NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

6 NYCRR PART 373 HAZARDOUS WASTE MANAGEMENT DRAFT PERMIT MODIFICATION FOR CWM CHEMICAL SERVICES L.L.C MODEL CITY FACILITY

RESIDUALS MANAGEMENT UNIT-TWO [RMU-2] LANDFILL AND RELATED UNITS

NIAGARA COUNTY

DEC PERMIT No. 9-2934-00022/00097
EPA ID No. NYD049836679

VOLUME 5 OF 5

NOTE: Draft modifications are identified by highlighted text or by notes on existing or new pages.

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ATTACHMENT K

~~Sections~~Appendices D-9, D-9a & D-11 RMU-1 and RMU-2 Response Action Plans & RMU-1 Minimum Waste Strength Curves

[*NOTE: Attachment K is being modified to add the RMU-2 Response Action Plan. This page and the subsequent 63 pages of the Plan are to be added to Attachment K.*]

Appendix D-9a
RMU-2 Response Action Plan

[*NOTE: Attachment K is being modified to add the RMU-2 Response Action Plan (RAP). This page and the subsequent 63 pages of the RAP are to be added to Attachment K.*]

CWM Chemical Services, LLC

Response Action Plan

Residuals Management Unit 2

Model City Facility
1550 Balmer Road
Model City, Niagara County, New York

April 2003
Revised August 2009
Revised August 2013

Appendices

1. Introduction

1.1 General

CWM Chemical Services, LLC (CWM) owns and operates the Model City Treatment Storage, Disposal, and Recovery (TSDR) Facility (Model City Facility), in Niagara County, New York. The Model City Facility is regulated at the federal level under the Resource Conservation and Recovery Act (RCRA) and the Toxic Substances Control Act. Since the United States Environmental Protection Agency (USEPA) has delegated the implementation of the RCRA regulations to the New York State Department of Environmental Conservation (NYSDEC), the Model City Facility operates under an NYSDEC-issued Permit pursuant to Title 6 of the New York Codes, Rules, and Regulations (6 NYCRR) Part 373. The general site layout, shown on Permit Drawing No. 2 of the permit drawing set, comprises waste receiving areas, storage and mixing tanks, chemical treatment facilities, biological treatment impoundments, and secure landfills. Current operations include treatment, recovery, stabilization, disposal, and transfer of hazardous and industrial non-hazardous waste.

As part of the permit application for Residuals Management Unit 2 (RMU-2) and as required by 6 NYCRR Part 373-2.14(o), a Response Action Plan (RAP) must be approved prior to receipt of any waste. The RAP is a site-specific plan that the owner develops to address leakage through the primary liner and into the secondary leachate collection systems (SLCSs) to minimize the potential migration of liquids out of the unit. This RAP, which is part of CWM's overall leachate management program, describes the criteria used to establish key inflow rates to the SLCSs that require the implementation of certain response actions as described herein. RMU-2 consists of six cells, each divided by a cell separation berm. This RAP pertains to all six cells. The layout of RMU-2, including the cell orientation and designations, is shown on Permit Drawing No. 5.

This RAP addresses the potential sources of inflows to the SLCSs in RMU-2 and discusses the development of site-specific performance characteristics for the individual cells comprising RMU-2. It should be noted that liquids encountered in the SLCSs of RMU-2 are not necessarily derived from contact with waste materials. Depending on the rate, responses to inflows of liquids into the SLCSs of RMU-2 include no action, modifying operating procedures, and, where appropriate, notifying the USEPA and the NYSDEC. The various response actions are described in Section 4.

1.2 Action Leakage Rate and Response Rate

In accordance with 6 NYCRR Parts 373-2.14(n) and (o), this RAP presents the Action Leakage Rate (ALR) for the cells within RMU-2, which is the primary trigger to implement a response action. The ALR is based on the maximum flow rate that the SLCS can collect and remove from the cell without the fluid head on the secondary liner exceeding 1 foot. Consistent with the Residuals Management Unit 1 (RMU-1) RAP, this RAP also presents a secondary trigger level known as the Response Rate (RR). The RR is based on the anticipated maximum inflow to the SLCS that could be expected under normal operating conditions. The RR could be used in identifying potential problems with the primary liner by alerting CWM personnel to unanticipated inflows to the SLCS. The trigger levels are presented both as “unit-specific” and “cell-specific.” The term “unit-specific” relates to a unit area (e.g., 1 acre), whereas “cell-specific” is a function of each cell area. (Unit-specific rates are presented in terms of gallons per acre per day [gpad]; cell-specific rates are presented in terms of gallons per day [gpd]). The development of the ALR and RR values is discussed in greater detail in Sections 2 and 3, respectively.

1.3 RMU-2 Overview

The facility has been a waste TSDR facility since 1972. The portion of the Model City Facility accommodating RMU-2 encompasses approximately 43.5 acres (as measured to the outside toe of the perimeter mechanically stabilized earth wall). RMU-2 is divided into six cells that are separated hydraulically from each other by intercell berms. The size of the six cells varies from approximately 5.77 acres to 6.32 acres (as measured planimetrically to the centerlines of the intercell berms and the top of slope for the sideslope liner system).

1.3.1 RMU-2 Liner System Description

RMU-2 has been designed to meet or exceed the requirements for hazardous waste landfills as specified in 6 NYCRR Part 373-2.14. As shown on Permit Drawing No. 15, the RMU-2 liner system consists of the following components (in descending order):

- *Primary Leachate Collection System*
  - 1 foot of operations layer stone on the cell floors and 2 feet of operations layer stone on the cell sideslopes;

- A layer of non-woven geotextile on the cell floors;
- 1 foot of granular drainage material on the cell floors with an 8-inch-diameter perforated leachate collection pipe along the cell centerline; and
- A layer of geocomposite on the cell floors and sideslopes.

· *Primary Liner System*

- An 80-mil textured high-density polyethylene (HDPE) geomembrane on the cell floors and sideslopes; and
- A geosynthetic clay liner (GCL) layer on the cell floors (which extends a minimum of 15 feet up the cell sideslopes) that provides a maximum equivalent hydraulic conductivity equal to or less than 1.5 feet of compacted clay with a hydraulic conductivity of 1×10^{-7} centimeters per second (cm/s).

· *Secondary Leachate Collection System*

- A layer of non-woven geotextile on the cell floors;
- 1 foot of granular drainage material on the cell floors with an 8-inch-diameter perforated collection pipe along the cell floor centerline; and
- A layer of geocomposite on the cell floors and sideslopes.

· *Secondary Liner System*

- An 80-mil textured HDPE geomembrane on the cell floor and sideslopes; and
- 3 feet of compacted glacial till or other suitable clay having a maximum hydraulic conductivity of 1×10^{-7} cm/s on the cell floor and sideslopes.

On the RMU-2 perimeter sideslopes, the granular drainage layer of the primary leachate collection system (PLCS) has been omitted (consistent with RMU-1). However, both the primary and secondary HDPE geomembranes extend up the perimeter sideslopes. A 2-foot-thick operations layer will be maintained over the PLCS on the sideslopes during waste placement to protect the underlying geocomposite and geomembrane from damage by operating equipment. The operations layer on the cell floors and sideslopes will be run-of-crush stone or equal.

A low-permeability cut-off wall will be keyed at least 1 foot into the Glaciolacustrine Clay layer (discussed in Section 1.3.3 below), as shown on Permit Drawing No. 15. The cut-off wall will significantly restrict lateral groundwater flow beneath RMU-2 after it is constructed.

1.3.2 Liquid Collection and Removal from the Leachate Collection Systems

Each cell within RMU-2 is separated hydraulically from adjacent cells by cell separation berms. Each cell is equipped with both a PLCS and an SLCS and separate riser pipes for each system. The PLCSs and SLCSs are designed and managed to control and remove liquids in a manner consistent with the requirements of 6 NYCRR Part 373-2.14(c)(3)(ii) and (iii). Sumps located at the low point of individual cells collect liquids that enter the leachate collection systems. Liquids that collect in the PLCSs and SLCSs will be removed by pumping through the HDPE sideslope riser pipes. Liquids will be removed from each PLCS at regular intervals with dedicated automatic pumps to provide effective leachate management and to minimize the hydrostatic head on the primary liner. The performance of the PLCSs of RMU-2 will be monitored based on regular documentation of the liquid volume encountered in and removed from the SLCSs of the six cells.

1.3.3 Geologic and Hydrogeologic Setting

Numerous past investigations have been conducted throughout the Model City Facility. Geologic and hydrogeologic investigations for the entire Model City Facility have been performed and were submitted to the NYSDEC and the USEPA in March 1985 (*Hydrogeologic Characterization*, Golder Associates, Inc. [Golder], March 1985). Two updates to the 1985 hydrogeologic report were prepared and submitted in 1988 (*Hydrogeologic Characterization Update*, Golder, February 1988) and in 1993 (*Hydrogeologic Characterization Update*, Golder, June 1993). These studies detail the physiography, drainage, regional geology, site stratigraphy, hydrogeology and site hydrologic parameters. In terms of hydrogeology, these studies focused on defining the uppermost aquifer underlying the Model City Facility, groundwater flow direction and rates. A supplemental geologic investigation within the footprint of RMU-2 was also performed and presented in a letter report entitled *Geotechnical Investigation for Proposed Residuals Management Unit Number 2 Western Expansion Area* (Golder, December 2002). In general, the 2002 geotechnical investigation confirmed the geologic findings presented in the 1985, 1988 and 1993 site-wide investigations. Additional hydrogeologic investigations were performed by Golder in 2004 and again in 2009 to obtain geological and subsurface site stratigraphy data specific to the proposed RMU-2 location. The 2009 investigation was summarized in a report entitled *Landfill Footprint Analytical Data Study and Western Boundary Relocation Investigation, Residuals Management Unit Number 2* (Golder, August 2009). Additionally, groundwater elevation was collected in 2008 in the area of the proposed RMU-2. Copies of the 2002 and 2009 Golder reports are presented in Appendices A-2 and A-4, respectively, of the *RMU-2 Engineering Report* (ARCADIS, April 2003, revised June 2013).

The facility is situated on the Ontario Plain that is an area of low topographic relief between the Niagara Escarpment and Lake Ontario. The upper portion of the stratigraphy at the Model City Facility generally includes low-permeability silt and clay tills over Glaciolacustrine Clay, underlain by a Glaciolacustrine Silt/Sand unit. Beneath these units is a lodgment of till (Basal Red Till) above shale bedrock. Over the northwestern portion of the Model City Facility, the Glaciolacustrine Clay is separated into an upper and lower member by a silt till (Middle Silt Till). Because of variations in topography, the thickness of the prevailing materials and the subbase depth of the cells, RMU-2 penetrates either one or both of the Upper Tills and the Glaciolacustrine Clay units.

In general, a varying thickness of in-situ glacial till will be left in place above the in-situ Glaciolacustrine Clay formation to withstand hydrostatic pressures and provide a suitable surface for construction equipment. The thickness of glacial till varies because of the irregularity of the surface of the Glaciolacustrine Clay. However, in particular areas, the entire in-situ glacial till may be removed in order to accommodate excavation grades in certain sump elevations. Natural surface elevations in the vicinity of RMU-2 are approximately 320 feet above mean sea level.

The typical hydraulic conductivity values of the geologic formations indicate that the Glaciolacustrine Silt/Sand stratum is the most permeable geologic unit and forms the uppermost aquifer underlying the Model City Facility. The Silt Till, Clay Till and Glaciolacustrine Clay above this aquifer are very low-permeability materials and restrict aquifer recharge from infiltration. The Basal Red Till and bedrock beneath the aquifer are also low-permeability units, although the shallow, weathered bedrock is more permeable than the deep bedrock.

Water level data collected on May 15, 2001 and in October 2004 from wells screened in the Glaciolacustrine Silt/Sand unit appear to represent the period of greatest piezometric heads for the confined aquifer since regular recording of site-wide groundwater elevation data began in the early 1980s. Of these two monitoring events, the May 2001 levels were found to be more critical (i.e., higher) and, thus, governed the establishment of design elevations for the RMU-2 cells. The May 2001 levels were also used to estimate the inflow rate of groundwater through the secondary liner (see Section 3).

2. Action Leakage Rate

2.1 General

The purpose of this section is to quantify the ALR for each cell within RMU-2. The NYSDEC defines the ALR as the maximum design leakage rate that the SLCS can remove without the fluid head on the secondary liner exceeding 1 foot. As such, the ALR is dependent on the hydraulic capacities of the various components of the SLCS. The ALR for RMU-2 is established by evaluating each component of the SLCS to determine the limiting component (i.e., the component having the least hydraulic capacity that would cause the fluid head on the secondary liner to exceed 1 foot). A factor of safety is typically applied to the hydraulic capacity of the limiting component to arrive at the actual ALR. The individual flow rate components that are used to determine the ALR are discussed in the following section. The ALR calculation is presented in Appendix A and summarized in Section 2.3.

2.2 ALR Flow Rate Components

The following hydraulic capacities for the various SLCS components are calculated to determine the ALR for each cell:

- Flow rate through the 8-inch-diameter perforated leachate collection pipe along the cell centerline;
- Flow rate through the geocomposite that drains directly to the SLCS sump;
- Flow rate through the drainage stone surrounding the perforated section of the 24-inch-diameter sideslope riser pipe within the SLCS sump; and
- Flow rate through the perforations in the horizontal portion of the sideslope riser pipe.

The analysis of each of these components is discussed in greater detail below.

2.2.1 Flow Rate through the Leachate Collection Pipe

Each cell within RMU-2 contains a perforated leachate collection pipe along the cell centerline that discharges into the sump. The leachate collection pipe collects liquids from the majority of the geocomposite in each cell (a portion of the geocomposite in each cell drains directly into the sump and bypasses the leachate collection pipe). The capacity of the leachate collection pipe is designed to exceed the contributing maximum flow rate from the geocomposite. Consequently, the maximum flow rate conveyed through the leachate collection pipe is assumed to equal the maximum possible flow rate from the contributing geocomposite. This flow rate is estimated by multiplying the flow per unit width through the geocomposite by two times the length of the leachate collection pipe length. The factor of two accounts for the entry of liquids from both sides of the leachate collection pipe.

2.2.2 Flow Rate through the Geocomposite Draining Directly into the SLCS Sump

As described above, a portion of the geocomposite in each cell bypasses the leachate collection pipe and drains directly into the sump. The maximum flow rate conveyed into the sump via this mechanism is estimated by multiplying the flow per unit width through the geocomposite by the perimeter of the SLCS sump.

2.2.3 Flow Rate through the Drainage Stone Surrounding the Perforated Section of the Sideslope Riser Pipe within the SLCS Sump

Liquids that drain into the SLCS sump from the surrounding geocomposite and the leachate collection pipe must permeate through the stone surrounding the perforated section of the sideslope riser pipe and pass through the perforations. The maximum flow rate through the drainage stone is computed using Darcy's law and a flow net for the drainage stone surrounding the perforated portion of the sideslope riser pipe.

2.2.4 Flow Rate through the Perforations in the Horizontal Portion of the Sideslope Riser Pipe

Liquids that flow through the drainage stone surrounding the perforated portion of the sideslope riser pipe must ultimately pass through the perforations themselves. The flow rate through the perforations is determined from calculations presented in Appendix E-3 of the RMU-2 Engineering Report, which are based on the orifice equation and the effective head on each perforation in the sideslope riser pipe.

2.3 ALR Values

For all cells within RMU-2, the limiting flow rate is determined to be the flow rate through the geocomposite that drains directly into the sump (discussed in Section 2.2.2). Because this flow rate is dependent on the post-settlement slope of the cell floor, the ALRs are cell-specific (i.e., the ALR per unit area differs from one cell to the next). The calculated ALRs are summarized in the following table. As discussed above, these ALRs are calculated by multiplying the limiting flow rate by a factor of safety. To maintain consistency with the RMU-1 RAP, a factor of safety of two is applied to the calculated ALRs, as recommended by the USEPA.

Table 1: Calculated ALR Values

Cell	Cell-Specific ALR [gpd]	Cell Area[1] [acres]	Unit-Specific ALR [gpad]
15	31,458	6.07	5,183
16	30,700	6.12	5,016
17	31,670	5.81	5,451
18	34,901	5.77	6,049
19	30,054	5.77	5,209
20	30,700	6.32	4,858

Notes:

1. Cell area is the planimetric area as measured to the centerlines of intercell berms and the top of slope for the sideslope liner system.

Based on the lowest unit-specific ALR shown above, a unit-specific ALR of 4,858 gpad is selected for every cell in RMU-2. This unit-specific ALR value is multiplied by each cell area to calculate a cell-specific ALR, as summarized in the following table.

Table 2: Final ALR Values

Cell	Unit-Specific ALR[1] [gpad]	Cell Area[2] [acres]	Cell-Specific ALR [gpd]
15	4,858	6.07	29,488
16	4,858	6.12	29,731
17	4,858	5.81	28,225
18	4,858	5.77	28,031
19	4,858	5.77	28,031
20	4,858	6.32	30,703

Notes:

1. Unit-specific ALR is based on the minimum calculated value (Cell 20) from Table 1.
2. Cell area is the planimetric area as measured to the centerlines of intercell berms and the top of slope for the sideslope liner system.

3. Response Rate

3.1 General

The purpose of this section is to quantify the RR for each cell within RMU-2. As described earlier in this RAP, the RR is the anticipated maximum inflow to the SLCS that could be expected under normal operating conditions. The individual flow rate components that are used to determine the RR are discussed in the following section. The RR calculation is presented in Appendix B and summarized in Section 3.3.

3.2 RR Flow Rate Components

In order to estimate the RR, it is necessary to identify potential inflow sources to the SLCS and estimate the peak anticipated inflow to the SLCS from each source. The following potential inflow sources to the SLCS are considered in the estimation of the RR:

- Leakage and permeation of liquids through the primary liner due to 1 foot of hydrostatic head on the primary liner;
- Leakage and permeation of groundwater through the secondary liner; and
- Leakage and permeation of consolidation water from the compacted clay layer in the secondary liner.

Construction liquids (i.e., liquids that have entered the cell during the SLCS construction period) are not considered in the RR because these liquids will have been collected by the SLCS during the earlier stages of cell operation. Furthermore, because the liner system of RMU-2 utilizes a GCL in the primary liner in lieu of the 1.5-foot-thick compacted clay layer used in RMU-1, the RMU-2 RR calculation does not consider the generation of liquids from the consolidation of a primary clay layer. The potential inflow sources to the SLCS are discussed in greater detail below and in Appendix B.

3.2.1 Leachate Inflow through the Primary Liner

Leakage and permeation through the primary liner is considered one of the three main long-term sources for liquids entering the SLCSs. Higher heads on the primary liner will cause a corresponding increase in flow to the SLCS due to permeation and leakage through the primary geomembrane. In addition, increased flows above the PLCS increase the probability of liquids coming in contact with a defect in the primary HDPE geomembrane, particularly on landfill perimeter sideslopes. The computation of leakage and permeation rates through the primary liner is discussed separately in the following sections.

3.2.1.1 Leakage of Leachate through the Primary Liner

Past studies have shown that, even when good construction practices are followed and thorough construction quality control/quality assurance procedures are used, several defects in the geomembrane may typically occur per acre during the course of installation. Defects in the form of pinholes are also known to occur during the manufacturing process. The frequency and size of these installation and manufacturing defects are estimated from the *Hydrologic Evaluation of Landfill Performance (HELP) Model User's Guide for Version 3* (USEPA, September 1994).

Leakage through defects in the primary liner geomembrane will occur whenever a hydrostatic head exists on the primary liner geomembrane and is a function of the frequency of defects, their size, head on the geomembrane and the hydraulic conductivity of the material beneath the geomembrane (i.e., the GCL). For the purposes of determining the RR, the leakage rate is estimated assuming 1 foot of head on the primary liner geomembrane. Using equations from the *HELP Model Engineering Documentation for Version 3* (USEPA, September 1994), leakage though the assumed geomembrane defects is estimated to be approximately 0.064 gpad and is the same for all cells within RMU-2.

3.2.1.2 Permeation of Leachate through the Primary Liner

Permeation of liquids through the primary liner will occur whenever a hydrostatic head exists on the primary liner. As with the leakage rate calculation in the preceding section, the permeation rate estimate assumes 1 foot of head on the primary liner geomembrane. In order for liquids to permeate completely through the primary liner and into the SLCS, they must pass through a geomembrane layer and a GCL. The presence of both of these low-permeability layers is accounted for in the permeation rate estimate by combining their individual thicknesses and using an average effective hydraulic conductivity, as recommended in the *HELP Model Engineering Documentation for Version 3* (USEPA, September 1994). The resulting permeation rate through the primary liner is 0.028 gpad and is the same for all cells within RMU-2.

3.2.2 Groundwater Inflow through Secondary Liner

In general, the elevations of the components in the secondary liner on the cell floors are below the historical high piezometric head in the confined aquifer (i.e., those recorded in May 2001). The resulting hydrostatic head exerted on the compacted clay layer and geomembrane in the secondary liner will cause groundwater to enter the SLCS by permeation and leakage through the geomembrane, similar to the mechanisms discussed in Section 3.2.1. Although the rate of groundwater inflow to the SLCS is expected to fluctuate due to seasonal variations in groundwater elevations, the presence of this external hydrostatic head is expected continuously throughout the life of the landfill. The computation of leakage and permeation rates of groundwater through the secondary liner is discussed separately in the following sections.

3.2.2.1 Leakage of Groundwater through the Secondary Liner

Leakage of groundwater into the SLCS through assumed defects in the secondary liner geomembrane (refer to Section 3.2.1.1) will occur whenever the confined aquifer piezometric head beneath a given cell exceeds the lowest SLCS elevation for that cell. For the purposes of determining the RR, the leakage rate of groundwater through the secondary liner is estimated using the bottom of the liner system design grades (i.e., subgrades) depicted on Permit Drawing No. 4 and the Glaciolacustrine Silt/Sand unit piezometric heads as measured in May 2001. Using equations from the *HELP Model Engineering Documentation for Version 3* (USEPA, September 1994), leakage of groundwater though the assumed defects in the secondary liner geomembrane is estimated to range from 2.25 to 6.06 gpad and is cell-specific.

3.2.2.2 Permeation of Groundwater through the Secondary Liner

Permeation of groundwater into the SLCS through the secondary liner will occur whenever the confined aquifer piezometric head beneath a given cell exceeds the lowest SLCS elevation for that cell. As with the leakage rate calculation in the preceding section, the permeation rate estimate is based on the design grades for the bottom of the compacted clay layer in the secondary liner and the average piezometric heads from the May 2001 monitoring event. In order for groundwater to permeate completely through the secondary liner and into the SLCS, it must pass through the compacted clay layer and the geomembrane. As discussed in Section 3.2.1.2, the presence of both of these low-permeability layers is accounted for in the permeation rate estimate by combining their individual thicknesses and using an average effective hydraulic conductivity. The flow rate of groundwater through the cell floors due to permeation is estimated to range from 0.09 to 0.24 gpad and is cell-specific.

3.2.3 Consolidation Water Inflow from the Secondary Liner Compacted Clay Layer

Construction of the cell liner system and subsequent waste filling activities result in increasing applied stresses to the compacted clay layer in the secondary liner. The applied stress will continue to increase until final waste grades are achieved and the final cover is installed, and is expected to slowly dissipate over time. The resulting consolidation of the compacted clay layer produces excess pore pressures within the clay, which drive water from the clay layer. The resulting flow rate depends on, and is expected to temporarily lag slightly behind, the filling rate. The inflow of consolidation water to the SLCS is expected to continue well after the closure of the cell and gradually diminish over time. As with the other potential inflow sources discussed thus far, this consolidation water will enter the SLCSs via leakage and permeation through the secondary liner. The computation of leakage and permeation rates of consolidation water through the secondary liner is based on modeling of the fill progression design prepared for Cell 20 (depicted on Permit Drawing No. 8 and discussed separately in the following sections.

3.2.3.1 Leakage of Consolidation Water through the Secondary Liner

The leakage rate of consolidation water through assumed defects in the secondary liner geomembrane is calculated using equations from the *HELP Model Engineering Documentation for Version 3* (USEPA, September 1994), as discussed in previous sections. The hydrostatic head used to calculate leakage is equal to the excess pore pressure produced within the compacted clay layer during consolidation divided by the unit weight of water. The resulting leakage rate through geomembrane defects is estimated to be approximately 35.46 gpad and is the same for all cells within RMU-2.

3.2.3.2 Permeation of Consolidation Water through the Secondary Liner

The permeation rate of consolidation water through the secondary liner geomembrane is estimated using Darcy's law. The flow rate of consolidation water through the cell floors is estimated to be approximately 1.08 gpad and is the same for all cells within RMU-2.

3.3 RR Values

The individual flow rates into the SLCS from the sources described in Section 3.2 are combined to generate a single unit-specific RR for each cell within RMU-2. The following table summarizes the estimated flow rates into the SLCS from each potential inflow source for each cell within RMU-2.

Table 3: Calculated Unit-Specific RR Inflow Components (from Calculations in Appendix B)

Cell	Leachate Inflow through Primary Liner		Groundwater Inflow through Secondary Liner		Consolidation Water Inflow through Secondary Liner		Combined [gpad]
	Leakage Rate [gpad]	Permeation Rate [gpad]	Leakage Rate [gpad]	Permeation Rate [gpad]	Leakage Rate [gpad]	Permeation Rate [gpad]	
15	0.064	0.028	5.17	0.21	35.46	1.08	42.01
16			6.06	0.24			42.93
17			3.09	0.13			39.85
18			3.77	0.15			40.55
19			4.51	0.18			41.32
20			2.25	0.09			38.97

Although the calculated RR values presented in Table 3 are deemed reasonable, a unit-specific value of 20 gpad has been requested by the NYSDEC based on a recommendation by USEPA for an allowable flow rate in SLCSs of double-lined landfill cells. Consequently, the USEPA recommended value of 20 gpad has been adopted for all RMU-2 cells. The following table presents the final RR value for each cell based on the USEPA recommended unit-specific value of 20 gpad.

Table 4: Final RR Values

Cell	Unit-Specific RR[1] [gpad]	Cell Area[2] [acres]	Cell-Specific RR [gpd]
15	20	6.07	121
16		6.12	122
17		5.81	116
18		5.77	115
19		5.77	115
20		6.32	126

Notes:
1. Unit-specific RR is based on USEPA recommended value.
2. Cell area is the planimetric area as measured to the centerlines of intercell berms and the top of slope for the sideslope liner system.

4. Response Actions

4.1 General

The purpose of this section is to outline the required response actions corresponding to various flow rates in the SLCS sumps of each cell within RMU-2, including the ALRs and RRs calculated in Sections 2 and 3, respectively. For all flow rates, the following procedure is required for monitoring of the SLCS:

- Each SLCS sump will be monitored at least once every 7 days for the presence of liquids. Pumpable amounts of liquids contained in the sump will be removed, and the liquid quantity will be measured and recorded. The inflow value will be determined by adding the liquid volumes removed each week divided by 7 days to establish a daily average inflow for the week. If liquids are removed more frequently than once every 7 days, the inflow will be determined for each pumping event.

4.2 Flow Rates at or Below the RR

Routine monitoring should continue. No action is required.

4.3 Flow Rates Between the RR and the ALR

1. Verbally notify the NYSDEC within 3 working days of an apparent exceedance of the RR. Complete one or more of the following activities to determine whether the apparent exceedance is actually due to an electronic or mechanical equipment malfunction:

   a. Evaluate the SLCS volume data transferred from RMU-2 to the aqueous wastewater treatment system computer terminal by checking recent level trends and alarm summary logs.

   b. Verify proper operation of the SLCS pump via computer control and by manually switching it on and off.

   c. Inspect the SLCS flow meter and verify its proper operation using timed pumping and comparing the estimated volume with the meter flow readings.

d. Remove the SLCS pump and level probe and inspect for any obvious defects. Verify proper operation of level probe by either electrical simulation or by manually placing the probe in water.

2. If the average daily flow to an SLCS sump for a weekly pumping event exceeds the RR and if not conclusively determined within 2 weeks of an apparent RR exceedance to be clearly attributable to an operational failure (e.g., equipment or power failures based on the investigation specified in Item 1 above), the following will be performed:

   a. Conduct a review of the most recent SLCS and PLCS analytical data available from the sampling programs required by the site permit.

   b. Immediately perform the following tests and observations on samples of the SLCS and PLCS liquids:

      – color;

      – turbidity;

      – specific-conductance; and

      – pH.

      Make a preliminary comparison of these values with the previous results and record the information.

   c. Perform, within 1 week after the RR exceedance, the sampling and analysis of the SLCS liquid that would normally occur on a quarterly basis. Test results are to be available within 45 days of the exceedance. Results will be reviewed with the NYSDEC to determine what, if any, additional response actions are necessary based on the results. This sampling will satisfy the next quarterly sampling requirements for that sump and cell.

   d. Increase monitoring and pumping frequency of the SLCS sump of the cell involved, if pumpable quantities are present, to every day until flow decreases below the RR. Also, verify that the automatic removal of liquid from the PLCS sumps is occurring as designed. If the automatic pumping of the PLCS is unable to maintain a level of 12 inches or less in the PLCS, evaluate whether it is necessary to increase the pumping rate and prioritization of that cell.

e. Review all analytical data and investigate alternative sources of liquid.

3. If the flow is between the RR and the ALR for 7 consecutive additional daily pumping events, provide written notification to the NYSDEC within 14 days from the date of determination and implement the following steps:

   a. Remove all standing water, if any, from within the landfill.

   b. Assess the potential cause or causes of the RR exceedance. In the affected cell, examine any exposed portions of the cell liner.

   c. Repair any observed damage.

   d. If no obvious defects are detected, propose mitigative actions to return the leakage rate to below the RR. Upon approval, sequentially inspect sideslope liner and likely locations of base liner, if necessary, removing waste as needed. Repair any observed damage.

   e. Document location, type and extent of liner damage, if any.

4. If the leakage rate cannot be returned and maintained below the RR after all feasible mitigative measures have been taken, automatic pumping and volume measurement of the secondary collection system must be instituted.

4.4 Flow Rates Greater than the ALR

1. Notify, in writing, the USEPA and NYSDEC within 7 working days from the date of determination if the average flow to an SLCS sump for one pumping event exceeds the ALR, if this is not clearly attributable to an operational disturbance. Determine the need to temporarily stop placing waste into the affected cell during the cell's normal operation, unless the ALR value is exceeded within the first 30 days of operation of the cell when flows are not truly representative and unless this occurs during post-closure operations. If the ALR value is exceeded after the first 30 days of cell operation, determine whether waste placement in the cell should cease until repairs to the lining system or other appropriate actions are completed and flows to the SLCS

sump have decreased to below the ALR. Prepare a written preliminary assessment report describing the amount of liquids; likely source of liquids; possible location, size and cause of any leaks and short-term actions taken and planned. Submit this report to the USEPA and NYSDEC within 14 days from the date of determination of exceedance. Waste placement may not resume in the cell until written notification is given by the NYSDEC.

2. Increase monitoring and pumping frequency from the SLCS sump of the cell involved, if pumpable quantities are present, to every day until flow decreases below the ALR. Also, verify that the automatic removal of liquid from the PLCS sumps is occurring as designed.

3. Perform the following tests and observations on samples of the SLCS and PLCS liquids:

   – color;

   – turbidity;

   – specific-conductance; and

   – pH.

   Make a preliminary comparison of these values with the previous results and record the information.

4. Determine, to the extent practicable, the location, size and cause of any leak.

5. Determine other short-term and longer-term actions necessary to mitigate or stop any leaks.

6. Within 30 days after the notification that the ALR has been exceeded, submit to the USEPA and the NYSDEC the results of the analyses of Responses 1 through 5 above, as well as the results of actions taken and actions planned.

7. If the average flow exceeds the ALR for two consecutive pumping events, implement the following steps:

a. Test a sample of the liquid obtained from the SLCS for constituents listed in the table in Appendix C;

b. Remove all standing water inside RMU-2;

c. Examine any exposed portion of the cell liner; and

d. Repair any observed damage.

8. If flow continues to exceed the ALR for an additional two pumping events, provide third-party inspection by a registered professional engineer who will investigate alternative sources of liquid, review available analytical and pumping event data for the cell to identify any trends and prepare a written report to the USEPA and the NYSDEC on the findings and recommended actions to protect human health and the environment. The Groundwater Monitoring Plan will also be evaluated to determine whether supplemental response actions are necessary.

9. As long as the flow rate in the SLCS exceeds the ALR, submit monthly reports to the USEPA and the NYSDEC summarizing actions taken and planned.

10. If the ALR value continues to be exceeded after taking all reasonable corrective measures, closure of the affected cell shall be considered.

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Appendix A

Action Leakage Rate Calculation

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Calculation Sheet

Client: CWM Chemical Services, LLC

Project Location: Model City, New York

Project: RMU-2 Response Action Plan **Project No.: B0023725.2011**

Subject: Appendix A: Action Leakage Rate Calculation

Prepared By: PTO **Date: August 2013**

Reviewed By: BMS **Date: August 2013**

Checked By: PHB **Date: August 2013**

OBJECTIVE:

Determine the action leakage rate (ALR) for the RMU-2 secondary leachate collection system (SLCS).

REFERENCES:

1. Appendix E-1 to the RMU-2 Engineering Report entitled “Liner System Geocomposite Design,” ARCADIS, February 2013.
2. Appendix E-2 to the RMU-2 Engineering Report entitled “Leachate Collection Pipe Design,” ARCADIS, May 2013.
3. Appendix E-3 to the RMU-2 Engineering Report entitled “Sideslope Riser Pipe Design,” ARCADIS, February 2013.
4. RMU-2 Permit Drawing No. 5 entitled “Top of Operations Layer Grades,” ARCADIS, February 2013.
5. Appendix C-1 to the RMU-2 Engineering Report entitled “Consolidation Settlement of Glaciolacustrine Clay,” P.J. Carey & Associates, PC, August 2009.
6. RMU-2 Permit Drawing No. 12 entitled “Typical Sump Plans,” ARCADIS, February 2013.
7. RMU-2 Technical Specification Section 02210 – Earthworks, ARCADIS, February 2013.

ASSUMPTIONS:

1. The pipe-full capacity of the 8-inch-diameter perforated leachate collection pipe along the centerline of the cell floor exceeds the maximum flowrate through the contributing geocomposite layer per Reference 2.
2. The flow capacity through the orifices in the 8-inch diameter perforated leachate collection pipe exceeds the maximum flowrate through the contributing geocomposite layer per Reference 2.

METHODOLOGY:

The ALR is equal to the steady-state flowrate through the SLCS which corresponds to 1 foot of head in the SLCS. In order for leachate to flow through the SLCS, it must be collected and conveyed to the sump (by one of several mechanisms) and then flow into the perforated section of the sideslope riser pipe and

Calculation Sheet

be pumped out. As such, several potentially limiting flowrates are evaluated to determine the ALR. They are:

- Flowrate from the 8-inch-diameter perforated leachate collection pipe along the cell centerline
- Flowrate from the geocomposite that drains directly into the sump
- Flowrate through the drainage stone in the vicinity of the perforated section of the sideslope riser pipe
- Flowrate through the perforations in the horizontal portion of the sideslope riser pipe

CALCULATIONS:

1. Flowrate from the 8-inch Diameter Perforated Leachate Collection Pipe

Based on Assumptions 1 and 2, the flowrate from the 8-inch-diameter pipe is not limited by the pipe-full flowrate or the flow through the orifices. Instead, the limiting flowrate is that of the contributing geocomposite layer. The daily flowrate from the geocomposite into the leachate collection pipe can be calculated as:

$$Q_{Pipe} = \Phi i(2L)$$

where,

Φ = geocomposite transmissivity = 18.6 cm^2/s = 0.020 ft^2/s (per Reference 1)

i = hydraulic gradient = average post-settlement slope of cell floor perpendicular to the leachate collection pipe (per Reference 5)
= 2.45% (Cell 15)
= 2.56% (Cell 16)
= 2.61% (Cell 17)
= 3.18% (Cell 18)
= 2.11% (Cell 19)
= 2.27% (Cell 20)

L = length of leachate collection pipe (later multiplied by 2 to account for flow from both sides of pipe)
= 267 ft (Cell 15)
= 452 ft (Cell 16)
= 644 ft (Cell 17)
= 623 ft (Cell 18)
= 305 ft (Cell 19)
= 408 ft (Cell 20)

$\therefore$ Q_{Pipe} = 0.262 cfs = 169,116 gpd (Cell 15)
= 0.462 cfs = 299,148 gpd (Cell 16)
= 0.672 cfs = 434,544 gpd (Cell 17)
= 0.792 cfs = 512,180 gpd (Cell 18)
= 0.257 cfs = 166,376 gpd (Cell 19)
= 0.370 cfs = 239,438 gpd (Cell 20)

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Calculation Sheet

2. Flowrate from the Geocomposite that Drains Directly into the Sump

Because of the cell floor grading, some of the geocomposite does not drain into the 8-inch-diameter leachate collection pipe. Instead, it drains directly into the sump. The daily flowrate from this component can be calculated as:

$$Q_{Geo} = L\Phi i$$

where,

Φ = geocomposite transmissivity (per Reference 1)
= 18.6 cm^2/s = 0.020 ft^2/s for hydraulic gradients of 0.10 or smaller
= 4.7 cm^2/s = 0.0051 ft^2/s for a hydraulic gradient of 0.33

i = hydraulic gradient perpendicular to the rim of the sump (varies depending on which of the four sump edges is analyzed)

L = length of geocomposite draining directly into the sump at the sump rim (varies depending on which of the four sump edges is analyzed)
= 33.1 ft along the sump edges that are parallel with the cell centerline
= 34.9 ft or 31.1 ft along the sump edges that are perpendicular to the cell centerline

The slope of the geocomposite along the two sump edges parallel to the cell centerline is assumed to be equal to the post-consolidation slope perpendicular to the cell centerline (per Reference 5), which were presented above for each cell. The slope of the geocomposite along the sump edge at the toe of the perimeter berm sideslope is assumed to be 33 percent. The slope of the geocomposite along the fourth sump edge (across the sump from the 33 percent perimeter berm sideslope) is assumed to be equal to the post-consolidation slope parallel to the cell centerline (per Reference 5), which are presented below for each cell:

i = hydraulic gradient = post-settlement slope of cell floor parallel to the leachate collection pipe (per Reference 5)
= 1.80% (Cell 15)
= 1.24% (Cell 16)
= 1.59% (Cell 17)
= 1.90% (Cell 18)
= 1.77% (Cell 19)
= 1.78% (Cell 20)

Thus for Cell 15, for example, the daily flowrate from the geocomposite at the sump fringe is:

$$Q = 0.020\ ft^2/s[(2)(33.1\ ft)(0.0245) + (34.9\ ft)(\ 0.0180)] + (0.0051\ ft^2/s)(31.1\ ft)(0.33) = 0.097\ cfs = 62{,}915\ gpd$$

Similarly, for Cells 16 through 20, the daily flowrate from the geocomposite at the sump fringe, Q_{Geo}, is:

$\therefore Q_{Geo}$ = 0.095 cfs = 61,400 gpd (Cell 16)
= 0.098 cfs = 63,339 gpd (Cell 17)
= 0.108 cfs = 69,802 gpd (Cell 18)
= 0.093 cfs = 60,107 gpd (Cell 19)

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Calculation Sheet

= 0.095 cfs = 61,400 gpd (Cell 20)

3. Flowrate Through the Drainage Stone Surrounding the Perforated Section of the Sideslope Riser Pipe

Because leachate enters the perforated section of the sideslope riser pipe through several sets of perforations, each with different heads, the daily flowrate through the drainage stone to the perforations is estimated using a flow net that assumes the circumference of the pipe is porous. The flow net is included in Attachment 1. The daily flowrate for the flow net is calculated as:

$$Q_{Flow\ net} = kH\frac{N_f}{N_d}L$$

where,

k = hydraulic conductivity of drainage stone = 0.4 cm/s = 1,134 ft/day (per Reference 7)
H = head difference between free surface at top of drainage stone (equal to 1 foot above the top of the secondary liner at the sump fringe) and average centroid of perforations (i.e., center of pipe)
= 2.7 ft
N_f = number of flow paths from flow net = 11
N_d = number of potential drops from flow net = 4
L = length of perforated section = 10 ft (Reference 6)

$\therefore$ $Q_{Flow\ net}$ = 84,200 ft^3/day = 629,860 gpd (Each cell – 15 through 20)

Because each cell in RMU-2 employs the same sump design, the above-calculated flowrate is constant for all cells in RMU-2.

4. Flowrate Through the Perforations of the Horizontal Portion of the Sideslope Riser Pipe

Based on Reference 3, the perforation pattern in the horizontal portion of the sideslope riser pipe provides a hydraulic capacity of 0.137 cfs per linear foot of perforated sideslope riser pipe. Reference 6 indicates that each sump contains 10 linear feet of perforated pipe. Therefore, the daily flowrate through the perforations in the horizontal portion of the sideslope riser pipe is:

Q_{perf} = (10 ft)(0.137 cfs/ft) = 1.37 cfs = 885,458 gpd (Each cell – 15 through 20)

Because each sump contains the same amount of perforated pipe, the above calculated flowrate is constant for all cells in RMU-2.

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Calculation Sheet

SUMMARY:

The daily flowrate from the drainage composite at the edge of the sump is the limiting factor for flow to the pump in the SLCS sump. Because this flowrate is cell-dependent, the ALR is cell-specific within RMU-2. To be conservative and maintain consistency with the RMU-1 ALR calculations, a factor of safety of 2 is applied to determine the cell-specific ALRs:

ALR = ½*62,915 gpd = 31,458 gpd (Cell 15)
= ½*61,400 gpd = 30,700 gpd (Cell 16)
= ½*63,339 gpd = 31,670 gpd (Cell 17)
= ½*69,802 gpd = 34,901 gpd (Cell 18)
= ½*60,107 gpd = 30,054 gpd (Cell 19)
= ½*61,400 gpd = 30,700 gpd (Cell 20)

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Appendix B

Response Rate Calculation

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Calculation Sheet

Client: CWM Chemical Services, LLC

Project Location: Model City, New York

Project: Response Action Plan Calculations **Project No.: B0023725.2011**

Subject: Appendix B: Response Rate Calculation

Prepared By: BMS **Date: August 2013**

Reviewed By: BMS **Date: August 2013**

Checked By: PHB **Date: August 2013**

OBJECTIVE:

Determine the response rate (RR) for the secondary leachate collection system (SLCS) in the RMU-2 cells.

REFERENCES:

1. RMU-2 Permit Drawing No. 4 entitled “Subgrade Grades,” ARCADIS, February 2013.

2. RMU-2 Permit Drawing No. 15 entitled “Liner System Sections and Details,” ARCADIS, February 2013.

3. “Report on Shear Strength Evaluation for Slope Stability Analyses RMU-1 Model City Treatment, Storage, and Disposal Facility Model City, New York,” Koerner, K.R., Gilbert, R.B., Stark, T.D., and Adams, F.T., March 2001.

4. “Hydrologic Evaluation of Landfill Performance (HELP) Model Engineering Documentation for Version 3,” U.S. Environmental Protection Agency, August 1994.

5. Appendix E-1 to the RMU-2 Engineering Report entitled “Liner System Geocomposite Design,” ARCADIS, February 2013.

6. RMU-2 Technical Specifications, Section 02210 entitled “Earthworks”, ARCADIS, February 2013.

7. Excess pore pressure data for secondary compacted clay layer during simulated construction of initial fill progression waste grades in Cell 20, PJ Carey & Associates, PC, provided to ARCADIS via e-mail August 6, 2013.

8. “Hydrologic Evaluation of Landfill Performance (HELP) Model User’s Guide for Version 3,” U.S. Environmental Protection Agency, September 1994.

ASSUMPTIONS:

1. Manufacturing defects within the geomembrane occur at the rate of 1 per acre and are approximately 1 mm in diameter (from page 81 of Reference 4). Therefore, each manufacturing defect is equivalent to a hole having an area of 0.0079 cm^2.

2. Installation defects within the geomembrane occur at the rate of 5 per acre and each is assumed to

Calculation Sheet

be 1 cm^2 in area (from page 82 of Reference 4).

3. The hydraulic conductivities of the various liner system components are:

   - Geomembrane: $2x10^{-13}$ cm/s = $5.7x10^{-10}$ ft/day (page 81 of Reference 4)
   - GCL: $5x10^{-9}$ cm/s = $1.4x10^{-5}$ ft/day (manufacturer literature)
   - Compacted clay: $1x10^{-7}$ cm/s = $2.8x10^{-4}$ ft/day (Reference 6)

4. The combined effective hydraulic conductivity through two or more liner components is calculated using the procedure described on page 29 of Reference 8.

METHODOLOGY:

The RR is equal to the maximum anticipated inflow to the SLCS from all likely sources.
Consistent with the RR calculation for RMU-1, the following inflow mechanisms are evaluated to determine the RR for RMU-2:

- Leakage and permeation through the primary liner due to 1 ft of head on primary liner
- Leakage and permeation through the secondary liner from groundwater
- Leakage and permeation through the secondary liner due to excess pore pressure from secondary clay layer consolidation

Since RMU-2 employs a GCL instead of a compacted clay layer in the primary liner, the RR calculation for RMU-2 does not include an analysis of consolidation water from a primary clay layer, as the RMU-1 RR did.

CALCULATIONS:

1. Leakage and Permeation Through Primary Liner Due to 1 ft of Head on Primary Liner

Leakage through the primary liner is attributable to the potential for a small number of manufacturer and installation defects in the primary liner geomembrane. The resulting flowrate through these imperfections is governed by the frequency of defects, their size, and the hydraulic conductivity of the material beneath the geomembrane (i.e., the GCL). Leakage through geomembrane imperfections is estimated using equation 149 from Reference 4:

$$q_h = k_s i_{ave} n \pi R^2 (0.87719)$$

where,

q_h = flow per unit area of geomembrane
k_s = hydraulic conductivity of controlling soil layer or GCL = $1x10^{-7}$ cm/s (clay) or $5x10^{-9}$ cm/s (GCL)
i_{ave} = average hydraulic gradient from HELP eqn. 150 (see below)
n = number of defects per unit area (Assumptions 1 and 2)
R = radius of wetted area around flaw from HELP eqns. 162 or 159 (see below)

The average hydraulic gradient is calculated using equation 150 from Reference 4:

Calculation Sheet

$$i_{ave} = 1 + \left[\frac{h_g}{2T_s \ln\left(\frac{R}{r_o}\right)}\right]$$

where,

h_g = head on geomembrane = 1 ft
T_s = thickness of controlling soil layer or GCL = 3 ft (clay) or 200 mil (GCL)
r_o = radius of flaw (calculated from Assumptions 1 and 2)

The radius of the wetted area around each flaw is dependent on the degree of contact between the geomembrane and the controlling soil layer adjacent to the flaw (i.e., whether the controlling layer is compacted clay or GCL). Based on Reference 4, the radius of the wetted area is calculated using equation 162 for situations where flawed geomembrane is in contact with compacted clay (based on "good" liner contact) or equation 159 for situations where flawed geomembrane is in contact with GCL (based on "excellent" liner contact). Equation 159 is as follows:

$$R = 0.5 a_o^{0.05} h_g^{0.5} k_s^{-0.06}$$

where,

a_o = area of flaw

Assuming the size and frequency of defects in Assumptions 1 and 2, a head of 1 foot on the primary liner results in the following leakage rates using the above equations:

q_h = 0.005 gal/acre/day (gpad) due to manufacturing defects (i.e., pinholes)
q_h = 0.059 gpad due to installation defects

Calculations for these leakage estimates are provided in Attachment 1.

Permeation through the primary liner occurs regardless of the presence of material or installation defects. The flowrate through the primary liner (both the geomembrane and the GCL) is estimated using Darcy's Law:

Q=kiA

where,

k = effective hydraulic conductivity of geomembrane and GCL = $7.0\text{x}10^{-13}$ cm/s = $2.0\text{x}10^{-9}$ ft/day
i = hydraulic gradient across geomembrane and GCL = H/t
H = head on primary liner = 1 ft
t = combined thickness of geomembrane and GCL = 80 mil + 200 mil = 0.0233 ft
A = area = 1 acre = 43,560 ft^2

Q = 0.0037 ft^3/day/acre = 0.028 gpad

Summing these individual components, a total of 0.092 gpad (0.005 + 0.059 + 0.028 = 0.092) is calculated to enter the SLCS from leachate flow in the PLCS.

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Calculation Sheet

2. Leakage and Permeation Through Secondary Liner from Groundwater

Leakage through the secondary liner from groundwater is evaluated using similar analyses outlined above except that the hydraulic heads, gradients, and hydraulic conductivities are different. To be conservative, the May 2001 piezometric heads from the confined aquifer in the Glaciolacustrine Silt/Sand unit are used. Groundwater levels measured during this time are generally accepted as representing the historical high since regular recording of site-wide groundwater levels began in the early 1980s. Using the piezometric head contours from this monitoring event, the following average piezometric heads are considered representative for the cells within RMU-2:

- Cell 15: 315.7 ft
- Cell 16: 315.9 ft
- Cells 17 and 18: 316.3 ft
- Cell 19: 316.4 ft
- Cell 20: 316.6 ft

Because the floor of each cell is sloped, the hydrostatic head acting on the bottom of the liner system varies across the cell floor. Therefore, an average hydrostatic head from the confined aquifer acting on the bottom of the compacted clay layer in the secondary liner of each cell is determined from an isopach surface created using Reference 1 and the average piezometric heads discussed above. Areas of the cell floor that lie above the average piezometric head elevation are not included in the computation of the average hydrostatic head because these areas would experience zero head. The resulting average hydrostatic head acting on the bottom of the compacted clay layer in the secondary liner of each cell is:

- Cell 15: 7.44 ft
- Cell 16: 8.66 ft
- Cell 17: 4.50 ft
- Cell 18: 5.49 ft
- Cell 19: 6.54 ft
- Cell 20: 3.26 ft

Supporting output for the determination of these average heads is included in Attachment 2 to this calculation sheet.

Groundwater inflow to the SLCS through defects in the secondary liner geomembrane is inhibited by the presence of the 3-foot thick compacted clay layer and is calculated using the equations from Reference 4 presented earlier. The radius of the wetted area is calculated using Equation 162 based on “good” contact between the geomembrane and the compacted clay layer as follows:

$$R = 0.26 a_o^{0.05} h_g^{0.45} k_s^{-0.13}$$

Table 1 below summarizes the calculated groundwater leakage rates for each cell due to manufacturing and installation defects.

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Calculation Sheet

Table 1 – Groundwater Leakage Through Secondary Geomembrane Flaws

Cell	Due to Manufacturing Defects [gpad]	Due to Installation Defects [gpad]	Total [gpad]
15	0.55	4.62	5.17
16	0.64	5.42	6.06
17	0.33	2.76	3.09
18	0.40	3.37	3.77
19	0.48	4.03	4.51
20	0.24	2.01	2.25

Calculations for the leakage estimates summarized in Table 1 are provided in Attachment 1.

Permeation through the secondary liner occurs regardless of the presence of material or installation defects. The flowrate through the secondary liner (both the compacted clay and the geomembrane) is estimated using Darcy's Law:

$Q=kiA$

where,

k = effective hydraulic conductivity of compacted clay and geomembrane = $9.0\text{x}10^{-11}$ cm/s = $2.6\text{x}10^{-7}$ ft/day
i = hydraulic gradient across compacted clay and geomembrane = H/t
H = cell-averaged head acting on the bottom of the compacted clay layer in the secondary liner (see values above)
t = combined thickness of compacted clay and geomembrane = 3 ft + 80 mil = 3.0067 ft
A = area = 1 acre = 43,560 ft^2

Q = 0.028 ft^3/day/acre = 0.21 gpad (Cell 15)
= 0.033 ft^3/day/acre = 0.24 gpad (Cell 16)
= 0.017 ft^3/day/acre = 0.13 gpad (Cell 17)
= 0.021 ft^3/day/acre = 0.15 gpad (Cell 18)
= 0.025 ft^3/day/acre = 0.18 gpad (Cell 19)
= 0.012 ft^3/day/acre = 0.09 gpad (Cell 20)

Table 2 summarizes the individual components representing groundwater leakage and permeation into the SLCS.

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Calculation Sheet

Table 2 – Groundwater Leakage and Permeation Totals

Cell	Leakage [gpad]	Permeation [gpad]	Total [gpad]
15	5.17	0.21	5.38
16	6.06	0.24	6.30
17	3.09	0.13	3.22
18	3.77	0.15	3.92
19	4.51	0.18	4.69
20	2.25	0.09	2.34

3. Leakage and Permeation Through Secondary Liner Due to Excess Pore Pressure from Secondary Clay Layer Consolidation

Landfill construction and waste placement will result in consolidation of the compacted clay layer in the secondary liner. Reference 7 includes excess pore pressures in the secondary compacted clay layer of Cell 20 at different times during simulated waste placement associated with the initial fill progression design depicted on RMU-2 Permit Drawing No. 8. Specifically, the waste is assumed to advance instantaneously by one lift thickness (6 feet) at a time, at which point, the load is held constant for a time period approximately equal to the elapsed time associated with the waste filling in that lift. At each lift, the pressures are calculated for various locations along a typical cross section passing through the cell at specific time steps. Reference 7 indicates that the peak excess pore pressure occurs when the waste mass is at elevation 383 ft. For the worst-case time step at that lift, an average excess pore pressure of 2,389 psf along the cell floor is calculated. This is equivalent to a head of approximately 38.3 feet. The leakage from this excess pressure through defects in the secondary liner is calculated using the equations from Reference 4 presented earlier. The leakage rates are as follows:

q_h = 3.50 gpad due to manufacturing defects
q_h = 31.96 gpad due to installation defects

Calculations for these leakage estimates are provided in Attachment 1.

The permeation through the geomembrane in the secondary liner from the excess pore pressure in the compacted clay layer is estimated using Darcy's Law:

$Q = kiA$

where,
k = effective hydraulic conductivity of compacted clay and geomembrane = 9.0×10^{-11} cm/s = 2.6×10^{-7} ft/day
i = hydraulic gradient across compacted clay and geomembrane = H/t
H = head on geomembrane = excess pore pressure/unit weight of water = 38.3 ft
t = combined thickness of compacted clay and geomembrane = 3 ft + 80 mil = 3.0067 ft
A = area = 1 acre = 43,560 ft^2

Q = 0.14 ft^3/day/acre = 1.08 gpad

Summing these individual components, a total of 36.54 gpad (3.50 + 31.96 + 1.08 = 36.54) is calculated to enter the SLCS from consolidation water from the secondary compacted clay layer.

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Calculation Sheet

The individual components quantified above are combined to yield a single RR value for each cell in RMU-2 as shown in Table 3.

Table 3 – Summary of Calculated RR Values

Cell	Leakage and Permeation Estimates from Various Sources [gpad]			
	From Leachate Flow in PLCS	From Groundwater Below Liner System	From Secondary Clay Consolidation	Total
15	0.092	5.38	36.54	42.01
16		6.30		42.93
17		3.22		39.85
18		3.92		40.55
19		4.69		41.32
20		2.34		38.97

Although the values summarized in Table 3 are deemed reasonable, a unit-specific value of 20 gpad has been requested by the NYSDEC, as recommended by USEPA (Federal Register No. 19, January 29, 1992) for leakage and permeation through primary liners.

SUMMARY:

The calculated RRs for the cells in RMU-2 range from 38.97 to 42.93 gpad. However, an RR of 20 gpad will be used for all cells based on a USEPA-recommended unit-specific value.

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Attachment 1

Calculated Leakages Through Geomembrane Flaws

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Leakage Through Primary Liner Due to Pinholes

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 159:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	1.00	0.3048
K_s = Permeability of Controlling Soil Layer [cm/s]	5.00E-09	5.00E-11
T_s = Thickness of Controlling Soil Layer [ft]	0.0167	0.00509016
r_0 = Radius of Flaw [mm]	0.5	0.0005
a_0 = Flaw Area [m^2]		7.85398E-07
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 159) [cm^2/s]		0.57
n = Density of Flaws [number per acre]	1	0.000247105

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 5.26

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 5.76E-14

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**0.005**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Leakage Through Primary Liner Due to Installation Defects

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 159:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	1.00	0.3048
K_s = Permeability of Controlling Soil Layer [cm/s]	5.00E-09	5.00E-11
T_s = Thickness of Controlling Soil Layer [ft]	0.0167	0.00509016
r_0 = Radius of Flaw [mm]	5.65	0.0057
a_0 = Flaw Area [m^2]		0.000100287
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 159) [cm^2/s]		0.72
n = Density of Flaws [number per acre]	5	0.001235527

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 7.17

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 6.38E-13

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**0.059**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Secondary Clay Layer Consolidation Water Leakage Due to Pinholes

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	38.30	11.67384
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	0.5	0.0005
a_0 = Flaw Area [m^2]		7.85398E-07
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Equn 162) [cm^2/s]		5.75
n = Density of Flaws [number per acre]	1	0.000247105

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.68

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 3.79E-11

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**3.503**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Secondary Clay Layer Consolidation Water Leakage Due to Installation Defects

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	38.30	11.67384
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	5.65	0.0057
a_0 = Flaw Area [m^2]		0.000100287
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 162) [cm^2/s]		7.33
n = Density of Flaws [number per acre]	5	0.001235527

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.89

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 3.46E-10

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**31.963**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 15 Groundwater Leakage Due to Pinholes

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	7.44	2.267712
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	0.5	0.0005
a_0 = Flaw Area [m^2]		7.85398E-07
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Equn 162) [cm^2/s]		2.75
n = Density of Flaws [number per acre]	1	0.000247105

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.14

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 5.90E-12

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**0.545**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 15 Groundwater Leakage Due to Installation Defects

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	7.44	2.267712
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	5.65	0.0057
a_0 = Flaw Area [m^2]		0.000100287
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 162) [cm^2/s]		3.51
n = Density of Flaws [number per acre]	5	0.001235527

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.19

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 5.00E-11

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**4.615**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 16 Groundwater Leakage Due to Pinholes

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	8.66	2.639568
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	0.5	0.0005
a_0 = Flaw Area [m^2]	X	7.85398E-07
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Equn 162) [cm^2/s]	X	2.95
n = Density of Flaws [number per acre]	1	0.000247105

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.17

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 6.90E-12

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**0.637**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 16 Groundwater Leakage Due to Installation Defects

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	8.66	2.639568
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	5.65	0.0057
a_0 = Flaw Area [m^2]		0.000100287
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 162) [cm^2/s]		3.76
n = Density of Flaws [number per acre]	5	0.001235527

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.22

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 5.87E-11

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**5.421**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 17 Groundwater Leakage Due to Pinholes

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	4.50	1.3716
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	0.5	0.0005
a_0 = Flaw Area [m^2]		7.85398E-07
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Equn 162) [cm^2/s]		2.20
n = Density of Flaws [number per acre]	1	0.000247105

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.09

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 3.57E-12

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**0.330**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 17 Groundwater Leakage Due to Installation Defects

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	4.50	1.3716
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	5.65	0.0057
a_0 = Flaw Area [m^2]	X	0.000100287
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 162) [cm^2/s]	X	2.80
n = Density of Flaws [number per acre]	5	0.001235527

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.12

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 2.99E-11

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**2.758**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 18 Groundwater Leakage Due to Pinholes

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	5.49	1.673352
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	0.5	0.0005
a_0 = Flaw Area [m^2]		7.85398E-07
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Equn 162) [cm^2/s]		2.40
n = Density of Flaws [number per acre]	1	0.000247105

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.11

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 4.35E-12

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**0.402**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 18 Groundwater Leakage Due to Installation Defects

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	5.49	1.673352
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	5.65	0.0057
a_0 = Flaw Area [m^2]		0.000100287
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 162) [cm^2/s]		3.06
n = Density of Flaws [number per acre]	5	0.001235527

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.15

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 3.65E-11

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**3.371**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 19 Groundwater Leakage Due to Pinholes

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	6.54	1.993392
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	0.5	0.0005
a_0 = Flaw Area [m^2]	X	7.85398E-07
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Equn 162) [cm^2/s]	X	2.60
n = Density of Flaws [number per acre]	1	0.000247105

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.13

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 5.18E-12

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**0.478**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 19 Groundwater Leakage Due to Installation Defects

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	6.54	1.993392
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	5.65	0.0057
a_0 = Flaw Area [m^2]		0.000100287
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 162) [cm^2/s]		3.31
n = Density of Flaws [number per acre]	5	0.001235527

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.17

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 4.37E-11

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**4.034**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 20 Groundwater Leakage Due to Pinholes

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	3.26	0.993648
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	0.5	0.0005
a_0 = Flaw Area [m^2]	X	7.85398E-07
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Equn 162) [cm^2/s]	X	1.90
n = Density of Flaws [number per acre]	1	0.000247105

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.07

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 2.62E-12

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**0.242**

Note: Shaded cells are calculated. All others are user-input.

Leakage Through Geomembrane Flaws Using HELP Model Methods

Scenario: Cell 20 Groundwater Leakage Due to Installation Defects

Step 1 - User Input and Calculation of Wetted Radius, R, Using HELP Model Eqn. 162:

	User-Input Value	Value in SI Units (m, s)
h_g = Hydraulic Head on Liner [ft]	3.26	0.993648
K_s = Permeability of Controlling Soil Layer [cm/s]	1.00E-07	1.00E-09
T_s = Thickness of Controlling Soil Layer [ft]	3	0.9144
r_0 = Radius of Flaw [mm]	5.65	0.0057
a_0 = Flaw Area [m^2]		0.000100287
R = Radius of Wetted Area Around Flaw (from HELP Model Engineering Documentation Eqn. 162) [cm^2/s]		2.42
n = Density of Flaws [number per acre]	5	0.001235527

Step 2 - Calculation of Average Hydraulic Gradient, i_{avg}, Using HELP Model Eqn. 150:

i_{avg} = 1.09

Step 3 -Calculation of Leakage Rate Through Flawed Geomembrane, q_h, Using HELP Model Eqn. 149:

q_h [m/s] = 2.17E-11

Step 4 - Determine Daily Leakage Volume Based on Acreage:

	Acres	Daily Leakage [gal]
Daily Leakage Volume:	**1**	**2.006**

Note: Shaded cells are calculated. All others are user-input.

ARCADIS

Attachment 2

Average Hydrostatic Head on Bottom of Secondary Clay Liner Compacted Clay Layer Due to Confined Aquifer

CELL 15 SURFACE TO DATUM VOLUME REPORT

ARCADIS
6723 Towpath Road PO Box 66
Syracuse, NY 13214
315.446.9120

Project: C:\Documents and Settings\BStone\Desktop\RMU-2 2009 Redesign.pro
Report Generated: Monday, July 27, 2009 11:08:07 AM

Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.

Shrinkage/swell factors: Excavation 1.0000 Fill 1.0000

DTM Surface Layer Name	Number of Points	Datum Elevation
P-SUBGRADE REV	4,374	315.70

Volume limited to that within the constraining boundary - Object 432790
Area within boundary: 265,607.44 Sq. Ft. (6.0975 Acres)
Total triangulated area: 265,608.57 Sq. Ft. (6.0975 Acres)

Excavation Volume Beneath Datum (Cu. Yd.)	Fill Volume Above Datum(Cu. Yd.)
44,105.0	57,987.7

Net Difference: 13,882.7 Cu. Yd. excess volume above datum

Subgrade Area Below El. 315.7 = 160,002 sq.ft.

Ave Depth Below El. 315.7 = 44,105 x 27 / 160,002 = 7.44 ft

CELL 16 SURFACE TO DATUM VOLUME REPORT

ARCADIS
6723 Towpath Road PO Box 66
Syracuse, NY 13214
315.446.9120

Project: C:\Documents and Settings\BStone\Desktop\RMU-2 2009 Redesign.pro
Report Generated: Monday, July 27, 2009 11:14:25 AM

Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.

Shrinkage/swell factors: Excavation 1.0000 Fill 1.0000

DTM Surface Layer Name	Number of Points	Datum Elevation
P-SUBGRADE REV	4,374	315.90

Volume limited to that within the constraining boundary - Object 432754
Area within boundary: 257,254.75 Sq. Ft. (5.9058 Acres)
Total triangulated area: 257,251.35 Sq. Ft. (5.9057 Acres)

Excavation Volume Beneath Datum (Cu. Yd.)	Fill Volume Above Datum(Cu. Yd.)
58,921.5	36,170.3

Net Difference: 22,751.2 Cu. Yd. excess volume beneath datum

Subgrade Area Below El. 315.9 = 183,665 sq.ft.

Ave Depth Below El. 315.9 = 58,922 x 27 / 183,665 = 8.66 ft

CELL 17 SURFACE TO DATUM VOLUME REPORT

ARCADIS
6723 Towpath Road PO Box 66
Syracuse, NY 13214
315.446.9120

Project: C:\Documents and Settings\BStone\Desktop\RMU-2 2009 Redesign.pro
Report Generated: Monday, July 27, 2009 11:26:29 AM

Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.

Shrinkage/swell factors: Excavation 1.0000 Fill 1.0000

DTM Surface Layer Name	Number of Points	Datum Elevation
P-SUBGRADE	3,917	316.30

Volume limited to that within the constraining boundary - Object 328341
Area within boundary: 251,917.38 Sq. Ft. (5.7832 Acres)
Total triangulated area: 251,917.39 Sq. Ft. (5.7832 Acres)

Excavation Volume Beneath Datum (Cu. Yd.)	Fill Volume Above Datum(Cu. Yd.)
28,473.1	20,931.8

Net Difference: 7,541.2 Cu. Yd. excess volume beneath datum

Subgrade Area Below El. 316.3 = 170,955 sq.ft.

Ave Depth Below El. 316.3 = 28,473 x 27 / 170,955 = 4.50 ft

CELL 18 SURFACE TO DATUM VOLUME REPORT

ARCADIS
6723 Towpath Road PO Box 66
Syracuse, NY 13214
315.446.9120

Project: C:\Documents and Settings\BStone\Desktop\RMU-2 2009 Redesign.pro
Report Generated: Monday, July 27, 2009 11:31:31 AM

Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.

Shrinkage/swell factors: Excavation 1.0000 Fill 1.0000

DTM Surface Layer Name	Number of Points	Datum Elevation
P-SUBGRADE REV	4,374	316.30

Volume limited to that within the constraining boundary - Object 317013
Area within boundary: 250,692.04 Sq. Ft. (5.7551 Acres)
Total triangulated area: 250,705.47 Sq. Ft. (5.7554 Acres)

Excavation Volume Beneath Datum (Cu. Yd.)	Fill Volume Above Datum(Cu. Yd.)
36,252.9	27,810.3

Net Difference: 8,442.6 Cu. Yd. excess volume beneath datum

Subgrade Area Below El. 316.3 = 178,273 sq.ft.

Ave Depth Below El. 316.3 = 36,253 x 27 / 178,273 = 5.49 ft

CELL 19 SURFACE TO DATUM VOLUME REPORT

ARCADIS
6723 Towpath Road PO Box 66
Syracuse, NY 13214
315.446.9120

Project: C:\Documents and Settings\BStone\Desktop\RMU-2 2009 Redesign.pro
Report Generated: Monday, July 27, 2009 11:36:11 AM

Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.

Shrinkage/swell factors: Excavation 1.0000 Fill 1.0000

DTM Surface Layer Name	Number of Points	Datum Elevation
P-SUBGRADE REV	4,374	316.40

Volume limited to that within the constraining boundary - Object 317013
Area within boundary: 252,340.43 Sq. Ft. (5.7929 Acres)
Total triangulated area: 252,335.73 Sq. Ft. (5.7928 Acres)

Excavation Volume Beneath Datum (Cu. Yd.)	Fill Volume Above Datum(Cu. Yd.)
34,173.3	60,479.6

Net Difference: 26,306.3 Cu. Yd. excess volume above datum

Subgrade Area Below El. 316.4 = 141,057 sq.ft.

Ave Depth Below El. 316.4 = 34,173 x 27 / 141,057 = 6.54 ft

CELL 20 SURFACE TO DATUM VOLUME REPORT

ARCADIS
6723 Towpath Road PO Box 66
Syracuse, NY 13214
315.446.9120

Project: C:\Documents and Settings\BStone\Desktop\RMU-2 2009 Redesign.pro
Report Generated: Monday, July 27, 2009 12:10:04 PM

Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.

Shrinkage/swell factors: Excavation 1.0000 Fill 1.0000

DTM Surface Layer Name	Number of Points	Datum Elevation
P-SUBGRADE REV	4,374	316.60

Volume limited to that within the constraining boundary - Object 317012
Area within boundary: 267,523.01 Sq. Ft. (6.1415 Acres)
Total triangulated area: 267,517.34 Sq. Ft. (6.1414 Acres)

Excavation Volume Beneath Datum (Cu. Yd.)	Fill Volume Above Datum(Cu. Yd.)
16,313.6	53,381.4

Net Difference: 37,067.8 Cu. Yd. excess volume above datum

Subgrade Area Below El. 316.6 = 135,222 sq.ft.

Ave Depth Below El. 316.6 = 16,314 x 27 / 135,222 = 3.26 ft

ARCADIS

Appendix C

Table of Priority Pollutants

TABLE OF
PRIORITY POLLUTANTS

NDPES NO.	COMPOUND
ACIDS	
1A	2-Chlorophenol
2A	2,4-Dichlorophenol
3A	2,4-Dimethylphenol
4A	4,6-Dinitro-o-cresol
5A	2,4-Dinitrophenol
6A	2-Nitrophenol
7A	4-Nitrophenol
8A	p-Chloro-m-cresol
9A	Pentachlorophenol
10A	Phenol
11A	2,4,6-Trichlorophenol
BASE/NEUTRALS	
1B	Acenaphthene
2B	Acenaphtylene
3B	Anthracene
4B	Benzidine
5B	Benzo(a)anthracene
6B	Benzo(a)pyrene
7B	Benzo(b)fluoranthene
8B	Benzo(ghi)perylene
9B	Benzo(k)fluoranthene
10B	bis(2-Chloroethoxy)methane
11B	bis(2-Chloroethyl)ether
12B	bis(2-Chloroisopropyl)ether
13B	bis(2-Ethylhexyl)phthalate
14B	4-Bromophenyl phenyl ether
15B	Butyl benzyl phthalate
16B	2-Chlornaphthalene
17B	4-Chlorophenyl phenyl ether
18B	Chrysene
19B	Dibenzo(a,h) anthracene
20B	1,2-Dichlorobenzene
21B	1,3-Dichlorobenzene
22B	1,4-Dichlorobenzene
23B	3,3-Dichlorobenzidine
24B	Diethyl phthalate
25B	Dimethyl phthalate
26B	Di-n-butyl phthalate
27B	2,4-Dinitrotoluene

NDPES NO.	COMPOUND
BASE/NEUTRALS (CONTINUED)	
28B	2,6-Dinitrotoluene
29B	Di-n-octyl phthalate
30B	1,2-Diphenylhydrazine
31B	Fluoranthene
32B	Fluorene
33B	Hexachlorobenzene
34B	Hexachlorobutadiene
35B	Hexachlorocyclopentadiene
36B	Hexachloroethane
37B	Indeno (1,2,3-c,d)pyrene
38B	Isophorone
39B	Naphthalene
40B	Nitrobenzene
41B	N-Nitrosodimethylamine
42B	N-Nitrosodi-n-propylamine
43B	N-Nitrosodiphenylamine
44B	Phenanthrene
45B	Pyrene
46B	1,2,4-Trichlorobenzene

METALS (TOTAL)

Antimony
Arsenic
Beryllium
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Zinc

TABLE OF PRIORITY POLLUTANTS

(Continued)

NOPES NO.	COMPOUND
PESTICIDES/PCB	
1P	Aldrin
2P	Alpha-BHC
3P	Beta-BHC
4P	Gamma-BHC
5P	Delta-BHC
6P	Chlordane
7P	4,4'-DDT
8P	4,4'-DDE
9P	4,4'-DDD
10P	Dieldrin
11P	Endosulfan I
12P	Endosulfan II
13P	Ensosulfan sulfate
14P	Endrin
15P	Endrin aldehyde
16P	Heptachlor
17P	Heptachlor epoxide
18P	PCB-1242
19P	PCB-1254
20P	PCB-1221
21P	PCB-1232
22P	PCB-1248
23P	PCB-1260
24P	PCB-1016
VOLATILES	
3V	Benzene
5V	Bromoform
6V	Carbon tetrachloride
7V	Chlorobenzene
8V	Chlorodibromethane
9V	Chloroethane

NDPES NO.	COMPOUND
VOLATILES (CONTINUED)	
10V	2-Chloroethylvinyl ether
11V	Chloroform
12V	Dichlorobromomethane
14V	1,1-Dichloroethane
15V	1,2-Dichloroethane
16V	1,1-Dichloroethylene
17V	1,2-Dichloropropane
18V	cis-1,3-Dichloropropylene
19V	Ethylbenzene
20V	Methyl bromide
21V	Methyl chloride
22V	Methylene chloride
23V	1,1,2,2-Tetrachloroethane
24V	Tetrachloroethylene
25V	Toluene
26V	1,2-Trans-dichloroethylene
27V	1,1,1-Trichloroethane
28V	1,1,2-Trichloroethane
29V	Trichloroethylene
31V	Vinyl chloride
18V	trans-1,3-Dichloropropylene

ATTACHMENT L

Sections D-10
Fugitive Dust Control Plan

[*NOTE: Attachment L is **NOT** being modified. It is presented in association with the Draft RMU-2 landfill modification since some of the requirements contained in this attachment are or may be applicable to the proposed units.*]

Date: April 2001

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FUGITIVE DUST CONTROL PLAN

Date: April 2001

FUGITIVE DUST CONTROL PLAN

As a hazardous waste management facility, the possibility exists that potentially contaminated dust could be released to the atmosphere. 6 NYCRR 373-2.14(c)(9) specifies that if a landfill contains any particulate matter which may be subject to wind dispersal, the owner or operator must cover or otherwise manage the landfill to control wind dispersal. Controls, such as wetting, must be applied to dusty waste streams when they are disposed of in the landfill to prevent particulate emissions. Vehicles exiting the landfill are cleaned of any gross contamination at the exit of the landfill. In order to control any potentially contaminated dust that may accumulate on the roads outside the landfill which are used by waste hauling vehicles, road maintenance is performed.

In addition to the control of potentially contaminated dust from waste management activities, CWM employs best management practices to reduce the amount of soil-type particulate dust. The practices are employed during construction, site and stockpile maintenance and the maintenance of roadways which are used by non-waste hauling vehicles.

I. Control of Potentially Contaminated Dust

A. Landfill Operations

1. Waste stream evaluation.

    a) Waste streams are evaluated for dusting potential during the approval process. Recommendations for dust control, including wetting, containerization, stabilization treatment, etc. will be included on the disposal decision for any wastes identified with dusting potential.

    b) Recommendations for dust control will be considered by the On-Site DEC Monitors during their review and approval of the landfill waste stream. DEC comments will be incorporated into the management approach as appropriate.

    c) Upon receipt of the first shipment of any new waste, the sampler will inspect the load and consider its potential for dusting. The disposal decision may be updated if necessary.

    d) A dusty load for direct landfill disposal will be flagged for special handling by the landfill personnel and the control method prescribed on the Waste Tracking Form.

2. Waste Disposal

    a) If the prescribed method for dust control is wetting, an operator with a water canon may wet the load in the container in the landfill. If required, an operator may use a backhoe to mix the water and the material in the container prior to dumping to ensure proper wetting of the waste. Additional water may be sprayed during the unloading or after waste placement.

b) Any excess or free liquid resulting from the operations contemplated by the activity above shall be treated as liquid from a precipitation event and shall not be deemed to constitute the disposal of free liquids or bulk waste containing free liquids. This interpretation is in keeping with USEPA policy contained in a statutory interpretative guidance document issued in April, 1986.

c) If a dusty waste load not previous identified as having a dusting potential is noted by the landfill personnel, the lab will be notified and the disposal decision amended as needed to specify controls.

d) If the specified dust controls are unsuccessful during a trial load, CWM shall cease disposal of additional loads and revise the dust control procedure.

e) In addition, a trash fence is employed to prevent wind blown debris from escaping the landfill. On a routine basis, all plastic and paper debris escaping the boundaries of the waste management area will be collected.

f) Additional water may be applied to the landfill operating area to control dust. DEC approved cover material such as ConCover may be used to provide dust control of the waste placed in the landfill.

g) All exposed waste is covered at the end of each day of operation using a DEC approved cover material.

NOTE: The procedures specified above in sections 1. a)-c) and 2. c)-d) must be included in this and any future versions of CWM's Fugitive Dust Control Plan according to a Memorandum of Understanding (89-151) between CWM and NYSDEC.

B. Roadways Used By Waste Hauling Vehicles

1. Potential Contamination Control

a) Vehicles or any other equipment which have entered the landfill facility where it has come into direct contact with waste, shall be inspected for gross contamination prior to leaving the landfill area.

b) Any gross contamination identified on the wheels or equipment will be physically removed before leaving the area to prevent contamination of on-site roads.

c) Despite the efforts described above, the potential exists that contaminated dust may be present on the roadways outside the landfill. These roadways will be cleaned and maintained. A sweeper or other road cleaning equipment may be employed to minimize dust accumulation on these roads. Water trucks may also be employed to wet the road surfaces and to minimize air borne dust. Note: If truck washing is performed at the landfill exit, the potential for contaminated dust on the roadway will be eliminated.

d) In addition, the site traffic control plan has generally limited these roadways to waste hauling vehicles. A low speed limit has been posted and speed bumps are employed to minimize dust generation.

II. Control of General Particulate Dust

A. Construction Projects

Dust management procedures for new site and landfill construction projects are addressed in the related permit applications where appropriate. A Stormwater Pollution Prevention Plan has been developed for construction projects affecting areas of at least 5 acres to control soil erosion and contain sediments.

B. Erosion

Vegetative cover is maintained using on-site and contracted services. This includes the application of clay, top soil, fertilizer, hydroseeding and hand seeding. Some berm areas may also be covered with stone or gravel. The use of gabion mats and especially Miramet geotextile fabric has reduced erosion and enhanced vegetative growth.

C. Other Site Roads

Roadways other than those used by waste hauling vehicles will be cleaned and maintained as good housekeeping dictates. In general, the paved roads will be swept as needed, weather permitting. These roads may be wetted down as needed to provide general dust management, adequate visibility and nuisance control.

III. Air Monitoring - Fugitive Dust Emissions

CWM has an Ambient Air Monitoring Program. This program determines the impact, if any, of the hazardous waste activities and other site activities on the surrounding air quality at the Model City facility. This Ambient Air Monitoring Program has been approved by NYSDEC.

A. PM-10 Monitoring

A detailed discussion of the PM-10 monitoring network relative to dust emissions is presented in the PM-10 monitoring system QA/QC manual previously approved by NYSDEC (H. Sandonato to J. Pizzuto, 9/26/90). This monitoring program demonstrates CWM's compliance with the national primary and secondary 24 hour ambient air quality standard for particulate matter of 150 micrograms/cubic meter, 24 hour average concentration. The level of the national primary and secondary annual standards for particulate matter is 50 micrograms/cubic meter, annual arithmetic mean.

The fugitive dust control measures discussed in this plan have consistently resulted in particulate matter levels below the ambient air quality standards. If this monitoring network begins to show levels above the standards, CWM will investigate the cause and revise the Fugitive Dust Control Plan, if necessary.

ATTACHMENT M

Surface Water Sampling & Analysis Plan

(The contents of Attachment M have been derived from the Permit application submitted by CWM Chemical Services, L.L.C.)

[*NOTE: Portions of Attachment M are being modified. Text proposed for addition is indicated in RED, and text proposed for deletion is indicated in ~~BLACK STRIKEOUT~~. Figures to be added or deleted are identified by a RED NOTE.*]

SURFACE WATER

SAMPLING AND ANALYSIS PLAN

Revised ~~July~~August 2013

DISCLAIMER

It should be noted that the State Pollutant Discharge Elimination System (SPDES) monitoring and compliance requirements which are applicable to this Facility, are not part of this Surface Water Sampling & Analysis Plan (SWSAP), but are referenced in this SWSAP for informational purposes only. Adherence to this SWSAP in no way obviates CWM from fulfilling its SPDES monitoring and compliance obligations.

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SECTION .... PAGE

LIST OF TABLES AND FIGURES

1.0 INTRODUCTION

CWM Chemical Services, L.L.C. (CWM) owns and operates a Treatment, Storage, Disposal and Recovery (TSDR) Facility at Model City, New York. As a condition of the Part 373-2 Operating Permit, the New York State Department of Environmental Conservation (NYSDEC) has required the preparation of a Surface Water Sampling and Analysis Plan (SWSAP).

The overall purpose of the SWSAP is to demonstrate that there is no migration of hazardous constituents from the Model City Facility into surface water run-off, (i.e. stormwater). This sampling and analysis program in which long term trends of surface water quality are monitored meets the objective.

The SWSAP provides procedures for collecting surface water samples that are:

1) fully comprehensive to cover any sampling circumstance that might occur during the routine monitoring program;

2) technically sound so that the surface water samples collected are subject to minimal sampling and analytical bias; and

3) uniform so that all the surface water samples are collected and analyzed in a consistent manner for comparison purposes.

The SWSAP has been prepared to satisfy the *routine surface and storm water monitoring requirements of the above-mentioned Operating Permit and CWM's current State Pollutant Discharge Elimination System (SPDES) Discharge Permit.*

This document only addresses the current monitoring requirements of the site's routine surface water monitoring programs. These programs are very specific as to sample collection, location, parameters, and frequencies. Other monitoring programs (Groundwater Monitoring, Air Monitoring, etc.) have sampling and analysis plans developed specifically for them.

2.0 SITE BACKGROUND

The Model City TSDR Facility is located in Niagara County, New York, near the Niagara River and Lake Ontario (see Figure 1). The facility was used for a variety of industrial purposes by the U.S. Government between 1942 and 1959.

The site was sold to a real estate company in 1966. In 1972, Chem-Trol Pollution Services purchased the site and began to use it as a private industrial waste operations facility. Chem-Trol was purchased by SCA Services, Inc. in 1973, then in 1984, SCA Services, Inc. was acquired by a WMI affiliate, Waste Management Acquiring Corporation, making SCA Chemical Services, Inc. a wholly-owned subsidiary of WMI.

In 1987, SCA Chemical Services, Inc. became a wholly owned subsidiary of Chemical Waste Management, Inc. and in July 1988, the facility name was changed to CWM Chemical Services, Inc. In 1998, CWM became a Limited Liability Company (L.L.C.) while its parent company, Waste Management, Inc. merged with USA Waste.

2.1 SITE DESCRIPTION

Current operations at the facility include treatment, recovery, disposal, and transfer of hazardous and industrial waste. The operations are comprised of waste receiving areas, storage and mixing tanks, chemical treatment facilities, biological treatment impoundments, and secure landfills.

The general site layout is shown on Figure 2.

2.2 SITE STRATIGRAPHY

The Model City Facility is situated on the Ontario Plain, an area of low topographic relief located between the Niagara Escarpment and Lake Ontario. The ground surface slopes northward at less than one percent with elevations ranging between approximately 310 and 320 feet above mean sea level.

Basically, the unconsolidated geology at the site consists of about 30 feet to 60 feet of glacial and glaciolacustrine deposits of Late Wisconsin Age. The glacial deposits overlie an estimated 1,000-foot thick sequence of red shale, siltstone, and sandstone of the Queenston Formation of Upper Ordovician Age.

2.3 SOIL CLASSIFICATION AND USE

The surface of the site is composed of low permeability soils. The U.S. Soil Conservation Service classifies many of the surface soil types present as Group C and Group D. These soil groups are characterized as having moderately high to high run-off potential, respectively, due to very slow infiltration rates.

Group C soil groups include the Appleton Silt Loam and the Ovid Silt Loam. Group D soil groups include the Canandaigua Silt Loam, Cheektowaga Fine Sandy Loam, Rhinebeck Silt Loam, Sun Silt Loam, and Madalin Silt Loam. Each group comprises approximately 50% of the soils on site~~, (Reference 5)~~.

The various land uses at the Model City Facility also influence site drainage characteristics. These uses are described in terms of the three general areas identified below:

1. Non-containment operational areas,
2. Active containment and disposal areas, and
3. Natural buffer area.

Each of these areas has different run-off and storage characteristics.

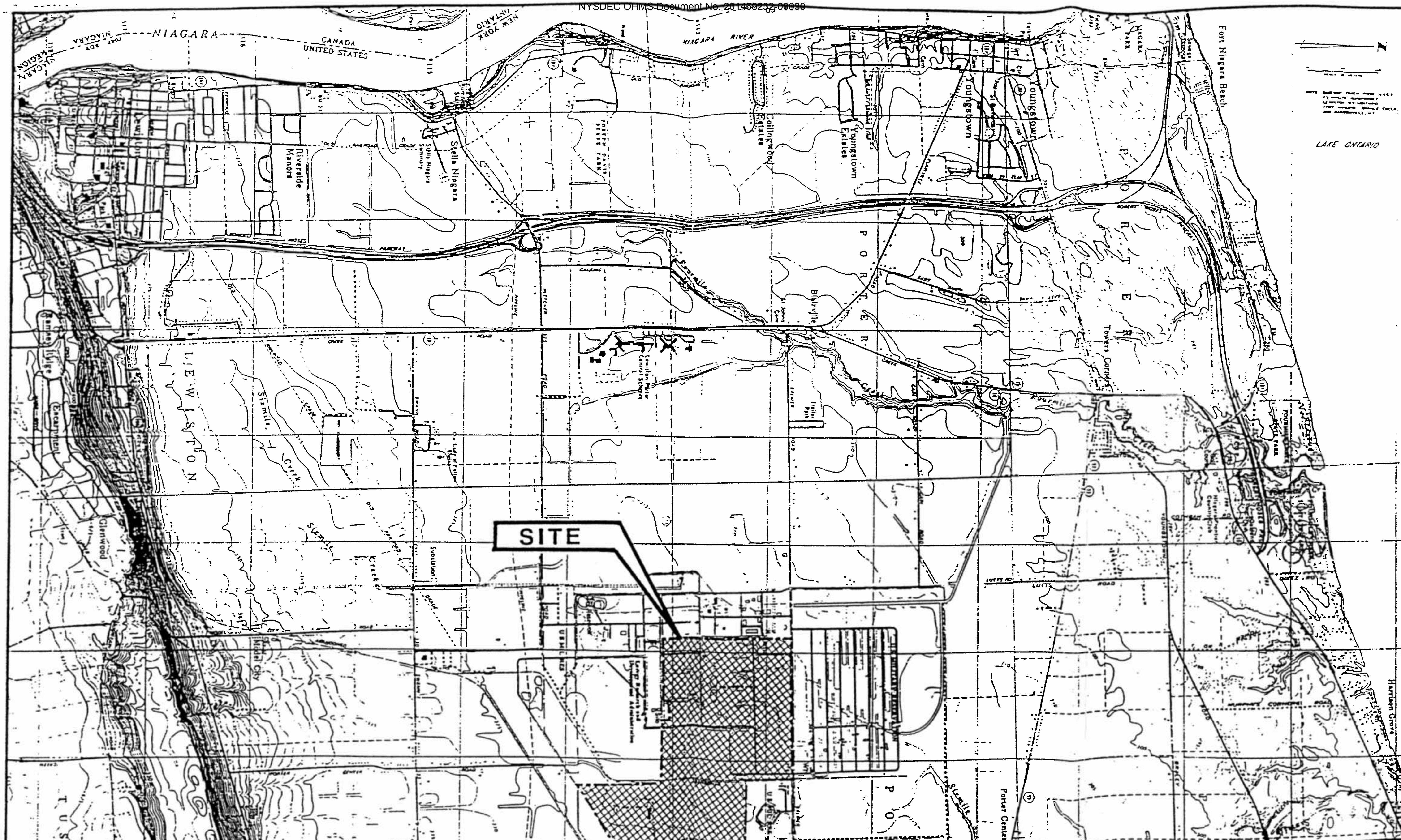
The non-containment operational areas include closed landfills, buildings, roads, parking lots, and open areas being prepared for future operations. These areas are not classified with a particular soil type as discussed above; rather they are referred to as "made land." The blacktop, roofing, and grading characteristics of these operational areas typically make them areas of rapid run-off.

The active containment and disposal areas include Stabilization, RMU-1, which is bermed, active tank farms, which have secondary containment, and the full trailer park, which has secondary containment. These areas act to contain surface water and prevent run-off and would not normally contribute to general site run-off. The RMU-2 landfill will add disposal capacity and the Stabilization and Full Trailer Parking Areas will be replaced.

The natural buffer areas consist of wooded areas, wetlands, ponds, and topographically low areas that generally act as water storage areas. These buffer areas are mostly located in the central and northern portions of the site.

FIGURE 1

SITE LOCATION MAP



JOB NO. 853-3055	SCALE AS SHOWN	SITE LOCATION MAP
DRAWN SKB	DATE 3/19/87	
CHECKED DJM	DWG. NO 176	
Golder Associates		CHEMICAL WASTE MANAGEMENT, INC. / FIGURE 1

FILE NUMBER 853-3047

FIGURE 2

FIGURE 2

MODEL CITY SURFACE WATER MONITORING POINT LOCATIONS

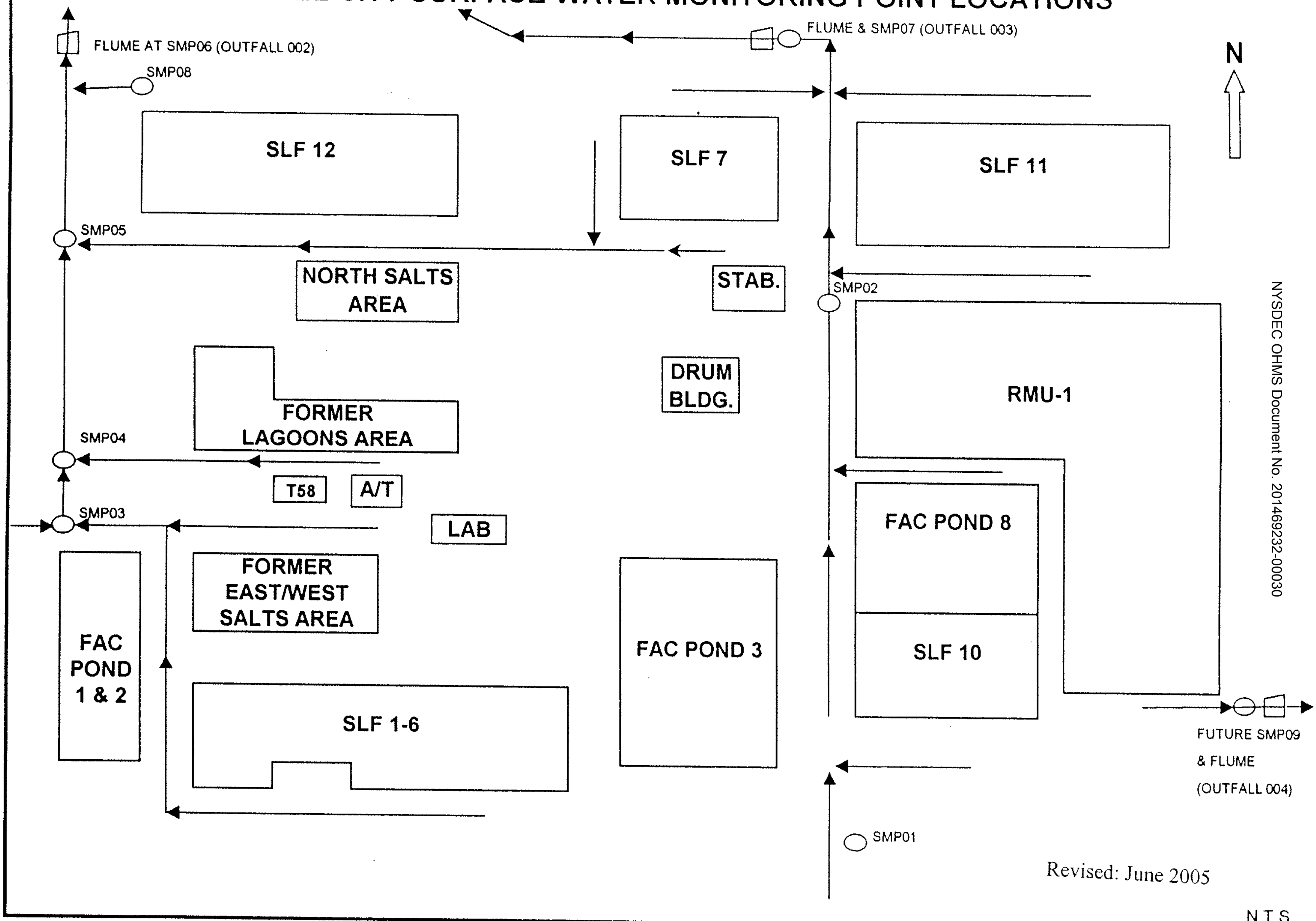
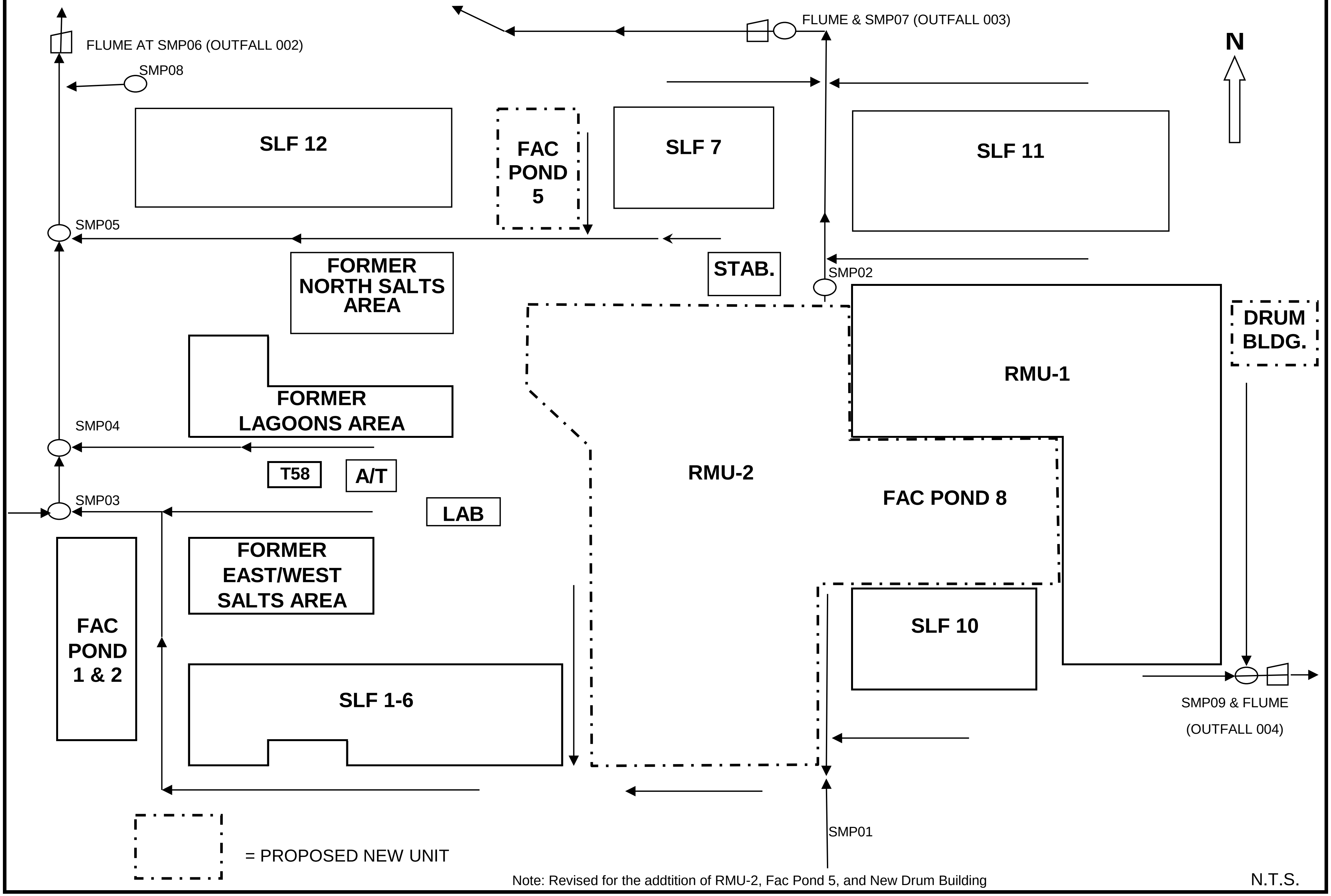


FIGURE 2a

NOTE: This page to be added.

FIGURE 2a - MODEL CITY SURFACE WATER MONITORING POINT LOCATIONS



Note: Revised for the addtition of RMU-2, Fac Pond 5, and New Drum Building

3.0 SURFACE WATER CONDITIONS

The Model City Facility receives 2.40 inches of precipitation (as rainfall) per month and ~~28.82~~29.3 inches per year on average. (Based on data collected at the Model City Facility from June 1976 through December 20~~09~~12). Surface water run-off from the Model City Facility ultimately flows to either Four Mile Creek (Surface Water Index No. H-156-1C, C) or Twelve Mile Creek (Surface Water Index No. H-156-1C-3, C). Most of the Facility drains north and west until it finally reaches Four Mile Creek approximately one-quarter mile north of the Facility's northwestern boundary. Four Mile Creek then flows north to Lake Ontario. According to 6 NYCRR Part 701.8, Four Mile Creek and its tributaries contain Class C fresh surface waters, which are suitable for fish propagation and survival.

Twelve Mile Creek receives some surface water discharge from a small part of the Facility's southeastern property. On January 6 2004, approval was received from NYSDEC to allow additional run-off from the eastern and southern portions of RMU-1. This run-off is discharged to a Storm Water Retention Basin and then through Outfall 004 (SMP09) to Twelve Mile Creek, which flows northward to Lake Ontario. According to 6 NYCRR Part 701.8, Twelve Mile Creek also contains Class C fresh surface waters in the area of the Model City Facility. (See W. Mirabile to J. Knickerbocker, 01/06/04).

Figure 2 relates the locations of the various waterways at the Facility.

3.1 SURFACE WATER DRAINAGE SYSTEM

Surface water run-off at the Facility is managed in a complex series of man-made and natural ditches, swales, basins, and control gates. Retention capacity for a 25-year, 24-hour storm is required under the Facility's Part 373 Operating Permit. The construction of retention basins and the placement of six control gates {SMP03, SMP04, SMP05, SMP07, SMP08, and SMP09} that are normally closed have achieved this retention. A seventh internal control gate {SMP02} is located upstream of SMP07. It is routinely left open, but may be closed if control or isolation of this area is desired.

Three main drainage channels receive all of the surface water run-off from the Facility. One channel receives run-off from the western and central portion of the Facility and is managed by 4 control gates. The second channel receives run-off from the eastern portion of the Facility and is managed by a control gate located at a retention basin north of the Facility. The third drainage channel flows to the southeast and receives controlled run-off from a portion of RMU-1.

Site surface water collects behind each of the six control gates in dedicated surface water holding areas; release occurs only after sampling and analytical qualification has occurred. Control gates are opened regularly and may be left open for several days to ensure that storage capacity is available for a large storm. The flow in all channels is intermittent; only occurring when there is sufficient precipitation to promote surface run-off.

3.2 CONTROL GATE OPERATION AND INSPECTION

As previously mentioned, storm water control gates are used to retain surface water until analytical qualification has occurred. These gates are equipped with manually-operated valves, which are used to release run-off.

Prior to release, water on the upstream side of each gate is visually inspected for an oil sheen or other visible evidence of potential contamination. Then it is sampled and analyzed for specific conductance. The results are compared with a “Site-Wide Alarm Value" of 2500 µmhos. (This value has been selected to prevent the unnecessary shutdown of operations due to groundwater infiltration, road salting, or other site wide construction activities; yet this value is still adequate for the determination of potential contamination based on the historic specific conductivity readings of landfill leachate and other on-site wastewaters.)

If the conductivity of the sample exceeds the alarm level, another sample is collected from the same location. If the conductivity of the resample exceeds the alarm level, then either the Technical Manager or Environmental Monitoring Manager is immediately notified. These individuals then determine whether to sample and analyze the surface water for VOCs, PCBs, or any other suspected contaminants.

Regardless of the conductivity level, CWM will sample and analyze the surface water at the control gates for VOCs, PCBs, or other suspected contaminants, if requested to do so by the On-Sire NYSDEC Monitors or other NYSDEC staff, unless it is demonstrated to the staff's satisfaction that such sampling is unnecessary. Also, CWM will, upon notification, allow the On-Site NYSDEC Monitors or other NYSDEC staff to collect surface water samples for NYSDEC analysis prior to, or during any release of surface water from a control gate.

Based on the results of any additional analyses and the manager's knowledge of activities (past or present) in the area, a decision will be made regarding the disposition of the stormwater. The manager will notify On-Site NYSDEC Monitors if elevated VOCs, PCBs, or other contamination is found. The presence of significant contamination may require the water to be processed to remove the constituent(s).

No storm water is released from the Facility at SMP06, SMP07, or SMP09 without prior testing if the manager has found or suspects contamination. All surface water released from control gates must meet the contamination concentration limits in the Facility's SPDES Permit at the respective Outfalls.

Continuous flow meters are installed at SMP06, SMP07, and SMP09 for measuring totalized flow exiting the Facility. Monthly, each flow meter is inspected to ensure that the equipment is in proper operating condition, (see Figure 3). The flow meters are routinely calibrated and maintained as necessary.

3.3 SURFACE WATER MONITORING LOCATIONS

The surface water monitoring point (SMP) sampling locations coincide with control gate locations unless noted and are as follows:

SMP01 - southwest of SLF 10, upgradient of all process areas. SMP01 is not equipped with a Control Gate. SMP01 is no longer routinely sampled. SMP01 was designated as an upgradient surface water reference point, which may be sampled in an investigation of a surface water contamination event.

SMP02 - northwest corner of RMU-1, receives surface water from the south of SLF 10 and from the west of SLF 10, Fac Pond 8, and RMU-1. SMP02 will also receive surface water from north and east portions of RMU-2 upon its closure (i.e., capping). SMP02 is an internal control gate, which is routinely maintained in an open position. It is no longer routinely sampled. It may be sampled in an investigation of a surface water contamination event.

SMP03 - northwest corner of FAC Ponds 1 & 2, receives surface water from a retention basin to the west and several smaller channels to the south and east. SMP03 will also receive surface water from western portions of RMU-2 upon its closure (i.e., capping). The water in SMP03 is routinely inspected and sampled for conductivity prior to opening the control gate. Additional sampling and analysis may be performed in the investigation of a surface water contamination event.

SMP04 - northwest corner of former West Drum Area, receives surface water from low lying areas in the vicinity of Tank 58 and the Aqueous Wastewater Treatment Facility. The water in SMP04 is routinely inspected and sampled for conductivity prior to opening the control gate. Additional sampling and analysis may be performed in the investigation of a surface water contamination event.

SMP05 - southwest corner of SLF 12, receives surface water from south of SLF 12 and north and west of the inactive Lagoons/Salts Areas. SMP05 will also receive surface water from western portions of RMU-2 upon its closure (i.e., capping). The water in SMP05 is routinely inspected and sampled for conductivity prior to opening the control gate.

Additional sampling and analysis may be performed in the investigation of a surface water contamination event.

SMP06 - SPDES Outfall 002, northwest of SLF 12, not equipped with a Control Gate, receives all water from SMP03, SMP04, SMP05, and SMP08. This location has a flow meter for measuring totalized flow and an ISCO Refrigerated Auto-Sampler or similar equipment.

SMP07 - SPDES Outfall 003, north of SLF 7 and SLF 11, this man-made Retention Basin receives all water from the northeast half of SLF 7, SLF 11, north of RMU-1, and SMP02. SMP07 will also receive surface water routed through SMP02 from north and east portions of RMU-2 upon its closure (i.e., capping). This location has a flow meter for measuring totalized flow and an ISCO Refrigerated Auto-Sampler or similar equipment.

SMP08 - a man-made Retention Basin north of SLF 12 and east of Castle Garden Road. The water in SMP08 is routinely inspected and sampled for conductivity prior to opening the control gate. Additional sampling and analysis may be performed in the investigation of a surface water contamination event

SMP09 - SPDES Outfall 004 is located southeast of RMU-1. This location has a flow meter for measuring totalized flow and an ISCO refrigerated Auto-Sampler or similar equipment.

3.4 OTHER SURFACE WATER RUN-OFF LOCATIONS

On occasion, precipitation from major rainfall events (or spring meltwater) may collect at locations other than those indicated above. For such occurrences, this water may be sampled and analyzed for Specific Conductance and/or PCBs and/or Volatile Organic Constituents and qualified for release at the nearest SMP location, if appropriate.

Water is released only after reviewing the analytical results. Careful consideration is given to the operating area from which the water may have come. Presence of significant contamination may require the water to be processed to remove the constituent(s). The manager will notify On-Site NYSDEC Monitors if elevated VOCs, PCBs, or other contamination is found.

3.5 MONITORING PARAMETERS, FREQUENCIES, AND METHODOLOGIES

Table A outlines the outfalls, parameters, analytical methodologies, and frequencies required by the current SPDES Permit. The SPDES requirements presented in this SWSAP can only be altered by obtaining a modification of both the Facility's SPDES and Part 373 Operating Permits.

USEPA/TSCA requirements for surface water monitoring were eliminated effective July 1996.

FIGURE 3

CWM CHEMICAL SERVICES, L.L.C.

MODEL CITY, NEW YORK

GENERAL FACILITY SITE INSPECTION REPORT

FREQUENCY: Monthly

DATE AND TIME OF INSPECTION: ___/___/___/___:___.
MM DD YY TIME

EQUIPMENT/PROCESS UNIT NAME: Storm Water Flow Monitoring Flumes and ISCO Auto Samplers

INSPECTION CHECKLIST

INSPECTION ITEM	Y/N	COMMENTS
Are the Flow Level Indicators and ISCO Auto Samplers receiving power?		
Are the Flow Level Indicators and ISCO Auto Samplers in good operating condition and functioning properly?		
Is the water level indicated appropriate?		
Is the recorder marking and printing properly?		
Is there sufficient chart paper?		
Is each flume free of cracks, debris, and blockage?		
Acceptable ISCO calibration check performed? (I.e. Actual calibration volume between 100% and 110% of expected?)		SMP06: Expected Vol. = 200 mL. Actual Vol. = SMP07: Expected Vol. = 200 mL. Actual Vol. = SMP09: Expected Vol. = 200 mL. Actual Vol. =

NAME/TITLE:____

SIGNATURE:____

TABLE A

NYSDEC SURFACE WATER MONITORING REQUIREMENTS

OUTFALL	FREQUENCY	PARAMETER	ANALYTICAL METHOD
002, 003, 004	CONTINUOUS	FLOW	IN FIELD
	EACH DAY OF RELEASE	SETTLEABLE SOLIDS	2540F
	WEEKLY	SPECIFIC CONDUCTANCE	2510B
		pH	SM 4500 H* B
		TOTAL SUSPENDED SOLIDS	SM 2540D
		TOTAL DISSOLVED SOLIDS	SM 2540C
		PCB	608
	EVERY 2 WEEKS	OIL & GREASE (HEXANE EXTRACTABLES)	1664
		DICHLORODIFLUOROMETHANE	624 or 601
		2-CHLOROETHYL VINYL ETHER	624
		METHYLENE CHLORIDE	
		VOC	
	MONTHLY	BOD-5	SM 5210B
		DISSOLVED OXYGEN	IN FIELD
		AMMONIA (as N)	350.1
		TOTAL COPPER	200.7/220.2
		TOTAL ZINC	200.7/289.1
		TOTAL PHENOLS	420.1
	As required by Radiation Environmental Monitoring Plan	ISOTOPIC URANIUM	USDOE A-01-R MOD
		ISOTOPIC THORIUM	USDOE A-01-R MOD
		RADIUM-226	USEPA 903.0 MOD
		RADIUM-228	USEPA 904.MOD
		GAMMA Cs-137 & HITS	USEPA 901.1

NOTES: The Frequencies, Parameters, and Analytical Methods are prescribed by CWM's SPDES Permit and Radiation Environmental Monitoring Plan (REMP), as applicable. Adjustments to the above requirements may be made if the SPDES Permit or REMP changes.

4.0 GENERAL RESPONSIBILITIES

4.1 PERSONNEL RESPONSIBILITIES

Surface water monitoring at the Model City Facility is performed under the direction of the Environmental Monitoring Manager.

The Environmental Monitoring Manager is responsible for:

- communication between the laboratory and regulatory personnel,
- (re)-training sample personnel,
- scheduling, supervision, and proper execution of the sampling event, including field equipment procurement, calibration, maintenance, field parameter measurements, sample event documentation , prompt sample shipment, and inspections, and
- accurate data evaluation and timely reporting.

4.2 ANALYTICAL LABORATORIES AND RESPONSIBILITIES

Adirondack Environmental Services, Inc. (AES) (Lab Code No. NY00063) in Albany, New York provides primary analytical services. Additionally, primary radiological services are provided by Test America in St. Louis, Missouri.

Each laboratory provides the Facility with all sampling containers and associated paperwork in a sealable container (cooler). The Laboratory Contact shall notify the Environmental Monitoring Manager if sample containers do not arrive on schedule or intact after a sampling event. The Laboratory Contact is also responsible for overseeing the laboratory analysis and notifying the Environmental Monitoring Manager if problems arise.

5.0 PRE-SAMPLING PROCEDURES

All procedures for sampling, sample preservation, sample storage, chain-of-custody and sample transfer, and equipment calibration and field measurements will follow all applicable requirements specified in the contract laboratory's quality assurance management plan, CWM Chemical Services LLC Quality Manual and equipment manufacturer's manuals.

Pre-sampling procedures include the procurement and calibration of equipment and procurement and preparation of sample containers. Each of these procedures is addressed in the following sections. Preparation for a sampling event begins at least two weeks before the event is to take place to allow adequate time to accomplish all of the procedures and to correct any problems that may surface.

5.1 LABORATORY NOTIFICATION/VERIFICATION

The Environmental Monitoring Manager works closely with the laboratory to schedule sampling events for each month. Two weeks prior to each sampling event, the Environmental Monitoring Manager notifies the laboratory of tentative sampling dates, number and types of samples, and numbers and types of blanks. The laboratory prepares the necessary sample containers and sends them to the site in coolers. The Environmental Monitoring Manager checks in the coolers and notifies the lab of any discrepancies.

5.2 PROCUREMENT, INSPECTION, AND CALIBRATION OF EQUIPMENT

The procurement of equipment is the responsibility of the Environmental Monitoring Manager.

Field measurements along with proper documentation are integral parts of the monitoring program. Before the actual trip to the field, all equipment necessary for a sampling event is cleaned, checked, and calibrated, as necessary. Prior to use in the field, all meters are calibrated to ensure proper working order and to render integrity to the measured values. Calibration procedures provided by the manufacturer are followed.

When Dissolved Oxygen (D O_2) Measurements are required, calibration of the D O_2 field meter is made using the Air Saturated with Water Method. Calibration is performed each day that D O_2 readings are taken and whenever D O_2 readings appear to be erratic.

NOTE: Instrument-specific calibration procedures are subject to change as newer field equipment is put into use. CWM will continue to follow the Manufacturer's recommendations and standard QA/QC procedures.

A Log Book is maintained for all field meters. The log book contains information including field meter serial number, name and model of meter, year purchased, QA results, calibration notes for each day the equipment is used, etc.

5.3 PROCUREMENT AND PREPARATION OF SAMPLE BOTTLES

The procurement and preparation of sample bottles is the responsibility of the laboratory. For routine VOC monitoring, only pre-cleaned, pre-preserved, 40-mL, glass vials with Teflon-lined septa are used.

If parameters other than VOCs are required, the laboratory also supplies these additional bottles. As necessary, pre-measured amounts of preserving reagents are supplied by the laboratory along with the sample bottles. The appropriate preservative is attached to each bottle in a small vial or has been added to each container as required by the analytical method.

The lab sends sample bottles, trip blanks, and field blank water to the site in sealed coolers. Upon arrival, the cooler seal is checked for intactness. The cooler is then "checked in" which involves removing the Chain-of-Custody (COC) and Field Information Form (FIF), visually examining, inventorying, and labeling the sample bottles, and ensuring the appropriate number and types of preservatives are present. Also, Trip Blank samples are examined for air bubbles.

(NOTE: Not all laboratories utilize an FIF. When an FIF is not used, a bound Field Notebook is kept to record pertinent information and observations surrounding the sampling event. Although "FIF" is used throughout this document, FIF should be considered interchangeable with "Field Notes".)

5.4 STORAGE AND HANDLING OF SAMPLING EQUIPMENT

The sample bottles are stored inside coolers. When unattended, the coolers (and bottles) are stored in a designated "clean area" with limited access during the day. This building is kept locked overnight.

All equipment is handled in a responsible manner to prevent breakage or contamination. New clean, powderless PVC or Latex gloves may be worn when handling any equipment that will come in contact with the sample water.

6.0 SAMPLING PROCEDURES

Sampling is performed during run-off events caused by either precipitation or snow/ice melt. When rain falls (or a thaw occurs) at a greater rate than water can be absorbed by the soil, the excess water flows over the ground surface and into the drainage courses. The rate at which this process occurs is dependent upon storm intensity, soil type, cover, grading, etc.

If there is no flow through a given outfall during a given week, then the sampling event is canceled and a record is made of the cancellation.

6.1 FIELD OBSERVATIONS

Upon arrival at the sample point, various field observations regarding conditions at the sample point and its surrounding area are made and recorded on the FIF. These observations may include:

- The presence and condition of the sample point identification marker;

- Physical surroundings that may bias the sample (i.e. high weeds, stagnant water - no flow, nearby activities, etc.);
- Weather conditions;
- Any upwind or upstream site activity; and
- Evidence of contamination such as a visual sheen.

6.2 FIELD MEASUREMENTS

Field measurements are taken immediately for D O_2 and temperature, if required, and recorded on the FIF. Any additional parameter measurements would also be recorded on the FIF, as required.

The duplicate field measurements, if any, are also recorded on the FIF.

6.3 GRAB SAMPLE COLLECTION

(**NOTE:** Sampling for pH, Specific Conductance, and Settleable Solids is performed by trained Site personnel. All of these samples are analyzed “in-house.” As such, collection, receiving, documentation, and laboratory procedures and methods may vary from those procedures that follow. However, the sampling and analysis for these parameters will be conducted in accordance with the latest edition of “Standard Methods for the Examination of Water and Wastewater.”)

Immediately prior to sampling, the sample point identity is recorded on the COC and FIF. The sample bottles, COC, and FIF forms are re-checked to ensure that all match with respect to sample point, parameter, and preservative.

Samples, which are to be split with regulatory agencies, are also checked for consistent sample point ID numbers and for other methods of identification if used by the agency.

Grab surface water samples are collected under flow conditions. Grab samples are collected for VOC, Oil & Grease, Phenols, Ammonia, BOD-5, Copper, and Zinc (and other additional parameters as may be required.) Grab samples may be taken using a dedicated, long-handled, polyethylene dipper. If used, the dipper is rinsed at least 3 times at each outfall before each use. New, disposable, powderless PVC or latex gloves may be worn at each sample point during sampling and are changed when dirty, torn, etc. Flow-proportioned composite samples are collected over approximately 24 hours for PCB, Total Suspended Solids (TSS), and Total Dissolved Solids (TDS) (and other additional parameters as may be required.) (See Section 6.4 below.)

When filling sample bottles, the following procedures and precautions are followed:

1. Bottle caps are removed carefully so that the inside of the cap is not touched. Bottle caps are not interchanged between sample bottles. Caps for VOC vials contain a Teflon-lined septum. The Teflon side of the septum must face the sample to prevent contamination of the sample through the septum.

2. The sample bottles are filled with a minimal amount of air contact and without contacting the inside of the bottles.

3. Sample bottles containing preservatives are filled with as little overflow as possible and are inverted to mix the preservative with the sample. If the required preservative(s) are not in the bottles, the bottles should be filled, leaving adequate space to add the preservative(s) later.

   No substitutes for the chemical preservatives supplied are used as the reagents are special high grade and are metal free. Arrangements may be made with the laboratory if the storage of additional preservatives at the site is necessary. If substitutions are made from on-site storage, it is noted on the COC form.

4. VOC vials are filled so that they contain no headspace. These sample vials, therefore, need to be over-filled (water tension will maintain a convex water surface in the bottle). The caps for these vials are replaced gently, so as to prevent introducing air bubbles in the sample. Check each vial by inverting and snapping it sharply with a finger. If any air bubbles appear, the vial is opened, more water is added, and the process is repeated until no air bubbles are present. The vial is not emptied and refilled as this would result in the loss of the preservative.

5. All sample bottles, once filled and preserved as necessary, are put on ice or refrigerated upon sample collection and shipped as such. The VOC vials are not placed in direct contact with ice as the samples may freeze and break.

6. Sample bottles, caps, or septa, which fall on the ground before filling, are thoroughly rinsed with sample water before being used or are discarded. All circumstances regarding dropped caps or bottles, and their subsequent rinsing and use, are noted on the FIF.

6.4 COMPOSITE SAMPLE COLLECTION

A flow-proportioned composite sample is collected for approximately 24 hours under normal flow conditions for PCB, TSS, and TDS. This sample is collected using a dedicated ISCO Model 6712FR Refrigerated Auto-Sampler or similar equipment.

The Auto-Sampler is programmed to collect a grab sample aliquot per a specified volume of stormwater run-off leaving the Facility in a 24-hour period as determined by the dedicated ISCO Model 4210 Flow Meter (or similar equipment.) If a heavier-than-normal (or lighter-than-normal) discharge volume is anticipated, the grab sampling frequency may be increased or decreased by adjusting the “Sample Pace” function on the Flow Meter. This function signals the Auto-Sampler to grab a sample each time a specified volume of liquid passes by the Flow Meter.

Proper Sample Pacing is essential to ensure that:

1. An adequate sample volume is collected,
2. the composite sample consists of at least 8 discreet grab samples, and
3. sampling continues for approximately 24 hours.

Improper Sample Pacing could result in:

1. Insufficient sample volume collected,
2. the termination of grab sampling well short of the required 24 hours, or
3. grab sampling to continue well beyond the required 24 hours.

However, as long as the sample volume collected is sufficient to perform analysis for the specified parameters (PCB, TSS, and TDS), the composite sample will be sent for analysis as usual.

Basic procedures for the collection of the composite sample are as follows:

1. Immediately prior to sampling, the sample point identity is recorded on the COC and FIF. The sample bottles, COC, and FIF forms are re-checked to ensure that all match with respect to sample point, parameter, and preservative.

2. Activate Auto-Sampler to immediately collect a sample thus demonstrating proper operability.

   If the Auto-Sampler has already been calibrated this collection month, skip this step. Otherwise, calibrate the Auto-Sampler. Catch the volume collected in a graduated cylinder and compare with the desired volume. If the volume collected is between 100%

and 110% of the desired volume, the calibration is acceptable. Re-calibrate as necessary to ensure an adequate sample volume is collected.

3. Remove the dedicated 5 gallon glass collection bottle from the refrigerator and rinse it thoroughly with fresh surface water run-off. Return bottle to refrigerator.

   Set the Sampler Pacing to the appropriate anticipated discharge volume.

4. Begin composite sampling. View initial sample collection to ensure proper operations.

5. Record date, start time, start volume, location, and other appropriate field information at this time.

As soon as possible after the completion of the 24-hour sample period, the following steps are taken.

1. Check the main menu screen to ensure that there were no interruptions in the sampling program. (Note any error messages that may impact sample integrity.)

2. Remove the sample collection bottle and, if used, the dedicated glass funnel. Agitate the sample collection bottle to ensure sample homogeneity. If used, rinse the dedicated, glass, sample funnel thoroughly.

3. Fill all sample bottles completely, leaving room for any necessary preservatives. Cap bottles, complete field information forms, and package samples for shipment to the lab.

4. Record the end time, end volume, and number of grab samples taken to make the composite.

{NOTE: During freezing weather conditions, the ISCO sample line may freeze before 24 hours have elapsed. In such instances, the "partial" composite sample is used providing sufficient volume is available to fill the necessary bottles. Circumstances surrounding these "partial" composite samples are noted.}

6.5 ORDER OF SAMPLE COLLECTION

In the event that parameters other than VOCs are required, the priority sequence of parameter collection during sampling is as follows:

Priority	Parameter
1	pH, Specific Conductance, Temperature, Dissolved Oxygen, Settleable Solids
2	Volatile Organics
3	PCB, Total Suspended Solids, Total Dissolved Solids
4	Total Metals {Copper and Zinc only}
5	Total Phenols
6	Ammonia
7	Oil & Grease
8	BOD-5
9	Radiologicals

This priority list is only followed if there was insufficient sample volume available to completely fill all sample bottles.

6.6 DUPLICATE SAMPLES

For every tenth sample collected, the sampling team must submit a duplicate sample to the lab. A different sample point is selected for the duplicate sample each time. Eventually, all sample points will be utilized as duplicates.

The duplicate sample, identified as "DUP," receives the same analyses as the other routine samples. The actual identity of the duplicate sample is noted in the Comments section of the FIF.

6.7 TRIP BLANKS AND FIELD BLANKS

Trip blanks and field blanks are used as controls and/or external QA/QC samples. They indicate contamination that may have been introduced in the field, in transit to or from the sampling site, during bottle preparation, sample log-in, or sample storage at the laboratory. The blanks may also reflect contamination that may have occurred during the analytical process.

Trip blanks are samples of GC/MS Reagent Grade water that are prepared at the same location and time as the bottles that are to be used for sampling. They remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the laboratory. Upon returning to the laboratory, they are analyzed for VOCs using the same QA/QC procedures as a sample. Trip blanks are not to be opened until they are returned to the lab. If they are opened by accident, it must be noted on the COC form.

Each daily shipment of coolers to the laboratory will contain a trip blank if any cooler contains samples for VOA analysis. Trip blanks are reported in the Technical Report as separate samples using "TB" as the sample point designation.

Field blanks are similar to trip blanks, however, the field blank is prepared at the sampling location using empty bottles and GC/MS reagent grade water supplied by the laboratory. The location where the field blank is prepared is noted in the Comments section of the FIF and on the COC.

The number of field blanks is dependent on the number of samples included in the sampling event. For every 10 VOC samples collected, one field blank is analyzed for VOCs. Field blank results are reported in the laboratory's Technical Report as separate samples using "FB" as the sample point designation.

6.8 SAMPLE PACKAGING AND SHIPMENT PROCEDURES

After sampling, samples are placed in coolers containing loose ice or are otherwise refrigerated in a clean, secure area until shipping arrangements can be made.

There are three important reminders for repacking the coolers:

1. Glass should not be packed in contact with glass. Ice or packing sleeves are placed around and between bottles.

2. Completed COC and FIF forms must be returned to the cooler <u>before</u> the cooler is sealed.

3. Sample coolers are sealed with a Custody Seal provided by the lab.

Once the samples have been placed on ice, the COC and FIF are completed. All paper work is then put into a plastic bag and placed inside the cooler. A member of the sampling team arranges for sample pickup and transportation to the laboratory. Coolers are transported via overnight courier for receipt at the laboratory within 72 hours of sample collection; often samples are received within 24 hours. (NOTE: Although samples are chilled after sampling, it is a priority to ship the samples to the lab as soon as possible. As a result, some of the samples may arrive at the lab with a temperature of greater than 4°C. The Lab notes this on the COC and these "warm" samples are typically analyzed as usual.)

6.9 SAMPLE RECEIPT

Upon arrival at the laboratory, the samples are logged-in and COC procedures are maintained until the analyses are completed and reported.

Once a cooler is received at the laboratory, the Environmental Monitoring Manager is notified if the Sample Control Group encounters any discrepancies. Prompt notification is essential since analyses could be delayed beyond the allowable holding times.

7.0 FIELD RECORDS AND DOCUMENTATION

Standard COC and FIFs are filled out during a sampling event and are used to establish and document COC, sampling conditions, field measurements, and sampler's names. The original forms are sent with the samples to the laboratory and copies are included in the Technical Report when the analysis is complete. All forms are completed using permanent ink only.

The Technical Report, including copies of the COC and FIF are maintained by the Environmental Monitoring Manager for easy reference. Analytical data is also permanently maintained in the site files.

7.1 CHAIN-OF-CUSTODY FORM

In order to maintain and document sample integrity, strict COC procedures are necessary.

From the time the empty sample bottles leave the laboratory until the analytical results are issued, the sample and/or sample containers are in the custody of trained CWM or laboratory personnel. In order to maintain COC, the samples must be either:

- in sight of the assigned custodian;
- locked in a tamper-proof location; or
- sealed with a tamper-proof seal.

A written record of sample bottle possession and transfer is maintained and documented on the COC form.

The COC form is signed with the date and time for the following activities:

- Initially, when the cooler is opened for inspection, the COC is signed and the condition is noted.
- Whenever the cooler is transferred to a new sample custodian if the tamper-proof seal has been compromised.
- When the cooler is finally sealed for transport to the laboratory. If samples collected from one sample point are placed in more than one cooler, a COC is placed in each cooler.

Additional information on the COC includes the sample point ID, sample date, and sample start time. Any problems with cooler or its contents are also noted on the form. Upon receipt of the cooler at the laboratory, the date and time the seal is broken, the condition of the samples, and the temperature, are recorded on the COC form.

7.2 FIELD INFORMATION FORM

The FIF contains information regarding site conditions, sampling procedures used, and field measurements. The FIF is filled out for each sample point and is enclosed along with the COC in the cooler. FIFs are filled out for each sample point, unless no sample is collected. Information to be documented is as follows:

<u>Sample Point</u> - which is contained on the COC is also recorded on the FIF.

<u>Sampling Information</u> - Includes the types of equipment used for sample collection.

Field Measurements - For surface water sampling events, temperature, and dissolved oxygen are determined, as required. Additional parameters, (e.g. color, odor, turbidity, etc.) may also be required.

Field Comments - The section on field comments may include the following field observations:

- Condition of the sample point and dedicated equipment;
- Weather conditions (e.g. wind speed and direction, precipitation, temperature, upwind activities, etc.);
- Sample appearance - odor, color, etc.;
- Location where field blank or duplicate is prepared;
- Duplicate field measurement results;
- Any other uncommon sampling conditions, such as sample splits with regulatory agencies, potential safety or health hazards (i.e. presence of flying, stinging insects, etc.).

Sampling Certification - On the bottom of the FIF, the sampler must certify that the sampling procedures used were in accordance with applicable USEPA, State, and Corporate Protocols.

NOTE: AES does not provide an FIF with their sample bottles. For samples sent to AES, pertinent information regarding the sampling event is documented in a field notebook.

8.0 LABORATORY HANDLING AND ANALYTICAL PROTOCOLS

The following information provides a brief description of how samples are analyzed.

8.1 LABORATORY PROCESSING PROCEDURES

The laboratory receives, logs-in samples, and maintains the COC procedures until the analyses are completed and reported, as described in Section 6.9.

8.2 LABORATORY METHODOLOGIES

For the routine surface water monitoring at the site, samples are analyzed according to Table A for NYSDEC SPDES requirements. The SPDES requirements presented in this SWSAP can only be altered by obtaining a modification of both the Facility's SPDES and Part 373 Operating Permits.

For the analysis of samples outside the routine monitoring program, the methodology will be specified by the Environmental Monitoring Manager and will depend on the Data Quality Objectives.

8.3 QUALITY ASSURANCE

The analytical laboratory used for the analysis of surface water samples has NYSDOH ELAP certification and CWM approval. In addition, QA is provided by following the standard analytical methods referenced in Table A. Technical Reports contain analytical results and methodologies, dates sampled and received, sample identification, COC, and FIFs.

8.4 QUALITY CONTROL

Quality control is provided in the field through the collection of duplicate samples, field blanks, trip blanks, and duplicate field measurements.

Duplicate - collected from any sample location (SMP) and analyzed for a complete set of parameters once every 10 samples, (see Section 6.6).

Field Blank - one collected and analyzed for every ten samples taken for VOC analysis only. (See Section 6.7).

Trip Blank - one analyzed for every "batch" of samples sent to the analytical laboratory for VOC analysis only. (See Section 6.7).

Numerous laboratory and field quality control checks are performed. The following list includes the various checks used and the frequency at which the checks are performed.

BLANKS

- Method Blank or Laboratory Blank - Daily
- Reagent Blank - Daily
- Trip Blank - Determined by field staff (daily with VOC analysis)
- Field Blank - Determined by field staff, once every 10 samples.

DUPLICATES

- Field Duplicate - Determined by field staff, once every 10 samples.
- Laboratory Duplicate - once every 20 samples or daily, whichever is more frequent
- Matrix Spike Duplicate - once every 20 samples or daily, whichever is more frequent

SPIKES

- Spiked Blank - once every 20 samples or daily, whichever is more frequent
- Surrogate Spike - every sample and QC sample, (organic analyses only)
- Matrix Spike - once every 20 samples or daily, whichever is more frequent

INDEPENDENT QC CHECKS

- Laboratory Control Standards - daily
- Blind QC - each analyte at least quarterly
- Check Sample - as requested by Quality Programs Coordinator
- Internal Standard - as method requires
- Standards - daily
- Control Standards - as method requires
- Method of Standard Additions - every sample that demonstrates matrix interference

9.0 DATA EVALUATION

Typically, all analytical results are reviewed within five days of receipt from the analytical laboratory.

Data from SMP06, SMP07, and SMP09 are compared with the discharge limitations established in the Facility's SPDES Permit. Any exceedences are noted in the monthly Discharge Monitoring Report (DMR) including an explanation of the potential cause(s).

Since the control gates are routinely closed and visually inspected and tested prior to release, it is unlikely that any potentially contaminated surface water would be released from the Facility. If such an unlikely situation were to occur, then a follow-up investigation would be performed to determine the source and extent of contamination. This investigation would be based upon current SPDES Permit requirements and guidance received from NYSDEC.

10.0 REPORTING

SPDES Discharge Monitoring Reports (DMRs) are due to NYSDEC by the 28^{th} of each month. DMR submittal requirements are specified in the Facility's SPDES Permit. If additional monitoring (i.e., an additional constituent or sampling event beyond that required under the Facility's SPDES Permit) is conducted, the results will be submitted as an appendix to the required DMR.

10.1 RECORDS

Records of all surface water monitoring activities, including Technical Reports, QA/QC Reports, COCs, and FIFs are maintained at the Model City Facility. The analytical labs also maintain a computer data base system which is backed-up daily for permanent storage.

ATTACHMENT N

Air & Meteorological Monitoring Plan

[*NOTE: Attachment N is **NOT** being modified. It is presented in association with the Draft RMU-2 landfill modification since some of the requirements contained in this attachment are or may be applicable to the proposed units.*]

Air & Meteorological Monitoring Plan

Monitoring Network

A NYSDEC-approved ambient air and meteorological monitoring network shall be operated and maintained at the CWM Model City facility. This program shall consist of a minimum of six (6) monitoring sites established at NYSDEC-approved locations and equipped with sampling devices and other equipment as necessary for ambient air quality and one (1) meteorological monitoring.

Air Quality Monitoring

Air samples shall be obtained from the monitoring network and analyzed for PM-10 in accordance with Methods published by the USEPA. CWM will sample for PM-10 once every six calendar days. Additional air sampling and analysis for Volatile Organic Compounds (VOCs) and/or Polychlorinated biphenals (PCBs) shall be performed if deemed necessary by the NYSDEC.

Meteorological Monitoring

Temperature, wind speed and wind direction shall be continuously measured at CWM=s on-site meteorological station and recorded. CWM shall also measure and record the date, or dates, duration (in hours) and amount (in inches) of all precipitation events at the facility's meteorological station. Other parameters shall also be measured if deemed necessary by the NYSDEC.

Quality Assurance / Quality Control (QA/QC)

The ambient air and meteorological monitoring network shall be maintained and all sampling and analysis shall be performed in accordance with the November 2000 and any subsequently Department approved revisions of the "CWM Meteorological Monitoring Network - Quality Assurance Project Plan", which is incorporated by reference into this Permit by **Condition B** in **Schedule 1 of Module I** of this Permit, and in accordance with the May 2005 and any subsequently Department approved revisions of the "PM-10 Air Monitoring Program QA/QC Manual". CWM shall compensate the NYSDEC for the costs incurred in the oversight and validation of the network QA/QC that are reported to CWM. Compensation procedures shall be the same as those specified by **Condition E** in **Schedule 1 of Module I** of this Permit for the environmental monitors.

Reporting of Monitoring Data

A monthly report of air monitoring data collected during each calendar month shall be submitted to the Region 9 Air and Solid & Hazardous Materials Engineers within ninety (90) days from the end of each calendar month or in accordance with an alternative Department approved submission schedule. Meteorological monitoring data shall be made available upon request.

ATTACHMENT O

Major / Minor Modifications

[*NOTE: Portions of Attachment O are being modified. Text proposed for addition is indicated in RED.*]

ATTACHMENT O - MAJOR/MINOR MODIFICATIONS

All Permit modifications shall be listed in the following Permit Modification Log.

PERMIT MODIFICATION LOG

The name of the specific document being modified (sections, and/or attachments)	Modified page numbers		Date of Revised pages	The effective date of permit modification	The nature of the modifications
	Old	New			
Schedule 1 of Module I Schedule I of Module I, Exhibit D (tanks) Attachment A Attachment D, Appendix D-3 (text) Attachment D, Appendix D-3, Section VIII Attachment D, Appendix D-3, Figures & Calcs. Attachment F (Inspection Forms) Attachment I, Section I.1 (Site-Wide Closure Plan)	S1-1 & S1-3 thru S1-5 D-3 thru D-15 Page 3 of 6 TofC I, 2, 3, 6, 7 & 19 thru 22 2 & 3 Fig. 20 cover page, Fig. 20 & Calc pages 1&2 1 Cover page & 8	S1-1 & S1-3 thru S1-5 D-3 thru D-17 Page 3 of 6 TofC I, 2, 3, 6, 7 & 19 thru 22 2 & 3 Fig. 20 cover page, Fig. 20 & Calc pages 1&2 1 Cover page & 8	09/2013	11/07/2013	**Minor Modification:** AWTS – Replace Multi-Media Filtration System Tanks T-3004 & T-3005 (delete closed tanks from Permit) with Arsenic Treatment System Tanks T-3010A. T-3010B, T-3010C, T-3010D and Cartridge Filter Units. Replacement results in a Net 70-gallon reduction in facility tank capacity. Tanks T-3010A/B/C/D treat aqueous waste by adsorption, and Cartridge Filter Units are used for filtration prior to adsorption.

The name of the specific document being modified (sections, and/or attachments)	Modified page numbers		Date of Revised pages	The effective date of permit modification	The nature of the modifications
	Old	New			
Incorporated Documents: P&IDs AWTS O&M Manual	Sheets 1, 24 & 25 Entire text, P&IDs Sheets 1, 24, 25 and AppD	Sheets 1, 24, 25 & 25a Entire text, P&IDs Sheets 1, 24, 25 & 25a	09/2013	11/07/2013 (continued)	
Schedule 1 of Module I Schedule I of Module I, Exhibit E (surface impoundments) Attachment A Attachment D, Appendix D-2 Attachment I, Section I.1 (Site-Wide Closure Plan)	S1-1 E-1 Page 3 of 6 2 Cover page & 7	S1-1 E-1 Page 3 of 6 2 Cover page & 7	10/2013	11/07/2013	**Minor Modification:** Revised to correct error in surface impoundment capacities.
Permit Table of Contents Schedule 1 of Module I Schedule I of Module I, Exhibit A	TofC Pages i thru iii S1-2 thru S1-4 & S1-14 A-8 thru A-10	TofC Pages i thru iii S1-2 thru S1-4 & S1-14 A-8 thru A-10	11/2013	12/12/2013	**Minor Modification:** Revisions to: 1) better clarify existing Permit conditions; 2) correct typographical and update/correct citations; 4) correct inadvertent omission of certain DOT containers; 5) re-instate some corrective action groundwater monitoring requirements which were inadvertently omitted; 6) make admin. changes to the Contingency Plan; and 7) add Attachment P, Permit condition index.

The name of the specific document being modified (sections, and/or attachments)	Modified page numbers		Date of Revised pages	The effective date of permit modification	The nature of the modifications
	Old	New			
Schedule I of Module I, Exhibit B	B-7 thru B-13	B-7 thru B-13	11/2013 (cont.)	12/12/2013 (cont.)	**Minor Modification:** Continued
Schedule I of Module I, Exhibit C	C-6 thru C-10	C-6 thru C-10			
Schedule I of Module I, Exhibit D	D-8 & D-12 thru D-17	D-8 & D-12 thru D-17			
Schedule I of Module I, Exhibit F	F-1, F-10 & F-51 thru F-71	F-1, F-10 & F-51 thru F-71			
Module IV	IV-2 thru IV-7	IV-2 thru IV-7			
Attachment C	Cover page & pgs. C-79, C-80, C-84 thru C-90, C-95, C-96 & C-98 thru C-110	Cover page & pgs. C-79, C-80, C-84 thru C-90, C-95, C-96 & C-98 thru C-109			
Permit Volume 2 Table of Contents	Tof C page	Tof C page			
Attachment D, Appendix D-1	5	5			
Attachment E	47 thru 64	47 thru 70			
Attachment F (Inspection Forms)	1 thru 18	1 thru 18			

The name of the specific document being modified (sections, and/or attachments)	Modified page numbers		Date of Revised pages	The effective date of permit modification	The nature of the modifications
	Old	New			
Attachment G	Cover page & pgs. 2 thru 4, 7 thru 9, 18, 25, 32, 56 & 57	Cover page & pgs. 2 thru 4, 7 thru 9, 18, 25, 32, 56 & 57	11/2013 (cont.)	12/12/2013 (cont.)	**Minor Modification:** Continued
Attachment P (new)	N/A	Cover page & pgs. P1 thru P-3			
Incorporated Documents: 1. Groundwater Extraction Systems O&M Manual; 2. Stabilization Facility O&M Manual; 3. RMU-1 O&M Manual; 4. Groundwater Sampling & Analysis Plan (SAP); 5. Site Radiological Survey Plan; 6. Radiation Environmental Monitoring Plan; and 7. Generic Small Project Soil Excavation Monitoring & Management Plan.	See instruction sheets after this table	See instruction sheets after this table			

The name of the specific document being modified (sections, and/or attachments)	Modified page numbers		Date of Revised pages	The effective date of permit modification	The nature of the modifications
	Old	New			
Incorporated Documents: 1.P&IDs 2.Groundwater Sampling & Analysis Plan (SAP)	Sheet 3 Cover Page, Tabs. 1,2,3&6, Figs. 1,2&5, App.D (entire)	Sheet 3 Cover Page, Tabs. 1,2,3&6, Figs. 1,2&5, App.D (entire)	12/2013	01/21/2014	**Minor Modification:** Revisions to make administrative changes such as correcting errors and updating information.
PERMIT – Permittee & Facility Info. Schedule 1 of Module I Schedule 1 of Module I, Exhibit A Schedule 1 of Module I, Exhibit C Schedule 1 of Module I, Exhibit D Schedule 1 of Module I, Exhibit E Schedule 1 of Module I, Exhibit G (new) Attachment A Attachment D, Appendix D-1 Attachment D, Appendix D-2 Attachment D, Appendix D-3 Attachment F (Inspection Forms) Attachment G Attachment I, Section I.1 Attachment I, Section I.1a (new) Attachment I, Section I.2a (new) Attachment J, Appendix D-6a (new) Attachment J, Appendix D-7a (new)	Affected pages to be determined.	Affected pages to be determined.	2013 & 2014	Pending	**Major Modification:** Revisions to: 1. Add new RMU-2 landfill including construction, operation, closure and post-closure requirements; 2. Add new Fac Pond 5 surface impoundment including construction, operation and closure requirements; 3. Add New Drum Management Building (NDMB) to replace existing Drum Management Building (DMB) including construction, operation and closure requirements; 4. Add New Full Trailer Park Area to replace existing South Trailer Parking Area including construction, operation and closure requirements; 5. Add Stabilization Facility New Trailer Park Area to replace existing Stabilization Facility Trailer Parking Area including construction, operation and closure requirements; 6. Add New T-109 Loading Area to replace existing T-109 Load/Unload Area Area including construction, operation and closure requirements;

The name of the specific document being modified (sections, and/or attachments)	Modified page numbers		Date of Revised pages	The effective date of permit modification	The nature of the modifications
	Old	New			
Attachment J, Appendix D-8a (new) Attachment K, Appendix D-9a (new) Attachment M **Incorporated Documents:** 1. Site-Wide and RMU-1 Closure Cost Estimates; 2. Process & Instrumentation Diagrams (P&IDs) for Tank Systems; 3. Aqueous Waste Treatment System O&M Manual; 4. Groundwater Sampling & Analysis Plan (SAP); 5. RMU-2 Engineering Report (new) 6. Transition Plan for RMU-2 (new) 7. RMU-2 Soil Excavation Monitoring & Management Plan including the RMU-2 Corrective Action Plan (new) 8. RMU-2 Closure Cost Estimate (new) 9. RMU-2 Post-Closure Cost Estimate (new) 10. Tank System Design & Assessment Report for Fac Pond 5 Tank T-9001 (new)	Affected pages to be determined.	Affected pages to be determined.	2013 & 2014 (cont.)	Pending (cont.)	**Major Modification:** (continued) 7. Add New T-158 Loading Area to replace existing T-158 Load/Unload Area Area including construction, operation and closure requirements; 8. Add New Tank T-9001 for new Fac Pond 5 Area including construction, operation and closure requirements; and 9. Modify various parts of the Permit to facilitate the above listed revisions.