Appendix I

Estimated Costs of the Corrective Measures Alternatives – Updated 2015

Engineer's Construction Preliminary Cost Estimate
Gude Landfill ACM Alternative 1

December 10, 2013

CAPITAL COST ESTIMATE

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description/Assumptions
					(Rounded to nearest thousand)	
1	**DESIGN ACTIVITIES**				$1,500,000	Engineer's estimate
	Line Item 1 Subtotal				**$1,500,000**	
	Contingency (20%)				$300,000	
	Line Item 1 Total				**$1,800,000**	
2	**SELECTIVE WASTE EXCAVATION/COVER SYSTEM**					
	Waste excavation (NW, W)	$13	1,200,000	CY	$15,600,000	Includes surface water management, excavation, truck loading, and hauling for processing on site
	Removal and reconstruction of landfill gas extraction wells	$200,000	1	LS	$200,000	Allowance, engineer's estimate
	Prepare process area and drying area pad	$125,000	2	LS	$250,000	1 acre membranes including sump (half of capping cost) for processing excavated waste
	Physical material screening	$3,000	2,250	DAY	$6,750,000	Equipment rental (trommel screen, finger screen, excavator, etc.) and crew cost
	Management of recovered materials	$400	2,250	DAY	$900,000	Crew of sorters for the duration of excavation
	Hauling recovered materials (metal)	$7	28,800	LCY	$201,600	Assume 2% of total excavation volume
	Hauling waste to Shady Grove Transfer Station (TS)	$7	900,000	LCY	$6,300,000	Assume 60% of total excavation volume
	Processing of sorted waste at TS/RRF	$25	700,000	ton	$17,500,000	Assume 1 ton/cy, unit cost provided by County
	Disposal of ash residue	$50	196,000	ton	$9,800,000	Assume weight of residue is 28% of weight of total waste processed, unit cost provided by County
	Hauling waste to HoneyGo Rubblefill	$40	220,800	LCY	$8,832,000	Approximately 100-mile roundtrip
	Disposal of waste at HoneyGo Rubblefill	$43	220,800	LCY	$9,494,400	Balance of excavated volume not sent to RRF or used onsite
	Management hazardous, radioactive or special waste	$150,000	1	LS	$150,000	Allowance, engineer's estimate
	Dewatering and containerizing leachate	$200	1,100	DAY	$220,000	Assume dewatering 50% of total excavation days
	Leachate hauling to Oaks Landfill	$1,900	1,100	DAY	$2,090,000	Hauling cost for 10 mile roundtrip for 50% of total excavation days
	Leachate disposal costs at Oaks Landfill	$9	53,000	1000 Gallon	$477,000	$9/1000gallons for cost to discharge to WSSC
	Hauling and backfill using reusable excavated soil on site	$5	290,400	LCY	$1,452,000	Non-cover soil fill for excavated areas
	Clean cover soil backfill	$20	40,000	CY	$800,000	Common fill material and labor cost for 2 feet cover over excavated areas
	Seeding and stabilization	$1,000	29	Acres	$29,000	Unit cost provided by County
	Line Item 2 Subtotal				**$81,046,000**	
	Contingency (20%)				$16,210,000	
	Line Item 2 Total				**$97,256,000**	
3	**ENHANCED BIOREMEDIATION**					
3.1	***Data Gaps and Pilot Study***					
	Surveying	$1,000	3	Days	$3,000	Stakeout for new well installation and as-built coordinates
	Clearing and grubbing	$6,850	24	Acres	$167,000	Clearing and grubbing including removing trees and grading in the southern areas
	Grading	$26,000	1	Each	$26,000	Grading in the southern areas
	Benches	$4,660	30	Days	$140,000	Constructing benches for access roads
	Soil for benches	$20	3200	CY	$64,000	
	Acess Road	$14	1200	LF	$17,000	
	Well geophysics and packer testing	$10,000	4	Each	$40,000	Fracture assessment in new injection wells
	Injection well installation	$7,500	8	Each	$60,000	Wells up to 100-ft deep
3.2	***Full Scale Remediation***					
	Surveying	$1,000	4	Days	$4,000	Stakeout for new well installation and as-built coordinates
	Well geophysics and packer testing	$10,000	20	Each	$200,000	Fracture assessment in new injection wells
	Injection well installation (NW, W)	$7,500	115	Each	$865,000	Wells up to 100-ft deep
	Injection well installation (SW, S, SE)	$15,000	97	Each	$1,450,000	Wells up to 100-ft deep, through waste
	Benches	$4,660	230	Days	$1,072,000	Constructing benches for access roads
	Soil for benches	$20	14400	CY	$288,000	
	Access Road	$14	5400	LF	$77,000	
	Line Item 3 Subtotal				**$4,473,000**	
	Contingency (20%)				$895,000	
	Line Item 3 Total				**$5,368,000**	
4	**ADDITIONAL MONITORING NETWORK**					
	Monitoring well installation	$7,500	7	Each	$53,000	Wells up to 100 ft deep
	Surveying	$1,000	1	Days	$1,000	Stakeout for new well installation and as-built coordinates
	Line Item 4 Subotal				**$54,000**	
	Contingency (20%)				$11,000	
	Line Item 4 Total				**$65,000**	
	TOTAL				**$104,489,000**	

OPERATIONS AND MAINTENANCE COSTS

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description
					(Rounded to nearest thousand)	
5	**ANNUAL O&M ENHANCED BIOREMEDIATION**					
	Annual reinjection	$53,000	1	Year	$53,000	Assumes one injection per year on average; possibly more frequent early in the remediation, with decreasing frequency over time.
	EVO	$13	41000	Gallon	$513,000	
	pH adjuster	$14	9000	Gallon	$123,000	
	Bioaugmentation cultures	$700	220	Each	$154,000	
	Water delivery	$0.20	5500000	Gallon	$1,100,000	
	Site maintenance	$25,000	1	Year	$25,000	Maintenance of wells, equipment and roads.
	Sampling of monitoring wells	$420	30	Each	$13,000	30 monitoring wells in areas receiving enhanced bioremediation (existing plus 7 additional wells)
	Line Item 5 Subotal				**$1,981,000**	
	Contingency (20%)				$397,000	
	TOTAL				**$2,378,000**	

Capital plus 20 years O&M **$152,049,000**

Costs and Assumptions for Alternative 1

Alternative 1, Selective Waste Excavation with Off-site Disposal and Enhanced Bioremediation

- Selective Waste Excavation and Cover System Improvements in the Northwest and West Areas.
- Enhanced Bioremediation in the Northwest, West, Southwest, South, and Southeast Areas.

Cost Estimate:

For this conceptual phase, several assumptions had to be made in order to develop conceptual cost estimates. Major assumptions used to estimate costs and schedules are listed in the "Cost and Schedule Assumptions" section of the work plan below.

Capital Cost Activities	**Cost**
Permitting, Design and Preconstruction Activities	$1,500,000
Selective Waste Excavation	$81,046,000
Enhanced Bioremediation Pilot Testing and Installation	$4,473,000
Additional Monitoring Network	$54,000
Contingency (20%)	$17,415,000
TOTAL CAPITAL COST	**$104,489,000**

Operation and Maintenance Cost	**Cost**
Enhanced Bioremediation Annual Reinjection and Equipment Maintenance	$1,981,000
Contingency (20%)	$397,000
TOTAL ANNUAL COST	**$2,378,000**

Capital cost with 20 years of O&M	**$152,049,000**

Cost and Schedule Assumptions:

Major assumptions made in order to develop conceptual cost estimates and likely durations of activities are listed below:

- In the Northwest, the depth to bedrock is 25.5 feet and the depth to groundwater is 15 feet (based on MW-8 boring logs).
- In the West, the depth to bedrock is 17 feet and the depth to groundwater is 39.5 feet (based on MW-7 boring logs).
- The depth of excavation is determined by the depth to bedrock or the depth to groundwater, whichever is shallower.

- Approximately 100 feet between the edge of waste and the property boundary is excavated in the Northwest and the West for space to implement enhanced bioremediation. In the Southwest, South, and Southeast areas, injection wells are placed through the waste.
- Approximately 7 additional monitoring wells, up to 100 feet deep, are installed to monitor compliance.
- Waste excavation cost includes surface water management, removing and reconstructing the landfill gas extraction system, preparing process area pads, material screening, leachate management, hauling and disposal of waste, management of recovered materials, management of potential hazardous materials encountered, and backfilling of excavated area with soil.
- Two feet of clean cover soil is placed over the excavated area backfilled with recovered soil.
- Process area pads are 1 acre impermeable liners.
- Physical material screening and management of recovered materials occur every day waste is excavated.
- Sixty percent of the total excavated waste volume disposed at the Shady Grove Transfer Station/Resource Recovery Facility (TS/RRF).
- The ash residue of the waste taken to the TS/RRF is 28 percent of the original volume processed at the TS/RRF.
- Recovered materials (metals) consist of 2 percent of the total excavated volume.
- All soil required for backfilling is recovered from the excavated waste.
- The remainder of the excavated volume not recovered or sent to the transfer station is disposed at HoneyGo Rubblefill.
- A maximum of 100,000 cubic yards per year (400 cubic yards per day) is excavated and processed.
- Dewatering and leachate management may be required for 50 percent of the excavation period.
- Leachate management and disposal was assumed to be required for 50 percent of the total excavation days.
- In areas with steep slopes, benches are required prior to construction of access roads and drilling of injection wells. Approximately one year was assumed for completing bench construction in all areas. Clean soil will be used for the benches.
- Wells for enhanced bioremediation are spaced approximately 30 feet apart. A total of 220 wells are used to cover the length of the property boundary in the Northwest, West, Southwest, South, and Southanneast areas.
- A total of 8 wells will be installed for pilot testing of enhanced bioremediation.
- The area of influence for injection wells is estimated using parameters from a site in Maryland.
- Surveying and fracture assessment is required prior to installing new injection wells.

- Enhanced bioremediation wells are injected with emulsified vegetable oil (EVO) and a bioaugmentation culture. The groundwater electron demand is estimated to be approximately 52 mg/L of EVO based on an enhanced bioremediation project at a site in Maryland.
- Well, equipment, and road maintenance is required annually.
- O&M estimates do not include current activities at Gude.

Engineer's Construction Preliminary Cost Estimate
Gude Landfill ACM Alternative 2

December 10, 2013

CAPITAL COST ESTIMATE

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description/Assumptions
					(Rounded to nearest thousand)	
1	**DESIGN ACTIVITIES**				$1,500,000	Engineer's estimate
	Line Item 1 Subtotal				**$1,500,000**	
	Contingency (20%)				$300,000	
	Line Item 1 Total				**$1,800,000**	
2	**SELECTIVE WASTE EXCAVATION/COVER SYSTEM**					
	Waste excavation (NW, W)	$13	1,200,000	CY	$15,600,000	Includes surface water management, excavation, truck loading, and hauling for processing on site
	Removal and reconstruction of landfill gas extraction wells	$200,000	1	LS	$200,000	Allowance, engineer's estimate
	Prepare process area and drying area pad	$125,000	2	LS	$250,000	1 acre membranes including sump (half of capping cost) for processing excavated waste
	Physical material screening	$3,000	400	DAY	$1,200,000	Equipment rental (trommel screen, finger screen, excavator, etc.) and crew cost
	Hauling and placement of waste onsite	$8	1,149,000	LCY	$9,192,000	Assume 90% of total excavation volume with a 1.2 bulking factor, 2 trips per hour by 18 CY truck, loading, grading at dump, compacting
	Tarping	$86,000	1	LS	$86,000	Setup, training, materials, and transportation for automatic tarping machine to cover 16,000 SF
	Clean cover soil for relocated waste	$20	400,000	CY	$8,000,000	Common fill material and labor cost for 2 feet cover over excavated areas
	Management hazardous, radioactive or special waste	$150,000	1	LS	$150,000	Allowance, engineer's estimate
	Dewatering and containerizing leachate	$200	200	DAY	$40,000	Assume dewatering 50% of total excavation days
	Leachate hauling to Oaks Landfill	$1,900	200	DAY	$380,000	Hauling cost for 10 mile roundtrip for 50% of total excavation days
	Leachate disposal costs at Oaks Landfill	$9	10,000	1000 Gallon	$90,000	$9/1000gallons for cost to discharge to WSSC
	Hauling and backfill using reusable excavated soil on site	$5	291,000	LCY	$1,455,000	Non-cover soil fill for excavated areas
	Clean cover soil backfill for excavated areas	$20	40,000	CY	$800,000	Common fill material and labor cost for 2 feet cover over excavated areas
	Seeding and stabilization	$1,000	29	Acres	$29,000	Unit cost provided by County
	Line Item 2 Subtotal				**$37,472,000**	
	Contingency (20%)				$7,495,000	
	Line Item 2 Total				**$44,967,000**	
3	**ENHANCED BIOREMEDIATION**					
3.1	***Data Gaps and Pilot Study***					
	Surveying	$1,000	3	Days	$3,000	Stakeout for new well installation and as-built coordinates
	Clearing and grubbing	$6,850	24	Acres	$167,000	Clearing and grubbing including removing trees and grading in the southern areas
	Grading	$26,000	1	Each	$26,000	Grading in the southern areas
	Benches	$4,660	30	Days	$140,000	Constructing benches for access roads
	Soil for benches	$20	3200	CY	$64,000	
	Acess Road	$14	1200	Each	$17,000	
	Well geophysics and packer testing	$10,000	4	Each	$40,000	Fracture assessment in new injection wells
	Injection well installation	$7,500	8	Each	$60,000	Wells up to 100-ft deep
3.2	***Full Scale Remediation***					
	Surveying	$1,000	4	Days	$4,000	Stakeout for new well installation and as-built coordinates
	Well geophysics and packer testing	$10,000	20	Each	$200,000	Fracture assessment in new injection wells
	Injection well installation (NW, W)	$7,500	115	Each	$865,000	Wells up to 100-ft deep
	Injection well installation (SW, S, SE)	$15,000	97	Each	$1,450,000	Wells up to 100-ft deep, through waste
	Benches	$4,660	230	Days	$1,072,000	Constructing benches for access roads
	Soil for benches	$20	14400	CY	$288,000	
	Access Road	$14	5400	LF	$77,000	
	Line Item 3 Subtotal				**$4,473,000**	
	Contingency (20%)				$895,000	
	Line Item 3 Total				**$5,368,000**	
4	**ADDITIONAL MONITORING NETWORK**					
	Monitoring well installation	$7,500	7	Each	$53,000	Wells up to 100 ft deep
	Surveying	$1,000	1	Days	$1,000	Stakeout for new well installation and as-built coordinates
	Line Item 4 Subotal				**$54,000**	
	Contingency (20%)				$11,000	
	Line Item 4 Total				**$65,000**	
	TOTAL				**$52,200,000**	

OPERATIONS AND MAINTENANCE COSTS

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description
					(Rounded to nearest thousand)	
5	**ANNUAL O&M ENHANCED BIOREMEDIATION**					
	Annual reinjection	$53,000	1	Year	$53,000	Assumes one injection per year on average; possibly more frequent early in the remediation, with decreasing frequency over time.
	EVO	$13	41000	Gallon	$513,000	
	pH adjuster	$14	9000	Gallon	$123,000	
	Bioaugmentation cultures	$700	220	Each	$154,000	
	Water delivery	$0.20	5500000	Gallon	$1,100,000	
	Site maintenance	$25,000	1	Year	$25,000	Maintenance of wells, equipment and roads.
	Sampling of monitoring wells	$420	30	Each	$13,000	30 monitoring wells in areas receiving enhanced bioremediation (existing plus 7 additional wells)
	Line Item 5 Subotal				**$1,981,000**	
	Contingency (20%)				$397,000	
	TOTAL				**$2,378,000**	

Capital plus 20 years O&M **$99,760,000**

Concept Work Plan for Alternative 2

Alternative 2, Selective Waste Excavation with On-site Placement and Enhanced Bioremediation

- Selective Waste Excavation and Cover System Improvements in the Northwest and West Areas.
- Enhanced Bioremediation in the Northwest, West, Southwest, South, and Southeast Areas.

Cost Estimate:

For this conceptual phase, several assumptions had to be made in order to develop conceptual cost estimates. Major assumptions used to estimate costs and schedules are listed in the "Cost and Schedule Assumptions" section of the work plan below.

Capital Cost Activities	**Cost**
Permitting, Design and Preconstruction Activities	$1,500,000
Selective Waste Excavation	$37,472,000
Enhanced Bioremediation Pilot Testing and Installation	$4,473,000
Additional Monitoring Network	$54,000
Contingency (20%)	$8,700,000
TOTAL CAPITAL COST	**$52,200,000**

Operation and Maintenance Cost	**Cost**
Enhanced Bioremediation Annual Reinjection and Equipment Maintenance	$1,981,000
Contingency (20%)	$397,000
TOTAL ANNUAL COST	**$2,378,000**

Capital cost with 20 years of O&M	**$99,760,000**

Cost and Schedule Assumptions:

Major assumptions made in order to develop conceptual cost estimates and likely durations of activities are listed below:

- In the Northwest, the depth to bedrock is 25.5 feet and the depth to groundwater is 15 feet (based on MW-8 boring logs).
- In the West, the depth to bedrock is 17 feet and the depth to groundwater is 39.5 feet (based on MW-7 boring logs).

- The depth of excavation is determined by the depth to bedrock or the depth to groundwater, whichever is shallower.
- Approximately 100 feet between the edge of waste and the property boundary is excavated in the Northwest and the West for space to implement enhanced bioremediation. In the Southwest, South, and Southeast areas, injection wells are placed through the waste.
- Approximately 7 additional monitoring wells, up to 100 feet deep, are installed to monitor compliance.
- Waste excavation cost includes surface water management, removing and reconstructing the landfill gas extraction system, preparing process area pads, material screening, leachate management, hauling and placement of excavated waste onsite, management of potential hazardous materials encountered, and backfilling of excavated area with soil.
- Excavated waste will be placed in open areas on top of the current landfill site and covered with a tarp at the end of each day. The waste placement work area will be restricted to one acre at any given time. Two feet of clean cover soil will be used to cover the excavated waste.
- Two feet of clean cover soil is placed over the excavated area backfilled with recovered soil.
- Process area pads are 1 acre impermeable liners.
- Physical material screening occurs every day waste is excavated.
- All soil required for backfilling is recovered from the excavated waste.
- A maximum of 3,000 cubic yards per day is excavated and processed.
- Dewatering and leachate management may be required for 50 percent of the excavation period.
- Leachate management and disposal was assumed to be required for 50 percent of the total excavation days.
- In areas with steep slopes, benches are required prior to construction of access roads and drilling of injection wells. Approximately one year was assumed for completing bench construction in all areas. Clean soil will be used for the benches.
- Wells for enhanced bioremediation are spaced approximately 30 feet apart. A total of 220 wells are used to cover the length of the property boundary in the Northwest, West, Southwest, South, and Southeast areas.
- A total of 8 wells will be installed for pilot testing of enhanced bioremediation.
- The area of influence for injection wells is estimated using parameters from a site in Maryland.
- Surveying and fracture assessment is required prior to installing new injection wells.
- Enhanced bioremediation wells are injected with emulsified vegetable oil (EVO) and a bioaugmentation culture. The groundwater electron demand is estimated to be

approximately 52 mg/L of EVO based on an enhanced bioremediation project at a site in Maryland.

- Well, equipment, and road maintenance is required annually.
- O&M estimates do not include current activities at Gude.

Engineer's Construction Preliminary Cost Estimate
Gude Landfill ACM Alternative 3

December 10, 2013

CAPITAL COST ESTIMATE

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description/Assumptions
					(Rounded to nearest thousand)	
1	**DESIGN ACTIVITIES**				$1,000,000	Engineer's estimate
	Line Item 1 Subtotal				**$1,000,000**	
	Contingency (20%)				$200,000	
	Line Item 1 Total				**$1,200,000**	
2	**EXTENSIVE WASTE EXCAVATION**					
	Waste excavation	$13	6,200,000	CY	$80,600,000	Includes surface water management, excavation, truck loading, and hauling for processing on site
	Stream diversion and restoration	$500,000	1	LS	$500,000	Assumes the stream is disturbed during excavation, unit cost provided by County.
	Removal of landfill gas extraction wells	$200,000	1	LS	$200,000	Allowance, engineer's estimate
	Prepare process area and drying area pad	$125,000	2	LS	$250,000	1-2 acre membranes including sump (half of capping cost) for processing excavated waste
	Physical material screening	$3,000	11,250	DAY	$33,750,000	Equipment rental (trommel screen, finger screen, excavator, etc.) and crew cost
	Management of recovered materials	$400	11,250	DAY	$4,500,000	Crew of sorters for the duration of excavation
	Hauling recovered materials (metal)	$7	148,800	LCY	$1,042,000	Assume 2% of total excavation volume
	Hauling waste to Shady Grove Transfer Station (TS)	$7	4,500,000	LCY	$31,500,000	Assume 60% of total excavation volume
	Processing of sorted waste at TS/RRF	$25	3,700,000	ton	$92,500,000	Assume 1 ton/cy, unit cost provided by County
	Disposal of ash residue	$50	1,036,000	ton	$51,800,000	Assume weight of residue is 28% of weight of total waste processed, unit cost provided by County
	Hauling waste to HoneyGo Rubblefill	$40	559,200	LCY	$22,368,000	Approximately 100-mile roundtrip
	Disposal of waste at HoneyGo Rubblefill	$43	559,200	LCY	$24,046,000	Balance of excavated volume not sent to RRF or used onsite
	Management hazardous, radioactive or special waste	$750,000	1	LS	$750,000	Allowance, engineer's estimate
	Dewatering and containerizing leachate	$200	5,630	DAY	$1,126,000	Assume dewatering 50% of total excavation days
	Leachate hauling to Oaks Landfill	$1,900	5,630	DAY	$10,697,000	Hauling cost for 10 mile roundtrip for 50% of total excavation days
	Leachate disposal costs at Oaks Landfill	$9	270,000	1000 Gallon	$2,430,000	$9/1000gallons for cost to discharge to WSSC
	Hauling and backfill using reusable excavated soil on site	$5	2,232,000	LCY	$11,160,000	Non-cover soil fill for excavated areas
	Clean cover soil backfill	$20	452,000	CY	$9,040,000	Common fill material and labor cost for 2 feet cover over excavated areas
	Seeding and stabilization	$1,000	140	Acres	$140,000	Unit cost provided by County
	Line Item 2 Subtotal				**$378,259,000**	
	Contingency (20%)				$75,652,000	
	Line Item 2 Total				**$453,911,000**	
3	**ADDITIONAL MONITORING NETWORK**					
	Monitoring well installation	$7,500	7	Each	$53,000	Wells up to 100 ft deep
	Surveying	$1,000	1	Days	$1,000	Stakeout for new well installation and as-built coordinates
	Line Item 3 Subtotal				**$54,000**	
	Contingency (20%)				$11,000	
	Line Item 3 Total				**$65,000**	
	TOTAL				**$455,176,000**	

OPERATIONS AND MAINTENANCE COSTS

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description
					(Rounded to nearest thousand)	
4	**ANNUAL ADDITION MONITORING FOR MNA**					
	Additional monitoring for MNA	$40,000	1	Each	$40,000	
	Line Item 4 Subotal				**$40,000**	
	Contingency (20%)				$8,000	
	TOTAL		$960,000		**$48,000**	

Capital plus 20 years O&M **$456,136,000**

Costs and Assumptions for Alternative 3

Alternative 3, Extensive Waste Excavation with MNA

- Extensive Waste Excavation, including removal of all waste.
- Monitored Natural Attenuation in all areas with MCL exceedances, with Enhanced Bioremediation as a potential contingency measure.

Cost Estimate:

For this conceptual phase, several assumptions had to be made in order to develop conceptual cost estimates. Major assumptions used to estimate costs and schedules are listed in the "Cost and Schedule Assumptions" section of the work plan below.

Capital Cost Activities	**Cost**
Permitting, Design and Preconstruction Activities	$1,000,000
Extensive Waste Excavation	$378,259,000
Additional Monitoring Network	$54,000
Contingency (20%)	$75,863,000
TOTAL CAPITAL COST	**$455,176,000**

Operation and Maintenance Cost	**Cost**
Annual Additional Monitoring for MNA	$40,000
Contingency (20%)	$8,000
TOTAL ANNUAL COST	**$48,000**

Capital cost with 20 years of O&M	**$456,136,000**

Cost and Schedule Assumptions:

Major assumptions made in order to develop conceptual cost estimates and likely durations of activities are listed below:

- Total landfill volume is estimated using the estimated waste placed in the landfill, the area of the limit of waste, a waste density of 1 ton per cubic yards, and a 1:3.3 soil to waste ratio.
- Approximately 7 additional monitoring wells, up to 100 feet deep, are installed to monitor compliance.
- O&M estimates do not include current activities at Gude.
- Waste excavation cost includes surface water management, stream diversion and reconstruction, removing the landfill gas extraction system, preparing process area pads,

material screening, leachate management, hauling and disposal of waste, management of recovered materials, management of potential hazardous materials encountered, backfilling of excavated area with soil, clean cover placement, seeding, and stabilization.

- Two feet of clean cover soil is placed over the excavated area backfilled with recovered soil.
- Process area pads are 1 acre impermeable liners.
- Physical material screening and management of recovered materials occur every day waste is excavated.
- Sixty percent of the total excavated waste volume disposed at the Shady Grove Transfer Station/Resource Recovery Facility (TS/RRF).
- The ash residue of the waste taken to the TS/RRF is 28 percent of the original volume processed at the TS/RRF.
- Recovered materials (metals) consist of 2 percent of the total excavated volume.
- Thirty percent of the total excavated waste volume is recovered soil used for backfilling on site.
- The remainder of the excavated volume not recovered or sent to the transfer station is disposed at HoneyGo Rubblefill.
- 100,000 cubic yards per year (400 cubic yards per day) is excavated and processed.
- Dewatering and leachate management may be required for 50 percent of the excavation period.
- Leachate management and disposal was assumed to be required for 75 percent of the total excavation days.

Engineer's Construction Preliminary Cost Estimate
Gude Landfill ACM Alternative 4

December 10, 2013

CAPITAL COST ESTIMATE

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description/Assumptions
					(Rounded to nearest thousand)	
1	**DESIGN ACTIVITIES**				$1,500,000	Engineer's estimate
	Line Item 1 Subtotal				**$1,500,000**	
	Contingency (20%)				$300,000	
	Line Item 1 Total				**$1,800,000**	
2	**COVER SYSTEM IMPROVEMENTS**					
	Clearing and grubbing	$5,000	29	Acres	$143,000	Northwest and West Areas
	Retrofit of landfill gas extraction wells	$150,000	1	LS	$150,000	Allowance, engineer's estimate includes risers for wells, replace piping
	Clean cover soil	$20	40,000	CY	$800,000	Common fill material and labor cost for 2 feet cover over excavated areas
	Seeding and stabilization	$1,000	29	Acres	$29,000	Unit cost provided by County
	Line Item 2 Subtotal				**$1,122,000**	
	Contingency (20%)				$225,000	
	Line Item 2 Total				**$1,347,000**	
3	**ADDITIONAL LANDFILL GAS COLLECTION**					
	Clearing and grubbing	$5,000	2	Acres	$10,000	Clearing area in southwest
	Construction of landfill gas extraction wells (N, NW, SW)	$5,000	15	Each	$75,000	Assumes average length of LFG pipe is 40ft and at $125/LF
	LFG well connection piping	$125	1,000	LF	$125,000	
	Seeding and stabilization	$1,000	2	Acres	$2,000	Unit cost provided by County
	Line Item 3 Subtotal				**$212,000**	
	Contingency (20%)				$43,000	
	Line Item 3 Total				**$255,000**	
4	**PUMP AND TREAT**					
	Clearing and grubbing	$6,850	24	Acres	$167,000	Clearing and grubbing including removing trees and grading in the southern areas
	Grading	$26,000	1	Each	$26,000	Grading in the southern areas
	Hydrogeologic investigation, bench, and pilot scale treatability studies	$100,000	1	LS	$100,000	
	Extraction wells (through waste)	$15,000	44	Each	$660,000	
	Extraction wells (beyond limit of waste)	$7,500	176	Each	$1,320,000	
	Treatment system construction and installation	$839,000	1	LS	$839,000	Adjusted for inflation
	Force main	$15	1760	LF	$26,400	Adjusted for inflation
	Building	$584,627	1	LS	$585,000	Adjusted for inflation and number of extraction wells
	Discharge pipe	$100,000	1	LS	$100,000	
	Electricity network extension	$55,000	1	LS	$55,000	
	Access Road	$14	6600	LF	$94,000	
	Line Item 4 Subotal				**$3,972,400**	
	Contingency (20%)				$795,000	
	Line Item 4 Total				**$4,767,400**	
5	**ADDITIONAL MONITORING NETWORK**					
	Monitoring well installation	$7,500	7	Each	$53,000	Wells up to 100 ft deep
	Surveying	$1,000	1	Days	$1,000	Stakeout for new well installation and as-built coordinates
	Line Item 5 Subotal				**$54,000**	
	Contingency (20%)				$11,000	
	Line Item 5 Total				**$65,000**	
	TOTAL				**$8,234,400**	

OPERATIONS AND MAINTENANCE COSTS

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description
					(Rounded to nearest thousand)	
6	**ANNUAL O&M PUMP AND TREAT**					
	System operation and maintenance	$500,000	1	Year	$500,000	
	Sampling	$3,000	12	Month	$36,000	Sampling for discharge to WSSC (monthly and quarterly)
	Reporting	$1,500	12	Month	$18,000	
	Discharge to WSSC	$9	231,000	1000 Gallon	$2,079,000	
	Well and pump maintenance	$1,000	110	Each	$110,000	
	Line Item 6 Subotal				**$2,743,000**	
	Contingency (20%)				$549,000	
	TOTAL				**$3,292,000**	

Capital plus 20 years O&M **$74,075,000**

Concept Work Plan for Alternative 4

Alternative 4, Additional Landfill Gas Collection and Cover System Improvements with Groundwater Pump and Treat

- Additional Landfill Gas Extraction Wells in the Northwest, West, and Southwest Areas.
- Cover System Improvements in the Northwest, West, and Southwest Areas.
- Groundwater P&T in the Northwest, West, Southwest, South, and Southeast Areas.

Cost Estimate:

For this conceptual phase, several assumptions had to be made in order to develop conceptual cost estimates. Major assumptions used to estimate costs and schedules are listed in the "Cost and Schedule Assumptions" section of the work plan below.

Capital Cost Activities	**Cost**
Permitting, Design and Preconstruction Activities	$1,500,000
Cover System Improvements	$1,122,000
Additional Landfill Gas Collection	$212,000
Groundwater Pump and Treat	$3,972,000
Additional Monitoring Network	$54,000
Contingency (20%)	$1,373,000
TOTAL CAPITAL COST	**$8,234,000**

Operation and Maintenance Cost	**Cost**
Groundwater Pump and Treat Equipment Maintenance and Utilities	$2,743,000
Contingency (20%)	$549,000
TOTAL ANNUAL COST	**$3,292,000**

Capital cost with 20 years of O&M	**$74,075,000**

Cost and Schedule Assumptions:

Major assumptions made in order to develop conceptual cost estimates and likely durations of activities are listed below:

- Cover system improvements include clearing and grubbing, placing 2 feet of clean cover soil on the entire slope, and retrofitting of the existing landfill gas extraction wells to be above the new soil cover.
- Landfill collection wells are approximately 40-ft deep and are placed through the waste.

- Additional piping is required to connect new landfill gas wells in the southwest to the existing system.
- Assume 7 new landfill gas wells are added in the Northwest and West Areas. The remaining 8 new LFG wells are added in the southern areas.
- Extraction wells are spaced approximately 30 feet apart. A total of 220 wells are used to cover the length of the property boundary in the Northwest, West, Southwest, South, and Southeast areas.
- Groundwater extraction wells are approximately 100-ft deep and are placed along the property boundary.
- Approximately 20% of the groundwater extraction wells are placed through the waste at the property boundary.
- The area of influence for extraction wells is estimated using parameters from a site in Maryland.
- Approximately 7 additional monitoring wells, up to 100 feet deep, are installed to monitor compliance.
- Pumps are operating continuously at an estimated maximum pump rate of 2 gallons per minute.
- Surveying and fracture assessment is required prior to installing new extraction wells.
- Extracted groundwater is treated with granular activated carbon (GAC) and discharged to WSSC. GAC maintenance is required quarterly.
- O&M estimates do not include current activities at Gude.
- Balancing and monitoring of new LFG wells is incidental to existing LFG contract.

Engineer's Construction Preliminary Cost Estimate
Gude Landfill ACM Alternative 5

December 10, 2013

CAPITAL COST ESTIMATE

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description/Assumptions
					(Rounded to nearest thousand)	
1	**DESIGN ACTIVITIES**				$750,000	Engineer's estimate
	Line Item 1 Subtotal				**$750,000**	
	Contingency (20%)				$150,000	
	Line Item 1 Total				**$900,000**	
2	**COVER SYSTEM IMPROVEMENTS**					
	Clearing and grubbing	$5,000	29	Acres	$143,000	Northwest and West Areas
	Retrofit of landfill gas extraction wells	$150,000	1	LS	$150,000	Allowance, engineer's estimate includes risers for wells, replace piping
	Clean cover soil	$20	40,000	CY	$800,000	Common fill material and labor cost for 2 feet cover over excavated areas
	Seeding and stabilization	$1,000	29	Acres	$29,000	Unit cost provided by County
	Line Item 2 Subtotal				**$1,122,000**	
	Contingency (20%)				$225,000	
	Line Item 2 Total				**$1,347,000**	
3	**ADDITIONAL LANDFILL GAS COLLECTION**					
	Clearing and grubbing	$5,000	2	Acres	$10,000	Clearing area in southwest
	Construction of landfill gas extraction wells (N, NW, SW)	$5,000	15	Each	$75,000	Assumes average length of LFG pipe is 40ft and at $125/LF
	LFG well connection piping	$125	1,000	LF	$125,000	
	Seeding and stabilization	$1,000	2	Acres	$2,000	Unit cost provided by County
	Line Item 3 Subtotal				**$212,000**	
	Contingency (20%)				$43,000	
	Line Item 3 Total				**$255,000**	
4	**ENHANCED BIOREMEDIATION**					
4.1	***Data Gaps and Pilot Study***					
	Surveying	$1,000	3	Days	$3,000	Stakeout for new well installation and as-built coordinates
	Clearing and grubbing	$6,850	24	Acres	$167,000	Clearing and grubbing including removing trees and grading in the southern areas
	Grading	$26,000	1	Each	$26,000	Grading in the southern areas
	Benches	$4,660	30	Days	$140,000	Constructing benches for access roads
	Soil for benches	$20	3200	CY	$64,000	
	Acess Road	$14	1200	LF	$17,000	
	Well geophysics and packer testing	$10,000	4	Each	$40,000	Fracture assessment in new injection wells
	Injection well installation	$15,000	8	Each	$120,000	Wells up to 100-ft deep
4.2	***Full Scale Remediation***					
	Surveying	$1,000	4	Days	$4,000	Stakeout for new well installation and as-built coordinates
	Well geophysics and packer testing	$10,000	20	Each	$200,000	Fracture assessment in new injection wells
	Injection well installation	$15,000	212	Each	$3,180,000	Wells up to 150-ft deep
	Benches	$4,660	230	Days	$1,072,000	Constructing benches for access roads
	Soil for benches	$20	14400	CY	$288,000	
	Access Road	$14	5400	LF	$77,000	
	Line Item 4 Subotal				**$5,398,000**	
	Contingency (20%)				$1,080,000	
	Line Item 4 Total				**$6,478,000**	
5	**ADDITIONAL MONITORING NETWORK**					
	Monitoring well installation	$7,500	7	Each	$53,000	Wells up to 100 ft deep
	Surveying	$1,000	1	Days	$1,000	Stakeout for new well installation and as-built coordinates
	Line Item 5 Subotal				**$54,000**	
	Contingency (20%)				$11,000	
	Line Item 5 Total				**$65,000**	
	TOTAL				**$9,045,000**	

OPERATIONS AND MAINTENANCE COSTS

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description
					(Rounded to nearest thousand)	
6	**ANNUAL O&M ENHANCED BIOREMEDIATION**					
	Annual reinjection	$53,000	1	Year	$53,000	Assumes one injection per year on average; possibly more frequent early in the remediation, with decreasing frequency over time.
	EVO	$13	41000	Gallon	$513,000	
	pH adjuster	$14	9000	Gallon	$123,000	
	Bioaugmentation cultures	$700	220	Each	$154,000	
	Water delivery	$0.20	5500000	Gallon	$1,100,000	
	Site maintenance	$25,000	1	Year	$25,000	Maintenance of wells, equipment and roads.
	Sampling of monitoring wells	$420	30	Each	$13,000	30 monitoring wells in areas receiving enhanced bioremediation (existing plus 7 additional wells)
	Line Item 6 Subotal				**$1,981,000**	
	Contingency (20%)				$397,000	
	TOTAL				**$2,378,000**	

Capital plus 20 years O&M **$56,605,000**

Concept Work Plan for Alternative 5

Alternative 5, Additional Landfill Gas Collection and Cover System Improvements with Enhanced Bioremediation

- Additional Landfill Gas Extraction Wells in the Northwest, West, and Southwest Areas.
- Cover System Improvements in the Northwest, West, and Southwest Areas.
- Enhanced Bioremediation in the Northwest, West, Southwest, South, and Southeast Areas.

Cost Estimate:

For this conceptual phase, several assumptions had to be made in order to develop conceptual cost estimates. Major assumptions used to estimate costs and schedules are listed in the "Cost and Schedule Assumptions" section of the work plan below.

Capital Cost Activities	**Cost**
Permitting, Design and Preconstruction Activities	$750,000
Cover System Improvements	$1,122,000
Additional Landfill Gas Collection	$212,000
Enhanced Bioremediation Pilot Testing and Installation	$5,398,000
Additional Monitoring Network	$54,000
Contingency (20%)	$1,508,000
TOTAL CAPITAL COST	**$9,045,000**

Operation and Maintenance Cost	**Cost**
Enhanced Bioremediation Annual Reinjection and Equipment Maintenance	$1,981,000
Contingency (20%)	$397,000
TOTAL ANNUAL COST	**$2,378,000**

Capital cost with 20 years of O&M	**$56,605,000**

Cost and Schedule Assumptions:

Major assumptions made in order to develop conceptual cost estimates and likely durations of activities are listed below:

- Cover system improvements include clearing and grubbing, placing 2 feet of clean cover soil on the entire slope, and retrofitting of the existing landfill gas extraction wells to be above the new soil cover.
- Landfill collection wells are approximately 40-ft deep and are placed through the waste.

- Additional piping is required to connect new landfill gas wells in the southwest to the existing system.
- Assume 7 new landfill gas wells are added in the Northwest and West Areas. The remaining 8 new LFG wells are added in the southern areas.
- The injection wells are placed approximately 100 feet from the property boundary to allow time for enhanced bioremediation to take place.
- Approximately 7 additional monitoring wells, up to 100 feet deep, are installed to monitor compliance.
- In areas with steep slopes, benches are required prior to construction of access roads and drilling of injection wells. Approximately one year was assumed for completing bench construction in all areas. Clean soil will be used for the benches.
- Wells for enhanced bioremediation are spaced approximately 30 feet apart. A total of 220 wells are used to cover the length of the property boundary in the Northwest, West, Southwest, South, and Southeast areas.
- A total of 8 wells will be installed for pilot testing of enhanced bioremediation.
- The area of influence for injection wells is estimated using parameters from a site in Maryland.
- Surveying and fracture assessment is required prior to installing new injection wells.
- Enhanced bioremediation wells are injected with emulsified vegetable oil (EVO) and a bioaugmentation culture. The groundwater electron demand is estimated to be approximately 52 mg/L of EVO based on an enhanced bioremediation project at a site in Maryland.
- Well, equipment, and road maintenance is required annually.
- O&M estimates do not include current activities at Gude.
- Balancing and monitoring of new LFG wells is incidental to existing LFG contract.

Engineer's Construction Preliminary Cost Estimate
Gude Landfill ACM Alternative 6

December 10, 2015

CAPITAL COST ESTIMATE

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description/Assumptions
					(Rounded to nearest thousand)	
1	**DESIGN ACTIVITIES**				$550,000	Engineer's estimate
	Line Item 1 Subtotal				**$550,000**	
	Contingency (20%)				$110,000	
	Line Item 1 Total				**$660,000**	
2	**SITE PREPARATION**					
	Clearing and grubbing	$6,850	110	Acres	$754,000	Clearing and grubbing including removing trees, entire toupee cap area
	Grading of existing cover	$5,125	47	Each	$241,000	Rough grade open sites 75,100-100,000 S.F.
	Subgrade cost	$24	172,000	CY	$4,128,000	Assumes half of the toupee cap would require 2 ft of soil
	Stormwater Management	$1,132,000	1	LS	$1,132,000	Assumes replacement of 3 ponds
	Line Item 2 Subtotal				**$6,255,000**	
	Contingency (20%)				$1,251,000	
	Line Item 2 Total				**$7,506,000**	
3	**TOUPEE CAPPING**					
	Geotextile	$0.12	4,618,000	SF	$555,000	8 oz. Non-woven needlepunched geotextile material, delivery, and installation
	Geomembrane	$0.50	4,618,000	SF	$2,309,000	40-mil LLDPE material, delivery, and installation
	Geocomposite	$0.50	4,618,000	SF	$2,309,000	300-mil 8-oz. GSE Fabrinet HF equivalent material, delivery, and installation
	Vegetative Support Soil	$24.00	257,000	CY	$6,168,000	SM or acceptable alternative; Material hauling and Installation costs only, 2 ft of soil over cap area
	Topsoil	$28.00	86,000	CY	$2,408,000	Material cost, delivery and placement, 4" soil over cap area
	Acess Road	$15	1200	LF	$18,000	
	Seeding and stabilization	$1,000	110	Acres	$110,000	Unit cost provided by County
	Line Item 3 Subtotal				**$13,877,000**	
	Contingency (20%)				$2,776,000	
	Line Item 3 Total				**$16,653,000**	
4	**ADDITIONAL LANDFILL GAS COLLECTION**					
	Retrofit of landfill gas extraction wells	$150,000	1	LS	$150,000	Allowance, engineer's estimate includes risers for wells, replace piping
	Construction of landfill gas extraction wells (N, NW, SW)	$5,000	15	Each	$75,000	Assumes average length of LFG pipe is 40ft and at $125/LF
	LFG well connection piping	$45	18,000	LF	$817,000	
	Valves	$2,000	10	Each	$20,000	
	Condensate traps	$7,000	15	Each	$105,000	
	Line Item 4 Subtotal				**$1,167,000**	
	Contingency (20%)				$234,000	
	Line Item 4 Total				**$1,401,000**	
5	**ADDITIONAL MONITORING NETWORK**					
	Monitoring well installation	$7,500	7	Each	$53,000	Wells up to 100 ft deep
	Surveying	$1,000	1	Days	$1,000	Stakeout for new well installation and as-built coordinates
	Line Item 5 Subotal				**$54,000**	
	Contingency (20%)				$11,000	
	Line Item 5 Total				**$65,000**	
	TOTAL				**$26,285,000**	

OPERATIONS AND MAINTENANCE COSTS

	Cost Categories and Items	Unit Cost	Quantity	Units	Total Cost	Description
					(Rounded to nearest thousand)	
6	**ANNUAL O&M TOUPEE CAP**					
	Cap Maintenance	$50,000	0.5	Year	$25,000	Assume cap maintenance (~ 1/4 acre area) every 2 years requires excavation, replacing geomembrane, and 2 ft of vegetative support soil
	Line Item 6 Subotal				**$25,000**	
	Contingency (20%)				$5,000	
	TOTAL				**$30,000**	

Capital plus 20 years O&M **$26,885,000**

Concept Work Plan for Alternative 6

Alternative 6, Toupee Capping and Additional Landfill Gas Collection

- Toupee Capping of the top of the Landfill (inclusive of the Northwest, West, Southwest, South, and Southeast Areas), as well as the Landfill side-slopes in the Northwest and West Areas.
- Additional Landfill Gas Collection in the Northwest, West, and Southwest Areas.

Cost Estimate:

For this conceptual phase, several assumptions had to be made in order to develop conceptual cost estimates. Major assumptions used to estimate costs and schedules are listed in the "Cost and Schedule Assumptions" section of the work plan below.

Capital Cost Activities	**Cost**
Permitting, Design and Preconstruction Activities	$550,000
Site Preparation	$6,255,000
Toupee Capping	$13,877,000
Additional Landfill Gas Collection	$1,167,000
Additional Monitoring Network	$54,000
Contingency (20%)	$4,382,000
TOTAL CAPITAL COST	**$26,285,000**

Operation and Maintenance Cost	**Cost**
Landfill Cap Excavation and Replacement in Localized Areas of Settlement	$25,000
Contingency (20%)	$5,000
TOTAL ANNUAL COST	**$30,000**

Capital cost with 20 years of O&M	**$26,885,000**

Cost and Schedule Assumptions:

Major assumptions made in order to develop conceptual cost estimates and likely durations of activities are listed below:

- Toupee Capping will cover approximately 110 acres, inclusive of the top of the Landfill and side-slopes in the Northwest and West Areas.

- Site preparation for the Toupee Cap will include clearing and grubbing, placing fill and grading over the existing cover to ensure a minimum 4 percent slope, and reconstruction of the stormwater management system.
- Clean soil will be used for fill where needed to achieve a minimum of 4 percent slope on the Toupee Cap.
- An 18 inch vegetative support soil layer will be placed above the Toupee Cap liner.
- Landfill gas collection wells are approximately 40-ft deep and are placed through the waste.
- New piping will be required for the entire landfill gas collection system.
- Assume 7 new landfill gas wells are added in the Northwest and West Areas. The remaining 8 new LFG wells are added in the southern areas.
- Approximately 7 additional monitoring wells, up to 100 feet deep, are installed to monitor compliance.
- O&M activities assumes repair of a 100 feet by 100 feet section of cap every 2 years, including 5 feet of excavation, 2 feet of soil fill, and replacing the geomembrane.
- O&M estimates do not include current activities at Gude.
- Balancing and monitoring of new LFG wells is incidental to existing LFG contract.