of the plan and schedule, the Executive Secretary determines that additional information is required, the Permittee shall provide all requested information and resolve all issues identified within a timeframe agreed to by the Executive Secretary and the Permittee. Within 60 days of Executive Secretary approval of said plan and schedule, the Permittee shall implement the approved plan and schedule.

3. Background Ground Water Quality Report for the new Mixed Waste Compliance Wells.

The Permittee shall submit for Executive Secretary approval four quarters of sampling, for all Mixed Waster parameters listed in Table 1E of this Permit, for new Mixed Waste embankment wells:

GW-151 GW-152 GW-153 GW-154

to evaluate which parameters, if any, require additional data so that it can be included in the Ground Water Protection Level Exceptions for Mixed Waste, Table 1F. This report shall include the wells and parameters needing additional evaluation. The Executive Secretary does not anticipate the background concentrations for any parameter listed in Table 1E to be greater than their respective ground water protection levels. As a result, compliance monitoring for these parameters will commence in the new Mixed Waste Embankment wells with the Permittee's completion of the four quarters of sampling. With the completion of this quarterly sampling if any parameters in any well requires additional evaluation, with which to calculate background values for inclusion in the Mixed Waste Exceptions Table, Table 1E, a minimum of an additional eight quarters of sampling will commence, to build a data population. The Permittee will than submit a background ground water quality report for the Mixed Waste embankment parameters and compliance monitoring well to be listed in Table 1E of this Permit .

This report shall include inter-well descriptive statistics for each Parameter, and well in question, such as:

a. Graphs of temporal concentration trends in each well for each monitoring constituent with an evaluation of seasonal and analytical variations,

b. Normality testing along with a discussion of those data points, if any, that are outliers and justification of why the outliers should or should not be removed from the population prior to performing statistical calculations,

c. Calculation of mean concentration and standard deviation for each constituent in each well, and

d. Calculation of mean concentration plus two (2) standard deviations for each constituent in each well.

After review and approval of this report, the Executive Secretary may reopen this Permit and revise the ground water protection levels for the Mixed Waste embankment compliance wells. Compliance monitoring will continue in compliance monitoring wells GW-130, GW-131, and GW-132 until their abandonment.

PART II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling

Samples taken in compliance with the monitoring requirements established under Part I shall be representative of the monitored activity. Failure by the Permittee to conduct all ground water and pore water sampling in compliance with the currently approved Water Monitoring Quality Assurance Plan in Appendix B of this Permit shall be considered a failure to monitor and may subject the Permittee to enforcement action.

B. Analytical Procedures

Water sample analysis must be conducted according to test procedures specified under UAC R317-6-6.3(L), unless other test procedures have been specified in this Permit. All sample analysis shall be performed by laboratories certified by the State Health Laboratory, or otherwise after prior written approval by the Executive Secretary.

C. Penalties for Tampering

The Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this Permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results

Monitoring results obtained during each reporting period specified in the Permit, shall be submitted to the Executive Secretary, at the following address:

Utah Department of Environmental Quality
Division of Radiation Control
195 North 1950 West
P.O. Box 144850
Salt Lake City, Utah 84114-4850
Attention: Ground Water Quality Program

E. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this Permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this Permit, using approved test procedures as specified in this Permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted. Such increased frequency shall also be indicated.

G. Records Contents

Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements,
2. The individual(s) who performed the sampling or measurements,
3. The date(s) and time(s) analyses were performed,

4. The individual(s) who performed the analyses,
5. The analytical techniques or methods used, and
6. The results of such analyses.

H. Retention of Records

The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and copies of all reports required by this Permit, and records of all data used to complete the application for this Permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Executive Secretary at any time.

I. Twenty-Four Hour Notice of Noncompliance Reporting

1. The Permittee shall verbally report any noncompliance which may endanger public health or the environment as soon as possible, but no later than 24 hours from the time the Permittee first became aware of the circumstances. The report shall be made to the Utah Department of Environmental Quality 24-hour number, (801) 536-4123, or to the Division of Water Quality, Ground Water Protection Section at (801) 538-6146, during normal business hours (8:00 am – 5:00 pm Mountain Time).
2. A written submission shall also be provided to the Executive Secretary within 5 days of the time that the Permittee becomes aware of the circumstances. The written submission shall contain:
    a) A description of the noncompliance and its cause,
    b) The period of noncompliance, including exact dates and times,
    c) The estimated time noncompliance is expected to continue if it has not been corrected, and
    d) Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.
3. Reports shall be submitted to the addresses in Part II.D, Reporting of Monitoring Results.

J. Other Noncompliance Reporting

Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for Part II.D are submitted.

K. Inspection and Entry

The Permittee shall allow the Executive Secretary or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the Permit;
2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Permit;
3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit; and

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

L. Monitoring Well "As-Built" Reports

In the event that additional ground water monitoring wells are required by the Executive Secretary, diagrams and description describing the final completion of the monitoring wells shall be submitted within 60 days of construction of each well. These reports will include:

1. Casing: depth, diameter, type of material, type of joints.
2. Screen: length, depth interval, diameter, material type, slot size.
3. Sand Pack: depth interval, material type and grain size.
4. Annular Seals: depth interval, material type.
5. Surface Casing(s) and Cap: depth, diameter, material type.
6. Survey Coordinates and Elevation: ground surface and elevation of water level measuring point in feet above mean sea level, measured to 0.01 of a foot. Said coordinates and elevation shall be conducted and certified by a Utah Licensed Land Surveyor.
7. Results of slug tests to determine local aquifer permeability in the vicinity of the well. Said tests shall conform with ASTM Method 4044-91. Test results and data analysis thereof shall be submitted for Executive Secretary approval.

M. Plugging and Abandonment Reports

Within 30 days of completion of plugging and abandonment of any environmental measurement system or instrument, including but not limited to ground water monitoring wells, piezometers, soil tensiometers or moisture instrumentation, or any other stationary device to make environmental measurements, the Permittee shall submit an "As-Plugged" report for Executive Secretary approval. Failure to comply with any condition of said approval shall constitute a violation of this Permit.

PART III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply

The Permittee must comply with all conditions of this Permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The Permittee shall give advance notice to the Executive Secretary of the Water Quality Board of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions

The Act provides that any person who violates a permit condition implementing provisions of the Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions is subject to a fine not exceeding $25,000 per day of violation. Any person convicted under Section 19-5-115(2) of the Act a second time shall be punished by a fine not exceeding $50,000 per day. Nothing in this Permit shall be construed to relieve the Permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense

It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Permit.

D. Duty to Mitigate

The Permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this Permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this Permit. Failure to maintain all treatment and control systems in fully functional operating order or condition at the facility is a violation of this Permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of the Permit.

PART IV. GENERAL REQUIREMENTS

A. Prior Approval

Pursuant to UAC R317-6-6.1.A, the Permittee may not construct, install, or operate waste or wastewater storage, treatment, or disposal facilities, or any other facility that discharges or may discharge pollutants that may move directly or indirectly into ground water without a ground water discharge permit from the Executive Secretary. Pursuant to UAC R317-6-6.3.J, the Permittee shall submit engineering plans, specifications, and plans for operation and maintenance of a proposed facility prior to Executive Secretary approval.

B. Planned Changes

The Permittee shall give notice to the Executive Secretary as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required when the alteration or addition could significantly change the nature of the facility or increase the quantity of pollutants discharged.

C. Modification of Approved Engineering Design, Specifications, or Construction

Any modification to the approved engineering design, specifications, or construction of the facility cited in this Permit shall require prior Executive Secretary approval. Said facilities shall include, but are not limited to:

1. Waste and Wastewater Disposal and Containment Facilities – including all related engineering containment such as liner, cover, and drainage systems,
2. Waste and Wastewater Handling and Storage Facilities – used to handle, manage or store wastes prior to permanent disposal,
3. Decontamination Facilities – used to decontaminate equipment used in the transportation or disposal of waste, and
4. Environmental Monitoring Systems and Equipment – including ground water monitoring wells, piezometers, meteorological monitoring equipment, soil moisture and lysimeter instrumentation, or any other permanent system, mechanism, or instrument to make environmental measurements required by this Permit.

D. Anticipated Noncompliance

The Permittee shall give advance notice of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

E. Permit Actions

This Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

F. Duty to Reapply

If the Permittee wishes to continue an activity regulated by this Permit after the expiration date of this Permit, the Permittee must apply for and obtain a permit renewal or extension. The application should be submitted at least 180 days before the expiration date of this Permit.

G. Duty to Provide Information

The Permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Permit, or to determine compliance with this Permit. The Permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by this Permit.

H. Other Information

When the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Executive Secretary, it shall promptly submit such facts or information.

I. Signatory Requirements

All applications, reports or information submitted to the Executive Secretary shall be signed and certified.

1. All permit applications shall be signed as follows:
   a) For a corporation: by a responsible corporate officer.
   b) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.
   c) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2) All reports required by the permit and other information requested by the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
   a) The authorization is made in writing by a person described above and submitted to the Executive Secretary, and,
   b) The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3) Changes to Authorization. If an authorization under Part IV.I.2 is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part IV.I.2 must submitted to the Executive Secretary prior to or together with any reports, information, or applications to be signed by an authorized representative.

4) Certification. Any person signing a document under this section shall make the following certification: "I certify under penalty of law that this document and all

5) attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

J. Penalties for Falsification of Reports

The Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this Permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

K. Availability of Reports

Except for data determined to be confidential by the Permittee, all reports prepared in accordance with the terms of this Permit shall be available for public inspection at the offices of the Executive Secretary. As required by the Act, permit applications, permits, effluent data, and ground water quality data shall not be considered confidential.

L. Property Rights

The issuance of this Permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

M. Severability

The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this Permit, shall not be affected thereby.

N. Transfers

This Permit may be automatically transferred to a new Permittee if:

1. The current Permittee notifies the Executive Secretary at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new Permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Executive Secretary does not notify the existing Permittee and the proposed new Permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

O. State Laws

Nothing in this Permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, penalties established pursuant to any applicable state law or regulation under authority preserved by Section 19-5-117 of the Act.

P. Reopener Provision

This Permit may be reopened and modified, following proper administrative procedures, to include the appropriate limitations and compliance schedule, if necessary, if one or more of the following events occur:

1. If new ground water standards are adopted by the Board, the Permit may be reopened and modified to extend the terms of the Permit or to include pollutants covered by new standards. The Permittee may apply for a variance under the conditions outlined in R317-6.4(D)
2. Changes have been determined in background ground water quality.
3. Determination by the Executive Secretary that changes are necessary in either the Permit or the facility to protect human health or the environment.

APPENDIX A:

Contingency Plan
for
Exceedances of Ground Water Protection Levels

SUBMITTED: August 5, 1991

APPROVED: September 24, 1991

RETITLED: June 30, 1999

APPENDIX B:

Water Monitoring Quality Assurance Plan

APPROVED: December 5, 1991

LATEST REVISION: August 30, 2011

APPENDIX C:

Construction Quality Assurance Plan for Collection Lysimeter Construction and Operation, Maintenance, and Closure Plans for Collection Lysimeters and Related Approvals

SUBMITTED: September 16, 1992 and October 21, 1992, respectively

APPROVED: September 21, 1992 and November 27, 1992, respectively

REVISED: June 27, 2011

APPENDIX D:

Reserved

APPENDIX E:

Procedure
for
Certification of 11e.(2) Material

REVISED: March 1994

APPENDIX F:

Post-Closure Monitoring Plan for LARW and 11e.(2) Disposal Cells

APPROVED: September 13, 1994

REVISED: January 18, 2000

APPENDIX G:

Weather Station Monitoring Plan

APPROVED: September 14, 1994

REVISED: October 31, 2008

APPENDIX H:

Reserved

APPENDIX I:

Reserved

APPENDIX J:

Best Available Technology (BAT) Performance Monitoring Plan

LATEST REVISION: December 12, 2011

APPENDIX K:

Best Available Technology (BAT) Contingency Plan

LATEST REVISION: November 14, 2011

Attachment B

DRC Staff Review of EnergySolutions Request:
DRC Technical Memorandum

EnergySolutions' Well Spacing Analyses for the Mixed Waste Embankment Expansion.

State of Utah
GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF RADIATION CONTROL
Rusty Lundberg
Director

MEMORANDUM

TO: John Hultquist, Licensing Manager JH 3/19/2012

FROM: Charles Bishop, PG, Hydrologeologist CBB 3/20/2012

DATE: November 7, 2011

SUBJECT: EnergySolutions' Well Spacing Analyses for the Mixed Waste Embankment Expansion.

EnergySolutions submitted a letter and report on July 19, 2011 requesting approval of a Class 3 Modification to their State-issued RCRA Part B Permit, Authorization for Top of Waste and Radon Barrier - Mixed Waste (MW) Cell Extension and Cover. This includes a northern expansion of the MW embankment. The MW embankment uses a mostly above-grade landfill design, constructed primarily of natural materials from the area and is in the southeastern corner of the Clive facility. The MW embankment is shown with respect to other Clive facility embankments in Figure 1. The Utah Division of Solid and Hazardous Waste (DSHW) reviews and approves modifications to design specifications of the MW embankment, and the State-issued Part B Permit. However, the MW embankment falls within overlapping regulatory jurisdictions for ground-water protection, with the Utah Division of Radiation Control (DRC) administrating a Ground Water Quality Discharge Permit (hereafter Permit). The EnergySolutions' Clive facility Permit requires ground-water protection levels for radiologic parameters be met for 500 years after closure, and that environmental impacts to ground water are kept within tolerable risk levels.

The present configuration of the MW embankment has 7 downgradient monitoring wells; 4 on the eastern side, 1 on the northeast corner, and 2 on the northern side. Downgradient monitoring wells for the present MW embankment is shown in figure 2. The DRC has reviewed the well spacing analysis of the proposed Class 3 modification to the MW embankment, proposed by EnergySolutions, for completeness and justification for approval of the well spacing analyses.

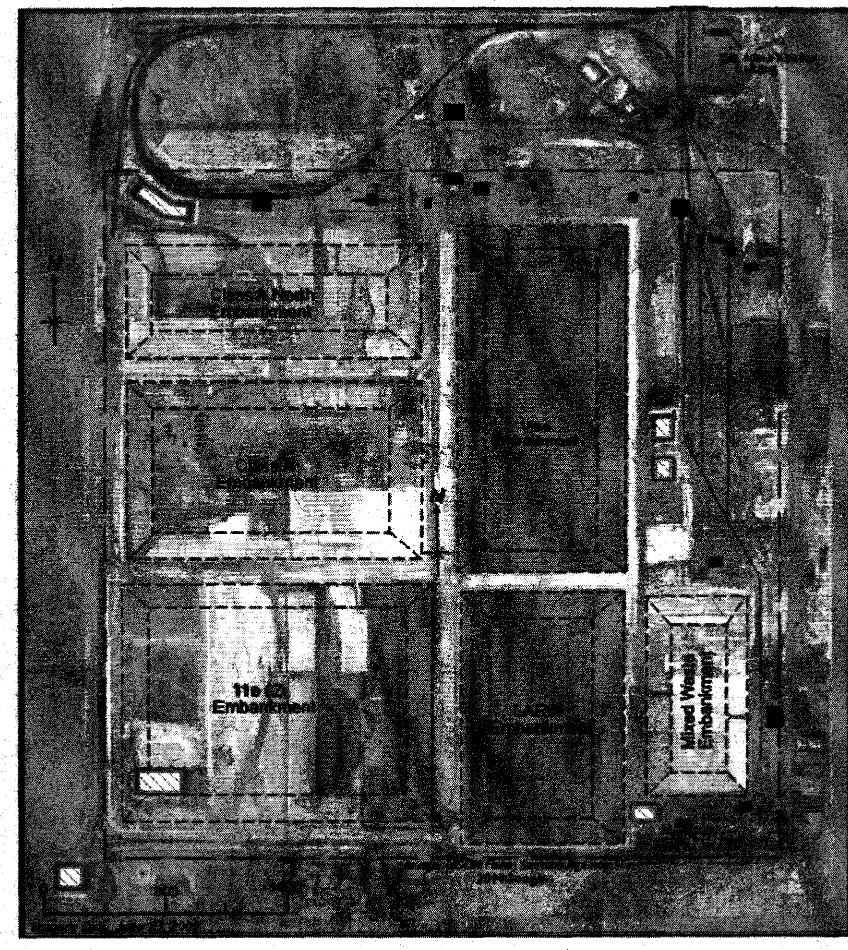

Figure 1. Layout of the Clive facility embankments, with the MW embankment in the southeastern part of the facility.

The design of a reliable and efficient ground-water monitoring network for the MW embankment is essential to identifying any leakage from the embankment, and determining its seriousness. EnergySolutions used an analytical model to determine well spacing. Because of the complexity of the equations involved in the analytical models, the analytical solutions are restricted to idealized cases where velocity is uniform over the area of interest and boundary conditions are well defined. The assumption of a uniform velocity and flow field implies constant hydrologic and transport properties and a uniform hydraulic gradient over the length of the plume, i.e. homogeneous and isotropic flow conditions within a uniform hydraulic gradient for the length of the plume. For the design of a dependable ground-water monitoring network for the MW embankment the following will need to be addressed:

> Can the analytical model, which is based on a homogeneity and isotropic aquifer, incorporate the effect of various uncertainties on contaminant transport used in ground-water monitoring network design?

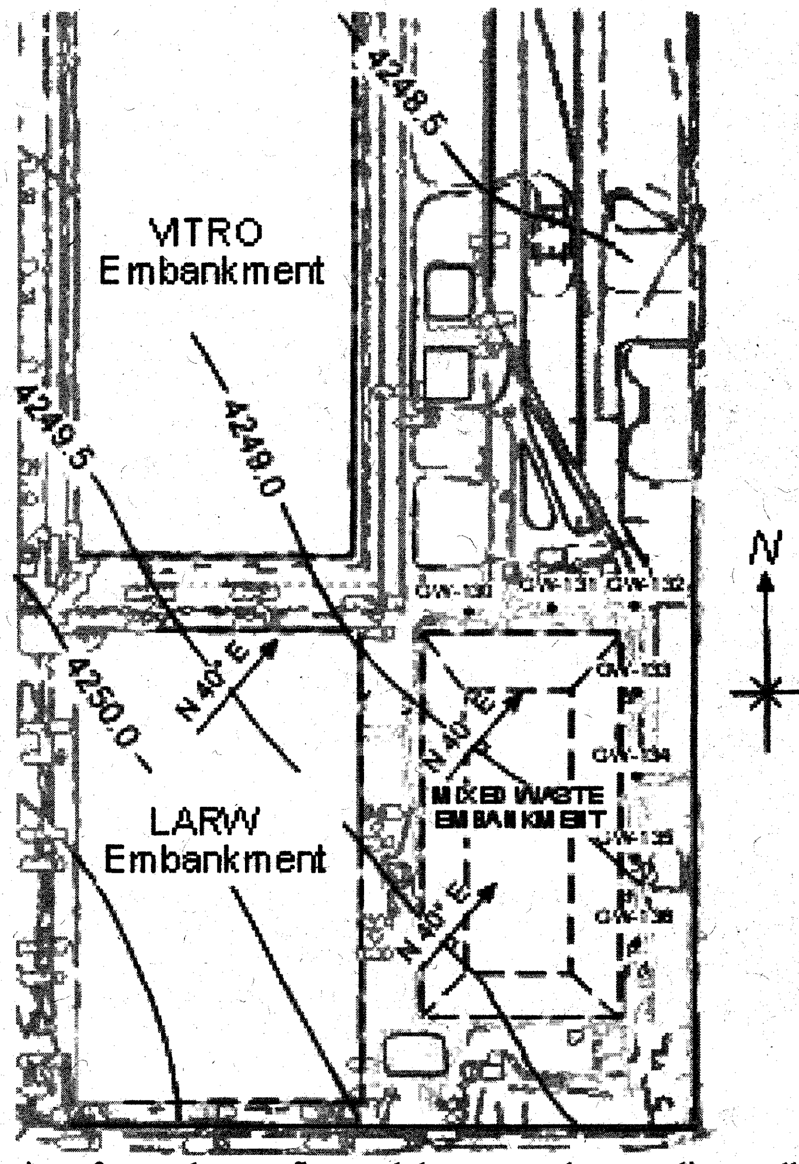

Figure 2. The direction of ground-water flow and the present downgradient wells for the MW embankment are also shown. Shallow aquifer hydraulic gradient below the MW embankment in November of 2010.

Can the uncertainty in subsurface characterization be quantified with the design of the monitoring network?

Are data sets developed that identify the size and shape of a plume, and the extent of migration into the buffer zone?

How many monitoring wells, and where should they be placed to maximize the likelihood of detection, the desired objectives?

> Is the well spacing network conservative for detecting the potential release of contaminants under the present ground-water flow direction, and will the well spacing remain adequate?

EnergySolutions' well spacing analysis estimates the effectiveness of the monitoring well network design by determining where a monitoring well would or would not detect a release from the embankment. The well spacing analysis utilized the Monitoring Efficiency Model (MEMO) developed by Golder Associated, Inc. MEMO is an analytical transport program used to optimize monitoring well locations, and is based upon a migrating contaminant plume's expansion as it moves down gradient from a continuous source. Assumptions of the plume generation routine used in the MEMO program includes one-dimensional ground-water velocity, i.e. negligible vertical ground-water flow and chemical transport; a uniform ground-water flow field; longitudinal, and transverse dispersion; first order degradation rates; finite contaminant source dimensions; and a steady-state (continuous) line source. The MEMO program was used to evaluate monitoring efficiency of various well locations, based on the ability of various well networks to intercept expected plumes of indicator parameters. Monitoring efficiency is defined as the ratio of the area of detection to the total areas of the site, and is determined using a grid of potential source points, defined within the potential source area, i.e. a contaminant plume is generated at each source point, if the plume is intersected by a monitoring well before it migrates beyond a specified boundary, the source is considered to be detected.

Input to the MEMO model includes discretization of the problem domain by defining the geometry of the potential source area, a grid of potential source points, buffer zone boundary, and monitoring well locations; and defining potential source width, contaminant transport parameters, and the dilution contour to be measured in the monitoring wells. Geometric data in the EnergySolutions' MEMO model used a standard coordinate system, and uniform source grid spacing. Site geometry includes coordinated for two source areas, the entire footprint of the embankment, 1.4×10^6 square feet [ft^2] and the area under the embankment top-slope 6.8×10^5 ft^2; the buffer zone grid spacing was set to 25 feet (ft) for the MW embankment; and monitoring well locations.

<u>Advection and Contaminant Velocities</u>

Ground-water flow and contaminant transport parameters for homogeneous and isotropic media under steady state flow conditions were used to determine the plume dimensions and configuration. Contaminant velocities were calculated using Darcy's law in the MEMO model with the following parameters:

> An aquifer effective porosity value of 0.29 was used. This value has been regarded as representative by the DRC in the past.
>
> Hydraulic gradients for the shallow aquifer below the MW embankment are calculated monthly by EnergySolutions, with an approximate average hydraulic gradient of 5.99×10^{-4} ft/ft, based on 18-years freshwater heads. The maximum permitted shallow aquifer hydraulic gradient below the MW embankment is 9.67×10^{-4} ft/ft, based on infiltration and transport modeling of the MW embankment. The ground-water flow direction in the

shallow aquifer below the MW embankment is considered to be approximately N40°E (see Figure 2). This ground-water flow direction has been used in previous well spacing analyses for both the Class A North, and MW embankments (Whetstone Associates, 2009a and 2009b). The hydraulic gradient and flow direction below the MW embankment are considered relatively uniform.

Underlying the MW embankment are the Unit 3 sand, and Unit 2 clay; wells are completed in the Unit 2 clay, and hydraulic conductivity have been determined for the Unit 2 clay. Hydraulic conductivities values were determined from the analysis of 96 slug test conducted in 36 wells and drill holes surrounding the MW embankment. Hydraulic conductivities evaluated in the well spacing analysis were 4.79×10^{-4} centimeters per seconds (cm/sec) (1.36 ft/day), based on the geometric mean; 7.03×10^{-4} cm/sec (1.99 ft/day), based on the upper 90% confidence level of the geometric mean; and 1.09×10^{-3} cm/sec (3.09 ft/day), based on the upper 90% confidence level of the arithmetic mean of aquifer tests.

Retardation factor is constituent specific and is calculated from the sorption coefficient (K_d), soil density, and effective porosity at the site. The calculated retardation factors are given in Table 1. The models used I-129 and Tc-99, K_d used for I-129 was 0.12 and for Tc-99 was 0.11. The retardation factors calculated were 1.662 and 1.607 respectively (see Table 1). The selection of I-129 and Tc-99 is considered conservative since these two parameters have very high mobility (low retardation) in ground water.

Table 1. Calculated retardation factors.

Constituent	K_d (L/kg)	Density (kg/m^3)	Porosity	Retardation factor
I-129	0.12	1,600	0.29	1.662
Tc-99	0.11	1,600	0.29	1.607

The MEMO program uses a plume generating routine to compute the sizes and shapes of the plumes from each grid point in the source area. The program assumes that solute is released along a continuous line source in a uniform aquifer, and predicts the concentration that would be observed at locations downgradient of the source. Average contaminant velocities used in the model and reported in the EnergySolutions report were calculated using the porosity, hydraulic gradient, hydraulic conductivity, and retardation factor for six scenarios for each constituent. Parameter values used in each scenario and the contaminant velocities are listed in Table 2.

Table 2. Calculated advection and contaminant velocities.

Constituent	Effective Porosity	Hydraulic Gradient (f/ft)		Hydraulic Conductivity (ft/day)		Retardation Factor	Advection Velocity (ft/day)	Contaminant Velocity (ft/day)
I-129	0.29	Permit Maximum	9.67E-04	Arithmetic mean +90% CI	3.09	1.662	1.03E-02	6.2E-03
I-129	0.29	Permit Maximum	9.67E-04	Geometric mean +90% CI	1.99	1.662	6.65E-03	4.00E-03
I-129	0.29	Permit Maximum	9.67E-04	Geometric mean	1.36	1.662	4.52E-03	2.72E-03

Constituent	Effective Porosity	Hydraulic Gradient (f/ft)		Hydraulic Conductivity (ft/day)		Retardation Factor	Advection Velocity (ft/day)	Contaminant Velocity (ft/day)
I-129	0.29	Average	5.99E-04	Arithmetic mean +90% CI	3.09	1.662	6.38E-03	3.84E-03
I-129	0.29	Average	5.99E-04	Geometric mean +90% CI	1.99	1.662	4.12E-03	2.48E-03
I-129	0.29	Average	5.99E-04	Geometric mean	1.36	1.662	2.8E-03	1.69E-03
Tc-99	0.29	Permit Maximum	9.67E-04	Arithmetic mean +90% CI	3.09	1.607	1.03E-02	6.41E-03
Tc-99	0.29	Permit Maximum	9.67E-04	Geometric mean +90% CI	1.99	1.607	6.65E-03	4.14E-03
Tc-99	0.29	Permit Maximum	9.67E-04	Geometric mean	1.36	1.607	4.52E-03	2.81E-03
Tc-99	0.29	Average	5.99E-04	Arithmetic mean +90% CI	3.09	1.607	6.38E-03	3.97E-03
Tc-99	0.29	Average	5.99E-04	Geometric mean +90% CI	1.99	1.607	4.12E-03	2.56E-03
Tc-99	0.29	Average	5.99E-04	Geometric mean	1.36	1.607	2.8E-03	1.74E-03

Contaminant velocity is a critical element in relation to the overall conservativeness of the model, because variations in the velocity will create differences in plume shape, i.e. high contaminant velocities will result in a long and narrow plume; whereas, slow velocities create a short-wedged shape plume. An evaluation of model parameter input values, to see if they are representative, and conservative based on site conditions, the elements of the contaminant velocity were follows:

Effective Porosity - The EnergySolutions' MEMO model used an effective porosity of 0.29, the same as used in other well spacing analysis, and in Infiltration and Transport modeling at the Clive facility. The advective velocity is somewhat sensitive to effective porosity, because of the inverse relationship; however, the shape of the plume is independent of effective porosity, so long as the effective porosity is uniform over the area of the plume. This value was determined through empirical laboratory testing of representative Clive facility samples and has been regarded as representative of the site by the DRC. Because effective porosity is a determined parameter, the value and assumption of uniformity is considered reasonable.

Hydraulic Gradient - is calculated by EnergySolutions using Surfure (contouring program) for the unconfined shallow ground-water aquifer beneath the MW embankment on a 50-foot centered grid. The hydraulic gradient below the MW embankment averaged 9.73×10^{-4} ft/ft in November 2010, based on fresh-water heads. Infiltration and Transport modeling of the MW embankment used a shallow aquifer hydraulic gradient value of 1.0×10^{-6} ft/ft (Whetstone Associated, Inc., 2000). The maximum allowable shallow aquifer hydraulic gradient beneath the MW embankment is 9.67×10^{-4}ft/ft, as specified in the Permit. Using the permit maximum average hydraulic gradient the maximum allowable hydraulic gradient beneath the MW embankment is conservative, because it is a higher hydraulic gradient, or a steeper gradient than the measured average monthly gradient, and the average gradient has not exceeded this limit.

The principal direction of ground-water flow in the shallow aquifer beneath the MW embankment was set at N40°E. The hydraulic gradient and flow direction below the MW embankment are a reasonable approximation of the ground-water flow direction beneath the embankment (see figure 2).

Hydraulic conductivity – used in the final MEMO model (used to determine the well spacing) as input was a hydraulic conductivity of the 90% confidence level of the arithmetic mean 3.09 ft/day (1.09×10^{-3} cm/sec). To verify that this value is conservative a comparison was made with an early well spacing analysis for the MW embankment, which used a value of 1.51 ft/day (5.32×10^{-4} cm/sec), and the MW embankment Infiltration and Transport modeling, which used a value of 2.17 ft/day (7.67×10^{-4} cm/sec). Although the variability of these properties over the area of the Clive facility have been documented, their variability over several hundred foot length of the plume considered in this analysis will be considerable less. The value of hydraulic conductivity used in the final MEMO model is a higher hydraulic conductivity than used in Infiltration and Transport modeling, and the early well spacing analysis. This is considered conservative since higher velocity will produce more narrow and elongated shaped plumes.

Retardation Factor –is constituent specific, and is calculated using the sorption coefficient (K_d), dry bulk density of 1.600 kg/m^3, and a volumetric water content of 0.29, based on the effective porosity developed by solving the equation. This value is consistent with historical uses at the facility.

Overall, these input values are conservative in that they will produce a narrow shaped plume that requires tighter monitoring well network spacing.

Plume Generation

The plume generator is the routine in MEMO that calculates the size and shape of the Plume. Input parameters required for plume generation are direction of ground-water movement; average contaminant velocity; longitudinal and transverse dispersivities; molecular diffusion coefficient; and first-order radioactive decay constant. The plume generation routine used in the MEMO program to determine the sizes and shapes of the plumes is a two-dimensional analytical transport routine developed by Domenico and Robbine (1985), which assumes that solute is released along a continuous line source in a uniform aquifer, and predicts the configuration and concentration of the plume as it migrates downgradient from the source. Vertical migration of contaminants through the unsaturated zone to the water table is assumed to create a source of contamination in ground water that generates the contaminant plume. The source width depends upon the dimensions of the release at the surface, and the subsequent dispersion in the vadose zone. Besides contaminant velocity, parameters used in the plume generator are:

Width of Line Source - depends on the surface leak type and amount of lateral spreading in the vadose zone prior to arriving at the water table. The one foot line spacing is conservative because it produces a narrow plume. The MW embankment model used a one foot line source.

Dispersivity – is the physical process of spreading at the plume boundary, which cause the periphery of the plume to have reduced concentrations. Longitudinal dispersion was set at 72.1 over a 721 foot flow path, one tenth the distance from the center of the top slope to the line of compliance wells along the ground-water flow direction, N40°E (transverse is normally set at one tenth longitudinal). The 72.1 feet distance is reported as the distance from the center of the cell to the edge of waste on the N 40° E alignment. The width of the plume is sensitive to the dispersivity, particularly transverse dispersivity. Dispersion values are justified in the modeling documentation by reference to Gelhar et al. (1992), which determined that longitudinal dispersivity is typically 10% of the longitudinal flow distance, while transverse dispersivity is typically 10% of the longitudinal dispersivity. Because the magnitudes for longitudinal and transverse dispersivities are not known for the Clive facility, conservative estimates were developed from the literature.

Diffusion Coefficient – is a mechanism for transport of solutes through the saturated zone, in the absence of significant advective flux. EnergySolutions utilized literature values of diffusion for I-129 and Tc-99 for a saturated porous medium. Specifically, an effective diffusion coefficient of 1.19×10^{-3} ft^2/day for I-129, and 9.03×10^{-4} ft^2/day for Tc-99. These values were used in the well spacing analyses performed previously for the MW embankment. The diffusion coefficient is quite small compared to the advective velocity term and can for the most part be neglected.

Decay Rate Constants – used in the modeling for the MW embankment are consistent with decay constants used for I-129 and Tc-99 in previous Class A North and MW embankments will spacing analyses. First order decay constants used for I-129 was 1.21×10^{-10} per day, and for Tc-99 was 8.99×10^{-9} per day. The use of these values essentially negates the effect of decay, thus the use of radionuclide with large half-life does not affect the model outcome.

Dilutions Contour Values – in applying the MEMO program' it is necessary to identify a dilution contour for the plume generation routine that is related to appropriate detection limits for the types of constituents to be detected at the monitoring wells. The value chosen as a design basis will depend upon the required degree of conservatism. Dilution contours for I-129 was set to 2.66×10^{-6}, and Tc-99 were set to the lowest possible values in the MEMO program of 1.00×10^{-6}, because the lowest dilution contour values for Tc-99 of 1.23×10^{-7}. EnergySolutions argues that since I-129 and Tc-99 have long half lives they would arrive at the buffer zone boundary from anywhere within the source area given a sufficiently long advective velocity transport time.

Because MEMO is based upon an analytical simulation of physical processes, evaluation of the suitability and adequacy of the model are determined from the physical parameters and processes governing contaminant migration, rather than upon qualitative judgments of how many wells are enough. The DRC considers the EnergySolutions MEMO model suitable owing to it:

Having been used in past well spacing analysis.

Using steady-state models, which is common approach.

Uses an adequate system geometry.

Uses a representative value for longitudinal and transverse dispersivity.

Uses a reasonable direction and magnitude of ground-water velocity in the vicinity of the embankment.

Using a 2-dimensional plume generator, which give reasonable results in situation where the lateral dimension of an aquifer is greater than its thickness.

Uses a continuous source of leachate, ensuring the plume does not disperse below detection limits.

Assuming the probability of a release is equally likely at any given location within the source areas.

Using a high transport velocity results in less lateral spreading of the plume and a closer optimum well spacing.

Sensitivity Analysis

A limited sensitivity analysis of the EnergySolutions' MW embankment well spacing model was performed on ground-water flow direction, and contaminant transport velocity. These parameters were considered to have the greatest uncertainties by EnergySolutions, so the sensitivity analysis was done to understand how they affected monitoring efficiency. Other parameters to which the model is suspected to be sensitive to are the buffer zone width, dispersivity, and well spacing. Buffer zone width defines the limit a plume may extent before it should be detected by a monitoring well. The closer the buffer zone boundary is to the sources, the closer the monitoring wells need to be to each other. Plumes that are detected at a monitoring well before passing through the buffer zone are considered to have been detected. Buffer zone width is established by Permit requirements, and the approach is consistent with previous MEMO modeling at the Clive facility. Aquifer dispersivity is the process of ground-water mixing at the plume boundaries, causing the periphery of the plume to be reduced in concentration, and is a primary control on the fate and transport of contaminants. The MEMO program uses longitudinal and transverse dispersivities to describe mechanical spreading and mixing. Dispersitivity in the aquifer is scale and directional dependent, with longer flow paths resulting in higher flow dispersivity and dispersion is more vigorous in the direction of flow compared to directions normal to flow.

Dispersivity is to some extent controlled by the program, with the program recommending that longitudinal dispersivity be set at one tenth the distance from the center of the top slope to the line of compliance wells in the direction of ground-water flow, and transverse disperdivity set to 10% of the longitudinal dispersivity. Well spacing was determined by running simulations with different well spacing, i.e. manual iterations were run to find the most favorable well spacing at the target efficiency of 95% or greater, well spacing at the expanded MW embankment is generally consistent with existing monitoring well networks. Ground-water flow direction in the sensitivity analysis was varied from N0°E to N90°E. Based on ground-water flow directions, monitoring well efficiencies range from 100 to 53% for I-129, and 100 to 60% for Tc-99. Well spacing was also evaluated for a conservative high contaminant velocity and an average velocity condition of 6.4 and 1.69 ft/day, respectively. Some well spacing evaluations performed using the average contaminant velocity resulted in upgradient non-detection zones. Table 3 lists the sensitivity analysis monitoring efficiencies. The simulation indicates the MW embankment monitoring well network will meet the 95% criterion for conditions that can be practically expected at the site. i.e. if ground-water flow deviated from N40°E the direction could vary for N12°E to N82°E and velocities change within a reasonable range.

Table 3. Sensitivity analysis of monitoring efficiency modeling for the MW embankment.

Model Run	Constituent	Type	Source Area	Flow Direction	Contaminant Velocity (ft/day)	Upgradient Non-Arrival Zone	Undetected Leaks	Monitoring Efficiency (%)
MWI129a	I-129	Base Case	Footprint	N40°E	6.02 E-03	None	286/8196	96.5
MWI129c	I-129	Sensitivity	Footprint	N40°E	1.69E-03	Excluded	311/7166	95.7
MWI129e	I-129	Sensitivity	Topslope	N40°E	1.69E-03	Included	15/4004	99.6
MWI129f	I-129	Sensitivity	Footprint	N40°E	6.2E-03	None	402/8196	95.1
MWI129g	I-129	Sensitivity	Footprint	N90°E	6.2E-03	None	618/8196	92.5
MWI129h	I-129	Sensitivity	Footprint	N90°E	1.69E-03	None	565/8196	95.1
MWI129i	I-129	Sensitivity	Footprint	N84°E	1.69E-03	None	407/8496	95.0
MWI129j	I-129	Sensitivity	Footprint	N0°E	6.20E-03	None	1456/8496	82.2
MWI129k	I-129	Sensitivity	Footprint	N0°E	1.69E-03	Included	3503/8186	57.3
MWI129L	I-129	Sensitivity	Footprint	N0°E	1.69E-03	Excluded	341/4837	93.0
MWI129m	I-129	Sensitivity	Topslope	N90°E	6.2E-03	None	2/4004	100
MWI129n	I-129	Sensitivity	Topslope	N90°E	1.69E-03	None	0/4004	100
MWI129o	I-129	Sensitivity	Footprint	N11°E	6.2E-03	None	346/8196	95.8
MWI129p	I-129	Sensitivity	Topslope	N0°E	6.2E-03	None	122/4004	97
MWI129q	I-129	Sensitivity	Topslope	N0°E	1.69E-03	None	407/8496	95.0
MWI129r	I-129	Sensitivity	Topslope	N0°E	1.69E-03	Included	1873/4004	53.2
MWI129s	I-129	Sensitivity	Footprint	N5°E	1.69E-03	Excluded	222/4837	95.4
MWTc99a	Tc-99	Base Case	Footprint	N40°E	6.41E-03	None	303/8196	96.3
MWTc99b	Tc-99	Sensitivity	Footprint	N40°E	1.74E-03	Included	833/8196	98.8
MWTc99c	Tc-99	Sensitivity	Footprint	N40°E	1.74E-03	Excluded	308/7507	95.9
MWTc99e	Tc-99	Sensitivity	Topslope	N40°E	1.74E-03	None	0/4004	100
MWTc99f	Tc-99	Sensitivity	Footprint	N85°E	6.41E-03	None	408/8196	95
MWTc99g	Tc-99	Sensitivity	Footprint	N90°E	6.41E-03	None	530/8196	93.5
MWTc99h	Tc-99	Sensitivity	Footprint	N90°E	1.74E-03	None	509/8196	93.8
MWTc99i	Tc-99	Sensitivity	Footprint	N85°E	1.74E-03	None	389/8196	95.3
MWTc99j	Tc-99	Sensitivity	Footprint	N0°E	6.41E-03	None	1575/8196	80.8
MWTc99k	Tc-99	Sensitivity	Footprint	N0°E	1.74E-03	Included	3199/8196	61.0
MWTc99L	Tc-99	Sensitivity	Footprint	N0°E	1.74E-03	Excluded	466/5395	91.4
MWTc99m	Tc-99	Sensitivity	Topslope	N90°E	6.41E-03	None	0/4004	100

Model Run	Constituent	Type	Source Area	Flow Direction	Contaminant Velocity (ft/day)	Upgradient Non-Arrival Zone	Undetected Leaks	Monitoring Efficiency (%)
MWTc99n	Tc-99	Sensitivity	Topslope	N90°E	1.74E-03	None	0/4004	100
MWTc99o	Tc-99	Sensitivity	Footprint	N12°E	6.41E-03	None	406/8196	95
MWTc99p	Tc-99	Sensitivity	Topslope	N0°E	6.41E-03	None	203/4004	94.9
MWTc99q	Tc-99	Sensitivity	Topslope	N0°E	1.74E-03	Included	1571/4004	60.8
MWTc99r	Tc-99	Sensitivity	Topslope	N0°E	1.74E-03	Excluded	5/2356	99.8
MWTc99s	Tc-99	Sensitivity	Footprint	N6°E	1.74E-03	Excluded	262/5250	95.0

Summary and Conclusions

The MEMO model, employed by EnergySolutions to design the MW embankment monitoring well network, provides a method for quantifying the efficiency of a monitoring well network. As with any analysis of transport phenomena, judgment is required in the selection of input parameters and there is uncertainty in some input parameters, which may render questionable the model results. In the present model configuration (as a deterministic tool) these uncertainties are addressed by the use of conservative input parameters, and the performance of a limited sensitivity analysis. Monitoring efficiency was determined in the EnergySolutions' MEMO models by creating a grid of potential source points, defined within the source area, with a spacing of 25 ft; defining the monitoring well network; defining a buffer zone boundary, which is the limits to which the plume may extend before it should be detected by a monitoring well, with a grid spacing of 25 ft (same order as the source area grid spacing); setting concentrations to be detected at the monitoring wells; and generating a contaminant plume at each source point using an analytical contaminant transport solution (plume generator). The MEMO program solved for concentrations at each grid point along the buffer zone boundary, and if the plume generated at a source point is intersected by a monitoring well before it migrates beyond the buffer zone boundary, the source point is considered to be detected. The monitoring efficiency is calculated from the plume being detected or not detected.

The MEMO model provides a number, and the location of wells required to achieve a certain level of confidence that embankment leaks will be detected, and a means of comparing the relative merits of alternative monitoring well networks, therefore allowing MW embankment monitoring well spacing optimizing. The well spacing analysis is optimized in the EnergySolutions report by running the MEMO model numerous times, with various networks of monitoring wells downgradient of the MW embankment (different well locations), to determine a monitoring well network that produced an monitoring efficiency of 95% or greater. In adopting this approach, the relative monitoring efficiencies are valid for comparing alternative network designs. Model out put with a greater than 95% or greater monitoring efficiency are given in Table 4.

Table 4. Summary of monitoring efficiency modeling for the MW embankment.

Model Run	Constituent	Type	Source Area	Flow Direction	Contaminant Velocity (ft/day)	Upgradient Non-Arrival Zone	Undetected Leaks	Monitoring Efficiency (%)
MWI129a	I-129	Base Case	Footprint	N40°E	6.02 x 10-3	None	286/8196	96.5
MWI129c	I-129	Sensitivity	Footprint	N40°E	1.69 x 10-3	Excluded	311/7166	95.7

Model Run	Constituent	Type	Source Area	Flow Direction	Contaminant Velocity (ft/day)	Upgradient Non-Arrival Zone	Undetected Leaks	Monitoring Efficiency (%)
MWI129d	I-129	Base Case	Topslope	N40°E	6.2 x 10-3	None	1/4004	100
MWI129e	I-129	Sensitivity	Topslope	N40°E	1.69E-03	Included	15/4004	99.6
MWI129f	I-129	Sensitivity	Footprint	N40°E	6.2E-03	None`	402/8196	95.1
MWI129i	I-129	Sensitivity	Footprint	N84°E	1.69E-03	None	407/8496	95.0
MWI129m	I-129	Sensitivity	Topslope	N90°E	6.2E-03	None	2/4004	100
MWI129n	I-129	Sensitivity	Topslope	N90°E	1.69E-03	None	0/4004	100
MWI129o	I-129	Sensitivity	Footprint	N11°E	6.2E-03	None	346/8196	95.8
MWI129p	I-129	Sensitivity	Topslope	N0°E	6.2E-03	None	122/4004	97
MWI129r	I-129	Sensitivity	Topslope	N0°E	1.69E-03	Excluded	14/2085	99.3
MWI129s	I-129	Sensitivity	Footprint	N5°E	1.69E-03	Excluded	222/4837	95.4
MWTc99a	Tc-99	Base Case	Footprint	N40°E	6.41E-03	None	303/8196	96.3
MWTc99c	Tc-99	Sensitivity	Footprint	N40°E	1.74E-03	Excluded	308/7507	95.9
MWTc99d	Tc-99	Base Case	Topslope	N40°E	6.41E-03	None	0/4004	100
MWTc99e	Tc-99	Sensitivity	Topslope	N40°E	1.74E-03	None	0/4004	100
MWTc99f	Tc-99	Sensitivity	Footprint	N85°E	6.41E-03	None	408/8196	95
MWTc99i	Tc-99	Sensitivity	Footprint	N85°E	1.74E-03	None	389/8196	95.3
MWTc99m	Tc-99	Sensitivity	Topslope	N90°E	6.41E-03	None	0/4004	100
MWTc99n	Tc-99	Sensitivity	Topslope	N90°E	1.74E-03	None	0/4004	100
MWTc99o	Tc-99	Sensitivity	Footprint	N12°E	6.41E-03	None	406/8196	95
MWTc99r	Tc-99	Sensitivity	Topslope	N0°E	1.74E-03	Excluded	5/2356	99.8
MWTc99s	Tc-99	Sensitivity	Footprint	N6°E	1.74E-03	Excluded	262/5250	95

Based on the optimized model outcomes, EnergySolutions has proposed a MW embankment well network using 4 existing wells, and the addition of 4 new wells; for a total downgradient well network of 5 wells east, 1 well at the northeast corner, and 2 wells north of the expanded MW embankment. This configuration provides efficiency greater than 95% for the proposed MW embankment ground-water monitoring network. Based on the various parameter used in the MEMO model for I-129 and Tc-99 for the source area and for the top-slope source the optimal distance between new wells will be 325.6 feet. Locations of shallow monitoring wells are identified along the downgradient sides (north and east side of the MW embankment). The new wells will be GW-151, GW-152, and GW-153 on the north side, and GW-154 on the east side of the embankment; the locations of the currently proposed wells are shown in Figure 3. Well GW-154 will be located 342.5 ft from existing well GW-133 due to requirements to keep monitoring wells located within 90 ft of the edge of waste. The proposed monitoring well network for the MW embankment is comparable with the other embankments monitoring well network configuration

Monitoring well I-30-100 will have to be abandoned due to the embankment expansion, this is a deep aquifer monitoring well listed in Part I.F.1.d of the Permit as a deep aquifer monitoring well. EnergySolutions proposes to install a deep aquifer monitoring well GW-153D as its replacement. The new well would be about 300 feet to the east, and 250 feet to the north of monitoring well I-30-100. The new location is appropriate to help characterized vertical gradients in the eastern portion of the Clive facility. Therefore the approval of the nested well pair location is recommended.

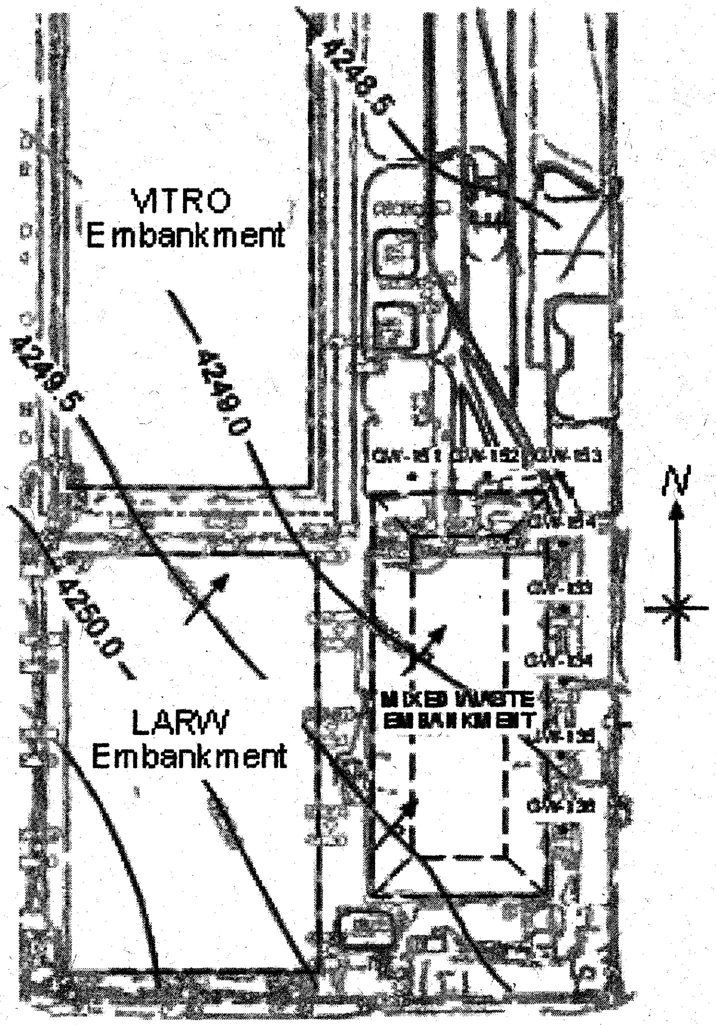

Figure 3. Hydraulic gradient for the shallow aquifer below the MW embankment in November 2010. The direction of ground-water flow and the proposed downgradient wells for the MW embankment are also shown

The spacing for wells surrounding the MW embankment was evaluated by EnergySolutons in July 2011. The optimal distance between wells is 325.6 ft, but the well spacing proposed is slightly irregular along the eastern side of the embankment to accommodate the required 90 feet to waste. The methods and approach used to select input parameters for the MEMO model is similar to those used in previous well spacing analysis. Conservative (protective) input parameters were used to provide a protective well spacing at the expanded MW embankment. Based on the review of the EnergySolutions submission it is recommended that the DRC accept the optimal distance between new wells of 325.6 ft, and request additional justification for the spacing between new proposed well GW-154 and existing well GW-133 of 342.5 ft.

References

Domenico, P.A., 1987, A analytical model for multidimensional transport of a decaying contaminant species: Journal of Hydrology, no. 91, pp.49-58.

Whetstone Associates, Inc., 2000, Mixed Waste Cell Infiltration and Transport Modeling Report: prepared for Envirocare of Utah, November 22, 2002.

Whetstone Associates, Inc., 2009a, Well spacing Evaluation EnergySolutions Mixed Waste Embankment: Prepared for EnergySolutions, LLC, March 9, 2009.

Whetstone Associates, Inc., 2009b, Well Spacing Evaluation EnergySolutions Class A North Embankment: Prepared for EnergySolutions, LLC, March 12, 2009.

Attachment C

DRC Staff Review of EnergySolutions Request:
DRC Technical Memorandum

EnergySolutions' response to the Division of Radiation Control's request for information concerning the Mixed Waste Embankment Extension, Well Spacing Analysis.

State of Utah
GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF RADIATION CONTROL
Rusty Lundberg
Director

MEMORANDUM

TO: John Hultquist, Licensing Manager JH 3/19/2012

FROM: Charles Bishop, PG, Hydrologeologist CBB 3/20/2012

DATE: November 7, 2011

SUBJECT: EnergySolutions' Well Spacing Analyses for the Mixed Waste Embankment Expansion.

EnergySolutions submitted a letter and report on July 19, 2011 requesting approval of a Class 3 Modification to their State-issued RCRA Part B Permit, Authorization for Top of Waste and Radon Barrier - Mixed Waste (MW) Cell Extension and Cover. This includes a northern expansion of the MW embankment. The MW embankment uses a mostly above-grade landfill design, constructed primarily of natural materials from the area and is in the southeastern corner of the Clive facility. The MW embankment is shown with respect to other Clive facility embankments in Figure 1. The Utah Division of Solid and Hazardous Waste (DSHW) reviews and approves modifications to design specifications of the MW embankment, and the State-issued Part B Permit. However, the MW embankment falls within overlapping regulatory jurisdictions for ground-water protection, with the Utah Division of Radiation Control (DRC) administrating a Ground Water Quality Discharge Permit (hereafter Permit). The EnergySolutions' Clive facility Permit requires ground-water protection levels for radiologic parameters be met for 500 years after closure, and that environmental impacts to ground water are kept within tolerable risk levels.

The present configuration of the MW embankment has 7 downgradient monitoring wells; 4 on the eastern side, 1 on the northeast corner, and 2 on the northern side. Downgradient monitoring wells for the present MW embankment is shown in figure 2. The DRC has reviewed the well spacing analysis of the proposed Class 3 modification to the MW embankment, proposed by EnergySolutions, for completeness and justification for approval of the well spacing analyses.

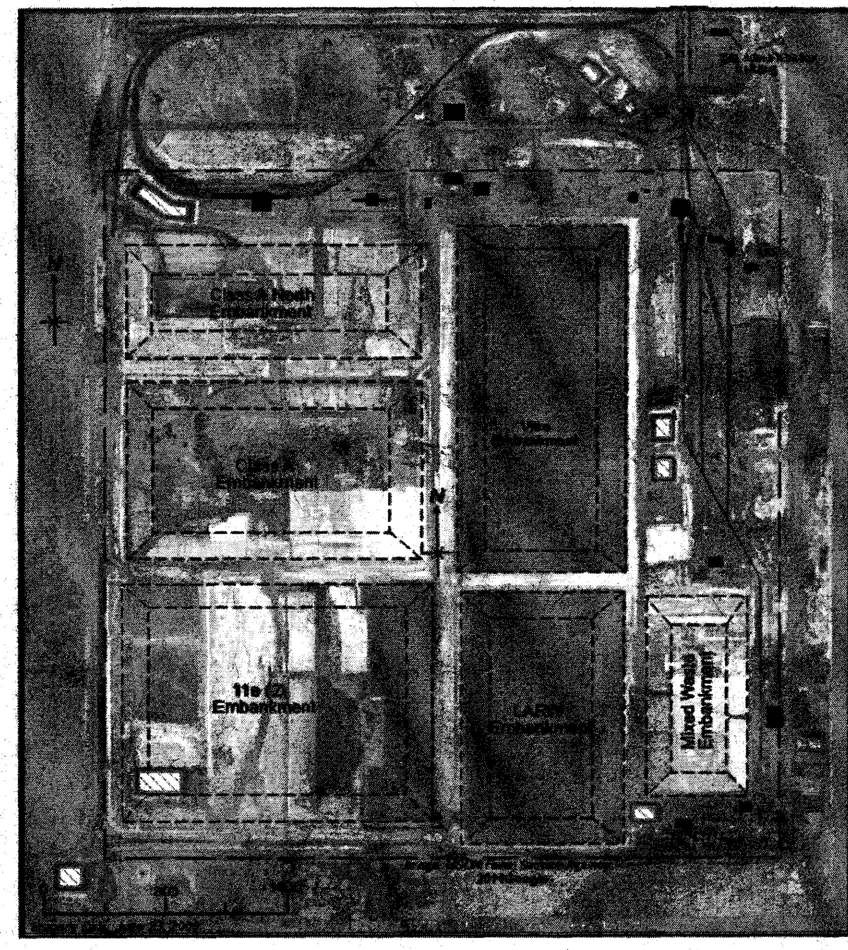

Figure 1. Layout of the Clive facility embankments, with the MW embankment in the southeastern part of the facility.

The design of a reliable and efficient ground-water monitoring network for the MW embankment is essential to identifying any leakage from the embankment, and determining its seriousness. EnergySolutions used an analytical model to determine well spacing. Because of the complexity of the equations involved in the analytical models, the analytical solutions are restricted to idealized cases where velocity is uniform over the area of interest and boundary conditions are well defined. The assumption of a uniform velocity and flow field implies constant hydrologic and transport properties and a uniform hydraulic gradient over the length of the plume, i.e. homogeneous and isotropic flow conditions within a uniform hydraulic gradient for the length of the plume. For the design of a dependable ground-water monitoring network for the MW embankment the following will need to be addressed:

> Can the analytical model, which is based on a homogeneity and isotropic aquifer, incorporate the effect of various uncertainties on contaminant transport used in ground-water monitoring network design?

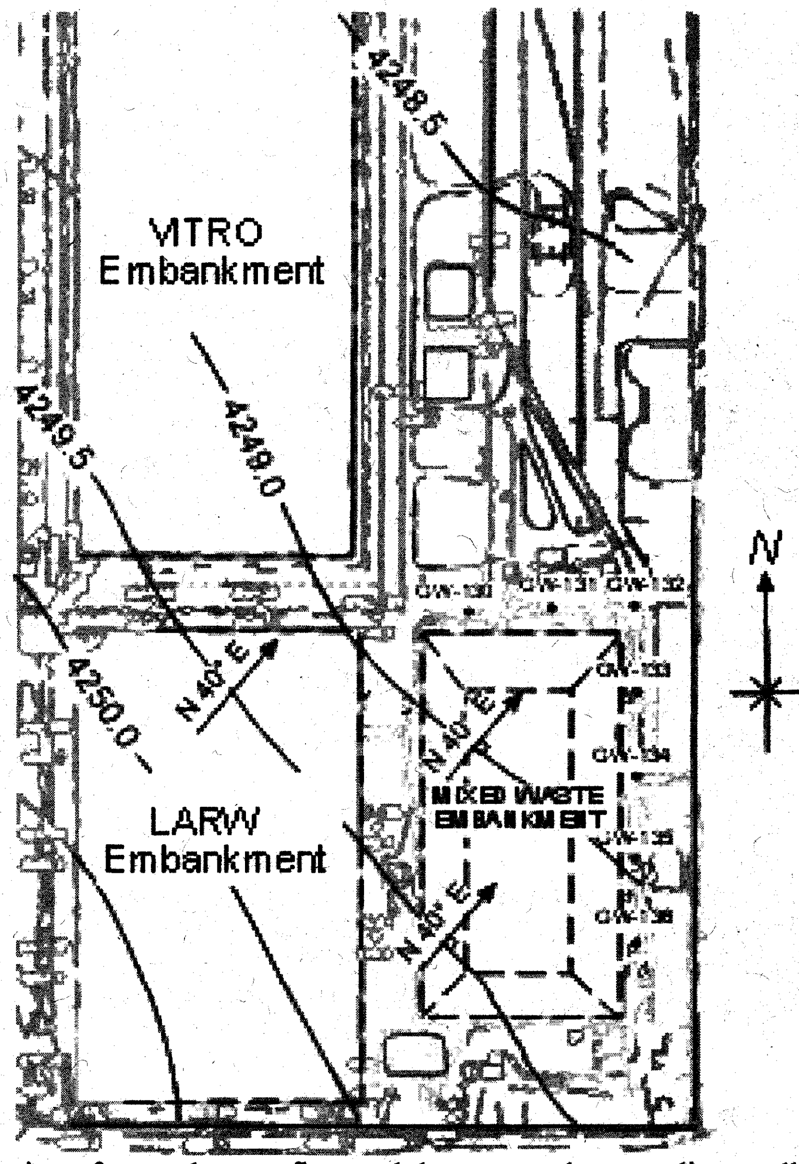

Figure 2. The direction of ground-water flow and the present downgradient wells for the MW embankment are also shown. Shallow aquifer hydraulic gradient below the MW embankment in November of 2010.

Can the uncertainty in subsurface characterization be quantified with the design of the monitoring network?

Are data sets developed that identify the size and shape of a plume, and the extent of migration into the buffer zone?

How many monitoring wells, and where should they be placed to maximize the likelihood of detection, the desired objectives?

> Is the well spacing network conservative for detecting the potential release of contaminants under the present ground-water flow direction, and will the well spacing remain adequate?

EnergySolutions' well spacing analysis estimates the effectiveness of the monitoring well network design by determining where a monitoring well would or would not detect a release from the embankment. The well spacing analysis utilized the Monitoring Efficiency Model (MEMO) developed by Golder Associated, Inc. MEMO is an analytical transport program used to optimize monitoring well locations, and is based upon a migrating contaminant plume's expansion as it moves down gradient from a continuous source. Assumptions of the plume generation routine used in the MEMO program includes one-dimensional ground-water velocity, i.e. negligible vertical ground-water flow and chemical transport; a uniform ground-water flow field; longitudinal, and transverse dispersion; first order degradation rates; finite contaminant source dimensions; and a steady-state (continuous) line source. The MEMO program was used to evaluate monitoring efficiency of various well locations, based on the ability of various well networks to intercept expected plumes of indicator parameters. Monitoring efficiency is defined as the ratio of the area of detection to the total areas of the site, and is determined using a grid of potential source points, defined within the potential source area, i.e. a contaminant plume is generated at each source point, if the plume is intersected by a monitoring well before it migrates beyond a specified boundary, the source is considered to be detected.

Input to the MEMO model includes discretization of the problem domain by defining the geometry of the potential source area, a grid of potential source points, buffer zone boundary, and monitoring well locations; and defining potential source width, contaminant transport parameters, and the dilution contour to be measured in the monitoring wells. Geometric data in the EnergySolutions' MEMO model used a standard coordinate system, and uniform source grid spacing. Site geometry includes coordinated for two source areas, the entire footprint of the embankment, 1.4×10^6 square feet [ft^2] and the area under the embankment top-slope 6.8×10^5 ft^2; the buffer zone grid spacing was set to 25 feet (ft) for the MW embankment; and monitoring well locations.

<u>Advection and Contaminant Velocities</u>

Ground-water flow and contaminant transport parameters for homogeneous and isotropic media under steady state flow conditions were used to determine the plume dimensions and configuration. Contaminant velocities were calculated using Darcy's law in the MEMO model with the following parameters:

> An aquifer effective porosity value of 0.29 was used. This value has been regarded as representative by the DRC in the past.
>
> Hydraulic gradients for the shallow aquifer below the MW embankment are calculated monthly by EnergySolutions, with an approximate average hydraulic gradient of 5.99×10^{-4} ft/ft, based on 18-years freshwater heads. The maximum permitted shallow aquifer hydraulic gradient below the MW embankment is 9.67×10^{-4} ft/ft, based on infiltration and transport modeling of the MW embankment. The ground-water flow direction in the

shallow aquifer below the MW embankment is considered to be approximately N40°E (see Figure 2). This ground-water flow direction has been used in previous well spacing analyses for both the Class A North, and MW embankments (Whetstone Associates, 2009a and 2009b). The hydraulic gradient and flow direction below the MW embankment are considered relatively uniform.

Underlying the MW embankment are the Unit 3 sand, and Unit 2 clay; wells are completed in the Unit 2 clay, and hydraulic conductivity have been determined for the Unit 2 clay. Hydraulic conductivities values were determined from the analysis of 96 slug test conducted in 36 wells and drill holes surrounding the MW embankment. Hydraulic conductivities evaluated in the well spacing analysis were 4.79×10^{-4} centimeters per seconds (cm/sec) (1.36 ft/day), based on the geometric mean; 7.03×10^{-4} cm/sec (1.99 ft/day), based on the upper 90% confidence level of the geometric mean; and 1.09×10^{-3} cm/sec (3.09 ft/day), based on the upper 90% confidence level of the arithmetic mean of aquifer tests.

Retardation factor is constituent specific and is calculated from the sorption coefficient (K_d), soil density, and effective porosity at the site. The calculated retardation factors are given in Table 1. The models used I-129 and Tc-99, K_d used for I-129 was 0.12 and for Tc-99 was 0.11. The retardation factors calculated were 1.662 and 1.607 respectively (see Table 1). The selection of I-129 and Tc-99 is considered conservative since these two parameters have very high mobility (low retardation) in ground water.

Table 1. Calculated retardation factors.

Constituent	K_d (L/kg)	Density (kg/m^3)	Porosity	Retardation factor
I-129	0.12	1,600	0.29	1.662
Tc-99	0.11	1,600	0.29	1.607

The MEMO program uses a plume generating routine to compute the sizes and shapes of the plumes from each grid point in the source area. The program assumes that solute is released along a continuous line source in a uniform aquifer, and predicts the concentration that would be observed at locations downgradient of the source. Average contaminant velocities used in the model and reported in the EnergySolutions report were calculated using the porosity, hydraulic gradient, hydraulic conductivity, and retardation factor for six scenarios for each constituent. Parameter values used in each scenario and the contaminant velocities are listed in Table 2.

Table 2. Calculated advection and contaminant velocities.

Constituent	Effective Porosity	Hydraulic Gradient (f/ft)		Hydraulic Conductivity (ft/day)		Retardation Factor	Advection Velocity (ft/day)	Contaminant Velocity (ft/day)
I-129	0.29	Permit Maximum	9.67E-04	Arithmetic mean +90% CI	3.09	1.662	1.03E-02	6.2E-03
I-129	0.29	Permit Maximum	9.67E-04	Geometric mean +90% CI	1.99	1.662	6.65E-03	4.00E-03
I-129	0.29	Permit Maximum	9.67E-04	Geometric mean	1.36	1.662	4.52E-03	2.72E-03

Constituent	Effective Porosity	Hydraulic Gradient (f/ft)		Hydraulic Conductivity (ft/day)		Retardation Factor	Advection Velocity (ft/day)	Contaminant Velocity (ft/day)
I-129	0.29	Average	5.99E-04	Arithmetic mean +90% CI	3.09	1.662	6.38E-03	3.84E-03
I-129	0.29	Average	5.99E-04	Geometric mean +90% CI	1.99	1.662	4.12E-03	2.48E-03
I-129	0.29	Average	5.99E-04	Geometric mean	1.36	1.662	2.8E-03	1.69E-03
Tc-99	0.29	Permit Maximum	9.67E-04	Arithmetic mean +90% CI	3.09	1.607	1.03E-02	6.41E-03
Tc-99	0.29	Permit Maximum	9.67E-04	Geometric mean +90% CI	1.99	1.607	6.65E-03	4.14E-03
Tc-99	0.29	Permit Maximum	9.67E-04	Geometric mean	1.36	1.607	4.52E-03	2.81E-03
Tc-99	0.29	Average	5.99E-04	Arithmetic mean +90% CI	3.09	1.607	6.38E-03	3.97E-03
Tc-99	0.29	Average	5.99E-04	Geometric mean +90% CI	1.99	1.607	4.12E-03	2.56E-03
Tc-99	0.29	Average	5.99E-04	Geometric mean	1.36	1.607	2.8E-03	1.74E-03

Contaminant velocity is a critical element in relation to the overall conservativeness of the model, because variations in the velocity will create differences in plume shape, i.e. high contaminant velocities will result in a long and narrow plume; whereas, slow velocities create a short-wedged shape plume. An evaluation of model parameter input values, to see if they are representative, and conservative based on site conditions, the elements of the contaminant velocity were follows:

Effective Porosity - The EnergySolutions' MEMO model used an effective porosity of 0.29, the same as used in other well spacing analysis, and in Infiltration and Transport modeling at the Clive facility. The advective velocity is somewhat sensitive to effective porosity, because of the inverse relationship; however, the shape of the plume is independent of effective porosity, so long as the effective porosity is uniform over the area of the plume. This value was determined through empirical laboratory testing of representative Clive facility samples and has been regarded as representative of the site by the DRC. Because effective porosity is a determined parameter, the value and assumption of uniformity is considered reasonable.

Hydraulic Gradient - is calculated by EnergySolutions using Surfure (contouring program) for the unconfined shallow ground-water aquifer beneath the MW embankment on a 50-foot centered grid. The hydraulic gradient below the MW embankment averaged 9.73×10^{-4} ft/ft in November 2010, based on fresh-water heads. Infiltration and Transport modeling of the MW embankment used a shallow aquifer hydraulic gradient value of 1.0×10^{-6} ft/ft (Whetstone Associated, Inc., 2000). The maximum allowable shallow aquifer hydraulic gradient beneath the MW embankment is 9.67×10^{-4}ft/ft, as specified in the Permit. Using the permit maximum average hydraulic gradient the maximum allowable hydraulic gradient beneath the MW embankment is conservative, because it is a higher hydraulic gradient, or a steeper gradient than the measured average monthly gradient, and the average gradient has not exceeded this limit.

The principal direction of ground-water flow in the shallow aquifer beneath the MW embankment was set at N40°E. The hydraulic gradient and flow direction below the MW embankment are a reasonable approximation of the ground-water flow direction beneath the embankment (see figure 2).

Hydraulic conductivity – used in the final MEMO model (used to determine the well spacing) as input was a hydraulic conductivity of the 90% confidence level of the arithmetic mean 3.09 ft/day (1.09×10^{-3} cm/sec). To verify that this value is conservative a comparison was made with an early well spacing analysis for the MW embankment, which used a value of 1.51 ft/day (5.32×10^{-4} cm/sec), and the MW embankment Infiltration and Transport modeling, which used a value of 2.17 ft/day (7.67×10^{-4} cm/sec). Although the variability of these properties over the area of the Clive facility have been documented, their variability over several hundred foot length of the plume considered in this analysis will be considerable less. The value of hydraulic conductivity used in the final MEMO model is a higher hydraulic conductivity than used in Infiltration and Transport modeling, and the early well spacing analysis. This is considered conservative since higher velocity will produce more narrow and elongated shaped plumes.

Retardation Factor –is constituent specific, and is calculated using the sorption coefficient (K_d), dry bulk density of 1.600 kg/m^3, and a volumetric water content of 0.29, based on the effective porosity developed by solving the equation. This value is consistent with historical uses at the facility.

Overall, these input values are conservative in that they will produce a narrow shaped plume that requires tighter monitoring well network spacing.

Plume Generation

The plume generator is the routine in MEMO that calculates the size and shape of the Plume. Input parameters required for plume generation are direction of ground-water movement; average contaminant velocity; longitudinal and transverse dispersivities; molecular diffusion coefficient; and first-order radioactive decay constant. The plume generation routine used in the MEMO program to determine the sizes and shapes of the plumes is a two-dimensional analytical transport routine developed by Domenico and Robbine (1985), which assumes that solute is released along a continuous line source in a uniform aquifer, and predicts the configuration and concentration of the plume as it migrates downgradient from the source. Vertical migration of contaminants through the unsaturated zone to the water table is assumed to create a source of contamination in ground water that generates the contaminant plume. The source width depends upon the dimensions of the release at the surface, and the subsequent dispersion in the vadose zone. Besides contaminant velocity, parameters used in the plume generator are:

Width of Line Source - depends on the surface leak type and amount of lateral spreading in the vadose zone prior to arriving at the water table. The one foot line spacing is conservative because it produces a narrow plume. The MW embankment model used a one foot line source.

Dispersivity – is the physical process of spreading at the plume boundary, which cause the periphery of the plume to have reduced concentrations. Longitudinal dispersion was set at 72.1 over a 721 foot flow path, one tenth the distance from the center of the top slope to the line of compliance wells along the ground-water flow direction, N40°E (transverse is normally set at one tenth longitudinal). The 72.1 feet distance is reported as the distance from the center of the cell to the edge of waste on the N 40° E alignment. The width of the plume is sensitive to the dispersivity, particularly transverse dispersivity. Dispersion values are justified in the modeling documentation by reference to Gelhar et al. (1992), which determined that longitudinal dispersivity is typically 10% of the longitudinal flow distance, while transverse dispersivity is typically 10% of the longitudinal dispersivity. Because the magnitudes for longitudinal and transverse dispersivities are not known for the Clive facility, conservative estimates were developed from the literature.

Diffusion Coefficient – is a mechanism for transport of solutes through the saturated zone, in the absence of significant advective flux. EnergySolutions utilized literature values of diffusion for I-129 and Tc-99 for a saturated porous medium. Specifically, an effective diffusion coefficient of 1.19×10^{-3} ft^2/day for I-129, and 9.03×10^{-4} ft^2/day for Tc-99. These values were used in the well spacing analyses performed previously for the MW embankment. The diffusion coefficient is quite small compared to the advective velocity term and can for the most part be neglected.

Decay Rate Constants – used in the modeling for the MW embankment are consistent with decay constants used for I-129 and Tc-99 in previous Class A North and MW embankments will spacing analyses. First order decay constants used for I-129 was 1.21×10^{-10} per day, and for Tc-99 was 8.99×10^{-9} per day. The use of these values essentially negates the effect of decay, thus the use of radionuclide with large half-life does not affect the model outcome.

Dilutions Contour Values – in applying the MEMO program' it is necessary to identify a dilution contour for the plume generation routine that is related to appropriate detection limits for the types of constituents to be detected at the monitoring wells. The value chosen as a design basis will depend upon the required degree of conservatism. Dilution contours for I-129 was set to 2.66×10^{-6}, and Tc-99 were set to the lowest possible values in the MEMO program of 1.00×10^{-6}, because the lowest dilution contour values for Tc-99 of 1.23×10^{-7}. EnergySolutions argues that since I-129 and Tc-99 have long half lives they would arrive at the buffer zone boundary from anywhere within the source area given a sufficiently long advective velocity transport time.

Because MEMO is based upon an analytical simulation of physical processes, evaluation of the suitability and adequacy of the model are determined from the physical parameters and processes governing contaminant migration, rather than upon qualitative judgments of how many wells are enough. The DRC considers the EnergySolutions MEMO model suitable owing to it:

Having been used in past well spacing analysis.

Using steady-state models, which is common approach.

Uses an adequate system geometry.

Uses a representative value for longitudinal and transverse dispersivity.

Uses a reasonable direction and magnitude of ground-water velocity in the vicinity of the embankment.

Using a 2-dimensional plume generator, which give reasonable results in situation where the lateral dimension of an aquifer is greater than its thickness.

Uses a continuous source of leachate, ensuring the plume does not disperse below detection limits.

Assuming the probability of a release is equally likely at any given location within the source areas.

Using a high transport velocity results in less lateral spreading of the plume and a closer optimum well spacing.

Sensitivity Analysis

A limited sensitivity analysis of the EnergySolutions' MW embankment well spacing model was performed on ground-water flow direction, and contaminant transport velocity. These parameters were considered to have the greatest uncertainties by EnergySolutions, so the sensitivity analysis was done to understand how they affected monitoring efficiency. Other parameters to which the model is suspected to be sensitive to are the buffer zone width, dispersivity, and well spacing. Buffer zone width defines the limit a plume may extent before it should be detected by a monitoring well. The closer the buffer zone boundary is to the sources, the closer the monitoring wells need to be to each other. Plumes that are detected at a monitoring well before passing through the buffer zone are considered to have been detected. Buffer zone width is established by Permit requirements, and the approach is consistent with previous MEMO modeling at the Clive facility. Aquifer dispersivity is the process of ground-water mixing at the plume boundaries, causing the periphery of the plume to be reduced in concentration, and is a primary control on the fate and transport of contaminants. The MEMO program uses longitudinal and transverse dispersivities to describe mechanical spreading and mixing. Dispersitivity in the aquifer is scale and directional dependent, with longer flow paths resulting in higher flow dispersivity and dispersion is more vigorous in the direction of flow compared to directions normal to flow.

Dispersivity is to some extent controlled by the program, with the program recommending that longitudinal dispersivity be set at one tenth the distance from the center of the top slope to the line of compliance wells in the direction of ground-water flow, and transverse disperdivity set to 10% of the longitudinal dispersivity. Well spacing was determined by running simulations with different well spacing, i.e. manual iterations were run to find the most favorable well spacing at the target efficiency of 95% or greater, well spacing at the expanded MW embankment is generally consistent with existing monitoring well networks. Ground-water flow direction in the sensitivity analysis was varied from N0°E to N90°E. Based on ground-water flow directions, monitoring well efficiencies range from 100 to 53% for I-129, and 100 to 60% for Tc-99. Well spacing was also evaluated for a conservative high contaminant velocity and an average velocity condition of 6.4 and 1.69 ft/day, respectively. Some well spacing evaluations performed using the average contaminant velocity resulted in upgradient non-detection zones. Table 3 lists the sensitivity analysis monitoring efficiencies. The simulation indicates the MW embankment monitoring well network will meet the 95% criterion for conditions that can be practically expected at the site. i.e. if ground-water flow deviated from N40°E the direction could vary for N12°E to N82°E and velocities change within a reasonable range.

Table 3. Sensitivity analysis of monitoring efficiency modeling for the MW embankment.

Model Run	Constituent	Type	Source Area	Flow Direction	Contaminant Velocity (ft/day)	Upgradient Non-Arrival Zone	Undetected Leaks	Monitoring Efficiency (%)
MWI129a	I-129	Base Case	Footprint	N40°E	6.02 E-03	None	286/8196	96.5
MWI129c	I-129	Sensitivity	Footprint	N40°E	1.69E-03	Excluded	311/7166	95.7
MWI129e	I-129	Sensitivity	Topslope	N40°E	1.69E-03	Included	15/4004	99.6
MWI129f	I-129	Sensitivity	Footprint	N40°E	6.2E-03	None	402/8196	95.1
MWI129g	I-129	Sensitivity	Footprint	N90°E	6.2E-03	None	618/8196	92.5
MWI129h	I-129	Sensitivity	Footprint	N90°E	1.69E-03	None	565/8196	95.1
MWI129i	I-129	Sensitivity	Footprint	N84°E	1.69E-03	None	407/8496	95.0
MWI129j	I-129	Sensitivity	Footprint	N0°E	6.20E-03	None	1456/8496	82.2
MWI129k	I-129	Sensitivity	Footprint	N0°E	1.69E-03	Included	3503/8186	57.3
MWI129L	I-129	Sensitivity	Footprint	N0°E	1.69E-03	Excluded	341/4837	93.0
MWI129m	I-129	Sensitivity	Topslope	N90°E	6.2E-03	None	2/4004	100
MWI129n	I-129	Sensitivity	Topslope	N90°E	1.69E-03	None	0/4004	100
MWI129o	I-129	Sensitivity	Footprint	N11°E	6.2E-03	None	346/8196	95.8
MWI129p	I-129	Sensitivity	Topslope	N0°E	6.2E-03	None	122/4004	97
MWI129q	I-129	Sensitivity	Topslope	N0°E	1.69E-03	None	407/8496	95.0
MWI129r	I-129	Sensitivity	Topslope	N0°E	1.69E-03	Included	1873/4004	53.2
MWI129s	I-129	Sensitivity	Footprint	N5°E	1.69E-03	Excluded	222/4837	95.4
MWTc99a	Tc-99	Base Case	Footprint	N40°E	6.41E-03	None	303/8196	96.3
MWTc99b	Tc-99	Sensitivity	Footprint	N40°E	1.74E-03	Included	833/8196	98.8
MWTc99c	Tc-99	Sensitivity	Footprint	N40°E	1.74E-03	Excluded	308/7507	95.9
MWTc99e	Tc-99	Sensitivity	Topslope	N40°E	1.74E-03	None	0/4004	100
MWTc99f	Tc-99	Sensitivity	Footprint	N85°E	6.41E-03	None	408/8196	95
MWTc99g	Tc-99	Sensitivity	Footprint	N90°E	6.41E-03	None	530/8196	93.5
MWTc99h	Tc-99	Sensitivity	Footprint	N90°E	1.74E-03	None	509/8196	93.8
MWTc99i	Tc-99	Sensitivity	Footprint	N85°E	1.74E-03	None	389/8196	95.3
MWTc99j	Tc-99	Sensitivity	Footprint	N0°E	6.41E-03	None	1575/8196	80.8
MWTc99k	Tc-99	Sensitivity	Footprint	N0°E	1.74E-03	Included	3199/8196	61.0
MWTc99L	Tc-99	Sensitivity	Footprint	N0°E	1.74E-03	Excluded	466/5395	91.4
MWTc99m	Tc-99	Sensitivity	Topslope	N90°E	6.41E-03	None	0/4004	100

Model Run	Constituent	Type	Source Area	Flow Direction	Contaminant Velocity (ft/day)	Upgradient Non-Arrival Zone	Undetected Leaks	Monitoring Efficiency (%)
MWTc99n	Tc-99	Sensitivity	Topslope	N90°E	1.74E-03	None	0/4004	100
MWTc99o	Tc-99	Sensitivity	Footprint	N12°E	6.41E-03	None	406/8196	95
MWTc99p	Tc-99	Sensitivity	Topslope	N0°E	6.41E-03	None	203/4004	94.9
MWTc99q	Tc-99	Sensitivity	Topslope	N0°E	1.74E-03	Included	1571/4004	60.8
MWTc99r	Tc-99	Sensitivity	Topslope	N0°E	1.74E-03	Excluded	5/2356	99.8
MWTc99s	Tc-99	Sensitivity	Footprint	N6°E	1.74E-03	Excluded	262/5250	95.0

Summary and Conclusions

The MEMO model, employed by EnergySolutions to design the MW embankment monitoring well network, provides a method for quantifying the efficiency of a monitoring well network. As with any analysis of transport phenomena, judgment is required in the selection of input parameters and there is uncertainty in some input parameters, which may render questionable the model results. In the present model configuration (as a deterministic tool) these uncertainties are addressed by the use of conservative input parameters, and the performance of a limited sensitivity analysis. Monitoring efficiency was determined in the EnergySolutions' MEMO models by creating a grid of potential source points, defined within the source area, with a spacing of 25 ft; defining the monitoring well network; defining a buffer zone boundary, which is the limits to which the plume may extend before it should be detected by a monitoring well, with a grid spacing of 25 ft (same order as the source area grid spacing); setting concentrations to be detected at the monitoring wells; and generating a contaminant plume at each source point using an analytical contaminant transport solution (plume generator). The MEMO program solved for concentrations at each grid point along the buffer zone boundary, and if the plume generated at a source point is intersected by a monitoring well before it migrates beyond the buffer zone boundary, the source point is considered to be detected. The monitoring efficiency is calculated from the plume being detected or not detected.

The MEMO model provides a number, and the location of wells required to achieve a certain level of confidence that embankment leaks will be detected, and a means of comparing the relative merits of alternative monitoring well networks, therefore allowing MW embankment monitoring well spacing optimizing. The well spacing analysis is optimized in the EnergySolutions report by running the MEMO model numerous times, with various networks of monitoring wells downgradient of the MW embankment (different well locations), to determine a monitoring well network that produced an monitoring efficiency of 95% or greater. In adopting this approach, the relative monitoring efficiencies are valid for comparing alternative network designs. Model out put with a greater than 95% or greater monitoring efficiency are given in Table 4.

Table 4. Summary of monitoring efficiency modeling for the MW embankment.

Model Run	Constituent	Type	Source Area	Flow Direction	Contaminant Velocity (ft/day)	Upgradient Non-Arrival Zone	Undetected Leaks	Monitoring Efficiency (%)
MWI129a	I-129	Base Case	Footprint	N40°E	6.02 x 10-3	None	286/8196	96.5
MWI129c	I-129	Sensitivity	Footprint	N40°E	1.69 x 10-3	Excluded	311/7166	95.7

Model Run	Constituent	Type	Source Area	Flow Direction	Contaminant Velocity (ft/day)	Upgradient Non-Arrival Zone	Undetected Leaks	Monitoring Efficiency (%)
MWI129d	I-129	Base Case	Topslope	N40°E	6.2 x 10-3	None	1/4004	100
MWI129e	I-129	Sensitivity	Topslope	N40°E	1.69E-03	Included	15/4004	99.6
MWI129f	I-129	Sensitivity	Footprint	N40°E	6.2E-03	None`	402/8196	95.1
MWI129i	I-129	Sensitivity	Footprint	N84°E	1.69E-03	None	407/8496	95.0
MWI129m	I-129	Sensitivity	Topslope	N90°E	6.2E-03	None	2/4004	100
MWI129n	I-129	Sensitivity	Topslope	N90°E	1.69E-03	None	0/4004	100
MWI129o	I-129	Sensitivity	Footprint	N11°E	6.2E-03	None	346/8196	95.8
MWI129p	I-129	Sensitivity	Topslope	N0°E	6.2E-03	None	122/4004	97
MWI129r	I-129	Sensitivity	Topslope	N0°E	1.69E-03	Excluded	14/2085	99.3
MWI129s	I-129	Sensitivity	Footprint	N5°E	1.69E-03	Excluded	222/4837	95.4
MWTc99a	Tc-99	Base Case	Footprint	N40°E	6.41E-03	None	303/8196	96.3
MWTc99c	Tc-99	Sensitivity	Footprint	N40°E	1.74E-03	Excluded	308/7507	95.9
MWTc99d	Tc-99	Base Case	Topslope	N40°E	6.41E-03	None	0/4004	100
MWTc99e	Tc-99	Sensitivity	Topslope	N40°E	1.74E-03	None	0/4004	100
MWTc99f	Tc-99	Sensitivity	Footprint	N85°E	6.41E-03	None	408/8196	95
MWTc99i	Tc-99	Sensitivity	Footprint	N85°E	1.74E-03	None	389/8196	95.3
MWTc99m	Tc-99	Sensitivity	Topslope	N90°E	6.41E-03	None	0/4004	100
MWTc99n	Tc-99	Sensitivity	Topslope	N90°E	1.74E-03	None	0/4004	100
MWTc99o	Tc-99	Sensitivity	Footprint	N12°E	6.41E-03	None	406/8196	95
MWTc99r	Tc-99	Sensitivity	Topslope	N0°E	1.74E-03	Excluded	5/2356	99.8
MWTc99s	Tc-99	Sensitivity	Footprint	N6°E	1.74E-03	Excluded	262/5250	95

Based on the optimized model outcomes, EnergySolutions has proposed a MW embankment well network using 4 existing wells, and the addition of 4 new wells; for a total downgradient well network of 5 wells east, 1 well at the northeast corner, and 2 wells north of the expanded MW embankment. This configuration provides efficiency greater than 95% for the proposed MW embankment ground-water monitoring network. Based on the various parameter used in the MEMO model for I-129 and Tc-99 for the source area and for the top-slope source the optimal distance between new wells will be 325.6 feet. Locations of shallow monitoring wells are identified along the downgradient sides (north and east side of the MW embankment). The new wells will be GW-151, GW-152, and GW-153 on the north side, and GW-154 on the east side of the embankment; the locations of the currently proposed wells are shown in Figure 3. Well GW-154 will be located 342.5 ft from existing well GW-133 due to requirements to keep monitoring wells located within 90 ft of the edge of waste. The proposed monitoring well network for the MW embankment is comparable with the other embankments monitoring well network configuration

Monitoring well I-30-100 will have to be abandoned due to the embankment expansion, this is a deep aquifer monitoring well listed in Part I.F.1.d of the Permit as a deep aquifer monitoring well. EnergySolutions proposes to install a deep aquifer monitoring well GW-153D as its replacement. The new well would be about 300 feet to the east, and 250 feet to the north of monitoring well I-30-100. The new location is appropriate to help characterized vertical gradients in the eastern portion of the Clive facility. Therefore the approval of the nested well pair location is recommended.

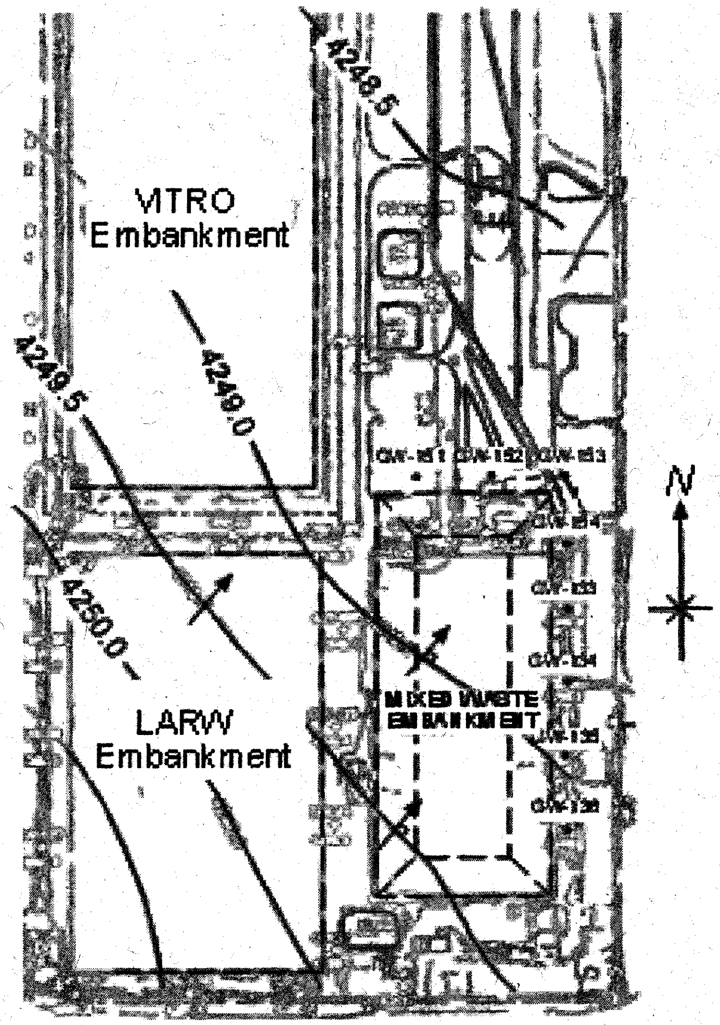

Figure 3. Hydraulic gradient for the shallow aquifer below the MW embankment in November 2010. The direction of ground-water flow and the proposed downgradient wells for the MW embankment are also shown

The spacing for wells surrounding the MW embankment was evaluated by EnergySolutons in July 2011. The optimal distance between wells is 325.6 ft, but the well spacing proposed is slightly irregular along the eastern side of the embankment to accommodate the required 90 feet to waste. The methods and approach used to select input parameters for the MEMO model is similar to those used in previous well spacing analysis. Conservative (protective) input parameters were used to provide a protective well spacing at the expanded MW embankment. Based on the review of the EnergySolutions submission it is recommended that the DRC accept the optimal distance between new wells of 325.6 ft, and request additional justification for the spacing between new proposed well GW-154 and existing well GW-133 of 342.5 ft.

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