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November 24, 2014

Payson Long
Remedial Bureau E
Division of Environmental Remediation
New York State Department of Environmental Conservation
625 Broadway
Albany, NY 12233-7013

Re: Kingsbury Landfill
Final Remedial Systems Optimization Summary Report

Dear Mr. Long:

The Kingsbury Landfill (Site) is an 18 acre closed landfill located on Burgoyne Avenue in the Village of Hudson Falls, Washington County, New York (Figure 1). The Site operated as a municipal dump prior to the establishment of regulations covering the operation and construction of waste facilities from 1930 to 1985. Regulated hazardous wastes disposed of at the Site include PCB-laden oil waste as well as halogenated solvents. Leachate generated at this site reached several surface water bodies adjacent to the site including the feeder/tow canal, Cutter Pond and a forested swamp. The New York State Department of Environmental Conservation (NYSDEC) has assigned the Site the ID No. 5-58-008, and applied the designation of a Type 2 inactive hazardous waste site. The Type 2 designation identifies the site involving hazardous wastes and is a potential threat to human health and the environment.

The Site is underlain by broad deltaic sand deposits of the Oakville soil series, which are continuous across the majority of the site, then thin and grade into silt and clay deposits of the Vergennes and Kingsbury soil series in the southern portion of the site. The deltaic sand varies in thickness from 60 feet to absent near the groundwater - surface water interface. The deltaic sands have proven to be a part of the most productive aquifer in the area. The silt and clay deposits underlie the aquifer in sufficient thickness to create an effective aquitard between the glacial soil aquifer and the bedrock aquifer.

In-situ permeability tests conducted on the silt/clay layer by O'Brien & Gere (Kingsbury – Fort Edward Sites Engineering Report, 1982) ranged from 1.2×10^{-6} centimeters per second (cm/sec) to 2.0×10^{-7} cm/sec. A test conducted at boring K25 (Subsurface Investigations, Kingsbury Site Remedial Program, O'Brien & Gere, 1983), located between KLF-7 and KLF-8, found the permeability of the clay layer to be 1.85×10^{-7} cm/sec. Hydraulic conductivity tests conducted by E.C. Jordan (Hydrogeologic Report, Table 5-1, 1991) reported the following values for monitoring wells screened in the sand and clay layers along the northern boundary of the cutoff wall (boring locations are shown on Figure 2 and the screened intervals are shown on Figures 8 and 9):

Monitoring Well	Geologic Unit	Hydraulic Conductivity (cm/sec)
MW-90-2A	Clay	3.9×10^{-6}
MW-90-2B	Clay	5.6×10^{-5}
MW-90-2C	Sand	2.6×10^{-2}
MW-90-3A	Clay	2.0×10^{-4}
MW-90-3B	Clay	7.9×10^{-7}
MW-90-3C	Sand	2.1×10^{-2}
MW-90-6A	Clay	4.8×10^{-7}
MW-90-6B	Clay	8.4×10^{-6}
MW-90-6C	Sand	5.5×10^{-3}
MW-90-7A	Clay	4.1×10^{-7}
MW-90-7B	Clay	1.3×10^{-5}
MW-90-7C	Sand	1.2×10^{-4}

The bedrock underlying the soil is considered a poor aquifer due to its narrow productive joints and inconsistent yield.

Groundwater flow beneath the Kingsbury landfill appears to be in an east-southeasterly direction, primarily through the delta sand deposits. The groundwater elevations intersect the ground surface elevation immediately to the south of the landfill feeding a number of springs which form wetlands in low-lying areas. The soil profile changes at or near this southern portion of the site with the sand deposits grading into clay soils creating the groundwater - surface water interface. Prior to the installation of the soil cap and slurry wall, groundwater flow beneath the landfill was estimated to be on the order of 20,000 gallons per day (gpd) moving at a rate of 0.67 feet per day toward the south/southeast (E.C. Jordan, December 1991).

There is very little current data available to determine where groundwater is entering the landfill waste mass. A hydrogeologic study was conducted by E.C. Jordan in 1990 and 1991. The purpose of the study was to identify the cause of high groundwater levels in the landfill, evaluate the seasonal fluctuations of the water table in the landfill and to determine the optimum level to mitigate future releases of landfill leachate. Four scenarios were modeled: leakage through the base; infiltration through the cap; leakage through the slurry wall; and existence of a mound within the landfill. E.C. Jordan concluded that the most likely cause of elevated groundwater levels in the landfill was net leakage through the upgradient slurry wall as a result of a leaky or poorly-keyed slurry wall or a sand seam in the clay layer present beneath site (which the slurry wall is keyed in to) that daylighted in the upgradient waste mass.

During the one-month data collection event in performed in April, May and June 2013, the groundwater elevation data indicated the location of a potential leak area as described above. Triplet wells are present in three locations around the landfill. At each of the three triplet locations, the deepest well (designated A) is screened in the clay or till layer beneath the landfill. At well triplets MW-90-6 and MW-90-7, located on the upgradient side of the landfill, the groundwater levels outside the slurry wall are significantly higher than inside the slurry wall as shown on Table 1 and Figure 11. In particular, the elevation of MW-90-6A is approximately 5 ft higher outside the slurry wall than inside the slurry wall, indicating the wall is functioning as designed.

However, the situation is reversed at triplet wells MW-90-2 and MW-90-3, which are also located in a hydraulically upgradient location. The groundwater elevations in the “B” and “C” wells drops approximately 15 ft from outside the slurry wall to inside as shown on Figure 12, However, the groundwater elevation of the “A” wells only drops about 3 ft across the slurry wall and is nearly 8 ft higher than MW-90-3B and MW-90-3C. This differential would indicate an upward gradient inside the slurry wall through the clay/till unit into the overlying sand unit.

In order to understand the hydrogeology of the landfill, a water balance of the landfill was conducted. The water balance calculations and a conceptual diagram of the flow are included in Appendix A. The inflows entering the study area included upgradient groundwater and infiltration from rainfall. The upgradient groundwater component was determined using Darcy’s Law. Using data collected from two monitoring wells (MW-90-13 and GMW-1), approximately 18,200 gpd is estimated to enter the upgradient study area boundary (similar to the 20,000 gpd estimated by E.C. Jordon). The amount of water infiltrating was calculated using the average rainfall (40 inches per year) for the Hudson Falls, New York area. The amount of precipitation entering into the landfill waste mass via infiltration through the cap was assumed to be negligible (*i.e.*, the integrity of the cap is still good). This could not be field verified since the pan lysimeters are not functioning. The estimated 10 percent of the total amount of rainfall infiltration used in the calculations was for water entering the groundwater outside of the landfill cap but within the study area. The 10 percent infiltration is based on an engineering estimate. The remaining 90 percent would either evaporate or run off. Using this assumption, approximately 5,500 gpd would enter the groundwater outside of the landfill from average rainfall falling in the landfill cap. The total inflow into the study area is therefore 23,700 gpd.

The outflows from the landfill include water exiting the study area downgradient of the landfill, groundwater discharging into the Feeder Canal, and water pumped from the landfill by the Interim Leachate Collection Treatment System (ILCTS). Using data collected from a monitoring well (MW-90-14) and the pond located downgradient of the landfill, approximately 7,350 gpd is exiting the downgradient study area. Data recently collected during routine visits shows that the ILCTS is treating approximately 6,500 gpd. The percent of water entering the Feeder Canal was calculated by balancing the amount of water entering the study area by the amount of water leaving the study area. Along this line of reasoning, approximately 9,850 gpd was entering the Feeder Canal.

Remedial actions at the Site included the construction of an engineered cap and cover system (low permeability clay cap) over the waste mass, a leachate collection system, and a soil-bentonite groundwater cut-off wall (slurry wall). The installation of an environmental monitoring network consisting of monitoring wells, landfill gas vents, landfill gas monitoring points, and pan lysimeters established a system allowing for periodic sampling in order to provide data necessary to assess the effectiveness of the remedial measures completed at the Site. Periodic monitoring has been conducted utilizing portions of the available network providing analytical data necessary to determine whether the remedial activities completed at the Site remain effective in protecting the environment and human health.

The slurry wall is constructed of a soil bentonite mixture and surrounds the waste mass forming a barrier around the landfill to isolate the waste from the surrounding groundwater. The wall elevation and depth of construction varies to match the geologic conditions encountered. The depth of slurry wall placement is controlled by the underlying clay surface, with trenching terminating six feet into the underlying clay in order to create an impermeable seal. The slurry was placed without failing any required quality control testing, but was required to be extended deeper in areas to address localized permeable soils. The top elevation of the slurry wall ranges from 202 ft around southern perimeter of the landfill to nearly 235 ft along the northern perimeter (near monitoring well cluster MW-90-6).

Accumulation of large volumes of leachate following slurry wall construction lead to the determination that active leachate extraction was necessary in order to avoid slope instability and the release of leachate into the environment. In 1988 and 1989, upgrades were completed to the leachate collection system and an ILCTS was installed to remove and treat leachate from the landfill. The ILCTS was designed to reduce the leachate head in the landfill thereby protecting the integrity of the engineered cap and cover system and mitigating the potential for leachate release into the environment. The ILCTS was designed for a maximum capacity of 30 gallons per minute (gpm) estimated to be sufficient to maintain the leachate elevation at or below the 202 foot action level. The leachate collection system was renovated in response to operational problems in 1995 and in 2008.

The ILCTS began operation in 1991, removing and treating almost two million gallons of leachate. The ILCTS was modified in 1995 in response to a number of operational problems. After the renovation, the plant was prepared for an indeterminate period of inactivity based on measurements that indicated leachate elevations in the landfill did not rise to the action level as quickly as anticipated.

Since 1991, the leachate elevation within the landfill has been monitored periodically, and found to have reached the 200 foot action level in some of the wells in 1999. The elevation fluctuated and then continued to rise and stay above 200 ft. The NYSDEC restarted the leachate treatment system in August of 2002 and operated until late fall. The system was restarted in May 2003 and operated until late fall. The ILCTS was not operated the following year but was restarted in August 2005. ILCTS process improvements were made in the seasons mentioned above. The ILCTS was operated for several months each year (Spring through Fall) during the years 2002, 2003, 2005, 2007, 2008 and 2009. The ILCTS has been operating continuously since 2009.

Continuous operation of the ILCTS has resulted in significant annual expenses. Consequently, NYSDEC is looking at alternatives to continuous operation of the ILCTS. One alternative would be to divert upgradient groundwater around the slurry wall to relieve the migration of groundwater under the wall. In order to evaluate this option, AECOM Technical Services Northeast, Inc. (AECOM) completed a series of geotechnical borings to evaluate whether a dewatering trench could be installed upgradient of the cut-off wall at the Site.

Twelve soil borings were installed at the Site along the northern perimeter road as shown on Figure 2. The proposed trench line is parallel to the road. Three of these locations were competed as piezometers (KLF-2, KLF-8 and KLF-10) and the other nine were grouted upon completion. After the borings were installed, groundwater elevations were monitored to establish the hydrogeologic conditions along the northern perimeter of the landfill. Groundwater levels were gauged weekly from monitoring wells at the Site for a period of two months. The data are included in Table 1. Two groundwater contour maps were prepared (data collected on April 25, 2013 and June 6, 2013) and are included as Figures 3 and 4. Hydrographs of the groundwater data were also prepared and included as Figures 5 and 6. As shown on the contour maps and the hydrographs, groundwater elevations varied only slightly during the two-month monitoring period.

A geologic cross-section was prepared using the data from the 12 soil borings and is included as Figure 7. Surface elevations along the perimeter road range from nearly 230 ft near the feeder tow road (KLF-1) to less than 200 ft at KLF-12 (eastern side of the landfill). The depth to the sand/clay contact varies significantly along the northern perimeter of landfill from approximately 25 feet below ground surface (ft bgs) at KLF-12 to 60 ft bgs at KLF-5. Groundwater elevations along the proposed trench line are slightly above 200 ft at the western side of line (KLF-2) and rise to approximately 210 ft near monitoring well cluster MW-90-2 and piezometer KLF-8. Groundwater elevations begin to decrease east of monitoring well cluster MW-90-6 and drop to less than 180 ft by MW-15, the eastern most monitoring well.

Two additional cross-sections were prepared to illustrate the difference in groundwater elevation across the cutoff wall. Figure 8 shows the variation in groundwater elevation at monitoring well clusters MW-90-2 and MW-90-3. There is a significant difference in groundwater elevation inside the cutoff wall depending on which wells are compared. The two wells screened in the sand and clay layers are 10 to 15 ft lower than monitoring wells outside the wall; however, the difference between MW-90-2A and MW-90-3A is only a few feet, indicating a significant upward gradient from the till layer found beneath the sand and clay layers inside the cutoff wall.

Figure 9 illustrates the groundwater elevation difference across the cutoff wall at monitoring well clusters MW-90-6 and MW-90-7. The groundwater elevation difference is approximately 10 to 12 ft. There does not appear to be the same upward gradient from the till to the sand layer as noted at monitoring well clusters MW-90-2 and MW-90-3 when comparing the three wells inside the cutoff wall.

The elevation of the pond located east of the landfill is approximately 175 ft as determined from USGS maps. This is approximately 20 ft lower than the surface elevation at KLF-12. It appears that if the groundwater elevation can be lowered to approximately 195 ft near KLF-2 and 185 ft near KLF-12, a passive gravity fed dewatering trench along the northern perimeter road should eliminate the need continuous pumping of the Interim Leachate Collection and Treatment System. A conceptual drawing of the proposed dewatering trench is shown on Figure 10. The cross section is at monitoring wells GMW-5 (inside the slurry wall) and MW-90-4 (outside the slurry wall). Several configurations of the trench were considered. The first option, 3A, is a single 12-inch pipe that would discharge to the pond east of the Site. The second option, 3B, has two 6-inch drain lines that would drain to the pond. The third option (3C) is similar to option 3B with two 6-inch drain lines; however, the shallow lines would drain to both the pond and the Feeder Canal. The drain lines would be valved to allow the discharge rate to be adjusted to regulate the drawdown in the trench.

Due to the history of this Site, a formal Record of Decision (ROD) or decision document was not prepared. Consequently, there are no formal remedial action objectives (RAOs). In light of this situation, the following RAOs are proposed:

1. Prevent contaminant discharge to surface water;
2. Prevent contaminant migration via groundwater from the landfill;
3. Maintain the landfill cap;
4. Control leachate generation; and
5. Source control.

Preventing contaminant discharge to surface water (RAO 1) can be achieved through monitoring the effluent discharge from the ILCTS and through periodic monitoring the landfill cap to look for seeps that might allow leachate to travel along the drainage swales to either the Feeder Canal or the pond east of the Site.

Preventing contaminant migration via groundwater (RAO 2) can be achieved through periodic sampling of the monitoring well network to identify any contaminant plumes emanating from the landfill.

Maintaining the landfill cap (RAO 3) can be achieved through periodic inspections of the landfill cap and monitoring of leachate levels inside the slurry wall.

Controlling leachate generation (RAO 4) can be achieved through cap maintenance and by monitoring leachate levels inside the slurry wall.

Source control (RAO 5) can be achieved through continued operation of the ILCTS to maintain leachate levels below the 200 ft elevation action level.

As part of the remedial optimization, five remedial options for the Kingsbury landfill were evaluated which included:

1. Upgradient groundwater extraction wells
2. Grout barrier upgradient of the Landfill

3. Passive dewatering trench
4. Install additional extraction points inside the cutoff wall near GMW-5 (upgradient side)
5. Continued operation of the current O&M system (baseline option)

The first four options present remedial measures to replace the current ILCTS. The costs for continued operation of the ILCTS were then calculated to present a baseline cost to compare the four options against.

A brief summary of each option is presented in Appendix B. The summary details each option along with the potential benefits and issues. A cost estimate is included at the end of Appendix B.

As shown in the cost summary in Appendix B, the estimated cost for installation of upgradient extraction wells is $2,820,000 (Option 1). The estimated cost to install a grout barrier upgradient of the landfill to divert groundwater around the landfill is $3,160,000 (Option 2). The estimated cost to install a gravity drain upgradient of the landfill with a single 12-inch line discharging to the pond east of the Site is $2,380,000 (Option 3A). A gravity drain with two 6-inch lines (one shallow and one deeper) discharging to the pond is estimated at $2,390,000 (Option 3B). A gravity drain with two 6-inch lines, with the shallow lines that drain to both the pond and the Feeder Canal is estimated at $2,560,000 (Option 3C). (Note that it is impractical to drain the deeper line to the Feeder Canal due to the elevation of the deeper drain line and the bottom of the Feeder canal.) The cost to install additional extraction wells inside the landfill is $4,060,000 (Option 4). The estimated cost for continued operation of the ILCTS is $4,000,000 over a 30-year period (Option 5, baseline cost).

Green and sustainable remedial calculations (GSR) for the five options were also prepared and are presented in Appendix B. The last two pages of the GSR calculations show projected electric usage and greenhouse gas (GHG) emissions over the 30 year operations span.

In comparing the options for projected electric usage, Options 2 (grout barrier), 3A, 3B and 3C, (dewatering trench) rank lowest in electric usage with 125,000 kilowatt hours (kwh), followed by Option 1 (pump discharge) at 2,030,000 kwh and Options 4 (pump discharge within the landfill) and 5 (continued operation of the ILCTS) at 3,750,000 kwh.

GHG emissions were calculated for carbon dioxide, carbon monoxide, nitrogen oxides, sulfur oxides and particulates (PM10 & PM2.5), Options 3A, 3B and 3C (dewatering trench) tended to have the lowest emissions numbers followed by Option 1 (upgradient extraction wells). Option 4 (pump discharge within the landfill) and Option 5 (continued operation of the ILCTS) had very similar numbers for each of the six categories with Option 4 tending to have slightly higher numbers. Option 2 (grout barrier) had the highest emissions numbers. As noted in the summary tables, Option 2 included emissions for cement manufacturing and on-site installation of the grout barrier.

Upon selection of one of the above remedial alternatives by NYSDEC, AECOM will prepare design drawings for the construction of the approved remedy at the Site.

Very truly yours,
AECOM Technical Services Northeast, Inc.

Paul Kareth
Project Manager

Scott Underhill, PE
Program Manager

Enclosures

Tables

Table 1
Kingsbury Landfill, Site 5-58-008
Groundwater Elevations - Arpil through June 2013

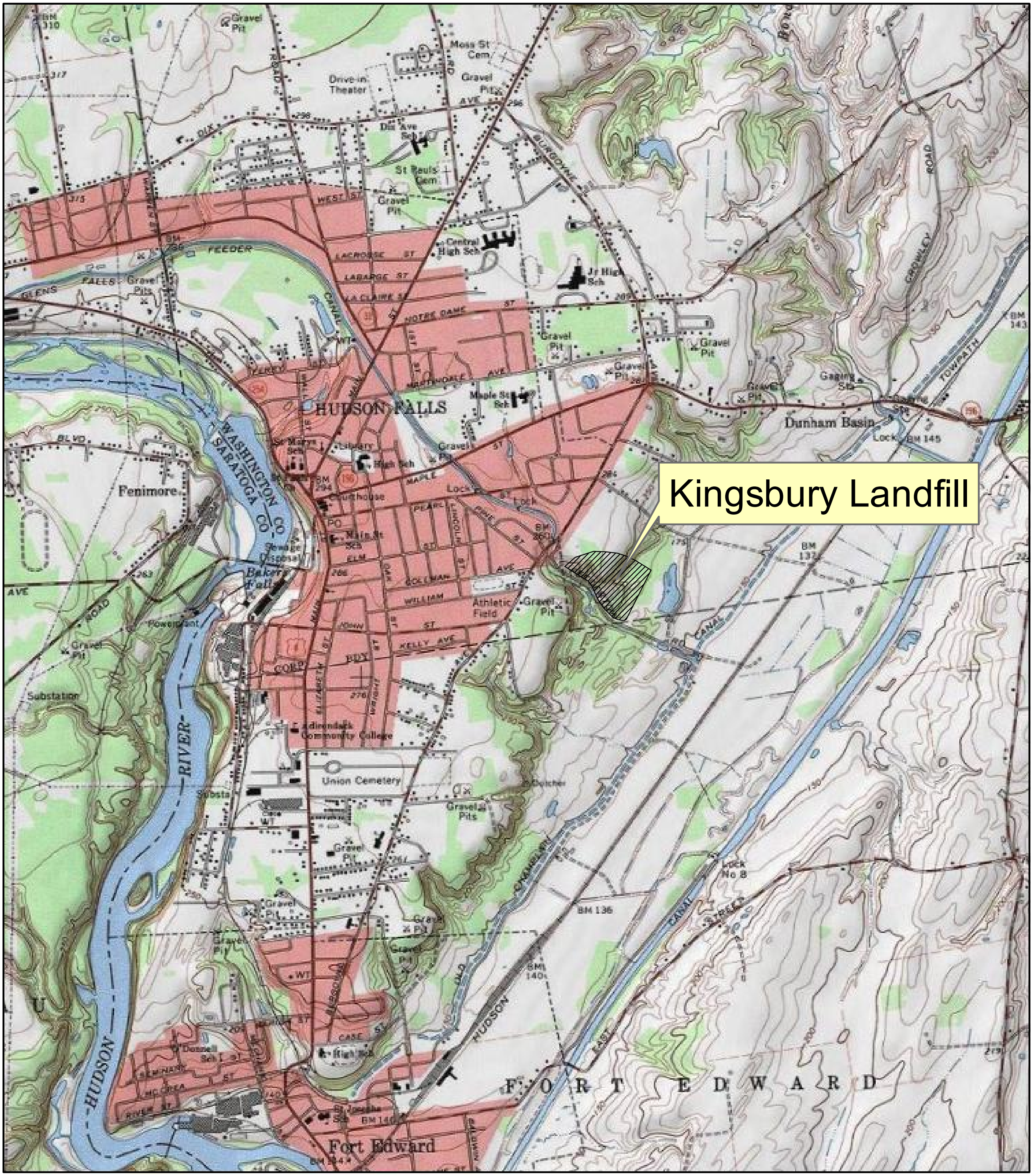
	Well ID	Slurry Wall Inside	Slurry Wall Outside	Ref El. (ft)	Date 4/18/13	4/25/13	5/2/13	5/9/13	5/16/13	5/23/13	5/30/13	6/6/13	6/13/13	6/20/13
Upgradient Wells	KLF-02		X	227.93	205.02	202.92	203.06	203.31	203.15	203.09	203.06	202.98	203.27	NC
	MW-90-1		X	220.68	209.88	209.87	209.86	209.91	209.87	209.87	209.86	209.87	210.06	NC
	MW-90-12		X	216.01	NC	210.73	NC	210.64	NC	210.71	NC	210.71	NC	NC
	PW-90-1		X	216.16	210.85	210.84	210.84	210.89	210.83	210.85	210.85	210.97	211.01	NC
	MW-90-2A		X	216.46	NC	210.89	NC	208.00	NC	207.97	NC	207.95	NC	NC
	MW-90-2B		X	216.38	NC	210.79	NC	210.81	NC	210.83	NC	211.17	NC	NC
	MW-90-2C		X	216.48	NC	210.85	210.85	210.88	210.85	210.83	210.85	210.85	210.88	210.96
	MW-90-3A	X		222.66	NC	204.55	NC	204.80	NC	204.66	NC	204.65	NC	NC
	MW-90-3B	X		222.45	NC	201.42	NC	195.97	NC	195.91	NC	195.95	NC	NC
	MW-90-3C	X		223.10	NC	195.56	195.67	195.79	195.67	195.60	195.59	195.60	195.58	195.58
	MW-90-4		X	219.24	NC	210.81	210.73	210.76	210.73	210.72	210.71	210.85	213.94	210.88
	GMW-5	X		223.39	NC	196.81	196.75	196.84	196.78	196.67	196.67	196.27	196.77	196.70
	GMW-1		X	273.32	210.71	211.73	211.70	211.75	211.50	211.70	211.75	211.77	211.89	NC
	KLF-08		X	218.80	211.23	211.22	211.50	211.20	211.18	211.17	211.17	211.33	211.45	NC
	MW-90-5		X	212.43	NC	209.14	209.11	209.10	209.02	209.05	209.14	209.19	209.46	209.30
	MW-90-13		X	212.37	208.33	208.31	207.66	208.15	208.08	208.07	208.15	207.98	208.60	NC
	PW-90-2		X	212.23	208.00	207.97	207.84	207.81	207.72	207.71	207.85	208.11	208.38	NC
	MW-90-6A		X	215.34	NC	202.81	NC	200.37	NC	199.08	NC	199.10	NC	NC
	MW-90-6B		X	215.14	NC	204.01	NC	203.82	NC	203.69	NC	203.70	NC	NC
	MW-90-6C		X	214.89	NC	207.56	207.42	207.39	207.31	207.29	207.28	207.28	208.00	207.66
	MW-90-7A	X		221.48	NC	194.11	NC	193.98	NC	193.85	NC	193.95	NC	NC
	MW-90-7B	X		221.66	NC	195.21	NC	195.22	NC	195.08	NC	195.25	NC	NC
	MW-90-7C	X		220.95	NC	195.24	195.33	195.45	195.35	195.30	195.24	195.34	195.35	195.21
	KLF-10		X	210.01	194.72	194.72	194.39	194.22	194.03	193.92	193.94	193.99	195.53	NC
Sidegradient Wells	GMW-2		X	198.20	188.41	188.52	188.23	187.97	187.77	187.55	188.23	187.58	188.73	NC
	MW-18		X	198.60	dry	dry	dry	dry	dry	dry	dry	dry	189.03	NC
	MW-15		X	185.53	176.56	179.57	179.41	176.30	176.22	178.79	176.79	178.80	180.26	NC
	MW-90-10A		X	206.06	NC	188.28	NC	188.10	NC	187.87	NC	188.08	NC	NC
	MW-90-10B		X	205.84	NC	189.58	NC	189.14	NC	188.64	NC	189.58	NC	NC
	MW-90-10C		X	205.98	NC	188.36	188.47	188.52	188.52	188.46	188.47	188.43	188.44	188.01
	MW-90-11A	X		212.06	NC	189.12	NC	189.09	NC	188.92	NC	188.96	NC	NC
	MW-90-11B	X		211.70	NC	191.94	NC	191.58	NC	190.92	NC	191.02	NC	NC
	MW-90-11C	X		212.36	194.91	194.74	194.85	194.90	194.90	194.79	194.85	194.81	194.82	194.39

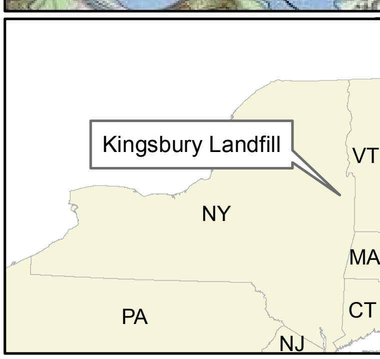
Table 1
Kingsbury Landfill, Site 5-58-008
Groundwater Elevations - Arpil through June 2013

	Well ID	Slurry Wall Inside	Slurry Wall Outside	Ref El. (ft)	Date 4/18/13	4/25/13	5/2/13	5/9/13	5/16/13	5/23/13	5/30/13	6/6/13	6/13/13	6/20/13
Downgradient Wells	MW-8A		X	180.47	NC	176.77	NC	176.76	NC	176.63	NC	176.72	NC	NC
	MW-90-14		X	187.66	NC	176.50	NC	176.46	NC	176.26	NC	176.27	NC	NC
	MW-90-8A		X	207.26	NC	180.77	NC	dry	NC	dry	NC	dry	NC	NC
	MW-90-8B		X	206.42	NC	195.50	NC	195.42	NC	182.57	NC	182.67	NC	NC
	MW-90-9A	X		213.58	NC	184.51	NC	184.44	NC	184.26	NC	184.37	NC	NC
	MW-90-9B	X		213.35	NC	dry	NC	dry	NC	dry	NC	dry	NC	NC
	GMW-3		X	181.06	NC	177.68	177.53	177.39	177.25	177.10	177.25	177.49	178.01	178.00
	MW-RW-1	X		215.60	NC	194.22	194.21	194.39	194.35	194.22	194.21	194.11	194.29	194.00
	MW-8		X	181.68	NC	176.76	175.64	174.92	174.90	174.53	177.60	176.39	176.90	176.12
	GMW-4		X	187.18	NC	178.72	177.69	178.40	178.17	178.34	178.40	178.74	179.19	179.03
	GMW-6	X		228.85	NC	195.56	195.64	195.43	195.64	195.57	195.56	195.62	195.35	195.43

NC - Not collected

Figures





USGS Hudson Falls Quadrangle

U.S.G.S. 1:24 000 SCALE TOPOGRAPHIC MAP

Prepared by: AECOM

Prepared for: New York State Department of Environmental Conservation

Kingsbury Landfill
NYSDEC Slte #5-58-008
Village of Hudson Falls, Washington County

Site Location

Date:	Scale:	Figure No. :
August 2013	1 inch = 2,500 feet	1

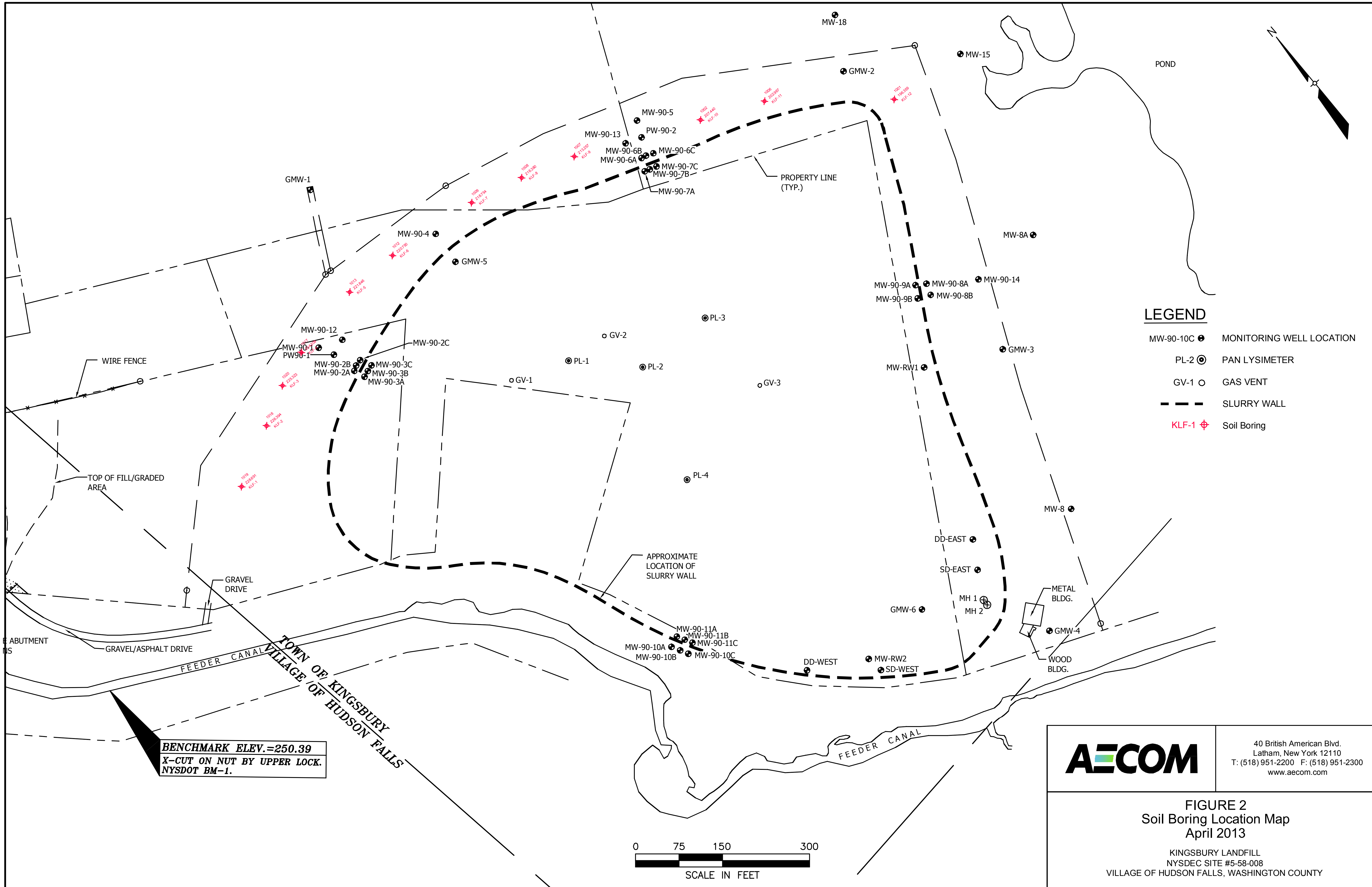


FIGURE 2
Soil Boring Location Map
April 2013

KINGSBURY LANDFILL
NYSDEC SITE #5-58-008
VILLAGE OF HUDSON FALLS, WASHINGTON COUNTY

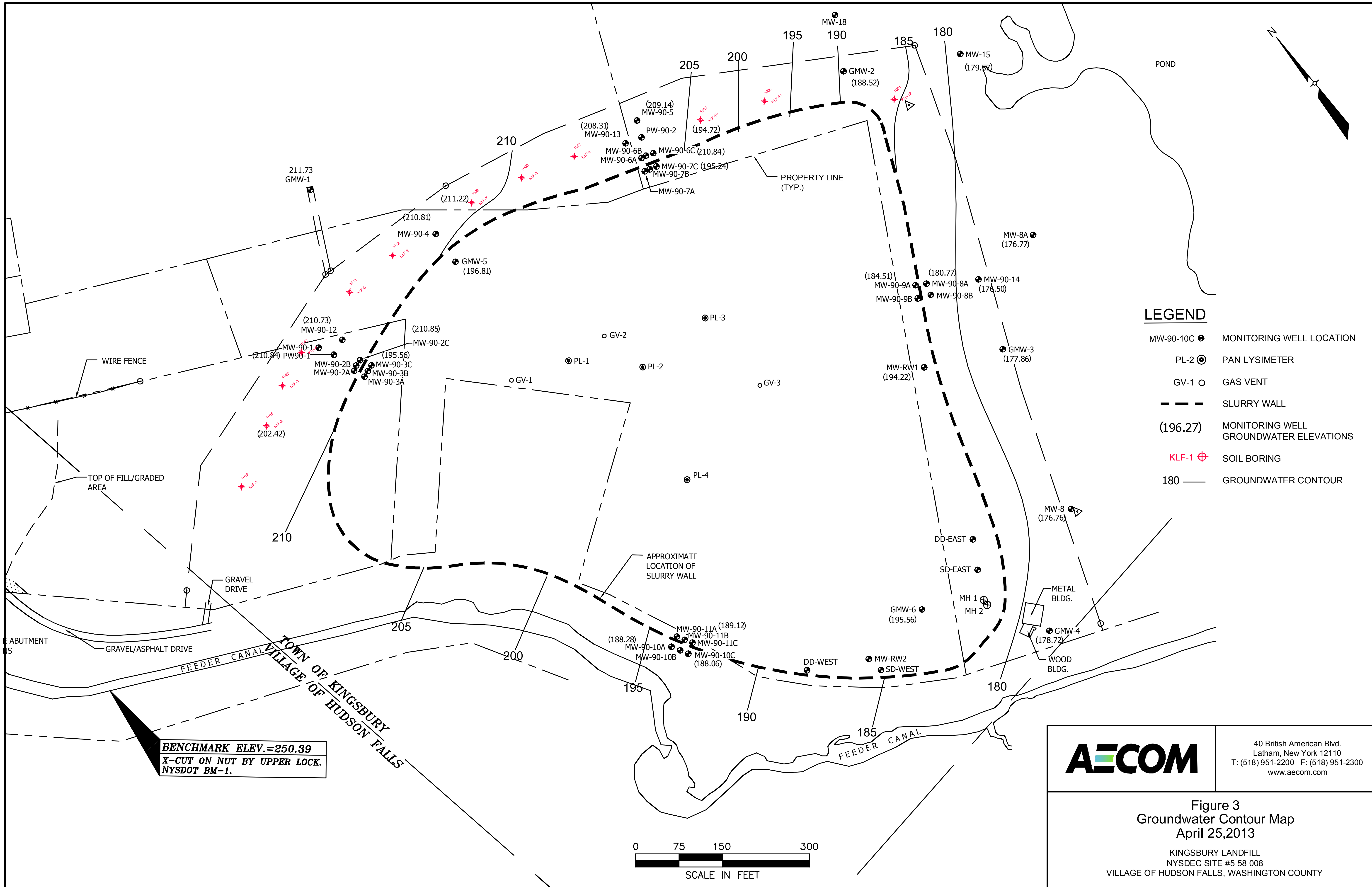


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Figure 3
Groundwater Contour Map
April 25,2013

KINGSBURY LANDFILL
NYSDEC SITE #5-58-008
VILLAGE OF HUDSON FALLS, WASHINGTON COUNTY

MAY 2013
60277036

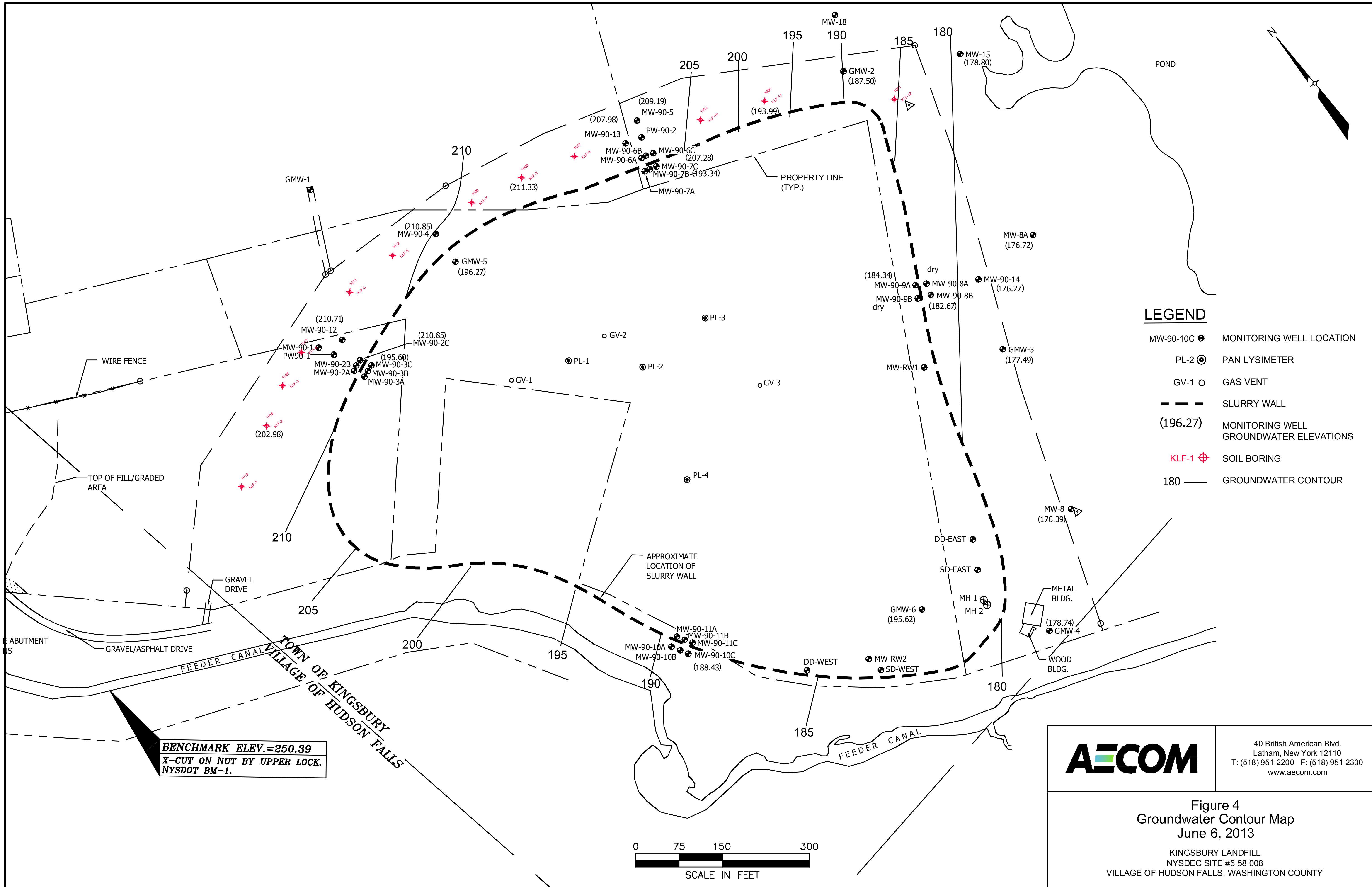

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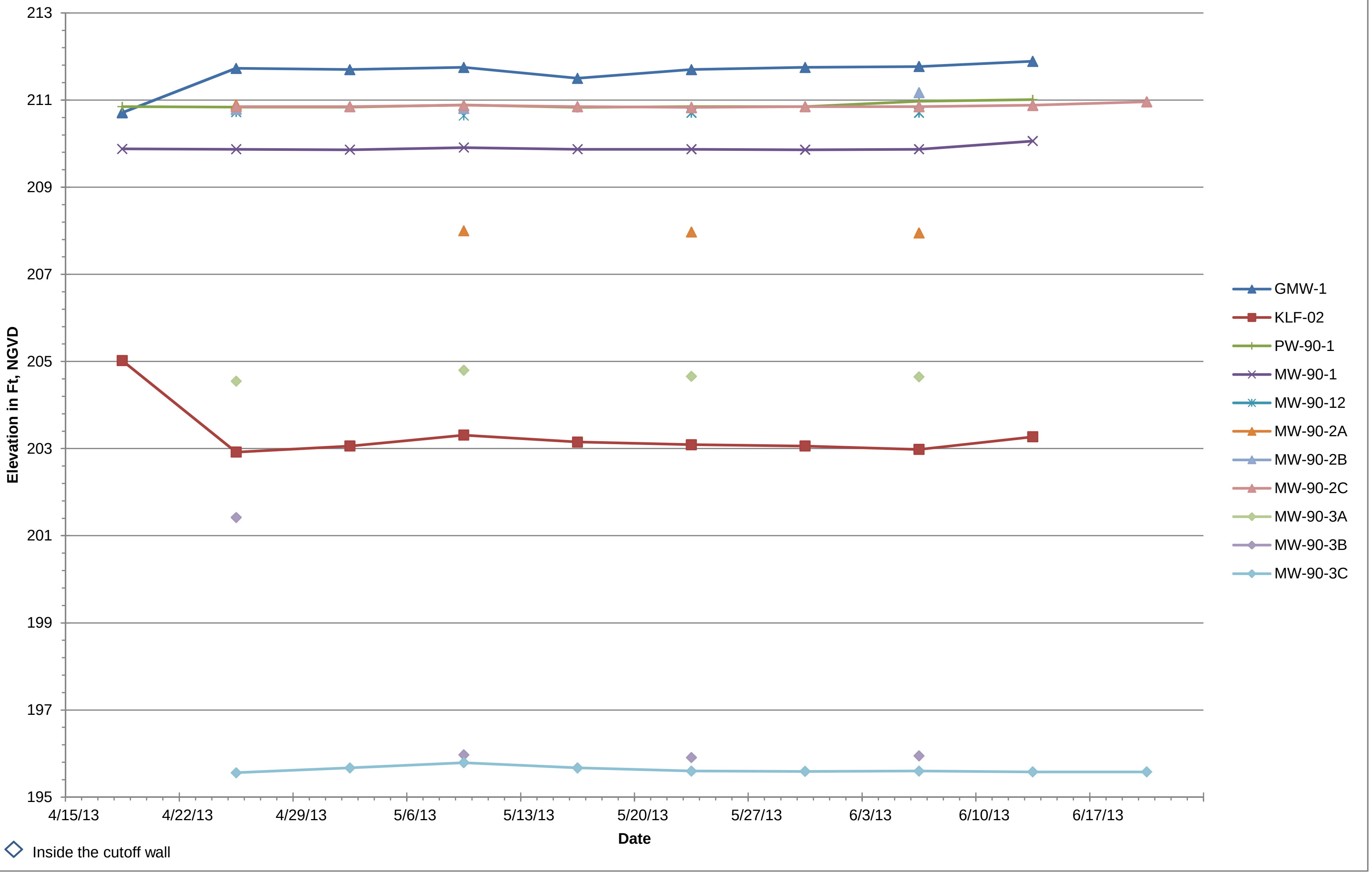
Figure 4
Groundwater Contour Map
June 6, 2013

KINGSBURY LANDFILL
NYSDEC SITE #5-58-008
VILLAGE OF HUDSON FALLS, WASHINGTON COUNTY

MAY 2013

60277036

FIGURE 5
GROUNDWATER HYDROGRAPH
WESTERN SIDE OF THE PROPOSED TRENCH
KINGSBURY LANDFILL (5-58-008)



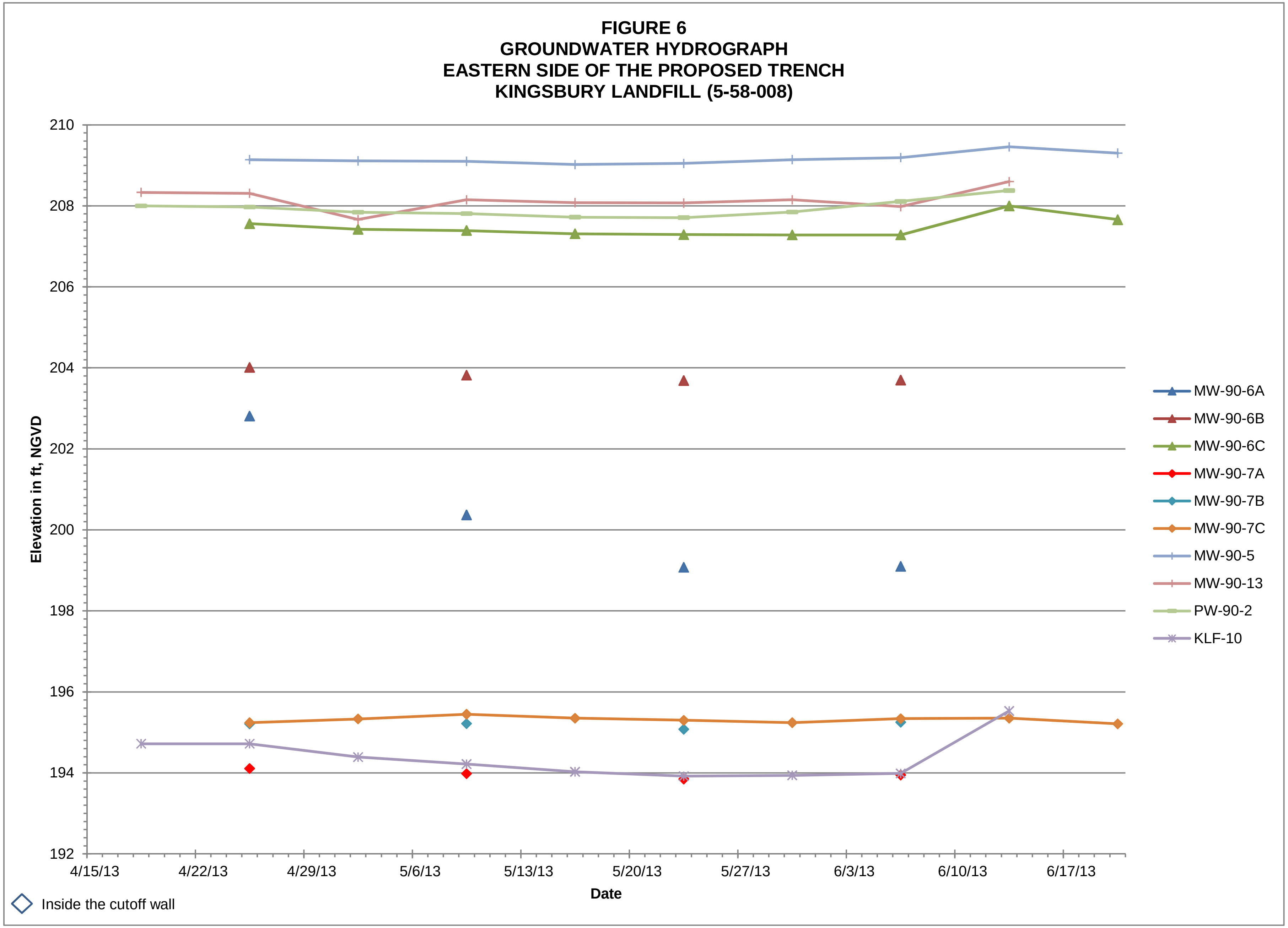
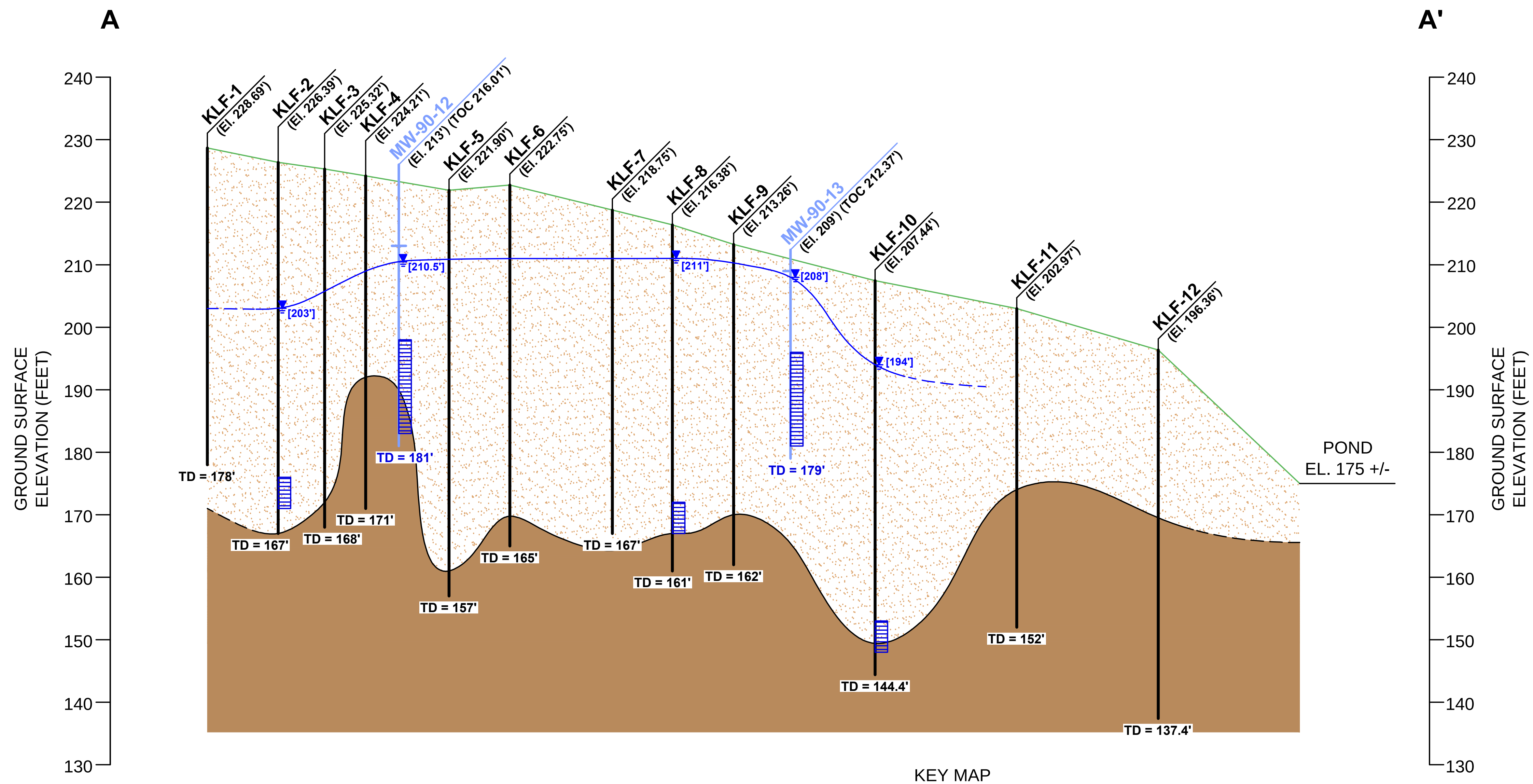
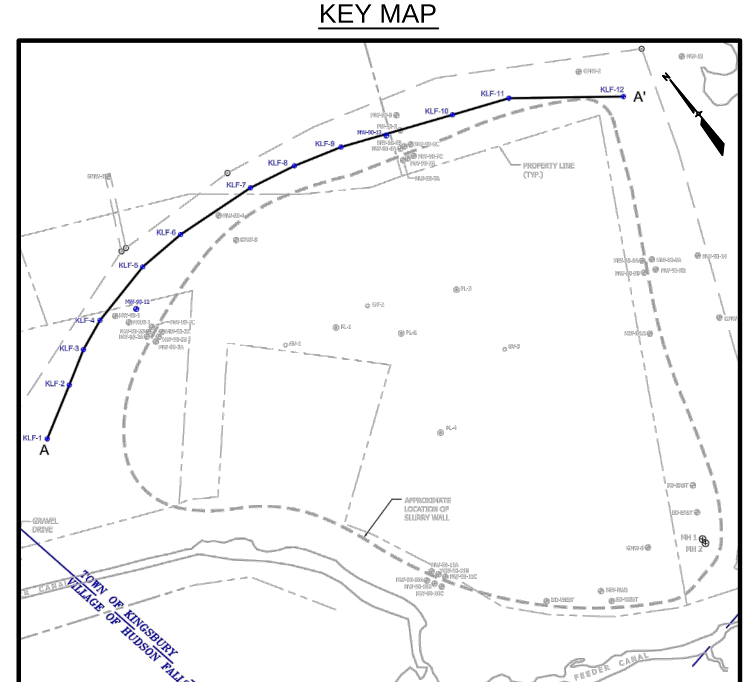


FIGURE 6
GROUNDWATER HYDROGRAPH
EASTERN SIDE OF THE PROPOSED TRENCH
KINGSBURY LANDFILL (5-58-008)
Elevation in ft, NGVD
210
208
206
204
202
200
198
196
194
192
4/15/13
4/22/13
4/29/13
5/6/13
5/13/13
5/20/13
5/27/13
6/3/13
6/10/13
6/17/13
Date
MW-90-6A
MW-90-6B
MW-90-6C
MW-90-7A
MW-90-7B
MW-90-7C
MW-90-5
MW-90-13
PW-90-2
KLF-10
Inside the cutoff wall



KEY MAP



HORIZONTAL SCALE: 0 100 200 400 SCALE IN FEET

VERTICAL SCALE EXAGGERATION 10x: 0 10 20 40 SCALE IN FEET

LEGEND:

- [203'] GROUNDWATER ELEVATIONS FROM JUNE 6, 2013 (DASHED WHERE INFERRED)
- TOC TOP OF CASING
- TD = TOTAL DEPTH
- SAND
- CLAY
- SCREEN
- BORING

NOTES:

1. GEOLOGIC CROSS SECTION DISPLAYED POINT TO POINT ALONG SOIL BORINGS, GROUNDWATER AND WELL INFORMATION IS PROJECTED.
2. CROSS-SECTION IS FOR CONCEPTUAL PURPOSES ONLY.

AECOM

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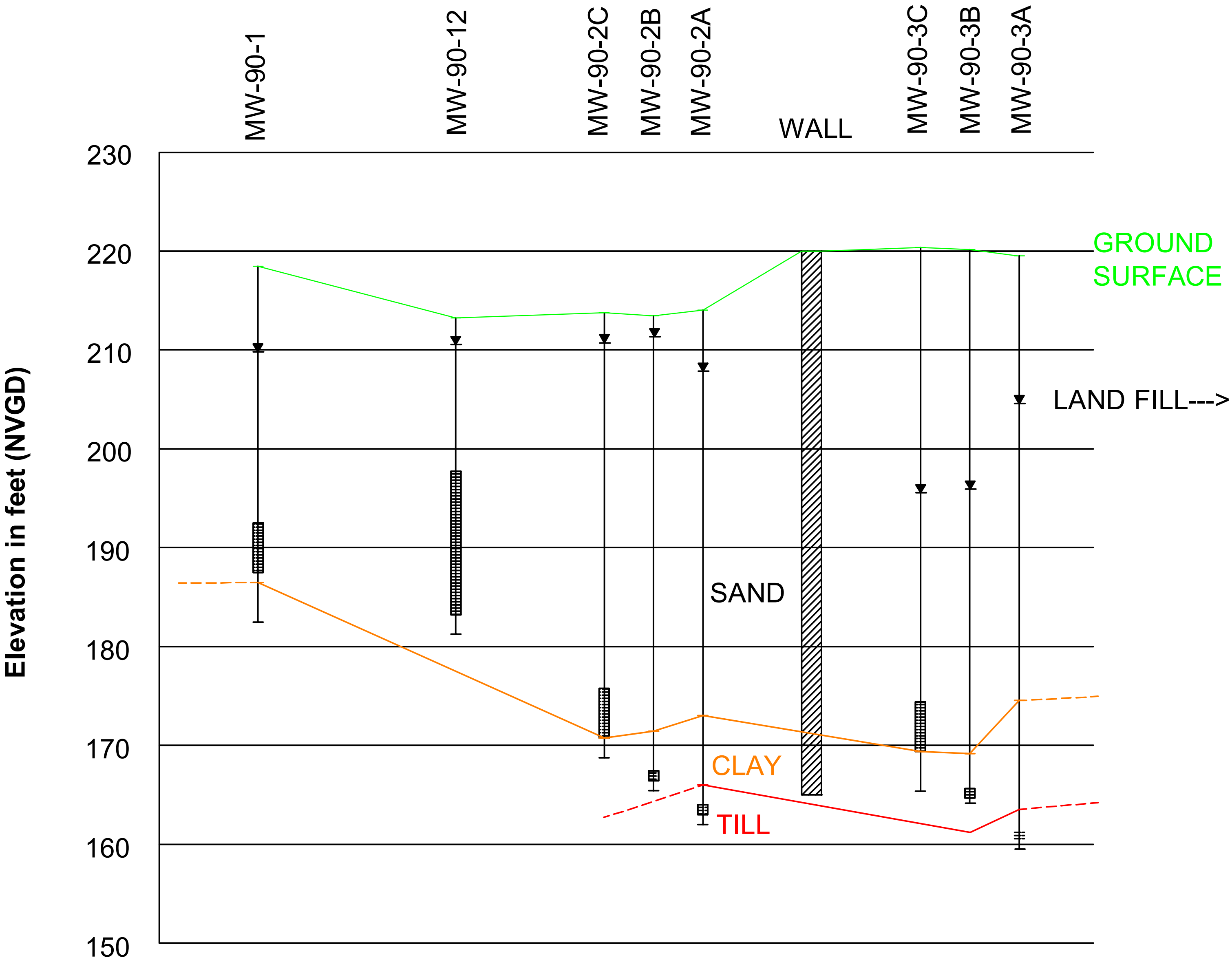
Latham, New York 12110
T: (518) 951-2200 F: (518) 951-2300
www.aecom.com

FIGURE 7
GEOLOGIC CROSS-SECTION

KINGSBURY LANDFILL
NYSDEC SITE #5-58-008
VILLAGE OF HUDSON FALLS, WASHINGTON COUNTY

AUGUST 2013 60277036



Notes:

▼ Water Level June 6, 2013

Horizontal axis not to scale. Refer to Figure 2 for well locations

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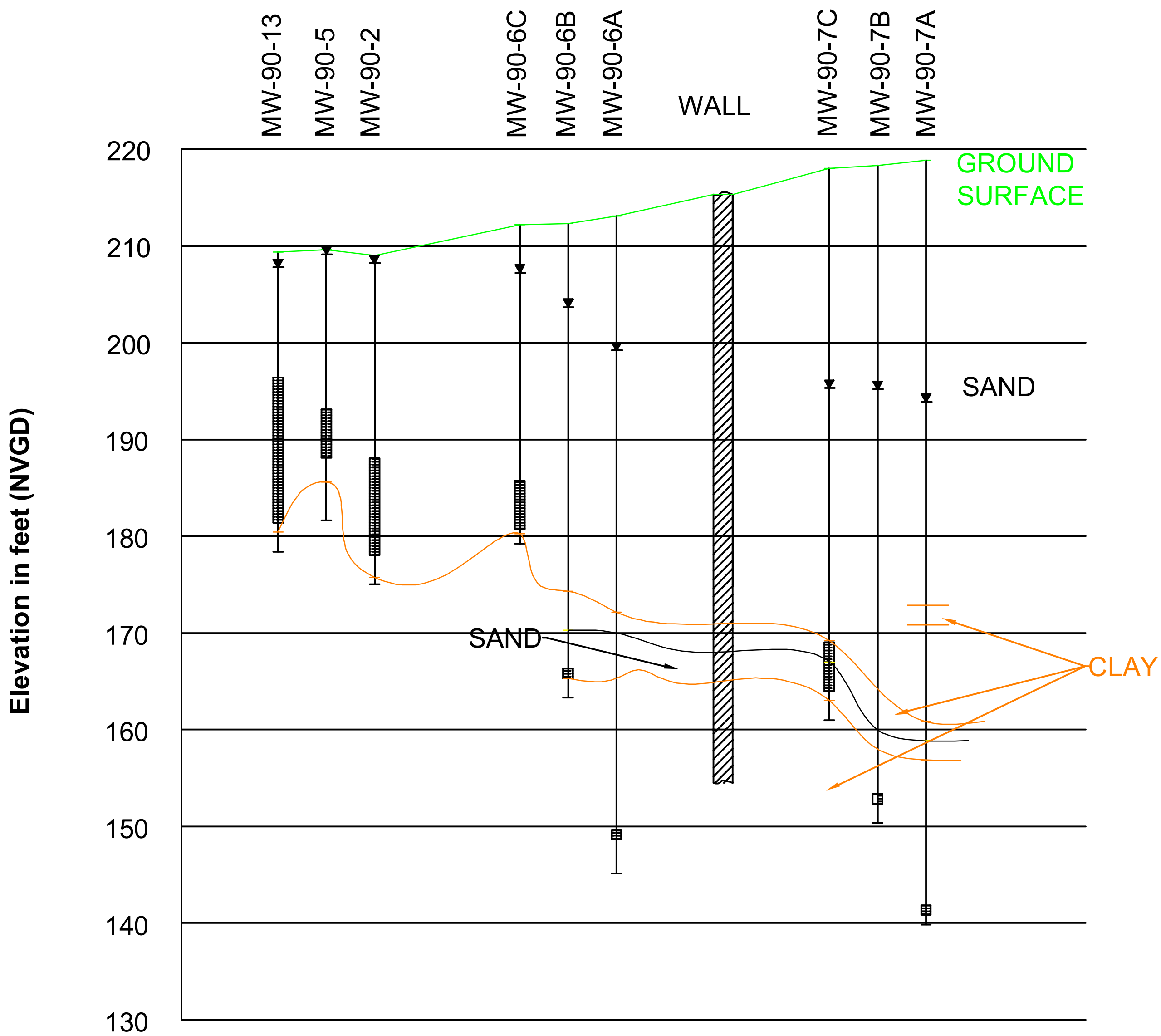
FIGURE 8
Geologic Cross Sections at Monitoring Well Clusters MW-90-2 and MW-90-3

KINGSBURY LANDFILL
NYSDEC SITE #5-58-008
VILLAGE OF HUDSON FALLS, WASHINGTON COUNTY

AUGUST 2013 60277036



Notes:

▼ Water Level June 6, 2013

Horizontal axis not to scale. Refer to Figure 2 for well locations

AECOM

40 British American Blvd.
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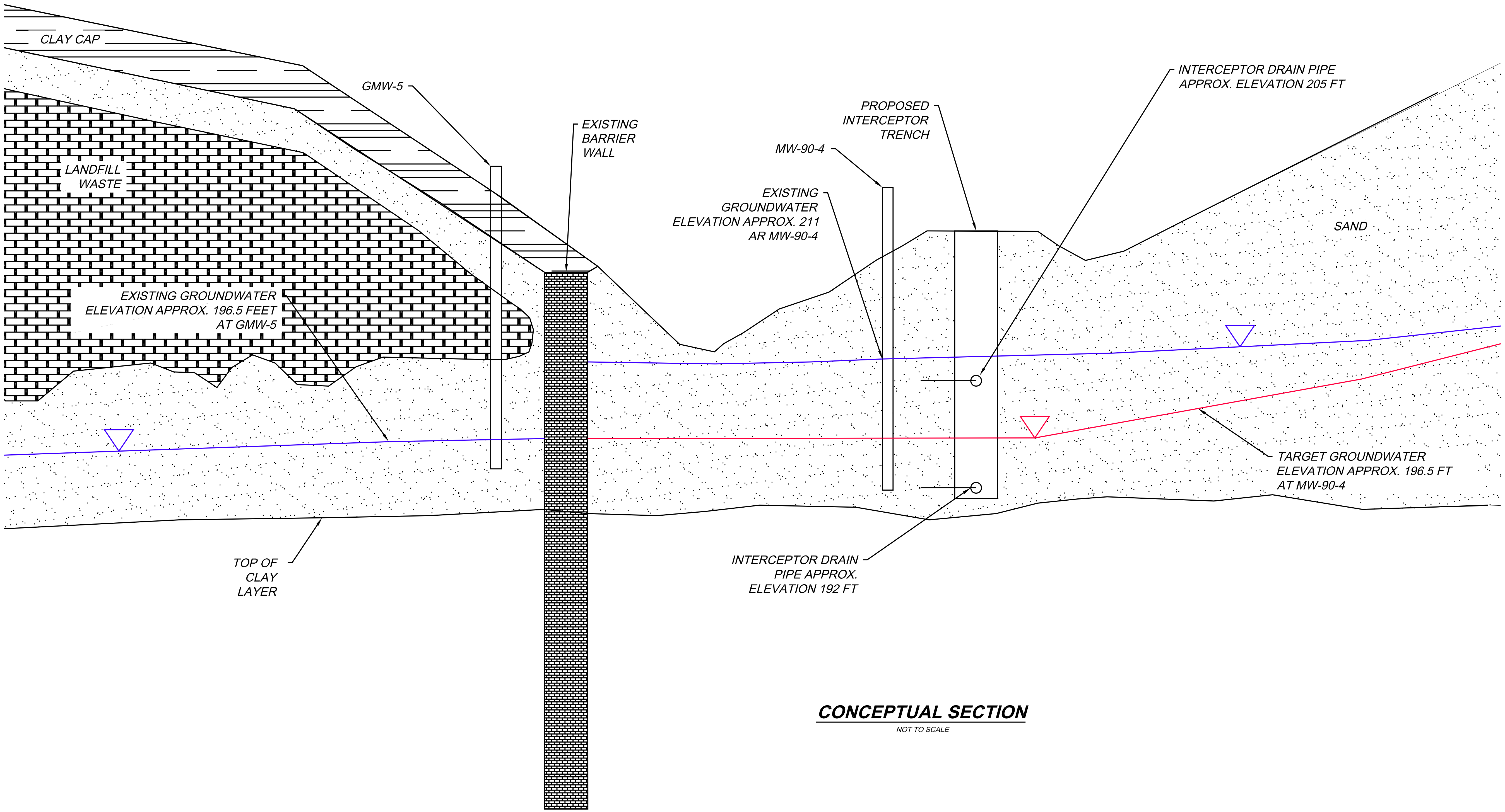
FIGURE 9
Geologic Cross Sections at Monitoring Well Clusters MW-90-6 and MW-90-7

KINGSBURY LANDFILL

NYSDEC SITE #5-58-008
VILLAGE OF HUDSON FALLS, WASHINGTON COUNTY

AUGUST 2013 60277036



CONCEPTUAL SECTION

NOT TO SCALE

Issue Status: DRAFT

AECOM

Figure: 10

CONCEPTUAL SECTION

KINGSBURY LANDFILL SITE
NYSDEC SITE #
KINGBURY, NEW YORK
Project No. 60277036 Date: NOVEMBER 2014

Project Management Initials: Designer: Checked: Approved: ANSI B 11" x 17"

Last saved by: THORPEM(2014-11-21) Last Plotted: 2014-11-21
Filename: \\USABY2FP001\DATA\PROJECTS\99164\CADD\RSO\RSO-FIGURE-X_KLF CONCEPTUAL TRENCH 2014.11.21.DWG

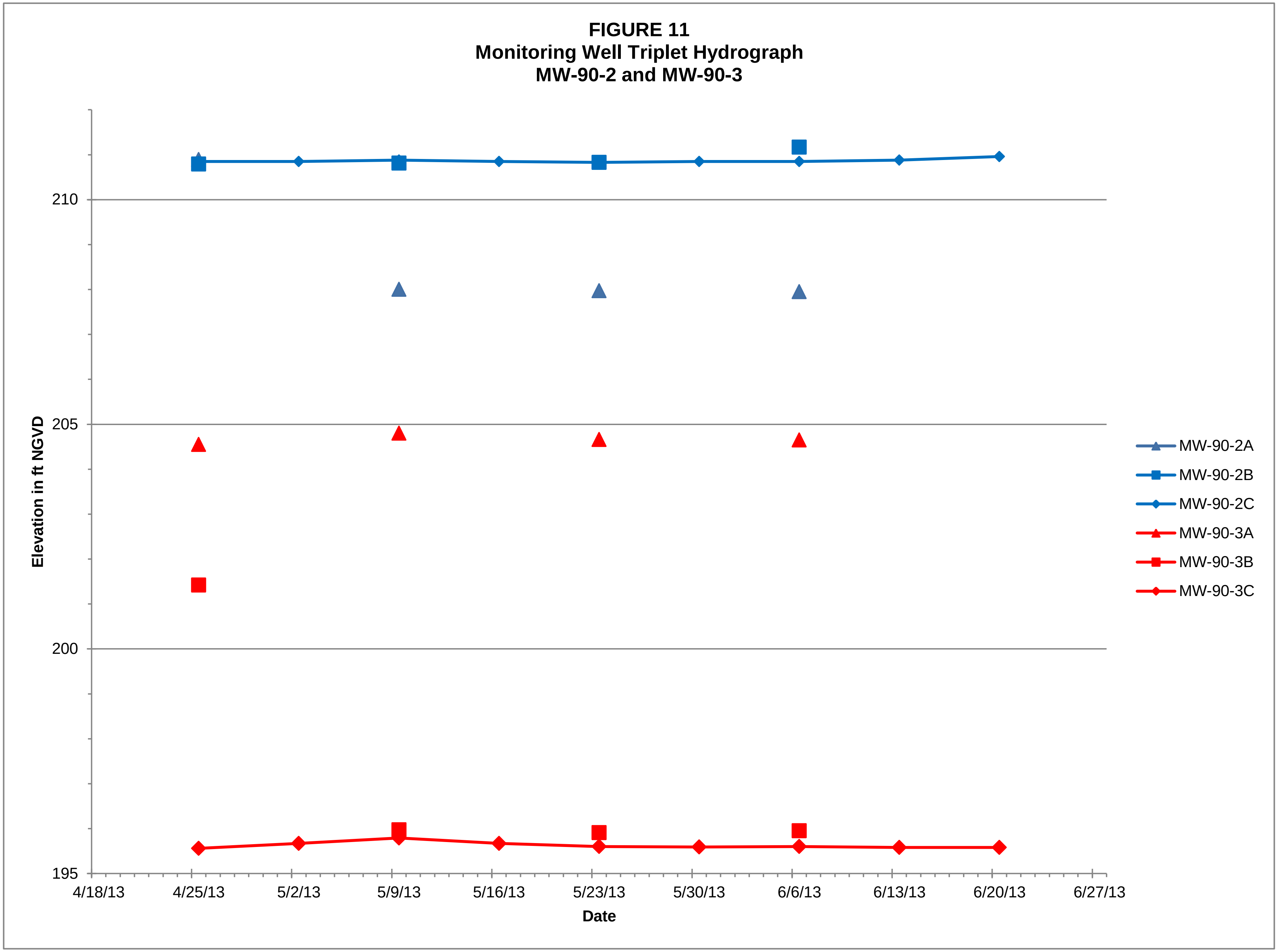


FIGURE 11
Monitoring Well Triplet Hydrograph
MW-90-2 and MW-90-3
Elevation in ft NGVD
210
205
200
195
4/18/13
4/25/13
5/2/13
5/9/13
5/16/13
5/23/13
5/30/13
6/6/13
6/13/13
6/20/13
6/27/13
Date
MW-90-2A
MW-90-2B
MW-90-2C
MW-90-3A
MW-90-3B
MW-90-3C

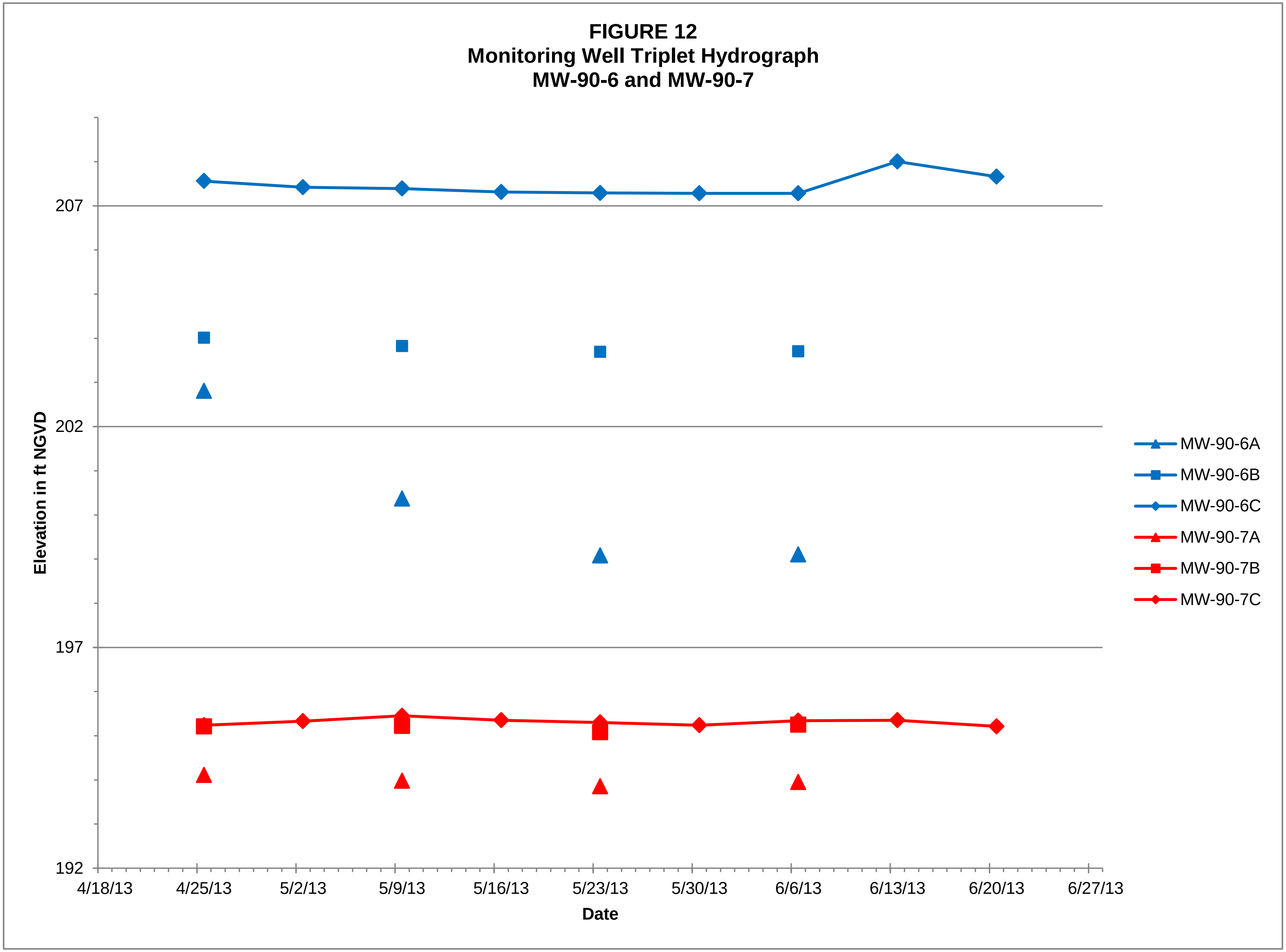


FIGURE 12
Monitoring Well Triplet Hydrograph
MW-90-6 and MW-90-7
Elevation in ft NGVD
207
202
197
192
4/18/13
4/25/13
5/2/13
5/9/13
5/16/13
5/23/13
5/30/13
6/6/13
6/13/13
6/20/13
6/27/13
Date
MW-90-6A
MW-90-6B
MW-90-6C
MW-90-7A
MW-90-7B
MW-90-7C

Appendix A

Water Balance Calculations

Task

Estimate the flow of water traveling upgradient and downgradient of the Kingsbury landfill.

References

EC Jordan Co., Kingsbury Landfill Site: Hydrogeologic Report Volume 1 – Text, December 1991.

Water Balance Calculations

K = hydraulic Conductivity
i = Hydraulic Gradient (∆h/∆l)
A = Cross-Sectional Area to the flow path

Influent Calculations

Q=kiA

Wells Used: MW-90-13 and GMW-1

$$K = \frac{6.6x10^{-3}\ cm}{s} for\ MW - 90 - 13$$

$$K = 6.6x10^{-3}\ \ cm/s$$

$$K = \frac{6.6x10^{-3} cm}{s} x \frac{60s}{min} x0.0328 \frac{ft}{cm} = 0.013 \frac{ft}{min}$$

i = $\frac{212.77\ ft - 208.46\ ft}{557\ ft} = 7.7x10^{-3} \frac{ft}{ft}$

$$A = 850\ ft\ x\ 18\ ft = 16{,}500\ ft^2$$

$$Q = 0.013\ \frac{ft}{min} x7.7x10^{-3} \frac{ft}{ft} x16{,}500\ ft^2 = 1.70\ \frac{ft^3}{min}$$

$$Q = 1.70\ \frac{ft^3}{min} x7.48 \frac{gal}{ft^3} = 12.70\ \frac{gal}{min}$$

$$12.70 \frac{gal}{min} x \frac{60\ min}{1\ hr} x \frac{24\ hr}{1\ day} = 18{,}200\ \frac{gal}{day}$$

Infiltration

Infiltration=iA

Average Rainfall in Hudson Falls, NY **=** 40 in/year

$$Average\ Rainfall = 40\frac{in}{year}\ x\ \frac{1\,ft}{12\ in}\ x\ \frac{1\ year}{365\ days} = \ 9.1x10^{-3}\frac{ft}{day}$$

$$Area\ of\ Landfill = 800{,}000\ ft^2$$

$$Infiltration = 9.1\ x\ 10^{-3}\ \frac{ft}{day} x\ 800{,}000\ ft^2 = 7{,}300\ \frac{ft^3}{day}$$

$$Infiltration = \ 7{,}300\ \frac{ft^3}{day}\ x7.48\ \frac{gal}{ft^3} = 55{,}000\ \frac{gal}{day}$$

$$Infiltration\ entering\ Groundwater\ (10\%) = 55{,}000\ \frac{gal}{day}\ x\ 10\% = 5{,}500\ \frac{gal}{day}$$

Effluent

Q=kiA

Wells used: MW-90-14 and Pond

$$K = \frac{6.6x10^{-3}\ cm}{s} for\ MW - 90 - 14$$

$$K = \frac{6.6x10^{-3}cm}{s} x\frac{60s}{min} x0.0328\frac{ft}{cm} = 0.013\frac{ft}{min}$$

i = $\frac{10.90\ ft - 8.80\ ft}{580\ ft} = 3.6x10^{-3}\frac{ft}{ft}$

$$A = 850\ ft\ x\ 17.15\ ft = 14{,}577.5\ ft^2$$

$$Q = 0.013\ \frac{ft}{min} x3.6x10^{-3}\frac{ft}{ft} x14{,}577.5\ ft^2 = 0.68\ \frac{ft^3}{min}$$

$$Q = 0.68\ \frac{ft^3}{min} x7.48\frac{gal}{ft^3} = 5.10\ \frac{gal}{min}$$

$$5.10\frac{gal}{min} x\frac{60\ min}{1\ hr} x\frac{24\ hr}{1\ day} = 7{,}350\ \frac{gal}{day}$$

Feeder Canal

Percent of Water Entering the Feeder Canal:

Influent = (Effluent +ILCTS + Feeder Canal)

$$23{,}700\ gpd = 7{,}350\ gpd + 6{,}500\ gpd + i_{Feeder\ Canal}$$

$$i_{Feeder\ Canal} = 9{,}850\ gpd$$

$$Percentage\ of\ Water\ Entering\ the\ Feeder\ Canal \frac{23{,}700\ gpd}{9{,}850\ gpd} = 0.4156 = 41.56\ \%$$

Estimated 41.56% of water enters the Feeder Canal.

$$Q(Feeder\ Canal) = Qgroundwater\ from\ west + Qinfiltration\ x\ 41.56\%$$

$$Q(Feeder\ Canal, 10\%\ Infiltration) = \left(18{,}200\ \frac{gal}{day} + 5{,}500\ \frac{gal}{day}\right) x\ 41.56\% = 9{,}850\ \frac{gal}{day}$$

Interim Leachate Collection Treatment System Calculations

Discharge flow from system: 4.5 $\frac{gal}{min}$

$$4.5\ \frac{gal}{min}\ x\ \frac{60\ min}{1\ hr}\ x\ \frac{24\ hr}{1\ day} = 6{,}500\ \frac{gal}{day}$$

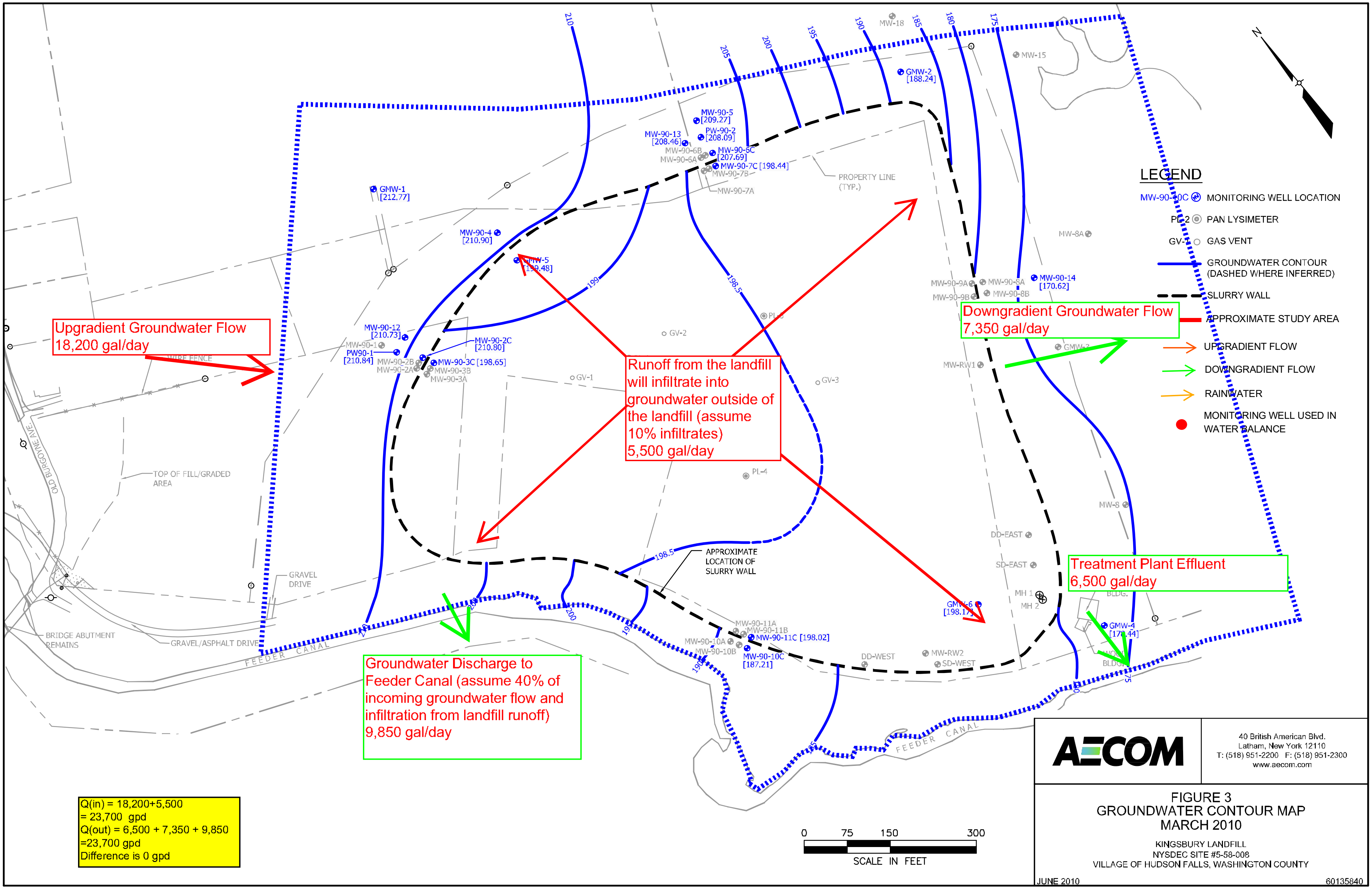
Total Influent and Effluent

Influent:

$$Q(10\%\ infiltration) = 18{,}200\ \frac{gal}{day} + 5{,}500\ \frac{gal}{day} = 23{,}700\ \frac{gal}{day}$$

Effluent:

$$Q(10\%\ infiltration) = 7{,}350\ \frac{gal}{day} + 9{,}850\ \frac{gal}{day} + 6{,}500\ \frac{gal}{day} = 23{,}700\ \frac{gal}{day}$$



\\USGRNS01\data\work\earth\Latham NY Work\Kingsbury Landfill\99164_001 Groundwater Contour Map.dwg, 6/30/2010 6:59:39 PM, splawnm

Appendix B

Remedial Options to Replace the ILCTS

Remedial Options to Replace the ILCTS – Revised November 2014

1) Upgradient Groundwater Extraction Wells

Premise
- Install a series of groundwater extraction wells (five) to dewater the aquifer upgradient of the existing cutoff wall to maintain the water table to below the action level required to prevent water from going over the slurry wall

Benefits
- Cost of installing a few extraction wells is relatively inexpensive
- Discharged groundwater could be pumped directly to the feeder canal or the pond without treatment (pending analyses showing no impacts to upgradient groundwater)
    - Sampling schedule (each well):
        - weekly for month 1
        - twice a month for months 2 & 3
        - monthly for months 4, 5 & 6
        - quarterly thereafter
- Should reduce the overall volume of leachate treated

Problems
- Transport of leachate from within the landfill to the upgradient groundwater if the cone of influence from the pumping wells penetrates a higher permeability lens that passes under the slurry wall
- Continued O&M to keep the extraction wells running
- Utility costs

2) Grout Barrier Upgradient of the Landfill

Premise
- Jet grout a new barrier wall upgradient of the existing cutoff wall to eliminate leak points (jet grout wall is assumed to be 1,000 feet long and seal off any high conductive lenses in the 30 feet to 60 feet interval – the size of this wall can be reduced through an extensive drilling program)

Benefits
- Finding and stopping the leaks would greatly reduce the amount of leachate needed to be removed and treated from the waste mass
- Should reduce overall volume of leachate treated
- ILCTS could be run infrequently as originally designed or shut off completely

Problems
- Probability of finding all the leak points is low, would require an extensive drilling program
- Could be difficult to extend the wall downward and tie it in to the existing wall to eliminate the flow path
- May require drilling inside the cutoff wall to locate leak points

3) Passive Dewatering Trench

Premise

- Install a dewatering trench (French drain) upgradient of the cutoff wall to dewater the aquifer to below the action level that requires operation of the ILCTS. The proposed trench would be installed along the existing access road, approximately 50 to 60 ft from the slurry wall. The trench would discharge into the pond or the Feeder Canal via gravity. Three scenarios were evaluated;
    1. Option 3A is one single 12-inch drain line discharging to the pond;
    2. Option 3B includes two 6-inch drain lines that discharge to the pond; and
    3. Option 3C includes two 6-inch drain lines with discharge to both the pond and the feeder canal. A conceptual drawing of the dewatering trench is included as Figure 10.

Benefits

- Passive dewatering system greatly reduces O&M costs
- Unlikely to create a reverse groundwater flow pulling leachate into the trench compared to extraction wells (option 1). The proposed dewatering trench will have one or two levels of drain lines and the discharge will be valved to manually control the discharge flow volume. The discharge will be regulated to achieve a leachate level inside the slurry wall of between 195 ft and 200 ft NGVD
- Should reduce overall volume of leachate treated
- ILCTS could be run infrequently as originally designed or shut off completely
- No treatment of groundwater required prior to discharge pending analysis to prove no impacts
    - Discharge sampling schedule:
        - weekly for month 1
        - twice a month for months 2, 3, 4, 5 & 6
        - monthly for months 7, 8, 9, 10 11, & 12
        - quarterly thereafter

Problems

- Upfront construction costs could be significant since a specialty contractor will be required
- Dewatering trench may not influence the underlying higher conductive lenses that currently create the leachate in the landfill

4) Install additional extraction points inside the cutoff wall near GMW-5 (upgradient side)

Premise

- The current leachate extraction lines are on the downgradient side of the landfill and are currently blocked with sediment. Installing extraction points on the upgradient side of the landfill would improve efficiency.

Benefits

- Improves flow inside the wall
- Improves extraction efficiency
- Improves leachate level control
- ILCTS could be run infrequently as originally designed

Problems

- Requires drilling through the cap
- Long connection runs to connect to the existing ILCTS
- Continued O&M costs to operate the ILCTS
- Prolonged flow through the cutoff wall may worsen the "leaks"

5) Continued Operation of the Current O&M System

Costs were calculated for comparison with the other options

KINGSBURY LANDFILL (5-58-008)

Cost Estimate - Option Summary

	Option 1: Pump Discharge Upgradient of Landfill	Option 2: Grout Barrier Upgradient of Landfill	Option 3A: 12" Gravity Drain Discharge Upgradient of Landfill	Option 3B: 2-6" Gravity Drains Discharge Upgradient of Landfill	Option 3C: 2-6" Gravity Drains Discharge Upgradient of Landfill w/ partial discharge to Feeder Canal	Option 4: Pump Discharge within Landfill	Option 5: Continued Current O&M
Capital Costs	$ 162,467	$ 1,776,000	$ 978,800	$ 985,600	$ 1,155,840	$ 60,083	$ -
O&M Costs	$ 1,789,014	$ 509,611	$ 531,468	$ 531,468	$ 531,468	$ 3,292,051	$ 3,292,051
One year operation of ILCTS	$ 165,000	$ 165,000	$ 165,000	$ 165,000	$ 165,000	$ -	$ -
Continued 5-quarter sampling	$ 701,696	$ 701,696	$ 701,696	$ 701,696	$ 701,696	$ 701,696	$ 701,696
Total	**$ 2,820,000**	**$ 3,160,000**	**$ 2,380,000**	**$ 2,390,000**	**$ 2,560,000**	**$ 4,060,000**	**$ 4,000,000**

KINGSBURY LANDFILL (5-58-008)

Option 1: Pump Discharge Upgradient of Landfill

Capital Costs

Item	Quantity	Unit	Cost/Unit	Total Cost
PVC Pipe for extraction wells (5 wells, 4 in., 40 ft. length, 10 ft screens)	200	LF	$4.41	$882.00
Well Drilling (5, 8 in. diameter, 40 ft. borehole)	200	LF	$55.50	$11,100.00
Pumps (10 gpm, 2HP, 4" submersible pump)	5	EACH	$2,425.00	$12,125.00
Well Protection Concrete Manhole (Precast, 4 ft. inside diameter, 4 ft depth)	5	EACH	$1,400.00	$7,000.00
Well Protection Manhole Excavation (5 ft width, 5 ft length, 4 ft.; excavate common earth with 0.5 CY Backhoe)	19	CY	$9.45	$175.00
Electric line (1500 ft) - estimated	4500	LF	$12.50	$56,250.00
Control Panel - estimated	5	EACH	$3,250.00	$16,250.00
Remote Access - estimated	1	EACH	$30,000.00	$30,000.00
Pipe to pond (6 inch diameter, HDPE corrugated pipe, 1500 ft long)	1500	LF	$5.95	$8,925.00
Pipe Discharge Line Trench (4 ft depth, 1500 ft long)	1500	LF	$8.67	$12,744.90
Pipe back fill (4ft depth, 4ft width, 1500 ft long)	889	CY	$6.66	$1,350.39
Discharge Sampling Lab Fees (Test America)	55	EACH	$103.00	$5,665.00
			Subtotal:	**$162,467.29**

O&M Costs

Item	Quantity		Cost/Unit	Total Cost (w/ amortization)
Pump Replacement (5 pumps every 3 years)	50	Units	$2,425.00	$121,250.00
AECOM Labor, Travel, & Reporting	30	YEAR	$24,000.00	$470,410.59
Subcontractors (Aztech)			$52,000.00	$1,019,222.95
Lab Fees (Test America)			$3,115.08	$61,056.94
Utilities			$5,973.00	$117,073.44
			Subtotal:	**$1,789,013.92**

5-Quarter Groundwater Sampling Costs

Item	Quantity		Cost/Unit	Total Cost
AECOM (oversight & reports)	30	YEAR	$15,400.00	$301,846.80
Aztech (24 5-qtr rounds)			$10,400.00	$203,844.59
Lab Fees (Test America)			$10,000.00	$196,004.41
			Subtotal:	**$701,695.80**

KINGSBURY LANDFILL (5-58-008)

Option 1: Pump Discharge Upgradient of Landfill (Continued)

O&M Costs for one-year of ILCTS Operation

Item	Quantity		Cost/Unit	Total Cost
AECOM	1	YEAR	$25,000.00	$25,000.00
Utilities to operate the ILCTS for one year			$15,000.00	$15,000.00
Subcontractor Labor (one yr for Aztech to run the ILCTS)			$110,000.00	$110,000.00
Lab Analytical (Test America, one yr of ILCTS)			$15,000.00	$15,000.00
			Subtotal:	**$165,000.00**
			Total Cost:	**$2,818,177.01**

Notes:

1. Assumes 30 year amortization with 3% GDP growth for O&M costs
2. Assumes one year of ILCTS operation, then shut down
3. Assumes weekly system inspection by Aztech and AECOM

KINGSBURY LANDFILL (5-58-008)

Option 2: Grout Barrier Upgradient of Landfill

Capital Costs

Item	Quantity	Unit	Cost/Unit	Total Cost
AECOM oversight	1	EA	$51,000.00	$51,000.00
Subsurface Pressure Grout Wall 1000 LF x 30 FT High (30 to 60 ft bgs)	30,000	SF	$57.50	$1,725,000.00
			Subtotal:	**$1,776,000.00**

O&M Costs

Item	Quantity		Cost/Unit	Total Cost (w/ amortization)
AECOM Labor, Travel, & Reporting	30	YEAR	$26,000.00	$509,611.48
Subcontractors (Aztech)			$0.00	$0.00
Lab Fees (Test America)			$0.00	$0.00
Utilities			$0.00	$0.00
			Subtotal:	**$509,611.48**

5-Quarter Groundwater Sampling Costs

Item	Quantity		Cost/Unit	Total Cost
AECOM (oversight & reports)	30	YEAR	$15,400.00	$301,846.80
Aztech (24 5-qtr rounds)			$10,400.00	$203,844.59
Lab Fees (Test America)			$10,000.00	$196,004.41
			Subtotal:	**$701,695.80**

O&M Costs for one-year of ILCTS Operation

Item	Quantity		Cost/Unit	Total Cost
AECOM	1	YEAR	$25,000.00	$25,000.00
Utilities to operate the ILCTS for one year			$15,000.00	$15,000.00
Subcontractor Labor (one yr for Aztech to run the ILCTS)			$110,000.00	$110,000.00
Lab Analytical (Test America, one yr of ILCTS)			$15,000.00	$15,000.00
			Subtotal:	**$165,000.00**
			Total Cost:	**$3,152,307.28**

Notes:

1. Assumes 30 year amortization with 3% GDP growth for O&M costs
2. Assumes one year of ILCTS operation, then shut down

KINGSBURY LANDFILL (5-58-008)

Option 3A: 12" Gravity Drain Discharge Upgradient of Landfill

Capital Costs

Item	Quantity	Unit	Cost/Unit	Total Cost
12 inch Discharge pipe (12 inch diameter, HDPE corrugated pipe)	1600	LF	$11.75	$18,800.00
Site Mobilization	1	EACH	$100,000.00	$100,000.00
Trenching equipment mobilization	1	EACH	$70,000.00	$70,000.00
Soils Management (2 ft x20ft x 1,600 ft)	2370	CY	$30.00	$71,111.11
Gravel Stone (2 ft x 20ft x 1,600 ft)	2370	CY	$24.00	$56,888.89
Discharge Pipe Trench Excavation and Backfill (30 ft deep, 1200 ft long)[3]	1600	LF	$600.00	$960,000.00
Discharge Sampling Lab Fees (Test America)	11	EACH	$103.00	$1,133.00
			Subtotal:	**$978,800.00**

O&M Costs

Item	Quantity		Cost/Unit	Total Cost (w/ amortization)
AECOM Labor, Travel, & Reporting	30	YEAR	$24,000.00	$470,410.59
Subcontractors (Aztech)			$0.00	$0.00
Lab Fees (Test America)			$3,115.08	$61,056.94
Utilities			$0.00	$0.00
			Subtotal:	**$531,467.54**

5-Quarter Groundwater Sampling Costs

Item	Quantity		Cost/Unit	Total Cost
AECOM (oversight & reports)	30	YEAR	$15,400.00	$301,846.80
Aztech (24 5-qtr rounds)			$10,400.00	$203,844.59
Lab Fees (Test America)			$10,000.00	$196,004.41
			Subtotal:	**$701,695.80**

O&M Costs for one-year of ILCTS Operation

Item	Quantity		Cost/Unit	Total Cost
AECOM	1	YEAR	$25,000.00	$25,000.00
Utilities to operate the ILCTS for one year			$15,000.00	$15,000.00
Subcontractor Labor (one yr for Aztech to run the ILCTS)			$110,000.00	$110,000.00
Lab Analytical (Test America, one yr of ILCTS)			$15,000.00	$15,000.00
			Subtotal:	**$165,000.00**
			Total Cost:	**$2,376,963.34**

Option 3A: 12" Gravity Drain Discharge Upgradient of Landfill (Continued)

Notes:

1. Assumes 30 year amortization with 3% GDP growth for O&M costs
2. Assumes one year of ILCTS operation, then shut down
3. Discharge Pipe Trench Excavation and Backfill cost estimate provided by Dewind
4. Assumes monthly system inspection
5. Soils Management includes preparation of, transfer to, spreading/grading of spoils and restoration of an onsite fill area.

KINGSBURY LANDFILL (5-58-008)

Option 3B: 2-6" Gravity Drains Discharge Upgradient of Landfill

Capital Costs

Item	Quantity	Unit	Cost/Unit	Total Cost
6 inch Discharge pipe (6 inch diameter, HDPE corrugated pipe, two lateral pipes)	3200	LF	$8.00	$25,600.00
Site Mobilization	1	EACH	$100,000.00	$100,000.00
Trenching equipment mobilization	1	EACH	$70,000.00	$70,000.00
Soils Management (2 ft x20ft x 1,600 ft)	2370	CY	$30.00	$71,111.11
Gravel Stone (2 ft x 20ft x 1,600 ft)	2370	CY	$24.00	$56,888.89
Discharge Pipe Trench Excavation and Backfill (30 ft deep, 1200 ft long)[3]	1600	LF	$600.00	$960,000.00
Discharge Sampling Lab Fees (Test America)	11	EACH	$103.00	$1,133.00
			Subtotal:	**$985,600.00**

O&M Costs

Item	Quantity		Cost/Unit	Total Cost (w/ amortization)
AECOM Labor, Travel, & Reporting	30	YEAR	$24,000.00	$470,410.59
Subcontractors (Aztech)			$0.00	$0.00
Lab Fees (Test America)			$3,115.08	$61,056.94
Utilities			$0.00	$0.00
			Subtotal:	**$531,467.54**

5-Quarter Groundwater Sampling Costs

Item	Quantity		Cost/Unit	Total Cost
AECOM (oversight & reports)	30	YEAR	$15,400.00	$301,846.80
Aztech (24 5-qtr rounds)			$10,400.00	$203,844.59
Lab Fees (Test America)			$10,000.00	$196,004.41
			Subtotal:	**$701,695.80**

O&M Costs for one-year of ILCTS Operation

Item	Quantity		Cost/Unit	Total Cost
AECOM	1	YEAR	$25,000.00	$25,000.00
Utilities to operate the ILCTS for one year			$15,000.00	$15,000.00
Subcontractor Labor (one yr for Aztech to run the ILCTS)			$110,000.00	$110,000.00
Lab Analytical (Test America, one yr of ILCTS)			$15,000.00	$15,000.00
			Subtotal:	**$165,000.00**
			Total Cost:	**$2,383,763.34**

Option 3B: 2-6" Gravity Drains Discharge Upgradient of Landfill (Continued)

Notes:

1. Assumes 30 year amortization with 3% GDP growth for O&M costs
2. Assumes one year of ILCTS operation, then shut down
3. Discharge Pipe Trench Excavation and Backfill cost estimate provided by Dewind
4. Assumes monthly system inspection
5. Soils Management includes preparation of, transfer to, spreading/grading of spoils and restoration of an onsite fill area.

KINGSBURY LANDFILL (5-58-008)

Option 3C: 2-6" Gravity Drains Discharge Upgradient of Landfill w/ partial discharge to Feeder Canal

Capital Costs

Item	Quantity	Unit	Cost/Unit	Total Cost
6 inch Discharge pipe (6 inch diameter, HDPE corrugated pipe, two lateral pipes)	3480	LF	$8.00	$27,840.00
Site Mobilization	1	EACH	$100,000.00	$100,000.00
Trenching equipment mobilization	1	EACH	$70,000.00	$70,000.00
Soils Management (2 ft x20ft x 1,880 ft)	2785	CY	$30.00	$83,555.56
Gravel Stone (2 ft x 20ft x 1,880 ft)	2785	CY	$24.00	$66,844.44
Discharge Pipe Trench Excavation and Backfill (30 ft deep, 1200 ft long)[3]	1880	LF	$600.00	$1,128,000.00
Discharge Sampling Lab Fees (Test America)	11	EACH	$103.00	$1,133.00
			Subtotal:	**$1,155,840.00**

O&M Costs

Item	Quantity		Cost/Unit	Total Cost (w/ amortization)
AECOM Labor, Travel, & Reporting	30	YEAR	$24,000.00	$470,410.59
Subcontractors (Aztech)			$0.00	$0.00
Lab Fees (Test America)			$3,115.08	$61,056.94
Utilities			$0.00	$0.00
			Subtotal:	**$531,467.54**

5-Quarter Groundwater Sampling Costs

Item	Quantity		Cost/Unit	Total Cost
AECOM (oversight & reports)	30	YEAR	$15,400.00	$301,846.80
Aztech (24 5-qtr rounds)			$10,400.00	$203,844.59
Lab Fees (Test America)			$10,000.00	$196,004.41
			Subtotal:	**$701,695.80**

O&M Costs for one-year of ILCTS Operation

Item	Quantity		Cost/Unit	Total Cost
AECOM	1	YEAR	$25,000.00	$25,000.00
Utilities to operate the ILCTS for one year			$15,000.00	$15,000.00
Subcontractor Labor (one yr for Aztech to run the ILCTS)			$110,000.00	$110,000.00
Lab Analytical (Test America, one yr of ILCTS)			$15,000.00	$15,000.00
			Subtotal:	**$165,000.00**
			Total Cost:	**$2,554,003.34**

Option 3C: 2-6" Gravity Drains Discharge Upgradient of Landfill w/ partial discharge to Feeder Canal (Continued)

Notes:

1. Assumes 30 year amortization with 3% GDP growth for O&M costs
2. Assumes one year of ILCTS operation, then shut down
3. Discharge Pipe Trench Excavation and Backfill cost estimate provided by Dewind
4. Assumes monthly system inspection
5. Soils Management includes preparation of, transfer to, spreading/grading of spoils and restoration of an onsite fill area.

KINGSBURY LANDFILL (5-58-008)

Option 4: Pump Discharge within Landfill

Capital Costs

Item	Quantity	Unit	Cost/Unit	Total Cost
PVC Pipe for extraction wells (4 in., 40 ft. length)	200	LF	$4.41	$882.00
Well Drilling (8 in. diameter, 40 ft.)	200	LF	$55.50	$11,100.00
Pumps (10 gpm, 2HP, 4" submersible pump)	3	EACH	$2,425.00	$7,275.00
Well Protection Concrete Manhole (Precast, 4 ft. inside diameter, 4 ft depth)	3	EACH	$1,400.00	$4,200.00
Well Protection Manhole Excavation (5 ft width, 5 ft length, 4 ft.; excavate common earth with 0.5 CY BackHoe)	11	CY	$9.45	$105.00
Discharge pipe (6 in. diameter HDPE material, 1967 ft. length)	1967	LF	$5.95	$11,703.65
Dischare Pipe Trench (4 ft. depth, 1967 ft length)	1967	LF	$8.67	$17,053.89
Discharge pipe Backfill (4ft depth, 4ft width, 1967 ft long)	1166	CY	$6.66	$7,763.09
			Subtotal:	**$60,082.63**

O&M Costs

Item	Quantity		Cost/Unit	Total Cost (w/ amortization)
AECOM Labor, Travel, & Reporting	30	YEAR	$32,200.00	$631,134.21
Subcontractors (Aztech)			$109,374.00	$2,143,778.67
Lab Fees (Test America)			$14,438.00	$282,991.17
Utilities			$11,946.00	$234,146.87
			Subtotal:	**$3,292,050.93**

5-Quarter Groundwater Sampling Costs

Item	Quantity		Cost/Unit	Total Cost
AECOM (oversight & reports)	30	YEAR	$15,400.00	$301,846.80
Aztech (24 5-qtr rounds)			$10,400.00	$203,844.59
Lab Fees (Test America)			$10,000.00	$196,004.41
			Subtotal:	**$701,695.80**
			Total Cost:	**$4,053,829.36**

Notes:

1. Assumes 30 year amortization with 3% GDP growth for O&M costs

KINGSBURY LANDFILL (5-58-008)

Option 5: Continued Current O&M

Capital Costs

Item	Quantity	Units	Cost/Unit	Total Cost
None	None	None	None	None
			Subtotal:	**$0.00**

O&M Costs

Item	Quantity		Cost/Unit	Total Cost (w/ amortization)
AECOM Labor, Travel, & Reporting	30	YEAR	$32,200.00	$631,134.21
Subcontractors (Aztech)			$109,374.00	$2,143,778.67
Lab Fees (Test America)			$14,438.00	$282,991.17
Utilities			$11,946.00	$234,146.87
			Subtotal:	**$3,292,050.93**

5-Quarter Groundwater Sampling Costs

Item	Quantity		Cost/Unit	Total Cost
AECOM (oversight & reports)	30	YEAR	$15,400.00	$301,846.80
Aztech (24 5-qtr rounds)			$10,400.00	$203,844.59
Lab Fees (Test America)			$10,000.00	$196,004.41
			Subtotal:	**$701,695.80**
			Total Cost:	**$3,993,746.73**

Notes:

1. Assumes 30 year amortization with 3% GDP growth for O&M costs

Appendix B

Green and Sustainable Remediation Calculations

Comparison of Options 1, 2, 3A, 3B, 4 & 5

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

EXCAVATION

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:						
Excavation Volume	CY	889	0	2370	1166	0
Other:						
Excavation Rate	CY/HR	200				
Fuel Consumption Rate	GAL/HR	8				
Constants:						
CO2 Emission Factor	LBS./GAL	26.635				
CO Emission Factor	LBS./GAL	0.154438				
NOX Emission Factor	LBS./GAL	0.716916				
SOX Emission Factor	LBS./GAL	0.0414509				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
CO2 Emissions	LBS.	947	0	3516	1242	0
CO Emissions	LBS.	5	0	20	7	0
NOX Emissions	LBS.	25	0	95	33	0
SOX Emissions	LBS.	1	0	5	2	0

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:						
Excavation Volume	CY	889	0	0	1166	0
Excavation Area	ACRE	0.0345	0	0	0.045241	0
Other:						
Excavation Rate	CY/HR	200				
Constants:						
PM10 Emission Factor	LBS./ACRE*HR	0.000998				
PM2.5 Emission Factor	LBS./ACRE*HR	0.000998				
PM10 percentage	%	75				
PM2.5 percentage	%	10.5				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
PM10 Emissions	LBS.	0.0115	0.0000	0.0000	0.0197	0.0000
PM2.5 Emissions	LBS.	0.0016	0.0000	0.0000	0.0028	0.0000

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

BACKFILL

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:						
Backfill Volume	CY	889	0	2370	1166	0
Other:						
Backfill Rate	CY/HR	400				
Fuel Consumption Rate	GAL/HR	8				
Constants:						
CO2 Emission Factor	LBS./GAL	26.635				
CO Emission Factor	LBS./GAL	0.154438				
NOX Emission Factor	LBS./GAL	0.716916				
SOX Emission Factor	LBS./GAL	0.0414509				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
CO2 Emissions	LBS.	474	0	1262	621	0
CO Emissions	LBS.	3	0	7	4	0
NOX Emissions	LBS.	13	0	34	17	0
SOX Emissions	LBS.	1	0	2	1	0

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:						
Backfill Volume	CY	889	0	2370	1166	0
Backfill Area	ACRE	0.0345	0	1.101928	0.045241	0
Other:						
Backfill Rate	CY/HR	400				
Constants:						
PM10 Emission Factor	LBS./ACRE*HR	0.000998				
PM2.5 Emission Factor	LBS./ACRE*HR	0.000998				
PM10 percentage	%	75				
PM2.5 percentage	%	10.5				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
PM10 Emissions	LBS.	0.0057	0.0000	0.4887	0.0099	0.0000
PM2.5 Emissions	LBS.	0.0008	0.0000	0.0684	0.0014	0.0000

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

OFFSITE TRANSPORTATION

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:						
Excavation	CY	31	0	0	31	0
Backfill	CY	0	0	0	0	0
Other:						
Distance to Landfill	MILES	100				
Truck Fuel Economy	MILES/GAL	10				
Truck Capacity	CY	10				
Constants:						
CO2 Emission Factor	LBS./MJ	0.03364				
CO Emission Factor	LBS./MILE	0.02004				
NOX Emission Factor	LBS./MILE	0.01311				
SOX Emission Factor	LBS./GAL	0.0414509				
Energy Content of Fuel	MJ/GAL	190				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
CO2 Emissions	LBS.	397	0	0	397	0
CO Emissions	LBS.	12	0	0	12	0
NOX Emissions	LBS.	8	0	0	8	0
SOX Emissions	LBS.	3	0	0	0	0

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Options 3A**	**Option 4**	**Option 5**
Soil Volumes:						
Excavation	CY	31	0	0	31	0
Backfill	CY	0	0	0	0	0
Other:						
Distance to Landfill	MILES	100				
Weight of Truck	Long Tons	25.4				
Truck Capacity	CY	10				
Road Surface Silt Loading	GRAINS/SF	0.3				
# of Wet Days	DAYS	0.0465421				
# of Days	DAYS	0.1551404				
Constants:						
PM10 Emission Factor	LBS./MILE	0.0004256				
PM2.5 Emission Factor	LBS./MILE	0.0003248				
PM10 Partical Size Multiplier	LBS./MILE	0.01487				
PM2.5 Partical Size Multiplier	LBS./MILE	0.00213				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
PM10 Emissions	LBS.	61.03	0.00	0.00	61.03	0.00
PM2.5 Emissions	LBS.	8.59	0.00	0.00	8.59	0.00

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

ON-SITE TRANSPORTATION

INPUTS:		**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:							
	Excavation	CY	858	0	2370	1135	0
	Backfill	CY	858	0	0	1135	0
Other:							
	Distance	MILES	0.5				
	Truck Fuel Economy	MILES/GAL	5				
	Truck Capacity	CY	20				
Constants:							
CO2 Emission Factor		LBS./MJ	0.03364				
CO Emission Factor		LBS./MILE	0.02004				
NOX Emission Factor		LBS./MILE	0.01311				
SOX Emission Factor		LBS./GAL	0.0414509				
Energy Content of Fuel		MJ/GAL	190				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
CO2 Emissions	LBS.	55	0	151	73	0
CO Emissions	LBS.	1	0	2	1	0
NOX Emissions	LBS.	1	0	2	1	0
SOX Emissions	LBS.	0	0	0	0	0

INPUTS:		**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:							
	Excavation	CY	858	0	2370	1135	0
	Backfill	CY	858	0	0	1135	0
Other:							
	Distance	MILES	0.5				
	Weight of Truck	Long Tons	25.4				
	Truck Capacity	CY	20				
	Road Surface Silt Loading	GRAINS/SF	0.3				
	# of Wet Days	DAYS	1.287				
	# of Days	DAYS	4.29				
Constants:							
PM10 Emission Factor		LBS./MILE	0.0004256				
PM2.5 Emission Factor		LBS./MILE	0.0003248				
PM10 Partical Size Multiplier		LBS./MILE	0.01487				
PM2.5 Partical Size Multiplier		LBS./MILE	0.00213				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
PM10 Emissions	LBS.	4.22	0.00	11.65	5.58	0.00
PM2.5 Emissions	LBS.	0.59	0.00	1.64	0.79	0.00

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

CONCRETE PRODUCTION

INPUTS:	Unit	Option 2
Volume of Soil	CY	5556
weight of soils	kg/CY	750
Percent Cement Mixture	%	4%
Total Cement	kg	166667
Constants:		
Embodied Energy Intensity	MJ/kg	1.54
CO2 Emission Factor	LBS./kg	1
CO Emission Factor	LBS./kg	0.154438
NOX Emission Factor	LBS./kg	0.0414509
SOX Emission Factor	LBS./kg	0.716916

Outputs:

Metric	Units	Option 2
CO2 Emissions	LBS.	166,667
CO Emissions	LBS.	25,740
NOX Emissions	LBS.	6,908
SOX Emissions	LBS.	119,486

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

ISS

INPUTS:	**Unit**	**Value**
Volume of Soil	CY	5556
ISS Rate	CY/DAY	300
Fuel Consumption Rate	GAL/DAY	200
Constants:		
CO2 Emission Factor	LBS./GAL	26.635
CO Emission Factor	LBS./GAL	0.154438
NOX Emission Factor	LBS./GAL	0.0414509
SOX Emission Factor	LBS./GAL	0.716916

Outputs:

Metric	Units	Option 2
CO2 Emissions	LBS.	98,648
CO Emissions	LBS.	572
NOX Emissions	LBS.	154
SOX Emissions	LBS.	2,655

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

SITE VISITS

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:						
Visits - Year 1	EACH	161	161	161	161	161
Visits - Years 2-30	EACH	57	9	17	161	161
Other:						
Distance (roundtrip)	MILES	100				
Fuel Economy	MILES/GAL	20				
Constants:						
CO2 Emission Factor	LBS./MJ	0.03364				
CO Emission Factor	LBS./MILE	0.02004				
NOX Emission Factor	LBS./MILE	0.01311				
SOX Emission Factor	LBS./GAL	0.0414509				
Energy Content of Fuel	MJ/GAL	190				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
CO2 Emissions	LBS.	57,972	13,486	20,901	154,357	154,357
CO Emissions	LBS.	7,271	1,691	2,621	19,359	19,359
NOX Emissions	LBS.	4,756	1,106	1,715	12,664	12,664
SOX Emissions	LBS.	15,038	3,498	5,422	40,042	40,042

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Options 3A & 3B**	**Option 4**	**Option 5**
Soil Volumes:						
Visits - Year 1	EACH	161	161	161	161	161
Visits - Years 2-30	EACH	57	9	17	161	161
Other:						
Distance (roundtrip)	MILES	100				
Weight of Truck	Long Tons	25.4				
Truck Capacity	CY	20				
Road Surface Silt Loading	GRAINS/SF	0.3				
# of Wet Days	DAYS	0.2415				
# of Days	DAYS	0.805				
Constants:						
PM10 Emission Factor	LBS./MILE	0.0004256				
PM2.5 Emission Factor	LBS./MILE	0.0003248				
PM10 Partical Size Multiplier	LBS./MILE	0.01487				
PM2.5 Partical Size Multiplier	LBS./MILE	0.00213				

Outputs:

Metric	Units	Option 1	Option 2	Options 3A & 3B	Option 4	Option 5
PM10 Emissions	LBS.	178.40	41.50	64.32	475.00	475.00
PM2.5 Emissions	LBS.	25.11	5.84	9.05	66.86	66.86

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

ELECTRIC USAGE

Option	kwh/year - Year 1	kwh/year - Years 2-30	Total (kwh)
1	125,000	65,700	2,030,300
2	125,000	0	125,000
3A & 3B	125,000	0	125,000
4	125,000	125,000	3,750,000
5	125,000	125,000	3,750,000

Assumptions

hp/pump	2
current yearly energy use (kwh/year)	125,000

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

COMBINED TOTALS

Metric	Unit	GHG Analysis (LBS.)					
		CO2 Emissions	CO Emissions	NOX Emissions	OSX Emissions	PM10 Emissions	PM2.5 Emissions
Option 1	LBS.	59,844	7,292	4,803	15,044	244	34
Option 2	LBS.	278,801	0	27,418	125,640	42	6
Option 3A & 3B	LBS.	24,840	2,646	1,818	5,428	76	11
Option 4	LBS.	156,690	19,383	12,723	40,044	542	76
Option 5	LBS.	154,357	19,359	12,664	40,042	475	67

Notes:

1.) Emissions for Options 1-5 include estimated excavation, backfill, onsite transportation, offsite T&D, and personnel site visits

2.) CO2, CO, NOX, and SOX Emissions associated with Option 2 also include cement manufacturing & installation onsite

Appendix B

Green and Sustainable Remediation Calculations

Comparison of Options 1, 2, 3C, 4 & 5

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

EXCAVATION

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Option 3C**	**Option 4**	**Option 5**
Soil Volumes:						
Excavation Volume	CY	889	0	2370	1166	0
Other:						
Excavation Rate	CY/HR	200				
Fuel Consumption Rate	GAL/HR	8				
Constants:						
CO2 Emission Factor	LBS./GAL	26.635				
CO Emission Factor	LBS./GAL	0.154438				
NOX Emission Factor	LBS./GAL	0.716916				
SOX Emission Factor	LBS./GAL	0.0414509				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
CO2 Emissions	LBS.	947	0	3516	1242	0
CO Emissions	LBS.	5	0	20	7	0
NOX Emissions	LBS.	25	0	95	33	0
SOX Emissions	LBS.	1	0	5	2	0

INPUTS:	**Unit**	**Option 1**	**Option 2**	**Option 3C**	**Option 4**	**Option 5**
Soil Volumes:						
Excavation Volume	CY	889	0	0	1166	0
Excavation Area	ACRE	0.0345	0	0	0.045241	0
Other:						
Excavation Rate	CY/HR	200				
Constants:						
PM10 Emission Factor	LBS./ACRE*HR	0.000998				
PM2.5 Emission Factor	LBS./ACRE*HR	0.000998				
PM10 percentage	%	75				
PM2.5 percentage	%	10.5				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
PM10 Emissions	LBS.	0.0115	0.0000	0.0000	0.0197	0.0000
PM2.5 Emissions	LBS.	0.0016	0.0000	0.0000	0.0028	0.0000

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

BACKFILL

INPUTS:	Unit	Option 1	Option 2	Option 3C	Option 4	Option 5
Soil Volumes:						
Backfill Volume	CY	889	0	2785	1166	0
Other:						
Backfill Rate	CY/HR	400				
Fuel Consumption Rate	GAL/HR	8				
Constants:						
CO2 Emission Factor	LBS./GAL	26.635				
CO Emission Factor	LBS./GAL	0.154438				
NOX Emission Factor	LBS./GAL	0.716916				
SOX Emission Factor	LBS./GAL	0.0414509				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
CO2 Emissions	LBS.	474	0	1484	621	0
CO Emissions	LBS.	3	0	9	4	0
NOX Emissions	LBS.	13	0	40	17	0
SOX Emissions	LBS.	1	0	2	1	0

INPUTS:	Unit	Option 1	Option 2	Option 3C	Option 4	Option 5
Soil Volumes:						
Backfill Volume	CY	889	0	2370	1166	0
Backfill Area	ACRE	0.0345	0	1.10192837	0.045241	0
Other:						
Backfill Rate	CY/HR	400				
Constants:						
PM10 Emission Factor	LBS./ACRE*HR	0.000998				
PM2.5 Emission Factor	LBS./ACRE*HR	0.000998				
PM10 percentage	%	75				
PM2.5 percentage	%	10.5				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
PM10 Emissions	LBS.	0.0057	0.0000	0.4887	0.0099	0.0000
PM2.5 Emissions	LBS.	0.0008	0.0000	0.0684	0.0014	0.0000

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

OFFSITE TRANSPORTATION

INPUTS:	Unit	Option 1	Option 2	Option 3C	Option 4	Option 5
Soil Volumes:						
Excavation	CY	31	0	0	31	0
Backfill	CY	0	0	0	0	0
Other:						
Distance to Landfill	MILES	100				
Truck Fuel Economy	MILES/GAL	10				
Truck Capacity	CY	10				
Constants:						
CO2 Emission Factor	LBS./MJ	0.03364				
CO Emission Factor	LBS./MILE	0.02004				
NOX Emission Factor	LBS./MILE	0.01311				
SOX Emission Factor	LBS./GAL	0.0414509				
Energy Content of Fuel	MJ/GAL	190				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
CO2 Emissions	LBS.	397	0	0	397	0
CO Emissions	LBS.	12	0	0	12	0
NOX Emissions	LBS.	8	0	0	8	0
SOX Emissions	LBS.	3	0	0	0	0

INPUTS:	Unit	Option 1	Option 2	Option 3C	Option 4	Option 5
Soil Volumes:						
Excavation	CY	31	0	0	31	0
Backfill	CY	0	0	0	0	0
Other:						
Distance to Landfill	MILES	100				
Weight of Truck	Long Tons	25.4				
Truck Capacity	CY	10				
Road Surface Silt Loading	GRAINS/SF	0.3				
# of Wet Days	DAYS	0.0465421				
# of Days	DAYS	0.1551404				
Constants:						
PM10 Emission Factor	LBS./MILE	0.0004256				
PM2.5 Emission Factor	LBS./MILE	0.0003248				
PM10 Partical Size Multiplier	LBS./MILE	0.01487				
PM2.5 Partical Size Multiplier	LBS./MILE	0.00213				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
PM10 Emissions	LBS.	61.03	0.00	0.00	61.03	0.00
PM2.5 Emissions	LBS.	8.59	0.00	0.00	8.59	0.00

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

ON-SITE TRANSPORTATION

INPUTS:		**Unit**	**Option 1**	**Option 2**	**Option 3C**	**Option 4**	**Option 5**
Soil Volumes:							
	Excavation	CY	858	0	2785	1135	0
	Backfill	CY	858	0	0	1135	0
Other:							
	Distance	MILES	0.5				
	Truck Fuel Economy	MILES/GAL	5				
	Truck Capacity	CY	20				
Constants:							
CO2 Emission Factor		LBS./MJ	0.03364				
CO Emission Factor		LBS./MILE	0.02004				
NOX Emission Factor		LBS./MILE	0.01311				
SOX Emission Factor		LBS./GAL	0.0414509				
Energy Content of Fuel		MJ/GAL	190				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
CO2 Emissions	LBS.	55	0	178	73	0
CO Emissions	LBS.	1	0	3	1	0
NOX Emissions	LBS.	1	0	2	1	0
SOX Emissions	LBS.	0	0	0	0	0

INPUTS:		**Unit**	**Option 1**	**Option 2**	**Option 3C**	**Option 4**	**Option 5**
Soil Volumes:							
	Excavation	CY	858	0	2785	1135	0
	Backfill	CY	858	0	0	1135	0
Other:							
	Distance	MILES	0.5				
	Weight of Truck	Long Tons	25.4				
	Truck Capacity	CY	20				
	Road Surface Silt Loading	GRAINS/SF	0.3				
	# of Wet Days	DAYS	1.287				
	# of Days	DAYS	4.29				
Constants:							
PM10 Emission Factor		LBS./MILE	0.0004256				
PM2.5 Emission Factor		LBS./MILE	0.0003248				
PM10 Partical Size Multiplier		LBS./MILE	0.01487				
PM2.5 Partical Size Multiplier		LBS./MILE	0.00213				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
PM10 Emissions	LBS.	4.22	0.00	13.69	5.58	0.00
PM2.5 Emissions	LBS.	0.59	0.00	1.93	0.79	0.00

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

CONCRETE PRODUCTION

INPUTS:	Unit	Option 2
Volume of Soil	CY	5556
weight of soils	kg/CY	750
Percent Cement Mixture	%	4%
Total Cement	kg	166667
Constants:		
Embodied Energy Intensity	MJ/kg	1.54
CO2 Emission Factor	LBS./kg	1
CO Emission Factor	LBS./kg	0.154438
NOX Emission Factor	LBS./kg	0.0414509
SOX Emission Factor	LBS./kg	0.716916

Outputs:

Metric	Units	Option 2
CO2 Emissions	LBS.	166,667
CO Emissions	LBS.	25,740
NOX Emissions	LBS.	6,908
SOX Emissions	LBS.	119,486

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

ISS

INPUTS:	**Unit**	**Value**
Volume of Soil	CY	5556
ISS Rate	CY/DAY	300
Fuel Consumption Rate	GAL/DAY	200
Constants:		
CO2 Emission Factor	LBS./GAL	26.635
CO Emission Factor	LBS./GAL	0.154438
NOX Emission Factor	LBS./GAL	0.0414509
SOX Emission Factor	LBS./GAL	0.716916

Outputs:

Metric	Units	Option 2
CO2 Emissions	LBS.	98,648
CO Emissions	LBS.	572
NOX Emissions	LBS.	154
SOX Emissions	LBS.	2,655

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

SITE VISITS

INPUTS:	Unit	Option 1	Option 2	Option 3C	Option 4	Option 5
Soil Volumes:						
Visits - Year 1	EACH	161	161	161	161	161
Visits - Years 2-30	EACH	57	9	17	161	161
Other:						
Distance (roundtrip)	MILES	100				
Fuel Economy	MILES/GAL	20				
Constants:						
CO2 Emission Factor	LBS./MJ	0.03364				
CO Emission Factor	LBS./MILE	0.02004				
NOX Emission Factor	LBS./MILE	0.01311				
SOX Emission Factor	LBS./GAL	0.0414509				
Energy Content of Fuel	MJ/GAL	190				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
CO2 Emissions	LBS.	57,972	13,486	20,901	154,357	154,357
CO Emissions	LBS.	7,271	1,691	2,621	19,359	19,359
NOX Emissions	LBS.	4,756	1,106	1,715	12,664	12,664
SOX Emissions	LBS.	15,038	3,498	5,422	40,042	40,042

INPUTS:	Unit	Option 1	Option 2	Option 3C	Option 4	Option 5
Soil Volumes:						
Visits - Year 1	EACH	161	161	161	161	161
Visits - Years 2-30	EACH	57	9	17	161	161
Other:						
Distance (roundtrip)	MILES	100				
Weight of Truck	Long Tons	25.4				
Truck Capacity	CY	20				
Road Surface Silt Loading	GRAINS/SF	0.3				
# of Wet Days	DAYS	0.2415				
# of Days	DAYS	0.805				
Constants:						
PM10 Emission Factor	LBS./MILE	0.0004256				
PM2.5 Emission Factor	LBS./MILE	0.0003248				
PM10 Partical Size Multiplier	LBS./MILE	0.01487				
PM2.5 Partical Size Multiplier	LBS./MILE	0.00213				

Outputs:

Metric	Units	Option 1	Option 2	Option 3C	Option 4	Option 5
PM10 Emissions	LBS.	178.40	41.50	64.32	475.00	475.00
PM2.5 Emissions	LBS.	25.11	5.84	9.05	66.86	66.86

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

ELECTRIC USAGE

Option	kwh/year - Year 1	kwh/year - Years 2-30	Total (kwh)
1	125,000	65,700	2,030,300
2	125,000	0	125,000
3C	125,000	0	125,000
4	125,000	125,000	3,750,000
5	125,000	125,000	3,750,000

<u>Assumptions</u>

hp/pump	2
current yearly energy use (kwh/year)	125,000

KINGSBURY LANDFILL (5-58-008)
GREEN AND SUSTAINABLE REMEDIATION CALCULATIONS

COMBINED TOTALS

Metric	Unit	GHG Analysis (LBS.)					
		CO2 Emissions	CO Emissions	NOX Emissions	SOX Emissions	PM10 Emissions	PM2.5 Emissions
Option 1	LBS.	59,844	7,292	4,803	15,044	244	34
Option 2	LBS.	278,801	28,003	27,418	125,640	42	6
Option 3C	LBS.	25,087	2,647	1,825	5,428	78	11
Option 4	LBS.	156,690	19,383	12,723	40,044	542	76
Option 5	LBS.	154,357	19,359	12,664	40,042	475	67

Notes:
1.) Emissions for Options 1-5 include estimated excavation, backfill, onsite transportation, offsite T&D, and personnel site visits
2.) CO2, CO, NOX, and SOX Emissions associated with Option 2 also include cement manufacturing & installation onsite