ENGINEERING REPORT
Leachate Management and Pond Sediment Removal Plan

LOCKWOOD ASH DISPOSAL SITE

Prepared on behalf of:

Lockwood Hills LLC
590 Plant Road
P.O. Box 187
Dresden, New York 14441

Prepared by:

DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 Grand Island Blvd.
Grand Island, New York 14072-2131

August 2015
Last Revised December 2018

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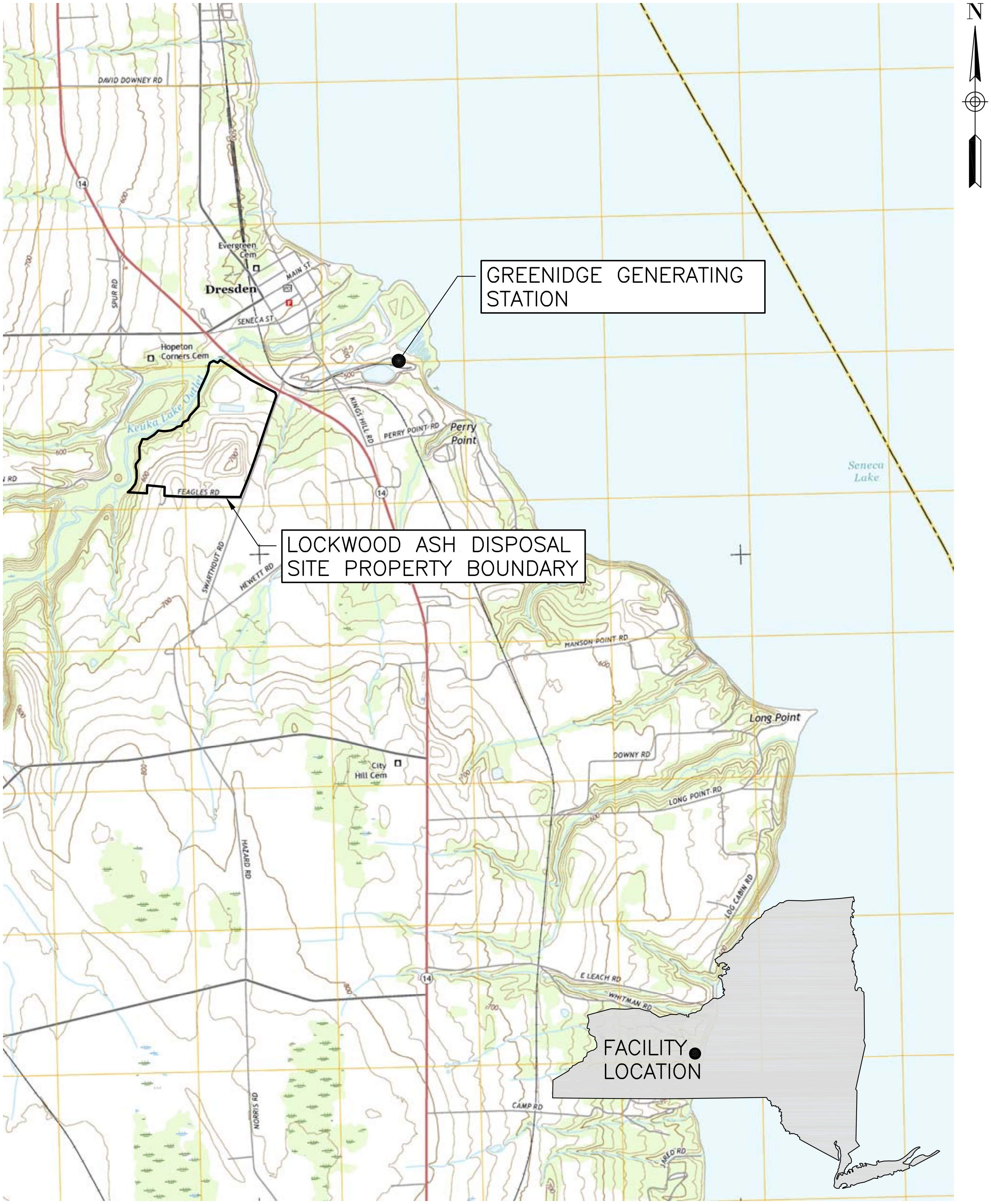
1 INTRODUCTION

The Lockwood Ash Disposal Site (Landfill or Lockwood) is located off State Route 14, approximately 0.75 miles west of the Greenidge Generating Station (Greenidge Station), which is an electric generating plant located on the west shore of Seneca Lake near the Village of Dresden in the Town of Torrey, Yates County, New York. Coal combustion byproducts (CCBPs) produced by the Greenidge Station during historic coal-fired operations including fly ash, bottom ash, water/wastewater sludge and mill rejects were previously disposed at the Landfill. The Landfill and Greenidge Station are identified on the map in Figure 1-1.

The Landfill is owned and operated by Lockwood Hills LLC (Lockwood Hills). The operation of the Landfill is carried out in accordance with the requirements of 6 NYCRR Part 360 Solid Waste Management Facility Permit No. 8-5736-00005/00003. Stormwater and leachate discharge from the Landfill are managed in accordance with the requirements of State Pollutant Discharge Elimination System (SPDES) Permit No. NY-0107069. Since 2015, activity at the Landfill has been limited to non-CCBP acceptable wastes such as occasional dewatered wastewater sludges from the Station's onsite wastewater treatment plant. Since the Station converted to using primarily natural gas, with biomass co-firing, in the future, the Landfill is expected to accept wastewater sludges, and biomass ash during periods that the Station co-fires with biomass.

Lockwood Hills entered into a Consent Order (No. R8-20140710-47) with the New York State Department of Environmental Conservation (NYSDEC or the Department) to, in part, segregate stormwater from leachate, treat and dispose of leachate, and remove and dispose of sediment in the existing leachate pond. The Consent Order also required Lockwood Hills to collect leachate flow measurements and submit a Leachate Monitoring and Analysis Report to the Department.



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DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

SITE LOCATION MAP REVISED ENGINEERING REPORT			
LOCKWOOD HILLS LLC			FIGURE 1-1
TOWN OF TORREY	YATES COUNTY	NEW YORK	
May 2018	SCALE: NOT TO SCALE	REVISION # 0	

Segregation of the stormwater from the Lockwood Hills Leachate Pond (Leachate Pond) was completed during the 2016 construction season and all remaining stormwater improvements required by the Consent Order were installed during the 2017 construction season. In accordance with the Consent Order, modifications to the leachate system and installation of the leachate flow metering equipment and appurtenances was completed in late spring/early summer of 2016. The flow meter began recording instantaneous and totalized flow measurements on July 1, 2016. The Leachate Flow Monitoring and Analysis Report was submitted on January 12, 2018 and approved by the NYSDEC on February 15, 2018.

A Revised Engineering Report was submitted to the Department on May 14, 2018, which included a Constructed Wetland Treatment System (CWTS) for managing leachate from the Landfill.

After consideration, the Department issued comments to Lockwood via a letter from Greg MacLean and Karis Manning to Bethany Acquisto dated July 19, 2018. After further correspondence, it was agreed that the necessary and appropriate level of treatment would be achieved with aeration and settling. This revision to the Engineering Report describes the current proposed design for the proposed Lockwood leachate treatment system and addresses outstanding comments from the Department's July 19, 2018.

2 BACKGROUND

2.1 LANDFILL STATUS

The permitted footprint of the Landfill is 44.2 acres. To date, 29.8 acres of the Landfill have been constructed, and approximately 1,566,000 cubic yards of waste disposed. The majority of the Landfill is under intermediate soil cover. The surface water drainage system that covers the entire Landfill isolates the waste materials, reduces infiltration, controls erosion, contains sediments, and conveys stormwater runoff to the local surface water drainage pattern.

Figure 2-1 illustrates the Landfill stages and infrastructure of the site.

2.2 LANDFILL BASELINER SYSTEM

Landfill baseliner construction involved the excavation of native soils, placement and compaction of perimeter embankments, the installation of groundwater depression drains, and the installation of containment liner and leachate collection systems.

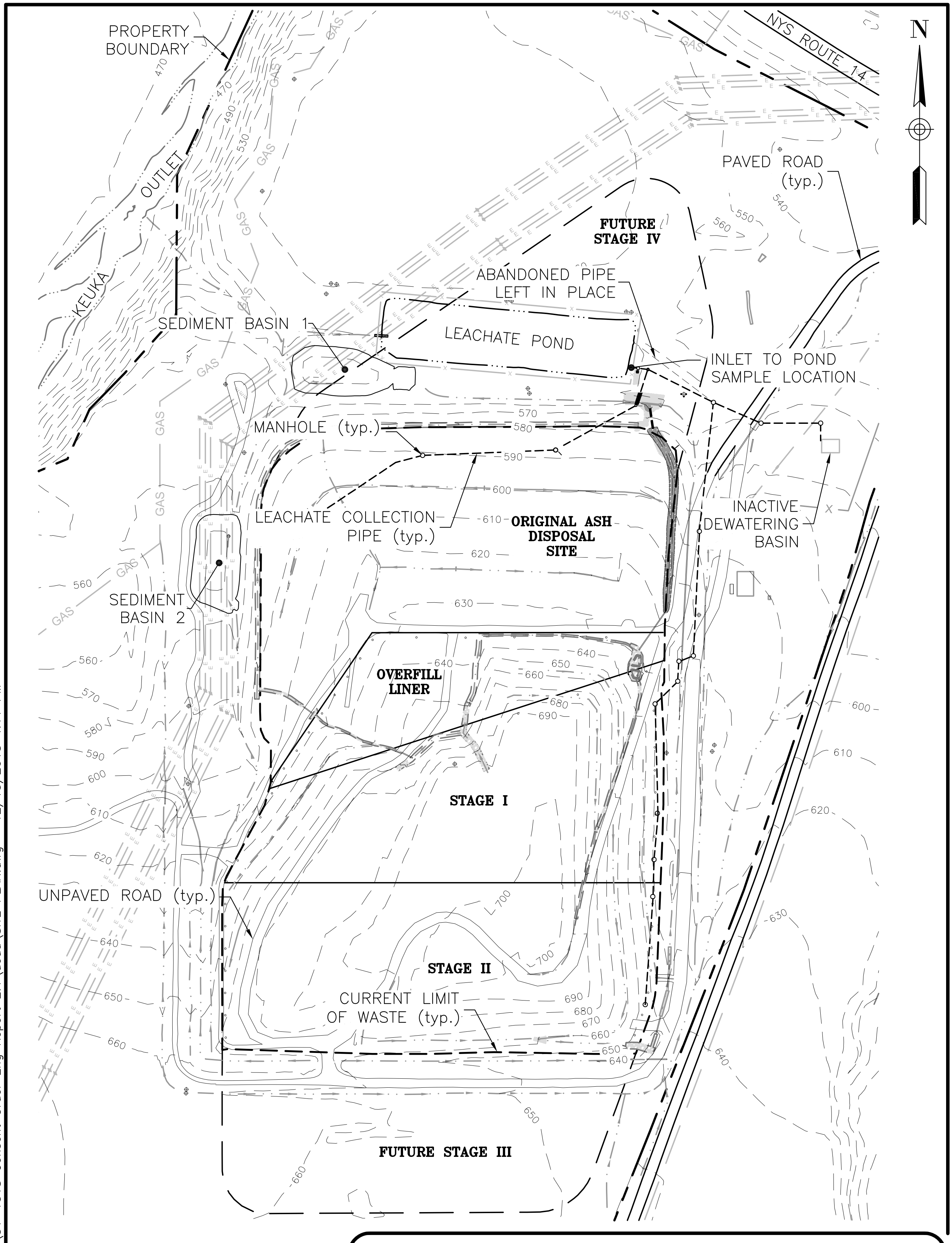
2.2.1 Original Ash Disposal Site

The Original Ash Disposal Site (OADS) was constructed in two phases, the first in 1979 and the second in 1981. The OADS containment liner system is constructed above a series of groundwater drain trenches and consists of a two-foot thick compacted soil barrier and overlying two-foot thick layer of bottom ash, which acts as the leachate drainage layer. A network of leachate collection pipes is installed in the drainage layer. The OADS is closed and has a soil based final cover system.

2.2.2 Stage I

Stage I was constructed in 1989 and 1990 including a basal area double liner and underlying groundwater drainage trenches above natural soil deposits, and a single geomembrane overfill liner atop the wastes in the southern portion of the OADS. The basal liner in Stage I consists of the following components in ascending order:

- A two-foot thick compacted soil liner;



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DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

SITE PLAN			
REVISED ENGINEERING REPORT			
LOCKWOOD HILLS LLC			FIGURE 2-1
TOWN OF TORREY	YATES COUNTY	NEW YORK	
December 2018	SCALE: 1" = 300'	REVISION # 0	

- A secondary leachate collection and removal system composed of a four-inch thick sand layer, with embedded band drains and a six-inch diameter PVC header;
- A geotextile cushion layer;
- A 50-mil polyvinyl chloride (PVC) geomembrane liner;
- A geotextile cushion layer; and,
- A two-foot thick drainage layer with an embedded leachate collection pipe network.

The geomembrane overfill liner atop the OADS consists of the following components, in ascending order:

- A geotextile cushion layer;
- A 50-mil PVC geomembrane liner;
- A geotextile cushion layer; and,
- A one-foot thick drainage layer including a leachate collection pipe network.

2.2.3 Stage II

Stage II was completed in 1992 as a double lined cell with a groundwater drainage trench system and basal liner consistent with the liner system in Stage I constructed on natural soil deposits.

2.3 APPROVED WASTES, ORIGIN AND COMPOSITION

The Landfill is approved for the disposal of fly ash, bottom ash, pulverized mill rejects, and wastewater treatment plant sludge from Greenidge Station. The Landfill is also permitted to accept waste from various other facilities, including former AES power plants, Garlock, Inc., and Eastman Kodak, although no waste from any of these facilities has been disposed of in the Landfill in several years. In the future, the primary waste stream disposed of in the Landfill is anticipated to be sludge from the Greenidge Station wastewater treatment plant and fly ash and bottom ash from Greenidge Station associated with the up to 19% biomass Greenidge Station is authorized to co-fire with natural gas. The approved design capacity for the Landfill is 1,729 tons per day.

The CCBP waste that was disposed of historically at the Landfill primarily derives its chemical composition from the parent material. The principal constituents from historic coal combustion operations are oxides of silica, aluminum, and iron. The disposed material also contains unburned carbon, oxides of calcium, magnesium, phosphorous, potassium, sulfur, sodium, and small amounts of titanium. Future biomass combustion by-products are expected to include calcium carbonate, magnesium, potassium, and phosphorus with trace amounts of iron, manganese, and zinc. The Greenidge Station wastewater treatment plant sludge is a mixture of calcium sulfate and metal hydroxides from the plant's wastewater treatment facility.

2.4 Existing Leachate Management System

Leachate is liquid, primarily derived from the infiltration of precipitation into the wastes, that is contained and collected by the Landfill's basal liner systems. Currently, leachate management at the Landfill focuses on the conveyance of collected leachate to the Leachate Pond where influent is collected to promote settling and sedimentation of particulate matter and suspended solids as treatment and subsequent discharge through the SPDES Outfall 001 to the Keuka Outlet.

Each Stage of the Landfill includes a network of perforated PVC lateral collection pipes that convey leachate flow to a PVC header pipe. The header pipe in turn conveys leachate to the Leachate Pond for treatment and discharge. The leachate collection system piping is equipped with cleanout risers extending above the ground surface and consisting of near vertical PVC pipe connected to the lateral collection pipe. These cleanouts allow for periodic cleaning (annually at a minimum) of the lateral collection pipe to help ensure they are free and clear of any obstructions that may reduce liner system efficiency. A detailed description of the leachate generation for each phase of construction is provided in Section 3.

The Landfill's leachate and stormwater management systems recently underwent improvements to combine and continuously monitor the flow rate of leachate discharges to the Leachate Pond from the OADS and Stages I and II, as well as, separate stormwater runoff that was formerly directed to the Leachate Pond. These modifications were mandated as the first step of improvements to the leachate management system required by the Consent Order.

The approximate 1.6-acre Leachate Pond can contain up to 4.0 feet of liquid with 2.0 feet of freeboard and a corresponding design capacity of approximately 1.5 to 2 million gallons. The bottom elevation of the existing Pond is 550 feet above mean sea level (famsl) and the design water surface elevation is 554 famsl. Discharge from the Leachate Pond is controlled through a manually operated outlet structure within its west bank.

All leachate is held within the Leachate Pond until the water surface reaches an elevation two feet below the spillway of the outlet structure. Once this level is reached, an ELAP certified laboratory technician obtains a pre-discharge grab sample of the stored liquid for analysis and confirms that the SPDES effluent limitations will not be exceeded during discharge. Treated water from the Leachate Pond is then directed to the Keuka Outlet via an approximate 600-foot long open channel. The Keuka Outlet discharges to Seneca Lake approximately 1.2 miles downstream of the discharge point.

2.5 STORMWATER MANAGEMENT SYSTEM

Per the Consent Order, modifications to the Landfill's stormwater management system were completed in 2016 and 2017 to reroute stormwater formerly discharged to the Leachate Pond and update drainage design to be consistent with the current NYSDEC Stormwater Management Design Manual. For the purpose of this report, the term "Sediment Basin" is used to describe a practice that is labeled "Wet Extended Detention Pond" in the Stormwater Management Design Manual. This included increasing the size of and replacing the outlet structures in Sediment Basins 1 and 2, constructing Forebays 1 and 2, modifying the junction area northeast of the Landfill to divert stormwater to Sediment Basin 1, widening the north channel to accommodate the additional diverted flow, and improving the conveyance and erosion control in several other channels in Lockwood's stormwater management system.

Sediment Basin 1 is located north of the OADS. The design includes a forebay, permanent pool and an aquatic bench to treat and control runoff prior to discharge through the outlet structure. The extended detention containment volume below the invert of the emergency spillway is approximately 72,000 cubic feet. Analysis of the as-built information concluded that Sediment Basin 1 will adequately control and convey the 100-year storm design storm event with 1.64 feet of freeboard.

Sediment Basin 2 is located west of the OADS. The design includes a forebay, permanent pool and an aquatic bench to treat and control stormwater runoff prior to discharge through the outlet structure. The extended detention containment volume below the invert of the emergency spillway is approximately 40,700 cubic feet. Analysis of the as-built information concluded that Sediment Basin 2 will adequately control and convey the 100-year storm design storm event with 1.82 feet of freeboard.

The design of both sediment basins includes a four-foot by four-foot, square concrete outlet control structure. Discharge of stormwater from smaller, more frequent events with a low-flow orifice designed to release the 1-year, 24-hour storm event over a minimum 24-hour period and spillways designed to safely pass the 100-year, 24-hour storm flow.

All modified channels were designed and constructed to adequately convey and contain flow and prevent erosion due to anticipated stormwater velocities from a 100-year storm event.

Additional detail on the design and construction of the stormwater system can be found in the following documents:

- *ENGINEERING REPORT: Stormwater Separation Plan*, by Daigler Engineering, PC, dated March 2016, Revised June 2016;
- *CONSTRUCTION REPORT: Leachate Flow Metering System & Stormwater Separation Construction*, by Daigler Engineering, PC, dated January 2017; and,
- Letter to Greg MacLean, NYSDEC DMM Regional Engineer, RE: *Lockwood Hills LLC Consent Order Case No. R8-20140710-47 2017: Record Drawings and Construction Summary, Stormwater & Leachate Separation Construction*, from Joseph P. Randel, dated January 23, 2018.

3 LEACHATE GENERATION RATES

3.1 HISTORIC LEACHATE GENERATION RATES

Historic quarterly leachate flow rate measurements obtained through the environmental monitoring program between March 2003 and April 2014 were analyzed in the original Engineering Report dated August 18, 2015. Leachate flow to the Leachate Pond was measured historically each calendar quarter at the following two pertinent locations:

- Discharge from OADS leachate collection system (Under Drain 1); and,
- Combined flow from Stage I baseliner and overfill liner, Stage II, and the Leak Detection System (21" Inlet to Pond).

The historic measured leachate flow rates are plotted on Figure 3-1.

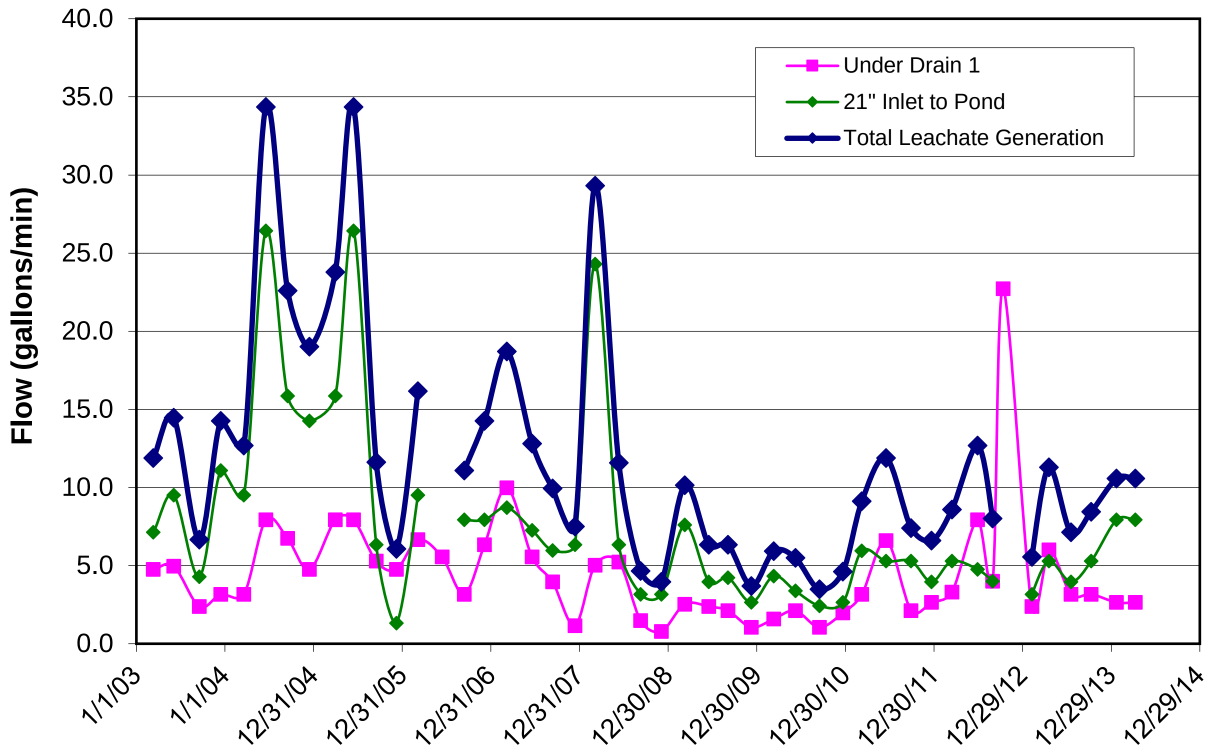

FIGURE 3-1: MEASURED LEACHATE FLOW RATES

Using the above historic dataset, the average rate of 440 gallon per acre per day (gpad) was computed as the sum of the geometric means for Under Drain 1 and 21" Inlet to Pond discharge.

A peak design rate of 620 gpad was computed as the 80th percentile of the total discharge rates from the two discharge pipes.

3.2 METERED LEACHATE GENERATION RATES

In accordance with the Consent Order, leachate flow metering equipment capable of measuring and recording instantaneous leachate flow rates and accumulating totalized flow volumes was installed at the Landfill per the approved Leachate Flow Monitoring Plan, dated January 29, 2016 and revised March 21, 2016. After a 17-month monitoring period between July 1, 2016 through November 30, 2017, metered leachate flow rates were analyzed, and the results are explained in detail in the approved Leachate Monitoring and Analysis Report, dated January 2018. Two design leachate generation rates were calculated using the 17-month dataset for the 29.83-acre existing Landfill baseliner area; an average design rate, and a peak design rate. The average design rate of 470 gpad was computed as the average leachate generation rate in gallons per day (gpd) divided by the total Landfill baseliner area, and the peak design rate of 625 gpad was computed as the 80th percentile of all recorded flow rates divided by the Landfill baseliner area.

3.3 DESIGN LEACHATE GENERATION RATES

According to subparagraph 363-4.3(e)(1)(iii) for landfills undergoing subsequent development, an analysis of the anticipated leachate generation rate should be conducted using the actual leachate generation data from the existing landfill to determine the design leachate generation rate. The Landfill is permitted for both vertical (overfill liner above the remaining 10.5 acres of OADS not currently under an overfill liner) and horizontal expansion (new baseliner in Stages III and IV). Therefore, the design of the leachate management system must consider the addition of leachate generation rates from the subsequent development/Landfill expansion. The proposed leachate management system is to be located within the same footprint as the current Leachate Pond following sediment removal. The Leachate Pond overlaps with the permitted footprint of Stage IV. Therefore, the proposed leachate management system described in Section 6 would have to be relocated prior to expansion of the Landfill into Stage IV. An analysis of potential leachate generation flow rates under future phases of Landfill construction per the Landfill's permitted Fill Progression Plan through Stage III was conducted to establish a conservative-case scenario for leachate generation. The calculations and Fill Progression Plan drawings are provided in

Attachment 1. Within each phase of construction, the leachate flow calculations consider the following conditions:

1. Open Liner – The critical factor of leachate generation for this condition is the contributing storm event. It is assumed that there is little or no waste over the baseliner. Therefore, stormwater runoff is assumed to be at the rate of the storm event. A 25-yr, 24-hr storm event is mandated by subparagraph 363-4.3(e)(1)(i). This storm event will release 4.14 inches of precipitation, which converts to a generation rate of 112,420 gpad. The probability of the 25-yr storm occurring on a day when the cell is open is very low. In any given year, the probability of a 25-yr storm is just 4%. The conditional probability of having an open liner and a 25-year storm is lower still.

   In accordance with subparagraph 363-4.3(e)(1)(ii), a 500-year, 24-hour storm event also was considered to evaluate the impacts of such an extreme event on the proposed leachate management system. The leachate generation rate of a 500-year, 24-hour storm is 185,733 gpad. The amount of leachate generated by the open liner conditions will be minimized by design. Landfill operations will include the use of temporary diversions of stormwater using geomembrane flaps. The geomembrane flaps will be placed to divert non-contact stormwater such that the maximum area of the open liner can be routed to the stormwater management system. Contact stormwater routed toward the leachate collection system can be limited in this manner to a one-acre area.

2. Active Landfilling – The critical factors governing leachate generation during active landfilling are largely dependent upon the precipitation rates and the operation of the Landfill. If temporary cover is not used over an active Landfill area, the permeability and pore water storage characteristics of the CCBP wastes and infiltration at the edges of the fill play critical roles in the rate and amount of leachate generated in the cell. The historic leachate generation rates from Stages I and II, prior to application of intermediate cover in May 2011, provide insight into the leachate generation rates from active filling at this Landfill. Prior to May 2011 active landfilling was occurring in Stages I and II, and the entire area was under no more than daily cover. The OADS was already closed and under a soil-based final cover system. The average leachate flow rate from Stages I and II during

this time period was 644 gpad. The 80th percentile or peak design flow rate was 822 gpad. Given that the data was collected on a quarterly basis, the representativeness of the measurements is lower than desirable; accordingly, a factor of safety of 1.3 has been applied, resulting in a peak design flow rate of 1,070 gpad for active landfilling.

3. Intermediate Cover – The flow monitoring of leachate as described in Section 3.2, occurred over a period of time where the entire Landfill was under either intermediate cover or a soil-based final cover system. The average design rate is 470 gpad and the peak design rate is 645 gpad. These generation rates are appropriate for all areas of intermediate cover. The facility's O&M Manual defines intermediate cover as a minimum six-inch thick layer of unclassified soil.

4. Final Cover – The critical factor governing leachate generation from a Landfill with final cover is a calculated rate of liquid migration through the final cover system, in this case a composite liner, due to geomembrane defects. Leachate generation for any landfill drops significantly once the final cover system is placed. The rate of liquid migration through the composite liner within the Landfill's final cover system design due to geomembrane defects is conservatively calculated to be 7.6 gpad.

Since the proposed leachate management system encroaches on Stage IV, the highest calculated flow scenario considers only phases of the Fill Progression Plan which occur prior to the construction of Stage IV. Under normal, non-storm conditions the highest calculated flow scenario for the life of the proposed leachate management system is 24,651 gpd. The proposed design conservatively uses a flow rate of 25,000 gpd as the sizing criteria for normal operating conditions. Under the open liner, 25-year storm scenario, up to 136,000 gpd of leachate is expected to be generated. The leachate management system design will be capable of handling such short-term storm surges with the available freeboard in the Leachate Pond as described in Section 6.

Assuming that the Landfill's leachate collection and removal system would pass all leachate generated during the 500-year, 24-hour storm event unhindered, up to approximately 209,300 gpd of leachate could be generated. This impact of this scenario is discussed in Section 6.3.4.1.

4 TEMPORARY/CONTINGENCY LEACHATE STORAGE AND TRANSPORT PLAN

A leachate storage and transport area will be constructed to manage leachate via storage and transport offsite during the removal of the leachate pond sediments and installation of the upgrades. A plan and sections of the temporary system are provided on Sheet 2 of the Drawings.

Temporary leachate storage will be accommodated using three interconnected 21,000-gallon mobile steel fixed-axle, “V”-bottomed tanks staged in a geomembrane-lined leak/spill containment basin. Leachate will be directed through a new leachate sewer from MH Common-1 to a flanged connection on the pressure relief valve atop the southern-most tank. The new eight-inch diameter PVC sewer will be fitted with a gate valve to control flow. Roughly $2/3^{rds}$ of the entire length of the sewer pipe will be below grade. After the pipe daylights, it will be supported with a bar joist pipe bridge fixed to a reinforced concrete footer on the west end and simply supported on the top of the tank on the east end. The tanks will be connected via industrial hose such that the liquid level will be equalized across the three tanks. One tank will be equipped with a high-level alarm and auto dialer that will alert on-call personnel of diminished storage capacity.

The geomembrane liner containment system for the leachate storage and transport area is composed of the following elements, in ascending order:

- Prepared subgrade soil layer;
- Possible geocomposite pore water drain, the need for which remains to be confirmed;
- 60-mil textured High Density Polyethylene (HDPE) geomembrane liner;
- cushion geotextile; and,
- Protective 12-inch (minimum), well-graded, low void, gravel layer.

The basin design provides for a maximum containment volume of 130,000 gallons, far greater than 110% of the volume of the combined capacity of the tanks (69,300 gallons) as required by 6 NYCRR 363-6.20.

The leachate storage volume and the transportation strategy are designed to manage leachate generation associated with the maximum measured leachate flow rates (see calculations in

Attachment 2). The transportation schedule will require up to 60 loads of leachate to be hauled from the site over a six-day work week at, hypothetically, sustained maximum flow rates. Under average flow conditions, a five-day work week will suffice with five loads per day. On Monday morning, the tanks are expected to be the fullest. Using the average leachate generation rate, relatively conservative task duration assumptions, and the suggested transportation schedule, the volume in the tanks is not expected to exceed 63% of maximum capacity. Even using the hypothetically sustained maximum leachate generation rate, the volume in the tanks would not exceed 90% of maximum capacity. On Monday morning, should there be equipment failure or other delay in the transportation schedule, nearly 40 hours of additional time will be available to make alternative arrangements before the tanks have reached full capacity under average flow conditions.

A plan and elevation views of the containment basin is shown on Sheet 2. To recover leachate from the tanks, a 4,200-gallon capacity vacuum tank truck will back into and stage in the basin for loading. The tanks will be emptied via a four-inch diameter pipe fitted with a gate valve and quick connect fitting installed on the four-inch drain at the bottom of the northern-most tank. The vacuum hose intake will be attached to the quick connect prior to opening the gate valve and energizing the vacuum pump. Once the tank truck is full, the driver will close the valve and shut down the vacuum pump. The truck driver will be responsible for visual confirmation of the unloading operation to prevent overflow or spillage. Any leakage from the tank or spillage from the pumping system will be contained and directed to the drain at the northwest corner of the basin.

Stormwater runoff accumulated inside the containment area will be contained via a normally-closed valve fitted to an eight-inch diameter drain discharging to a reconfigured drainage channel outside the containment basin. Clean stormwater, confirmed by visual, and if necessary, confirmatory sampling and laboratory analysis, will be released by opening the valve and directing this flow to the sitewide surface water management system. In the event of any sign of contamination, stormwater runoff will be pumped into the leachate storage tanks for offsite treatment.

Leachate will be transported across Route 14 to the Greenidge Station's wastewater treatment plant for treatment and discharge to Seneca Lake under the Plant's SPDES permitted Outfall 002.

As further explained in Section 8.1, once the permanent leachate management system is completed, the temporary storage system will be closed, the new leachate sewer will be disconnected at a flange installed west of the pipe bridge, and the open end will be capped. The remaining pipe and pipe bridge will be stored onsite inside the containment basin. After the tanks are completely emptied, they will be removed from the site. The lined containment basin, leachate sewer line and pipe bridge, sump and valved drain will remain in-place for contingency use in the future should the need arise. The drain to the containment area will be left in the open position to freely drain the area when not in use.

5 REMOVAL AND MANAGEMENT OF LEACHATE POND SEDIMENTS

5.1 GENERAL

According to the Consent Order, this Engineering Report shall detail a plan that will remove accumulated sediment from the Leachate Pond and dispose of it properly.

The following list outlines in chronological order the basic components of the sediment removal and disposal plan:

- Sediment sampling and analysis;
- Sediment removal; and,
- Sediment disposal.

A detailed plan of sediment sampling, removal and disposal was prepared based on the U.S. Army Corps of Engineers, Engineering and Design: Dredging and Dredged Material Management EM 1110-2-5025 July 2015. Each of the main elements of the plan is discussed below.

5.2 SEDIMENT SAMPLING PLAN

The sediment sampling plan was prepared and performed prior to modifications to the Landfill's leachate and stormwater systems, such that the Leachate Pond had two influent leachate pipes (21" Inlet to Pond and Under Drain 1) and a stormwater channel inlet.

5.2.1 Sediment Volume

The sediment thickness was measured to help estimate the volume of sediment to be managed. The area of the Leachate Pond is known from the design and the available mapping of the site. Together, sediment thickness and the Leachate Pond area will be used to estimate the volume of sediment to be managed.

Measurements to determine the sediment thickness were taken on December 2, 2015 using a manual auger and tape measure. The depth to the top of sediment and the depth to the top of the compacted soil liner were measured from the water line. The sediment thickness was then calculated by subtracting the depth of water from the depth to the top of the compacted soil liner. The depth measurements were taken at three locations across the Leachate Pond width at a spacing of approximately 108 feet. The depth measurements also focused on defining the increased sediment thickness near the leachate and stormwater inlets at the eastern limit of the Leachate Pond. In total the respective depths were measured at 19 locations across the Leachate Pond. The sediment thickness ranged from a high of approximately 4.5 feet at the eastern limit to approximately 0.4 feet at the western limit near the Leachate Pond outlet structure.

The computed sediment volume was used to determine the final design and size of the sediment disposal area. The sediment volume was calculated using the end area method. Cross sections were plotted along the depth measurements and the respective cross-sectional areas were determined. The cross-sectional areas were then multiplied by the lengths between the cross sections and added together which generated a volume of approximately 4,000 cubic yards. This volume is considered conservative as it represents the fully saturated sediment volume which will likely be lower after the Leachate Pond is drained for the sediment removal. The daily field report with the depth measurements and the sediment volume calculation are included in Attachment 2.

5.2.2 Sediment Properties

For the most part, the sediments were observed to consist predominantly of fly ash and other CCBPs, and to some lesser degree soil sediments that were deposited prior to the separation of leachate and stormwater runoff. However, confirming the physical and chemical properties of the sediment is considered important in determining the best way to manage the material. The sediment was sampled on December 2, 2015 using a Shelby tube sediment sampler. The thin wall sampler was advanced to the full depth of the sediment. A composite sample was created by mixing three samples collected near the stormwater and leachate inlets at the eastern limit of the Leachate Pond.

Since the material is destined for disposal in the active area of the Landfill, it is prudent to establish and document the chemical nature of the materials. The concentrations of the following indicator parameters were determined: boron, calcium, iron; manganese, sodium, and sulfate.

These analytes were selected because they are included in the routine quarterly environmental monitoring program required by the Landfill's solid waste permit. One Toxicity Characteristic Leaching Procedure (TCLP) test was also conducted on the sediment. The sediment characteristics were compared to the 40 CFR 261.24 maximum concentrations of contaminants for the toxicity characteristics and soil cleanup objectives for unrestricted use found in 6 NYCRR 375-6.8(a). The sample was delivered to TestAmerica Laboratories, Inc. of Amherst, New York who conducted the laboratory testing. The test results are shown on Table 5-1. As shown in the table, the test results are below the maximum concentrations for toxicity levels and are consistent with the leachate testing conducted through the environmental monitoring program. Since the sediment itself is already below unrestricted use limits, confirmatory sampling following sediment removal was determined to be unnecessary. The laboratory report is provided in Attachment 4.

TABLE 5-1: COMPOSITE SEDIMENT SAMPLE RESULTS

Parameter	**Sediment Sample**	**6 NYCRR[A] 375-6.8**	**40 CFR[B] 261.24**
Metals (*Method 6010C*)	mg/Kg	ppm	mg/L
Boron	72.2	--	--
Calcium	60,300	--	--
Iron	18,900	--	--
Manganese	437	1,600	--
Sodium	691	--	--
Sulfate (*Method D516-90*)	3,050	--	--
TCLP Metals (*Method 1311/6010C*)	mg/L	ppm	mg/L
Arsenic	0.16	13	5.0
Barium	0.38	350	100.0
Cadmium	< 0.0005	2.5	1.0
Chromium	0.015	30 (1) [C]	5.0
Lead	0.021	63	5.0
Selenium	< 0.0087	3.9	1.0
Silver	< 0.0017	2	5.0
TCLP Mercury (*Method 1311/7470A*)	< 0.00012	0.18	0.2

Notes: A. 6 NYCRR 375-6.8, Table 375-6.8(a): Unrestricted Use Soils Cleanup Objectives.
B. 40 CFR 261.24, Table 1: Maximum Concentration of Contaminants for the Toxicity Characteristic.
C. Trivalent chromium (hexavalent chromium).

5.3 SEDIMENT REMOVAL AND DISPOSAL PLAN

Due to the manageable size of the Leachate Pond and the relatively small amount of sediment expected, a mechanical sediment removal process is proposed. The sediment removal and disposal plan consist of the following steps:

1. Free liquid contained within the Leachate Pond will be sampled and discharged via Outfall 001 in accordance with the Landfill's SPDES Permit;

2. Leachate in-route to the leachate Pond will be redirected to the contingency leachate storage and transport area (Section 4);
3. A low ground pressure bulldozer will push sediment toward a track mounted excavator staged on the bank. The excavator will load the sediment into water-tight trucks for transport to the disposal area (Section 5.3.2);
4. Sediment will be unloaded at the disposal area to be landfilled. Loads containing a significant volume free liquid will be unloaded at the confined disposal area (5.3.2.2) where the sediment will be allowed to dry prior to landfilling; and,
5. The sediment disposal area will be covered with six inches of intermediate cover soil and three inches of topsoil/vegetation once the dredged material has dried to a suitable consistency.

5.3.1 Geotechnical Considerations

Over time, sediment within the Leachate Pond has settled in two separate and distinct formations exhibiting a wide range of in-place densities and moisture contents. In general, the most abundant sediment formation is located within 120 feet of the east bank of the Leachate Pond, the surface of which is often observed breaking the phreatic surface of the pond. The sediment profile was observed by Daigler Engineering (DE) personnel to be compact along the surface with increasing density with depth. The grain size distribution is generally consistent with a sandy silt, trace fine gravel, which readily expresses free water when subject to external stresses. The second formation is located throughout the bottom of the Leachate Pond west of the compact sandy silt sediment formation; observed to be very loose and obviously saturated, with a grain size distribution consistent with a clayey silt, trace coarse to fine sand.

Following Leachate Pond dewatering, the phreatic surface within the compact sandy silt sediment formation (east side of the leachate pond) will depress. As a result, the sediment will undergo consolidation due to drawdown seepage forces, increased effective stress from overburden sediment, and desiccation. These consolidation mechanisms will operate in concert with the compact in-place density to further reduce the specific retention and the volume of pore water remaining after Leachate Pond dewatering. Based on field observations, the retained pore water is expected to be released when the sediment is subject to vibrations and shear stresses during transportation and disposal. As such, landfilling is expected to be an appropriate disposal method for the sandy silt sediment, as detailed in Section 5.3.2.1.

Conversely, it is unlikely the specific yield of the loose clayey silt sediment (noted along the bottom of the Leachate Pond) will allow for sufficient drainage prior to dredging efforts; and therefore, the material is expected to require confined disposal as detailed in Section 5.3.2.2.

5.3.1.1 Laboratory Testing of Mixed Sediment

Activities related to the dredging, transport, and disposal of Leachate Pond sediment will likely result in the mixing of both abovementioned formations at some time. Therefore, in an effort to characterize the mixed material, samples from both formations were composited by DE on November 8, 2018 and forwarded to Third Rock, LLC of East Aurora, New York for Atterberg limit and moisture content testing. The results presented in Attachment 3 show that the mixed material exhibited a natural water content of 66.2%, a plastic limit of 23%, and a liquid limit of 36%. The plasticity index and liquidity index were calculated to be 13% and 3.3, respectively.

The plasticity of the sample is presumed attributable to the clayey silt formation as the sandy silt sediment exhibited very low plasticity, or non-plastic behavior in the field, if any. Furthermore, the moisture content qualifies the mixed sediment for landfilling in accordance with paragraph 363-7.1(h)(2)(i). The sediment exhibits a relatively high liquidity index which can be correlated to a high sensitivity; suggesting the sediment will become "extra quick" and lose a significant portion of its undisturbed undrained shear strength upon disturbance during excavation[1]. The possibility of this quick condition supports the construction of a small confined disposal area for use by the Contractor as needed, and specialized placement methods during landfilling as detailed hereon.

5.3.2 Sediment Disposal Area

The location and details of the sediment disposal area are shown on Sheet 1 and Sheet 3 of the Drawings. The sediment disposal area will be located within the double-lined area of Stages I and II of the Landfill. A conceptual grading plan is provided to illustrate the general makeup of the sediment disposal area; consisting of a Land Disposal Area (LDA) and Confined Disposal Area

[1] Kulhawy, F. H. and Mayne, P. W. (1990). Manual on Estimating Soil Properties for Foundation Design. Electric Power Research Institue, Palo Alto, California.

(CDA). Surfaces of the Landfill which will receive dredged sediment will be stripped entirely of topsoil and intermediate cover to promote downward seepage of retained water released upon placement. Contact between the newly placed sediment and in-place CCBP waste will also reduce the likelihood of surface seeps and a buildup of destabilizing positive pore pressures.

5.3.2.1 Land Disposal Area

Based on field observations and laboratory test data, the compact sandy silt sediment and mixed sediment suitable for landfilling is expected to "pump" retained water to the surface during placement such that the material will become quick or "spongy". This pumping action may temporarily reduce the strength and consistency of the sediment and may also limit the ability to obtain desirable densities. If sources of moisture are minimized, the sediment is expected to dry such that the material will crumble and scarify readily to accommodate mechanical compaction effort. As such, it is anticipated a large majority of the dredged sediment will not require confined disposal but can be immediately landfilled as long as a method to manage free water and leachate is provided. Therefore, the working face will be graded to develop a topography to promote drainage to a perimeter channel which will discharge to the CDA. Since reducing moisture is of importance to the success of mechanical compaction, the LDA will not accept dredged sediment during or immediately following rainfall events.

Each load of dredged sediment will be visually inspected by the Contractor. Loads containing a significant volume of free liquid will be diverted to the CDA. Sediment deemed suitable for the LDA will be spread in four-inch thick, loose lifts via a low ground pressure bulldozer. Each lift of sediment will be placed across the entire surface area of the active LDA working face prior to placement of overlying lifts. The large surface area will help facilitate drying and drainage by gravity into the underlying waste. Initial lifts of sediment will be mixed with existing in-place CCBP waste to reduce drying time and improve stability of the interface.

5.3.2.2 Confined Disposal Area

The proposed CDA is a prismatic track surrounded by embankments to form a confined area. The western embankments will be constructed with soil produced from the stripping of intermediate cover. At the discretion of the Contractor, the CDA will be used to retain and store excessively wet loads of sediment not suitable for immediate landfilling, thereby preventing the migration of liquid from the dredged material to the surrounding area. As detailed on Sheet 3 of the Drawings, the CDA can contain approximately 500 cubic yards of dredged sediment.

The wet sediment will be deposited in a relatively uniform thickness, so the rate of water removal is uniform across the CDA. The CDA will also collect leachate and surface water discharged from the LDA during landfilling. Under normal operations, the CDA will be passively dewatered as collected liquid infiltrates the underlying waste and into the landfill's leachate collection system. However; to expedite dewatering, the Contractor may utilize a vacuum truck to remove ponded liquid from the CDA sump and transport the liquid for treatment and disposal at the Greenidge Station Wastewater Treatment Plant. Alternative methods of dewatering may be used upon approval by DE and the NYSDEC. Once the sediment has reached a suitable consistency and moisture content, the sediment will be removed and disposed in the LDA.

6 LEACHATE MANAGEMENT SYSTEM[2]

6.1 SELECTION CONSIDERATIONS AND ENVIRONMENTAL BENEFITS

Water quality based effluent limits (WQBELs) are designed to protect the quality of a receiving water by ensuring that State water quality standards are met during a discharge. These water quality standards maintain the chemical, physical, and biological integrity of the surface water and are thereby protective of human health, fish, and wildlife.

As demonstrated by years of sampling and analysis of the discharge from the Leachate Pond, simple settling of the pollutants has been successful in meeting the WQBELs established for Keuka Outlet. With the addition of a cascade aerator to the leachate treatment system, effluent quality will be enhanced even further.

While the treatment of the leachate to levels protective of human health and the environment is readily achievable using either offsite or onsite technologies, the overriding benefit of using the proposed onsite technology is the elimination of approximately 1,300 heavy diesel trucks that would be needed to haul leachate from the Landfill to an offsite treatment facility each year. Notwithstanding the improved treatment of the leachate by the proposed system, the savings in carbon emissions alone would make the use of an onsite technology preferable.

Upon review of the above benefits and the treatment necessary, aeration and settling were identified as best management practices for the management and treatment of leachate at Lockwood. There are many other environmental benefits that make these sustainable, passive technologies the preferred leachate treatment methods. Following treatment with aeration and settling, the effluent will be released to the Keuka Outlet under the conditions of Lockwood's industrial SPDES permit. The design basis, process selection justification, and process sizing and details are presented in this Section. The aeration and settling treatment approach is desired for the Lockwood Landfill based on, among other things, the following benefits:

- Proven success of long-term treatment in similar applications;
- Simple to operate and maintain;

[2] A large contribution to this section was provided by Brown in Caldwell in a report prepared for Lockwood Hills LLC dated October 1, 2018.

- Inconsequential environmental impact;
- Passive gravity flow and passive aeration eliminates the need for offsite electrical power;
- Not dependent upon the eternal availability and use of heavy diesel trucks to haul leachate, which in-turn reduces emissions, fuel demand, localized noise, vibration, and wear and tear on local roadways;
- Self-sustaining process that does not rely on the willingness/commitment of a wastewater treatment plant to accept leachate long into the future;
- Reduced loading to the local wastewater treatment plant;
- Significantly reduced carbon footprint and greenhouse gas emissions compared to more common store, haul, and treat options;
- Low noise;
- Ability to produce high quality effluent on a year-round basis;
- Excessive oversight is not necessary for proper function of the system, reducing maintenance;
- Low energy and fuel need;
- Long term cost viability due to affordable operation and maintenance costs; and,
- Increased future usability of the land.

6.2 LEACHATE CHARACTERISTICS

Lockwood has historically collected and analyzed leachate for multiple parameters on a quarterly basis since 2003, or earlier for most analytes. The parameters of concern for design of the leachate management system will be those included in the SPDES permit and shown in Table 6-1.

All leachate generated by the Landfill is combined in MH Common-1 prior to flowing through the Leachate Meter Pit and into the Leachate Pond. The average concentrations for eight quarterly sampling events since July 2016 are presented in Table 6-1. These samples were collected after flow had passed through the Leachate Meter Pit just before entering the Leachate Pond. Combination of the leachate flows in MH Common-1 and flow through the flume are assumed to have provided complete mixing, and are, therefore, representative of average leachate characteristics entering the Leachate Pond.

TABLE 6-1: RAW LEACHATE CONCENTRATIONS AND SPDES LIMITS

Parameter	Unit	Permit Limit (Daily Max)	Average Leachate Concentration into Pond	Maximum/Range Leachate Concentration into Pond
Aluminum (Total)	mg/L	2.4	0.09+	< 0.10
Cadmium (Total)	mg/L	0.11	0.004+	< 0.005
Copper (Total)	mg/L	1.0	0.002++	0.003
Iron (Total)	mg/L	4.0	6.9	30.4
Zinc (Total)*	mg/L	2.0	0.008++	0.003
Mercury (Total)**	ng/L	50	2.9++	11.0
Manganese (Total)	mg/L	3.0	0.54	0.67
Total Suspended Solids	mg/L	50	Not Measured	
Arsenic (Total)	mg/L	0.1	0.023	0.039
Selenium (Total)	mg/L	0.07	0.030	0.038
Boron (Total)	mg/L	Monitor	19.36	29.7
Temperature	Deg. F	Monitor	53.15	44.6 – 60.8
pH	SU	6.0-9.0	7.93	7.5 – 8.3

+All data less than detection limit; detection limits averaged at face value.

++Combination of detected values and less than detection data; Less than detection data included in average as ½ the detection limit.

*Average concentration for zinc only includes 3 annual samplings

**Under mandatory Mercury Minimization Program in pursuit of Statewide WQBEL of 0.7 ng/L

Based on the average concentration of the parameters shown in Table 6-1, all parameters except iron are under the daily maximum SPDES permit limits.

Several water quality parameters have been historically monitored in the untreated leachate, which are important for the design of an appropriate treatment system for iron removal. These include pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP).

Historical DO concentrations are shown in Figure 6-1. The average DO concentration in influent leachate is approximately 6 mg/L. The lowest recorded DO concentration was 0.95 mg/L.

The stoichiometric oxygen requirement for iron precipitation is 0.143 mg/L per mg/L of dissolved iron (see calculation in Attachment 4). Assuming the maximum concentration of iron measured in the leachate, 30.4 mg/L, is all dissolved, the minimum required DO concentration is 4.35 mg/L. This is consistent with the minimum desired DO concentration for favorable (i.e., rapid) iron precipitation kinetics, which is 4 to 5 mg/L. There is no improvement in the rate of iron precipitation for DO concentrations greater than 5 mg/L[3]. Thus, the leachate will require aeration to maintain a minimum DO concentration of 4.4 mg/L.

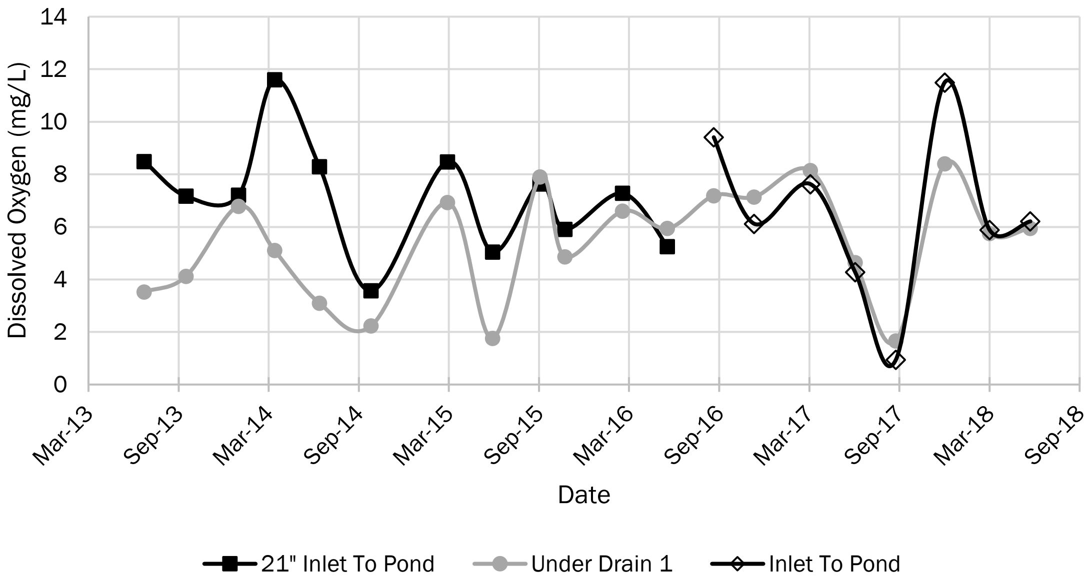

FIGURE 6-1: HISTORICAL DISSOLVED OXYGEN CONCENTRATIONS

Historical pH of the influent leachate is shown in Figure 6-2 . Since July 2016, the influent leachate average pH is 8 and the minimum measured pH is 7.5. The rate of iron oxidation is highly dependent on pH and should occur rapidly in oxygenated waters at pH greater than 7.2.[4] Thus, the naturally alkaline leachate pH is favorable for iron precipitation.

[3] Ghosh, O'Conner, and Engelbrecht. (1966). "Precipitation of Iron in Aerated Groundwaters", *Journal of the Sanitary Engineering Division*, Proceedings of the American Society of Civil Engineers, **92**, p 211.
[4] Stumm and Lee. (1961). "Oxygenation of Ferrous Iron", *Industrial and Engineering Chemistry*, **53**, p 143.

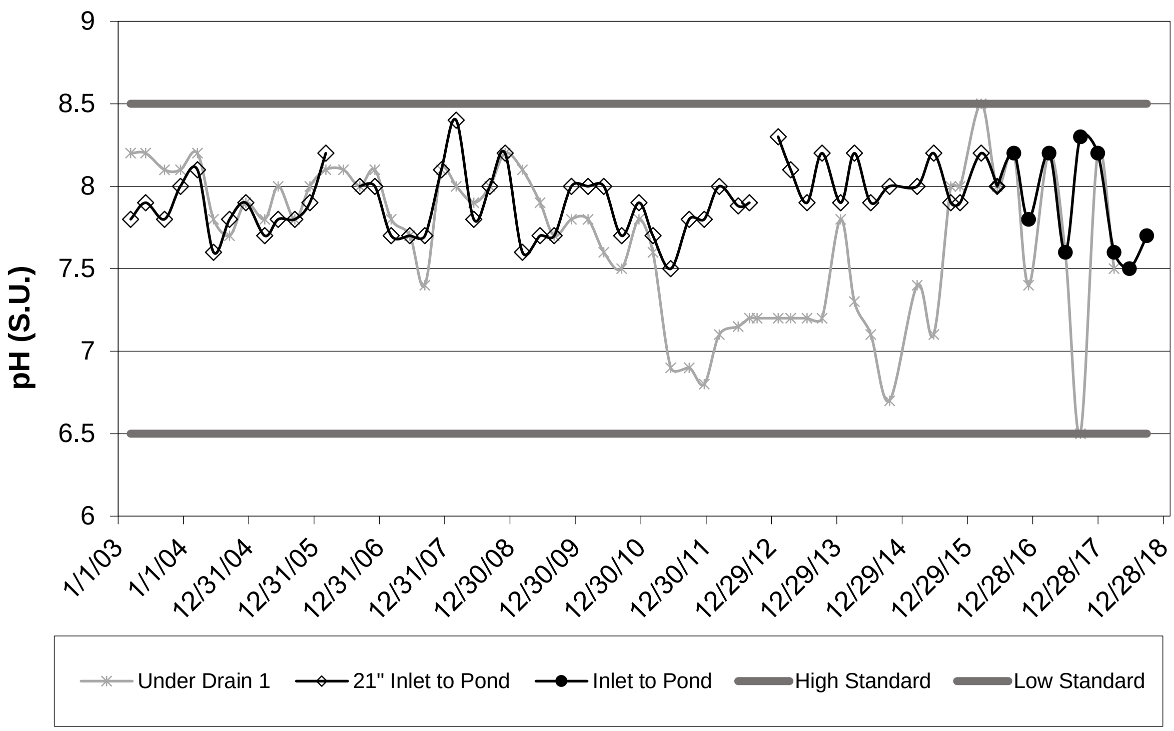

FIGURE 6-2: HISTORICAL pH

An additional parameter used to gauge the form of iron, whether ferrous (dissolved) or ferric (precipitate) is ORP. While the available data set is dated (from 2003-2006) and contains only seven data points, the average ORP in the leachate is 185 millivolts. Thus, at average conditions, the leachate is oxidized and alkaline, which suggests that iron is already precipitating within the system.

6.3 Onsite Treatment System

6.3.1 Basis of Design

The basis of design for the proposed leachate treatment/management system (Proposed Leachate Treatment System) uses the peak design leachate generation rate of 25,000 gpd with additional detention and storage capacity/freeboard to safely manage at least a 25-year, 24-hour storm during open liner operating conditions. This approach accounts for expansion of the Landfill up through Phase 2 of the Lockwood Fill Progression Plan, as described in Section 3.

Analytical results from site specific leachate sampling events were reviewed to develop prudent design concentrations that would be characteristic of the leachate flowing into the Proposed Leachate Treatment System, as presented in Section 6.2.

Additional site-specific conditions were considered during this evaluation, including:

- Location: To make use of the existing Outfall 001 and the natural discharge channel to the Keuka Outlet, use of the current Leachate Pond footprint for the Proposed Leachate Treatment System is preferred. This location also allows for a low maintenance, low energy, flow by gravity configuration of the system.
- Utilities: Overhead power lines cross the available area and a gas line runs along a portion of the northern border near State Route 14.
- Topographic / Boundary Limitations: Use of the existing Leachate Pond simplifies installation of the Proposed Leachate Treatment System by limiting the extent of excavation necessary. The existing size of the Leachate Pond is more than sufficient for the proposed design.

Based on a review of the above considerations, aeration and settling is a viable approach for treating leachate from the Landfill that will satisfy SPDES effluent limits on a year-round basis. Specifically:

- The present and future flow rates are acceptable for treatment by aeration and settling;
- The contaminants present are either below, or can be reliably treated to below, existing technology-based SPDES limits, which are more stringent than the WQBELs for Keuka Outlet;
- The cold-weather climate will not adversely affect the ability of the Proposed Leachate Treatment System to perform well;
- There is space available to construct the Proposed Leachate Treatment System; and,
- There is a large knowledge base of employing aeration and settling for iron removal with documented performance and design standards.

For these reasons, aeration and settling is selected as the best fit for addressing the specific conditions of the Lockwood leachate.

6.3.2 Process Selection

For Lockwood, the removal of iron drives the process selection. The leachate has relatively mild concentrations of iron with levels on average of 6.9 mg-Fe/L and maximum values up 30.4 mg-Fe/L. The proposed treatment will reliably achieve the current permit limit of 4 mg-Fe/L. Other parameters will likely also be removed; although, the measure of success will be focused on the capacity of the Proposed Leachate Treatment System to consistently achieve low levels of iron concentration in the effluent.

The recommended process train for the Proposed Leachate Treatment System includes two unit treatment processes; cascade aeration and settling. The cascade aerator is sized to provide sufficient oxygen to oxidize soluble iron to form a precipitate and the settling pond is sized to provide residence time to gravity settle precipitates prior to discharge. Controlling design assumptions and calculations for each component are presented below.

6.3.3 System Components

6.3.3.1 Cascade Aerator

The cascade aerator will increase the dissolved oxygen concentration of the leachate to promote the oxidation of ferrous iron to iron hydroxide precipitate. Turbulent flow created in the cascade aerator allows for increased surface area between the liquid and air, which allows diffusion of oxygen into the leachate. The Barrett equation was used to determine the required height of the cascade aerator. The Barrett equation relates the height of a cascade aerator to the oxygen deficit ratio, wastewater type, cascade geometry, and water temperature. Calculations for sizing of the cascade aerator can be found in Attachment 4. The cascade aerator was sized using the most conservative initial conditions, i.e., minimum leachate DO concentration of 0.95 mg/L and the maximum leachate temperature of 60.8° F (16° C).

The overall height of the cascade aerator required to maintain a minimum DO concentration of 4.4 mg/L was determined to be 3.2 feet or 38 inches. The geometry of the cascade aerator was designed to conform with the applicable range of parameters for use of the Barrett equation. As such, the cascade aerator will consist of an initial drop out of the leachate sewer followed by a series of three weir steps for a total of four steps. Each step will have a height of 9.5 inches and a length of 12 inches. V-notched weirs will be employed to promote more efficient nappe flow conditions. Improved aeration efficiency of the triangular notch weir over other weir shapes has been demonstrated in controlled laboratory studies[5].

Tailwater depth is also an important factor with regard to weir aeration as aeration efficiency generally increases with increasing tailwater depth. Avery and Novak (1978)[6] found that the optimum tailwater depth for stepped weirs should be approximately 0.6 times the drop in surface water elevation. Therefore, a weir invert height of 0.327 ft (or approximately four inches) above each step was calculated to provide the maximum aeration efficiency as shown in Attachment 4.

The weir steps of the cascade aerator will be formed within the bottom of a four-foot by four-foot square concrete structure. Leachate will enter the cascade aerator following the existing MH Common-1 and will discharge into the settling pond. Drawing Sheet 4 shows the proposed cascade aeration system.

6.3.3.2 Settling Pond

The settling pond will follow the cascade aerator. The settling pond will provide adequate detention time for the precipitation of iron hydroxide and settlement of suspended solids in the leachate. Sizing calculations for the settling pond can be found in Attachment 5. A settling pond with water surface dimensions of 128 feet wide by 555 feet long by 3 feet deep will have approximately 104 days of detention time at the average inflow rate (43 days at the maximum inflow rate). The required detention time to capture at least 90% of the iron precipitate was determined using Stoke’s Law to be approximately 1.7 days at a three-foot pond depth. This amount of time is far exceeded under both average and maximum flow conditions.

Scouring velocity of the design particle size was evaluated for a dual purpose. On the settling pond inlet side, the scouring velocity must be regularly exceeded in the inlet pipe to mitigate clogging the pipe with iron precipitate between the cascade aerator and the settling pond.

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[5] Baylar, A. and Bagatur, T. (2000). Aeration performance of weirs. *Water SA* **26**(4), pp 521-526.
[6] Avery, S. and Novak, P. (1978). Oxygen transfer at hydraulic structures. *Journal Hydraulic Engineering, ASCE* **104** (HY11), pp. 1521-1540.

Manning's equation was rearranged to solve for the minimum pipe slope necessary to exceed self-cleaning velocities on a regular basis. The design slope of the settling pond inlet pipe is 0.005, as shown on Sheet 4, which is well above the 0.001 minimum calculated slope.

On the other hand, the horizontal flow velocity through the settling pond must be less than the scouring velocity to avoid resuspension of settled sediment. The settling pond dimensions provide a horizontal settling velocity that is approximately three orders of magnitude lower than the calculated scouring velocity for both the average and maximum flow conditions. Additionally, the particle travel distance was calculated. Even at the maximum leachate flow rate, 90% of the iron precipitate is estimated to settle out of the water column within 62 feet of the inlet. Given the full 555-foot length of the settling pond, collection of sediment at the outlet should be minimal and scouring of solids around the discharge structure during batch discharge events is not expected to be significant.

The settling pond outlet structures consists of a three-foot square concrete pond drain and a four-foot square concrete overflow structure. Discharge from the settling pond is controlled by a butterfly valve on the overflow structure discharge pipe. The existing meter pit, currently in place on the inlet side of the Leachate Pond, will be relocated in the Proposed Leachate Treatment System a minimum distance of 25 pipe diameters, or 16 feet[7], downstream of the butterfly valve to reduce the likelihood of turbulent flow in the flume approach.

During batch discharge events, the lockable butterfly valve will be operated in the fully-open position to allow discharge from the overflow structure, which receives flow from the settling pond drain. The outlet pipe from the overflow structure is fitted with an orifice plate to help regulate discharge flowrates to below 150 gallons per minute (gpm), the maximum flow rate that can be conveyed by the 60-degree large V-trapezoidal flume. Based on calculations provided in Attachment 5, the orifice plate bore may be no larger than 2.4 inches to limit discharge to below 150 gpm.

When the butterfly valve is fully open, the maximum discharge rate established by the 2.4-inch orifice plate bore in the Proposed Leachate Treatment System is 216,000 gpd. Thus, the normal

[7] Calculated using the inner diameter of an eight-inch SCH 80 PVC pipe (7.625 inches).

daily maximum flow rate permitted by the SPDES permit, 250,000 gpd, will not be exceeded. If the flow rate in the Keuka Outlet in Dresden, New York (USGS Site #04232482) drops below 27 cubic feet per second (cfs), the maximum allowable discharge rate is restricted to 140,000 gpd as required by Footnote (d) in the SPDES Permit. In this case, the butterfly valve can be operated in a partially-open condition to reduce the discharge rate as desired, and the lower rate can be confirmed by the instantaneous downstream flow meter measurements.

The settling pond will be located within the footprint of the existing Leachate Pond. The existing Pond will be reshaped to provide an extra foot of depth and 3H:1V side slopes (currently the sides slopes are 2H:1V). The extra depth will allow for installation of the liner system without changing the final bottom elevation of the settling pond. The shallower slope will provide for easier installation of the liner system as described in Section 6.3.3.3. Penetrations of the geomembrane for the inlet pipe and outlet structures will be secured using geomembrane boots and HDPE concrete embedment strips, such as GSE's PolyLock strip, for a leak-proof seal. The geosynthetics will be installed with a two-foot runout at elevation 555. The extent of the geosynthetics at elevation 555 is used in the calculations for the maximum pond depth and available freeboard calculations.

While the settling pond is currently proposed to be operated under batch discharge conditions, the overflow structure is design to also be operable under continuous flow conditions at some time in the future, if appropriate, with NYSDEC approval. To facilitate the transition to continuous flow discharge, a PVC flange will be solvent welded to the settling pond drain discharge pipe inside the overflow structure. Once the flange is capped, the phreatic surface of the settling pond would rise and discharge into the overflow structure via the overflow weir. The butterfly valve would be set in the fully opened position to provide uninterrupted discharge to the meter pit. To avoid flooding the cascade aerator, the overflow weir in the overflow structure is designed at elevation 553.5. This sets the normal operating depth of the settling pond at 3.5 feet, with 1.5 feet of freeboard. Thus, the operating volume of the settling pond is approximately 1.68 million gallons and the full containment capacity is roughly 2.48 million gallons.

If the volume of leachate in the settling pond is already at maximum operating capacity, the available freeboard of about 808,700 gallons is sufficient to contain the additional leachate generated by the Landfill during fill progression Phase 1b with an open liner and a 25-year, 24-hour storm (136,000 gpd), plus the volume of precipitation that will fall directly on the settling pond (224,822 gallons). Therefore, the settling pond is sufficient in size.

6.3.3.3 Containment Liner System Design

The settling pond design includes a geomembrane liner containment system composed of the following elements, in ascending order:

- Prepared subgrade soil layer;
- 60-mil textured HDPE geomembrane liner;
- 10 oz. non-woven cushion geotextile; and,
- Protective 12-inch (minimum) NYSDOT 304-2.02 Type II (well-graded, low void) gravel layer.

Installation of a HDPE geomembrane liner requires specialized expertise. The geosynthetics subcontractor must be able to demonstrate previous experience in the installation of geosynthetic liner systems. The field crew foreman must have a documented minimum qualification of successful installation experience on at least 30 acres of comparable geosynthetic system construction from a minimum of five different projects. Geomembrane seaming personnel must have a documented minimum qualification of successful installation experience on at least 20 acres of comparable geomembrane liner system construction.

All construction outside of the geosynthetics, including the grading of the settling pond and the temporary leachate storage and transport containment area, as well as, installation of the cascade aerator, pond discharge structures, piping systems, and stormwater management elements, do not require specialized expertise and can be performed by any of the pre-qualified earthwork/general contractors who will submit bids for the work.

6.3.4 System Operation and Maintenance Considerations

6.3.4.1 Operations

The proposed permanent leachate management system is a low maintenance system and will not require extensive attention. The following sections describe normal operations and operations under certain special conditions.

Normal Operation

Flow through the system from the landfill to final effluent discharge is by gravity. No pumps will be used to transfer leachate between treatment units. The leachate will be passively aerated via the cascade aerator. Therefore, no external electrical power is necessary for proper operation of the treatment train.

Treated effluent will be discharged from the system in batch. The water level in the settling pond will be monitored on a routine basis. A staff gauge will be installed near the discharge structure to facilitate water level readings. Once the pond reaches a water depth of 3.0 feet, a pre-discharge sampling event will be performed to confirm all SPDES permit parameters are below their effluent limits[8]. Once confirmed, a batch discharge event is initiated. A composite sample is taken during the first 24-hours of the discharge for analysis of most parameters per the SPDES permit. A grab sample is taken upon collection of the composite sample for all remaining parameters.

Analysis will be conducted by an ELAP-certified laboratory using USEPA-approved analytical methods (40 CFR 136). The current constituents are listed in Table 6-1 in Section 6.2. Effluent flow will be measured using the relocated flow meter pit and flume. The solar panel will also be relocated to power the level instrument and data logger. Flow will be recorded and logged every minute as is done currently for the influent.

Normal operations will also include routine visual inspection of the system for excessive sediment accumulation and evidence of damage caused by rodents, inclement weather, or other adverse site conditions. Routine inspections should be performed monthly, at a minimum, as well as after significant storm events.

Winter Operation

While the Proposed Leachate Treatment System is expected to perform in an acceptable manner under freezing conditions, the following features have been incorporated in the design to address the potential for debilitating freezing of the proposed treatment system:

[8] Note that once the pond depth is at 3.0 feet, approximately twenty days are available at the average leachate flow rate before the maximum operating depth of 3.5 feet is reached.

- Leachate pipes and the cascade aerator will be buried to take advantage of the insulating properties of the surrounding soils;
- Turbulence and air entrainment created by the cascade aerator will reduce the potential for freezing at the inlet; and,
- The outlet used under batch discharge conditions is submerged to avoid potential interference caused by ice formation.

While limited freezing of leachate may occur at the mouth of the inlet pipe, (i.e., icicle formation) at extremely cold temperatures, pipe flow will be maintained due to the oversized eight-inch pipe, the relatively warm temperature of the leachate emanating from the Landfill, and the turbulent conditions created by the aerator. The inlet pipe will be periodically visually observed in extremely low temperatures to confirm leachate continues to flow freely into the settling pond.

During winter, access roads will be plowed when needed to maintain access to the settling pond (both inlet and outlet ends) and associated structures.

Operation During Extreme Wet Weather Event

As described in Section 6.3.3.2, the Proposed Leachate Management System can easily accommodate a 25-year, 24-hour storm event that includes the open liner condition. Per subparagraph 363-4.3(e)(ii), the system performance under a 500-year, 24-hour storm must also be evaluated. One acre of open liner during a 500-year, 24-hour storm will produce approximately 185,700 gpad of leachate. The total approximate leachate generation rate under the worst-case future Landfill phase (Phase 1b with open liner) is approximately 209,300 gpd. In addition to the incoming leachate, approximately 370,000 gallons of precipitation will fall directly onto the approximate 2-acre drainage shed of the settling pond. Thus, approximately 580,780 gallons of liquid will be added to the system in one day due to a 500-year, 24-hour storm. Should this storm occur when the liquid level in the settling pond is already at maximum operating depth (3.5 feet), the available free-board (808,770 gallons) is still sufficient to contain the entire storm volume without overtopping the liner. Only 72% of the full containment capacity of the Proposed Leachate Treatment System is reached. Therefore, no special steps are required to be taken in anticipation of an extreme storm event.

Long-Term Operations

In Phase 3 of the Landfill's planned fill progression, the area occupied by the Proposed Leachate Treatment System lies within the Landfill's future Stage IV. Therefore, in the long-term, the leachate management system would be eventually replaced as the Landfill progresses to Stage IV. However, should the Landfill not progress beyond Stage III, and the system proposed herein remains in-service, it is anticipated that the batch discharge operations would at some point be replaced with continuous discharge operations, which the proposed system was designed to facilitate. For continuous discharge operations, the weir in the overflow structure would control the water surface elevation in the settling pond and the hydraulic residence time would continue to be sufficient. The discharge rate would be controlled by the orifice plate installed on the discharge pipe from the overflow structure. Such a change would be preceded by an application to the Department for SPDES permit modification. Eventually, effluent monitoring results would be expected to support transition into the custodial care period.

6.3.4.2 Maintenance

Routine maintenance includes addressing any corrective actions noted during monthly visual inspections. Rodent activity shall be controlled through the use of locally appropriate means. Erosion, burrowing, or other defects shall be addressed and repaired promptly, as appropriate to ensure the stability and performance of the system. The settling pond drain and orifice plate shall be kept free and clear of debris such as twigs and leaves that could hinder flow.

The leachate sewer piping and manholes leading to the settling pond, as well as the cascade aerator, will require annual cleaning to remove accumulated solids. The required annual cleaning of the will include the entire sewer system all the way to the settling pond. Cleanouts installed or proposed to be installed on the 8-inch sewer pipes will be utilized in a sequential fashion to flush accumulated sediment downstream into the settling pond. The v-notched weirs in the cascade aerator will be removable such that the plates can be taken out during the annual flushing to facilitate a more thorough cleaning.

While the butterfly valve on the outlet side of the settling pond will be used during every discharge event, the gate values on the inlet side should be periodically exercised to ensure operability. The effluent flow meter utilizes water depth measurements as the discharge flows through the defined shape of the flume. The accuracy of the flow meter should be verified during every discharge event by taking a manual depth reading and comparing it to the meter's display.

The settling pond will need to be gauged periodically using a "sludge judge" or similar gauging device to determine the amount of settled solids. Calculations show that approximately 90% of the solids should settle out within 25 to 26 feet of the inlet under average flow conditions. Therefore, gauging should be performed near the inlet. If the depth of solids exceeds two feet as measured at several locations across the settling pond, then sediment removal should be performed. Based on the calculations provided in Attachment 5, sediment removal is estimated to be required about every 15 years, depending on the solids loading to the settling pond and pond solids removal efficiency. When it is determined the sediment is to be removed, Lockwood will notify the NYSDEC of the planned schedule to clean the settling pond such that the Department has the opportunity to observe the operation.

While the settling pond is out of operation, gate valves at MH Common-1 would be operated to divert leachate from the onsite treatment system to the contingency storage and transport area for temporary tank and haul operations.

After the settling pond is drained, the gate at the access ramp will be opened and a small low ground pressure bulldozer will enter the settling pond for the purpose of pushing the soft sediments to the northeast corner of the pond where they can be removed by a long reach hydraulic excavator loading sealed tailgate dump trucks for proper disposal. Once the sediment is removed, careful inspection of the surface of the protective gravel layer will be completed to determine whether the integrity of the underlying geomembrane may have been compromised. In the event observations of the surface of the gravel layer suggests the containment liner may have been compromised, manual excavation of the gravel layer will expose the liner system in the area of question to determine the need for repair. If deemed necessary, repairs will be made in accordance with the site specific CQA/CQC Plan for liner system installation and repair.

Gauging should also be performed in the concrete settling pond drain and in the sump of the pond overflow structure. Should significant sediment accumulation be observed, these areas can be maintained with a vacuum truck.

7 PERMIT CONSIDERATIONS

As required by Consent Order Paragraph III.F, after completion of construction of the Proposed Leachate Treatment System, Lockwood will request modification of the Landfill's SPDES and Part 360 Permits. The Landfill's SPDES permit will be modified to identify the change in wastewater type and the addition of discharge flow metering. No other modifications of the SPDES Permit will be necessary.

Upon completion of construction of the Proposed Leachate Treatment System, Lockwood will also request modification of the Part 360 permit documents, specifically, the Operations and Maintenance Manual (O&M manual), the Contingency Plan, the Environmental Monitoring Plan, and the Site Analytical Plan will be modified. The O&M manual will be modified to describe proper operations and maintenance of the Proposed Leachate Treatment System discussed in Section 6.3.4. A passage on contingency measures related to the geosynthetics-lined containment area for temporary storage and transport operations, as presented in Section 4, will be added to the Contingency Plan.

The Environmental Monitoring Plan and Site Analytical Plan will be modified to identify the changes in the leachate sewer and treatment system.

8 IMPLEMENTATION SEQUENCE AND SCHEDULE

8.1 SEQUENCE OF ACTIVITIES

The following summarizes the proposed construction approach and sequence.

1. The installation of sediment and erosion controls around the temporary/contingency leachate storage and transport area will occur first, followed by construction of the containment basin.

2. The new leachate sewer line with pipe bridge and gate valves will be installed to divert leachate to the temporary system. Three fixed-axle, V-bottomed tanks will be delivered to the site and installed by the supplier within the containment basin and leachate flow will be diverted temporarily to the tanks.

3. The Leachate Pond will be drained by discharging clarified water via existing Outfall 001. The water will be discharged in accordance with the conditions of the existing SPDES permit.

4. Site preparation activities such as fence removal, temporary access road construction, installation of additional sediment and erosion controls, and preparation of the sediment disposal area will take place during the time the Leachate Pond is discharging.

5. Once the Leachate Pond is drained and site preparation activities are completed, sediment will be removed in accordance with the Sediment Removal and Disposal Plan described in Section 5.3. Sediment removal is anticipated to be completed within eight to ten days.

6. Once sediment removal is complete, construction of the Proposed Leachate Management System will commence. Construction activities will include: excavation and shaping of the settling pond, compacted fill placement, subgrade preparation, liner system installation, and installation of infrastructure (cascade aerator, outlet control structures, valves, pipes, effluent metering manhole). The leachate management system construction should be completed within forty to fifty days.

7. Once construction is completed, the leachate will be redirected from the temporary leachate storage tanks and the leachate management system, including the cascade aerator and settling pond, will begin operating.

6. All leachate will be drained from the temporary tanks to an upstream manhole (MH I/II/S-1). The empty tanks and all other rented equipment will be removed from the site. The permanent leachate sewer line will be capped, and the containment area drain valve will be left in the open position.

7. Finally, reinstallation of the settling pond perimeter fencing and restoration of the work area, access roads, and stormwater features, including seed and mulch where necessary, will be completed.

8. Upon completion of all work, the Certification Report and Record Drawings will be submitted to the NYSDEC.

8.2 PROJECT SCHEDULE

Per Paragraph III B. of the Consent Order, this section of the Engineering Report presents a proposed schedule for implementation of the items presented in this report. All work is to be completed no later than November 1, 2019 as required by the Consent Order. Figure 8-1 is a Gantt chart presentation of the schedule for implementation of the main tasks and key subtasks for construction as identified in the previous sections, as well as, follow on activities required by Paragraphs III E. and F. of the Consent Order. The main tasks and their projected completion dates include:

Projected Completion Date

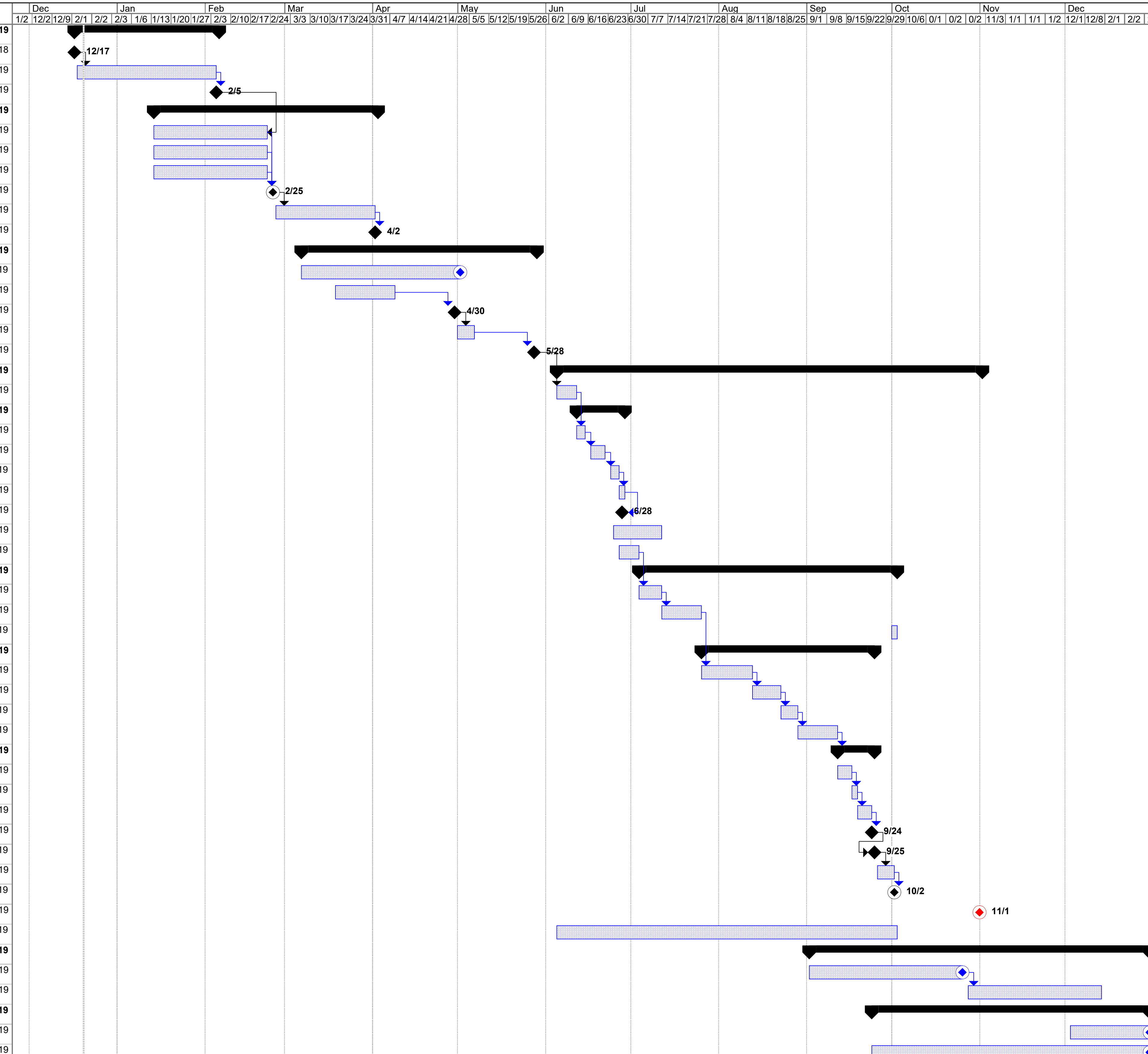
1. Engineering Report (NYSDEC Approval of) .... February 5, 2019 (assumed)
2. Engineering Plans and Specifications (1.+6 Months) .... February 25, 2019
3. Construction Cost Estimate (NYSDEC Approval of 2.+60 Days) .... May 1, 2019
4. Pre-Construction Activity .... May 28, 2019
5. Temporary/Contingency Leachate Storage and Transport Area .... June 28, 2019
6. Leachate Pond Sediment Removal .... July 25, 2019
7. Leachate Management & Treatment System Construction .... September 24, 2019
8. Completion of Construction .... October 2, 2019
9. Certification Report and Record Drawings (8.+60 Days) .... October 25, 2019
10. Permit Modification Applications (NYSDEC Approval of 9.+30 Days) .... December 30, 2019

The timeframes required by the Consent Order, as listed in parentheses after each task, are met or exceeded. Projected durations and dependencies are shown on Figure 8-1. The durations of tasks and subtasks shown in the construction schedule were supported by conservative production calculations (not included). As identified in Figure 8-1, all necessary work will be completed before the Consent Order deadline of November 1, 2019.

LOCKWOOD HILLS LLC

FIGURE 8-1: LOCKWOOD ASH DISPOSAL SITE CONSENT ORDER COMPLIANCE SCHEDULE

ID	Task Name	Duration	Start	Finish
1	**ENGINEERING REPORT**	**37 days**	**Mon 12/17/18**	**Tue 2/5/19**
2	Submit Remaining Response to Comments and ENGINEERING REPORT, Rev2	1 day	Mon 12/17/18	Mon 12/17/18
3	NYSDEC Review /Response to Comments & Negotiation	35 days	Tue 12/18/18	Mon 2/4/19
4	Receive NYSDEC Approval of Engineering Report	1 day	Tue 2/5/19	Tue 2/5/19
5	**CONSTRUCTION DOCUMENTS**	**57 days**	**Mon 1/14/19**	**Tue 4/2/19**
6	Final Design	30 days	Mon 1/14/19	Fri 2/22/19
7	Prepare Engineering Plans	30 days	Mon 1/14/19	Fri 2/22/19
8	Prepare Specifications	30 days	Mon 1/14/19	Fri 2/22/19
9	Submit ENGINEERING PLANS AND SPECIFICATIONS	1 day	Mon 2/25/19	Mon 2/25/19
10	NYSDEC Review /Response to Comments & Negotiation	25 days	Tue 2/26/19	Mon 4/1/19
11	Receive NYSDEC Approval for Engineering Plans and Specifications	1 day	Tue 4/2/19	Tue 4/2/19
12	**PRE-CONSTRUCTION ACTIVITY**	**59 days**	**Thu 3/7/19**	**Tue 5/28/19**
13	Submit CONSTRUCTION COST ESTIMATE	40 days	Thu 3/7/19	Wed 5/1/19
14	Preparation of Bid Documents	15 days	Tue 3/19/19	Mon 4/8/19
15	Bids Due	1 day	Tue 4/30/19	Tue 4/30/19
16	Selection of Contractor(s)	4 days	Wed 5/1/19	Mon 5/6/19
17	Mandatory Pre-Construction Meeting	1 day	Tue 5/28/19	Tue 5/28/19
18	**CONSTRUCTION**	**108 days**	**Wed 6/5/19**	**Fri 11/1/19**
19	Initial Mobilization	5 days	Wed 6/5/19	Tue 6/11/19
20	**Leachate Storage and Transport Area**	**13 days**	**Wed 6/12/19**	**Fri 6/28/19**
21	Install Sediment and Erosion Controls	3 days	Wed 6/12/19	Fri 6/14/19
22	Construct Containment Basin	5 days	Mon 6/17/19	Fri 6/21/19
23	Install New Leachate Pipe, Pipe Bridge, and Valves	3 days	Mon 6/24/19	Wed 6/26/19
24	Install Rented Fixed-Axle Tanks and Connecting Hose	2 days	Thu 6/27/19	Fri 6/28/19
25	Initiate Use of Leachate Storage Tanks	1 day	Fri 6/28/19	Fri 6/28/19
26	Drain Leachate Pond	13 days	Tue 6/25/19	Thu 7/11/19
27	Site Preparation	5 days	Thu 6/27/19	Wed 7/3/19
28	**Leachate Pond Sediment Removal and Disposal**	**65 days**	**Thu 7/4/19**	**Wed 10/2/19**
29	Prepare Sediment Disposal Area	6 days	Thu 7/4/19	Thu 7/11/19
30	Dredge Sediment from Leachate Pond Footprint	10 days	Fri 7/12/19	Thu 7/25/19
31	Close Confined Disposal Area	2 days	Tue 10/1/19	Wed 10/2/19
32	**Leachate Management & Treatment System Construction**	**43 days**	**Fri 7/26/19**	**Tue 9/24/19**
33	Excavation & Grading	12 days	Fri 7/26/19	Mon 8/12/19
34	Install Geomembrane Liner	8 days	Tue 8/13/19	Thu 8/22/19
35	Install Cushion Geotextile	4 days	Fri 8/23/19	Wed 8/28/19
36	Place Protective Gravel Layer	10 days	Thu 8/29/19	Wed 9/11/19
37	**Support Structures**	**9 days**	**Thu 9/12/19**	**Tue 9/24/19**
38	Install Cascade Aerator	3 days	Thu 9/12/19	Mon 9/16/19
39	Install Outlet Structures	2 days	Tue 9/17/19	Wed 9/18/19
40	Relocate and Install Effluent Monitoring Flume and Flow Meter	3 days	Thu 9/19/19	Mon 9/23/19
41	Initiate Use of Onsite Leachate Management System	1 day	Tue 9/24/19	Tue 9/24/19
42	Close Leachate Storage and Transport Area	1 day	Wed 9/25/19	Wed 9/25/19
43	Site Restoration	4 days	Thu 9/26/19	Tue 10/1/19
44	Construction Complete	1 day	Wed 10/2/19	Wed 10/2/19
45	Construction Complete Deadline	1 day	Fri 11/1/19	Fri 11/1/19
46	Construction Quality Assurance/Construction Quality Control Program	86 days	Wed 6/5/19	Wed 10/2/19
47	**POST-CONSTRUCTION ACTIVITY**	**86 days**	**Mon 9/2/19**	**Mon 12/30/19**
48	Submit CERTIFICATION REPORT AND RECORD DRAWINGS	40 days	Mon 9/2/19	Fri 10/25/19
49	NYSDEC Review /Response to Comments & Negotiation	35 days	Mon 10/28/19	Fri 12/13/19
50	**Modify Permits**	**70 days**	**Tue 9/24/19**	**Mon 12/30/19**
51	SPDES Permit	20 days	Tue 12/3/19	Mon 12/30/19
52	Part 360 Permit	70 days	Tue 9/24/19	Mon 12/30/19



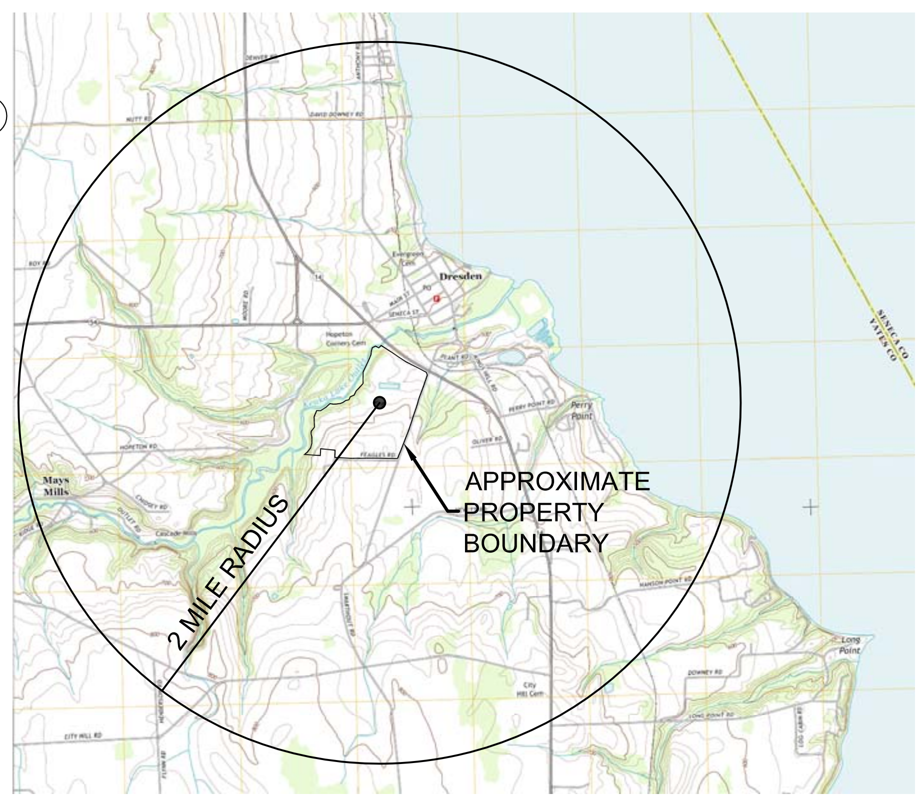
DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING

DRAWING SET

LOCKWOOD HILLS LLC

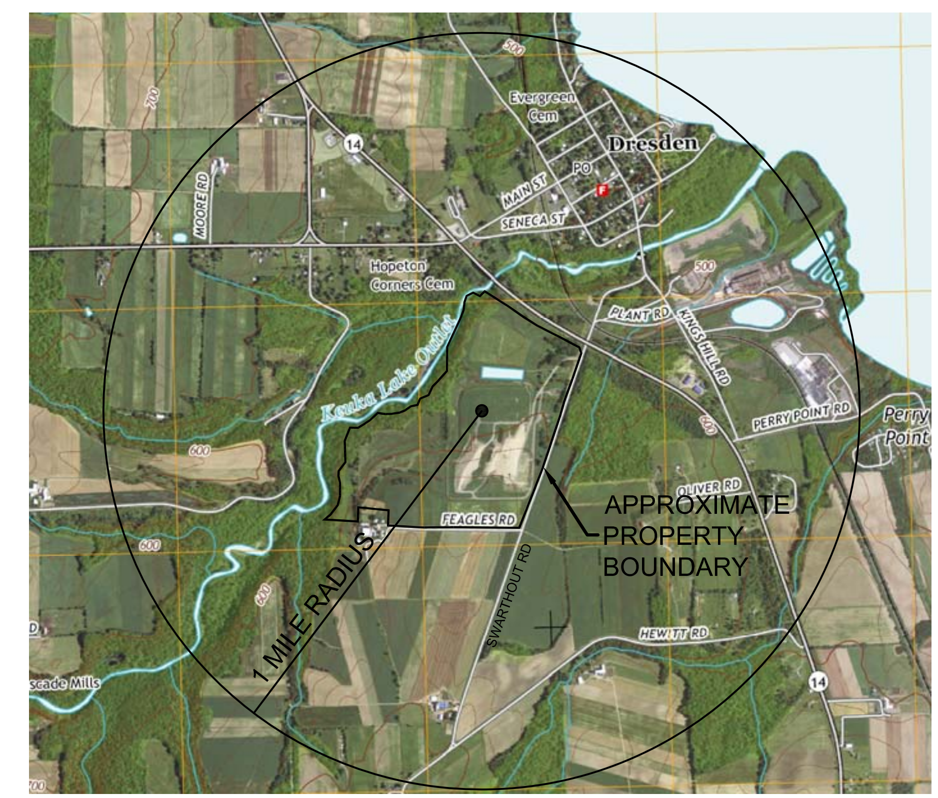
LOCKWOOD ASH DISPOSAL SITE
LEACHATE MANAGEMENT AND POND SEDIMENT REMOVAL PLAN
ENGINEERING DRAWINGS

TOWN OF TORREY, YATES COUNTY, NEW YORK
DECEMBER 2018



VICINITY MAP
NOT TO SCALE

INDEX OF DRAWINGS



LOCATION MAP
NOT TO SCALE

PREPARED FOR:
LOCKWOOD HILLS LLC
590 PLANT ROAD
P.O. BOX 187
DRESDEN, NEW YORK 14441

PREPARED BY:
DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

DATE:	DWG:	CHECKED BY:	PROJ. NO.:	DRAWING:
DECEMBER 2018	TITLE SHEET.dwg			1 OF 5

PLOTTED HALF–SCALE

PRELIMINARY NOT FOR CONSTRUCTION

LEGEND:

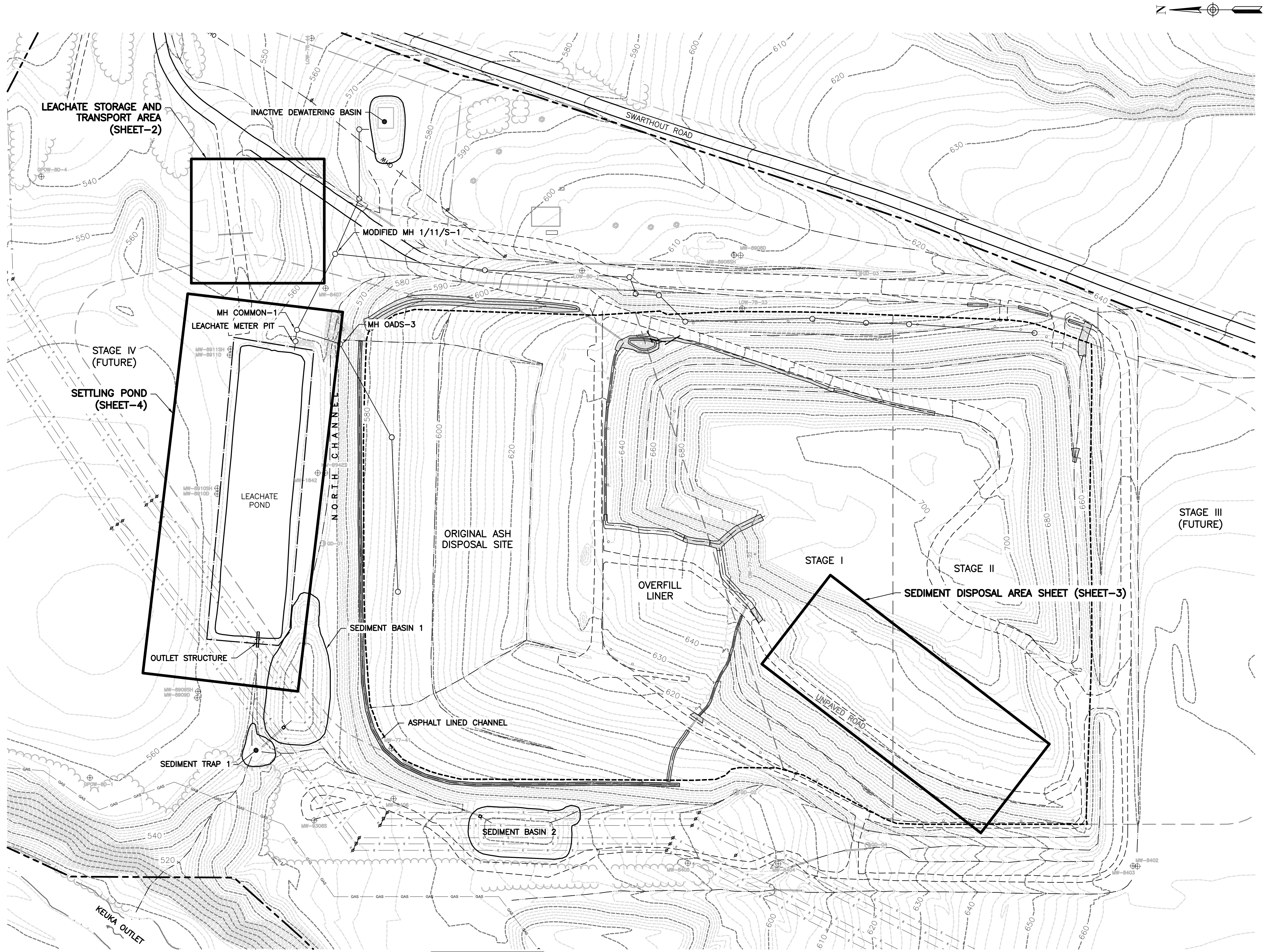
- 550 — GROUND SURFACE 10' CONTOUR
- GROUND SURFACE 2' CONTOUR
- PAVED ROAD
- UNPAVED ROAD
- FENCE
- LIMIT OF EXISTING WASTE
- PERMITTED LIMIT OF WASTE
- PROPERTY BOUNDARY
- MONITORING WELL
- OVERHEAD POWER LINES AND POLES
- LEACHATE SEWER AND MANHOLE
- GAS — GAS LINE
- DRAINAGE CHANNEL
- ROCK-LINED CHANNEL
- CULVERT
- GROUNDWATER DRAIN

NOTES:

1. TOPOGRAPHY AND PLANIMETRICS SHOWN ON THIS DRAWING HAVE BEEN COMPILED BY KUCERA INTERNATIONAL, INC. USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED FEBRUARY 4 2010. TOPOGRAPHY WAS SUPPLEMENTED WITH SURVEY FROM WILLSON ASSOCIATES ON 11/13/17, 11/24/17, AND 12/21/17.
2. VERTICAL CONTROL IS THE GREENIDGE STATION PLANT DATUM. HORIZONTAL CONTROL IS REFERENCED TO THE NEW YORK STATE GRID NAD 83.

INVERT TABLE (EXISTING CONDITIONS)

STRUCTURE	RIM	PIPE SIZE	IN 1	IN 2	OUT 1
MH 1/11/S-1	565.20	21", 8", 6"	558.51 (21")	558.57 (6")	558.53 (8")
MH COMMON-1	562.13	8"	557.17	556.99	556.99
LEACHATE METER PIT	561.07	8"	556.84	-	556.82
MH OADS-3	563.28	12", 8"	559.13 (12")		557.84 (8")



Q:\Lockwood Hills LLC\31-1518 Consent Order Eng Report 2.1\cad\Construction Drawings\CD-1 EXISTING CONDITIONS SITE PLAN.dwg 12/20/2018 2:27 PM

ALTERATION OF ANY SURVEY, DRAWING, DESIGN, SPECIFICATION OR REPORT MUST BE COMPLETED IN ACCORDANCE WITH SECTION 7209 PROVISION 2 OF THE NEW YORK STATE EDUCATION LAW.

NO.	REVISION	BY	DATE

DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

JAMES A. DAIGLER, P.E.
NYSPE NO. 061689

DATE: December 2018

PLOTTED HALF-SCALE

PRELIMINARY NOT FOR CONSTRUCTION

100' 0' 100'

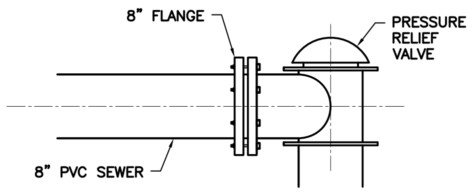
PREPARED FOR: LOCKWOOD HILLS LLC
DES. BY: DRW. BY: CHK. BY:
DWG. CD-1 EXISTING CONDITIONS SITE PLAN.dwg

EXISTING CONDITIONS SITE PLAN
LEACHATE MANAGEMENT AND POND SEDIMENT REMOVAL PLAN
TOWN OF TORREY | YATES COUNTY | STATE OF NEW YORK

SHEET 1

LEGEND:

- EXISTING GROUND MAJOR CONTOUR
- EXISTING GROUND MINOR CONTOUR
- PROPOSED GROUND MAJOR CONTOUR
- PROPOSED GROUND MINOR CONTOUR
- PAVED ROAD
- UNPAVED ROAD
- DRAINAGE CHANNEL
- PROPERTY BOUNDARY
- MONITORING WELL
- OVERHEAD POWER LINES
- LEACHATE SEWER AND MANHOLE
- PROPOSED GATE VALVE
- CONTAINMENT LINER EXTENT



8" x 8" x 8" SEWER/TANK CONNECTION
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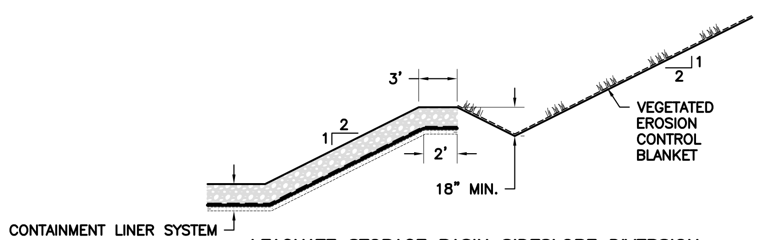

LEACHATE STORAGE BASIN SIDESLOPE DIVERSION
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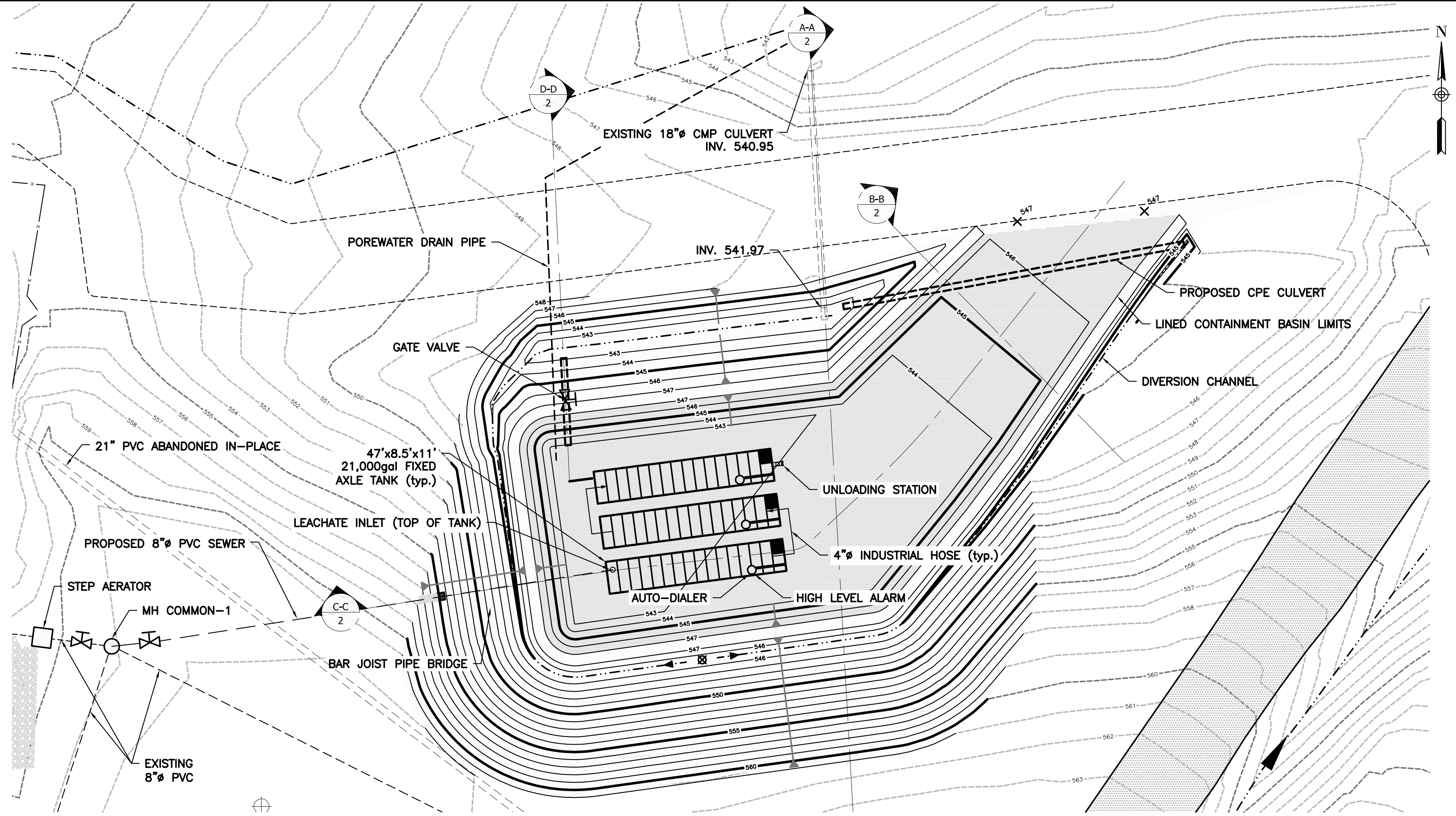

PLAN VIEW
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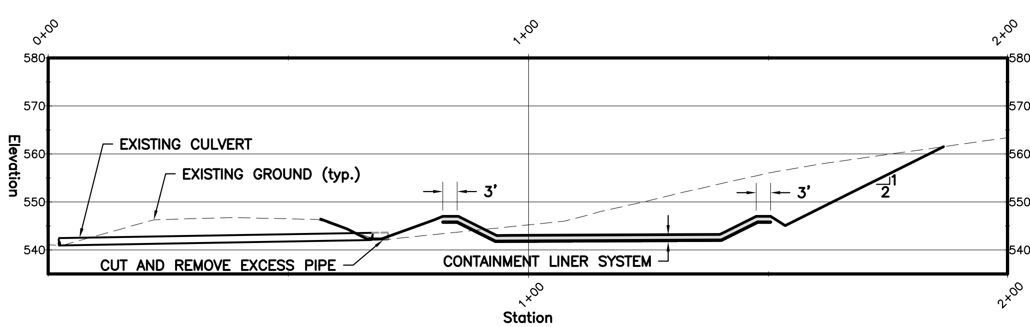

SECTION VIEW A–A
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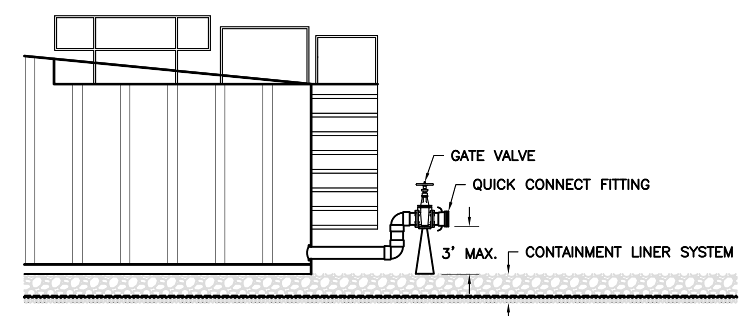

TANK UNLOADING STATION
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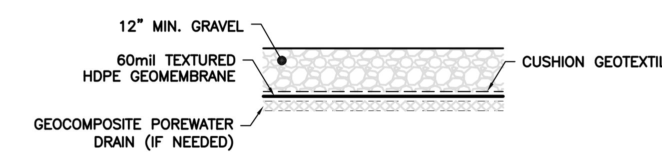
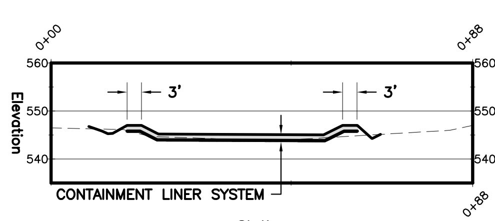
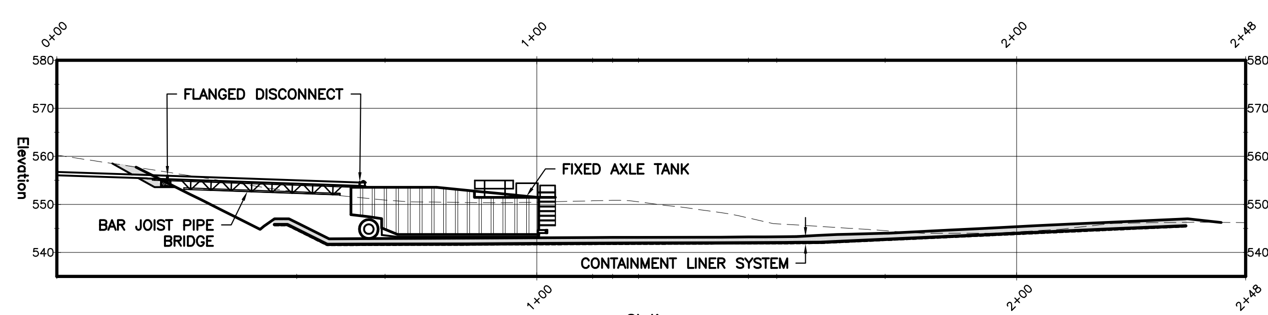


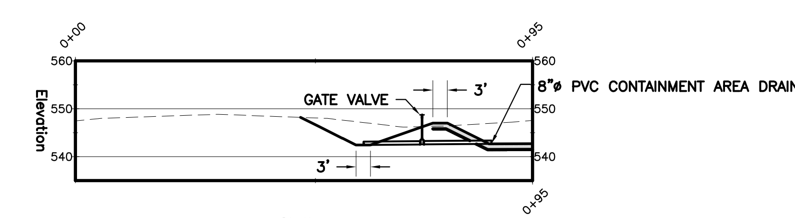
CONTAINMENT LINER SYSTEM
SCALE: NOT TO SCALE



SECTION VIEW B–B
SCALE: 1"=20'



SECTION VIEW C–C
SCALE: 1"=20'



SECTION VIEW D–D
SCALE: 1"=20'

NO.	REVISION	BY	DATE

DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

JAMES A. DAIGLER, P.E.
NYSPE NO. 061689

DATE: December 2018

PLOTTED HALF-SCALE

PRELIMINARY
NOT FOR CONSTRUCTION

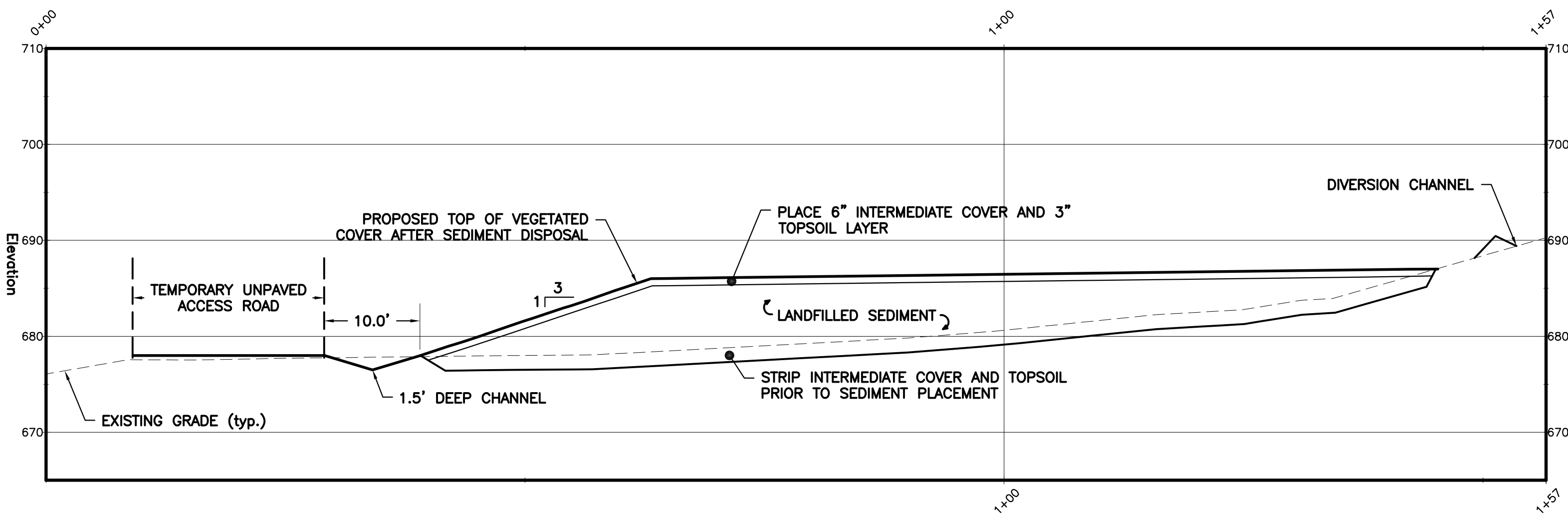
SCALE: NOTED

PREPARED FOR: LOCKWOOD HILLS LLC			LEACHATE STORAGE AND TRANSPORT AREA
DES. BY:	DRW. BY:	CHK. BY:	LEACHATE MANAGEMENT AND POND SEDIMENT REMOVAL PLAN
DWG. CD-2 LEACHATE STORAGE PLAN.dwg			TOWN OF TORREY / YATES COUNTY / STATE OF NEW YORK

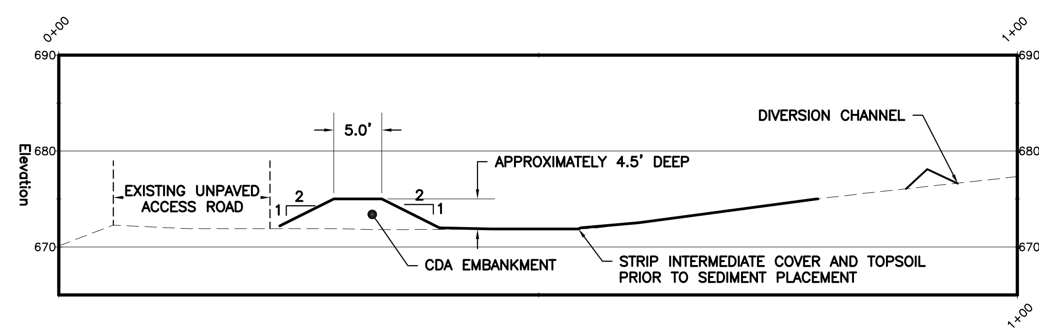
SHEET 2

NOTES:

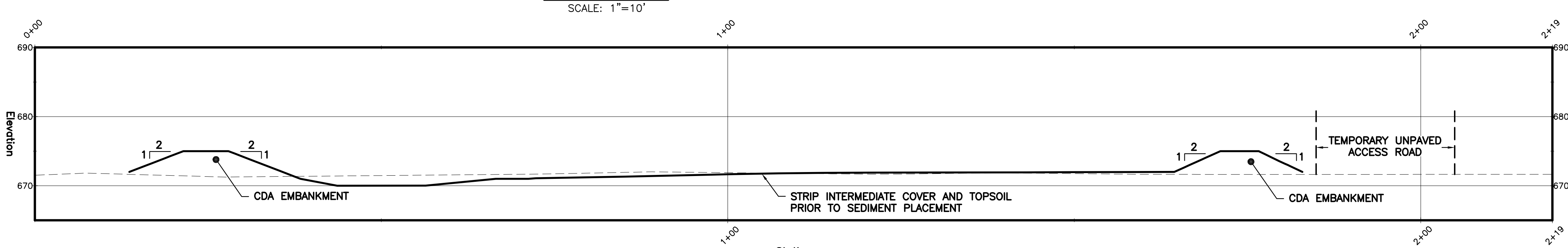
1. AT THE DISCRETION OF THE CONTRACTOR, THE PROPOSED CONFINED DISPOSAL AREA (CDA) WILL BE USED TO CONTAIN AND STORE EXCESSIVELY WET LOADS NOT SUITABLE FOR IMMEDIATE LANDFILLING AT THE LAND DISPOSAL AREA (LDA). ONCE THE SEDIMENT CONTAINED IN THE CDA REACHES A SUITABLE CONSISTENCY AND MOISTURE CONTENT, THE SEDIMENT SHALL BE REMOVED AND DISPOSED AT THE LDA.
2. SURFACES OF THE LANDFILL WHICH WILL RECEIVE DREDGED SEDIMENT (FOOTPRINT OF THE LDA AND CDA), SHALL BE STRIPPED ENTIRELY OF INTERMEDIATE COVER AND TOPSOIL PRIOR TO SEDIMENT PLACEMENT. TOPSOIL SHALL BE STOCKPILED FOR FUTURE USE AND INTERMEDIATE COVER SHALL BE USED TO CONSTRUCT THE CDA EMBANKMENT.
3. SEDIMENT DEEMED SUITABLE FOR THE LDA WILL BE SPREAD IN FOUR-INCH THICK LOOSE LIFTS.
4. THE FIRST LIFT OF DREDGED SEDIMENT PLACEMENT SHALL BE MIXED WITH EXISTING WASTE TO EXPEDITE DRYING.
5. EACH LIFT OF SEDIMENT WILL BE PLACED ACROSS THE ENTIRE SURFACE AREA OF THE ACTIVE LDA WORKING FACE PRIOR TO PLACEMENT OF OVERLYING LIFTS.
6. THE SURFACE OF THE LDA SHALL BE GRADED TO DEVELOP A TOPOGRAPHY THAT DRAINS LEACHATE AND SURFACE WATER TO THE PROPOSED PERIMETER CHANNEL THAT DISCHARGES TO THE CDA.
7. UNDER NORMAL OPERATION, THE CDA SHALL BE PASSIVELY DEWATERED AS COLLECTED LIQUID INFILTRATES THROUGH THE UNDERLYING WASTE. HOWEVER, THE CONTRACTOR MAY UTILIZE A VACUUM TRUCK TO REMOVE PONDED LIQUID FROM THE CDA SUMP FOR DISPOSAL AT THE GREENIDGE GENERATION LLC WASTEWATER TREATMENT PLANT. ALTERNATIVE METHODS OF DEWATERING MAY BE USED UPON APPROVAL FROM DAIGLER ENGINEERING, P.C. (DE) AND THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC).
8. THE CDA SHALL BE DECONSTRUCTED FOLLOWING THE REMOVAL OF THE FINAL LOAD OF SEDIMENT. SOILS USED TO CONSTRUCT THE CDA EMBANKMENT SHALL BE REUSED AS INTERMEDIATE COVER.
9. FOLLOWING FINAL RECEIPT OF SEDIMENT, REMOVAL OF THE CDA, AND CONFIRMATION OF SUFFICIENT STABILITY ALL SURFACES OF THE LDA AND FORMER CDA MUST BE GRADED WITH SIX INCHES OF INTERMEDIATE COVER AND THREE INCHES OF TOPSOIL TO ACCOMADATE SEEDING AND MULCHING.



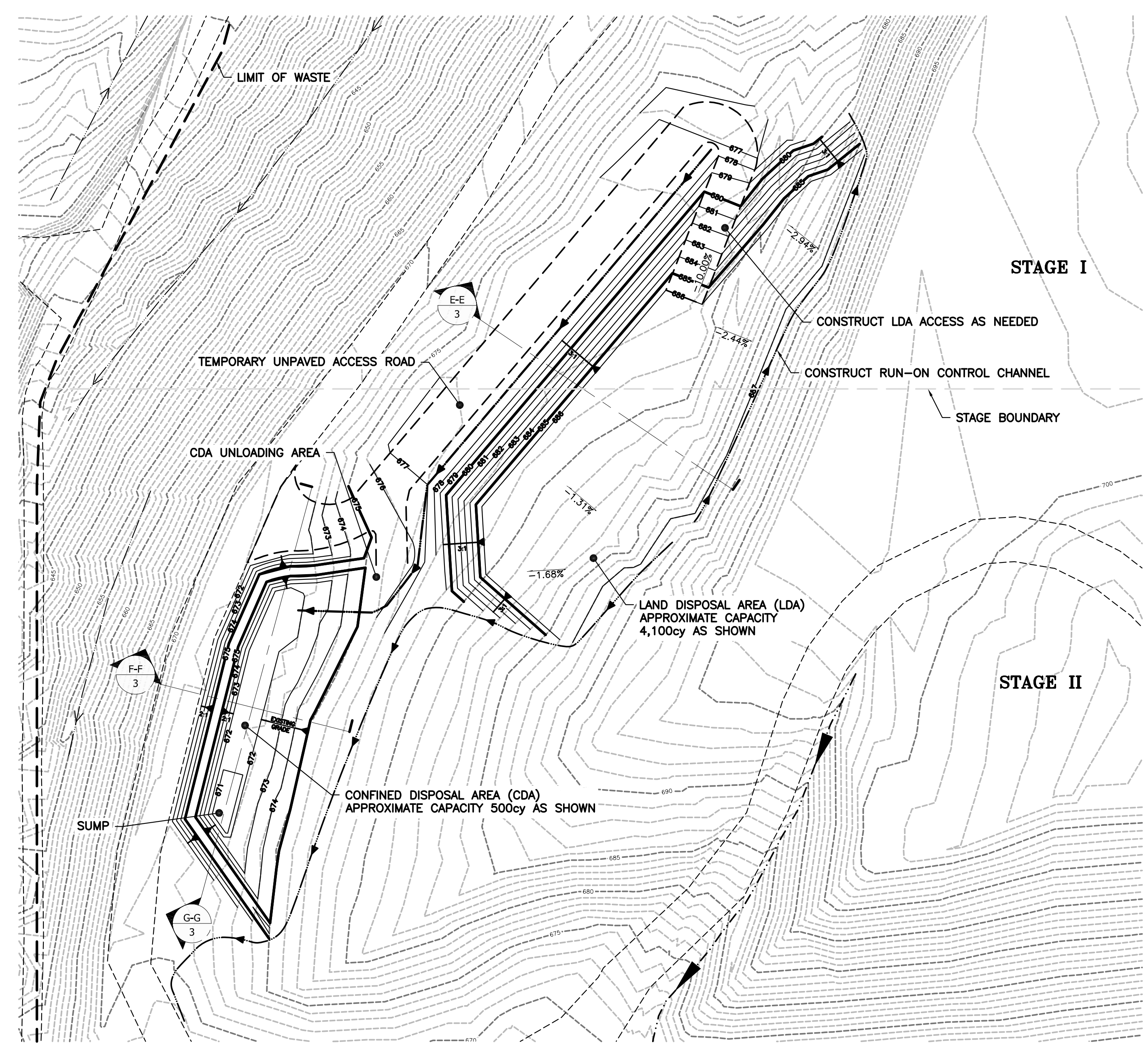
SECTION VIEW E–E
SCALE: 1"=10'



SECTION VIEW F–F
SCALE: 1"=10'



SECTION VIEW G–G
SCALE: 1"=10'



PLAN VIEW
SCALE: 1"=40'

LEGEND:

- EXISTING GROUND MAJOR CONTOUR
- EXISTING GROUND MINOR CONTOUR
- PROPOSED GROUND MAJOR CONTOUR
- PROPOSED GROUND MINOR CONTOUR
- EXISTING UNPAVED ACCESS ROAD
- TEMPORARY UNPAVED ACCESS ROAD
- EXISTING DRAINAGE CHANNEL
- PROPOSED DRAINAGE CHANNEL

ALTERATION OF ANY SURVEY, DRAWING, DESIGN, SPECIFICATION OR REPORT MUST BE COMPLETED IN ACCORDANCE WITH SECTION 7209 PROVISION 2 OF THE NEW YORK STATE EDUCATION LAW.

NO.	REVISION	BY	DATE

DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

JAMES A. DAIGLER, P.E.
NYSPE NO. 061689

DATE: December 2018

PLOTTED HALF-SCALE

PRELIMINARY NOT FOR CONSTRUCTION

SCALE: NOTED

PREPARED FOR: LOCKWOOD HILLS LLC			SEDIMENT DISPOSAL AREA	SHEET 3
DES. BY:	DRW. BY:	CHK. BY:	LEACHATE MANAGEMENT AND POND SEDIMENT REMOVAL PLAN	
DWG. CD-3 SEDIMENT DISPOSAL AREA.dwg			TOWN OF TORREY / YATES COUNTY / STATE OF NEW YORK	

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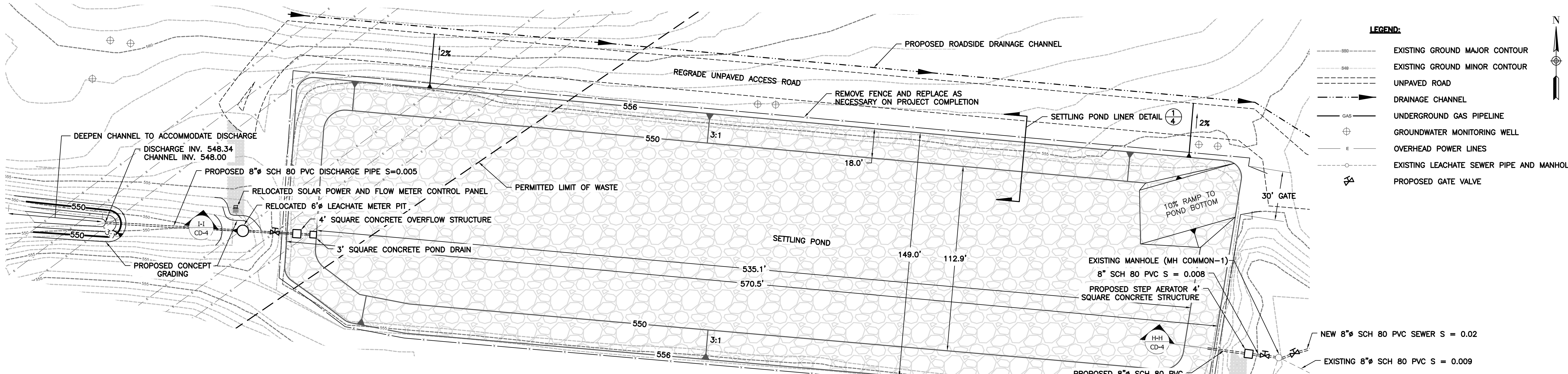
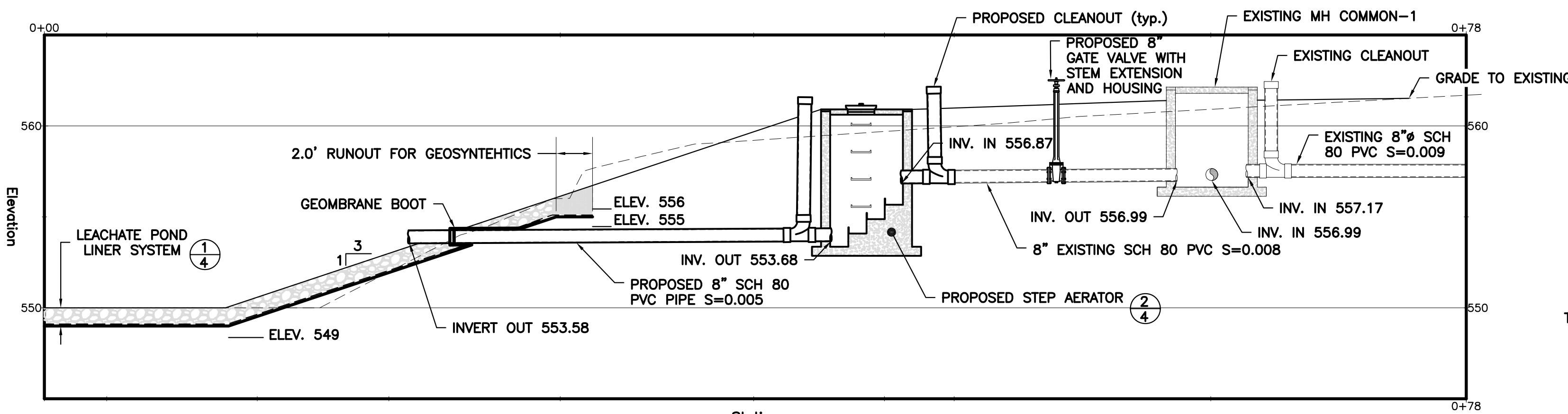
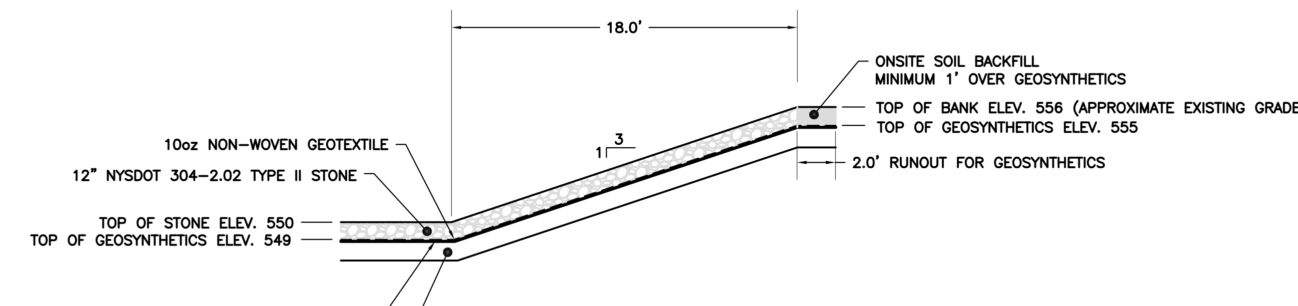


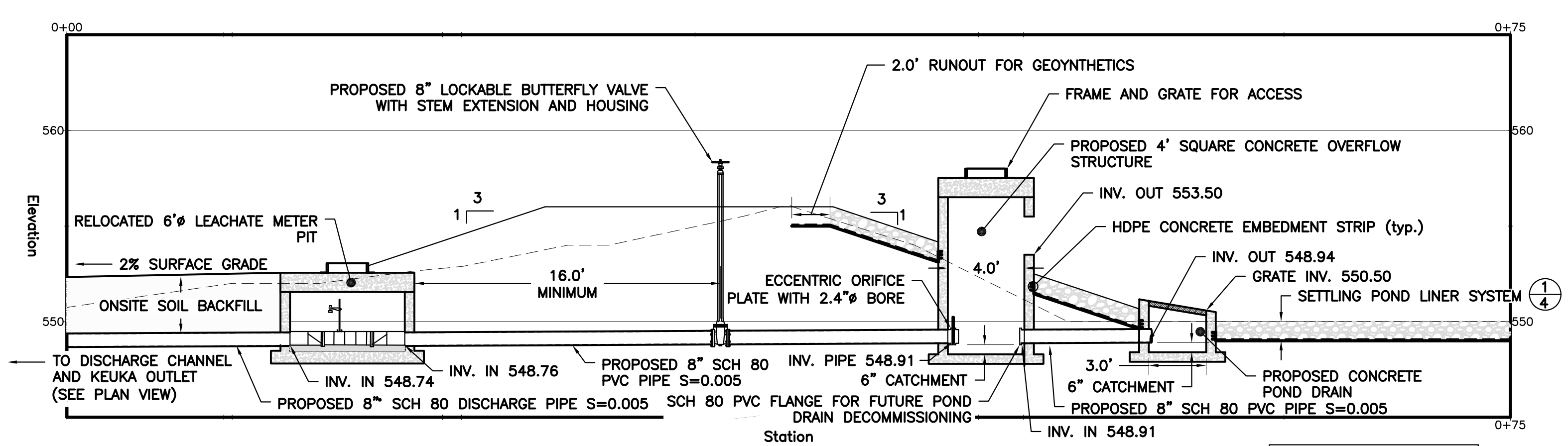
PLAN VIEW
SCALE: 1"=30'



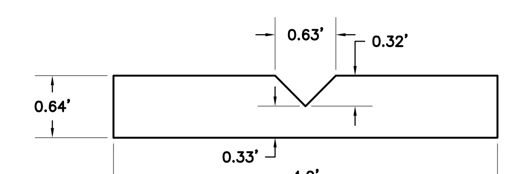
PROFILE H–H SETTLING POND INLET
SCALE: 1"=5'



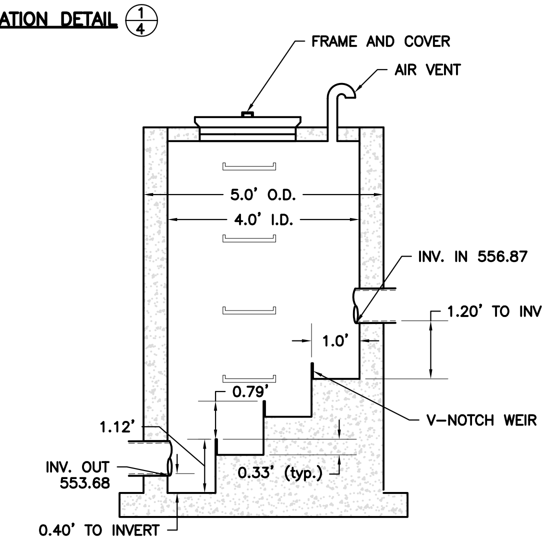
SETTLING POND LINER SLOPE/TERMINATION DETAIL 1/4
SCALE: 1"=5'



PROFILE I–I SETTLING POND OUTLET
SCALE: 1"=5'



V–NOTCH WEIR DETAIL 3/4
SCALE: 1"=2'



STEP AERATOR DETAIL 2/4
SCALE: 1"=2'

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NO.	REVISION	BY	DATE

PLOTTED HALF–SCALE

PRELIMINARY
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CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

JAMES A. DAIGLER, P.E.
NYSPE NO. 061689

DATE: December 2018

SCALE: NOTED

PREPARED FOR:	LOCKWOOD HILLS LLC		SETTLING POND			SHEET 4
DES. BY:	DRW. BY:	CHK. BY:	LEACHATE MANAGEMENT AND POND SEDIMENT REMOVAL PLAN			
DWG.	CD-4 SETTLING POND.dwg		TOWN OF TORREY	YATES COUNTY	STATE OF NEW YORK	

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ATTACHMENT 1

Leachate Generation Rate and Quantity Calculations

Lockwood Ash Disposal Site

Design (80th Percentile) Leachate Generation Rates

(with 24-yr, 24-hour Storm)

Conditions	GPAD	Method to determine flow rate
Landfilling	1,070	Historic measured 80th Percentile Flow x 1.3 factor of safety
Intermediate Cover	625	80th Percentile Flow rate from Leachate Monitoring and Analysis Report, Daigler Engineering, Jan 2018
Final Cover	7.6	Calculated migration through composite liner

PHASE 1a (current landfill, operating condition)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
~~Active Landfill Area~~	~~0.0~~	~~1,070~~	0
Intermediate Cover	29.8	625	18,625
~~Final Cover~~	~~0.0~~	~~7.6~~	0
TOTAL	**29.8**		**18,625**

PHASE 1b (active landfill of OADS overfill area; NO OPEN LINER)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
Active Landfill Area	13.5	1,070	14,445
Intermediate Cover	16.3	625	10,206
~~Final Cover~~	~~0.0~~	~~7.6~~	0
TOTAL	**29.8**		**24,651**

PHASE 1b (active landfill of OADS overfill area; with open liner)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
Open Liner	1.0	112,420	112,420
Active Landfill Area	12.5	1,070	13,375
Intermediate Cover	16.3	625	10,206
~~Final Cover~~	~~0.0~~	~~7.6~~	0
TOTAL	**29.8**		**136,001**

PHASE 2 (NO OPEN LINER)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
Active Landfill Area	13.3	1,070	14,231
Intermediate Cover	14.5	625	9,063
Final Cover	9.2	7.6	70
TOTAL	**37.0**		**23,363**

PHASE 2 (with open liner)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
Open Liner	1.0	112,420	112,420
Active Landfill Area	12.3	1,070	13,161
Intermediate Cover	14.5	625	9,063
Final Cover	9.2	7.6	70
TOTAL	**37.0**		**134,713**

BEFORE PHASE 3 - RELOCATE LMS TO BEGIN PREPARATION OF STAGE IV

25-year, 24-hr storm**	4.14	in/day
assume open liner area can be controlled to one arce using rain flaps	4.14	in-acre/day
Open Liner Generation =	112,420	gpad

****(source:https://hdsc.nws.noaa.gov/hdsc/pfds/ using Dresden, NY)**

* Intermediate cover is defined as minimum 6" thick layer of unclassified soil in the facility's O&M Manual

* Areas from Fill Progression Plans (See Attached)

Lockwood Ash Disposal Site

Design (80th Percentile) Leachate Generation Rates

(w/ 500-yr, 24-hr Storm)

Conditions	GPAD	Method to determine flow rate
Landfilling	1,070	Historic measured 80th Percentile Flow x 1.3 factor of safety
Intermediate Cover	625	80th Percentile Flow rate from Leachate Monitoring and Analysis Report, Daigler Engineering, Jan 2018
Final Cover	7.6	Calculated migration through composite liner

PHASE 1a (current landfill, operating condition)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
~~Active Landfill Area~~	~~0.0~~	~~1,070~~	0
Intermediate Cover	29.8	625	18,625
~~Final Cover~~	~~0.0~~	~~7.6~~	0
TOTAL	**29.8**		**18,625**

PHASE 1b (active landfill of OADS overfill area; NO OPEN LINER)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
Active Landfill Area	13.5	1,070	14,445
Intermediate Cover	16.3	625	10,206
~~Final Cover~~	~~0.0~~	~~7.6~~	0
TOTAL	**29.8**		**24,651**

PHASE 1b (active landfill of OADS overfill area; with open liner)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
Open Liner	1.0	185,733	185,733
Active Landfill Area	12.5	1,070	13,375
Intermediate Cover	16.3	625	10,206
~~Final Cover~~	~~0.0~~	~~7.6~~	0
TOTAL	**29.8**		**209,314**

PHASE 2 (NO OPEN LINER)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
Active Landfill Area	13.3	1,070	14,231
Intermediate Cover	14.5	625	9,063
Final Cover	9.2	7.6	70
TOTAL	**37.0**		**0**

PHASE 2 (with open liner)

Phase Condition	Size (acre)	Generation Rate (gpad)	Flow (gpd)
Open Liner	1.0	185,733	185,733
Active Landfill Area	12.3	1,070	13,161
Intermediate Cover	14.5	625	9,063
Final Cover	9.2	7.6	70
TOTAL	**37.0**		**208,026**

BEFORE PHASE 3 - RELOCATE LMS TO BEGIN PREPARATION OF STAGE IV

500-year, 24-hr storm**	6.84	in/day
assume open liner area can be controlled to one arce using rain flaps	6.84	in-acre/day
Open Liner Generation =	185,733	gpad

****(source:https://hdsc.nws.noaa.gov/hdsc/pfds/ using Dresden, NY)**

* Intermediate cover is defined as minimum 6" thick layer of unclassified soil in the facility's O&M Manual

* Areas from Fill Progression Plans (See Attached)

Lockwood Ash Disposal Site

Average Leachate Generation Rates

Conditions	GPAD	Method to determine flow rate
Landfilling	644	Average leachate flow rate before May 2011
Intermediate Cover	470	Average Flow rate from Leachate Monitoring and Analysis Report, Daigler Engineering, Jan 2018
Final Cover	7.6	Calculated migration through composite liner

PHASE 1a (current landfill, operating condition)				
	Phase Condition	**Size (acre)**	**Generation Rate (gpad)**	**Flow (gpd)**
	~~Active Landfill Area~~	~~0.0~~	~~644~~	0
	Intermediate Cover	29.8	470	14,006
	~~Final Cover~~	~~0.0~~	~~7.6~~	0
	TOTAL	**29.8**		**14,006**

PHASE 1b (active landfill of OADS overfill area; NO OPEN LINER)				
	Phase Condition	**Size (acre)**	**Generation Rate (gpad)**	**Flow (gpd)**
	Active Landfill Area	13.5	644	8,694
	Intermediate Cover	16.3	470	7,675
	~~Final Cover~~	~~0.0~~	~~7.6~~	0
	TOTAL	**29.8**		**16,369**

PHASE 1b (active landfill of OADS overfill area; with open liner)				
	Phase Condition	**Size (acre)**	**Generation Rate (gpad)**	**Flow (gpd)**
	Open Liner	1.0	112,420	112,420
	Active Landfill Area	12.5	644	8,050
	Intermediate Cover	16.3	470	7,675
	~~Final Cover~~	~~0.0~~	~~7.6~~	0
	TOTAL	**29.8**		**128,145**

PHASE 2 (NO OPEN LINER)				
	Phase Condition	**Size (acre)**	**Generation Rate (gpad)**	**Flow (gpd)**
	Active Landfill Area	13.3	644	8,565
	Intermediate Cover	14.5	470	6,815
	Final Cover	9.2	7.6	70
	TOTAL	**37.0**		**15,450**

PHASE 2 (with open liner)				
	Phase Condition	**Size (acre)**	**Generation Rate (gpad)**	**Flow (gpd)**
	Open Liner	1.0	112,420	112,420
	Active Landfill Area	12.3	644	7,921
	Intermediate Cover	14.5	470	6,815
	Final Cover	9.2	7.6	70
	TOTAL	**37.0**		**127,226**

BEFORE PHASE 3 - RELOCATE LMS TO BEGIN PREPARATION OF STAGE IV

25-year, 24-hr storm**	4.14	in/day
assume open liner area can be controlled to one arce using rain flaps	4.14	in-acre/day
Open Liner Generation =	112,420	gpad

****(source:https://hdsc.nws.noaa.gov/hdsc/pfds/ using Dresden, NY)**

* Intermediate cover is defined as minimum 6" thick layer of unclassified soil in the facility's O&M Manual

* Areas from Fill Progression Plans (See Attached)

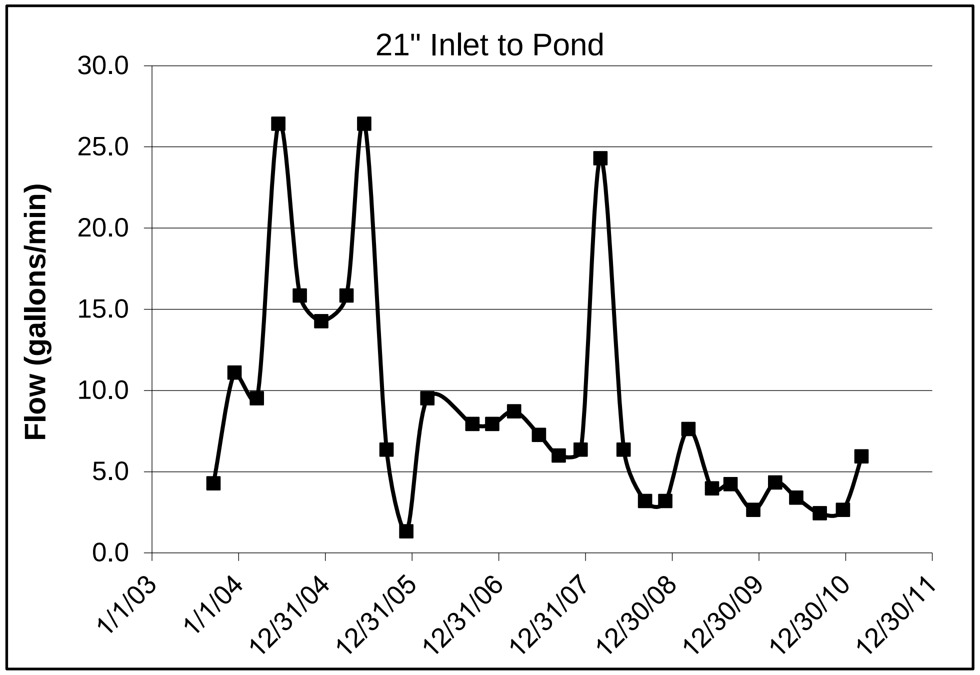
Active Landfill Leachate Generation Calculations

Flow, gallon/min

Date	21" Inlet to Pond
3/12/03	7.1
6/4/03	9.5
9/17/03	4.3
12/15/03	11.1
03/19/04	9.5
6/17/04	26.4
9/15/04	15.9
12/14/04	14.3
3/30/05	15.9
6/14/05	26.4
9/15/05	6.3
12/7/05	1.3
3/6/06	9.5
9/12/06	7.9
12/5/06	7.9
3/7/07	8.7
6/19/07	7.3
9/11/07	6.0
12/12/07	6.3
3/4/2008	24.3
6/10/08	6.3
9/8/2008	3.2
12/2/2008	3.2
3/9/2009	7.6
6/16/2009	4.0
9/3/2009	4.2
12/8/2009	2.6
3/10/2010	4.3
6/7/2010	3.4
9/14/2010	2.4
12/20/2010	2.6
3/8/2011	5.9

21" Inlet to Pond = Influent to the Sediment Basin from Stage I and II, including the Leak detection system and the Stage I overfill liner

Stage I Area (including overfill area)	10.704	Acres
Stage II Area	8.567	Acres
Total tributary area to 21" Inlet to Pond	19.271	Acres



Data Prior to May 2011 - 21" Inlet to Pond Only

Point	*Flow (GPM)*	*Rank*	*Percent*
6	26.4	1	96.70%
10	26.4	1	96.70%
21	24.3	3	93.50%
7	15.9	4	87.00%
9	15.9	4	87.00%
8	14.3	6	83.80%
4	11.1	7	80.60%
	11.00		**80.00%**
2	9.5	8	70.90%
5	9.5	8	70.90%
13	9.5	8	70.90%
17	8.7	11	67.70%
15	7.9	12	61.20%
16	7.9	12	61.20%
25	7.6	14	58.00%
18	7.3	15	54.80%
1	7.1	16	51.60%
11	6.3	17	41.90%
20	6.3	17	41.90%
22	6.3	17	41.90%
19	6.0	20	38.70%
33	5.9	21	35.40%
29	4.3	22	32.20%
3	4.3	23	29.00%
27	4.2	24	25.80%
26	4.0	25	22.50%
30	3.4	26	19.30%
23	3.2	27	12.90%
24	3.2	27	12.90%
28	2.6	29	6.40%
32	2.6	29	6.40%
31	2.4	31	3.20%
12	1.3	32	0.00%

Average Leachate Flow Rates Before Layup (May 2011):

Average	8.6
Gal/Day	12,410.8
GPAD	**644.0**

→ **~ 644 GPAD**

80th Percentile Leachate Flow Rate Before Layup (May 2011):

gpm	11.00	
Gal/day	15,840.0	
GPAD	822.0	
FS = 1.3	**1068.55**	→ **~ 1070 GPAD**

BY MKS DATE 5/2/18 | **DAIGLER ENGINEERING, P.C.** | JOB NO. 31-0816

CHKD. BY BAM DATE 5/2/18 | CIVIL & GEO-ENVIRONMENTAL ENGINEERING | SHEET NO. 1 OF 1

2620 Grand Island Blvd. – Grand Island, NY – 14072
Ph: (716) 773-6872 – Fax: (716) 773-6873

SUBJECT Lockwood - Leachate Generation Rates

FINAL COVER

Use Giroud, et al 1997 - Final Cover Infiltration Eqn.

$Q = C_{qo}\, n \left(1 + 0.1 (h/t_s)^{0.95}\right) a^{0.1}\, h^{0.9}\, K_s^{0.74}$

Q = Leakage rate through the Defect (m^3/s)

C_{qo} = Contact quality factor = 0.7 for fair contact

n = # of defects in geomembrane → Assume 4/Acre

h = Head on geomembrane = 18" = 0.4572 m

t_s = Thickness of soil below geomembrane = 6" = 0.152 m

a = Area of circular defect = $3.1416 \times 10^{-6}\ m^2$ for 2.0 mm dia.

K_s = Soil Permeability = 1×10^{-5} cm/s = 1×10^{-7} m/s

– Neglect GCL (conservative)

$$Q = (0.7)(4)\left[1 + 0.1\left(\frac{0.4572\,m}{0.152\,m}\right)^{0.95}\right](3.1416 \times 10^{-6}\,m^2)^{0.1}(0.4572\,m)^{0.9}(1 \times 10^{-7}\,m/s)^{0.74}$$

$Q = (0.28)(1.284675)(0.281653)(0.494420)(6.6 \times 10^{-6})$

$Q = 3.31 \times 10^{-7}\ m^3/s$ ${}_{-6}$ $1\ m^3 = 264.17$ gal

$= 8.74 \times 10^{-5}$ g/s → For 1 Acre

→ 8.74×10^{-5} g/s $\left(\frac{60\,s}{1\,m}\right)\left(\frac{60\,m}{1\,hr}\right)\left(\frac{24\,hr}{1\,d}\right)$ → For 1 Acre

= 7.55 g/d → For 1 Acre

→ Use 7.6 GPAD ✓

Intermediate Cover

From Leachate Monitoring and Analysis Report, Jan 2018

Avg Design = 470 GPAD, Peak Design = 625 GPAD

→ Use Peak Design = 625 GPAD for rate base design ✓

Active Landfill

From Historic Leachate generation rates prior to 5/2011 with a 1.3 factor of safety → Use 1070 GPAD ✓

BY KMR DATE 11/1

CHKD. BY BMM DATE 11/2/18

DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING

2620 Grand Island Blvd. – Grand Island, NY – 14072
Ph: (716) 773-6872 – Fax: (716) 773-6873

JOB NO. 31-1518

SHEET NO. 1 OF 1

SUBJECT Unit Storm Volume Calculations

- 25-year storm, 24-hr. storm:

$$4.14 \text{ in/day} \times 1 \text{ acre} = 4.14 \text{ in-acres/day}$$

$$\left(4.14 \frac{\text{in-acres}}{\text{day}}\right)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right)\left(\frac{43{,}560 \text{ ft}^2}{1 \text{ acre}}\right)\left(\frac{7.48 \text{ gal}}{\text{ft}^3}\right)$$

$$= 112{,}410.9 \text{ gpad} \checkmark$$

- 100-year storm, 24-hr. storm:

$$5.22 \text{ in/day} \times 1 \text{ acre} = 5.22 \text{ in-acres/day}$$

$$\left(5.22 \frac{\text{in-acres}}{\text{day}}\right)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right)\left(\frac{43{,}560 \text{ ft}^2}{1 \text{ acre}}\right)\left(\frac{7.48 \text{ gal}}{\text{ft}^3}\right)$$

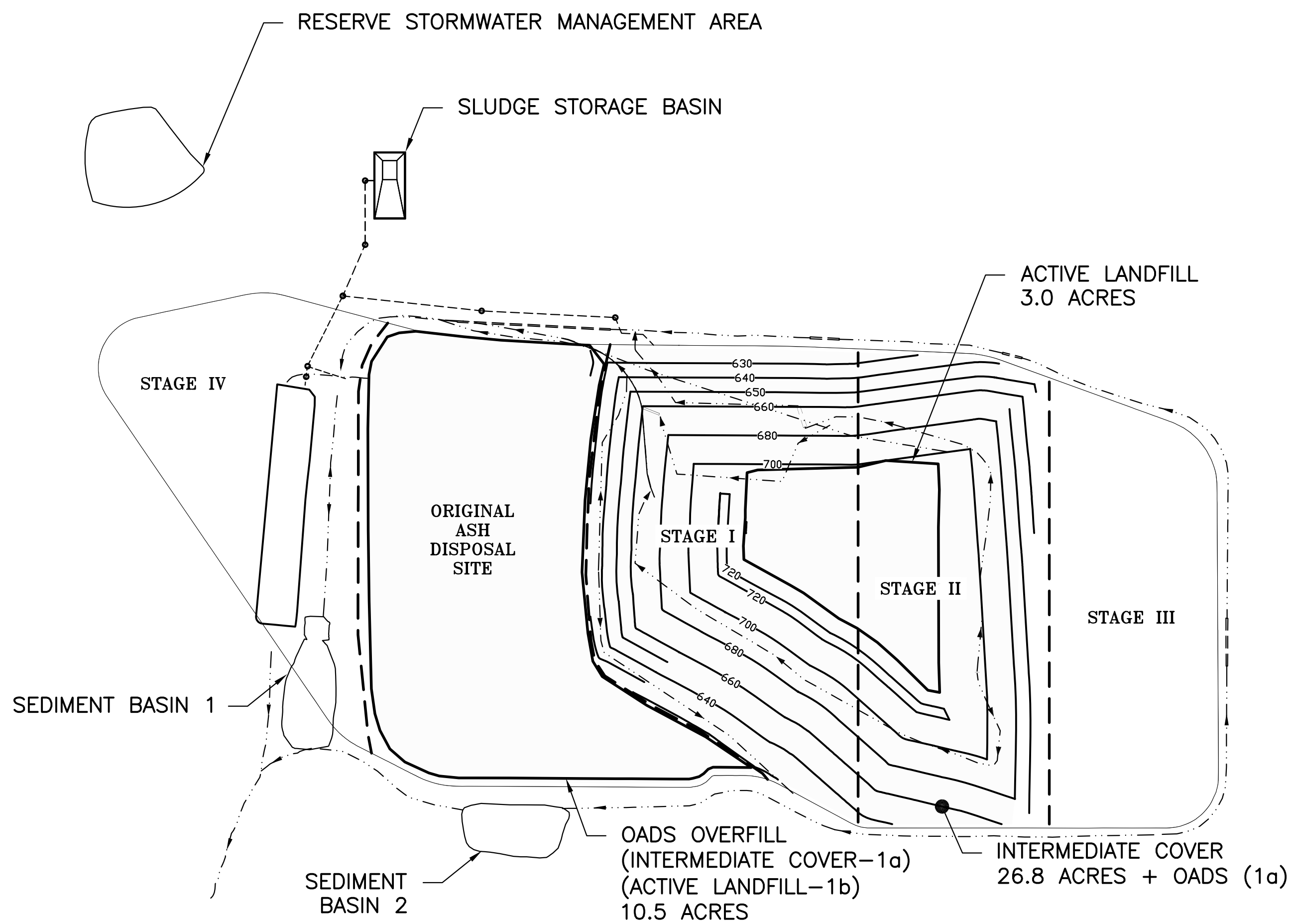
$$= 141{,}735.5 \text{ gpad} \checkmark$$

- 500-year storm, 24-hr. storm:

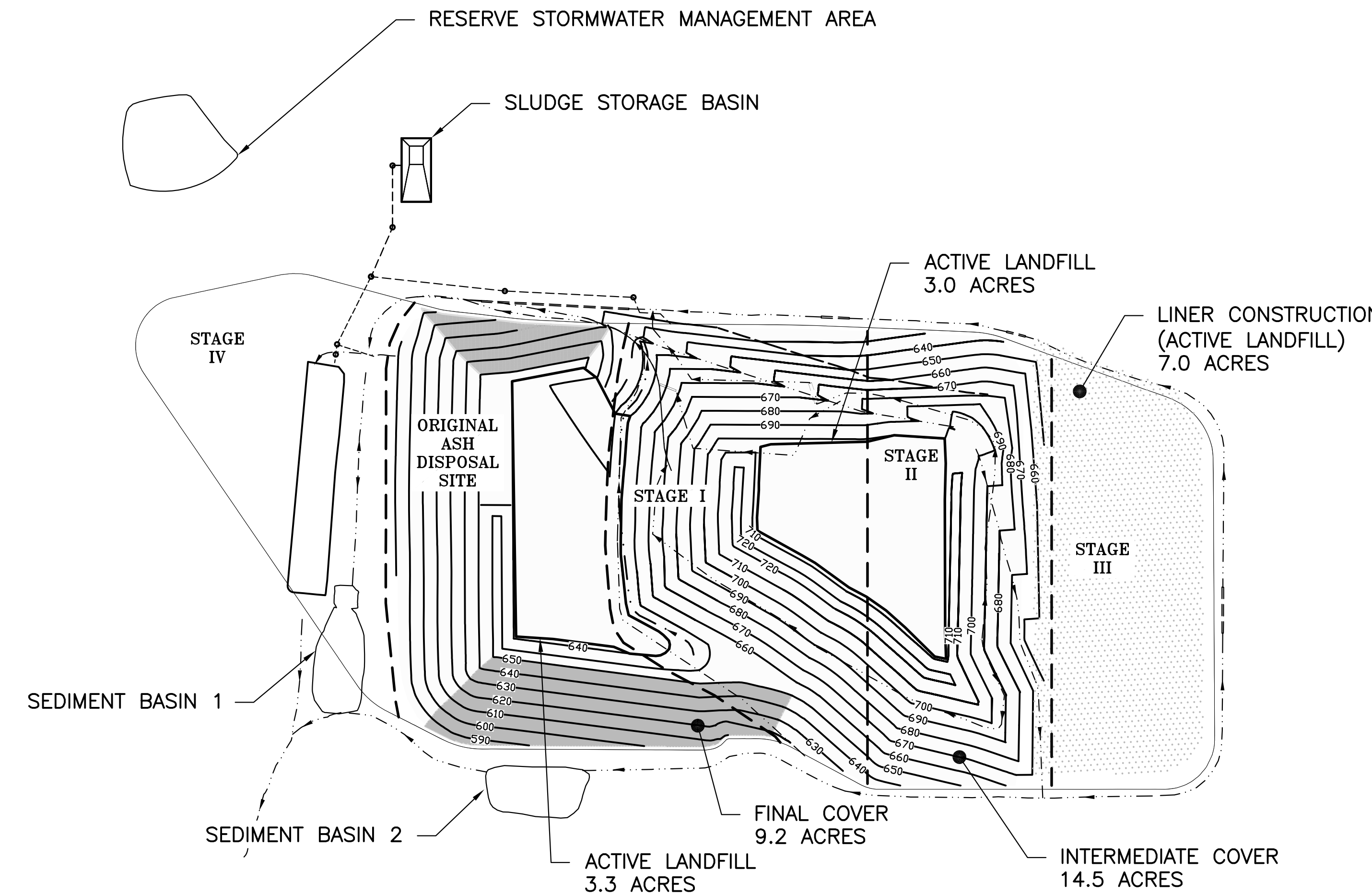
$$6.84 \text{ in/day} \times 1 \text{ acre} = 6.84 \text{ in-acres/day}$$

$$\left(6.84 \frac{\text{in-acres}}{\text{day}}\right)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right)\left(\frac{43{,}560 \text{ ft}^2}{1 \text{ acre}}\right)\left(\frac{7.48 \text{ gal}}{\text{ft}^3}\right)$$

$$= 185{,}722.4 \text{ gpad} \checkmark$$



PHASE 1 FILLING AND DRAINAGE PLAN



PHASE 2 FILLING AND DRAINAGE PLAN

PHASE 1a (CURRENT LANDFILL, AS OPERATING)

ACTIVE LANDFILL	= 3.0 ACRES
INTERMEDIATE COVER	= 26.8 ACRES
TOTAL	= 29.8 ACRES

PHASE 1b (ACTIVE LANDFILL OF OADS OVERFILL)

ACTIVE LANDFILL	= 13.5 ACRES
INTERMEDIATE COVER	= 16.3 ACRES
TOTAL	= 29.8 ACRES

FINAL COVER

LEACHATE TRANSFER PIPE AND MANHOLE

STORMWATER CHANNEL

PHASE 2

ACTIVE LANDFILL	= 13.3 ACRES
INTERMEDIATE COVER	= 14.5 ACRES
FINAL COVER	= 9.2 ACRES
TOTAL	= 37.0 ACRES

400' 0' 400' 800'

NO.	REVISION	BY	DATE

DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

JAMES A. DAIGLER, P.E.
NYSPE NO. 061689

DATE: December 2018

PRELIMINARY NOT FOR CONSTRUCTION

SCALE: 1"=400'

PREPARED FOR: LOCKWOOD HILLS LLC

DES. BY: DRW. BY: CHK. BY:

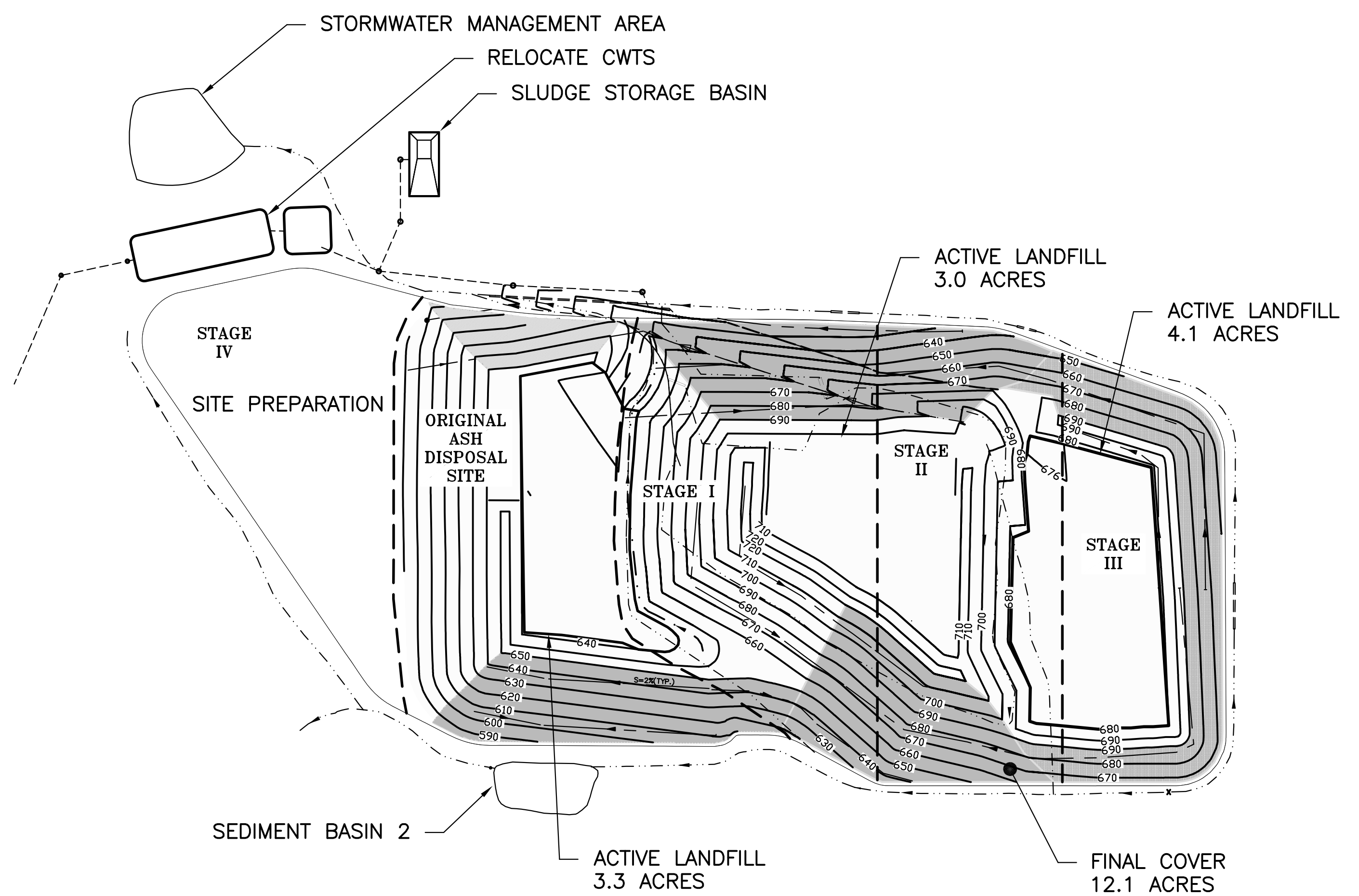
DWG: Phasing Plan 1–4.dwg

PHASE 1-2 FILL PROGRESSION PLAN

LOCKWOOD ASH DISPOSAL SITE

TOWN OF TORREY | YATES COUNTY | NEW YORK

SHEET 1



PHASE 3 FILLING AND DRAINAGE PLAN

PHASE 3

ACTIVE LANDFILL	=	10.4 ACRES
INTERMEDIATE COVER	=	14.5 ACRES
FINAL COVER	=	12.1 ACRES
TOTAL	=	37.0 ACRES

FINAL COVER

LEACHATE TRANSFER PIPE AND MANHOLE

STORMWATER CHANNEL

400' 0' 400' 800'

Q:\Lockwood Hills LLC\31-1317 Part 360 Permit Renewal App\acad\Phasing Plan 1-4.dwg 9/28/2018 9:54 AM

NO.	REVISION	BY	DATE

DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING
2620 GRAND ISLAND BLVD. GRAND ISLAND, NEW YORK 14072
(716) 773-6872 (716) 773-6873 FAX

JAMES A. DAIGLER, P.E.
NYSPE NO. 061689

DATE: September 2018

PRELIMINARY NOT FOR CONSTRUCTION

SCALE: 1"=400'

PREPARED FOR: LOCKWOOD HILLS LLC			PHASE 3 PROGRESSION PLAN LOCKWOOD ASH DISPOSAL SITE
DES. BY:	DRW. BY:	CHK. BY:	
DWG: Phasing Plan 1-4.dwg			TOWN OF TORREY / YATES COUNTY / NEW YORK

SHEET
2

ATTACHMENT 2

Temporary Leachate Storage and Transportation Design Calculations

Objective: Find the required volume of a storage tank

Assumptions:

- Use a 21,000-gallon, steel, epoxy coated tank (Baker corp).

Knowns:

- Leachate Generation Rate (From: Leachate Monitoring and Analysis Report, Daigler Engineering PC, January 2018)

Average	Q_{avg} =	14,000	gpd	=	583	gph	(current conditions)
Max Rate	Q_{max} =	34,200	gpd	=	1,425	gph	(current conditions)

Calculations:

- Required storage based on Weekly Leachate Generation vs Transportation at maximum leachate flow rates
  (see table and graph on Leachate Generation versus Transportation Pages)
  = 57,000 gallons

- Required number of storage Frac Tanks = Required Storage/21,000 gallons
  2.71 tanks

- Provided Number of tanks (Rounded to nearest whole number) = 3 tanks

- Provided storage = Number of tanks x 21,000 gallons per tank = 63,000 gallons

- Percent of tank volume used at peak storage = 63% under average flow rates
  90% under maximum flow rates

- Time for storage if there is an equipment failure or other transportation delay on Monday morning =
  (Provided storage - Required storage)/leachate generation rate = 39.57 hours under average flow rates
  4.21 hours under maximum flow rates

Solution:

- An appropriate level of storage volume (63,000 gallons) can be provided with 4 tanks given the assumed transportation schedule provided on Page 2 of this calculation.

Objective: Find the required number of trips for transportation of leachate

Assumptions:

- Size of the vacuum truck is 4,200 gallons (D.C. Rauscher Inc)
- Disposal is to Greenidge WWTP

Load	20	min	Assuming 4,000 working volume at approximately:	200	gpm
Travel to	10	min			
Unload	5	min			
Travel from	10	min			
Total	45	min/trip			
	0.75	hours/trip			

- Assume 75% operator work efficiency

  1.00 hours/trip

- Leachate Generation Rate (from page 1 of 2)

Average	14,000	gpd
Max	34,200	gpd

Calculations:

- Required number of trips per week = 7 days x Leachate Generation Rate/working volume of vacuum truck

Average	24.50	trips/week
Max	59.85	trips/week

- Round up to whole number of trips per week

Average	25	trips/week
Max	60	trips/week

- Required working hours for transportation of leachate = Total travel time x Number of whole trips

Average	25.00	working hours/week	- One truck is sufficient
Max	60.00	working hours/week	- Assume 1 truck with overtime

- Calculate the maximum number of trips for a single truck per 8 hour workday

  8.00 trips/day/employee

  8 trips/day/truck

Assumed Transportation Schedule

Day	Trips (Avg)	Trips (Max)
Monday	5	12
Tuesday	5	12
Wednesday	5	10
Thursday	5	10
Friday	5	8
Saturday	0	8
Sunday	0	0
Total	25	60

Example schedule for 12 trips

	Trip #	
Start Day	1	7:00 AM
	2	8:00 AM
	3	9:00 AM
	4	10:00 AM
	5	11:00 AM
Lunch Break		12:00 PM
	6	1:00 PM
	7	2:00 PM
	8	3:00 PM
	9	4:00 PM
	10	5:00 PM
	11	6:00 PM
	12	7:00 PM
Conclude		8:00 PM

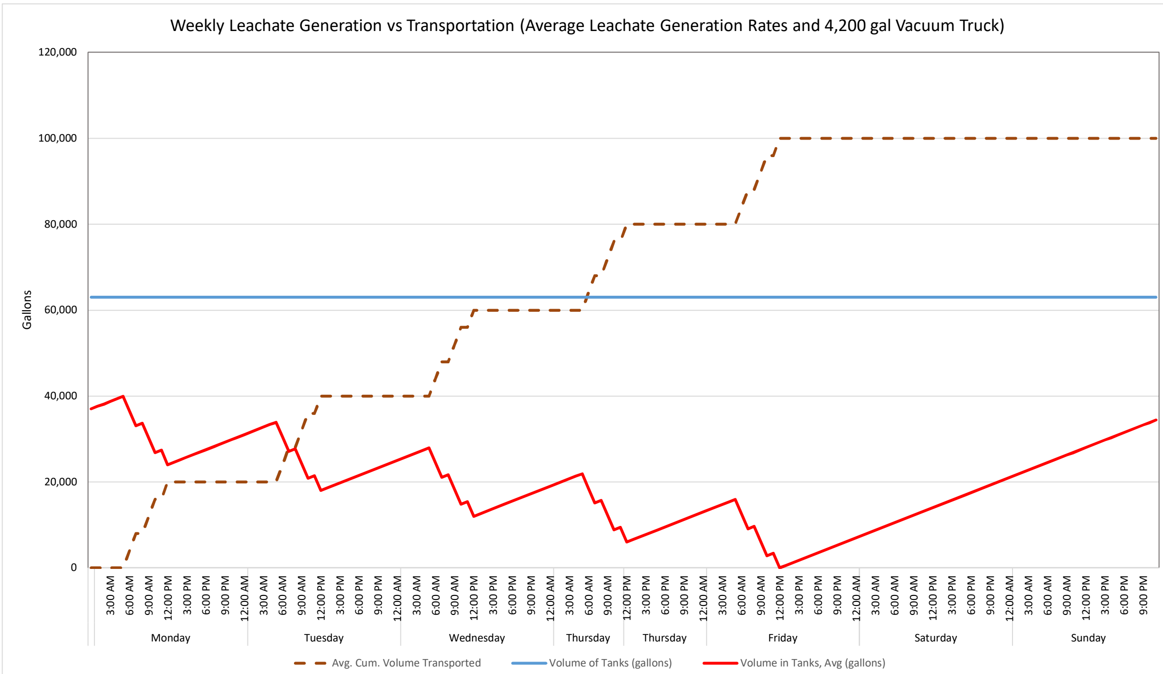
Lockwood Ash Disposal Site
Leachate Generation versus Transportation

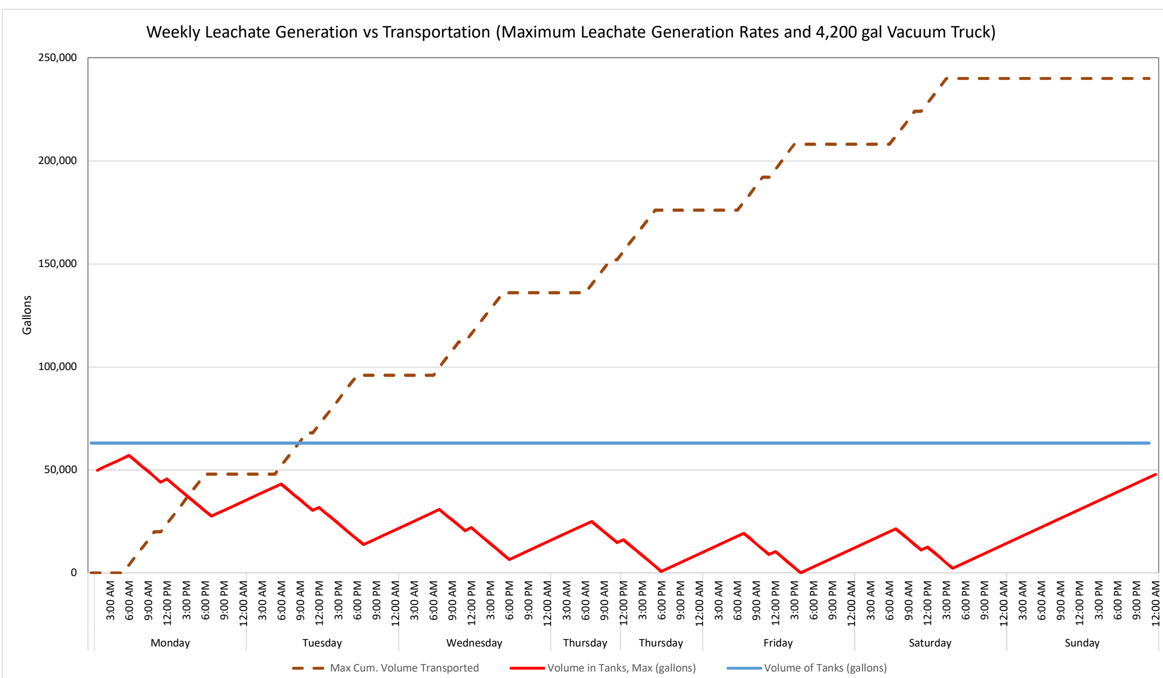
Day	Hour	Average Generation (gal)		Max Generation (gal)		Avg Transported (gal)		Max Transported (gal)		Volume in Tanks, Avg (gallons)	Volume in Tanks, Max (gallons)
		Hourly	Avg. Cumulative Leachate Generation	Hourly	Max Cumulative Leachate Generation	Hourly	Avg. Cum. Volume Transported	Hourly	Max Cum. Volume Transported		
Monday	1:00 AM	583	583	1,425	1,425	0	0	0	0	37,000	49,875
	2:00 AM	583	1,167	1,425	2,850	0	0	0	0	37,583	51,300
	3:00 AM	583	1,750	1,425	4,275	0	0	0	0	38,167	52,725
	4:00 AM	583	2,333	1,425	5,700	0	0	0	0	38,750	54,150
	5:00 AM	583	2,917	1,425	7,125	0	0	0	0	39,333	55,575
	6:00 AM	583	3,500	1,425	8,550	0	0	0	0	39,917	57,000
	7:00 AM	583	4,083	1,425	9,975	4,000	4,000	4,000	4,000	36,500	54,425
	8:00 AM	583	4,667	1,425	11,400	4,000	8,000	4,000	8,000	33,083	51,850
	9:00 AM	583	5,250	1,425	12,825	0	8,000	4,000	12,000	33,667	49,275
	10:00 AM	583	5,833	1,425	14,250	4,000	12,000	4,000	16,000	30,250	46,700
	11:00 AM	583	6,417	1,425	15,675	4,000	16,000	4,000	20,000	26,833	44,125
	12:00 PM	583	7,000	1,425	17,100	0	16,000	0	20,000	27,417	45,550
	1:00 PM	583	7,583	1,425	18,525	4,000	20,000	4,000	24,000	24,000	42,975
	2:00 PM	583	8,167	1,425	19,950	0	20,000	4,000	28,000	24,583	40,400
	3:00 PM	583	8,750	1,425	21,375	0	20,000	4,000	32,000	25,167	37,825
	4:00 PM	583	9,333	1,425	22,800	0	20,000	4,000	36,000	25,750	35,250
	5:00 PM	583	9,917	1,425	24,225	0	20,000	4,000	40,000	26,333	32,675
	6:00 PM	583	10,500	1,425	25,650	0	20,000	4,000	44,000	26,917	30,100
	7:00 PM	583	11,083	1,425	27,075	0	20,000	4,000	48,000	27,500	27,525
	8:00 PM	583	11,667	1,425	28,500	0	20,000	0	48,000	28,083	28,950
	9:00 PM	583	12,250	1,425	29,925	0	20,000	0	48,000	28,667	30,375
	10:00 PM	583	12,833	1,425	31,350	0	20,000	0	48,000	29,250	31,800
	11:00 PM	583	13,417	1,425	32,775	0	20,000	0	48,000	29,833	33,225
	12:00 AM	583	14,000	1,425	34,200	0	20,000	0	48,000	30,417	34,650
Tuesday	1:00 AM	583	14,583	1,425	35,625	0	20,000	0	48,000	31,000	36,075
	2:00 AM	583	15,167	1,425	37,050	0	20,000	0	48,000	31,583	37,500
	3:00 AM	583	15,750	1,425	38,475	0	20,000	0	48,000	32,167	38,925
	4:00 AM	583	16,333	1,425	39,900	0	20,000	0	48,000	32,750	40,350
	5:00 AM	583	16,917	1,425	41,325	0	20,000	0	48,000	33,333	41,775
	6:00 AM	583	17,500	1,425	42,750	0	20,000	0	48,000	33,917	43,200
	7:00 AM	583	18,083	1,425	44,175	4,000	24,000	4,000	52,000	30,500	40,625
	8:00 AM	583	18,667	1,425	45,600	4,000	28,000	4,000	56,000	27,083	38,050
	9:00 AM	583	19,250	1,425	47,025	0	28,000	4,000	60,000	27,667	35,475
	10:00 AM	583	19,833	1,425	48,450	4,000	32,000	4,000	64,000	24,250	32,900
	11:00 AM	583	20,417	1,425	49,875	4,000	36,000	4,000	68,000	20,833	30,325
	12:00 PM	583	21,000	1,425	51,300	0	36,000	0	68,000	21,417	31,750
	1:00 PM	583	21,583	1,425	52,725	4,000	40,000	4,000	72,000	18,000	29,175
	2:00 PM	583	22,167	1,425	54,150	0	40,000	4,000	76,000	18,583	26,600
	3:00 PM	583	22,750	1,425	55,575	0	40,000	4,000	80,000	19,167	24,025
	4:00 PM	583	23,333	1,425	57,000	0	40,000	4,000	84,000	19,750	21,450
	5:00 PM	583	23,917	1,425	58,425	0	40,000	4,000	88,000	20,333	18,875
	6:00 PM	583	24,500	1,425	59,850	0	40,000	4,000	92,000	20,917	16,300
	7:00 PM	583	25,083	1,425	61,275	0	40,000	4,000	96,000	21,500	13,725
	8:00 PM	583	25,667	1,425	62,700	0	40,000	0	96,000	22,083	15,150
	9:00 PM	583	26,250	1,425	64,125	0	40,000	0	96,000	22,667	16,575
	10:00 PM	583	26,833	1,425	65,550	0	40,000	0	96,000	23,250	18,000
	11:00 PM	583	27,417	1,425	66,975	0	40,000	0	96,000	23,833	19,425
	12:00 AM	583	28,000	1,425	68,400	0	40,000	0	96,000	24,417	20,850
Wednesday	1:00 AM	583	28,583	1,425	69,825	0	40,000	0	96,000	25,000	22,275
	2:00 AM	583	29,167	1,425	71,250	0	40,000	0	96,000	25,583	23,700
	3:00 AM	583	29,750	1,425	72,675	0	40,000	0	96,000	26,167	25,125
	4:00 AM	583	30,333	1,425	74,100	0	40,000	0	96,000	26,750	26,550
	5:00 AM	583	30,917	1,425	75,525	0	40,000	0	96,000	27,333	27,975
	6:00 AM	583	31,500	1,425	76,950	0	40,000	0	96,000	27,917	29,400
	7:00 AM	583	32,083	1,425	78,375	4,000	44,000	0	96,000	24,500	30,825
	8:00 AM	583	32,667	1,425	79,800	4,000	48,000	4,000	100,000	21,083	28,250
	9:00 AM	583	33,250	1,425	81,225	0	48,000	4,000	104,000	21,667	25,675
	10:00 AM	583	33,833	1,425	82,650	4,000	52,000	4,000	108,000	18,250	23,100
	11:00 AM	583	34,417	1,425	84,075	4,000	56,000	4,000	112,000	14,833	20,525
	12:00 PM	583	35,000	1,425	85,500	0	56,000	0	112,000	15,417	21,950
	1:00 PM	583	35,583	1,425	86,925	4,000	60,000	4,000	116,000	12,000	19,375
	2:00 PM	583	36,167	1,425	88,350	0	60,000	4,000	120,000	12,583	16,800
	3:00 PM	583	36,750	1,425	89,775	0	60,000	4,000	124,000	13,167	14,225
	4:00 PM	583	37,333	1,425	91,200	0	60,000	4,000	128,000	13,750	11,650
	5:00 PM	583	37,917	1,425	92,625	0	60,000	4,000	132,000	14,333	9,075
	6:00 PM	583	38,500	1,425	94,050	0	60,000	4,000	136,000	14,917	6,500
	7:00 PM	583	39,083	1,425	95,475	0	60,000	0	136,000	15,500	7,925
	8:00 PM	583	39,667	1,425	96,900	0	60,000	0	136,000	16,083	9,350
	9:00 PM	583	40,250	1,425	98,325	0	60,000	0	136,000	16,667	10,775
	10:00 PM	583	40,833	1,425	99,750	0	60,000	0	136,000	17,250	12,200
	11:00 PM	583	41,417	1,425	101,175	0	60,000	0	136,000	17,833	13,625
	12:00 AM	583	42,000	1,425	102,600	0	60,000	0	136,000	18,417	15,050
Thursday	1:00 AM	583	42,583	1,425	104,025	0	60,000	0	136,000	19,000	16,475
	2:00 AM	583	43,167	1,425	105,450	0	60,000	0	136,000	19,583	17,900
	3:00 AM	583	43,750	1,425	106,875	0	60,000	0	136,000	20,167	19,325
	4:00 AM	583	44,333	1,425	108,300	0	60,000	0	136,000	20,750	20,750
	5:00 AM	583	44,917	1,425	109,725	0	60,000	0	136,000	21,333	22,175
	6:00 AM	583	45,500	1,425	111,150	0	60,000	0	136,000	21,917	23,600
	7:00 AM	583	46,083	1,425	112,575	4,000	64,000	0	136,000	18,500	25,025
	8:00 AM	583	46,667	1,425	114,000	4,000	68,000	4,000	140,000	15,083	22,450
	9:00 AM	583	47,250	1,425	115,425	0	68,000	4,000	144,000	15,667	19,875
	10:00 AM	583	47,833	1,425	116,850	4,000	72,000	4,000	148,000	12,250	17,300
	11:00 AM	583	48,417	1,425	118,275	4,000	76,000	4,000	152,000	8,833	14,725

Lockwood Ash Disposal Site
Leachate Generation versus Transportation

Day	Hour	Average Generation (gal)		Max Generation (gal)		Avg Transported (gal)		Max Transported (gal)		Volume in Tanks, Avg (gallons)	Volume in Tanks, Max (gallons)
		Hourly	Avg. Cumulative Leachate Generation	Hourly	Max Cumulative Leachate Generation	Hourly	Avg. Cum. Volume Transported	Hourly	Max Cum. Volume Transported		
	12:00 PM	583	49,000	1,425	119,700	0	76,000	0	152,000	9,417	16,150
	1:00 PM	583	49,583	1,425	121,125	4,000	80,000	4,000	156,000	6,000	13,575
	2:00 PM	583	50,167	1,425	122,550	0	80,000	4,000	160,000	6,583	11,000
	3:00 PM	583	50,750	1,425	123,975	0	80,000	4,000	164,000	7,167	8,425
	4:00 PM	583	51,333	1,425	125,400	0	80,000	4,000	168,000	7,750	5,850
	5:00 PM	583	51,917	1,425	126,825	0	80,000	4,000	172,000	8,333	3,275
Thursday	6:00 PM	583	52,500	1,425	128,250	0	80,000	4,000	176,000	8,917	700
	7:00 PM	583	53,083	1,425	129,675	0	80,000	0	176,000	9,500	2,125
	8:00 PM	583	53,667	1,425	131,100	0	80,000	0	176,000	10,083	3,550
	9:00 PM	583	54,250	1,425	132,525	0	80,000	0	176,000	10,667	4,975
	10:00 PM	583	54,833	1,425	133,950	0	80,000	0	176,000	11,250	6,400
	11:00 PM	583	55,417	1,425	135,375	0	80,000	0	176,000	11,833	7,825
	12:00 AM	583	56,000	1,425	136,800	0	80,000	0	176,000	12,417	9,250
	1:00 AM	583	56,583	1,425	138,225	0	80,000	0	176,000	13,000	10,675
	2:00 AM	583	57,167	1,425	139,650	0	80,000	0	176,000	13,583	12,100
	3:00 AM	583	57,750	1,425	141,075	0	80,000	0	176,000	14,167	13,525
	4:00 AM	583	58,333	1,425	142,500	0	80,000	0	176,000	14,750	14,950
	5:00 AM	583	58,917	1,425	143,925	0	80,000	0	176,000	15,333	16,375
	6:00 AM	583	59,500	1,425	145,350	0	80,000	0	176,000	15,917	17,800
	7:00 AM	583	60,083	1,425	146,775	4,000	84,000	0	176,000	12,500	19,225
	8:00 AM	583	60,667	1,425	148,200	4,000	88,000	4,000	180,000	9,083	16,650
	9:00 AM	583	61,250	1,425	149,625	0	88,000	4,000	184,000	9,667	14,075
	10:00 AM	583	61,833	1,425	151,050	4,000	92,000	4,000	188,000	6,250	11,500
	11:00 AM	583	62,417	1,425	152,475	4,000	96,000	4,000	192,000	2,833	8,925
Friday	12:00 PM	583	63,000	1,425	153,900	0	96,000	0	192,000	3,417	10,350
	1:00 PM	583	63,583	1,425	155,325	4,000	100,000	4,000	196,000	0	7,775
	2:00 PM	583	64,167	1,425	156,750	0	100,000	4,000	200,000	583	5,200
	3:00 PM	583	64,750	1,425	158,175	0	100,000	4,000	204,000	1,167	2,625
	4:00 PM	583	65,333	1,425	159,600	0	100,000	4,000	208,000	1,750	50
	5:00 PM	583	65,917	1,425	161,025	0	100,000	0	208,000	2,333	1,475
	6:00 PM	583	66,500	1,425	162,450	0	100,000	0	208,000	2,917	2,900
	7:00 PM	583	67,083	1,425	163,875	0	100,000	0	208,000	3,500	4,325
	8:00 PM	583	67,667	1,425	165,300	0	100,000	0	208,000	4,083	5,750
	9:00 PM	583	68,250	1,425	166,725	0	100,000	0	208,000	4,667	7,175
	10:00 PM	583	68,833	1,425	168,150	0	100,000	0	208,000	5,250	8,600
	11:00 PM	583	69,417	1,425	169,575	0	100,000	0	208,000	5,833	10,025
	12:00 AM	583	70,000	1,425	171,000	0	100,000	0	208,000	6,417	11,450
	1:00 AM	583	70,583	1,425	172,425	0	100,000	0	208,000	7,000	12,875
	2:00 AM	583	71,167	1,425	173,850	0	100,000	0	208,000	7,583	14,300
	3:00 AM	583	71,750	1,425	175,275	0	100,000	0	208,000	8,167	15,725
	4:00 AM	583	72,333	1,425	176,700	0	100,000	0	208,000	8,750	17,150
	5:00 AM	583	72,917	1,425	178,125	0	100,000	0	208,000	9,333	18,575
	6:00 AM	583	73,500	1,425	179,550	0	100,000	0	208,000	9,917	20,000
	7:00 AM	583	74,083	1,425	180,975	0	100,000	0	208,000	10,500	21,425
	8:00 AM	583	74,667	1,425	182,400	0	100,000	4,000	212,000	11,083	18,850
	9:00 AM	583	75,250	1,425	183,825	0	100,000	4,000	216,000	11,667	16,275
	10:00 AM	583	75,833	1,425	185,250	0	100,000	4,000	220,000	12,250	13,700
	11:00 AM	583	76,417	1,425	186,675	0	100,000	4,000	224,000	12,833	11,125
Saturday	12:00 PM	583	77,000	1,425	188,100	0	100,000	0	224,000	13,417	12,550
	1:00 PM	583	77,583	1,425	189,525	0	100,000	4,000	228,000	14,000	9,975
	2:00 PM	583	78,167	1,425	190,950	0	100,000	4,000	232,000	14,583	7,400
	3:00 PM	583	78,750	1,425	192,375	0	100,000	4,000	236,000	15,167	4,825
	4:00 PM	583	79,333	1,425	193,800	0	100,000	4,000	240,000	15,750	2,250
	5:00 PM	583	79,917	1,425	195,225	0	100,000	0	240,000	16,333	3,675
	6:00 PM	583	80,500	1,425	196,650	0	100,000	0	240,000	16,917	5,100
	7:00 PM	583	81,083	1,425	198,075	0	100,000	0	240,000	17,500	6,525
	8:00 PM	583	81,667	1,425	199,500	0	100,000	0	240,000	18,083	7,950
	9:00 PM	583	82,250	1,425	200,925	0	100,000	0	240,000	18,667	9,375
	10:00 PM	583	82,833	1,425	202,350	0	100,000	0	240,000	19,250	10,800
	11:00 PM	583	83,417	1,425	203,775	0	100,000	0	240,000	19,833	12,225
	12:00 AM	583	84,000	1,425	205,200	0	100,000	0	240,000	20,417	13,650
	1:00 AM	583	84,583	1,425	206,625	0	100,000	0	240,000	21,000	15,075
	2:00 AM	583	85,167	1,425	208,050	0	100,000	0	240,000	21,583	16,500
	3:00 AM	583	85,750	1,425	209,475	0	100,000	0	240,000	22,167	17,925
	4:00 AM	583	86,333	1,425	210,900	0	100,000	0	240,000	22,750	19,350
	5:00 AM	583	86,917	1,425	212,325	0	100,000	0	240,000	23,333	20,775
	6:00 AM	583	87,500	1,425	213,750	0	100,000	0	240,000	23,917	22,200
	7:00 AM	583	88,083	1,425	215,175	0	100,000	0	240,000	24,500	23,625
	8:00 AM	583	88,667	1,425	216,600	0	100,000	0	240,000	25,083	25,050
	9:00 AM	583	89,250	1,425	218,025	0	100,000	0	240,000	25,667	26,475
	10:00 AM	583	89,833	1,425	219,450	0	100,000	0	240,000	26,250	27,900
	11:00 AM	583	90,417	1,425	220,875	0	100,000	0	240,000	26,833	29,325
Sunday	12:00 PM	583	91,000	1,425	222,300	0	100,000	0	240,000	27,417	30,750
	1:00 PM	583	91,583	1,425	223,725	0	100,000	0	240,000	28,000	32,175
	2:00 PM	583	92,167	1,425	225,150	0	100,000	0	240,000	28,583	33,600
	3:00 PM	583	92,750	1,425	226,575	0	100,000	0	240,000	29,167	35,025
	4:00 PM	583	93,333	1,425	228,000	0	100,000	0	240,000	29,750	36,450
	5:00 PM	583	93,917	1,425	229,425	0	100,000	0	240,000	30,333	37,875
	6:00 PM	583	94,500	1,425	230,850	0	100,000	0	240,000	30,917	39,300
	7:00 PM	583	95,083	1,425	232,275	0	100,000	0	240,000	31,500	40,725
	8:00 PM	583	95,667	1,425	233,700	0	100,000	0	240,000	32,083	42,150
	9:00 PM	583	96,250	1,425	235,125	0	100,000	0	240,000	32,667	43,575
	10:00 PM	583	96,833	1,425	236,550	0	100,000	0	240,000	33,250	45,000
	11:00 PM	583	97,417	1,425	237,975	0	100,000	0	240,000	33,833	46,425
	12:00 AM	583	98,000	1,425	239,400	0	100,000	0	240,000	34,417	47,850

Lockwood Ash Disposal Site
Leachate Generation versus Transportation





ATTACHMENT 3

Leachate Pond Sediment Sampling Laboratory Reports

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Buffalo
10 Hazelwood Drive
Amherst, NY 14228-2298
Tel: (716)691-2600

TestAmerica Job ID: 480-91981-1
Client Project/Site: Leachate Pond Analysis - Sediment

For:
Daigler Engineering , PC
2620 Grand Island Blvd
Grand Island, New York 14072

Attn: Mr. Timothy Hooper

Authorized for release by:
12/16/2015 10:30:04 AM
Anne Pridgeon, Project Management Assistant I
anne.pridgeon@testamericainc.com

Designee for

Ryan VanDette, Project Manager II
(716)504-9830
ryan.vandette@testamericainc.com

The test results in this report meet all 2003 NELAC and 2009 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Qualifiers

Metals

Qualifier	Qualifier Description
B	Compound was found in the blank and sample.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Case Narrative

Job ID: 480-91981-1

Laboratory: TestAmerica Buffalo

Narrative

Job Narrative
480-91981-1

Comments
No additional comments.

Receipt
The sample was received on 12/2/2015 4:00 PM; the sample arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 4.6º C.

Metals
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Organic Prep
Method(s) 1311: Due to the matrix and associated reaction to the extraction fluid, the laboratory was unable to perform the leaching procedure with the required 100g for the following sample: SED SAMPLE 1 (480-91981-1). The volume of leaching fluid was adjusted proportionally to maintain a 20:1 ratio of leaching fluid to weight of sample. Reporting limits (RLs) are not affected.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client Sample ID: SED SAMPLE 1 — Lab Sample ID: 480-91981-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	72.2		3.9	0.37	mg/Kg	1	☼	6010C	Total/NA
Calcium	60300	B	97.8	6.5	mg/Kg	1	☼	6010C	Total/NA
Iron	18900		19.6	6.8	mg/Kg	1	☼	6010C	Total/NA
Manganese	437	B	0.39	0.063	mg/Kg	1	☼	6010C	Total/NA
Sodium	691		274	25.4	mg/Kg	1	☼	6010C	Total/NA
Arsenic	0.16		0.015	0.0056	mg/L	1		6010C	TCLP
Barium	0.38	J	1.0	0.10	mg/L	1		6010C	TCLP
Chromium	0.015	J	0.020	0.010	mg/L	1		6010C	TCLP
Lead	0.021		0.020	0.0030	mg/L	1		6010C	TCLP
Sulfate	3050		492	246	mg/Kg	5		D516-90, 02	ASTM Leach

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client Sample ID: SED SAMPLE 1

Lab Sample ID: 480-91981-1

Date Collected: 12/02/15 12:00

Matrix: Solid

Date Received: 12/02/15 16:00

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	**0.16**		0.015	0.0056	mg/L		12/04/15 10:20	12/07/15 13:41	1
Barium	**0.38**	**J**	1.0	0.10	mg/L		12/04/15 10:20	12/07/15 13:41	1
Cadmium	ND		0.0020	0.00050	mg/L		12/04/15 10:20	12/07/15 13:41	1
Chromium	**0.015**	**J**	0.020	0.010	mg/L		12/04/15 10:20	12/07/15 13:41	1
Lead	**0.021**		0.020	0.0030	mg/L		12/04/15 10:20	12/07/15 13:41	1
Selenium	ND		0.025	0.0087	mg/L		12/04/15 10:20	12/07/15 13:41	1
Silver	ND		0.0060	0.0017	mg/L		12/04/15 10:20	12/07/15 13:41	1

Method: 7470A - TCLP Mercury - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00020	0.00012	mg/L		12/04/15 10:45	12/04/15 15:04	1

General Chemistry - ASTM Leach

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**3050**		492	246	mg/Kg			12/11/15 14:46	5

Client Sample ID: SED SAMPLE 1

Lab Sample ID: 480-91981-1

Date Collected: 12/02/15 12:00

Matrix: Solid

Date Received: 12/02/15 16:00

Percent Solids: 53.8

Method: 6010C - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	**72.2**		3.9	0.37	mg/Kg	☼	12/03/15 17:50	12/04/15 12:50	1
Calcium	**60300**	**B**	97.8	6.5	mg/Kg	☼	12/03/15 17:50	12/04/15 12:50	1
Iron	**18900**		19.6	6.8	mg/Kg	☼	12/03/15 17:50	12/04/15 12:50	1
Manganese	**437**	**B**	0.39	0.063	mg/Kg	☼	12/03/15 17:50	12/04/15 12:50	1
Sodium	**691**		274	25.4	mg/Kg	☼	12/03/15 17:50	12/04/15 12:50	1

1 2 3 4 5 6 7 8 9 10 11 12 13 14

QC Sample Results

Client: Daigler Engineering , PC
Project/Site: Leachate Pond Analysis - Sediment

TestAmerica Job ID: 480-91981-1

Method: 6010C - Metals (ICP)

Lab Sample ID: MB 480-278013/1-A
Matrix: Solid
Analysis Batch: 278313

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 278013

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	ND		2.1	0.20	mg/Kg		12/03/15 17:50	12/04/15 12:38	1
Calcium	4.45	J	53.0	3.5	mg/Kg		12/03/15 17:50	12/04/15 12:38	1
Iron	ND		10.6	3.7	mg/Kg		12/03/15 17:50	12/04/15 12:38	1
Manganese	0.0381	J	0.21	0.034	mg/Kg		12/03/15 17:50	12/04/15 12:38	1
Sodium	ND		148	13.8	mg/Kg		12/03/15 17:50	12/04/15 12:38	1

Lab Sample ID: LCSSRM 480-278013/2-A
Matrix: Solid
Analysis Batch: 278313

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 278013

Analyte	Spike Added	LCSSRM Result	LCSSRM Qualifier	Unit	D	%Rec	%Rec. Limits
Boron	137	122.4		mg/Kg		89.3	59.9 - 141.6
Calcium	6610	5743		mg/Kg		86.9	74.1 - 125.9
Iron	14400	13020		mg/Kg		90.4	35.6 - 163.9
Manganese	410	353.4		mg/Kg		86.2	76.3 - 123.9
Sodium	2480	2259		mg/Kg		91.1	65.3 - 134.3

Lab Sample ID: MB 480-278146/2-A
Matrix: Solid
Analysis Batch: 278615

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 278146

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.015	0.0056	mg/L		12/04/15 10:20	12/07/15 13:29	1
Barium	ND		1.0	0.10	mg/L		12/04/15 10:20	12/07/15 13:29	1
Cadmium	ND		0.0020	0.00050	mg/L		12/04/15 10:20	12/07/15 13:29	1
Chromium	ND		0.020	0.010	mg/L		12/04/15 10:20	12/07/15 13:29	1
Lead	ND		0.020	0.0030	mg/L		12/04/15 10:20	12/07/15 13:29	1
Selenium	ND		0.025	0.0087	mg/L		12/04/15 10:20	12/07/15 13:29	1
Silver	ND		0.0060	0.0017	mg/L		12/04/15 10:20	12/07/15 13:29	1

Lab Sample ID: LCS 480-278146/3-A
Matrix: Solid
Analysis Batch: 278615

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 278146

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	1.00	0.980		mg/L		98	80 - 120
Barium	1.00	1.02		mg/L		102	80 - 120
Cadmium	1.00	0.966		mg/L		97	80 - 120
Chromium	1.00	1.01		mg/L		101	80 - 120
Lead	1.00	0.945		mg/L		94	80 - 120
Selenium	1.00	1.04		mg/L		104	80 - 120
Silver	1.00	0.974		mg/L		97	80 - 120

Client: Daigler Engineering , PC
Project/Site: Leachate Pond Analysis - Sediment

TestAmerica Job ID: 480-91981-1

Method: 6010C - Metals (ICP) (Continued)

Lab Sample ID: LB2 480-277999/1-B
Matrix: Solid
Analysis Batch: 278615

Client Sample ID: Method Blank
Prep Type: TCLP
Prep Batch: 278146

Analyte	LB2 Result	LB2 Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.015	0.0056	mg/L		12/04/15 10:20	12/07/15 13:22	1
Barium	ND		1.0	0.10	mg/L		12/04/15 10:20	12/07/15 13:22	1
Cadmium	ND		0.0020	0.00050	mg/L		12/04/15 10:20	12/07/15 13:22	1
Chromium	ND		0.020	0.010	mg/L		12/04/15 10:20	12/07/15 13:22	1
Lead	ND		0.020	0.0030	mg/L		12/04/15 10:20	12/07/15 13:22	1
Selenium	ND		0.025	0.0087	mg/L		12/04/15 10:20	12/07/15 13:22	1
Silver	ND		0.0060	0.0017	mg/L		12/04/15 10:20	12/07/15 13:22	1

Lab Sample ID: 480-91981-1 MS
Matrix: Solid
Analysis Batch: 278615

Client Sample ID: SED SAMPLE 1
Prep Type: TCLP
Prep Batch: 278146

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	0.16		1.00	1.19		mg/L		104	75 - 125
Barium	0.38	J	1.00	1.36		mg/L		98	75 - 125
Cadmium	ND		1.00	1.01		mg/L		101	75 - 125
Chromium	0.015	J	1.00	0.969		mg/L		95	75 - 125
Lead	0.021		1.00	1.01		mg/L		99	75 - 125
Selenium	ND		1.00	1.10		mg/L		110	75 - 125
Silver	ND		1.00	1.04		mg/L		104	75 - 125

Lab Sample ID: 480-91981-1 MSD
Matrix: Solid
Analysis Batch: 278615

Client Sample ID: SED SAMPLE 1
Prep Type: TCLP
Prep Batch: 278146

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	0.16		1.00	1.16		mg/L		101	75 - 125	3	20
Barium	0.38	J	1.00	1.32		mg/L		94	75 - 125	3	20
Cadmium	ND		1.00	0.980		mg/L		98	75 - 125	3	20
Chromium	0.015	J	1.00	0.943		mg/L		93	75 - 125	3	20
Lead	0.021		1.00	0.975		mg/L		95	75 - 125	3	20
Selenium	ND		1.00	1.07		mg/L		107	75 - 125	2	20
Silver	ND		1.00	1.02		mg/L		102	75 - 125	3	20

Method: 7470A - TCLP Mercury

Lab Sample ID: MB 480-278159/2-A
Matrix: Solid
Analysis Batch: 278302

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 278159

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00020	0.00012	mg/L		12/04/15 10:45	12/04/15 15:00	1

Lab Sample ID: LCS 480-278159/3-A
Matrix: Solid
Analysis Batch: 278302

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 278159

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.00668	0.00690		mg/L		103	80 - 120

Lab Sample ID: LB2 480-277999/1-C
Matrix: Solid
Analysis Batch: 278302

Client Sample ID: Method Blank
Prep Type: TCLP
Prep Batch: 278159

Analyte	LB2 Result	LB2 Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00020	0.00012	mg/L		12/04/15 10:45	12/04/15 14:59	1

Lab Sample ID: 480-91981-1 MS
Matrix: Solid
Analysis Batch: 278302

Client Sample ID: SED SAMPLE 1
Prep Type: TCLP
Prep Batch: 278159

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	ND		0.00668	0.00702		mg/L		105	80 - 120

Lab Sample ID: 480-91981-1 MSD
Matrix: Solid
Analysis Batch: 278302

Client Sample ID: SED SAMPLE 1
Prep Type: TCLP
Prep Batch: 278159

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	ND		0.00668	0.00702		mg/L		105	80 - 120	0	20

Method: D516-90, 02 - Sulfate

Lab Sample ID: MB 480-279417/114
Matrix: Solid
Analysis Batch: 279417

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	ND		5.0	2.5	mg/Kg			12/11/15 14:36	1

Lab Sample ID: MB 480-279417/12
Matrix: Solid
Analysis Batch: 279417

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	ND		5.0	2.5	mg/Kg			12/11/15 10:02	1

Lab Sample ID: LCS 480-279417/11
Matrix: Solid
Analysis Batch: 279417

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Sulfate	30.0	28.53		mg/Kg		95	90 - 110

Lab Sample ID: LCS 480-279417/113
Matrix: Solid
Analysis Batch: 279417

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Sulfate	30.0	27.64		mg/Kg		92	90 - 110

Lab Sample ID: MB 480-278687/1-A
Matrix: Solid
Analysis Batch: 279417

Client Sample ID: Method Blank
Prep Type: ASTM Leach

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	ND		100	50.0	mg/Kg			12/11/15 10:22	1

Metals

Leach Batch: 277999

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	TCLP	Solid	1311	
480-91981-1 MS	SED SAMPLE 1	TCLP	Solid	1311	
480-91981-1 MSD	SED SAMPLE 1	TCLP	Solid	1311	
LB2 480-277999/1-B	Method Blank	TCLP	Solid	1311	
LB2 480-277999/1-C	Method Blank	TCLP	Solid	1311	

Prep Batch: 278013

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	Total/NA	Solid	3050B	
LCSSRM 480-278013/2-A	Lab Control Sample	Total/NA	Solid	3050B	
MB 480-278013/1-A	Method Blank	Total/NA	Solid	3050B	

Prep Batch: 278146

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	TCLP	Solid	3010A	277999
480-91981-1 MS	SED SAMPLE 1	TCLP	Solid	3010A	277999
480-91981-1 MSD	SED SAMPLE 1	TCLP	Solid	3010A	277999
LB2 480-277999/1-B	Method Blank	TCLP	Solid	3010A	277999
LCS 480-278146/3-A	Lab Control Sample	Total/NA	Solid	3010A	
MB 480-278146/2-A	Method Blank	Total/NA	Solid	3010A	

Prep Batch: 278159

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	TCLP	Solid	7470A	277999
480-91981-1 MS	SED SAMPLE 1	TCLP	Solid	7470A	277999
480-91981-1 MSD	SED SAMPLE 1	TCLP	Solid	7470A	277999
LB2 480-277999/1-C	Method Blank	TCLP	Solid	7470A	277999
LCS 480-278159/3-A	Lab Control Sample	Total/NA	Solid	7470A	
MB 480-278159/2-A	Method Blank	Total/NA	Solid	7470A	

Analysis Batch: 278302

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	TCLP	Solid	7470A	278159
480-91981-1 MS	SED SAMPLE 1	TCLP	Solid	7470A	278159
480-91981-1 MSD	SED SAMPLE 1	TCLP	Solid	7470A	278159
LB2 480-277999/1-C	Method Blank	TCLP	Solid	7470A	278159
LCS 480-278159/3-A	Lab Control Sample	Total/NA	Solid	7470A	278159
MB 480-278159/2-A	Method Blank	Total/NA	Solid	7470A	278159

Analysis Batch: 278313

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	Total/NA	Solid	6010C	278013
LCSSRM 480-278013/2-A	Lab Control Sample	Total/NA	Solid	6010C	278013
MB 480-278013/1-A	Method Blank	Total/NA	Solid	6010C	278013

Analysis Batch: 278615

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	TCLP	Solid	6010C	278146
480-91981-1 MS	SED SAMPLE 1	TCLP	Solid	6010C	278146
480-91981-1 MSD	SED SAMPLE 1	TCLP	Solid	6010C	278146
LB2 480-277999/1-B	Method Blank	TCLP	Solid	6010C	278146

Metals (Continued)

Analysis Batch: 278615 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 480-278146/3-A	Lab Control Sample	Total/NA	Solid	6010C	278146
MB 480-278146/2-A	Method Blank	Total/NA	Solid	6010C	278146

General Chemistry

Analysis Batch: 277876

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	Total/NA	Solid	Moisture	

Leach Batch: 278687

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	ASTM Leach	Solid	D3987-85	
MB 480-278687/1-A	Method Blank	ASTM Leach	Solid	D3987-85	

Analysis Batch: 279417

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
480-91981-1	SED SAMPLE 1	ASTM Leach	Solid	D516-90, 02	278687
LCS 480-279417/11	Lab Control Sample	Total/NA	Solid	D516-90, 02	
LCS 480-279417/113	Lab Control Sample	Total/NA	Solid	D516-90, 02	
MB 480-278687/1-A	Method Blank	ASTM Leach	Solid	D516-90, 02	278687
MB 480-279417/114	Method Blank	Total/NA	Solid	D516-90, 02	
MB 480-279417/12	Method Blank	Total/NA	Solid	D516-90, 02	

Client: Daigler Engineering , PC
Project/Site: Leachate Pond Analysis - Sediment

TestAmerica Job ID: 480-91981-1

Client Sample ID: SED SAMPLE 1
Date Collected: 12/02/15 12:00
Date Received: 12/02/15 16:00

Lab Sample ID: 480-91981-1
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Leach	1311			277999	12/03/15 13:18	JLS	TAL BUF
TCLP	Prep	3010A			278146	12/04/15 10:20	KJ1	TAL BUF
TCLP	Analysis	6010C		1	278615	12/07/15 13:41	LMH	TAL BUF
TCLP	Leach	1311			277999	12/03/15 13:18	JLS	TAL BUF
TCLP	Prep	7470A			278159	12/04/15 10:45	JRK	TAL BUF
TCLP	Analysis	7470A		1	278302	12/04/15 15:04	JRK	TAL BUF
ASTM Leach	Leach	D3987-85			278687	12/08/15 12:29	MDL	TAL BUF
ASTM Leach	Analysis	D516-90, 02		5	279417	12/11/15 14:46	LED	TAL BUF
Total/NA	Analysis	Moisture		1	277876	12/02/15 20:38	CMK	TAL BUF

Client Sample ID: SED SAMPLE 1
Date Collected: 12/02/15 12:00
Date Received: 12/02/15 16:00

Lab Sample ID: 480-91981-1
Matrix: Solid
Percent Solids: 53.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			278013	12/03/15 17:50	CMM	TAL BUF
Total/NA	Analysis	6010C		1	278313	12/04/15 12:50	AMH	TAL BUF

Laboratory References:

TAL BUF = TestAmerica Buffalo, 10 Hazelwood Drive, Amherst, NY 14228-2298, TEL (716)691-2600

Client: Daigler Engineering , PC
TestAmerica Job ID: 480-91981-1
Project/Site: Leachate Pond Analysis - Sediment

Laboratory: TestAmerica Buffalo

Unless otherwise noted, all analytes for this laboratory were covered under each certification below.

Authority	Program	EPA Region	Certification ID	Expiration Date
New York	NELAP	2	10026	03-31-16

The following analytes are included in this report, but certification is not offered by the governing authority:

Analysis Method	Prep Method	Matrix	Analyte
7470A	7470A	Solid	Mercury
D516-90, 02		Solid	Sulfate
Moisture		Solid	Percent Moisture
Moisture		Solid	Percent Solids

Method Summary

Method	Method Description	Protocol	Laboratory
6010C	Metals (ICP)	SW846	TAL BUF
7470A	TCLP Mercury	SW846	TAL BUF
D516-90, 02	Sulfate	ASTM	TAL BUF
Moisture	Percent Moisture	EPA	TAL BUF

Protocol References:

ASTM = ASTM International

EPA = US Environmental Protection Agency

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL BUF = TestAmerica Buffalo, 10 Hazelwood Drive, Amherst, NY 14228-2298, TEL (716)691-2600

Sample Summary

Client: Daigler Engineering , PC
Project/Site: Leachate Pond Analysis - Sediment

TestAmerica Job ID: 480-91981-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
480-91981-1	SED SAMPLE 1	Solid	12/02/15 12:00	12/02/15 16:00

Chain of Custody Record

TAL-4124 (1007)

Temperature on Receipt ______

Drinking Water? Yes ☐ No ☒

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Client	Project Manager	Date	Chain of Custody Number
DAIGLER ENGINEERING	DAVE LENOX	12-2-15	292430

Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page
2620 GRAND ISLAND BLVD.	(716) 773 6872		Page 1 of ___

City	State	Zip Code	Site Contact	Lab Contact
GRAND ISLAND	NY	14072		

Project Name and Location (State)	Carrier/Waybill Number
LOCKWOOD HILLS SED SAMPLING (NY)	

Contract/Purchase Order/Quote No.

Analysis (Attach list if more space is needed)

Special Instructions/ Conditions of Receipt

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Matrix: Aqueous	Matrix: Sed.	Matrix: Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	6010C	7470A	6010C	D516-90,02	Special Instructions/ Conditions of Receipt
SED SAMPLE 1 1-16oz 2-4oz	12-2-15	12:00pm			X								+	+	+	+	

480-91981 Chain of Custody

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required: ☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other ______

QC Requirements (Specify)

Relinquished By	Date	Time	Received By	Date	Time
1. SAM DAIGLER	12-2-15	4:00pm	1. [signature]	12/2/15	1600
2.			2.		
3.			3.		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

#14.6°

Login Sample Receipt Checklist

Client: Daigler Engineering , PC

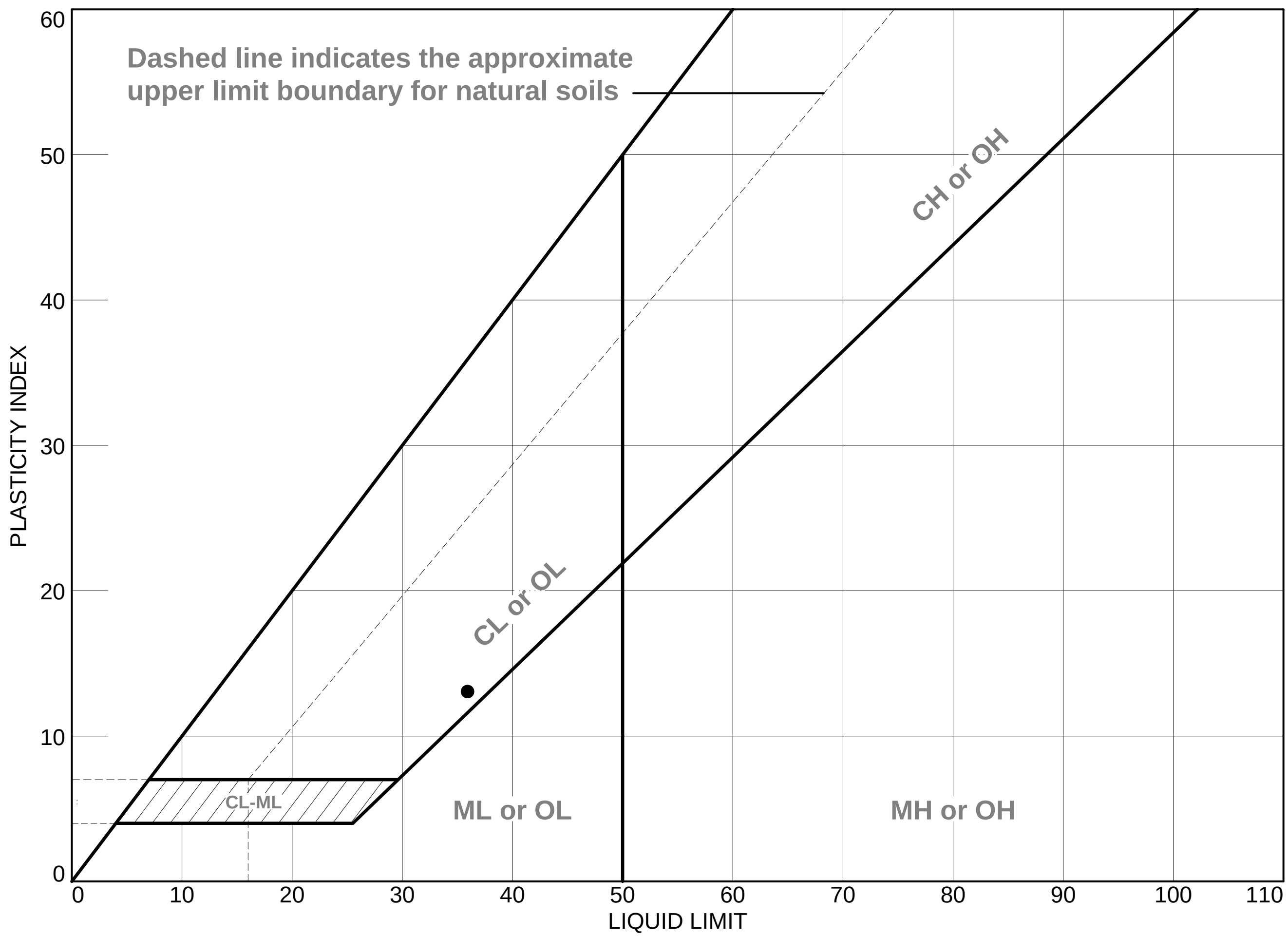
Job Number: 480-91981-1

Login Number: 91981
List Number: 1
Creator: Hulbert, Michael J

List Source: TestAmerica Buffalo

Question	Answer	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Sampling Company provided.	True	DAIGLER ENGINEERING
Samples received within 48 hours of sampling.	True	
Samples requiring field filtration have been filtered in the field.	True	
Chlorine Residual checked.	N/A	

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Lockwood	18-SED-Lockwood-C		66.2	23	36	13	

3rd Rock, LLC **East Aurora, NY**	**Client:** Daigler Engineering **Project:** Leachate Pond Sediment Sample **Project No.:** 18-043 **Figure**

Tested By: JMA 12/3/18 **Checked By:** CMP

ATTACHMENT 4

Cascade Aerator Design Calculations

Cascade Aerator Design

Objective: Determine the stoichiometric amount of oxygen required to precipitate iron from the leachate.

Knowns:

- Redox Reaction for oxidation of ferrous iron (Fe^{2+}) to iron hydroxide precipitate ($Fe(OH)_3$).

$$2Fe^{2+} + \tfrac{1}{2}O_2 + 5H_2O = 2Fe(OH)_{3(S)} + 4H^+$$

- Maximum concentration of iron in the leachate = 30.4 mg/L

Assumptions:

- All iron in the leachate is ferrous iron.

Calculations:

- $$\frac{0.5 \text{ mol } O_2}{2 \text{ mol } Fe^{2+}} \times \frac{1 \text{ mol } Fe^{2+}}{55{,}845 \text{ mg}} \times \frac{32{,}000 \text{ mg}}{1 \text{ mol } O_2} = 0.143 \frac{\text{mg/L } O_2}{\text{mg/L } Fe^{2+}}$$

- Concentration of oxygen needed:

$$30.4 \text{ mg/L Fe} \times 0.143 \frac{\text{mg/L } O_2}{\text{mg/L } Fe^{2+}} = 4.35 \text{ mg/L } O_2$$

Solution:

- **The minimum amount of oxygen needed to oxidize, and therefore precipitate, the maximum concentration of iron in the leachate is 4.4 mg/L O_2.**

Cascasde Aerator Design

Objective: **Determine the appropriate height of the Cascade Aerator necessary to oxidize and precipitate iron from the leachate.**

Approach:

- Use Barrett Equation:

$$H = \frac{R-1}{(0.11) \times a \times b \times (1 + 0.046 \times T)} \qquad \text{Where:} \quad R = \frac{C_S - C_0}{C_S - C}$$

- Reference: Metcalf & Eddy, Inc. (1991) Wastewater Engineering: Treatment, Disposal, and Reuse. McGraw-Hill, Inc., New York, New York. p 510.

Knowns:

- C_0 = Initial dissolved oxygen concentration in the leachate
  - Minimum C_0 = 0.95 mg/L
  - Maximum C_0 = 12 mg/L
  - Average C_0 = 6 mg/L
- C = Dissolved oxygen concentration required to precipitate out iron = 4.4 mg/L (from Cascade Aerator Design, Page 1 of 5)
- T = Temperature of the leachate in Degrees Celsius
  - Minimum T = 1 Deg C
  - Maximum T = 16 Deg C
  - Average T = 10.5 Deg C
- C_S = Saturation concentration of dissolved oxygen as a function of temperature

T, Deg C	C_s, mg/L
0	14.6
1	14.2
5	12.76
10	11.28
11	11.02
15	10.07
16	9.86
20	9.08

Assumptions:

- a = Water quality parameter = 0.8 assuming wastewater treatment plant effluent (conservative estimate)
- b = Weir geometry parameter = 1.3 assuming step weirs

Calculations:

- *R and H* increases as T increases; therefore, use maximum *T*. T = 16 Deg C
- H increases as C_0 decreases; therefore, use minimum C_0. C_0 = 0.95 mg/L
- R = 1.63
- H = 3.18 ft
  38.2 in

Solution:

- **The total drop in in height the leachate must fall to achieve maximum oxidation, and therefore precipitation, of iron is 3.2 feet or 38 inches.**

Cascasde Aerator Design

Objective: Determine the appropriate geometery of the Cascade Aerator steps.

Approach:

- Approximate as close as possible typical system geometery for use of the Barrett Equation.

		Applicable Range			
- Hydraulic Loading Rate at average design flow =		100,000	-	500,000	gal/ft of width per day
- Step Dimensions,	Height =	6	-	12	inches
	Length	12	-	24	inches

- Reference: Metcalf & Eddy, Inc. (1991) Wastewater Engineering: Treatment, Disposal, and Reuse. McGraw-Hill, Inc., New York, New York. p 510.

Knowns:

- Average Leachate flow rate = 14,000 gallons per day
- Maximum Design Leahate flow rate = 25,000 gallons per day
- Total required drop in height = 38 inches

Assumptions:

- None

Calculations:

- The minimum amount of equally sized steps required to achieve the total required drop in height while remaining within the applicable step height range
  = total required drop / maximum step height = 3.2
  Number of Steps = 4 (rounded up to the nearest whole number)
  Height of Each Step = 9.5 inches

- The minimum length of each step while remaining within the applicable range will be utilized, therefore:
  Length of Each Step = 12 inches

- Overall Step Length = 48 inches = 4 feet

- Given the relatively low leachate flow rates, the step width will be designed to the minimum applicable hydraulic loading rate.

- Step width = Average leachate flow rate / minimum hydraulic loading rate = $\dfrac{14{,}000 \text{ gallons per day}}{100{,}000 \text{ gal/ft of width per day}}$
  = 0.14 ft
  = 1.68 in

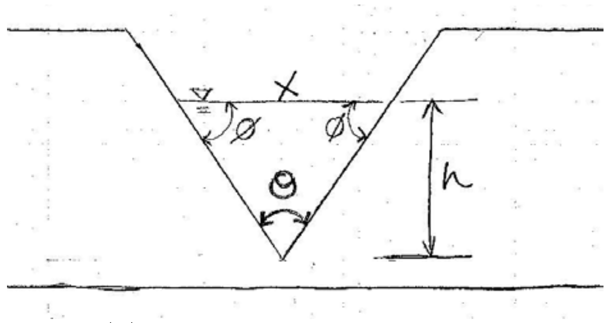
- Step width = Maximum Design leachate flow rate / minimum hydraulic loading rate = $\dfrac{25{,}000 \text{ gallons per day}}{100{,}000 \text{ gal/ft of width per day}}$
  = 0.25 ft
  = 3 in

- Given how narrow the optimum step width is, a V-notched step weir is proposed for use within the aerator to narrow low flows while allowing passage of larger flows.

Solution:

- **The Cascade Aerator Step Geometery will consist of four 9.5 in (H) by 12 in (L) steps and V-notched weirs placed on each step.**

Objective: Determine the optimum angle for the V-notch weir



Equations: $Q = 4.28C \times tan\left(\frac{\theta}{2}\right) \times (h+k)^{5/2}$

$x = \frac{2h}{tan\emptyset}$ $\quad\quad \emptyset = \frac{180-\theta}{2}$ $\quad\quad$ Therefore, $\quad h = \frac{xtan\left(\frac{180-\theta}{2}\right)}{2}$

where: C = 0.607165052-0.0008744466963Θ +6.10393334E-06Θ^2

k = 0.0144902648-0.000339555535Θ +3.29819003E-06Θ^2-1.06215442E-08Θ^3

Q = flow rate in cfs

Θ = notch angle in degrees

h = head (ft)

x = width of flow

Knowns:

Q =	14,000	gpd	=	0.02166	cfs	(average)
Optimum x =	1.7	in		0.14	ft	

(from *Cascade Aerator Design* calculation Page 3 of 5, Step width under average flow conditions)

Find Θ using solver:

Θ =	89.9066	degrees
C =	0.577883995	
k =	0.002902893	ft
h =	0.126209518	ft
Q =	0.021664763	cfs
delta Q =	0.00000	cfs

Solution: A 90-degree V-notched wier will approximate optimum conditions.

Objective: Determine geometry of the step weirs.

Approach:

- Determine optimum tailwater depth downstream of inlet pipe and each weir:

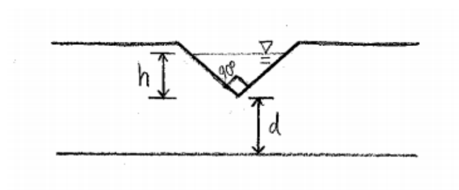
$$h_{opt} = 0.6(h_d)$$

Source: Avery, S. and Novak, P. (1978). Oxygen Transfer at Hydraulic Structures. *J. Hydral. Eng* ., ASCE **104** (HY 11) 1521-1540.

h_{opt} = Optimum tailwater height
h_d = Drop height (Height of Each Step from *Cascasde Aerator Design* Calculation, page 3 of 5)

- Determine height of flow through v-notch weir:

$$Q = 2.49h^{2.48}$$



where,
Q = Flowrate over weir (ft^3/s)
h = Flow depth above invert of weir (ft)

- Determine distance between weir invert and top of each step by subtracting h from h_{opt}:

$$d = h_{opt} - \text{h}$$

where,
d = distance between weir invert and top of step

- Specify the weir be fabricated to contain at least 1.5 times the calculated height of flow for Q_{max}, or $1.5(h_{max})$.

Knowns:

Q_{avg} =	14,000	gal/day	=	0.022	ft^3/s	(current conditions)
Q_{max} =	34,200	gal/day	=	0.053	ft^3/s	(current conditions)
Q_{design} =	25,000	gal/day	=	0.039	ft^3/s	(in consideration of future expansion)

Source: *Leachate Monitoring and Analysis Report, Daigler Engineering PC, January 2018*

h_d =	9.5	inches	=	0.792	feet

Calculation:

h_{opt} =	0.475	feet				
h_{avg} =	0.148	feet	for	Q_{avg} =	14,000	gal/day
h_{max} =	0.212	feet	for	Q_{max} =	34,200	gal/day
h_{design} =	0.187	feet	for	Q_{design} =	25,000	gal/day
d =	0.327	feet	for	Q_{avg} =	14,000	gal/day
$1.5(h_{max})$ =	0.317	feet				
$d+1.5(h_{max})$	0.645	feet	=	7.737774	inches	

Solution:

- For average flow conditions, the optimal tailwater height is achieved when the distace between the weir invert and top of each upstream step is 0.327 feet.
- The weir plate will be fabricated with an overall height of at least 0.645 feet (approximately 8 inches) and with the V-notch invert at 0.327 feet from the bottom of the plate.

BY JPR DATE 11/28/18 CHKD. BY BAM DATE 12/4/18

DAIGLER ENGINEERING, P.C.
CIVIL & GEO-ENVIRONMENTAL ENGINEERING

2620 Grand Island Blvd. – Grand Island, NY – 14072
Ph: (716) 773-6872 – Fax: (716) 773-6873

JOB NO. 31-1518

SHEET NO. 1 OF 1

SUBJECT STEP AERATOR GEOMETRY

Step length = 12" = 1.0' ✓

drop height = 9.5" = 0.792' ✓

total drop height = 38" = 3.167' ✓

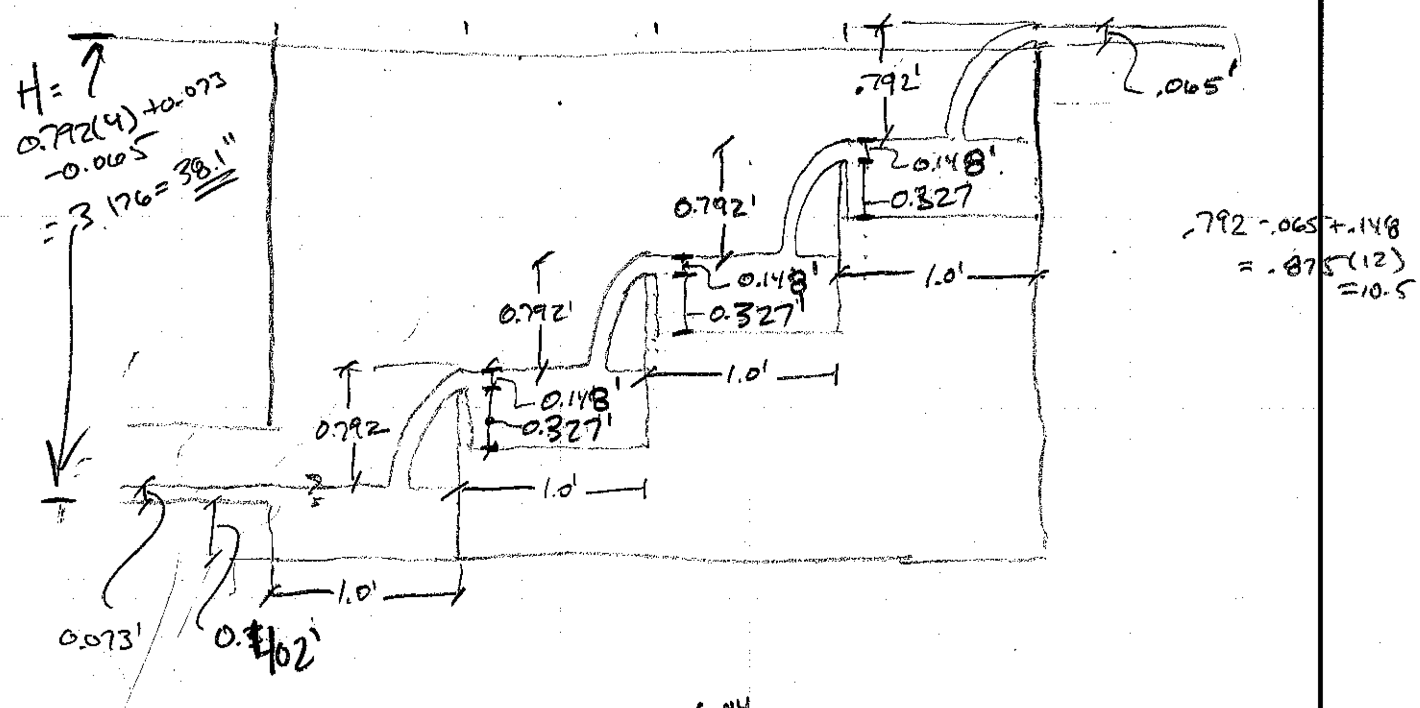
Incoming 8" pipe @ 0.008 ft/ft – depth of flow = 0.78" = 0.065' ✓

Outgoing 8" pipe @ 0.005 ft/ft – depth of flow = 0.88" = 0.073' ✓

V notch weir depth of flow = 0.148' ✓

Pool depth = $0.6\frac{(9.5")}{12} = 0.475$ ✓

Pool depth below invert = .475 − .148 = .327' ✓



.792 − .148 + .073 = .717 (12) = 8.604

ATTACHMENT 5

Settling Pond Design Calculations

Settling Pond Design

Objective: **Determine the necessary detention time and settling pond length for iron precipitate to settle out of the leachate.**

Approach:

- Use Stoke's Law to find the particle settling velocity (*Vc*):

$$V_c = \frac{g(\rho_s - \rho)d^2}{18\mu} \qquad \text{Where:} \quad V_c = \frac{D}{T_D} \qquad \text{and Particle Travel distance, } L = \quad L = \frac{Q}{WV_c}$$

- Reference: Metcalf & Eddy, Inc. (1991) Wastewater Engineering: Treatment, Disposal, and Reuse. McGraw-Hill, Inc., New York, New York. pp 222-224.

Knowns:

- *Q* = Leachate influent flow rate =

Q_{avg} =	14,000	gpd	=	1,872 ft^3/day
Q_{max} =	34,200	gpd	=	4,572 ft^3/day
Q_{design} =	25,000	gpd	=	3,342 ft^3/day

- *g* = Accerleration due to gravity, constant = 9.80665 m/s^2
- ρ_s = Density of iron hydroxide = 4.25 g/cm^3 = 4,250 kg/m^3
- ρ = Density of water, a function of temperature
- μ = Dynamic Viscosity of water, a function of temperature

T, Deg C	ρ, kg/m^3	μ, kg/m-s
0	999.8	0.00178
5	1,000.0	0.00152
10	999.7	0.00131
15	999.1	0.00114
20	998.2	0.00100

NOTE: Temperature range is inclusive of the measured temperature of the leachate in Degrees Celcius
Minimum *T* = 1 Deg C
Maximum *T* = 16 Deg C
Average *T* = 10.5 Deg C

Assumptions:

- *d* = Particle size/diameter of $Fe(OH)_3$ precipitate = 0.1 microns = 0.0001 mm (minimum size)
  Approximately 90% greater than = 2.5 microns = 0.0025 mm
- Reference: Fedorova, A.S. *et al.* (2017). The study of processes of iron hydroxide coagulation and sedimentation. API Conf. Proc. 1886, 020031-1-020031-7.
- *W* = Pond operating width, W_{ws} = 128 ft

Calculations:

- Find particle settling velocity (*Vc*) with temperature:

T, Deg C	@ 0.1 microns *Vc*, mm/d	@ 2.5 microns *Vc*, mm/d	@ 0.1 microns *Vc*, in/d	@ 2.5 microns *Vc*, in/d	
0	0.86	537	0.034	21.1	<---- Low temperature is worst case
5	1.01	630	0.040	24.8	
10	1.17	732	0.046	28.8	
15	1.34	840	0.053	33.1	
20	1.53	955	0.060	37.6	

- Find detention time (T_D) with with Pond Depth (*D*) at 0 degrees C:

D, ft	@ 0.1 microns T_D, days	@ 2.5 microns T_D, days
2	709.6	1.14
3	1064.5	1.70
4	1419.3	2.27
5	1774.1	2.84

- Find *L*:

	@ 2.5 microns *L*, ft
Q_{avg} =	25.75
Q_{max} =	62.92
Q_{design} =	45.99

Solution:

- **With an operating depth between two and five feet, the settling pond must provide a minimum detention time of 2.84 days to capture at least 90% of the iron precipitate. Capture efficieny will increase as operating depth decreases and detention time increases.**

Settling Pond Design

Objective: Determine the volume and detention time (design, ideal) of the settling pond.

Approach:

- Volume of a Prismoid $V = \left(\frac{d}{6}\right)(A_{ws} + A_b + 4A_m)$

Where:

d =	Liquid Depth		
A_{ws} =	Area at water surface	$A_{ws} = L_{ws} * W_{ws}$ **or**	$A_{ws} = (L - 2ES \times FB)(W - 2SS \times FB)$
A_b =	Area at bottom	$A_b = (L_{ws} - 2ES \times d)(W_{ws} - 2SS \times d)$	
A_m =	Area at midsection	$A_m = (L_{ws} - ES \times d)(W_{ws} - SS \times d)$	

*Note: FB, SS, ES, L_{WS}, W_{WS}, L and W are defined below.

- Detention Time, T_D = V/Leachate influent flow rate, Q

Knowns:

- Length of existing Pond = L_{max} = 576 ft
- Width of Existing Pond = W_{max} = 149 ft
- Depth of Existing Pond = 6 ft

- Leachate influent flow rate: Q_{avg} = 14,000 gpd (current conditions)

(From: Leachate Monitoring and Analysis Report, Daigler Engineering PC, January 2018)

Q_{avg} =	14,000	gpd	(current conditions)
Q_{max} =	34,200	gpd	(current conditions)
Q_{design} =	25,000	gpd	(in consideration of future expansion)

Assumptions:

- Settling Pond Design:

Length (Top)	L	564	feet
Width (Top)	W	137	feet
Side slopes	SS	3	on 1
End Slopes	ES	3	on 1
Total Depth	D	4.5	feet
Liquid Depth	d	3	feet
Freeboard	FB	1.5	feet

Notes:
Top = top of geosynthetic liner system, not top of slope.
Total Depth = depth between top of geosynthetic liner system (elev. 555.00) and invert of pond drain (elev. 550.50)

- Minimum operational detention time at average flow rates equals 90 - 120 days such that batch discharge occurs no more than once every three to four months on average.

Calculations:

- Length at operating water surface, L_{ws} = 555 ft $L_{WS} = L - 2(FB \times ES)$
- Width at operating water surface, W_{ws} = 128 ft $W_{WS} = W - 2(FB \times SS)$
- A_{ws} = 71,040 ft^2
- A_b = 59,070 ft^2 L:W ratio = 4.34 :1
- A_m = 64,974 ft^2
- V = 195,003 ft^3 = 1,458,724 gal
- V_{FB} = 108,117 ft^3 = 808,771 gal $V_{FB} = \frac{FB}{6}\left[(LxW) + (A_{WS}) + \left(4(L - 2 \times FB \times SS)(W - 2 \times FB \times SS)\right)\right]$

- T_D :
  - @ Q_{avg} = 104.19 days
  - @ Q_{max} = 42.65 days
  - @ Q_{design} = 58.35 days

Solution:

- **Given the design settling pond dimensions and maximum operating depth, the pond liquid volume, available freeboard volume and detention time (i.e., required frequency of batch discharge) is sufficient.**

Settling Pond Design

Objective: **Determine the scouring velocity for iron precipitate; both minimum velocity for self-cleaning of the pipe inlet from the cascade aerator and maximum velocity for prevention of solids loss through the outlet structure.**

Approach:

- Scouring Velocity in a Pipe: $V_s = \sqrt{\dfrac{8k(s-1)gd}{f}}$
- Reference: Metcalf & Eddy, Inc. (1991) Wastewater Engineering: Treatment, Disposal, and Reuse. McGraw-Hill, Inc., New York, New York. P 476.

Knowns:

- *g* = Acceleration due to gravity, constant = 9.80665 m/s^2
- ρ_s = Density of iron hydroxide = 4.25 g/cm^3 = 4250 kg/m^3
- ρ = Density of water = ~ 1,000 kg/m^3
- *s* = specific gravity of iron hydroxide precipitate = ρ_s/ρ 4.25

Assumptions:

- *d* = Particle size/diameter of $Fe(OH)_3$ precipitate = 0.1 microns = 0.0001 mm (minimum size)
  Approximately 90% greater than = 2.5 microns = 0.0025 mm
- Reference: Fedorova, A.S. *et al.* (2017). The study of processes of iron hydroxide coagulation and sedimentation. API Conf. Proc. 1886, 020031-1-020031-7.
- *k* = constant related to the type of material being scoured = 0.04 for unigranular sand like material
  0.06 for more sticky, interlocking matter
  assumed *k* = 0.06 based on observation of existing accumulated sediments
- *f* = Darcy-Weisbach friction factor for a pipe = 0.03

Calculations:

- V_s = 0.0357 m/s = 0.1171 fps

Solution:

- **To ensure that iron precipitate does not accumulate in the pipe between the cascade aerator and the settling basin, the velocity of the pipe must regularly exceed the scouring velocity of 0.12 fps.**
- **To ensure that settled iron precipitate does not resuspend and get carried out with an effluent discharge, the velocity of the discharge outlet pipe must not exceed the scouring velocity of 0.12 fps during a batch discharge.**

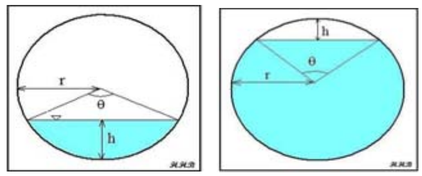
Settling Pond Design

Objective: Determine the minimum slope required on the inlet pipe to provide scouring velocity for self-cleaning of the inlet pipe.

Approach:

- Use Manning's equation solved for slope: $s_{min} = \left(\dfrac{V_s \times n}{1.49 \times R_h^{2/3}}\right)^2$
- Reference: Young, D.F. *et al* . (1997) A Brief Introduction to Fluid Mechanics. John Wiley & Sons, Inc., New York, New York. P 440.
- Where the hydraulic radius, R_h, for a partially full pipe is defined as: $R_h = A/P$

where,
y = depth of leachate flow in pipe
$If\ y > r, P = 2\pi r - \theta r$ $\quad$ $If\ y < r, P = \theta r$
$If\ y > r, h = D - y$ $\quad$ $If\ y < r, h = y$



and,
$\theta = 2\ x \cos^{-1}\left(\dfrac{r-h}{r}\right)$

- Use solver to find *y* given the area of a circular segment = $A = \dfrac{Q}{V_s} = r^2 \cos^{-1}\left(\dfrac{r-y}{r}\right) - (r-y)\sqrt{2ry - y^2}$

Knowns:

- *n* = Manning's coefficient for roughness = 0.013 assuming a smooth plastic pipe
  Reference: Oregon Department of Transportation Hydraulics Manual
- V_s = Scouring Velocity, previously calculated = 0.1171 fps 10,121 ft/day
- *Q* = Leachate influent flowrate =

Q_{avg} =	14,000 gpd	=	1,872	ft^3/day
Q_{max} =	34,200 gpd	=	4,572	ft^3/day
Q_{design} =	25,000 gpd	=	3,342	ft^3/day

Assumptions:

- *D* = Diameter of the proposed influent pipe = 8.0 in = 0.67 ft
- *r* = radius of the proposed influent pipe = 4.0 in = 0.33 ft

Calculations:

- *A* = $\dfrac{Q_{avg}}{V_s}$ 0.1849 ft^2 $\quad = r^2 \cos^{-1}\left(\dfrac{r-h}{r}\right) - (r-h)\sqrt{2rh - h^2}$ -----> 0.1849 ft^2
- *y* = height of water in the pipe = 0.35 ft
- *h* = 0.32 ft
- *Θ* = 3.05 rad
- *P* = 1.08 ft
- R_h = 0.17 ft
- s_{min} = 1.1E-05 ft/ft or *0.001%*

Solution:

- **Using the average flow rate in the calculations above ensures that the scour velocity is exceeded regularly.**
- **The minimum slope on the the inlet pipe to ensure iron precipitate does not accumulate in the pipe is 0.001%.**

Settling Pond Design

Objective: Determine the velocity through the settling pond.

Approach:

- Velocity = $\mathcal{V} = \frac{Q}{A}$

Where: $\mathcal{V}$ = Velocity
Q = Leachate flow rate
A = cross-sectional Area $A = {}^{1}/_{2}\,(W_{ws} + W_B)d$

Knowns:

• Width at operating water surface, W_{ws} =	128	ft	From Settling Pond Design calculation, Page 2 of 6
• Width at the bottom, W_B =	110.00	ft	
• Liquid Depth, d =	3	ft	

- Leachate influent flow rate:
(From: Leachate Monitoring and Analysis Report, Daigler Engineering PC, January 2018)

Q_{avg} =	1,872	ft^3/day	(current conditions)
Q_{max} =	4,572	ft^3/day	(current conditions)
Q_{design} =	3,342	ft^3/day	(in consideration of future expansion)

Assumptions:

None

Calculations:

- A = 357 ft^2

• $\mathcal{V}$ =	@ Q_{avg} =	5.24	ft/day	=	0.000061	fps
	@ Q_{max} =	12.81	ft/day	=	0.000148	fps
	@ Q_{design} =	9.36	ft/day	=	0.000108	fps

Solution:

- **Given the design settling basin dimensions and the leachate influent flow rate, the horizontal velocity through the pond will be approximately three orders of magnitude lower than the 0.12 fps scouring velocity; therefore the probability of carrying solids out with the discharge is extremely low.**

Settling Pond Design

Objective: Determine Size of Discharge Orifice

Approach:

- Use solver to determine the size of the discharge orifice such that the 60-degree large V-trapezoidal flume maximum flow rate, $Q_{flume, max}$, is not exceeded.

- Calculate flow rate through orifice assuming a trial diameter

  $Q = CA\sqrt{2gh}$ Source: New York State Stormwater Design Manual, Chapter 8: Stormwater Management Design Examples

  where,

  Q = Discharge flow rate
  C = Coefficient of discharge = 0.6
  g = Gravitational constant = 32.3 ft/s2
  A = Area of orifice opening $A = \left(\frac{\pi}{4}\right)D^2$
  D = Trial diameter of orifice
  h = Depth of flow measured from the center of the orifice $h = ELEV_{pond,max} - ELEV_{inv} + \frac{D}{2}$
  $ELEV_{pond, max}$ = Maximum elevation of Leachate Pond phreatic surface.
  $ELEV_{inv}$ = Invert elevation of orifice

- Set $Q_{flume, max}$ equal to the calculated $Q_{orifice}$ to determine maximum diameter of orifice

Assumptions:

- Maximum discharge, $Q_{orifice}$, will occur when the phreatic surface of the leachate Pond is at the maximum elevation

Knowns:

C =	0.6			
g =	32.2 ft/s^2			
Trial D =	2.4 in	=	0.202	ft
$ELEV_{pond, max}$ =	553.50			
$ELEV_{inv}$ =	548.94			
$Q_{flume, max}$ =	150.0 gal/min	=	0.334	ft^3/s

Calculation:

h =	4.66 ft			
A =	0.032 ft^2			
$Q_{orifice}$ =	150.0 gal/min	=	0.334	ft^3/s

Solution:

- The orifice must be no greater than 2.4 inches (or 4-13/32 inches) in diameter to prevent the orifice discharge ($Q_{orifice}$) from exceeding the flow capacity of the flume ($Q_{flume, max}$).

Settling Pond Design

Objective: Determine Volume of Fe(OH)3 Accumulation Per Year and Estimate Time Between Dredging Events.

Approach:

- Convert concentration of iron hydroxide precipitate (Fe(OH)3) in leachate from mg/L to lbf/ft^3:

$$\frac{lbf}{ft^3} = \frac{mg}{L}\left(\frac{1g}{1000mg}\right)\left(\frac{1lbm}{453.59237g}\right)\left(\frac{28.3168L}{1ft^3}\right)\left(\frac{32.178lbf}{1lbm}\right)$$

- Calculate mass flowrate of Fe(OH)3 into Settling Pond:

$$M_{Fe(OH)3} = (C_{Fe(OH)3})(Q_{avg})$$

where,
$M_{Fe(OH)3}$ = Mass flowrate of Fe(OH)3 into Settling Pond (lbf/s)
$C_{Fe(OH)3}$ = Concentration of Fe(OH)3 (lbf/ft^3)
Q_{avg} = Average Leachate Flowrate (ft^3/s)

- Apply efficiency factor to calculate mass of Fe(OH)3 captured by Settling Pond:

$$M_{Fe(OH)3,\,captured} = (M_{Fe(OH)3})(EF)$$

where,
EF = Efficiency factor (%)

- Convert mass flowrate of Fe(OH)3 to accumulated volume:

$$V_{Fe(OH)3} = \frac{M_{Fe(OH)3}}{\gamma_{sed}}$$

where,
$V_{Fe(OH)3}$ = Accumulated volume of Fe(OH)3 (ft^3/s)
Υ_{sed} = Assumed unit weight of accumulated Fe(OH)3 after settlement (lbf/ft^3)

- Estimate time between settling pond dredging events (T_{dredge}) assuming all sediment settles within the particle travel distance calculated on Page 1 of 7 of the the *Settling Pond Design Calculation* :

$$T_{dredge} = \frac{(W_{ws}L)(2ft)}{V_{Fe(OH)3}}$$

*Assume sediment accumulation of two feet triggers dredging.

where,
W_{ws} = Pond operating width (ft)
L = Particle travel distance (ft)

Assumptions:

- Sediment will settle to an in-place unit weight of: 100 lb/ft^3 (assumption)
- Sediment will be dredged once accumulation within the particle travel distance reaches two feet in depth.

Knowns:

Q_{avg} =	14,000	gal/day	=	0.022 ft^3/s	(current conditions)

Source: *Leachate Monitoring and Analysis Report, Daigler Engineering PC, January 2018*

$C_{Fe(OH)3}$ =	30.4	mg/L	Source: Cascade Aerator Design, Page 1 of 5
EF =	90%		Source: Settling Pond Design, Page 1 of 7
L =	25.75	ft	Source: Settling Pond Design, Page 1 of 7
W_{ws} =	128.00	ft	Source: Settling Pond Design, Page 2 of 7

Calculation:

$C_{Fe(OH)3}$ =	0.06107	lbf/ft^3					
$M_{Fe(OH)3}$ =	0.0013	lbf/s	=	114.3	lbf/day		
$M_{Fe(OH)3,\,captured}$ =	0.0012	lbf/s	=	102.9	lbf/day		
$V_{Fe(OH)3}$ =	1.19E-05	ft^3/s	=	1.029	ft^3/day	=	375 $ft^3/year$
T_{dredge} =	17.6	years					

Solution:

- With an Fe(OH)3 accumulation rate of 375 ft^3/year, the Settling Pond will require dredging approximately once every 17.6 years.