CALCULATIONS

Date:	June 12, 2014	**Made by:**	DPM
Project No.:	130-0193	**Checked by:**	ATN
Subject:	Leachate Pump Station	**Reviewed by:**	JRD
Project Short Title:	**CHESAPEAKE ENERGY CENTER ASH LANDFILL – SWP #440**		

1.0 OBJECTIVE

The objective of this analysis is to evaluate the hydraulic performance of the proposed leachate pump station for the Chesapeake Energy Center Ash Landfill (Facility). The pump station will pump collected leachate from the northeast corner of the landfill to the Oily Waste Pond. The hydraulic performance of the pump station is based on the computed inlet flows from the calculation package titled "Leachate Pipe Capacity" by Golder Associates.

2.0 METHOD

The capacity of the pump station will be evaluated using a system curve spreadsheet.

3.0 INPUTS AND ASSUMPTIONS

1. Peak daily leachate flow was modeled using a peak design basis flow of 36.5 GPM, based on the contributing solid leachate conveyance pipes. Note this is three times the anticipated actual flow.

4.0 PUMP AND PIPE CALCULATIONS

4.1 Discharge Pipe Capacity

The attached spreadsheet uses the Hazen-Williams equation to calculate the velocity and resulting friction losses in the two-inch SDR-17 HDPE discharge pipe (I.D. = 2.079"). A range of flows were computed and plotted, resulting in the "system curve" for this specific location.

4.2 Pump Selection

Manufacturer-provided flow data for a series of pumps was used to develop "pump curves" which were plotted on the same graph as the system curve. Where the two curves intersect is known as the "duty point" where the system is expected to operate when the pump is running. For the initial installation, a Cole-Parmer Model 75507-60 pump should be used to provide the required capacity during the initial dewatering period. As flow decreases, a smaller Cole-Parmer model # 75507-50 pump can be used. Other pumps of similar capacity may be used after evaluation. The chart on the next page shows the system and pump curve plots.

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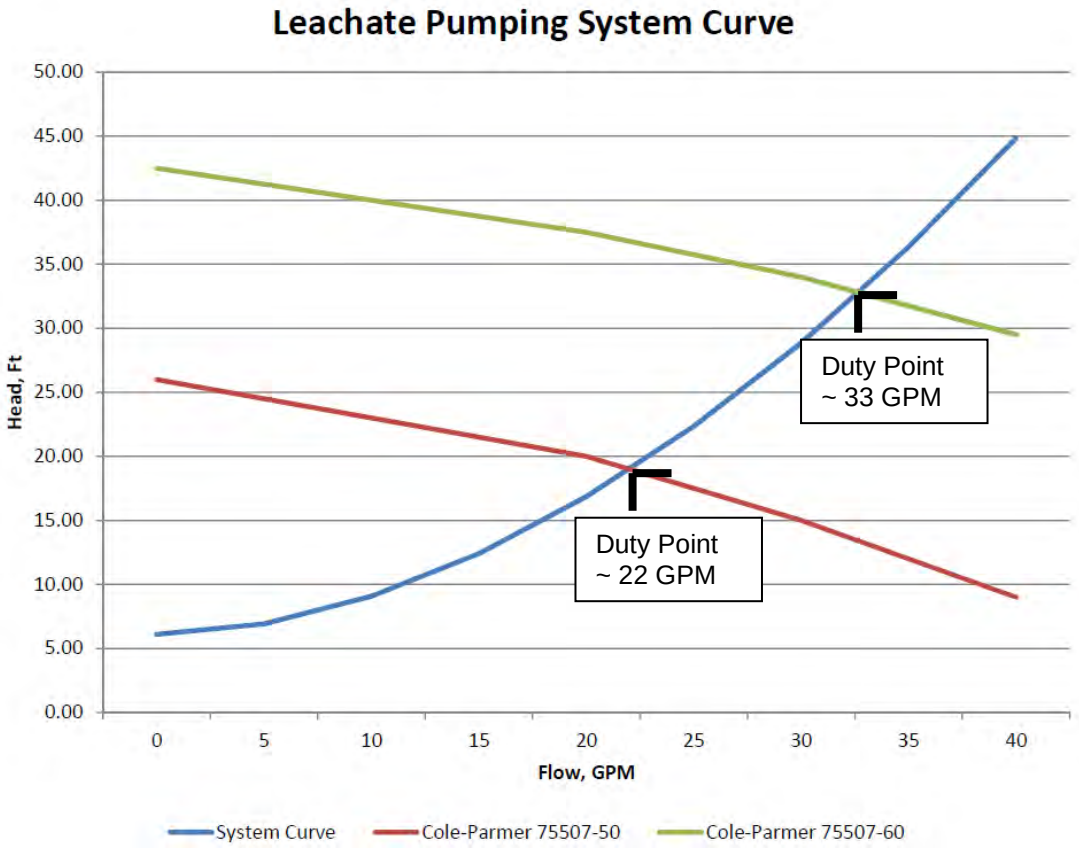


5.0 PUMP STATION SIZING

The volume of the pump station was selected to provide the pump adequate fluid volume and recharge cycle time to prevent premature pump failure. A 48-inch diameter epoxy-lined concrete manhole was selected to provide the desired characteristics. At the actual peak inflow anticipated (12.2 GPM), the pump will cycle (on/off) approximately 3 times per hour.

6.0 CONCLUSIONS

Based on the results of the calculations, the perforated leachate collection pipes and the solid conveyance pipes are designed to adequately collect and convey leachate to the discharge point under all anticipated operating conditions.

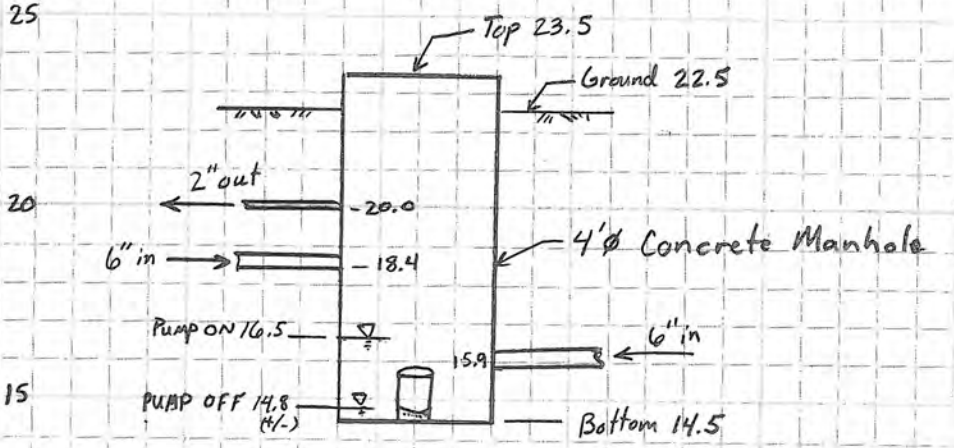
7.0 REFERENCES

1. CEC Ash Landfill Leachate Pipe Capacity calculations package prepared by Golder Associates Inc., November 2013.

2. CEC Ash Landfill Permit Amendment Drawings prepared by Golder Associates Inc., Project No. 130-0193.

Golder Associates	SUBJECT CEC Landfill Leachate Sump Design		
	Job No. 130-0193 Ref.	Made by DPM Checked JRD Reviewed	Date 11/21/13 Sheet 1 of 1

Proposed CEC Leachate Sump in NE Corner



Manhole Volume / Ft

$\pi r^2 = \pi(2^2) = 12.57\ ft^3/ft = 94.0$ gallons / Ft

$\Delta_{on-off} = 1.7$ Feet $\Rightarrow$ Volume of leachate $= (1.7)(94.0) = \underline{159.8\ gallons}$

Duty point of 75507-60 pump is ~ 33 GPM

Pump on time ~ 7.7 minutes (Net pump out rate: 33 - 12.2 = 20.8 GPM)

Recharge Rate @ peak = 12.2 GPM (actual, not 3x)

Recharge time ~ 13.1 minutes

Cycle time = 20.8 minutes ~ 2.9 cycles per hour, 70 cycles per day

Pipe Friction by Hazen-Williams

C	130	
Low flow	0	gpm
Increment	5	gpm
Pipe length, ft	1,156	
Pipe ID, inches	2.079	
Start Elevation	14.5	
End Elevation	20.6	
Fitting Loss, K	0.57	90 Ell
Fitting Loss, K	0.95	check valve

System Curve Development

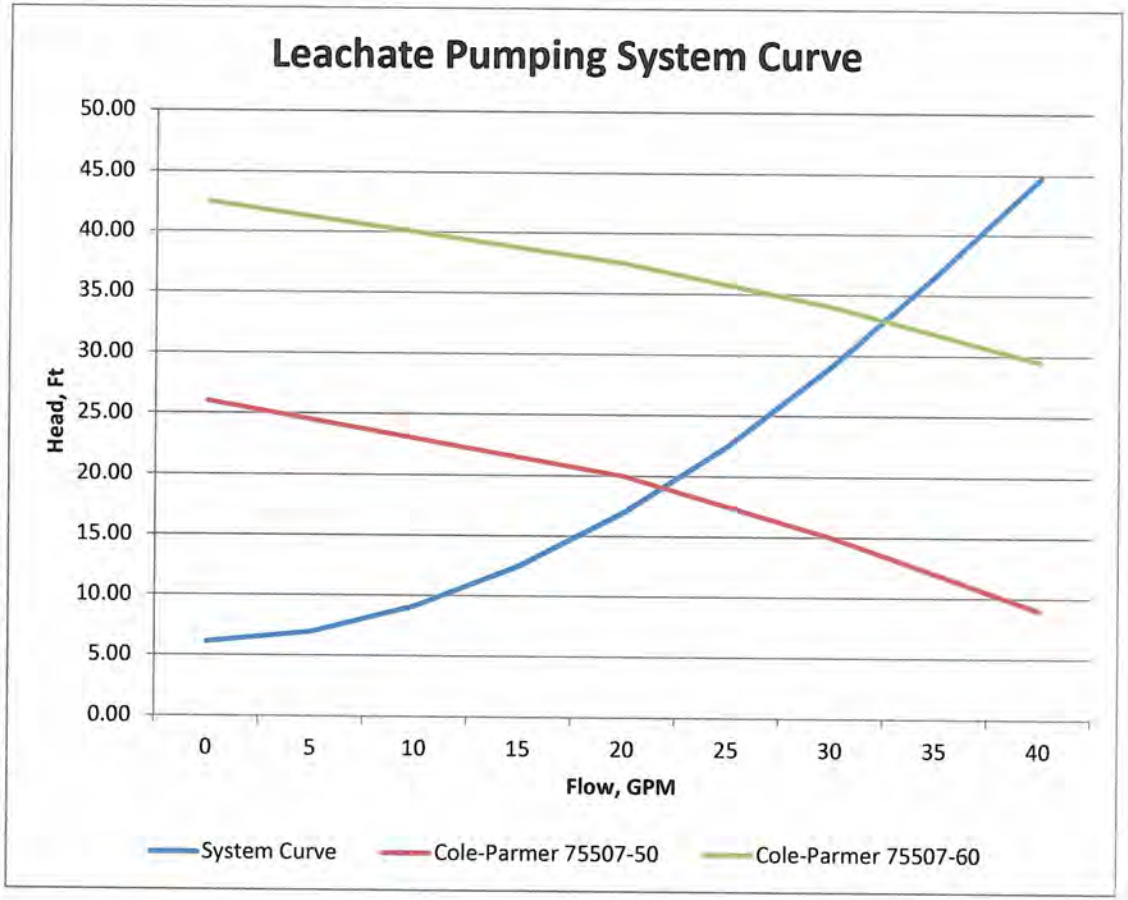
Flow, GPM	Velocity	Hf	Hs	Hk	TDH
0	0	0.00	6.1	0.00	6.11
5	0.47	0.83	6.1	0.01	6.95
10	0.95	2.98	6.1	0.02	9.13
15	1.42	6.31	6.1	0.05	12.50
20	1.89	10.75	6.1	0.08	16.98
25	2.36	16.24	6.1	0.13	22.53
30	2.84	22.75	6.1	0.19	29.11
35	3.31	30.26	6.1	0.26	36.70
40	3.78	38.74	6.1	0.34	44.84

Cole-Parmer 75507-60

Flow, GPM	Head, ft
0	42.5
5	41.25
10	40
15	38.75
20	37.5
25	35.75
30	34
35	31.75
40	29.5

Cole-Parmer 75507-50

Flow	Head
0	26
5	24.5
10	23
15	21.5
20	20
25	17.5
30	15
35	12
40	9



Where:

Hf = Friction Head loss in pipe by H-W equation, ft of water

Hs = Static head (elevation difference), ft of water

Hk = Friction Head loss through fittings, ft of water

$$Hf = .002083 * \mathrm{L}\left(\frac{100}{C}\right)^{1.85} * \left(\frac{GPM^{1.85}}{d^{4.8655}}\right) \qquad Hk = \Sigma K * \left(\frac{v^2}{2g}\right)$$

Made By: DPM
Checked: JRD
Reviewed: ATN