LINCOLN STONE QUARRY CLOSURE ALTERNATIVE ANALAYSIS

Submitted to

Midwest Generation

Submitted by

Geosyntec consultants

engineers | scientists | innovators

January 2022

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LIST OF ACRONYMS

AACE	Association for the Advancement of Cost Engineering
AGQS	Applicable Groundwater Quality Standards
bgs	below ground surface
CO_2	Carbon Dioxide
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
COIPs	Constituents of Potential Interest
CQA	Construction Quality Assurance
CY	Cubic Yard
°F	Degrees Fahrenheit
ft^3	Cubic Feet
ft AMSL	feet above mean sea level
GIA	Groundwater Impact Assessment
GMZ	Groundwater Management Zone
IAC	Illinois Administrative Code
ICA	Interim Corrective Actions
IEPA	Illinois Environmental Protection Agency
lb	Pounds
lbs/yd^3	Pounds per Cubic Yard
LLDPE	Linear Low-Density Polyethylene
MCY	Million Cubic Yards
MNA	Monitored Natural Attenuation
MSW	municipal solid waste
USEPA	United States Environmental Protection Agency
ZOA	Zone of Attenuation

EXECUTIVE SUMMARY

The Lincoln Stone Quarry (LSQ) consists of three units, the West Fill Area (WFA) which has a soil cover, the Main Quarry and the North Quarry. The Main Quarry is currently inactive and requires closure since the existing Joliet # 9 and #29 power plant units have been converted to natural gas. The Main Quarry is approximately 43 acres in size and approximately 150 feet in depth and contains approximately 2.6 million cubic yards (cy) of coal combustion residuals (CCRs). The WFA is approximately 17 acres in size and contains approximately 1.7 million cy of CCRs. The North Quarry did not accept waste materials and therefore does not require closure.

Geosyntec developed and evaluated eight different closure approaches or alternatives at the LSQ: (1) Closure by Removal of CCRs to an existing off-site permitted landfill, (2) Closure by Removal of CCRs to a new on-site landfill, (3) Closure in Place with IEPA Prescribed Final Cover, (4) Closure in Place with Alternate Final Cover System, (5) Consolidate and Close in Place, (6) Closure in Place with Hydraulic Controls, (7) Closure in Place with Hydraulic Containment, and (8) Closure in Place with a Wet Cap.

All closure scenarios were assessed for several different factors including short and long-term effectiveness in controlling future releases to the environment, risk to nearby receptors, groundwater and surface water protection, and cost. Additional factors such as: actuarial risk (i.e., worker safety and vehicle safety) and greenhouse gas assessments were further evaluated to define impacts on public safety and the environment. **Table ES-1** provides a summary of the closure scenario factors including costs.

Scenario 1 “Closure by Removal to an Existing Off-Site Landfill” had the highest accident rate (vehicle and worker safety) and greenhouse gas footprint. Scenario 1 was also assessed to be impractical due to the lack of available nearby permitted airspace, cost, dewatering challenges, accident potential, lack of transportation infrastructure, and significant greenhouse gas footprint that results from removal of 4.3 million cubic yards of CCR to an off-site landfill. Continued operation of the current groundwater extraction system would also be required to address residual groundwater quality in the GMZ and potential seepage from the WFA. Lastly, groundwater modeling indicates that the required dewatering of the LSQ would impact (i.e. dry out) nearby private water wells.

Scenario 2 “Closure in Place to a New On-Site Landfill” and Scenario 8 “Closure in Place with Wet Cap” were also assessed to not be implementable. For Scenario 2, there was not on-site property available or nearby property for purchase for a new landfill. Scenario 8 was assessed as not implementable due to the difficultly to get regulatory approval for a “wet” cap design.

The Closure in Place scenarios (Scenario Nos. 3 -7) eliminated the removal of over 4.3 million cubic yards of CCR and therefore, reduce accident potential and greenhouse gas emissions by an order of magnitude when compared to Closure by Removal scenarios. Additionally, by

eliminating stormwater recharge through the CCR waste mass via final cover placement, a more effective inward groundwater hydraulic gradient condition will be obtained after closure thereby addressing existing and future groundwater quality.

Various closure in place scenario alternatives were completed. For example, Scenario 5 "Consolidate and Close in Place" reduced the closure footprint, thereby reduced the volume of CCRs requiring regrading and final cover area placement, which resulted in the most cost effective Closure in Place scenarios that are deemed implementable. Scenarios 6 and 7 (hydraulic control and containment) provides additional and redundant engineered control systems for groundwater protection. The closure in place scenarios would require continued operation of the current groundwater extraction system to address residual groundwater quality in the southern groundwater management zone (GMZ) and potential seepage from the WFA.

When all factors were considered, the Closure in Place scenarios provided both short- and long-term effectiveness in the prevention of future releases to groundwater and surface water sources and provide the best protection to public health, welfare and safety when other factors such as greenhouse gas emissions, worker safety and traffic safety were assessed. Based on the most recent information availability, Scenario 4 "Closure in Place with Alternate Final Cover" is the preferred closure scenario because this scenario will have the lowest potential impact to the environment while ensuring protection to public health, welfare and safety.

SECTION 1

INTRODUCTION

1.1 Terms of Reference

This report was prepared by Geosyntec Consultants (Geosyntec) for the Lincoln Stone Quarry (LSQ) near Joliet, Illinois at the request of Midwest Generation, LLC. (Midwest Generation). This report was authored by Mr. Jesse P. Varsho, P.E., P.G. (Illinois), Ms. Megan Martz and Ms. Megan Kilian, and it was reviewed by Mr. Phil Harvey, P.G. (Illinois) and Dr. Ryan Fimmen, all Geosyntec.

1.2 Background and Scope of Work

The LSQ is owned and operated by Midwest Generation and occupies approximately 120 acres on the south side of the Des Plaines River in Joliet, Illinois. LSQ is geologically located in dolomite bedrock. The LSQ is located at the Joliet #9 Generating Station at 1601 South Patterson Road.

The purpose of this report is to present the results of a closure alternatives analysis for the LSQ. For each closure option the risk, effectiveness of controlling future releases, and the implementation process was evaluated and discussed. Finally, a Class 4 cost estimate under Association for the Advancement of Cost Engineering (AACE) Classification Standard was completed. This closure alternative analysis generally follows the methodology described in the 35 Illinois Administrative Code (IAC) 845.710 regulations.

As noted above, as part of this assignment, Geosyntec reviewed the previous closure plan and associated groundwater impact assessment (GIA) model for the Landfill to identify if the assumptions used in these analyses are reasonable and represent current and/or anticipated future site conditions, and if the analyses are technically appropriate.

1.3 Limitations of Report

As requested by Midwest Generation, the focus of this alternative closure evaluation is on identifying and evaluating closure scenarios based on several different criteria. Therefore, the scope of services conducted by Geosyntec did not involve a detailed review of all LSQ's operations, environmental data, and systems. Geosyntec's conclusions and recommendations are considered preliminary and may be revised based on additional data or new information that becomes available.

The following information, as summarized in Section 11, was relied upon by Geosyntec in performing its evaluation and preparing this report. Other than developing our own independent cost estimate, as explained in Section 10.5, Geosyntec did not independently validate the accuracy of the information contained in these documents.

SECTION 2

SITE INFORMATION

2.1 General Site Information

Midwest Generation currently operates two natural gas-fired generating stations, located in unincorporated Will County near Joliet, Illinois. The LSQ has operated as a disposal facility for bottom ash/boiler slag from the two formerly coal-fired generating stations (Joliet Stations #9 and #29) since circa 1962. The overall disposal facility consists of an inactive portion referred to as the WFA, the North Quarry that did not receive CCR, and the inactive bottom ash/slag disposal area referred to as the Main Quarry as shown on **Figure 2-1**. LSQ is operating under an Illinois Environmental Protection Agency (IEPA) solid waste landfill Permit Number 1994-241-LFM, Modification No. 24, dated June 11, 2018 [IEPA, 2018].

Initial disposal activities began in the WFA, approximately 14 acres in size, and included disposal of fly ash, bottom ash, and slag. The WFA ceased accepting CCRs in approximately 1975 and the area was leveled to drain stormwater and vegetated. In the early 1980's, the existing soil cap was enhanced with additional two feet of soil [IPCB, 1996].

The North Quarry (also referred to as the Lower Quarry) is located north of the Main Quarry and contains a settling pond and pumping system for discharging water to the Des Plaines River. The North Quarry did not accept waste materials and therefore does not require closure.

The consolidated CCR waste volumes within the Main Quarry are estimated at 2.6 million cubic yards (MCY) and 1.7 MCY for the WFA for a total CCR volume of 4.3 MCY. Analysis and discussion of Closure in Place scenarios utilize the total CCR volume in design and cost calculations provided herein, however for the Closure by Removal scenarios a volume bulking or swell factor of 30 percent was applied to the consolidated CCR volume based on the grain size distribution (i.e. silts and sands) of the CCR [Coduto, 1998]. The estimated waste volume can reasonably be expected to expand upon excavation, dewatering, and loading for transport to the selected landfill. The expanded volume is estimated at 5.6 MCY for Closure by Removal design and cost calculations.

2.2 Permit History

The operating permit for the LSQ was renewed with Modification No. 24, dated June 11, 2018. That current permit was due to expire May 21, 2019 but is still considered active as the permit renewal application was submitted in a timely manner. Relevant permit modifications include for LSQ include:

- Permit Log No. 2019-059, pending; for renewal of the current operating permit;

- Permit Log No. 2018-105, approved 3/13/2018; approved the annual assessment report of the interim corrective action (ICA) as required by permit conditions.

- Permit Log No. 2012-113, approved 4/3/2012; approved the construction quality acceptance (CQA) report for the expanded ICA extraction wells at the facility;

- Permit Log No. 2011-15, approved 4/1/2011; approved the expansion of the existing ICA extraction well system along the southside of the facility; and

- Permit Log No. 2009-443, approved 9/3/2009; approved the installation of ICA extraction wells in the southwest corner of the facility.

2.3 Adjusted Standard

On Aug. 15, 1996, the Pollution Control Board granted the prior owner of the Quarry an adjusted standard from certain operating and closure requirements of 35 Ill. Adm. Code 811 and 814 due to the unique nature of the Quarry ("Adjusted Standard" or "Order", AS 96-9). Condition 7 of the Adjusted Standard provided for two methods for the Main Quarry's closure. The two methods were either wet closure for which no final cover was required or, dry closure by installation of a two-stage cover system consisting of two feet of soil with a hydraulic conductivity of 1×10^{-7} cm/sec overlain by four inches of topsoil. (Ex. 1, Order, Condition 7, pp. 22-23) [IPCB, 1996].

In 2015, the U.S.EPA promulgated the Coal Combustion Residual ("CCR") Rules, 40 CFR 257. Under the CCR rules, as it is currently drafted, all CCR impoundments utilizing a "closure in place" scenario are to be closed via dry closure. Because the Main Quarry may be defined as a "CCR Impoundment" as defined in the Federal CCR rules, the Main Quarry may be closed via dry closure with a two-stage cover system [NRG, 2016].

2.4 Environmental Controls

2.4.1 Liner and Leachate Collection Systems

The requirement for a liner system, leachate drainage, collection, and management system does not apply to the Main Quarry as stated in Order and Opinion of the IPCB, AS-96-9, dated August 15, 1996 [IPCB, 1996].

2.4.2 Groundwater Monitoring System

Groundwater quality and flow conditions for the facility are monitored on a quarterly basis through an approved groundwater monitoring well network consisting of both detection wells and assessment wells, which cover all four sides of the facility. A map illustrating the locations of the monitoring wells is provided as **Figure 2-1**.

Most of the groundwater monitoring locations consist of "well clusters" with two to three wells per cluster. The "WT", "S" and "D" nomenclature on **Figure 2-1** indicates at what level or depth below groundwater surface (bgs), a particular well is screened. "WT" stands for a well screened across the water table. "S" stands for a well screened within the "shallow" bedrock zone. "D" stands for a well screened within the "deep" bedrock zone.

The operating permit for the facility requires quarterly groundwater quality monitoring for pH, specific conductance, temperature, water level, ammonia, arsenic, boron, cadmium, chloride, fluoride, manganese, molybdenum, potassium, selenium, sodium, sulfate, total dissolved solids, total organic carbon and zinc. In addition, barium, copper, iron, lead, mercury and nitrate are monitored on an annual basis. The results of each round of groundwater monitoring are compared against applicable groundwater quality standards (AGQSs) or background levels that were developed for the facility and included in its permit. Certain monitored parameters have been detected at various on-site monitoring wells above the respective AGQSs including permit well locations G46S, G47S and G48S located at the southeast side of the landfill [KPRG, 2010].

2.4.3 Stormwater Management

Current surface water control features include earthen berms, discharge piping, Main Quarry bedrock walls, and vegetated perimeter lands of the Quarry. Surface water discharges to the Des Plaines River (via the North Quarry), and is regulated by NPDES Permit Number IL0002216, which a timely renewal application was submitted prior to the current expiration date of October 31, 2019 (Aptim, 2019). Discussion of anticipated future stormwater management features under closed conditions is presented in detail in Section 9.2.

2.4.4 Permitted Final Cover System

The closure plan for the Quarry has been revised to accommodate the requirements in the federal CCR rule, 40 CFR Part 257. The revised closure plan was included in the permit renewal application [KPRG, 2019b]. It is noted that the revised closure plan includes a standard dry closure final cover and wet closure as currently approved by the existing operating permit and existing Adjusted Standard (AS-96-9, dated August 15, 1996), as well as a proposed alternate final cover synthetic turf system called ClosureTurf®.

Proposed alternate closure scenarios within the permit-approved dry, wet, and synthetic turf closure systems are discussed further in Section 4 of this report.

2.4.5 Groundwater Extraction System and Groundwater Management Zone (GMZ)

Pursuant to Permit Modification Nos. 12 and 13, dated December 1, 2009 and July 1, 2010, respectively, IEPA required Interim Corrective Actions (ICA) to address the reversal of flow within the lower Silurian dolomite adjacent to the southern portion of the landfill, and an interim Groundwater Management Zone (GMZ) to define and monitor groundwater concentrations of

boron, molybdenum, arsenic, and sulfate that exceeded the respective AGQSs in the area proximal to the south/southeastern corner of the Main Quarry. Migration of the constituents of potential interest (COPIs) to the southeast is related to the reversal of groundwater flow (normally northerly, inward gradient) due to increased pumping at the nearby Laraway Quarry. The ICA consists of two main components [KPRG, 2020]:

- A twelve well groundwater extraction system along the southern edge of the Main Quarry and WFA has been operating since February 2012. The objective of this pumping system is to establish a sufficient hydraulic trough between the Main Quarry/WFA and the southern LSQ property boundary to capture water moving from the facility to the south and to re-establish an inward hydraulic gradient from the south property boundary to the north. The extraction system has been performing adequately.

- Assessment groundwater quality monitoring on a quarterly basis for the full list of permit-specified G1 and G2 parameters from both on-site and off-site monitoring wells. The objectives of the monitoring are to define the extent of migration to the southeast for the interim GMZ and to evaluate the effectiveness of the extraction wells system operation on water quality along the southeast perimeter of the landfill.

SECTION 3

GEOLOGIC AND HYDROGEOLOGIC SETTING

3.1 Regional Geologic Setting

Regional and site-specific data documents fractures in the Silurian dolomite. This is consistent in describing a primary joint set that is vertical and oriented about N52E and N40W. The N40W joints are described as "more distinct". Natural spacing between the joint sets ranges from 3 to more than 10 feet, and joint apertures are described as less than 1/16th-inch. Bedding plane fractures are also noted. Descriptions from the quarry walls and from cores obtained during drilling show significant clay infilling of the vertical joints and bedding plane fractures. Evidence of water movement through fractures is interpreted from iron staining and mineralization (primarily calcite, with some pyrite and marcasite) [KPRG & Geo-Hydro, Inc., 2013].

Additional fracturing is observed at the quarry wall and the fractures/joints at the wall tend to be more open. This is interpreted to be a localized phenomenon that is the result of the blasting and unloading from quarry operations. This effect does not appear to extend greater than about 10 or 15 feet away from the quarry wall [KPRG, 2013].

3.2 Site Geology

3.2.1 Unconsolidated Units

Surface soils around the LSQ facility are comprised of approximately 30 feet of unconsolidated glacial overburden (the thickness varies across the site).

3.2.2 Bedrock

Dolomite beneath the facility is divided into a "shallow" Silurian zone and a "deep" Ordovician zone. These two more permeable zones are separated by a lower permeability shale (Brainard Shale). The shallow zone dolomite is approximately 140 – 150 feet thick, placing the contact between the base of the dolomite and the top of the shale at approximately 430 – 440 feet above mean sea level (ft MSL). The thickness of the Brainard Shale is approximately 10 feet, with its base elevation ranging from approximately 420 – 430 feet MSL. The deep zone dolomite is 30 – 40 feet thick, placing the contact between the base of the deep zone and the underlying Scales Shale regional aquitard at an elevation of approximately 380 – 400 feet MSL.

The deepest portions of the LSQ Main Quarry lie at an elevation of approximately 477 feet MSL, which is within the Silurian dolomite zone and above the Brainard Shale low permeability zone.

Previous hydrogeologic evaluations have interpreted a horizon of higher permeability within the Silurian dolomite. The higher permeability zone extends from approximately 500 feet MSL down to 430 feet MSL and is partially penetrated by the LSQ. This increased permeability feature assists in the understanding an interpretation of existing groundwater flow conditions beneath the site. [KPRG & Geo-Hydro, Inc., 2013].

The Silurian dolomite is divided into four units identified as a weathered bedrock rind, Joliet Formation dolomite, Kankakee Formation dolomite and the Elwood/Wilhelmi dolomite. Beneath the Silurian dolomite is the Ordovician age Maquoketa Group consisting of the Brainerd Shale, Fort Atkinson dolomite and the Scales Shale. The Scales Shale unit is a recognized regional aquitard, which hydraulically isolates the deeper bedrock aquifers from the shallower units [KPRG, 2020].

3.2.3 Mining Operations

Prior to being used as a disposal facility for bottom ash/boiler slag beginning in 1960's, limestone bedrock was mined from the Quarry. The overall size of the Quarry is approximately 2,250 feet by 1,230 feet in plan area (total plan area of approximately 66 acres). The overall plan area of the Quarry consists of the WFA, the Main Quarry, access roads, and undisturbed land along the perimeter. The plan area of the WFA is approximately 14 acres and the Main Quarry is approximately 43 acres, with the remaining 9 acres consisting of the access roads and undisturbed land. The approximate top elevation of the Quarry ranges from 582 feet MSL along the north, 596 feet MSL along the east, 590 feet MSL along the west, and 608 feet MSL along the south. The bottom of the quarry ranges from 477 feet MSL along the northeast portion to 520 feet MSL along the northwest portion. The southern portion of the Quarry is around 495 MSL, with higher elevations (500 to 520 feet MSL) along the perimeter [KPRG, 2019].

The Laraway Quarry facility is located directly southeast of the LSQ facility and is continuing to expand quarry operations within its permitted limits. The associated depression of the local groundwater table will continue to be a factor in controlling the inward groundwater gradient at the LSQ facility until operations at the Laraway Quarry are complete and groundwater can return to its natural elevation and northerly flow direction.

3.3 Site Hydrogeology

Groundwater beneath the facility occurs under unconfined water table conditions. The monitoring wells screened across the interface between the unsaturated and saturated zones are referred to above as the "WT-series" or "water table wells." The base of the Main Quarry is at elevations ranging from approximately 494 to 477 feet MSL, which is within the lower portion of the Silurian Dolomite. The deeper portion of the Main Quarry is on the south side of the facility and the shallower portion is toward the north. Shallow zone (or S-series) monitoring wells are screened at elevations at or just below the base of the Main Quarry.

The Brainerd Shale is a lower permeability zone, which hydraulically separates the overlying Silurian dolomite from the Fort Atkinson dolomite. Deep zone (or D-series) monitoring wells at the facility are screened within the Fort Atkinson dolomite. Both water level and chemistry data from the deep zone wells indicate that the Brainerd Shale provides separation between the shallow and deep zones. Groundwater flow within the deep zone is to the west. [KPRG, 2020]

3.3.1 Groundwater Flow

Groundwater flow near and under the Main Quarry would naturally be to the north and toward the Des Plaines River. However, the static water level in the Main Quarry is generally maintained at an elevation of 540 to 550 ft MSL which is below the natural water table of the surrounding deposits. This surface water level is maintained in the Main Quarry by a stormwater pipe that drains the Main Quarry to the north into the Southeast Pond, which eventually drains to the Des Plaines River. Accordingly, there is an existing inward gradient from the shallow deposits into the Main Quarry without the influence of the nearby Laraway Quarry which is discussed below.

Field observations during drilling, formation packer testing at various depth intervals, and down-hole geophysical logging conducted by previous consultants have identified that the lower portion of the Silurian dolomite is more permeable than the upper portion of the dolomite. Ongoing dewatering operations within the Laraway Quarry (approximately 1,000 feet to the southeast) over the last 18 years have affected the natural flow conditions within the area such that it created a component of groundwater flow away from the eastern half of the south side of the Main Quarry to the southeast, toward Laraway Quarry. This water is drawn through the defined higher permeability materials within the lower portion of the Silurian dolomite. Flow at the water table has continued to move to the north and discharges to the Main Quarry in accordance with permit requirements. The Laraway Quarry dewatering operations have not affected the natural inward gradient into the Main Quarry from the east and the south at the water table. The amount of overburden between Laraway Quarry and the Main Quarry allows sufficient storage at the water table level [KPRG, 2020].

3.3.2 Groundwater Quality

Since the start of expanded extraction system pumping on February 16, 2012, quarterly groundwater quality data has been obtained from wells G38S, G39S, G45S, G46WT, G46S, G47WT, G47S, G48WT, G48S, and T01S through T11S. The samples were analyzed for the full list of G1 and G2 parameters specified in the current operating permit. The 2019 sampling data from permit wells along the southern perimeter of the LSQ and off-site assessment wells to the south are summarized in Section 6.2 of this report. It is noted that detections of constituents (including COPIs boron, molybdenum, arsenic, and sulfate) in off-site monitoring wells above the established AGQS are contained within the IEPA approved GMZ established as part of the overall ICA as discussed above [KPRG, 2020].

3.3.3 Previous and Current Groundwater Controls

As discussed in Section 2.4.5, the existing ICA include a groundwater extraction system consisting of 12 wells (X101 – X112). The wells are generally constructed to a depth of approximately 142 to 146 feet bgs, with 40 feet of 0.032-inch slot screen. This results in screened pumping intervals of approximately 444 feet MSL to 484 feet MSL. This screened interval coincides with the higher permeability zone within the lower portion of the Silurian dolomite and intercepts the base of the southern boundary of the Main Quarry.

The operation of the ICA extraction well system is regularly affected by scaling and mineralization related to the natural geochemical reaction between the CCR leachate (including COPIs boron, molybdenum, arsenic, and sulfate) and the minerals in the Silurian dolomite as groundwater circulates through. An existing O&M plan routinely assesses system components, and provides guidance on cleaning, repair, and replacement schedules for scaled pumps and conveyance lines.

SECTION 4

PROPOSED ALTERNATE CLOSURE SCENARIOS

This section provides a high-level summary of potential alternate closure scenarios that were evaluated; additional detail regarding the level of effort required to implement a given closure scenario is provided in Section 9.

4.1 Closure by Removal

The Closure by Removal scenarios consider levels of effort necessary to excavate existing CCR waste from the Main Quarry and relocate it to a permitted landfill facility. The source removal approach is intended to mitigate potential near-term impacts to human health and the environment via the groundwater exposure pathway, as well as minimize long-term management needs associated with post-closure stewardship at the LSQ facility. High-level work scope summaries of the two Closure by Removal scenarios are provided below, and the associated cost estimates are provided in **Appendix D**.

4.1.1 Existing Off-Site MSW Landfill

Closure by Removal with material placement at an existing off-site municipal solid waste (MSW) landfill involves dewatering and maintaining the depressed hydraulic conditions at the Main Quarry, excavation, loading, transport, and disposal of 5.6 MCY of CCR material (existing in-place 4.3 MCY plus 30% expansion factor).

Based upon a review of the 2020 Landfill Capacity Report [IEPA, 2021], there are two off-site permitted active landfills in Will County: Laraway Recycling & Disposal and/or Prairie View Recycling & Disposal. These facilities may be able to accept some or all of the CCRs from the Lincoln Stone Quarry. The next nearest out of county landfill is the Livingston Landfill located over 50 miles from the LSQ. Additional discussion of available landfill disposal capacity is provided in Section 9.1.2.

4.1.2 Modes of Transport

The recent approved Illinois regulations related to CCR closure alternatives, Illinois Administrative Code (IAC) 845.710, requires the assessment various forms of transport for the closure by removal scenarios. The various transport modes to be included in the closure alternatives include rail, barge, trucks or a combination of these transportation modes. Each of these transport modes are discussed below:

4.1.2.1 Rail Transport

Rail may be advantageous as a transport mode since it minimizes the need for trucks to transport CCRs on public roadways, and therefore, minimizes the potential impacts to public roadways and associated users. In order to transport CCRs from the LSQ two transfer stations would have to be sited, permitted, designed, and operated. The first transfer station would have to be located at the LSQ facility and would transfer CCRs from haul trucks to a rail car. The second transfer station would have to be located near the proposed disposal facility to order to transfer the CCR from the rail cars to a haul trucks for disposal at the third-party off-site disposal facility.

Based on Geosyntec's experience at designing similar facilities and the anticipated CCR volumes and rates, we estimate the necessary transfer station building size would be on the order of 25,000 to 30,000 square feet. Other necessary infrastructure that would be necessary would include a rail spur to stage loading or unloading of rail cars and then connect to the rail line. The size of the rail spur, based on Geosyntec previous experience, would be on the order of 2,500 feet by 300 feet (750,000 sq. feet or approximately 17 acres).

In reviewing the available areas at the LSQ facility, there is not sufficient area for the rail transfer station at the Main Quarry or WFA (i.e., land south of Patterson Road). For potential areas on the North Quarry (i.e., land north of Patterson Road), the vast majority of the area is needed to support stormwater management after closure of the facility and therefore is not available for development. Additionally, a road crossing and associated permit would be necessary to cross the public Patterson Road and would create an additional public hazard due to the significant volumes of trucks crossing over the road.

Lastly, Geosyntec is not aware of any active rail transfer stations in Illinois or adjacent states. Therefore, it would take a minimum of three years, most likely closer to five years, to site, permit, design and construct a rail transfer station at the disposal site which would unnecessarily extend the closure schedule.

Due to the above-mentioned factors, closure by removal via rail transport was assessed to be unfeasible at LSQ and therefore was eliminated from further discussion.

4.1.2.2 Barge Transport

Similar to the rail transport mode, barge transport would require development of two transfer stations; one at the LSQ facility and one near the third-party off-site disposal facility. Unlike rail, there could still be significant truck hauling on public roads in order to transport the CCR from the barge to proposed disposal facility. A similar sized transfer station building would be required to transfer the CCRs from the haul trucks to the barge (approximately 25,000 square feet) but the rail spur would not be required, but the barge transfer station would have to be located adjacent to the Des Plaines River. Additionally, multiple permits would be required to cross Patterson Road and the existing multiple rail lines.

In reviewing the available area adjacent to Des Plaines River, there is not significant area for development of a barge transfer station due to the presence of the existing, multiple rail lines. Similar to the rail transfer station, Geosyntec is not aware of any active or permitted barge transfer stations in Illinois or adjacent states. Therefore, it would take a minimum of three years, most likely closer to five years, to site, permit, design and constructed a rail transfer station near the disposal site which would unnecessarily extend the closure schedule.

Due to the above-mentioned factors, closure by removal via barge transport was assessed to be unfeasible at LSQ and therefore was eliminated from further discussion.

4.1.2.3 Truck Transport

Truck transport is feasible at the LSQ because it does not require additional infrastructure or permits; and therefore, will be the transport mode that will be evaluated for the closure by removal scenarios.

4.1.3 New On-site CCR Landfill

Tasks associated with Closure by Removal with material placement at a new on-site landfill are the same as those associated with placement at an existing off-site landfill noted previously, with additional considerations for developing a new landfill, including but not limited to:

- Siting (estimated 45 acres required to place 4.3 MCY of CCR material, notwithstanding soil borrow and landfill operational needs)
- Financing and purchasing property (if necessary)
- Landfill zoning, permitting, designing
- Landfill construction and operation
- Engineering and environmental compliance
- Financial assurance and closure, post-closure responsibilities

It is understood that as of the completion of this report, there is no land in the vicinity of the LSQ facility currently owned by Midwest Generation or adjacent parcels available for purchase that would suffice for a new landfill development.

4.2 Closure In-Place

The Closure In-Place scenarios consider levels of effort necessary to implement approved final closure systems at the LSQ facility as the CCR waste currently exists *in-situ*. The intent of this type of approach is to mitigate risks associated with dewatering and excavating the waste,

transporting the CCR waste through multiple additional communities, and disposing of the CCR waste in a MSW landfill environment while preserving the protection of human health and the environment in the vicinity of the LSQ facility. The proposed final CCR grades are shown in **Figure 4-1**. High-level work scope summaries of the two Closure in Place scenarios are provided below, and the associated cost estimates are provided in **Appendix C**. With the exception of Closure Scenario 8 (Wet Closure), the closure in-place scenario cost estimates included the WFA.

4.2.1 IEPA Prescribed Final System

For the purposes of this evaluation, Geosyntec utilized the prescribed final cover system as required by 35 IAC 811 or the pending 35 IAC 845 regulations. The IEPA prescribed final cover system consists of (from bottom to top): 1 foot recompacted cohesive soil layer, 40 mil linear low-density polyethylene (LLDPE), geocomposite drainage layer and 3 feet of protective cover soils with the upper 6-inches capable of supporting vegetation.

A drainage system consisting of a series of "finger drains" would be installed under the final cover system to address groundwater seepage that enters the CCR waste mass. The collected groundwater seepage would be discharged to the North Quarry [KPRG, 2019b]

4.2.2 Alternate Final Cover System

As discussed in Section 2, the LSQ was a previous stone quarry and therefore the availability of on-site soils for final cover system construction is limited. To minimize the need to develop an off-site burrow pit, Geosyntec evaluated an alternate final cover system (ClosureTurf®) that minimizes the need for off-site soils.

ClosureTurf® is a three-component system comprised of (bottom to top): structured geomembrane, engineered turf, and a specialized sand infill. The engineered turf component gives the system its natural look and feel of grass while protecting the geomembrane from extreme weather conditions for the long term while minimize the need to perform maintenance of conventional soil caps.

The sand infill component is placed between the blades of the engineered turf and allows the system to be driven on by maintenance vehicles while also providing additional protection from weathering. ClosureTurf® is subtitle D compliant and is can be installed in a quick and efficient manner.

4.3 Consolidate and Close in Place

Each Closure in Place scenario will include some level of effort to consolidate and grade the existing CCR material to prepare it for the final cover system (and associated structural fill, as needed). The Consolidate and Close in Place scenarios will incorporate the greatest level of

earthworks effort with respect to the existing CCR, as the intent is to minimize the need for imported structural fill.

Determining structural and chemical stability of the material directly below any final cover system is crucial to evaluate long-term durability of the system. It is feasible that the existing CCR material meets structural and chemical specifications for a final cover system – if this is the case (to be determined via a thorough sampling and analysis plan), it could minimize the volume of imported structural fill that would need to be purchased and placed prior to installing the final cover system. The proposed consolidate CCR waste footprint and grades are shown on **Figure 4-2**. Once the existing CCR is consolidated, either the prescribed final cover system (Section 4.2.1) or alternate final cover system (Section 4.2.2) could be utilized.

4.4 Closure In-Place with Hydraulic Controls or Containment

4.4.1 Hydraulic Control via Pumping (Groundwater or Leachate Pumping)

Under this closure scenario, liquid or leachate extraction wells would be installed in the CCR waste in order to enhance the natural inward gradient conditions at the LSQ. The leachate extraction wells would be installed approximately 60 feet into the waste mass at a density of one (1) well per acre, in order to lower liquid levels in the CCR waste mass. Pumped water or leachate would be discharged through the facility's NPDES permit. A conceptual layout of the proposed leachate extraction system is illustrated on **Figure 4-3**.

4.4.2 Hydraulic Containment

Another potential method for providing additional groundwater protection at the LSQ is hydraulic containment. Hydraulic containment at the LSQ would involve installing a hydraulic barrier to slow the movement of groundwater and associated contaminants from the Main Quarry and WFA. For unconsolidated units (i.e. soils) a bentonite slurry wall would be installed within the soil mass.

For consolidated units (i.e. rock) the primary pathways for groundwater movement are through facture patterns in the dolomite bedrock. For this case, the bedrock fractures would be sealed through the addition of grout injection via either vertical or angle rock borings. Since the vast majority of the Main Quarry is located in dolomite bedrock, this closure alternative would focus on hydraulic containment via grouting of the dolomite bedrock fractures as shown on **Figure 4-4**.

4.4.3 Wet Closure

Other containment systems, mainly sediment caps, allow for "wet closure" as an alternative which involves installation of a physical barrier system (typically engineered sand or other physically durable but transmissive material) that fully caps the containments below the natural water table, while also allowing natural reduction and/or oxidation processes to continue. Benefits of this type of system include low ongoing cap system O&M, minimal stormwater and water table controls, and minimal risk of exposure for human health and the environment.

4.5 Post-Closure Care

All closure scenarios will be required to develop and implement closure and post-closure care plans that discuss the activities required during post-closure care since CCRs will remain in place at either the WFA and/or Main Quarry. The post-closure care plan will describe the maintenance, sampling and inspection programs for appropriate function of all of the engineering control systems installed at the LSQ during the post-closure care period.

The anticipated post-closure care period for the LSQ is 30 years. The proposed end use of the LSQ will be a natural area of passive open space. The proposed end use will complement and provide a buffer with the current land uses and natural features (e.g., the Des Plaines River) that surround the property.

SECTION 5

EXPOSURE ASSESSMENT

5.1 Conceptual Exposure Model (CEM)

Land and water uses around the LSQ under both current and reasonably anticipated future conditions were used to develop a conceptual exposure model (CEM) that identifies potentially complete exposure pathways by which receptors could come into contact with constituents of potential interest (COPIs) (i.e. CCR and CCR leachate). The components of a complete exposure pathway are as follows:

- source or release from a source;
- mechanisms of release and transport;
- exposure media (i.e., a point-of-contact); and
- receptor and exposure route.

Based on constituent source and transport considerations and existing chemical data, potentially impacted exposure media at the Facility are: (i) on-site soil and CCR materials; (ii) on-site groundwater; (iii) sediment and surface water of the Des Plaines River; and (iv) off-site groundwater. This section presents relevant information on the LSQ facility and surrounding area to identify potential receptors and exposure routes for each of the potentially impacted exposure media. Exposure routes include existing, near-term, and short-term human receptors along with ecological habitats.

5.1.1 Surrounding Land, Groundwater, and Surface Water Uses/Designations

A desktop survey of land and water use conditions was conducted to identify potential receptors within a one-mile radius of the Facility, hereafter reviewed to as the "area of interest." This desktop survey included (i) a review of the zoning within the area of interest, (ii) the identification of wetlands and surface water bodies using the US Fish and Wildlife Service Wetlands Mapper, (iii) the identification of potential water supply sources using online resources, and (iv) a focused online search to locate potential threatened and endangered species within the vicinity of the Facility.

5.1.1.1 Land Use

The 120-acre LSQ facility and the surrounding Joliet #9 Station is zoned for agricultural and industrial land uses[1]. Land use and zoning surrounding the Station is variable. Within a one-mile radius, zoning is primarily residential to the northeast, industrial to the north, northwest, and south; and municipal to the southeast. North of the industrial area to the north is the Des Plaines River. Other key land uses are discussed below:

- The Des Plaines River serves as both a stormwater and groundwater "sink."
- The land uses within the 0.5-mile radius are heavily developed with some green corridors along the Des Plaines River corridor or buffers to previous or existing mining activities.
- The vast majority (>70 percent) of the land uses within the 0.5 miles radius are either industrial (storage yards and aggregate) or mining activities.
- Residential land uses are present north east of the LSQ but make up less than 30 percent of the land uses within a 0.5-mile radius.

5.1.1.2 Groundwater Use and Public Water Supply

There are numerous potential private and public groundwater receptors surrounding LSQ. There are approximately 32 private wells within the subdivision to the east of the quarry. The wells within this subdivision have an average depth of 193 feet and are screened within the limestone aquifer.

Additionally, there are two public water supply wells located at 1703 S. Chicago St (east of LSQ). These public water supply wells service the Modern Mobile Home Park located to the East of Lincoln Stone Quarry and access the Devonian-Silurian Dolomite aquifer. IEPA Public Water Supply No. 20385 has a depth of 350 feet and a pumping rate of 30 gpm, while IEPA Public Water Supply No. 20386 has a depth of 300 feet and a pumping rate of 18 gpm. An exhibit showing the location of water wells in the vicinity of the LSQ is provided in **Appendix B**.

Previous and existing groundwater potentiometric maps and three-dimensional groundwater modeling has demonstrated that there has not been any groundwater movement from the LSQ towards the residential neighborhood located to the northeast of LSQ [KPRG, 2019a].

5.1.1.3 Wetlands

Based on review of national wetland maps and GIS data viewer, no wetlands were identified in the vicinity of the LSQ. Wetlands were mapped within the Main Quarry due to the presence of

[1] https://www.willcountyillinois.com/County-Offices/Administration/GIS-Division/GIS-Data-Viewer

standing water, but site visits verified that the standing water in the Main Quarry should not be classified as a wetland [NRG, 2018].

5.1.2 Potential Receptors and Exposure Media

Receptors with potentially complete exposure pathways to CCR constituents at or in the vicinity of the LSQ facility are described below. These receptors were identified based on the current setting and existing/anticipated future land uses at the LSQ facility and surrounding area. Importantly, the presence of a receptor does not indicate exposure is occurring. Three groups of human receptors are identified:

- Current receptors, which are also representative of long-term future receptors in the event no action is taken at the LSQ facility, which is unlikely;
- Near-term future receptors, who represent receptors potentially present at or in the vicinity of the Facility during closure activities;
- Long-term future receptors, who represent receptors potentially present at or in the vicinity of the Facility once closure is completed.

5.1.2.1 Current Human Receptors

Human receptors with potentially complete exposure pathways to CCR constituents at or in the vicinity of the LSQ under current conditions, are described below.

- Current Station Workers: Full-time workers are employed at the Joliet #9 Station to support natural gas power generation. Job duties for most full-time workers are carried out within the Station buildings. Some specialized workers may come into contact with CCR material at the Main Quarry during intermittent monitoring, inspection, or maintenance activities but these workers receive specialty training and are required to use personal protective equipment to limit exposure. Potable water at the Station is supplied by a deep well that is screened well below the upper most aquifer (dolomite bedrock) therefore, Station worker exposure to groundwater as potable water is an incomplete exposure pathway.
- Current Contractors: Current contractors may perform inspections, periodic maintenance, and environmental sampling in the vicinity of the LSQ but these workers receive specialty training and are required to use personal protective equipment to limit exposure.
- Current Trespassers: There is a possibility that non-authorized receptors may access the Facility by trespassing from the north (Patterson Road) or east (South Brandon Road) but access is restricted through signage, perimeter fencing and security. Nonetheless, the possibility of on-site trespassing cannot be excluded under current conditions.

- Current Off-Facility Recreationalists: The portion of the adjacent Des Plaines River is used for commercial transport (i.e. barges) and therefore recreational uses are limited. Swimming has not been observed in the vicinity of the Facility and, given the industrial setting and lack of wadable access, is therefore unlikely. There are fish consumption advisories for the Des Plaines River in Will County based on non-site-related constituents [polychlorinated biphenyls (PCBs)][2]; however, recreational angling may occur. Recreational activities are generally associated with intermittent shorter-term exposures to environmental media, relative to workers.

- Current Off-Facility Residents: There is a residential neighborhood northeast of the Main Quarry. Groundwater flows northwest beneath the LSQ; thus, residences to the northeast are not downgradient of the LSQ. As shown in **Appendix B**, there are approximately 32 private drinking water well(s) within an 0.5-mile. Other private wells were identified east of the Site at varying distances within the 1-mile radius, but these are either unlikely to be downgradient of the LSQ facility, are served by municipal water, and/or are not classified for drinking water use.

5.1.2.2 Near-Term Future Human Receptors

Human receptors with potentially complete exposure pathways to CCR constituents at or in the vicinity of the Facility during closure (i.e., in the near-term future), are described below. The receptors identified below include those that may be directly or indirect exposed to CCR constituents as well as receptors that may be at risk of injury or other incident due to closure-related activities (e.g., construction).

- Landfill Closure Contractors involved in the near-term future closure have the greatest potential for direct contact with CCR material while directing the excavation and movement of CCR material, but these workers will receive specialty training and will be required to use personal protective equipment to limit exposure. Other contractors, such as those performing periodic inspection and monitoring activities may also have incidental contact. Station employee project oversight personnel, third party construction oversight personnel, or regulatory inspectors would fall under the other contractor category.

- Truck drivers will haul CCR material off-site and haul fill and cover material into the LSQ facility during closure, but these workers will receive specialty training and will be required to use personal protective equipment to limit exposure.

- Highway users could be affected if CCR materials are transported on public roads if a traffic accident were to occur. In the event of an accident, any spillage would be removed from the road as part of incident response. Any routine or accidental exposures would be transitory and highway users would be unlikely to have direct contact with the material.

[2] http://www.idph.state.il.us/envhealth/fishadv/desplainesriver.htm

As discussed in Section 4, rail or barge transport modes for CCR removal were assessed to be non-feasible at the LSQ.

5.1.2.3 Long-Term Future Receptors are Current Human Receptors

Human receptors with potentially complete exposure pathways to CCR constituents at or in the vicinity of the LSQ facility after closure is completed, are described below.

- Future Station Workers: Similar to current conditions, full-time workers are expected to be employed at the Joliet #9 Station. No completed exposure pathways are anticipated for these receptors under post-closure conditions.

- Future Contractors: As with current conditions, contractors may be present at the Facility in the future to perform inspections, periodic maintenance, and environmental sampling. However, with the exception of intrusive (subsurface) activities, closure will substantially reduce, if not eliminate, the potential for future contractors to be exposed to CCR constituents. These contractors would also receive specialty training and will be required to use personal protective equipment to further limit exposure.

- Future Trespassers: There is a possibility that non-authorized receptors may access the Facility by trespassing from the north (Patterson Road) or east (South Brandon Road). Closure will substantially reduce, if not eliminate, the potential for future trespassers to be exposed to CCR constituents.

- Future Off-Facility Recreationalists: The adjacent Des Plaines River will likely continue to be used for commercial and recreation uses, accordingly there is a potential for exposure to CCR constituents if they migrate to the river.

- Future Off-Facility Residents: Development of the LSQ for residential use represents an exceedingly small possibility that does not warrant further consideration. Groundwater flows northwest beneath the LSQ; thus, residences to the northeast are not downgradient of the LSQ facility.

  As shown in **Appendix B**, there are approximately 32 private drinking water well(s) within an 0.5-mile. Other private wells were identified east of the Site at varying distances within the 1-mile radius, but these are either unlikely to be downgradient of the LSQ facility, are served by municipal water, and/or are not classified for drinking water use. Based on the City of Joliet and Will County GIS Data Viewer websites, any non-developed properties within 1.0 miles of the LSQ are not zoned as residential.

5.1.2.4 Ecological Habitat and Receptors

The LSQ and surrounding Joliet Station are developed/disturbed and provide ecological habitat that is limited in both extent and quality. Some areas of on-site CCR management units may support emergent vegetation that may attract wildlife; however, based on planned closure activities, the LSQ facility is likely to be dominated by maintained grasses and provide limited habitat quantity and quality. Similarly, ecological habitat in surrounding residential, industrial, and municipal use areas is currently limited in both extent and quality and is not expected to change in the future.

North of the facility, the Des Plaines River and associated riparian habitat does provide habitat that supports a variety of ecological receptors, including plants, invertebrates, fish, and aquatic-dependent wildlife (e.g., piscivorous birds and mammals).

Geosyntec requested an EcoCAT report (**Appendix A**) for the LSQ facility. The EcoCAT report reviews databases from the Illinois Department of Natural Resources to identify threatened and endangered (T&E) species potentially present in the vicinity of the Facility and are discussed in more detail below.

- Killifish – the proposed closure scenarios will not impact water quality associated with the Illinois River and therefore the LSQ will not have an impact on the Killifish population. The existing NPDES permit requires testing and reporting to ensure that the facility will not have an adverse effect on surface water quality.

- Osprey – the proposed closure options will not disturb existing wildlife habitat for this species.

SECTION 6

RISK AND EFFECTIVENESS ASSESSMENT

6.1 Screening Level Risk Evaluation Objectives and Methods

This section describes a framework for a site-specific risk-based approach to evaluate the analytical data for environmental media in the context of potential human and ecological receptors that may be exposed to CCR constituents associated with the Facility. Direct exposure to CCR materials is currently controlled through institutional and engineering controls and planned closure activities will render this pathway incomplete in the long-term. Therefore, this framework primarily addresses groundwater and surface water media that could be affected by the potential migration and transport of CCR leachate associated with the LSQ facility, with an emphasis on potential human and ecological receptors that could be exposed to these constituents in groundwater and downgradient surface water bodies.

Potential risks to human and ecological receptors exposed to COPIs are quantitatively evaluated using a screening-level approach that compares estimates of exposure (i.e., reported concentrations) to estimates of effect (i.e., media-specific screening levels). This approach is a commonly used to screen for the potential for risk and to evaluate if additional assessment is required.

6.1.1 Exposure Estimates for COPIs

For this evaluation, exposure estimates are based on the following analytical data:

- Groundwater data from compliance wells (G31, G33, G41, and G42) collected between 2017 and 2019 and analyzed for the parameters listed in previous reports [KPRG, 2020a].

- Outfall water data from NPDES outfalls 001 (Circ Water), 003 (R&Y Pond), and 005 (Quarry (Ash Pond)) collected between 2017 and 2019 and analyzed for the parameters listed in previous reports [NRG, 2020].

Analytical results collected between 2017 and 2019 were selected as representative of current and future conditions. Multiple quarterly sampling events were considered to minimize the potential that seasonal fluctuations in concentrations affect the results of this evaluation.

For both human and ecological receptors, the initial screening step compares maximum detected COPI concentrations to health-based screening levels. If maximum detected concentrations are less than applicable screening levels, the COPI is excluded from further evaluation. Notably, there is no direct exposure (i.e. ingestion) to groundwater from the compliance wells (wells are locked) or water collected from the outfalls (located within secured fence area). Rather, human and ecological receptors are potentially present in downgradient locations where decreased

concentrations are expected due to a combination of physical and chemical attenuation processes. Therefore, exceedance of a screening level does not indicate a potential for risk, only the need for additional evaluation. Further, the objective of this evaluation is to rank relative risks for the purposes of selecting a closure approach.

6.1.2 Effects Estimates for COPIs

Effects values for the COPI evaluation are based on the protection of human or ecological receptors. Screening levels are designed to provide a conservative estimate of the concentration to which a receptor (human or ecological) can be exposed without experiencing adverse health effects. Due to the conservative methods used to derive screening levels, it can be assumed with reasonable certainty that concentrations below screening levels will not result in adverse health effects, and that no further evaluation is necessary. Concentrations above conservative risk-based screening levels do not necessarily indicate a potential risk exists but indicate that further evaluation is warranted.

Preliminary, health-based screening levels represent the lowest of the following:

- Illinois Water Quality Standards (WQS) based on chronic endpoints for aquatic life and human health; and

- Illinois Administrative Code (IAC) 620 Class I Potable Use Groundwater Standards.

In the absence of a WQS or IAC, the AGQS or the acceptable limit defined in the permit is used as a point-of-comparison. The AGQS was only used as the screening level for evaluating molybdenum in groundwater and oil and grease concentrations measured in NPDES outfall water.

6.2 Potential Toxicity Hazards for Human Receptors

Baseline protectiveness and long-term protectiveness evaluations considered theoretical health risks from exposure to COPIs present in environmental media at and in the vicinity of the Facility. Short-term protectiveness evaluations considered two major categories of potentially adverse outcomes: theoretical health risks from exposure to COPIs present in environmental media at and in the vicinity of the Facility and risks of injuries or fatalities to workers and the community from remediation-related activities.

With respect to the existing exposure risks at the LSQ, COPIs present in surface water and groundwater are considered de minimis risk due to existing institutional and engineering controls at the facility, on-going monitoring of surface water conditions, groundwater plume behavior, and the location of the impacts relative to potential receptors (public and private water wells). Examples of institutional controls include documented groundwater use restrictions which is currently placed for permitted groundwater management zone at the LSQ. Engineering controls

examples include groundwater extraction wells (currently installed at the LSQ) to reduce the exposure to downgradient human receptors from groundwater.

Surface water analytical data collected as part of NPDES compliance monitoring indicates no exceedances of permitted concentration standards. Any surface water criteria exceedances are related to groundwater quality in southern GMZ, and accordingly are not applicable to the surface water exposure route. Groundwater samples from locations north of the Main Quarry are below surface water screening levels, therefore there is no risk of groundwater discharge to surface water causing exceedances of surface water criteria [KPRG, March 2020].

Groundwater analytical data collected as part of the overall LSQ's groundwater assessment monitoring plan indicates that the facility's COPIs (boron, molybdenum, arsenic, and sulfate) are being effectively managed by the groundwater ICA extraction system, and despite occasional short-term fluctuations in individual groundwater well concentrations, the long-term trends indicate an overall decrease in COPI concentrations and areal extent of COPIs within the GMZ.

The COPI groundwater plume is delineated and controlled by the extraction system and is generally decreasing in extent and concentration. Additionally, the COPI concentrations that exceed respective AGQSs are located on the south and southeast sides of the Main Quarry, which are not upgradient of private or public water wells within the vicinity of the LSQ facility, and therefore not complete exposure pathways [KPRG, March 2020].

6.3 Risk of Incidents

Protecting the health and safety of contract workers and the general public is a major concern during implementation of remedial actions [USEPA, 1988]. As such, the potential for remediation-related incidents is a critical component of evaluating short-term risks for potential closure alternatives. In contrast to typical regulatory health risk assessment methodologies that incorporate theoretical assumptions to evaluate potential risks associated with exposures to chemicals in the environment (e.g., cancer risk from exposure to carcinogenic constituents), the risk of incident assessment develops actual or expected risks based on empirical data derived from incident rates from similar activities.

The risk of incident assessment, also referred to as actuarial risk assessment, calculates the probability that an injury or fatality will occur during a given remedial alternative. Actuarial risks, such as the probability of a middle-aged man dying during the next year (as used to set life insurance rates), are the most ideal available estimates because they are based on actual observations of such an event and are therefore highly accurate [USEPA, 2001].

For each closure alternative, labor and transportation projections were calculated (e.g., number of hours worked and trucks entering/exiting the facility) and these projections were evaluated using statistical data on injury and fatality rates for traffic accidents involving large trucks and construction activities based on the following references.

- Bureau of Labor Statistics (BLS). 2006. Injuries, Illnesses, and Fatalities in Construction, 2004. Compensation and Working Conditions. May 2006.

- BLS. 2013. Current Population Survey. Census of Fatal Occupational Injuries. Available at: http://www.bls.gov/iif/oshcfoi1.htm#2011. Accessed 8/15/2013.

- United States Department of Transportation (USDOT). 2003. An Analysis of Fatal Large Truck Crashes. National Highway Traffic Safety Administration. DOT HS 809 569. June 2003.

- USDOT. 2012. Large Truck and Bus Crash Facts. Federal Motor Carrier Safety Administration Analysis Division. FMCSA-RRA-12-023. August 2012.

6.3.1 Results of Vehicle Accidents

Vehicle accident frequency for three different types of accidents (property damage, personnel injury and fatalities) for the various closure scenarios is summarized in **Table 6-1**. Intuitively, those scenarios that require greater mileage to execute correspond to the highest potential for vehicle accidents. The Closure by Removal scenarios generate the highest potential accident rate; the calculated accident rates for closure scenarios 1 and 2 are more than four times higher the vehicle accident rates for scenarios 3 through 8.

6.3.2 Results for Worker Accidents

Worker accident frequency for the alternative closure scenarios is summarized in **Table 6-2**. Like the vehicle accident calculations, those scenarios that require greater hours to execute correspond to the highest potential for worker accidents. The Closure by Removal scenarios generate the highest potential accident rate – the calculated worker accident rates for scenarios 1 and 2 are more than seven times higher the rates for closure scenarios 3 through 8.

6.4 Greenhouse Gas Evaluation

Greenhouse Gas Evaluation for the closure scenarios is represented by the level of effort associated with main vehicle components for each of the work scopes: CCR removal/regrading and transportation, liner/cap soil borrow and placement, and geosynthetic material delivery and placement. Methodology summaries for each component of the overall greenhouse gas impact calculation are discussed below.

CCR removal/regrading refers to activities conducted to remove the CCR material from the Main Quarry and transport it to another landfill (on-site or off-site) and regrading of the existing CCR waste mass to prepare the subgrade for final capping activities. Liner/cap soil borrow and placement refers to vehicle usage associated with excavation of soil material from borrow areas

for use in the liner or capping systems, as applicable. Lastly, geosynthetic delivery and placement relates to vehicle usage associated with transporting and installing these materials.

The quantity of diesel fuel consumed was estimated based upon hours of operation for the heavy equipment (bulldozers, scrapers, etc.). Estimated diesel consumption values and corresponding CO_2 generation rates are provided in **Table 6-3**. Facility-specific fuel consumption data for earthworks operations are not applicable to the LSQ facility as typical closure activities do not involve earthworks equipment or tasks.

The diesel fuel consumed by the dump trucks and flatbed tractor trailers used to transport the excavated CCR material, soil, and geosynthetics were estimated using the hauling distance between origin and destination. Estimated diesel consumption values are provided in **Table 6-3**.

As anticipated, the Closure by Removal scenarios generate the highest estimated greenhouse gas emission rates per cubic yard of CCR material managed. The increased truck miles required to transport the CCR material from LSQ to either an off-site or on-site landfill combined with the elevated heavy equipment hours of operation required to excavate the CCR material result in greenhouse gas generation rates (kg CO_2 per CY) that are more than six times higher than those for each of the six Closure In-Place scenarios. Maintenance and replacement impacts were not specifically calculated for each piece of equipment within each scenario; those impacts can be assumed to scale with mileage and hours of operation impacts.

SECTION 7

EFFECTIVENESS OF CONTROLLING FUTURE RELEASES

7.1 Closure Timelines

Depending upon the selected closure scenario, the time for closure is estimated to range from two years (Closure in Place) to fourteen years (Closure by Removal) as detailed in **Table 7-1**. Siting a new on-site landfill would likely require an additional three to four years to procure and purchase the necessary real estate (landfill and soil borrow), complete the regulatory permitting process, develop detailed design and construction specs, and mobilize the resources necessary to construct and operate an active landfill facility capable of receiving the expanded 5.6 MCY of CCR waste removed from the LSQ facility.

Given the extended timeline and level of effort required to execute the Closure by Removal scenarios, the potential for future releases associated with transporting CCR waste over the road to an off-site landfill facility is likely to be compounded by several elements. Factors including but not limited to the number of transport trucks, the miles covered, the communities encountered, and efficacy of dewatering activities each have bearing on the potential for future releases. Out of an abundance of caution, if selected, the Closure by Removal scenarios would benefit from a comprehensive robust risk analysis and accompanying work plan to account for and mitigate factors associated with transporting 5.6 MCY of CCR material through the greater Chicagoland area.

Conversely, the Closure in Place scenarios do not require those same factors to be considered, as any work associated with CCR waste transport would be confined to the existing LSQ facility. Given the inherent additional levels of protection against potential future releases provided by the Closure in Place scenarios, these scenarios would also benefit from a work plan to coordinate internal transportation procedures associated with CCR waste management, though this work plan scope would likely be simplified as compared to that recommended for the Closure by Removal approach.

7.2 Technical Guidance

7.2.1 USEPA's Presumptive Remedy

Preferred technologies for common site remedy corrective actions based on previous performance are referred to as presumptive remedies by the USEPA. The objective of presumptive remedies is to use past experiences to streamline site investigation activities and speed up the implementation of corrective actions. The USEPA has selected containment as the presumptive remedy for CERCLA municipal landfills due to the volume and heterogeneity of the waste [USEPA, 1993].

LSQ's closure scenarios 3 through 8 which utilize the Closure in Place strategy are consistent with the USEPA presumptive remedy of containment for CERCLA municipal landfills. The LSQ is not a CERCLA municipal landfill but is permitted as a landfill within the IEPA municipal solid waste landfill (MSWLF) program. The LSQ shares many of the same environmental concerns (i.e. leachate impacting groundwater, impacted stormwater run-off and physical waste migration) as a CERCLA municipal landfill, with the exception of landfill gas generation, therefore containment is the appropriate presumptive remedy at the LSQ.

7.2.2 Illinois FIRST Abandoned Landfill Program

In 1999, Illinois lawmakers included $65 million budget into the Illinois FIRST program to address problems at 33 of the state's worst abandoned landfills which were located in 21 counties across Illinois. Problems encountered at the abandoned landfills included erosion of cover, exposed garbage, and groundwater and surface water contamination [IEPA, 2000].

The proposed corrective actions to stabilize and close the abandoned landfills included capping and grading the entire waste mass with two to three feet of soil cover, vegetation of the soil cover, and installation of stormwater drainage controls. The proposed IEPA goals for closure of the 33 abandoned landfills were to stabilize the landfill by minimizing stormwater infiltration and migration of waste, accommodate settlement, and facilitate long-term maintenance.

LSQ's closure scenarios 3 through 8, which utilize the Closure in Place strategy, are consistent with the IEPA approach for the closure of the state's 33 worst abandoned landfills. Additionally, the LSQ Closure in Place scenarios will include leachate removal and groundwater monitoring programs over a 30-year post-closure care period.

7.3 Extent of Containment Practices will Reduce Future Releases

The Closure by Removal scenarios will remove the CCR waste mass, and therefore will remove the source of potential future releases from only the Main Quarry. The Closure in Place scenarios will reduce future releases through the following actions:

- Prevent direct physical contact with CCRs;
- Minimize stormwater infiltration and resulting contaminant leaching to ground water;
- Control surface water run-on and run-off and thereby minimize erosion to the final cover system; and
- Collect and treat existing or potential future extracted groundwater and leachate and contain existing contaminant plumes and prevent future migration.

7.4 Treatment Technologies

At this time, it is not anticipated that supplemental treatment technologies will be utilized to treat the CCR waste mass in either the Closure by Removal or Closure in Place scenarios. Leachate and extracted groundwater will continue to be managed and discharged through the LSQ's NPDES permit for the Closure in Place scenarios.

7.5 Long-Term Reliability of Engineering and Institutional Controls

Closure by Removal will remove the waste mass and therefore the "source" of potential contamination from the Main Quarry and WFA, and accordingly will not rely on engineering or institutional controls. Note that Closure by Removal will not address the existing groundwater impacts in the GMZs.

Closure in Place will rely on the following engineering and institutional controls:

- Engineering Controls
    - Landfill Final Cover System
    - Groundwater Extraction System
    - Natural Hydraulic Gradients
- Institutional controls
    - Groundwater Management Zone
    - NPDES monitoring
    - Deed Restriction

The proposed institutional controls for the LSQ have been implemented at many other facilities in the state of Illinois and have demonstrated long-term reliability in minimizing the risk to human health and the environment via groundwater exposure pathways.

The proposed engineering controls such as the final cover system have been utilized at hundreds of solid waste facilities across the United States since the 1980s. The solid waste industry along with support from the USEPA and state agencies has demonstrated the long-term reliability and effectiveness of the proposed final cover system in waste containment and minimizing leachate generation. Reducing leachate generation is the most effective way to eliminate the need for future corrective actions related to groundwater protection.

SECTION 8

GROUNDWATER PROTECTION AND ASSOCIATED GROUNDWATER MODELING

8.1 Overview of Current Permitted GIA Models

The groundwater impact assessment (GIA) model is a regulatory requirement under 35 IAC 811. The GIA model is a contaminant transport model that takes the landfill design and operations and the site specific hydrogeologic conditions to model groundwater concentrations over time. The GIA model predicts groundwater concentrations 100 feet from the waste boundary [zone of attenuation (ZOA)] 100 years after the landfill is closed. The predicted groundwater concentrations, 100 years after closure, are then compared to existing groundwater quality standards (AGQS). The regulations under 35 IAC 811 require that the predicated groundwater concentrations are less than or equal to the existing groundwater (i.e. AGQS).

The LSQ has a permitted GIA model that has been approved by the IEPA as part of the regulatory permit renewal process. As part of the permit renewal process, LSQ was required to review existing groundwater and landfill conditions and compare those conditions to modeled conditions in the GIA model. If the GIA model conditions are different, LSQ was required to update the GIA Model. The most recent update was approved as Modification No. 21 to Permit No. 1994-241-LFM, dated 14 August 2015.

8.2 Conceptual Site Model

8.2.1 Geologic Units

The conceptual site model that was developed and permitted at the LSQ models the Silurian and Ordovician age units. The Silurian unit consists of four different dolomite formations: bedrock rind, Joliet formation, Kankakee formation and the Elwood/Wilhelimi formation. The Silurian unit is underlain by the Ordovician age unit - the Maquoketa Group - that consists of the following formations: Brainard Shale formation, Fort Atkinson dolomite formation, and the Scales Shale formation. The Scales Shale formation acts as the regional aquitard and the base of the conceptual site model [KPRG & Geo-Hydro, Inc., 2013].

As discussed in Section 2 and shown on **Figure 2-2**, the deepest elevation of the LSQ is approximately 477 feet mean sea level (feet MSL) and the southern half invert of the LSQ quarry is in direct contact with the Elwood/Wilhelmi Dolomite and the northern half invert is in contact with the Kankakee Dolomite formation.

8.2.2 Uppermost Aquifer

The current permitted GIA and associated conceptual site model was developed and modeled so that the primary contaminate transport was through dolomite aquifer (i.e. uppermost aquifer). The

GIA Model assumed that there were two water separate bearing units: (1) shallow dolomite zone, and (2) deep dolomite zone which are separated by the Brainard Shale [KPRG & Geo-Hydro, Inc., 2013].

8.2.2.1 Shallow Dolomite Zone

The elevations of the shallow dolomite zone range between 585 to 445 feet MSL with an approximate thickness of 140 to 150 feet. Groundwater flow, along the north and west portions of the facility, generally flows south to north eventually discharging to the Des Plaines River. Beginning around 1993, groundwater flow in the south east portion of the facility started to exhibit a shift of groundwater flow to the south-southeast direction. This revised groundwater flow is associated with dewatering activities occurring at the Laraway Quarry. Additional information for this this unit is summarized in Section 3.2.

8.2.2.2 Deep Zone

The elevations of the deep dolomite zone range between 435 to 400 feet MSL with an approximate thickness of 30 to 40 feet. Groundwater flow in the deep dolomite zone in the south east portion of the facility started to exhibit to the south and southeast flow direction. Additional information for this this unit is summarized in Section 3.2.

8.2.3 Groundwater Model Software and Transport Modeling Mechanisms

The permitted GIA model utilizes a three-dimensional software Visual MODFLOW® Version 4.1 which allows the user to represent physical conditions at the site along with the capacity to model site conditions over time. The Visual MODFLOW® software package included the containment transport program MT3D (Mass Transport in 3 Dimensions) to simulate mass transport from the LSQ as required by GIA regulations.

Advective flux, hydrodynamic/mechanical dispersion and diffusion were the various containment transport mechanisms that were utilized within the permitted GIA model. The model conservatively did not include source reduction, biologic decay or soil/rock sorption or other decay process and therefore overestimates groundwater concentrations [KPRG & Geo-Hydro, Inc., 2013].

8.2.4 Leachate Quality

As discussed in Section 2.1, the WFA was operated prior to the Main Quarry and accepted fly ash, bottom ash and slag. Leachate quality at the WFA was based on both CCR characterization borings and pore water samples collected over time. The Main Quarry leachate quality was based on sampling taken at the NPDES permitted outfall location and includes precipitation, groundwater flow into the North Quarry and extracted groundwater. The leachate quality is different at the WFA versus the Main Quarry due to the type of CCRs accepted and the type of coal burned [KPRG & Geo-Hydro, Inc., 2013].

8.3 Summary of Groundwater Modeling of Proposed Closure Alternative Scenarios

A numerical groundwater flow model (Model) was created for Midwest Generation Joliet #9 Station Lincoln Stone Quarry and the surrounding area as part of the GIA completed in 2013 as part of the landfill permit renewal (BAS, 2022). The Model was reviewed and approved by Illinois EPA for use in support of engineering evaluations of corrective action/closure alternatives.

The Model was updated slightly to use a more recent version of MODFLOW (MODFLOW-NWT), to define the current quarry water levels in the Main Quarry and Boyd's Quarry, to simulate current pumping rates in the groundwater extraction well system, and to improve the calibration to measured, recent water levels at the site. The updated calibrations confirm that the model continues to replicate the observed northward hydraulic gradient toward the river at the water table, and a south-eastern component of groundwater flow toward Laraway Quarry in the permeable horizon in the shallow dolomite.

The updated, calibrated steady state flow model simulated 100 years of chemical transport from LSQ. Four conceptual corrective action/closure scenarios were evaluated in support of the engineering analysis of alternatives and are presented in the Numerical Groundwater Flow Model [KPRG, 2022]. The four conceptual scenarios were:

- Conceptual Closure Alternative 1 – Complete dewatering of the LSQ to facilitate the direct removal of the CCR materials for off-site landfill disposal which models Closure Scenarios 1 and 2).
- Conceptual Closure Alternative 2 – In-place closure with regrading of the CCR materials and subsequent capping to preclude direct infiltration of precipitation through unsaturated CCR materials which models Closure Scenarios 3, 4, and 5.
- Conceptual Closure Alternative 3 – Same as Closure Alternative 2 but with the addition of hydraulic containment with the placement of a low permeability barrier along the east and south sides of the LSQ which models Closure Scenario 7.
- Conceptual Closure Alternative 4 – Same as Closure Alternative 2 but with the addition of hydraulic controls with the installation and operation of 47 extraction wells within the LSQ which models Closure Scenario 6.

The general conclusions from the groundwater modelling for each of the conceptual closure alternatives are:

- Conceptual Closure Alternative 1 more quickly reduces the relative impacts in the shallow dolomite groundwater system, but the required drawdown will negatively affect private well performance which may result in dewatering private residential wells dry east of LSQ.
- Conceptual Closure Alternatives 2, 3 and 4 do not negatively affect private well performance and will not cause dewatering of residential wells.

- Conceptual Alternatives 2, 3 and 4 have similar short-term reduction in constituent concentrations. Alternatives 3 and 4 provide for some additional long-term performance improvement in constituent concentrations in existing groundwater.
- Regardless of the conceptual alternative evaluated, meeting proposed groundwater protection standards for various constituents will take time, and therefore implementation of institutional controls such as GMZs and property deed restrictions for water use will be required. These institutional controls have already been implemented has been shown to be protective of public health, welfare and safety related to groundwater exposure.

Based upon the conclusions of the Numerical Groundwater Flow Model [BAS, 2022], dewatering of the Main Quarry as a component of the Closure by Removal scenarios (alternate closure scenarios 1 and 2) will negatively impact the nearby residential water wells by causing a long-term drawdown of natural water levels, which presents an implementation concern for the LSQ. The Closure In-Place scenarios (alternate closure scenarios 3 through 8) do not require dewatering within the Main Quarry, and therefore will not negatively impact the nearby residential water wells.

8.4 Summary of Fate and Transport of Contaminants over Time

Both the revised GIA Model [KPRG & Geo-Hydro, Inc., 2013] and additional GIA information submittal [KPRG, 2013] modeled several hydrogeologic scenarios such as preexisting conditions (no Laraway Quarry pumping), Laraway Quarry pumping, ICA groundwater extraction, cessation of Laraway Quarry pumping and passive closed conditions. The evaluation of alternative closure scenarios has only included continued ICA pumping or the passive closed condition scenarios.

For the ICA pumping scenario, the twelve groundwater extraction wells were modeled and calibrated to match current groundwater extraction and groundwater quality conditions. Additionally, once the Laraway Quarry ceases dewatering activities, the ICA pumping activities can stop since an inward gradient will redevelop in the southeast corner of the Main Quarry [KPRG, 2013].

Under this passive closed scenario (i.e. facility no longer accepting waste), the Main Quarry was modeled with a recharge of 4.5 in/yr (i.e. background rainfall precipitation and no landfill cover), the ICA groundwater extraction wells were turned off, and the Laraway Quarry pumping had ceased. Results of this GIA model scenario demonstrated that 100-years after closure, 30 of the 42 groundwater monitoring locations meet all groundwater quality standards, including all wells south of the Main Quarry. The remaining 12 groundwater monitoring locations were located between the LSQ and the Des Plaines River within the zone of attenuation established by the LSQ's adjusted standard [KPRG, 2013]. Per the LSQ's adjusted standard:

> "Groundwater quality at or beyond the zone of attenuation for the Joliet/Lincoln Quarry Site shall be maintained at each constituent's background concentration (p. 22)."

Therefore, groundwater wells within the zone of attenuation do not have to meet background quality standards and will instead serve as sentinel wells to monitor the efficacy of the extraction well system as a control on concentrations at the downgradient edge of the zone of attenuation.

8.5 Assessment of Impact of Proposed Closure Alternates to Permitted GIA Model

8.5.1 Assessment of Closure by Removal Scenarios

The Closure by Removal scenarios (alternate closure scenarios 1 and 2) will remove the source of leachate from the Main Quarry and WFA. This will have a positive impact on the permitted GIA results by reducing the majority of the source material and increasing groundwater flow distances to the southern groundwater management zone. ICA pumping will be required until the existing groundwater quality returns to required groundwater standards to address existing groundwater quality. Closure by Removal scenarios would remove the source of groundwater quality exceedances, but ICA pumping would have to continue to address groundwater quality exceedances present in the existing groundwater north and south of the LSQ.

8.5.2 Assessment of Closure in Place Scenarios

The Closure in Place scenarios (alternate closure scenarios 3 through 7) include installation of a final cover system that will reduce the rainfall recharge from 4.5 in/yr to less than 0.1 in/yr. This will reduce the hydraulic head levels within the Main Quarry thereby enhancing the inward gradient conditions that LSQ was designed for. The ICA pumping will continue to the extent that the current south to southeast gradient is influenced by the Laraway Quarry or until groundwater conditions within the GMZ have reached applicable groundwater standards.

As discussed in Section 8.3, groundwater modelling for the closure in-place scenarios with leachate extraction provides some limited improvements to existing groundwater quality as compared to no leachate extraction.

8.6 Potential Corrective Actions

8.6.1 Hydraulic Controls

As discussed in Section 8.3 the results of GIA model (i.e., fate and transport of contaminants over time) are significantly influenced by the hydraulic gradients around the LSQ. The LSQ was designed and permitted as an inward gradient landfill, in contrast to modern landfills with liner and leachate collection systems. Therefore, the primary hydraulic control system for groundwater protection is gradient control.

Under alternate closure scenarios 6 and 7, we have included additional hydraulic or gradient controls to provide a “belt and suspenders” approach to groundwater protection. The implementation of these hydraulic controls is discussed in more detail in Section 9.

8.6.2 MNA/Geochemistry

In general, Monitored Natural Attenuation (MNA) is a feasible remedial alternative to groundwater impacts at sites with demonstrated source control, dilute plumes, and known plume behavior. These factors provide the basis for determining the aquifer's capacity to successfully remediate the constituents of concern to concentrations below applicable clean up levels.

MNA is often favorable at sites impacted with constituents which are reactive with the native groundwater and/or lithology such that their mobility is limited. For reactive inorganic species, geochemistry of the groundwater and constituents of concern is often controlled by pH and Oxidation-Reduction Potential (ORP). This is particularly true for inorganic species with multiple oxidation states (e.g., selenium, cobalt, and arsenate), as oxidation state determines which aqueous species a constituent will react with. Interaction with different aqueous species can change the overall charge of the constituent of concern, subsequently affecting its sorption and precipitation behavior. Changes in pH and ORP over time can also affect the reversibility of MNA processes, potentially shifting the reaction toward dissolution instead of precipitation.

Other groundwater geochemistry factors affecting the efficacy of MNA include the presence of other constituents which can affect the overall attenuation via processes such as coprecipitation or competitive sorption/desorption.

Based upon the known source characteristics (i.e., leachate quality), and the known plume behavior (inward gradient controlled by extraction wells), the potential for MNA to be beneficial at the LSQ site appears favorable but would be reliant on maintaining those conditions until clean-up levels are reached. Statistical analysis is recommended to better estimate that timeline.

8.6.3 In-Situ Groundwater Treatment

Based on the low levels of inorganic concentrations, site geologic and hydrogeologic conditions (i.e. fracture hydrogeologic flow) and the lateral and vertical extent of groundwater plumes, in-situ groundwater treatment is not practicable or feasible at LSQ.

SECTION 9

CLOSURE ALTERNATIVES IMPLEMENTING EVALUATION

9.1 Closure by Removal (Scenarios 1 and 2)

9.1.1 CCR Excavation and Removal Criteria

"CCR removal" refers to the process of verifying and documenting that the CCR has been removed from the ash pond. The vast majority of material in the Main Quarry is bottom ash referred to here as CCR. The CCR removal verification is based on removing visible CCR until dolomite bedrock is encountered.

During CCR removal activities, stormwater run-on into the Main Quarry will be minimized to the extent practicable through the use of berms along the perimeter of the Main Quarry. A phasing plan will be developed during the closure design that describes how stormwater diversion will be constructed to manage stormwater run-on and run-off during CCR removal and site restoration activities. Water management during CCR removal at LSQ will be conducted to ensure compliance with LSQ water quality permits.

The time needed for CCR excavation is estimated to be between four to five years and will vary be based on many site-specific factors including access into and out of the ash pond, haul routes, dewatering methods, detailed CCR excavation and final restoration phasing plans, the excavation working face size, and excavation and hauling methods. In addition, LSQ will establish methods for observing, monitoring, and documenting CCR excavation and compliance with the approved Closure Plan.

9.1.2 Availability of Nearby Landfill Airspace

Geosyntec evaluated Chicagoland MSW landfill airspace inventory based on the 2019 Landfill Capacity Report [IEPA, 2021]. Pertinent MSW landfills within 20 miles of the LSQ facility as related to the Closure by Removal scenarios include:

- Laraway Recycling & Disposal facility (Laraway RDF) – 6.67 MCY available airspace (Jan 1, 2021),
    - 5.0 years of life expectancy based upon estimated filling rate,
- Prairie View Recycling & Disposal Facility (Prairie View RDF) – 13.99 MCY available airspace (Jan 1, 2021), and
    - 17.0 years of life expectancy based upon estimated filling rate.

The proposed schedule for closure by removal and placement at an existing landfill (Scenario 2) is over 7 years, therefore, the Laraway RDF is not a practical option for disposal since it has less than 5 years of disposal capacity which will be used by its existing customer base. Will County has a capacity guarantee of 20 years with the Prairie View RDF and therefore, has limited ability to take on new source of waste during the anticipated LSQ closure schedule [Will County, 2017].

The next nearest active permitted landfill is the Livingston Landfill that is located over 50 miles from the LSQ. While there are nearby landfills to the LSQ that have available airspace, the airspace is contractually obligated (Prairie View RDF) to other entities such as Will County or there is not enough airspace available (Laraway Landfill) during the anticipated closure schedule.

9.1.3 Availability of On-Site Landfill

Calculations indicate approximately 30 acres of useable permitted land would be needed to construct a new on-site landfill capable of accommodating the volume of CCR material to be removed from the Main Quarry. An additional 20 acres would be necessary to allow for property line setbacks, operational buildings and infrastructure, and landfill engineering and compliance management systems (leachate, access, compliance monitoring, etc.). Per discussions with LSQ facility representatives and review of aerial and land use maps, there is no owned land totaling approximately 50 contiguous acres in the vicinity of the LSQ Main Quarry, therefore construction of an on-site landfill is not an option.

9.1.4 Co-Disposal with MSW

Several different heat-generating mechanisms exist in most MSW landfills that include both biological and chemical reactions. Barlaz and Benson (2018) summarize potential exothermic chemical reactions in MSW landfills which include:

- Anaerobic metal corrosion of aluminum and iron;
- Hydration and carbonation of MSW (incinerator) combustion ash or CCR; and
- Acid-base neutralization.

Based on measured in-situ waste mass temperatures, typical MSW landfill heat generation is dominated by anerobic decomposition (i.e., methanogenesis); but, for example, if significant volumes of industrial waste such as CCR or aluminum waste is placed in a MSW landfill, then chemical reactions may become a more dominant heat-generating mechanism and may cause elevated temperatures. Elevated temperatures at MSW landfills may lead to significant compliance issues such as: odors, air emissions, elevated temperatures, poor leachate quality and settlement. Because of these concerns with co-disposal of MSW with CCR and associated heat generation, third-party landfills may place limits on the volume of CCR they accept or may not accept any volume of CCRs.

9.1.5 Dewatering

Dewatering will include removing water using a variety of methods, including but not limited to passive, gravity-based methods (e.g., rim ditches) and/or active dewatering methods (e.g., pumps and well points) as needed to allow for CCR excavation and transportation. The groundwater flow volume and the difficulty of dewatering will increase with depth due to the increase in static head (i.e., increased depth) acting on the pump and associated impacts on the pump performance curves (i.e., higher heads decrease pump flow rates. Additional dewatering activities, such as cutoff walls, may be needed to address the increase in groundwater flow.

Based upon the results of Conceptual Closure Alternative 1 in the Numerical Groundwater Flow Model [BAS, 2022], dewatering the Main Quarry to facilitate removal of CCR materials is possible but impractical due to impacts on nearby residential water wells. There are four residential well locations within 500 feet east of the Main Quarry. Per the Model, "the two locations closer to Boyd's Quarry show declining water levels of about 11 feet, whereas the two locations further from Boyd's Quarry show higher water level drawdowns approaching 30 feet from dewatering of LSQ. These drawdowns will have the unintended consequence of negatively affecting private well performance and/or result in some wells going dry."

For the closure by removal scenarios, dewatering water will be managed and discharged in accordance with the LSQ's approved National Pollutant Discharge Elimination System (NPDES) Industrial Wastewater Discharge Individual Permit IL0002216 [IEPA, 2014].

9.1.6 Necessary Permits or Approvals from Other Agencies

For the closure by removal scenarios, additional permits or approvals that may be required include:

- Local or state permits for a new road entrance and/or traffic improvements on Patterson Road;
- Modification of existing third-party off-site landfill permit for waste acceptance of CCRs; and
- New or modification of existing NDPES permit to address CCR dewatering discharge.

9.2 Closure In-Place (Scenarios 3 through 8)

9.2.1 Necessary Permits or Approvals from Other Agencies

At this time the following permits or approvals may be required for the closure in-place scenarios:

- Modification of existing LSQ IEPA BOL permit for proposed alternate final cover system (i.e., ClosureTurf®) for closure scenario 4;

- Modification of existing LSQ IEPA BOL permit for revised final landform for closure scenario 5 (consolidate and close in-place);
- Modification of existing LSQ IEPA BOL permit and potential NPDES permit for additional leachate extraction wells and discharge for closure scenario 6 (consolidate and close in-place);
- Modification of existing LSQ IEPA BOL permit for revised final landform for closure scenario 5 (hydraulic control); and
- Local permit for installation of borings and associated grout injection for closure scenario 7 (hydraulic containment).

9.2.2 Post-Closure Inspection and Maintenance Program

Areas that have received final cover will be inspected a minimum of once per quarter. Any eroded or damaged areas in the final cover will be promptly repaired. The erosion of the final cover (if a ClosureTurf® is not utilized) from the surfaces of the landfill where vegetation has not yet been established will be controlled and repaired. Additional detail on the maintenance program for the final cover will be contained in permitted closure and post-closure care plan [KPRG, 2019b].

9.3 Consolidate and Closure in Place (Scenario 5)

9.3.1 Limited Dewatering and Waste Excavation

One of the advantages for the consolidate and closure in place scenario (Scenario 5) is that the need for dewatering and waste excavation is minimized by consolidating the area of CCR waste placement. By consolidating the area of waste placement, this also minimizes the volume of CCR waste to be regraded in order to develop positive grades for the final cover.

9.3.2 Slope Stability

In order to consolidate the CCR in the Main Quarry, steeper slopes will be required than current conditions. A detailed slope stability analysis will have to be performed to verify that these slopes will be stable under the proposed grading plan. Based on Geosyntec's experience at other CCR closures, 4 horizontal to 1 vertical (H:V) slopes can be developed with adequate factors of safety for slope stability.

9.4 Closure In-Place with Hydraulic Controls

9.4.1 Leachate Pumping for Inward Gradient Control

As discussed in Sections 2 and 3, the LSQ was designed as an inward gradient landfill. An inward gradient landfill maintains liquid levels in the waste mass lower than the surrounding groundwater

elevations. Therefore, groundwater flows into the waste mass, minimizing impacts to off-site groundwater quality. Under this closure scenario, liquid or leachate extraction wells would be installed in through the final cover and into the CCR waste mass at a density of one well per acre to lower the liquid levels in CCR waste mass. The approximate average depth of the leachate extraction wells would be 60 feet.

The leachate extraction wells would be installed using drilling techniques for wet sand deposits such as mud rotary or sonic drilling. A specialty well screen and well pack would be installed to minimize the potential of clogging due to the coarse grain bottom ash present in the Main Quarry. A down-hole electronic or pneumatic pump would be installed to lower liquid levels. Pump water or leachate would be discharged through the facility's NPDES permit.

9.4.2 Closure In-Place with Hydraulic Containment – Grouting

Under this closure scenario, the bedrock fractures would be sealed with grout and thereby creating a low permeability "grout curtain" around the southern edge of the LSQ. This closure scenario would be implemented by installation of vertical or angle rock cores and the application of pressurized grout.

The effectiveness of the grout curtain will depend on several factors such as orientation of existing bedrock fracture pattern, chemical capability of the grout and intake rate of grout into the fractures. Additional rows of rock core "lines" can be installed should the initial "line" of grouted rock cores require supplemental grout. Once the grout is installed, the CCR can be dewatered, relocated and final cover applied.

There are several case studies in the Chicagoland area where grout was utilized to minimize inflow or outflow from previous bedrock quarries, this technology has not evaluated based on the unique site-specific conditions (i.e., bedrock fractures due to weathering and blasting) at the LSQ; therefore, an extensive pilot testing program would be required to verify that this technology would be feasible and implementable.

9.4.3 Wet Closure

Wet closure is a technically viable option and has the potential to enhance natural attenuation processes as a remedy for groundwater migrating through and downgradient of the LSQ facility. While wet closure is considered an effective and protective means to close and maintain the Main Quarry, it is understood to be a generally unfavorable closure alternative scenario given the current local regulatory and political climate.

9.5 Class IV Cost Estimate

Geosyntec performed a Class IV cost estimate, per AACE classification standard, for each of the eight closure scenarios. A Class IV cost estimate under the AACE classification standards includes the following primary and secondary characteristics (AACE 2016):

- Maturity Level of Project Definition Deliverables: 1 to 15%;
- End Usage (i.e. typical purpose of estimate): Study or Feasibility
- Methodology[3]: Parametric models
- Expected Accuracy Range: L: -15% to -20%
  H: +20% to 50%

Summary of the cost estimates for each of the eight closure scenarios are provided on **Tables 9-1 through 9-8**. Detailed cost estimates with quantities and unit rates are presented in **Appendix A**. At this time, quantities and unit rates used to develop the cost estimates are considered preliminary and are intended for discussion purposes. As additional information becomes available either through discovery or additional analysis, the cost estimates and timelines will be refined accordingly. Development of the draft cost estimates was intentionally broad, so that any subsequent refinement would not result in substantial change to the overall projected costs relative to the other closure scenarios.

In general, the Closure in Place scenarios provide the most cost- and time-efficient approaches. Line items with the greatest effective weight on the overall project cost and timeline include location and volume off-site soil borrow, volume of CCR for regrading and off-site CCR disposal.

[3] Geosyntec cost estimate methodology included detailed unit costs with take-offs which is more similar to a Class 2 cost estimate methodology.

SECTION 10

CONCULSIONS

Geosyntec has evaluated two different closure approaches for the LSQ: Closure by Removal and Closure in Place. The two Closure by Removal scenarios that were assessed are: (1) removal of CCRs to an existing off-site permitted landfill, and (2) removal of CCRs to a new on-site landfill. For the Closure in Place approach, six different closure scenarios were evaluated: (3) IEPA Prescribed Final Cover, (4) Alternate Final Cover System, (5) Consolidate and Close in Place, (6) Closure in Place with Hydraulic Controls and (7) Closure in Place with Hydraulic Containment, and (8) Closure in Place with Wet Cap. Each of the closure scenarios were evaluated for the following factors:

- Magnitude and reduction of existing risks;
- Risk to nearby receptors, including the environment and community;
- Short and long-term effectiveness in controlling future releases;
- Groundwater protection;
- Protection to surrounding surface water;
- Time for closure and post-closure care;
- Long-term reliability of the engineering and institutional controls;
- Potential need for future corrective actions;
- Implementation; and
- Cost.

All closure scenarios were assessed on the short and long-term effectiveness in controlling future releases to the environment and risk to nearby receptors. The remaining closure factors (groundwater and surface water protection, long-term reliability, future corrective actions, implementation and cost) are summarized for each closure scenario in **Table ES-1**. Geosyntec also performed an actuarial risk and greenhouse assessments to further define impacts from the various closure scenarios on public health and the environment.

Scenario 1 “Closure by Removal” was evaluated as not implementable due to the lack of available nearby permitted landfill airspace. There are two nearby landfills with permitted airspace, but the permitted airspace is either guaranteed under contract to another entity (Prairie View RDF to Will County) or the landfill operating life (Laraway RDF) is less than the Scenario 1 closure schedule. Dewatering the Main Quarry to facilitate removal of CCR materials is impractical due to drawdown impacts on nearby residential private water wells. Additionally, Scenario 1 had the highest vehicle and worker accident rate and greenhouse gas footprint. Lastly, the current ICA groundwater extraction system would still be required to be operated for Scenario 1 to address existing groundwater quality in the southern GMZ. Therefore, Scenario 1 should not be considered as a closure approach at the LSQ due to the lack of nearby permitted airspace, cost, dewatering

challenges and impacts on nearby residential water wells, accident (worker and vehicle) potential and significant greenhouse gas footprint. Other transportation modes such as rail and barge were assessed to be non-feasible due to the lack of available area to build the necessary on-site transfer station facility and lack of transfer station infrastructure for disposal at an off-site third-party disposal facility.

Closure Scenarios 2 and 8 should also be excluded from further consideration due to the following reasons. Scenario 2 "Closure in Place at New On-Site Landfill" was not implementable because there is not nearby property available for purchase or development for a new on-site landfill. The lowest cost, accident potential and greenhouse gas emissions were Scenario 8 "Closure in Place with Wet Cap" but this closure scenario is, more likely than not, not implementable due to challenges in receiving regulatory approval for a "wet" cap design.

The Closure in Place scenario (Scenario No. 3) eliminated the removal of over 4.3 MCY of CCR and instead proposes to install a final cover system over the CCRs. The final cover system will effectively eliminate the infiltration of stormwater into the waste mass, thereby, significantly reducing leachate generation. The reduction in leachate generation will reduce the leachate head or driving force from the LSQ and therefore, create a more effective inward hydraulic gradient condition which will provide protection to local and regional groundwater resources. Additionally, the proposed final cover will eliminate and potential impacts to nearby surface water resources.

Various Closure in Place scenario alternatives (Scenario Nos. 4 -8) were assessed which included, alternate final cover systems (ClosureTurf® and wet), consolidate and close, and additional environmental control systems. For example, Scenario 5 "Consolidate and Close in Place" reduced the closure footprint, thereby reduced the volume of CCRs requiring regrading and final cover placement and therefore, was the most cost effective of the Closure in Place scenarios. Scenarios 6 and 7 (hydraulic control and containment) provides an additional and redundant engineered control system for groundwater protection. Each of these Closure in Place scenario alternatives provide equivalent levels of protection to the public and environment receptors as Scenario No. 3.

Lastly, when all factors are considered, the Closure by Removal scenarios were not implementable due to limits on either nearby permitted waste disposal airspace, lack of transfer station infrastructure for rail or barge transport or available property to develop a new landfill. Additionally, the Closure by Removal scenarios would have larger impacts, as compared to the Closure in Place scenarios, to the environment in the form of greenhouse gas emissions and human health in the form of worker safety and vehicle accidents. Based on site specific conditions and groundwater modelling, Closure in Place Scenario 4 "Closure in Place with Alternate Final Cover" is the recommended closure scenario because this scenario provides both short- and long-term protection to groundwater and surface water resources along with ensuring overall protection to the public health, welfare and safety.

SECTION 11

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TABLES

Table ES-1
Summary of Closure Alternatives at Lincoln Stone Quarry

Closure Scenario	Closure Cost Estimate ($ million)	Post-Closure Cost Estimate ($ million)	Groundwater Protection	Surface Waters Protection	Implementation	Notes
Closure by Removal Scenarios						
Scenario 1 – Closure by Removal at Existing Off-Site Landfill	466.99	0.05	Current ICA extraction system would be required to be operated to manage current groundwater in permitted GMZs. Operate until Laraway Quarry operations cease or until GWQS met within the GMZ	Surface water would be protected through removal of the CCR from Main Quarry and West Fill Area (WFA)	Nearby landfills have limited airspace that may not be available due to capacity commitments or limited site life (< 5 years), increase risk to vehicle and work accidents to significant CCR volume handing. Alternate transportation methods (i.e. barge or rail) to remote landfills is not feasible due to: (1) lack of on-site area to building transfer facility and (2) lack of existing infrastructure to transfer transported CCR to remote landfill. Required dewatering of the LSQ has a high probability of causing nearby private water wells to run dry.	Highest greenhouse gas footprint for all of the closure scenarios.
Scenario 2 – Closure by Removal at New On-Site Landfill	121.20	5.08			Not feasible, no land available on-site or nearby to develop an on-site landfill.	
Closure in Place Scenarios						
Scenario 3 – Closure in Place with IEPA Prescriptive Final Cover	27.14	5.09	Current ICA extraction system would be required to operate until Laraway Quarry ceases operations or until GWQS are met within the GMZ. Final cover system would reduce leachate head in Main Quarry thereby improving inward gradient conditions.	The proposed final cover system would isolate CCRs from stormwater and thereby providing protection to surface waters.	Similar closure scenario has been implemented at hundreds of landfills and CCR surface impoundments.	Current permitted closure plan for LSQ.
Scenario 4 – Closure in Place with Alternate Final Cover	23.59	3.64				Alternate final cover system would be a ClosureTurf® or equivalent system.
Scenario 5 – Consolidate and Close with IEPA Prescriptive Final Cover	22.54	5.09			Standard of practice for closure of CCR surface impoundments.	Minimizes volume of off-site soils required to reach final surface grades.
Scenario 6 – Closure in Place with IEPA Prescriptive Final Cover w/ Hydraulic Controls	27.74	7.80	Inward gradient conditions would be enhanced through leachate removal and elimination of stormwater percolation.		Requires installation of 60-foot leachate extraction wells with a density of 1 well per acre. Specialty well pack will be required to address well screen clogging issues.	Requires increased leachate and groundwater extraction during post-closure.
Scenario 7 – Closure in Place with IEPA Prescriptive Final Cover w/ Hydraulic Containment	37.12	5.09	Groundwater flow from Main Quarry would be significantly reduced due to installation of low permeability wall along southern edge of the Main Quarry.		Effectiveness will be dependent on fracture pattern and grout combability. Additional "lines" can be installed to reduce permeability.	Have been implemented at one to two quarry sites for stormwater management in the Chicagoland area to minimize groundwater infiltration.
Scenario 8 – Closure in Place with IEPA Prescriptive Final Cover – "Wet Closure"	16.17	5.09	Groundwater protection would be provided by enhanced MNA. ICA extraction system would be needed for residual plume		High unlikely to receive regulatory approval.	Standard of practice to address impacted sediment sites where material is left in place.

Table 6-1: Accident Frequency for Lincoln Stone Quarry Closure Alternatives							
Closure Scenario	**Total On-Site Miles**	**On-Site Miles per Year**	**Total Off-Site Miles**	**Off-Site Miles per Year**	**Trucking Accidents involving Property Damage [1]**	**Trucking Accidents Involving Personnel Injury [3]**	**Truck Crash Fatalities [4]**
SCENARIO 1: Closure by Removal and Placement at an Existing Landfill	169,400	14,463	3,388,000	289,261	3.36	0.15119	0.05194
SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill	1,711,783	121,158	664,400	47,025	2.24	0.10099	0.03469
SCENARIO 3: Closure in Place with IEPA Prescribed Final Cover Design	48,843	25,507	305,400	159,484	0.34	0.01506	0.00517
SCENARIO 4: Closure in Place with Alternate Final Cover Design	40,605	15,842	49,600	19,351	0.09	0.00384	0.00132
SCENARIO 5: Consolidate and Close in Place	41,351	15,134	234,973	85,999	0.27	0.01175	0.00403
SCENARIO 6: Close in Place with Hydraulic Controls	48,963	15,016	306,000	93,846	0.34	0.01509	0.00518
SCENARIO 7: Close in Place with Hydraulic Containment	48,843	3,457	305,400	21,616	0.34	0.01506	0.00517
SCENARIO 8: Close in Place with "Wet" Cap	2,150	152	43,000	3,043	0.05	0.00192	0.00066

Assumptions

1. Sources: United States Department of Transportation (USDOT), (see Section 11 "References" for USDOT 2012)
3. A accident rate of 94.2 accidents per 100 million vehicle miles involving property damage (USDOT 2012).
3. A injury rate of 4.25 injuries per 100 million vehicle miles (USDOT 2012).
3. A fatality rate of 1.46 deaths per 100 million vehicle miles (USDOT 2012).
4. Refer to Appendix C for calculation of total on-site and off-site miles

Table 6-2: Worker Accident Frequency for Lincoln Stone Quarry Closure Alternatives			
Closure Scenario	**No. of Days**	**Total Hours [4]**	**Recordable Worker Accidents/Cases [1,2,3]**
SCENARIO 1: Closure by Removal and Placement at an Existing Landfill	2,915	562,900	4.785
SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill	2,891	492,300	4.185
SCENARIO 3: Closure in Place with IEPA Prescribed Final Cover Design	489	34,500	0.293
SCENARIO 4: Closure in Place with Alternate Final Cover Design	530	39,200	0.333
SCENARIO 5: Consolidate and Close in Place	441	31,400	0.267
SCENARIO 6: Close in Place with Hydraulic Controls	579	37,400	0.318
SCENARIO 7: Close in Place with Hydraulic Containment	669	40,300	0.343
SCENARIO 8: Close in Place with "Wet" Cap	197	16,800	0.143

Assumptions

1. Sources: U.S. Bureau of Labor Statistics (BLS), U.S. Department of Labor (see Section 11 "References" for BLS 2006 and 2013)
2. The incidence rates represent the number of injuries and illnesses per 100 full-time equivalent workers and were calculated as: (N/EH) x 200,000, where N = number of injuries and illness, EH = total hours worked by all employees during the calendar year.
3. A incidence rate of 1.7 per 200,000 hours (see note 2) was assumed for heavy and civil engineering construction (NAICS code 237).
4. Refer to Appendix C for calculation of total worker hours.

Table 6-3: Greenhouse Gas Emissions Estimates for Lincoln Stone Quarry Closure Alternatives				
Closure Scenario	**Total Miles (On- & Off-Site)**	**Total Hours (Heavy Equip)**	**Total Impact (kg CO2)**	**Impact Rate (kg CO2 per CY CCR)**
SCENARIO 1: Closure by Removal and Placement at an Existing Landfill	3,557,400	400,500	40,868,099	15.72
SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill	2,376,183	327,900	32,972,291	12.68
SCENARIO 3: Closure in Place with IEPA Prescribed Final Cover Design	354,243	10,800	1,336,849	0.51
SCENARIO 4: Closure in Place with Alternate Final Cover Design	90,205	7,100	749,171	0.29
SCENARIO 5: Consolidate and Close in Place	276,323	9,900	1,181,454	0.45
SCENARIO 6: Close in Place with Hydraulic Controls	354,963	11,400	1,393,885	0.54
SCENARIO 7: Close in Place with Hydraulic Containment	354,243	4,400	735,446	0.28
SCENARIO 8: Close in Place with "Wet" Cap	45,150	3,000	322,946	0.12

Assumptions

1. 6.5 operating hours per day per vehicle was utilized to calculate the total hours of heavy equipment; refer to Appendix C for summary of number of
2. Heavy equipment was assumed to have an average travel speed of 11.2 miles per gallon (2011 HINO 268/268A spec literature).
3. Heavy equipment was assumed to average 60 miles per operating hour.
4. Heavy equipment was assumed to average 6.5 gallons per operating hours.
5. One gal of diesel fuel consumed equals 10.18 kg of CO_2 (USEPA emissions conversion)
6. Reference data from AMCOL Report, Tables A.2 and A.3, unless otherwise referenced.

Geosyntec consultants

Project: Lincoln Stone Quarry Closure Alternatives
Task: Alternatives Cost Analysis
Client: Midwest Generation, LLC (MWG)
Proj. No. CHE8420
Date: September 30, 2021

Created By:	TWW	07/09/20
Reviewed By:	DK	07/21/20
Approved By:	JPV	10/13/21
Revised By:	JPV	02/17/21
Revised By:	REW	9/30/2021

Appendix D - Estimated Schedule Critical Path Items

Table 7-1: Closure Scenarios' Schedule
Critical Path Working Days

Tasks	00.50	01.00 - 06.00		07.20	07.50	07.00, 08.00, 09.00	10.00	11.00			
Scenario	**Siting/ Permitting**	**Mob**	**Dewatering, Erosion, Demolition, Etc.**	**CCR Excavation to Landfill**	**Ash Recontouring**	**Liner & Cap Installation [4, 5]**	**Hydraulic Control/ Containment**	**Turf and Grasses[6]**	**Days**	**Months**	**Years**
SCENARIO 1: Closure by Removal and Placement at an Existing Landfill	180	10	120	2795	0	0	0	0	3,105	140.6	11.7
SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill	1095	10	120	2150	0	600	0	21	3,996	169.5	14.1
SCENARIO 3: Closure in Place with IEPA Prescribed Final Cover Design	0	10	120	0	114	234	0	21	499	23.0	1.9
SCENARIO 4: Closure in Place with Alternate Final Cover Design	180	10	120	0	114	10	0	285	720	30.8	2.6
SCENARIO 5: Consolidate and Close in Place	365	10	120	0	67	234	0	21	816	32.8	2.7
SCENARIO 6: Closure in Place with Hydraulic Control	365	10	120	0	114	234	90	21	954	39.1	3.3
SCENARIO 7: Closure in Place with Hydraulic Containment	365	10	120	0	114	234	180	21	1,044	43.3	3.6
SCENARIO 8: Closure in Place Wet Closure	365	10	0	0	60	132	0	5	572	21.6	1.8

Notes:

1 Assumes 6 months of dewatering prior to earthwork.
2 Assumes Tasks 03.00 - 06.00 occur during the initial dewatering.
3 Assumes ditching and access roads are installed during earthwork.
4 Scenario 2 requires construction of both a bottom, leachate and final cover systems.
5 ClosureTurf installation was assumed to be 10,000 sq. feet per day.
6 Turf and Grasses Installation time includes: soil prep, soil amendments, erosion control measures, seed application.
7 Please refer to Appendix C (for hauling rates for soil) and Appendix D (for construction production rates).

Project: Lincoln Stone Quarry Closure Alternatives
Task: Alternatives Cost Analysis
Client: Midwest Generation, LLC (MWG)
Proj. No. CHE8420
Date: September 30, 2021

Created By:	TWW	07/09/20
Reviewed By:	DK	07/21/20
Approved By:	JPV	10/13/21
Revised By:	JPV	02/17/21
Revised By:	REW	09/30/21

COST SUMMARY

Table 9-1
SCENARIO 1: Closure by Removal and Placement at an Existing Landfill

	Task		COST	
01.00	Mobilization / Demobilization	$	352,000	
02.00	Dewatering and Temp. SW Management	$	8,261,000	
03.00	Erosion and Sediment Controls	$	278,000	
04.00	Instrumentation	$	20,000	
05.00	Demolition	$	233,000	
06.00	Site Clearing	$	-	
07.00	Earthwork	$	334,233,000	
08.00	Geosynthetics	$	-	
09.00	Pond Closure - Ditch and Apron Construction	$	-	
10.00	Hydraulic Control / Containment	$	-	
11.00	Turf and Grasses	$	-	
12.00	SW Management Features - New Landfill	$	-	
	Sub Total Cost	**$**	**343,377,000**	
	Contingency	$	103,013,000	30%
	Design and Engineering Fees[1]	$	3,434,000	1%
	Owners Costs	$	17,169,000	5%
	Closure Scenario Subtotal	**$**	**466,993,000**	
	30-year Post-Closure	$	50,000	
	Closure & PCC Scenario Total	**$**	**467,043,000**	

Note: 1. This this scenario design and engineering fees were reduced to 1% due to the high cost of waste transport and disposal that would impact design and engineering fees

Table 9-2
SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill

	Task		COST	
00.50	Siting and IEPA Permitting	$	2,725,000	
01.00	Mobilization / Demobilization	$	356,000	
02.00	Dewatering and Temp. SW Management	$	7,199,000	
03.00	Erosion and Sediment Controls	$	315,000	
04.00	Instrumentation	$	20,000	
05.00	Demolition	$	80,000	
06.00	Site Clearing	$	1,018,000	
07.00	Earthwork	$	59,663,000	
08.00	Geosynthetics	$	11,324,000	
09.00	Pond Closure - Ditch and Apron Construction	$	-	
10.00	Hydraulic Control / Containment	$	-	
11.00	Turf and Grasses	$	611,000	
12.00	SW Management Features - New Landfill	$	273,000	
	Sub Total Cost	**$**	**83,584,000**	30%
	Contingency	$	25,075,000	10%
	Design and Engineering Fees	$	8,358,000	5%
	Owners Costs	$	4,179,000	
	Scenario Total	**$**	**121,196,000**	
	30-year Post-Closure	***$***	***5,083,000***	
	Closure & PCC Scenario Total	**$**	**126,279,000**	

Project: Lincoln Stone Quarry Closure Alternatives
Task: Alternatives Cost Analysis
Client: Midwest Generation, LLC (MWG)
Proj. No. CHE8420
Date: September 30, 2021

Created By:	TWW	07/09/20
Reviewed By:	DK	07/21/20
Approved By:	JPV	10/13/21
Revised By:	JPV	02/17/21
Revised By:	REW	09/30/21

COST SUMMARY

Table 9-3
SCENARIO 3: Closure in Place with IEPA Prescribed Final Cover Design

	Task		COST	
01.00	Mobilization / Demobilization	$	245,000	
02.00	Dewatering and Temp. SW Management	$	486,000	
03.00	Erosion and Sediment Controls	$	220,000	
04.00	Instrumentation	$	26,000	
05.00	Demolition	$	80,000	
06.00	Site Clearing	$	251,000	
07.00	Earthwork	$	9,970,000	
08.00	Geosynthetics	$	6,407,000	
09.00	Pond Closure - Ditch and Apron Construction	$	157,000	
10.00	Hydraulic Control / Containment	$	-	
11.00	Turf and Grasses	$	878,000	
12.00	SW Management Features - New Landfill	$	-	
	Sub Total Cost	**$**	**18,720,000**	
	Contingency	$	5,616,000	30%
	Design and Engineering Fees	$	1,872,000	10%
	Owners Costs	$	936,000	5%
	Scenario Total	**$**	**27,144,000**	
	30-year Post-Closure	**$**	**5,085,000**	
	Closure & PCC Scenario Total	**$**	**32,229,000**	

Table 9-4
SCENARIO 4: Closure in Place with Alternate Final Cover Design

	Task		COST	
01.00	Mobilization / Demobilization	$	253,000	
02.00	Dewatering and Temp. SW Management	$	518,000	
03.00	Erosion and Sediment Controls	$	223,000	
04.00	Instrumentation	$	26,000	
05.00	Demolition	$	80,000	
06.00	Site Clearing	$	48,000	
07.00	Earthwork	$	6,521,000	
08.00	Geosynthetics	$	-	
09.00	Pond Closure - Ditch and Apron Construction	$	157,000	
10.00	Hydraulic Control / Containment	$	-	
11.00	Turf and Grasses	$	8,440,000	
12.00	SW Management Features - New Landfill	$	-	
	Sub Total Cost	**$**	**16,266,000**	
	Contingency	$	4,880,000	30%
	Design and Engineering Fees	$	1,627,000	10%
	Owners Costs	$	813,000	5%
	Scenario Total	**$**	**23,586,000**	
	30-year Post-Closure	**$**	**3,639,000**	
	Closure & PCC Scenario Total	**$**	**27,225,000**	

Table 9-5
SCENARIO 5: Consolidate and Close in Place

	Task		COST	
01.00	Mobilization / Demobilization	$	243,000	
02.00	Dewatering and Temp. SW Management	$	571,000	
03.00	Erosion and Sediment Controls	$	220,000	
04.00	Instrumentation	$	26,000	
05.00	Demolition	$	80,000	
06.00	Site Clearing	$	251,000	
07.00	Earthwork	$	7,924,000	
08.00	Geosynthetics	$	5,305,000	
09.00	Pond Closure - Ditch and Apron Construction	$	157,000	
10.00	Hydraulic Control / Containment	$	-	
11.00	Turf and Grasses	$	765,000	
12.00	SW Management Features - New Landfill	$	-	
	Sub Total Cost	**$**	**15,542,000**	
	Contingency	$	4,663,000	30%
	Design and Engineering Fees	$	1,554,000	10%
	Owners Costs	$	777,000	5%
	Scenario Total	**$**	**22,536,000**	
	30-year Post-Closure	**$**	**5,085,000**	
	Closure & PCC Scenario Total	**$**	**27,621,000**	

Project: Lincoln Stone Quarry Closure Alternatives
Task: Alternatives Cost Analysis
Client: Midwest Generation, LLC (MWG)
Proj. No. CHE8420
Date: September 30, 2021

Created By:	TWW	07/09/20
Reviewed By:	DK	07/21/20
Approved By:	JPV	10/13/21
Revised By:	JPV	02/17/21
Revised By:	REW	09/30/21

COST SUMMARY

Table 9-6
SCENARIO 6: Closure in Place with Hydraulic Control

	Task		COST		
01.00	Mobilization / Demobilization	$	245,000		
02.00	Dewatering and Temp. SW Management	$	553,000		
03.00	Erosion and Sediment Controls	$	220,000		
04.00	Instrumentation	$	26,000		
05.00	Demolition	$	80,000		
06.00	Site Clearing	$	251,000		
07.00	Earthwork	$	9,970,000		
08.00	Geosynthetics	$	6,407,000		
09.00	Pond Closure - Ditch and Apron Construction	$	157,000		
10.00	Hydraulic Control / Containment	$	345,000		
11.00	Turf and Grasses	$	878,000		
12.00	SW Management Features - New Landfill	$	-		
	Sub Total Cost	**$**	**19,132,000**		
	Contingency	$	5,740,000	30%	
	Design and Engineering Fees	$	1,913,000	10%	
	Owners Costs	$	957,000	5%	
	Scenario Total	**$**	**27,742,000**		
	30-year Post-Closure	***$***	***7,763,000***		
	Closure & PCC Scenario Total	**$**	**27,742,000**		

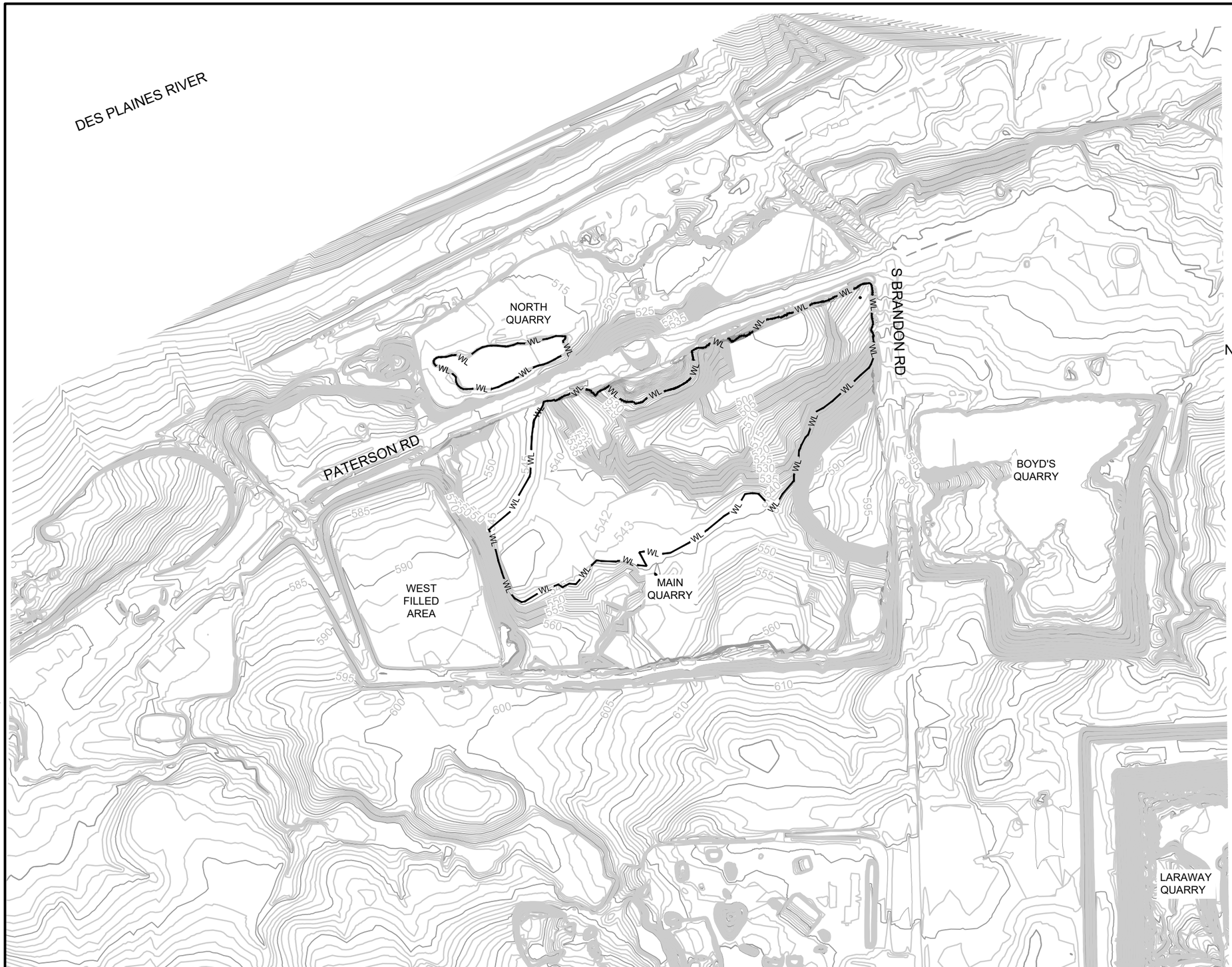
Table 9-7
SCENARIO 7: Closure in Place with Hydraulic Containment

	Task		COST		
01.00	Mobilization / Demobilization	$	245,000		
02.00	Dewatering and Temp. SW Management	$	486,000		
03.00	Erosion and Sediment Controls	$	220,000		
04.00	Instrumentation	$	26,000		
05.00	Demolition	$	80,000		
06.00	Site Clearing	$	251,000		
07.00	Earthwork	$	9,970,000		
08.00	Geosynthetics	$	6,407,000		
09.00	Pond Closure - Ditch and Apron Construction	$	157,000		
10.00	Hydraulic Control / Containment	$	6,878,000		
11.00	Turf and Grasses	$	878,000		
12.00	SW Management Features - New Landfill	$	-		
	Sub Total Cost	**$**	**25,598,000**		
	Contingency	$	7,679,000	30%	
	Design and Engineering Fees	$	2,560,000	10%	
	Owners Costs	$	1,280,000	5%	
	Scenario Total	**$**	**37,117,000**		
	30-year Post-Closure	***$***	***5,085,000***		
	Closure & PCC Scenario Total	**$**	**37,117,000**		

Table 9-8
SCENARIO 8: Closure in Place Wet Closure

	Task		COST		
01.00	Mobilization / Demobilization	$	232,000		
02.00	Dewatering and Temp. SW Management	$	280,000		
03.00	Erosion and Sediment Controls	$	30,000		
04.00	Instrumentation	$	-		
05.00	Demolition	$	50,000		
06.00	Site Clearing	$	48,000		
07.00	Earthwork	$	10,366,000		
08.00	Geosynthetics	$	-		
09.00	Pond Closure - Ditch and Apron Construction	$	144,000		
10.00	Hydraulic Control / Containment	$	-		
11.00	Turf and Grasses	$	-		
12.00	SW Management Features - New Landfill	$	-		
	Sub Total Cost	**$**	**11,150,000**		
	Contingency	$	3,345,000	30%	
	Design and Engineering Fees	$	1,115,000	10%	
	Owners Costs	$	558,000	5%	
	Scenario Total	**$**	**16,168,000**		
	30-year Post-Closure	***$***	***5,085,000***		
	Closure & PCC Scenario Total	**$**	**21,253,000**		

FIGURES



LEGEND

- EXISTING MINOR CONTOUR (1-FT INTERVAL)
- EXISTING MAJOR CONTOUR (5-FT INTERVAL)
- WL — WL — APPROXIMATE ORDINARY HIGH WATER MARK
- EXISTING SLUICE PIPES
- GS20S — MONITORING WELL
- X102 — EXTRACTION WELLS

NOTE:

1. FIGURE ADAPTED FROM AUTOCAD DRAWING "EXISTING SITE CONDITIONS" FROM KPRG.

N

0 400 800

SCALE IN FEET

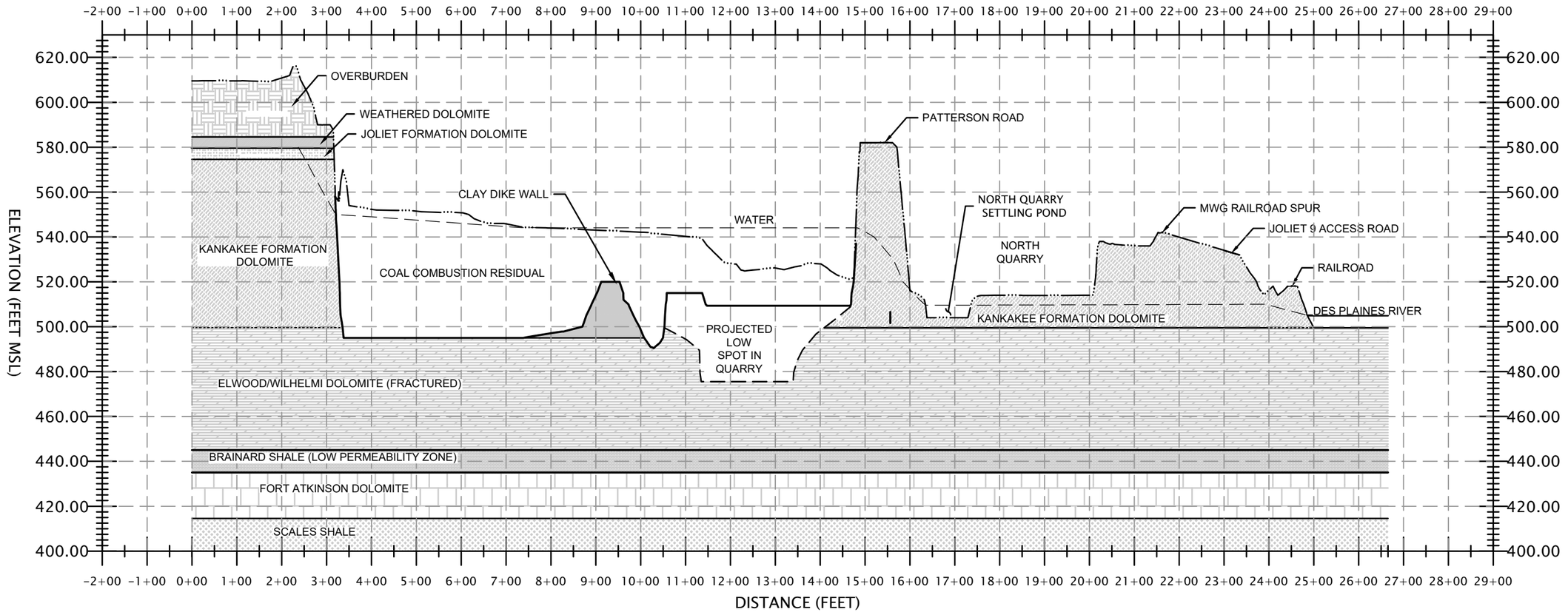
EXISTING SITE CONDITIONS
LINCOLN STONE QUARRY
JOLIET,IL

Geosyntec consultants

FIGURE 2-1

PROJECT NO: CHE8420 | OCTOBER 2021

J:\DWG\NNRG\LSQ\CHE8404-001 EXISTING CONDITION - Last Saved by: MKatelieva on 7/29/20



NOTE:

1. FIGURE ADAPTED FROM "LINCOLN STONE QUARRY AREA CROSS-SECTION" DATED 2/17/2020, PREPARED BY KPRG.

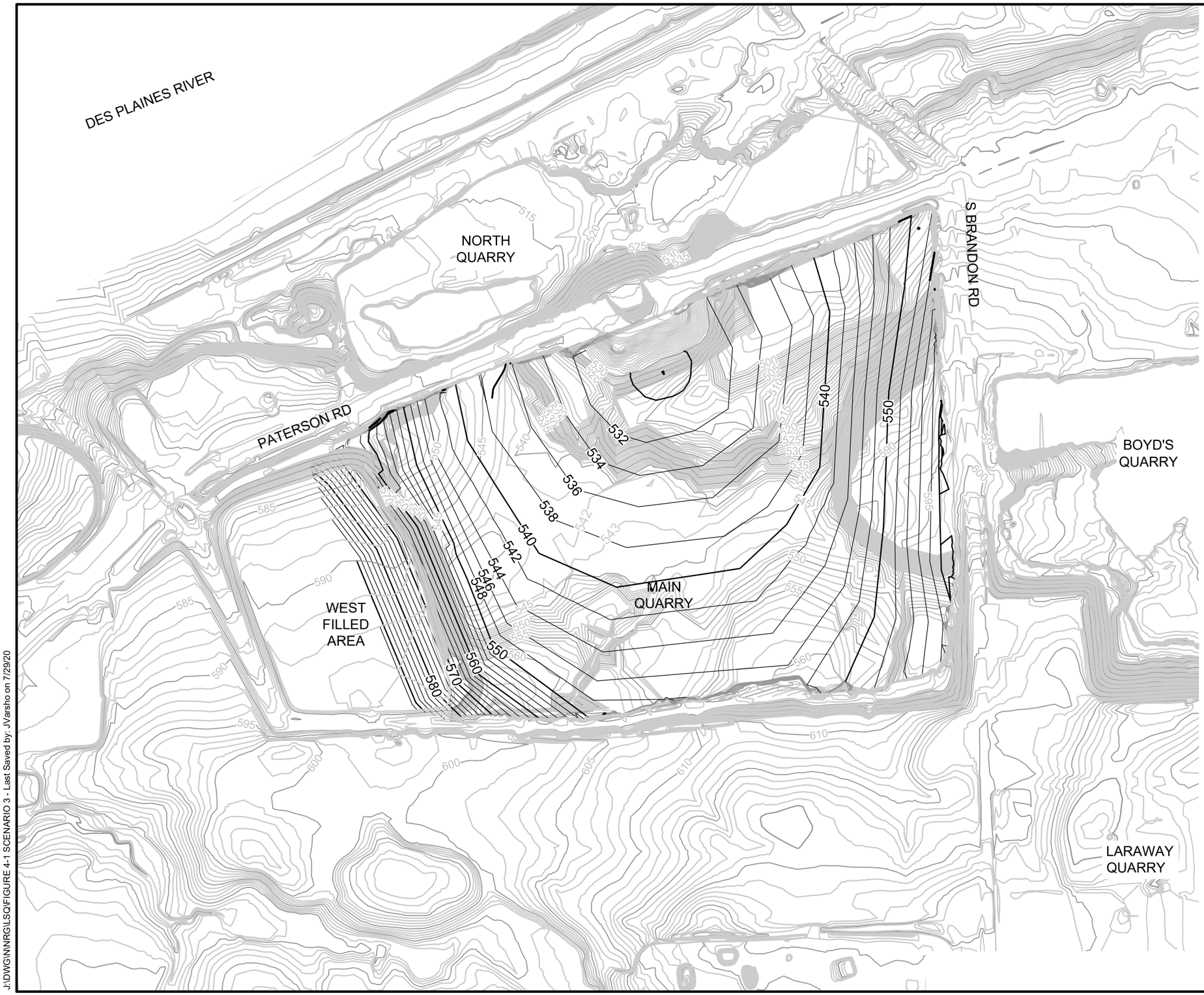
GEOLOGIC CROSS SECTION
LINCOLN STONE QUARRY
JOLIET,IL

Geosyntec consultants

FIGURE 2-2

PROJECT NO: CHE8420 | OCTOBER 2021

J:\DWG\NNRG\LSQ\FIGURE 3-1 GEOLOGICAL CROSS SECTION - Last Saved by: JVarsho on 7/29/20



LEGEND

- EXISTING MINOR CONTOUR (1-FT INTERVAL)
- EXISTING MAJOR CONTOUR (5-FT INTERVAL)
- PROPOSED CCR FINAL GRADE MAJOR CONTOUR (5- FT INTERVAL)
- PROPOSED CCR FINAL GRADE MINOR CONTOUR (1- FT INTERVAL)
- EXISTING SLUICE PIPES

NOTE:

1. FIGURE ADAPTED FROM AUTOCAD DRAWING "PROPOSED GRADING PLAN" FROM KPRG.

N

0 300 600

SCALE IN FEET

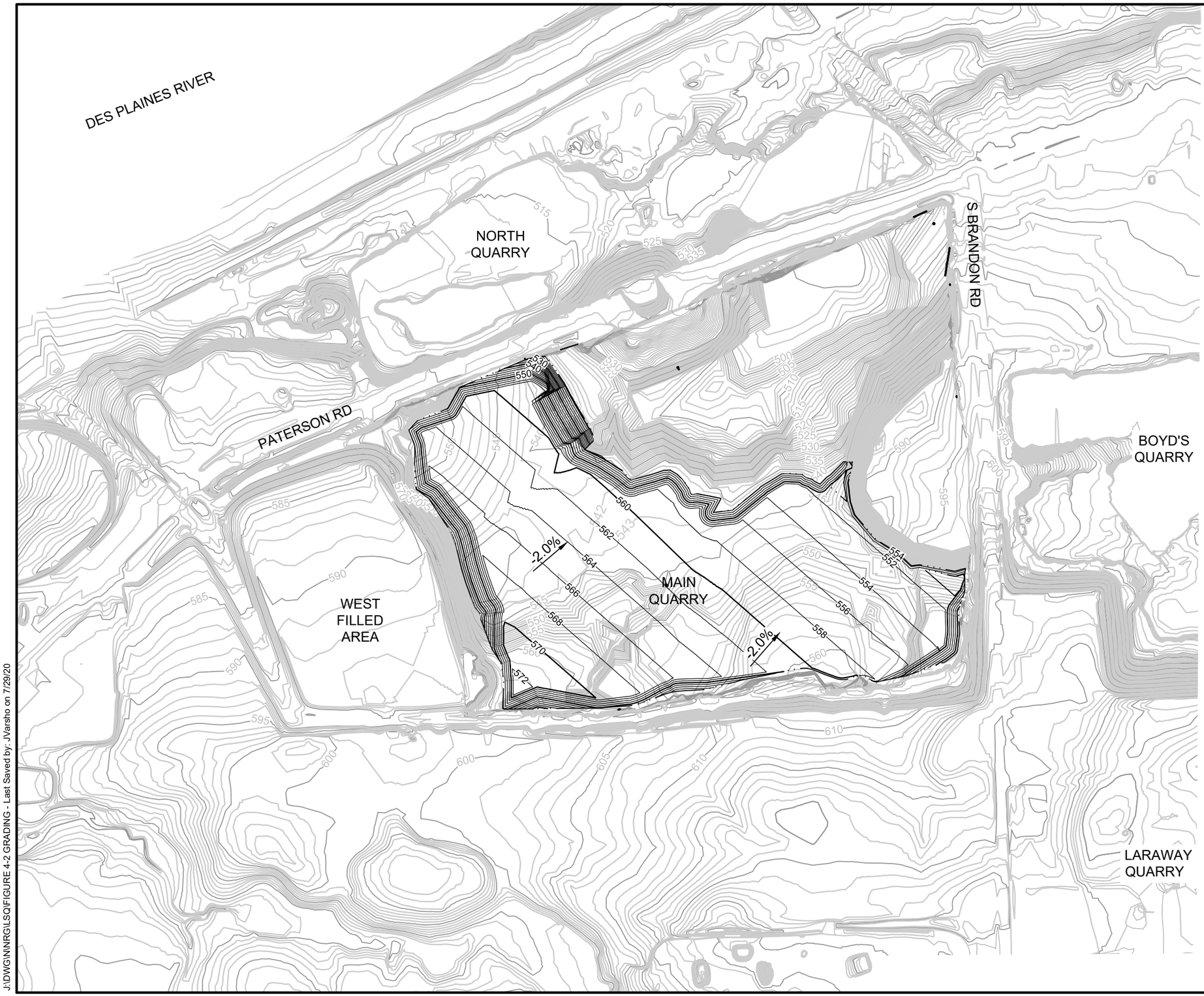
SCENARIO 3
CLOSURE IN PLACE FINAL CCR GRADES
LINCOLN STONE QUARRY
JOLIET,IL

Geosyntec consultants

FIGURE 4-1

PROJECT NO: CHE8420 | OCTOBER 2021

J:\DWG\NINRGL\SQI\FIGURE 4-1 SCENARIO 3 - Last Saved by: JVarsho on 7/29/20



LEGEND

- EXISTING MINOR CONTOUR (1-FT INTERVAL)
- EXISTING MAJOR CONTOUR (5-FT INTERVAL)
- PROPOSED CCR FINAL GRADE MAJOR CONTOUR (5- FT INTERVAL)
- PROPOSED CCR FINAL GRADE MINOR CONTOUR (1- FT INTERVAL)
- EXISTING SLUICE PIPES

VOLUME: **CCR PROPOSED GRADE**

BASE SURFACE	EG
COMPARISON SURFACE	CCR GRADING
CUT VOLUME	2000.07 CU. YD.
FILL VOLUME	443349.41 CU. YD.
NET VOLUME	441349.34 CU. YD.<FILL>

VOLUME: **CCR DISPOSAL VOLUME**

BASE SURFACE	BOTTOM OF ASH
COMPARISON SURFACE:	EG
CUT VOLUME	1701.55 CU. YD.
FILL VOLUME	386922.69 CU. YD.
NET VOLUME	385221.14 CU. YD.<FILL

0 300 600

SCALE IN FEET

N

SCENARIO 5
CONSOLIDATE AND CLOSURE IN PLACE
LINCOLN STONE QUARRY
JOLIET,IL

Geosyntec consultants

FIGURE 4-2

PROJECT NO: CHE8420 | OCTOBER 2021

J:\DWG\NNRG\LSQ\FIGURE 4-2 GRADING - Last Saved by: JVarsho on 7/29/20

DES PLAINES RIVER

NORTH QUARRY

S BRANDON RD

PATERSON RD

BOYD'S QUARRY

MAIN QUARRY

WEST FILLED AREA

LARAWAY QUARRY

LW1 LW2 LW3 LW4 LW5 LW6 LW7 LW8 LW9 LW10 LW11 LW12 LW13 LW14 LW15 LW16 LW17 LW18 LW19 LW20 LW21 LW22 LW23 LW24 LW25 LW26 LW27 LW28 LW29 LW30 LW31 LW32 LW33 LW34 LW35 LW36 LW37 LW38 LW39 LW40 LW41 LW42 LW43 LW44 LW45 LW46 LW47

LEGEND

- EXISTING MINOR CONTOUR (1-FT INTERVAL)
- EXISTING MAJOR CONTOUR (5-FT INTERVAL)
- PROPOSED CCR FINAL GRADE MAJOR CONTOUR (5- FT INTERVAL)
- PROPOSED CCR FINAL GRADE MINOR CONTOUR (1- FT INTERVAL)
- EXISTING SLUICE PIPES
- LW135 LEACHATE EXTRACTION WELL

NOTE:

1. FIGURE ADAPTED FROM AUTOCAD DRAWING "PROPOSED GRADING PLAN" FROM KPRG.

N

0 300 600

SCALE IN FEET

SCENARIO 6
CLOSURE IN PLACE WITH HYDRAULIC CONTROLS
LINCOLN STONE QUARRY
JOLIET,IL

Geosyntec consultants

FIGURE 4-3

PROJECT NO: CHE8420 | OCTOBER 2021

J:\DWG\NINRGL\SQ\FIGURE 4-3 SCENARIO 6 - Last Saved by: JVarsho on 7/29/20

DES PLAINES RIVER

NORTH QUARRY

S BRANDON RD

PATERSON RD

BOYD'S QUARRY

MAIN QUARRY

WEST FILLED AREA

LARAWAY QUARRY

LEGEND

- EXISTING MINOR CONTOUR (1-FT INTERVAL)
- EXISTING MAJOR CONTOUR (5-FT INTERVAL)
- PROPOSED CCR FINAL GRADE MAJOR CONTOUR (5- FT INTERVAL)
- PROPOSED CCR FINAL GRADE MINOR CONTOUR (1- FT INTERVAL)
- EXISTING SLUICE PIPES
- PROPOSED DOLOMITE GROUT WALL

NOTE:

1. FIGURE ADAPTED FROM AUTOCAD DRAWING "PROPOSED GRADING PLAN" FROM KPRG.

N

0 300 600

SCALE IN FEET

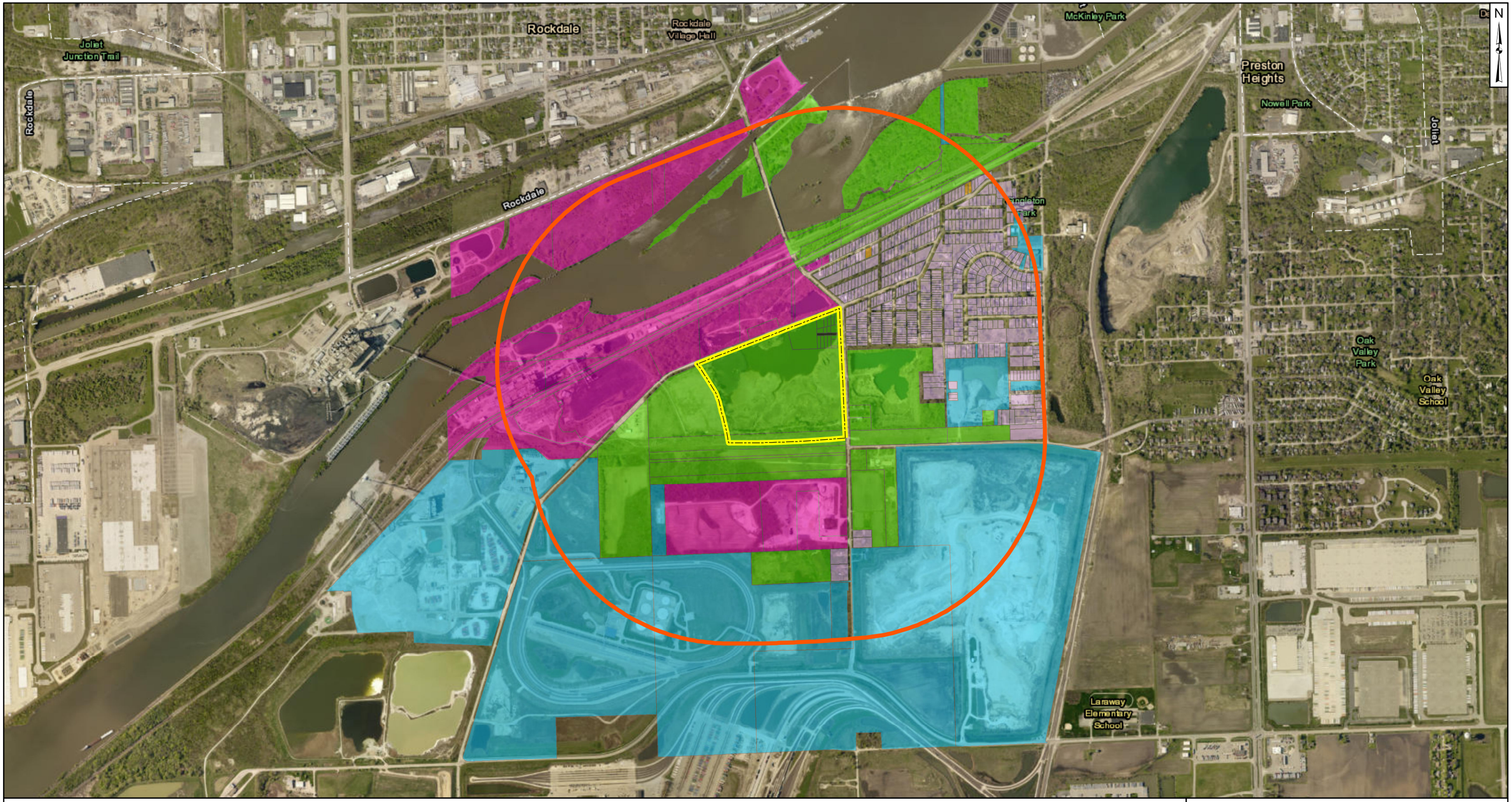
SCENARIO 7
CLOSURE IN PLACE WITH HYDRAULIC CONTAINMENT
LINCOLN STONE QUARRY
JOLIET,IL

Geosyntec consultants

FIGURE 4-4

PROJECT NO: CHE8420 | OCTOBER 2021

J:\DWG\NNRGL\SQ\FIGURE 4-4 SCENARIO 7 - Last Saved by: JVarsho on 7/29/20



Legend

- Agricultural
- Commercial
- Industrial
- Municipal
- Residential
- Site Boundary
- 1/2 Mile Buffer

Notes

- Land use zoning data provided by Will County Illinois GIS Division
- Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

700 350 0 700 Feet

Land Use Map

Lincoln Stone Quarry
1601 S. Patterson Road
Joliet, Illinois

Geosyntec consultants

Columbus, Ohio | October 2021

Figure **5-1**

Z:\DWG\N\NRG\LSQ\mxds\Landuse Map.mxd. HDuff. 8/3/2020. CHE8420.

APPENDICES

Appendix A

EcoCAT

EcoCAT
Ecological Compliance Assessment Tool

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Applicant: Geosyntec Consultants
Contact: Megan Martz
Address: 1420 Kensington Road
Oak Brook, IL 60523

Project: LSQ
Address: 1601 S. Patterson Rd., Joliet

IDNR Project Number: 2100952
Date: 07/17/2020

Description: Closure planning for Lincoln Stone Quarry

Natural Resource Review Results

This project was submitted for information only. It is not a consultation under Part 1075.

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Markgraf Quarry INAI Site
Banded Killifish *(Fundulus diaphanus)*
Banded Killifish *(Fundulus diaphanus)*
Osprey *(Pandion haliaetus)*

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Will

Township, Range, Section:
35N, 10E, 20
35N, 10E, 21
35N, 10E, 28
35N, 10E, 29

IL Department of Natural Resources Contact
Impact Assessment Section
217-785-5500
Division of Ecosystems & Environment

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

Terms of Use

By using this website, you acknowledge that you have read and agree to these terms. These terms may be revised by IDNR as necessary. If you continue to use the EcoCAT application after we post changes to these terms, it will mean that you accept such changes. If at any time you do not accept the Terms of Use, you may not continue to use the website.

1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.

2. Unauthorized attempts to upload, download, or change information on this website are strictly prohibited and may be punishable under the Computer Fraud and Abuse Act of 1986 and/or the National Information Infrastructure Protection Act.

3. IDNR reserves the right to enhance, modify, alter, or suspend the website at any time without notice, or to terminate or restrict access.

Security

EcoCAT operates on a state of Illinois computer system. We may use software to monitor traffic and to identify unauthorized attempts to upload, download, or change information, to cause harm or otherwise to damage this site. Unauthorized attempts to upload, download, or change information on this server is strictly prohibited by law.

Unauthorized use, tampering with or modification of this system, including supporting hardware or software, may subject the violator to criminal and civil penalties. In the event of unauthorized intrusion, all relevant information regarding possible violation of law may be provided to law enforcement officials.

Privacy

EcoCAT generates a public record subject to disclosure under the Freedom of Information Act. Otherwise, IDNR uses the information submitted to EcoCAT solely for internal tracking purposes.

EcoCAT
Ecological Compliance Assessment Tool

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

EcoCAT Receipt

Project Code 2100952

APPLICANT	DATE
Geosyntec Consultants Megan Martz 1420 Kensington Road Oak Brook, IL 60523	7/17/2020

DESCRIPTION	FEE	CONVENIENCE FEE	TOTAL PAID
EcoCAT Consultation	$ 25.00	$ 1.00	$ 26.00

TOTAL PAID $ 26.00

Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702
217-785-5500
dnr.ecocat@illinois.gov

Appendix B

Residential Well Survey

EXPLANATION

- R32S — GROUNDWATER MONITORING WELL WITH PARAMETERS EXCEEDING AGQS AND CLASS I STANDARDS
- G43S — GROUNDWATER MONITORING WELL
- S501 — SURFACE WATER MONITORING POINT
- ZOA
- WATER BODY
- APPROXIMATE LOCATION OF WATER WELLS IDENTIFIED BY ILLINOIS STATE WATER SURVEY (ISWS) WELL LOGS, ILLINOIS STATE GEOLOGICAL SURVEY (ISGS) WELL LOGS OR BY ISGS QUESTOR SYSTEM DATA.

NOTES:

1. QUARRY BOUNDARIES ARE APPROXIMATE TAKEN FROM AERIAL PHOTOGRAPHS.
2. WELL LOCATIONS HAVE NOT BEEN FIELD VERIFIED.
3. DATA FOR WELLS WITHIN THE 1 MILE RADIUS ARE LOCATED IN TABLE.
4. * – ADDRESS DOES NOT MATCH LOG QUARTER SECTION INFORMATION.

Well	Parameter	Units	Class I	AGQS	1stQtr03	2ndQtr03	3rdQtr03	4thQtr03	4thQtr03re	1stQtr04	1stQtr04re	2ndQtr04	2ndQtr04re	3rdQtr04	3rdQtr04re
G30S	Chloride, dissolved	mg/L	200	144.29	110	140	140	160	160	150	170	150	200	190	260
G31D	Fluoride, dissolved	mg/L	4	1.73	4.9	4.8	4.6	3.9	3.8	6.3	5	4.4	4.1	4.5	4.3
G31S	Boron, dissolved	ug/L	2000	5924.16	5700	6100	5300	4400		4600		4500		4400	
G38S	Chloride, dissolved	mg/L	200	144.29	82	330	220	200	170	180	250	300	240	240	180
G42D	Fluoride, dissolved	mg/L	4	1.73	3.3	4.2	4	4.5	4.7	3.6	4	3.8	3.8	3.8	3.7
R08S	Boron, dissolved	ug/L	2000	5924.16	7700	6900	7300	7200	6300	7000	6900	6500	7000	6200	6700
R08S	pH (Field)	units	6.5-9.0	6.14-8.56	9.12	8.9	8.84	9.16	8.34	9.28	9.33	8.39	9.42	8.74	8.85
R32S	Boron, dissolved	ug/L	2000	5924.16	7200	5900	4400	3700		3500		2200		3200	
R32S	Chloride, dissolved	mg/L	200	144.29	67	<100	250	210	220	190	230	290	250	210	190
R32S	pH (Field)	units	6.5-9.0	6.14-8.56	9.16	8.73	8.13	7.91	8.11	8.31	8.21	7.89	8.56	7.98	8.26

Note: A shaded cell indicates the result is greater than the Class I and AGQS standard.

PROPERTY EXPLANATION

- LINCOLN STONE QUARRY
- MIDWEST GENERATION
- OLIN
- COMMONWEALTH EDISON
- VULCAN MATERIALS CO.
- LARAWAY RDF

35N 10E

DES PLAINES RIVER

BRANDON LOCKS

BRANDON BRIDGE

G42S G42D G33S G33D G41S G41D G20S R16D G30D G30S G31S G31D R08S R08D G43D G43S G44S/D G43I

BOYD'S QUARRY

SUBSTATION #9

PATTERSON ROAD

ZURICH ROAD

LARAWAY QUARRY (Active)

CHICAGO STREET

LARAWAY SCHOOL

W. LARAWAY ROAD

BRANDON ROAD

IEPA #IL9702638

IEPA #IL9702820

IEPA #IL9701747

IEPA #IL9701739

DRAFT

N

800 0 800 1600 3200

SCALE: IN FEET

NO.	DATE	REASONS DESCRIPTION	BY

ANDREWS ENVIRONMENTAL ENGINEERING INC.
3535 Mayflower Blvd., Springfield, IL 62711
Tel (217) 787-2334 Fax (217) 787-6495
Pontiac, IL • Naperville, IL • Indianapolis, IN

DESIGNED BY: LLM DRAWN BY: LAE APPROVED BY: LLM

RESIDENTIAL WELL ANALYSIS

PLANS PREPARED FOR
MIDWEST GENERATION, LLC
JOLIET, WILL COUNTY, ILLINOIS

DATE: NOVEMBER 2004
PROJECT ID: 2002-124
FILE: J:\DWG\POT...11-10-04
SHEET NUMBER: FIG. 2

Appendix C

Mileage, Workhours and Greenhouse Gas Calculations

Appendix C - Mileage Calculations

SCENARIO 1: Closure by Removal and Placement at an Existing Landfill

Activity	No. of Trucks	On-Site Roundtrip (miles)	Off-Site Roundtrip (miles)	Total On-Site Miles	On-Site Miles per Year	Total Off-Site Miles	Off-Site Miles per Year	Notes
CCR Removal & Placement	338,800	0.5	10	169,400	14,463	3,388,000	289,261	Relocation of 3.4 Million CY, Assumes a 16.5 CY dump truck, 10 roundtrip miles to Laraway Landfill
Subtotal				***169,400***	***14,463***	***3,388,000***	***289,261***	

SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill

Activity	No. of Trucks	On-Site Roundtrip (miles)	Off-Site Roundtrip (miles)	Total On-Site Miles	On-Site Miles per Year	Total Off-Site Miles	Off-Site Miles per Year	Notes
CCR Removal & Placement	338,800	5	0	1,694,000	119,899	0	0	Relocation of 3.4 Million CY, Assumes a 16.5 CY dump truck
Bottom Liner Placement	13,200	0.5	10	6,600	467	132,000	9,343	3 foot thick clay layer over 30 acres (193,600 CY), 16.5 CY dump truck
LCS	4,400	0.5	20	2,200	156	88,000	6,229	1 foot sand layer over 30 acres (193,600 CY), 16.5 CY dump truck
HDPE	19	1.5	2,200	29	2	41,800	2,959	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Geotextiles	38	1.5	2,200	57	4	83,600	5,917	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Final Cover Soil	17,600	0.5	10	8,800	623	176,000	12,457	4 foot thick cover over 30 acres (193,600 CY), 16.5 CY dump truck
LLDPE	19	1.5	2,200	29	2	41,800	2,959	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Geocomposite	46	1.5	2,200	69	5	101,200	7,163	24 rolls per truck, 12 x 150 panel dimensions, manufacture in Houston (Solomax)
Subtotal				***1,711,783***	***121,158***	***664,400***	***47,025***	

SCENARIO 3: Closure in Place with IEPA Prescribed Final Cover Design

Activity	No. of Trucks	On-Site Roundtrip (miles)	Off-Site Roundtrip (miles)	Total On-Site Miles	On-Site Miles per Year	Total Off-Site Miles	Off-Site Miles per Year	Notes
CCR Removal & Placement	40,300	1	0	40,300	21,045	0	0	Relocation of 664,000 CY of CCR, Assumes a 16.5 CY dump truck
Final Cover Soil	16,900	0.5	10	8,450	4,413	169,000	88,254	4 foot thick cover over 43 acres (193,600 CY), 16.5 CY dump truck
LLDPE	18	1.5	2,200	27	14	39,600	20,680	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Geocomposite	44	1.5	2,200	66	34	96,800	50,550	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Subtotal				***48,843***	***25,507***	***305,400***	***159,484***	

SCENARIO 4: Closure in Place with Alternate Final Cover Design

Activity	No. of Trucks	On-Site Roundtrip (miles)	Off-Site Roundtrip (miles)	Total On-Site Miles	On-Site Miles per Year	Total Off-Site Miles	Off-Site Miles per Year	Notes
CCR Removal & Placement	40,300	1	0	40,300	15,723	0	0	Relocation of 664,000 CY of CCR, Assumes a 16.5 CY dump truck
Closure Turf	23	1.5	2,000	35	13	46,000	17,947	12 rolls per truck, 23 x 300 panel dimensions, manufacture in Georgetown, South Carolina
0.5-inch sand infill	180	1.5	20	270	105	3,600	1,405	local quarry - 20 mile roundtrip
Subtotal				***40,605***	***15,842***	***49,600***	***19,351***	

SCENARIO 5: Consolidate and Close in Place

Activity	No. of Trucks	On-Site Roundtrip (miles)	Off-Site Roundtrip (miles)	Total On-Site Miles	On-Site Miles per Year	Total Off-Site Miles	Off-Site Miles per Year	Notes
CCR Removal & Placement	34,810	1	0	34,810	12,740	0	0	Relocation 573,300 CY of CCR, Assumes a 16.5 CY dump truck
Final Cover Soil	12,937	0.5	10	6,469	2,367	129,373	47,350	4 foot thick cover over 33 acres (193,600 CY), 16.5 CY dump truck
LLDPE	14	1.5	2,200	21	8	30,800	11,273	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Geocomposite	34	1.5	2,200	51	19	74,800	27,376	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Subtotal				***41,351***	***15,134***	***234,973***	***85,999***	

SCENARIO 6: Close in Place with Hydraulic Controls

Activity	No. of Trucks	On-Site Roundtrip (miles)	Off-Site Roundtrip (miles)	Total On-Site Miles	On-Site Miles per Year	Total Off-Site Miles	Off-Site Miles per Year	Notes
CCR Removal & Placement	40,300	1	0	40,300	12,359	0	0	Relocation 573,300 CY of CCR, Assumes a 16.5 CY dump truck
Final Cover Soil	16,900	0.5	10	8,450	2,591	169,000	51,830	4 foot thick cover over 43 acres (193,600 CY), 16.5 CY dump truck
LLDPE	18	1.5	2,200	27	8	39,600	12,145	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Geocomposite	44	1.5	2,200	66	20	96,800	29,687	24 rolls per truck, 12 x 150 panel dimensions, manufacture in Houston (Solomax)
Drilling and Piping	120	1	5	120	37	600	184	Assumes 120 days for drilling and piping, driller staying within 5 miles during field activities
Subtotal				***48,963***	***15,016***	***306,000***	***93,846***	

SCENARIO 7: Close in Place with Hydraulic Containment

Activity	No. of Trucks	On-Site Roundtrip (miles)	Off-Site Roundtrip (miles)	Total On-Site Miles	On-Site Miles per Year	Total Off-Site Miles	Off-Site Miles per Year	Notes
CCR Removal & Placement	40,300	1	0	40,300	2,852	0	0	Relocation 573,300 CY of CCR, Assumes a 16.5 CY dump truck
Final Cover Soil	16,900	0.5	10	8,450	598	169,000	11,962	4 foot thick cover over 43 acres (193,600 CY), 16.5 CY dump truck
LLDPE	18	1.5	2,200	27	2	39,600	2,803	12 rolls per truck, 22 x 400 panel dimensions, manufacture in Houston (Solomax)
Geocomposite	44	1.5	2,200	66	5	96,800	6,851	24 rolls per truck, 12 x 150 panel dimensions, manufacture in Houston (Solomax)
Drilling and Grouting	200	1	5	200	14	1,000		Assumes 200 days for drilling and grouting, driller staying within 5 miles during field activities
Subtotal				***48,843***	***3,457***	***305,400***	***21,616***	

SCENARIO 8: Close in Place with "Wet" Cap

Activity	No. of Trucks	On-Site Roundtrip (miles)	Off-Site Roundtrip (miles)	Total On-Site Miles	On-Site Miles per Year	Total Off-Site Miles	Off-Site Miles per Year	Notes
Barrier Soil Cap	4,300	0.5	10	2,150	152	43,000	3,043	12-inch sand "wet" cap
Subtotal				***2,150***	***152***	***43,000***	***3,043***	

Appendix C - Hourly Calculation

Number of Hours Per Day	8 hours	Number of hours per 8-hour shift
Number of Equipment Hours Per Day	6.5 hours	

SCENARIO 1: Closure by Removal and Placement at an Existing Landfill

Activity	No. of Days	No. of Employees	Total Hours	Pieces of Heavy Equipment per Day	Equipment Hours	Notes
Dewatering	120	4	3,840	1	780	Pumping system is equilavent to one heavy piece of equipment
CCR Excavation to Landfill	2795	25	559,000	22	399,685	twenty trucks for CCR relocation + two loaders
Ash Recontouring	0	0	0	0	0	
Liner/Cap Installation	0	0	0	0	0	
Hydraulic Control/ Containment	0	0	0	0	0	
Turf and Grasses	0	0	0	0	0	
Subtotal	***2915***		***562,900***	***100***	***400,500***	

SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill

Activity	No. of Days	No. of Employees	Total Hours			Notes
Dewatering	120	4	3,840	1	780	Pumping system is equilavent to one heavy piece of equipment
CCR Excavation to Landfill	2150	25	430,000	22	307,450	twenty trucks for CCR relocation + two loaders
Ash Recontouring	0	0	0	0	0	
Liner/Cap Installation	600	12	57,594	5	19,498	Liner Construction on average is 5 pieces of eqiupment (excavator, 2 dump trucks, compactor, smooth drum roller)
Hydraulic Control/ Containment	0	0	0	0	0	
Turf and Grasses	21	5	840	1	137	Hydromulch sprayer
Subtotal	***2891***		***492,300***	***100***	***327,900***	

SCENARIO 3: Closure In-Place with IEPA Prescribed Final Cover Design

Activity	No. of Days	No. of Employees	Total Hours			Notes
Dewatering	120	4	3,840	1	780	Pumping system is equilavent to one heavy piece of equipment
CCR Excavation to Landfill	0	0	0	0	0	
Ash Recontouring	114	8	7,327	3	2,232	3 pieces of equipment (dozer, excavator and dump truck)
Liner/Cap Installation	234	12	22,441	5	7,597	Liner Construction on average is 5 pieces of eqiupment (excavator, 2 dump trucks, compactor, smooth drum roller)
Hydraulic Control/ Containment	0	0	0	0	0	
Turf and Grasses	21	5	840	1	137	Hydromulch sprayer
Subtotal	***489***		***34,500***	***100***	***10,800***	

SCENARIO 4: Closure In-Place with Alternate Final Cover Design

Activity	No. of Days	No. of Employees	Total Hours			Notes
Dewatering	120	4	3,840	1	780	Pumping system is equilavent to one heavy piece of equipment
CCR Excavation to Landfill	0	0	0	0	0	
Ash Recontouring	114	8	7,327	3	2,232	3 pieces of equipment (dozer, excavator and dump truck)
Liner/Cap Installation	10	8	648	5	329	Liner Construction on average is 5 pieces of eqiupment (excavator, 2 dump trucks, compactor, smooth drum roller)
Hydraulic Control/ Containment	0	0	0	0	0	
Turf and Grasses	285	12	27,360	2	3,705	Closureturf Installation (2 pieces of heavy equipment: lull and sand sprayer)
Subtotal	***530***		***39,200***	***100***	***7,100***	

Appendix C - Hourly Calculation

Number of Hours Per Day 8 hours Number of hours per 8-hour shift

SCENARIO 5: Consolidate and Close In-Place

Activity	No. of Days	No. of Employees	Total Hours			Notes
Dewatering	120	4	3,840	1	780	Pumping system is equilavent to one heavy piece of equipment
CCR Excavation to Landfill	0	0	0	0	0	
Ash Recontouring	67	8	4,270	3	1,301	3 pieces of equipment (dozer, excavator and dump truck)
Liner/Cap Installation	234	12	22,441	5	7,597	Liner Construction on average is 5 pieces of eqiupment (excavator, 2 dump trucks, compactor, smooth drum roller)
Hydraulic Control/ Containment	0	0	0	0	0	
Turf and Grasses	21	5	840	1	137	Hydromulch sprayer
Subtotal	***441***		***31,400***	***100***	***9,900***	

SCENARIO 6: Close in Place with Hydraulic Controls

Activity	No. of Days	No. of Employees	Total Hours			Notes
Dewatering	120	4	3,840	1	780	Pumping system is equilavent to one heavy piece of equipment
CCR Excavation to Landfill	0	0	0	0	0	
Ash Recontouring	114	8	7,327	3	2,232	3 pieces of equipment (dozer, excavator and dump truck)
Liner/Cap Installation	234	12	22,441	5	7,597	Liner Construction on average is 5 pieces of eqiupment (excavator, 2 dump trucks, compactor, smooth drum roller)
Hydraulic Control/ Containment	90	4	2,880	1	585	one piece of equipment (driller rig for extraction wells in waste mass)
Turf and Grasses	21	5	840	1	137	Hydromulch sprayer
Subtotal	***579***		***37,400***	***100***	***11,400***	

SCENARIO 7: Close in Place with Hydraulic Containment

Activity	No. of Days	No. of Employees	Total Hours			Notes
Dewatering	120	4	3,840	1	780	Pumping system is equilavent to one heavy piece of equipment
CCR Excavation to Landfill	0	0	0	1	0	
Ash Recontouring	114	8	7,327	1	744	3 pieces of equipment (dozer, excavator and dump truck)
Liner/Cap Installation	234	12	22,441	1	1,519	Liner Construction on average is 5 pieces of eqiupment (excavator, 2 dump trucks, compactor, smooth drum roller)
Hydraulic Control/ Containment	180	4	5,760	1	1,170	one piece of equipment (driller rig)
Turf and Grasses	21	5	840	1	137	Hydromulch sprayer
Subtotal	***669***		***40,300***	***100***	***4,400***	

SCENARIO 8: Close in Place with "Wet" Cap

Activity	No. of Days	No. of Employees	Total Hours			Notes
Dewatering	0	4	0	0	0	
CCR Excavation to Landfill	0	0	0	0	0	
Ash Recontouring	60	8	3,840	3	1,170	3 pieces of equipment (dozer, excavator and dump truck)
Liner/Cap Installation	132	12	12,713	2	1,721	2 pieces of equipment (floating platform and sand launcher)
Hydraulic Control/ Containment	0	4	0	0	0	
Turf and Grasses	5	5	200	1	33	areas outside of waste footrpint for site restoration
Subtotal	***197***		***16,800***	***100***	***3,000***	

Appendix D

Cost Estimate Calculations

Geosyntec consultants

Project: Lincoln Stone Quarry Closure Alternatives
Task: Alternatives Cost Analysis
Client: Midwest Generation, LLC (MWG)
Proj. No. CHE8420
Date: September 30, 2021

Created By:	TWW	07/09/20
Reviewed By:	DK	07/21/20
Approved By:	JPV	10/13/21
Revised By:	JPV	02/17/21
Revised By:	REW	09/30/21

Available Site Data

Appendix D - Impoundment Summary			
Item	**Quantity**	**Unit**	**Notes**
Full Quarry Area	57	AC	
West Fill Area (WFA)	14	AC	
Main Quarry Area + WFA	57	AC	43 acres Main Quarry plus 14 acres WFA
Quarry Area to be Cleared	10	AC	
Vol. of Coal Ash	4,300,000	CY	Land Permit Renewal (2/18/19) 2.6MCY +1.7MCY (WFA)
WFA Volume	1,700,000	CY	
Regrading/Relocated CCR Volume for In-Place Closure	511,000	CY	
Perimeter Length	7,900	LF	WFA added
Dike Volume	0	CY	No dikes
Dewatering Duration	6	MO	Prior to the start of earthwork
Borrow Area	20	AC	Assumes a 10 ft deep excavation for Scenarios 3, 5, 6, and 7
Borrow Perimeter	1,000	LF	
IEPA Pond Closure Cover Elements			
Compacted Earth Layer	1	FT	1-ft thick with a hydraulic conductivity of $1x10^{-7}$ cm/sec or less
Protective Cover Layer	2	FT	2-ft thick soil with the capability to support vegetation
Volume required for Closure Soil	331,060	CY	
Existing Groundwater Monitoring Wells	39	EA	
Existing Groundwater Extraction Wells	12	EA	
Pond Consolidate and Close in Place Summary			
Item	**Quantity**	**Unit**	**Notes**
Consolidation Area	33	AC	
Consolidated Perimeter Length	3,700	FT	
Relocated CCR Volume	387,000	CY	
New Landfill Summary			
Item	**Quantity**	**Unit**	**Notes**
New Landfill Area	45	AC	Estimated
New Landfill Area Perimeter	5,600	LF	
New Landfill Length	1,400	LF	
New Landfill Width	1,400	LF	
Landfill Invert (below ground surface)	30	FT	
Landfill Height (above ground surface)	70	FT	
IEPA Landfill Liner and Final Cover Elements			35 IAC 811
Compacted Earth Layer	3	FT	1-ft thick low permeability liner
HDPE Geomembrane	60	mil	
Final Cover Barrier Layer	1	FT	1-ft thick with a hydraulic conductivity of $1x10^{-7}$ cm/sec or less
LLDPE Geomembrane	40	mil	
Protective Cover Layer	3	FT	36-in thick soil with the capability to support vegetation

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Appendix D - Production Rates

Hauling Scenario	No. Trucks	CY	Wait (mins)	MPH	Cycle (mins)	CY/Day	Daily Production (tons/day)	Reference
Coal Ash to Existing Landfill	20	16.5	15	20	20	99	2,000	RS Means 3123 2320 3078
Coal Ash to New Landfill	20	16.5	15	40	40	132	2,600	RS Means 3123 2320 3078
Borrow to New Landfill (Onsite)	10	16.5	15	20	6	231	2,300	RS Means 3123 2320 6040
Borrow to New Landfill (Offsite)	10	16.5	15	40	20	165	1,700	RS Means 3123 1643 5500 + 3123 2320 3080
Recontouring (Onsite)	10	34	15	5	1	578	5,800	RS Means 3123 2320 6040
Borrow for Closure (Onsite)	10	16.5	15	20	6	231	2,300	RS Means 3123 2320 6040
Borrow for Closure (Offsite)	10	16.5	15	40	20	165	1,700	RS Means 3123 2320 3080

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Appendix D - Estimated Schedule Critical Path Items

Table 7-1: Closure Scenarios' Schedule
Critical Path Working Days

Tasks	00.50	01.00 - 06.00		07.20	07.50	07.00, 08.00, 09.00	10.00	11.00			
Scenario	**Siting/ Permitting**	**Mob**	**Dewatering, Erosion, Demolition, Etc.**	**CCR Excavation to Landfill**	**Ash Recontouring**	**Liner & Cap Installation [4, 5]**	**Hydraulic Control/ Containment**	**Turf and Grasses[6]**	**Days**	**Months**	**Years**
SCENARIO 1: Closure by Removal and Placement at an Existing Landfill	180	10	120	2795	0	0	0	0	3,105	140.6	11.7
SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill	1095	10	120	2150	0	600	0	21	3,996	169.5	14.1
SCENARIO 3: Closure in Place with IEPA Prescribed Final Cover Design	0	10	120	0	114	234	0	21	499	23.0	1.9
SCENARIO 4: Closure in Place with Alternate Final Cover Design	180	10	120	0	114	10	0	285	720	30.8	2.6
SCENARIO 5: Consolidate and Close in Place	365	10	120	0	67	234	0	21	816	32.8	2.7
SCENARIO 6: Closure in Place with Hydraulic Control	365	10	120	0	114	234	90	21	954	39.1	3.3
SCENARIO 7: Closure in Place with Hydraulic Containment	365	10	120	0	114	234	180	21	1,044	43.3	3.6
SCENARIO 8: Closure in Place Wet Closure	365	10	0	0	60	132	0	5	572	21.6	1.8

Notes:

1 Assumes 6 months of dewatering prior to earthwork.
2 Assumes Tasks 03.00 - 06.00 occur during the initial dewatering.
3 Assumes ditching and access roads are installed during earthwork.
4 Scenario 2 requires construction of both a bottom, leachate and final cover systems.
5 ClosureTurf installation was assumed to be 10,000 sq. feet per day.
6 Turf and Grasses Installation time includes: soil prep, soil amendments, erosion control measures, seed application.
7 Please refer to Appendix C (for hauling rates for soil) and Appendix D (for construction production rates).

Geosyntec consultants

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Appendix D: Unit Rates

Appendix D: Unit Rates

Task		Unit	Unit Rate ($/unit)	Unit Cost Reference[1,2]	Notes / Assumptions
01.00	**Engineering and Contingency**				
01.01	Design and Engineering Fees	%	10%	Past project experience	For the Closure by Removal and Placement at an Existing Landfill (Scenario 1) this was reduced to 1% due to the high cost of waste transport and disposal that would impact design and engineering fees
01.02	Owners Cost	%	5%	Past project experience	
01.03	Contingency	%	30%	Past project experience	
01.00	**Mobilization / Demobilization**				
01.01	Mobilization	LS	$100,000	Past project experience	
01.02	Demobilization	LS	$100,000	Past project experience	
01.03	Construction Trailer	EA	$12,161	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	MO	$1,000.00	Past project experience	Utilities and maintenance
01.05	Construction Entrances	EA	$5,000.00	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				
02.01	Dewatering Sumps	EA	$25,000.00	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	MO	$50,000.00	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	MO	$5,000.00	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	LF	$148.00		Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	LF	$267.50		Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	LF	$387.00		Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	EA	$2,915.19	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	YR	$50,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				
03.01	Erosion and Sediment Controls	LS	$75,000.00	2020 project bids	
03.02	Erosion Control Blankets	SY	$2.20	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the perimeter
03.03	Silt Fence	LF	$2.19	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	EA	$1,700.00	Past project experience	Installation and Removal
03.05	EPSC Maintenance	MO	$1,500.00	Past project experience	
04.00	**Instrumentation**				
04.01	Piezometer Installation	EA	$2,000.00	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	EA	$500.00	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	EA	$2,500.00	N/A	
04.04	Monitoring Well Extension	EA	$500.00	N/A	
04.05	Settlement Plates	EA	$500.00	2020 project bids	1 per ~20 acres
05.00	**Demolition**				
05.01	Piezometer Abandonment	EA	$3,000.00	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	EA	$3,000.00	Past project experience	Assumes monitoring wells will not be impacted
05.03	Sluice Pipelines	LS	$50,000.00	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				

06.01	Stripping Topsoil and Vegetation, Quarry	CY	$4.72	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	AC	$4,821.30	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	CY	$4.72	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	AC	$6,366.48	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	CY	$4.72	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	AC	$6,366.48	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				
07.10	**Dust Control**				
07.11	Water Truck	MO	$14,101.86	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental
07.20	**Coal Ash Excavation to Landfill**				
07.21	Coal Ash Excavation and Loading	BCY	$1.39	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	LCY	$4.21	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle, 30% swell
	Coal Ash Hauling to Existing Landfill	LCY	$4.21	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle, 30% swell
07.23	Coal Ash Spreading	LCY	$2.07	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	ECY	$0.28	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	MO	$5,903.51	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.26	Landfill Disposal Tipping Fee	TON	$58.29	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf
07.30	**Landfill Bottom Liner**				
07.31	Landfill Excavation	BCY	$1.39	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.32	Landfill Excavation Soil Hauling	BCY	$2.90	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle, 10% swell
07.33	Clay Layer Borrow Excavation and Loading (On-site)	LCY	$4.14	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10% swell
07.34	Clay Layer Borrow Excavation and Loading (On-site)	LCY	$8.76	RS Means 3123 1643 5500 + 3123 2320 3080	
07.35	Clay Layer Spreading	LCY	$2.45	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	ECY	$1.76	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	SY	$0.25	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				
07.41	Clay Layer Borrow Pit Purchase	BCY	$2.50	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	BCY	$1.39	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	LCY	$4.14	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10% swell
	Clay Layer Borrow Hauling (Offsite)	LCY	$7.37	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle, 10% swell
07.44	Clay Layer Borrow Spreading	LCY	$2.45	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	ECY	$1.76	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	BCY	$1.39	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	LCY	$4.14	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10% swell
	Protective Layer Borrow Hauling (Offsite)	LCY	$7.37	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle, 10% swell
07.48	Protective Layer Borrow Spreading	LCY	$2.45	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	ECY	$0.96	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				
07.51	Excavation and Loading	BCY	$1.39	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10% recontouring
07.52	Hauling	LCY	$4.14	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30% swell
07.53	Spreading	LCY	$2.45	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	ECY	$0.28	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink

07.55	Moisture Conditioning	MO	$5,903.51	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				
07.61	Borrow Soil	BCY	$2.50	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	BCY	$1.39	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	LCY	$4.14	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30% swell
	Clay Layer Hauling (Offsite)	LCY	$7.37	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle, 10% swell
07.64	Clay Layer Spreading	LCY	$2.45	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	ECY	$1.76	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	BCY	$1.39	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	LCY	$4.14	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30% swell
	Protective Layer Hauling (Offsite)	LCY	$7.37	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle, 10% swell
07.68	Protective Layer Spreading	LCY	$2.45	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	ECY	$0.96	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	Wet or Sediment Cap	CY	$130.00	Project Costs	12-inch sand cap
07.70	**Soil Contouring Fill / Regrading**				
07.71	Excavation and Loading	BCY	$1.39	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	LCY	$4.14	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10% swell
07.73	Spreading	LCY	$2.45	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	ECY	$0.96	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				
07.81	Access Road - Closure	SY	$10.39	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide / perimeter
07.82	Access Road - Borrow	SY	$10.39	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide / perimeter
07.83	Access Road - Landfill	SY	$10.39	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide / perimeter
08.00	**Geosynthetics**				
08.10	**Landfill and Closure Cap Geosynthetic Components**				
08.11	40-mil double sided textured LLDPE Geomembrane	SF	$0.81	2020 project bids	
08.12	Double-Sided Tri-place Geocomposite	SF	$1.32	2020 project bids	
08.13	Anchor Trench - Closure Cap	LF	$9.27	2020 project bids	
08.20	**Landfill Bottom Liner Geosynthetic Components**				
08.21	60-mil double sided textured HDPE Geomembrane	SF	$0.85	2020 project bids	
08.22	Double-Sided Tri-place Geocomposite	SF	$1.32	2020 project bids	
08.23	Anchor Trench - Landfill Bottom Liner	LF	$9.27	2020 project bids	
08.24	Geotextile (Cushion 8 oz/yd2)	SF	$0.30	Project Bids	Woven, heavy duty, 600 lb. tensile strength
08.25	Geotextile - (Filter 4 oz/yd2)	SF	$0.25	Project Bids	
08.30	**Leachate Collection and Transmission System**				
08.31	Leachate Collection System (1 foot thick)	CY	$16.00		
08.32	6-inch SDR 11 HDPE Pipe	LF	$9.50		
08.33	Gravel Trench for V-Trench	LF	$26.00		Leachate Collection "V" Notch Drain "Burrito Wrap" - Includes Granular Fill, Geotextile Envelope (Nonwoven 4 oz/SY), Underlying
08.34	Leachate Sumps	EA	$5,000.00	20' x 20' x 3'	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	EA	$8,500.00		
08.36	Leachate Transmission Piping (2x4 HDPE)	LF	$4.50		Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	LF	$78.00		
08.38	Leachate Vault and Control Panel	EA	$25,000.00		
08.39	Leachate Vault Utilities	LF	$24.55	RS Means 337119175840	4 conduits in 5" diameter PVC conduit with backfill

08.40	Above Grade Leachate Storage Tank	EA	$500,000	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	Gal	$0.001	Project Costs	On-site discharge through NPDES permit (cost for pumps)
08.42	Leachate Treatment (Off-site)	Gal	$0.070	Project Costs	Discharge to WWTP, 40-mile one way travel
09.00	**Pond Closure - Ditch and Apron Construction**				
09.01	Geotextile Fabric	SY	$2.55	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	LCY	$71.19	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	TON	$38.70	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	LCY	$4.89	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				
10.01	Borehole Drilling for Bedrock Fractures	LF	$75.00	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth (USACOE, 2017)
10.02	Grouting of Bedrock Fractures	CY	$70.79	RS Means 3173 1310 0820	
10.03	Leachate Discharge Piping	LF	$6.50	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	VLF	$85.00	Project Bids	
11.00	**Turf and Grasses**				
11.01	Hydroseed and Mulch	SY	$2.25	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	SF	$2.44	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	TON	$50.00	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	TON	$341.00	Past project experience	7 lbs/SF
11.05	Anchor Trench	LF	$9.27	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	AC	$30,000.00	Past project experience	In place of seeding
11.07	Soil Amendments	AC	$500.00	Past project experience	To support vegetative growth

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Revised By:	JPV	02/17/21
Revised By:	REW	09/30/21

Task Breakdown and Cost

Appendix D: Post Closure Unit Rates

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost Per Year	Years	Total Cost	Unit Cost Reference[1,2]	Notes / Assumptions
14.00	**Cover Maintenance**				**$21,691.35**				
14.01	Years 1 - 10 (1% of cover area)	2,759	cy	$4.39	$12,111.13	10	$121,111	Past project experience	
14.02	Years 10 - 30 (0.5% of cover area)	1,089	cy	$4.39	$4,780.22	20	$95,604	Past project experience	
14.03	Quarterly Cover Inspections	4	Event	$1,200.00	$4,800.00	30	$144,000	Past project experience	
15.00	**Vegetation Maintenance**				**$21,375.00**				
15.01	Years 1 - 10 (1% of cover area)	57	Acre	$15,000.00	$8,550.00	10	$85,500	Past project experience	
15.02	Years 20 - 30 (0.5% of cover area)	57	Acre	$15,000.00	$4,275.00	20	$85,500	Past project experience	
15.03	Mowing	57	Acre	$150.00	$8,550.00	30	$256,500	Past project experience	
15.00	**Clean Closure Groundwater Monitoring**	**5**	**wells**		**$10,000.00**				
15.01	Collection and Reporting	4	Event	$250.00	$5,000.00	5	$25,000	Past project experience	
15.02	Quarterly Analytical Lab Testing	4	Event	$250.00	$5,000.00	5	$25,000	Past project experience	
15.03	Semi-Annual Analytical Lab Testing	0	Event	$250.00	$0.00	5	$0	Past project experience	
16.00	**Landfill Groundwater Monitoring**	**39**	**wells**		**$66,500.00**				
16.01	Collection and Reporting	4	Event	$250.00	$39,000.00	30	$1,170,000	Past project experience	
16.02	Quarterly Analytical Lab Testing	2	Event	$250.00	$19,500.00	30	$585,000	Past project experience	
16.03	Semi-Annual Analytical Lab Testing	2	Event	$1,000.00	$8,000.00	30	$240,000	Past project experience	
17.00	**Leachate Management**				**$141,000.00**				
17.01	Leachate Pump and Control Panel Maint.	1	Year	$15,000.00	$15,000.00	30	$450,000		
17.02	Leachate Generation	73,000,000	$ per Gallon	$0.001	$73,000.00	30	$2,190,000	Off-site disposal	200,000 gallons per day for inward gradient control
17.03	Leachate Line Cleaning & Jetting	1	Year	$3,000.00	$3,000.00	30	$90,000	Past project experience	Jetting every 5 years ($15,000 every 5 years)
17.04	ICA Dewatering Extraction System O&M	1	Year	$50,000.00	$50,000.00	30	$1,500,000	Past project experience	Jetting every 5 years ($15,000 every 5 years)
18.00	**Miscellaneous Maintenance**								
18.01	Misc. Maintenance	1	Year	$25,000.00	$25,000.00	30	$750,000	Past project experience	Includes boundary and access control maintenance, stormwater management system and monitoring well replacement
						Total Cost	**$5,083,216**		
						Total Cost Per Year	***$169,441***	Scenario Closure In Place	
						Total Cost Per Year *Acre	**$3,766**		
						Total Cost Per Year	***$258,774***	Scenario Closure In Place with Leachate Removal	
						Total Cost Per Year	***$10,000***	Scenario Closure by Removal	
						Total Cost Per Year	***$169,441***	Scenario Closure by Removal by On-site New Landfill	
						Total Cost Per Year	***$121,300***	Scenario Closure In Place - ClosureTurf	

[1]RSMeans data based on Site Work and Landscape, 2020, Joliet, IL, Standard Union, Total O&P

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SCENARIO 1: Closure by Removal and Placement at an Existing Landfill

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost ($)	Unit Cost Reference[1,2]	Notes / Assumptions
01.00	**Mobilization / Demobilization**				**$352,000**		
01.01	Mobilization	1	LS	$100,000.00	$100,000	Past project experience	0
01.02	Demobilization	1	LS	$100,000.00	$100,000	Past project experience	0
01.03	Construction Trailer	1	EA	$12,160.60	$12,000	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	135	MO	$1,000.00	$135,000	Past project experience	Utilities and maintenance
01.05	Construction Entrances	1	EA	$5,000.00	$5,000	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				**$8,261,000**		
02.01	Dewatering Sumps	10	EA	$25,000.00	$250,000	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	135	MO	$50,000.00	$6,750,000	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	135	MO	$5,000.00	$675,000	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	0	LF	$148.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	0	LF	$267.50	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	0	LF	$387.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	0	EA	$2,915.19	$0	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	12	YR	$50,000.00	$586,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				**$278,000**		
03.01	Erosion and Sediment Controls	1	LS	$75,000.00	$75,000	2020 project bids	0
03.02	Erosion Control Blankets	0	SY	$2.20	$0	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the
03.03	Silt Fence	0	LF	$2.19	$0	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	0	EA	$1,700.00	$0	Past project experience	Installation and Removal
03.05	EPSC Maintenance	135	MO	$1,500.00	$203,000	Past project experience	0
04.00	**Instrumentation**				**$20,000**		
04.01	Piezometer Installation	10	EA	$2,000.00	$20,000	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	0	EA	$500.00	$0	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	0	EA	$2,500.00	$0	N/A	0
04.04	Monitoring Well Extension	0	EA	$500.00	$0	N/A	0
04.05	Settlement Plates	0	EA	$500.00	$0	2020 project bids	1 per ~20 acres
05.00	**Demolition**				**$233,000**		
05.01	Piezometer Abandonment	10	EA	$3,000.00	$30,000	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	51	EA	$3,000.00	$153,000	Past project experience	Monitoring and Extraction Wells
05.03	Sluice Pipelines	1	LS	$50,000.00	$50,000	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				**$0**		
06.01	Stripping Topsoil and Vegetation, Quarry	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	0	AC	$4,821.30	$0	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				**$334,233,000**		
07.10	**Dust Control**				**$0**		
07.11	Water Truck	0	MO	$14,101.86	$0	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental
07.20	**Coal Ash Excavation to Landfill**				**$334,046,000**		
07.21	Coal Ash Excavation and Loading	4,300,000	BCY	$1.39	$5,977,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
	Coal Ash Hauling to Existing Landfill	5,590,000	LCY	$4.21	$23,534,000	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
07.23	Coal Ash Spreading	0	LCY	$2.07	$0	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment

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07.26	Landfill Disposal Tipping Fee	5,224,500	TON	$58.29	$304,535,000	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf
07.30	**Landfill Bottom Liner**				**$0**		
07.31	Landfill Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.32	Landfill Excavation Soil Hauling	0	BCY	$2.90	$0	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle,
07.33	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.34	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$8.76	$0	RS Means 3123 1643 5500 + 3123 2320 3080	0
07.35	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				**$0**		
07.41	Clay Layer Borrow Pit Purchase	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Clay Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.44	Clay Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Protective Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.48	Protective Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				**$0**		
07.51	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10%
07.52	Hauling	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
07.53	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.55	Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				**$0**		
07.61	Borrow Soil	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Clay Layer Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.64	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Protective Layer Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.68	Protective Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	Wet or Sediment Cap	0	CY	$130.00	$0	Project Costs	12-inch sand cap
07.70	**Soil Contouring Fill / Regrading**				**$0**		
07.71	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.73	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				**$187,000**		
07.81	Access Road - Closure	18,000	SY	$10.39	$187,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.82	Access Road - Borrow	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.83	Access Road - Landfill	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
08.00	**Geosynthetics**				**$0**		
08.10	**Landfill and Closure Cap Geosynthetic Components**				**$0**		
08.11	40-mil double sided textured LLDPE Geomembrane	0	SF	$0.81	$0	2020 project bids	0
08.12	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0

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08.13	Anchor Trench - Closure Cap	0	LF	$9.27	$0	2020 project bids	0
08.20	**Landfill Bottom Liner Geosynthetic Components**				**$0**		
08.21	60-mil double sided textured HDPE Geomembrane	0	SF	$0.85	$0	2020 project bids	0
08.22	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0
08.23	Anchor Trench - Landfill Bottom Liner	0	LF	$9.27	$0	2020 project bids	0
08.25	Geotextile - (Filter 4 oz/yd2)	0	SF	$0.25	$0	Project Bids	0
08.30	**Leachate Collection and Transmission System**				**$0**		
08.31	Leachate Collection System (1 foot thick)	0	CY	$16.00	$0	0	0
08.32	6-inch SDR 11 HDPE Pipe	0	LF	$9.50	$0	0	0
08.33	Gravel Trench for V-Trench	0	LF	$26.00	$0	0	Leachate Collection "V" Notch Drain "Burrito Wrap" -
08.34	Leachate Sumps	0	EA	$5,000.00	$0	20' x 20' x 3'	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	0	EA	$8,500.00	$0	0	0
08.36	Leachate Transmission Piping (2x4 HDPE)	0	LF	$4.50	$0	0	Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	0	LF	$78.00	$0	0	0
08.38	Leachate Vault and Control Panel	0	EA	$25,000.00	$0	0	0
08.39	Leachate Vault Utilities	0	LF	$24.55	$0	RS Means 337119175840	4 conduits in 5" diameter PVC conduit with backfill
08.40	Above Grade Leachate Storage Tank	0	EA	$500,000.00	$0	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	0	Gal	$0.00	$0	Project Costs	On-site discharge through NPDES permit (cost for pumps)
08.42	Leachate Treatment (Off-site)	0	Gal	$0.07	$0	Project Costs	Discharge to WWTP, 40-mile one way travel
09.00	**Pond Closure - Ditch and Apron Construction**				**$0**		
09.01	Geotextile Fabric	0	SY	$2.55	$0	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	0	LCY	$71.19	$0	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	0	TON	$38.70	$0	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	0	LCY	$4.89	$0	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				**$0**		
10.01	Borehole Drilling for Bedrock Fractures	0	LF	$75.00	$0	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth
10.02	Grouting of Bedrock Fractures	0	CY	$70.79	$0	RS Means 3173 1310 0820	0
10.03	Leachate Discharge Piping	12	LF	$6.50	$0	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	0	VLF	$85.00	$0	Project Bids	0
11.00	**Turf and Grasses**				**$0**		
11.01	Hydroseed and Mulch	0	SY	$2.25	$0	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	0	SF	$2.44	$0	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	0	TON	$50.00	$0	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	0	TON	$341.00	$0	Past project experience	7 lbs/SF
11.05	Anchor Trench	0	LF	$9.27	$0	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	0	AC	$30,000.00	$0	Past project experience	In place of seeding
11.07	Soil Amendments	0	AC	$500.00	$0	Past project experience	To support vegetative growth
12.00	**SW Management Features - New Landfill**				**$0**		
12.01	Soil Excavation for Detention Basin	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.02	Basin Vegetation	0	SY	$2.25	$0	RS Means 3292 1913 1100	Bluegrass, hydro or air seeding, with mulch and fertilizer
12.03	Basin Outlet Structure	0	EA	$10,000.00	$0	Past project experience	Outlet structure and associated discharge piping
12.04	Culverts (30-inch)	0	EA	$387.00	$0	Past project experience	Includes Excavation, Pipe, Bedding, and Backfill
12.05	Perimeter Stormwater Ditch/Road Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.06	Perimeter Stormwater Ditch/Road Fill	0	LCY	$2.18	$0	RS Means 312323145440	Backfill, structural, clay, 300 H.P. dozer, 300' haul
12.07	Perimeter Stormwater Ditch Grading	0	LF	$0.40	$0	RS Means 312319100200	Cut Drainage Ditch, Clay and Till, 10' w x 3'-4' deep
12.08	Fine Grading of Perimeter Stormwater Ditch	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
12.09	Terrace Berms	0	CY	$3.50	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grades
12.10	Drainage Downchutes	0	LF	$25.00	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grade, Rip-Rap
13.00	**30-year Post-Closure**				**$50,000**		
13.01	Annual Care	5	YR	$10,000.00	$50,000	Past project experience	Includes monitoring, maintenance, inspections
				Sub Total	**$343,377,000**	**DOES NOT INCLUDE 30-YEAR POST CLOSURE**	
				Contingency	**$103,013,000**	**30%**	
				Design and Engineering Fees	**$3,434,000**	**1%**	Reduced from other scenarios due to the high cost of waste disposal

Geosyntec consultants

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Owners Costs	**$17,169,000**	**5%**
Scenario Total	**$466,993,000**	

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SCENARIO 2: Closure by Removal and Placement at a New CCR Landfill

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost ($)	Unit Cost Reference[1,2]	Notes / Assumptions
00.50	**Siting and IEPA Permitting**				**$2,725,000**		
01.51	Land Acquisition	75	ACRES	$12,000.00	$900,000	Will County Survey	75 acres for 30 acre waste footprint and associated ancillary facilities (buffer, screening berms, SW, etc.)
01.52	Local Siting	1	EA	$1,200,000.00	$1,200,000	Project Experience	
01.53	IEPA Permitting	1	EA	$150,000.00	$150,000	Project Experience	
01.54	CQA Documentation	30	AC	$10,000.00	$300,000	Project Experience	CQA oversight, surveying and reporting
01.55	IEPA Annual Reporting	8	YR	$20,000.00	$160,000	Project Experience	Closure Cost Estimate, Groundwater monitoring, Annual Report
01.56	Closure Certification	1	EA	$15,000.00	$15,000	Project Experience	
01.00	**Mobilization / Demobilization**				**$356,000**		
01.01	Mobilization	1	LS	$100,000.00	$100,000	Past project experience	0
01.02	Demobilization	1	LS	$100,000.00	$100,000	Past project experience	0
01.03	Construction Trailer	1	EA	$12,160.60	$12,000	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	134	MO	$1,000.00	$134,000	Past project experience	Utilities and maintenance
01.05	Construction Entrances	2	EA	$5,000.00	$10,000	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				**$7,199,000**		
02.01	Dewatering Sumps	10	EA	$25,000.00	$250,000	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	114	MO	$50,000.00	$5,675,000	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	114	MO	$5,000.00	$568,000	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	0	LF	$148.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	0	LF	$267.50	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	0	LF	$387.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	0	EA	$2,915.19	$0	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	14	YR	$50,000.00	$706,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				**$315,000**		
03.01	Erosion and Sediment Controls	1	LS	$75,000.00	$75,000	2020 project bids	0
03.02	Erosion Control Blankets	0	SY	$2.20	$0	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the
03.03	Silt Fence	13,500	LF	$2.19	$30,000	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	5	EA	$1,700.00	$9,000	Past project experience	Installation and Removal
03.05	EPSC Maintenance	134	MO	$1,500.00	$201,000	Past project experience	0
04.00	**Instrumentation**				**$20,000**		
04.01	Piezometer Installation	10	EA	$2,000.00	$20,000	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	0	EA	$500.00	$0	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	0	EA	$2,500.00	$0	N/A	0
04.04	Monitoring Well Extension	0	EA	$500.00	$0	N/A	0
04.05	Settlement Plates	0	EA	$500.00	$0	2020 project bids	1 per ~20 acres
05.00	**Demolition**				**$80,000**		
05.01	Piezometer Abandonment	10	EA	$3,000.00	$30,000	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	0	EA	$3,000.00	$0	Past project experience	Assumes monitoring wells will not be impacted
05.03	Sluice Pipelines	1	LS	$50,000.00	$50,000	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				**$1,018,000**		
06.01	Stripping Topsoil and Vegetation, Quarry	43,556	CY	$4.72	$206,000	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	54	AC	$4,821.30	$260,000	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	44,000	CY	$4.72	$208,000	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	54	AC	$6,366.48	$344,000	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				**$59,663,000**		
07.10	**Dust Control**				**$1,890,000**		
07.11	Water Truck	134	MO	$14,101.86	$1,890,000	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental

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07.20	**Coal Ash Excavation to Landfill**				**$43,077,000**		
07.21	Coal Ash Excavation and Loading	4,300,000	BCY	$1.39	$5,977,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	5,590,000	LCY	$4.21	$23,534,000	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
	Coal Ash Hauling to Existing Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
07.23	Coal Ash Spreading	5,590,000	LCY	$2.07	$11,571,000	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	4,300,000	ECY	$0.28	$1,204,000	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	134	MO	$5,903.51	$791,000	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.26	Landfill Disposal Tipping Fee	0	TON	$58.29	$0	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf
07.30	**Landfill Bottom Liner**				**$11,533,000**		
07.31	Landfill Excavation	2,177,778	BCY	$1.39	$3,027,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.32	Landfill Excavation Soil Hauling	2,177,778	BCY	$2.90	$6,316,000	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle,
07.33	Clay Layer Borrow Excavation and Loading (On-site)	261,333	LCY	$4.14	$1,082,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
07.34	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$8.76	$0	RS Means 3123 1643 5500 + 3123 2320 3080	0
07.35	Clay Layer Spreading	261,333	LCY	$2.45	$640,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	235,200	ECY	$1.76	$414,000	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	217,778	SY	$0.25	$54,000	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				**$2,847,000**		
07.41	Clay Layer Borrow Pit Purchase	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	72,600	BCY	$1.39	$101,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	79,860	LCY	$4.14	$331,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
	Clay Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.44	Clay Layer Borrow Spreading	79,860	LCY	$2.45	$196,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	72,600	ECY	$1.76	$128,000	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	217,800	BCY	$1.39	$303,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	239,580	LCY	$4.14	$992,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
	Protective Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.48	Protective Layer Borrow Spreading	239,580	LCY	$2.45	$587,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	217,800	ECY	$0.96	$209,000	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				**$0**		
07.51	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10%
07.52	Hauling	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
07.53	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.55	Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				**$0**		
07.61	Borrow Soil	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
	Clay Layer Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.64	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
	Protective Layer Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.68	Protective Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	**Soil Contouring Fill / Regrading**				**$0**		
07.71	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
07.73	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				**$316,000**		
07.81	Access Road - Closure	18,000	SY	$10.39	$187,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.82	Access Road - Borrow	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /

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07.83	Access Road - Landfill	12,444	SY	$10.39	$129,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
08.00	**Geosynthetics**				**$11,324,000**		
08.10	**Landfill and Closure Cap Geosynthetic Components**				**$5,052,000**		
08.11	40-mil double sided textured LLDPE Geomembrane	2,352,000	SF	$0.81	$1,905,000	2020 project bids	0
08.12	Double-Sided Tri-place Geocomposite	2,352,000	SF	$1.32	$3,095,000	2020 project bids	0
08.13	Anchor Trench - Closure Cap	5,600	LF	$9.27	$52,000	2020 project bids	0
08.20	**Landfill Bottom Liner Geosynthetic Components**				**$6,440,000**		
08.21	60-mil double sided textured HDPE Geomembrane	2,352,000	SF	$0.85	$1,999,000	2020 project bids	0
08.22	Double-Sided Tri-place Geocomposite	2,352,000	SF	$1.32	$3,095,000	2020 project bids	0
08.23	Anchor Trench - Landfill Bottom Liner	5,600	LF	$9.27	$52,000	2020 project bids	0
08.24	Geotextile (Cushion 8 oz/yd2)	2,352,000	SF	$0.30	$706,000	Project Bids	Woven, heavy duty, 600 lb. tensile strength
08.25	Geotextile - (Filter 4 oz/yd2)	2,352,000	SF	$0.25	$588,000	Project Bids	0
08.30	**Leachate Collection and Transmission System**				**$2,362,000**		
08.31	Leachate Collection System (1 foot thick)	79,852	CY	$16.00	$1,278,000		
08.32	6-inch SDR 11 HDPE Pipe	4,200	LF	$9.50	$40,000		
08.33	Gravel Trench for V-Trench	4,200	LF	$26.00	$109,000		Leachate Collection "V" Notch Drain "Burrito Wrap" - Includes Granular Fill, Geotextile Envelope (Nonwoven 4
08.34	Leachate Sumps	3	EA	$5,000.00	$15,000	sumps every 500 feet, length 2,100 feet	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	6	EA	$8,500.00	$51,000		
08.36	Leachate Transmission Piping (2x4 HDPE)	8,400	LF	$4.50	$38,000		Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	540	LF	$78.00	$42,000		
08.38	Leachate Vault and Control Panel	3	EA	$25,000.00	$75,000		
08.39	Leachate Vault Utilities	8,400	LF	$24.55	$206,000		
08.40	Above Grade Leachate Storage Tank	1	EA	$500,000.00	$500,000	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	8,211,662	Gal	$0.001	$8,000	Project Costs	On-site discharge through NPDES permit (cost for pumps)
09.00	**Pond Closure - Ditch and Apron Construction**				**$0**		
09.01	Geotextile Fabric	0	SY	$2.55	$0	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	0	LCY	$71.19	$0	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	0	TON	$38.70	$0	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	0	LCY	$4.89	$0	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				**$0**		
10.01	Borehole Drilling for Bedrock Fractures	0	LF	$75.00	$0	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth
10.02	Grouting of Bedrock Fractures	0	CY	$70.79	$0	RS Means 3173 1310 0820	0
10.03	Leachate Discharge Piping	14	LF	$6.50	$0	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	0	VLF	$85.00	$0	Project Bids	0
11.00	**Turf and Grasses**				**$611,000**		
11.01	Hydroseed and Mulch	261,600	SY	$2.25	$589,000	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	0	SF	$2.44	$0	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	0	TON	$50.00	$0	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	0	TON	$341.00	$0	Past project experience	7 lbs/SF
11.05	Anchor Trench	0	LF	$9.27	$0	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	0	AC	$30,000.00	$0	Past project experience	In place of seeding
11.07	Soil Amendments	45	AC	$500.00	$22,000	Past project experience	To support vegetative growth
12.00	**SW Management Features - New Landfill**				**$273,000**		
12.01	Soil Excavation for Detention Basin	26,000	BCY	$1.39	$36,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.02	Basin Vegetation	15,600	SY	$2.25	$35,000	RS Means 3292 1913 1100	Bluegrass, hydro or air seeding, with mulch and fertilizer
12.03	Basin Outlet Structure	1	EA	$10,000.00	$10,000	Past project experience	Outlet structure and associated discharge piping
12.04	Culverts (30-inch)	2	EA	$387.00	$1,000	Past project experience	Includes Excavation, Pipe, Bedding, and Backfill
12.05	Perimeter Stormwater Ditch/Road Excavation	2,074	BCY	$1.39	$3,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.06	Perimeter Stormwater Ditch/Road Fill	2,074	LCY	$2.18	$5,000	RS Means 312323145440	Backfill, structural, clay, 300 H.P. dozer, 300' haul
12.07	Perimeter Stormwater Ditch Grading	5,600	LF	$0.40	$2,000	RS Means 312319100200	Cut Drainage Ditch, Clay and Till, 10' w x 3'-4' deep
12.08	Fine Grading of Perimeter Stormwater Ditch	18,667	SY	$0.25	$5,000	RS Means 3122 1610 3300	gentle slope grading
12.09	Terrace Berms	10,370	CY	$3.50	$36,000	Past project experience	Borrow/Load, Haul, Place, Fine Grades
12.10	Drainage Downchutes	5,600	LF	$25.00	$140,000	Past project experience	Borrow/Load, Haul, Place, Fine Grade, Rip-Rap

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13.00	**30-year Post-Closure**				**$5,083,000**		
13.01	Annual Care	30	YR	$169,440.53	$5,083,000	Past project experience	Includes monitoring, maintenance, inspections
				Sub Total	**$83,584,000**	**DOES NOT INCLUDE 30-YEAR POST CLOSURE**	
				Contingency	**$25,075,000**	**30%**	
				Design and Engineering Fees	**$8,358,000**	**10%**	
				Owners Costs	**$4,179,000**	**5%**	
				Scenario Total	**$121,196,000**		

Geosyntec consultants

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SCENARIO 3: Closure In-Place with IEPA Prescribed Final Cover Design

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost ($)	Unit Cost Reference[1,2]	Notes / Assumptions
01.00	**Mobilization / Demobilization**				**$245,000**		
01.01	Mobilization	1	LS	$100,000	$100,000	Past project experience	0
01.02	Demobilization	1	LS	$100,000	$100,000	Past project experience	0
01.03	Construction Trailer	1	EA	$12,161	$12,000	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	23	MO	$1,000.00	$23,000	Past project experience	Utilities and maintenance
01.05	Construction Entrances	2	EA	$5,000.00	$10,000	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				**$486,000**		
02.01	Dewatering Sumps	3	EA	$25,000.00	$75,000	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	6	MO	$50,000.00	$286,000	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	6	MO	$5,000.00	$29,000	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	0	LF	$148.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	0	LF	$267.50	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	0	LF	$387.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	0	EA	$2,915.19	$0	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	2	YR	$50,000.00	$96,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				**$220,000**		
03.01	Erosion and Sediment Controls	1	LS	$75,000.00	$75,000	2020 project bids	0
03.02	Erosion Control Blankets	26,000	SY	$2.20	$57,000	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the
03.03	Silt Fence	8,900	LF	$2.19	$19,000	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	20	EA	$1,700.00	$34,000	Past project experience	Installation and Removal
03.05	EPSC Maintenance	23	MO	$1,500.00	$35,000	Past project experience	0
04.00	**Instrumentation**				**$26,000**		
04.01	Piezometer Installation	10	EA	$2,000.00	$20,000	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	10	EA	$500.00	$5,000	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	0	EA	$2,500.00	$0	N/A	0
04.04	Monitoring Well Extension	0	EA	$500.00	$0	N/A	0
04.05	Settlement Plates	2	EA	$500.00	$1,000	2020 project bids	1 per ~20 acres
05.00	**Demolition**				**$80,000**		
05.01	Piezometer Abandonment	10	EA	$3,000.00	$30,000	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	0	EA	$3,000.00	$0	Past project experience	Assumes monitoring wells will not be impacted
05.03	Sluice Pipelines	1	LS	$50,000.00	$50,000	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				**$251,000**		
06.01	Stripping Topsoil and Vegetation, Quarry	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	10	AC	$4,821.30	$48,000	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	16,000	CY	$4.72	$76,000	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	20	AC	$6,366.48	$127,000	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				**$9,970,000**		
07.10	**Dust Control**				**$0**		
07.11	Water Truck	0	MO	$14,101.86	$0	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental
07.20	**Coal Ash Excavation to Landfill**				**$0**		
07.21	Coal Ash Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
	Coal Ash Hauling to Existing Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
07.23	Coal Ash Spreading	0	LCY	$2.07	$0	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment

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Revised By:	REW	09/30/21

07.26	Landfill Disposal Tipping Fee	0	TON	$58.29	$0	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf
07.30	**Landfill Bottom Liner**				**$0**		
07.31	Landfill Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.32	Landfill Excavation Soil Hauling	0	BCY	$2.90	$0	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle,
07.33	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.34	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$8.76	$0	RS Means 3123 1643 5500 + 3123 2320 3080	0
07.35	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				**$0**		
07.41	Clay Layer Borrow Pit Purchase	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Clay Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.44	Clay Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Protective Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.48	Protective Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				**$5,365,000**		
07.51	Excavation and Loading	511,000	BCY	$1.39	$710,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10%
07.52	Hauling	664,000	LCY	$4.14	$2,749,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
07.53	Spreading	664,000	LCY	$2.45	$1,627,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	511,000	ECY	$0.28	$143,000	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.55	Moisture Conditioning	23	MO	$5,903.51	$136,000	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				**$4,395,000**		
07.61	Borrow Soil	276,000	BCY	$2.50	$690,000	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	92,000	BCY	$1.39	$128,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Clay Layer Hauling (Offsite)	101,200	LCY	$7.37	$746,000	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.64	Clay Layer Spreading	101,200	LCY	$2.45	$248,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	92,000	ECY	$1.76	$162,000	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	184,000	BCY	$1.39	$256,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Protective Layer Hauling (Offsite)	202,400	LCY	$7.37	$1,492,000	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.68	Protective Layer Spreading	202,400	LCY	$2.45	$496,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	184,000	ECY	$0.96	$177,000	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	Wet or Sediment Cap	0	CY	$130.00	$0	Project Costs	12-inch sand cap
07.70	**Soil Contouring Fill / Regrading**				**$0**		
07.71	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.73	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				**$210,000**		
07.81	Access Road - Closure	18,000	SY	$10.39	$187,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.82	Access Road - Borrow	2,222	SY	$10.39	$23,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.83	Access Road - Landfill	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
08.00	**Geosynthetics**				**$6,407,000**		
08.10	**Landfill and Closure Cap Geosynthetic Components**				**$6,407,000**		
08.11	40-mil double sided textured LLDPE Geomembrane	2,979,504	SF	$0.81	$2,413,000	2020 project bids	0

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08.12	Double-Sided Tri-place Geocomposite	2,979,504	SF	$1.32	$3,921,000	2020 project bids	0
08.13	Anchor Trench - Closure Cap	7,900	LF	$9.27	$73,000	2020 project bids	0
08.20	**Landfill Bottom Liner Geosynthetic Components**				**$0**		
08.21	60-mil double sided textured HDPE Geomembrane	0	SF	$0.85	$0	2020 project bids	0
08.22	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0
08.23	Anchor Trench - Landfill Bottom Liner	0	LF	$9.27	$0	2020 project bids	0
08.25	Geotextile - (Filter 4 oz/yd2)	0	SF	$0.25	$0	Project Bids	0
08.30	**Leachate Collection and Transmission System**				**$0**		
08.31	Leachate Collection System (1 foot thick)	0	CY	$16.00	$0	0	0
08.32	6-inch SDR 11 HDPE Pipe	0	LF	$9.50	$0	0	0
08.33	Gravel Trench for V-Trench	0	LF	$26.00	$0	0	Leachate Collection "V" Notch Drain "Burrito Wrap" - Includes Granular Fill, Geotextile Envelope (Nonwoven 4
08.34	Leachate Sumps	0	EA	$5,000.00	$0	20' x 20' x 3'	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	0	EA	$8,500.00	$0	0	0
08.36	Leachate Transmission Piping (2x4 HDPE)	0	LF	$4.50	$0	0	Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	0	LF	$78.00	$0	0	0
08.38	Leachate Vault and Control Panel	0	EA	$25,000.00	$0	0	0
08.39	Leachate Vault Utilities	0	LF	$24.55	$0	RS Means 337119175840	4 conduits in 5" diameter PVC conduit with backfill
08.40	Above Grade Leachate Storage Tank	0	EA	$500,000.00	$0	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	0	Gal	$0.00	$0	Project Costs	On-site discharge through NPDES permit (cost for pumps)
09.00	**Pond Closure - Ditch and Apron Construction**				**$157,000**		
09.01	Geotextile Fabric	4,500	SY	$2.55	$11,000	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	0	LCY	$71.19	$0	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	3,500	TON	$38.70	$135,000	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	2,300	LCY	$4.89	$11,000	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				**$0**		
10.01	Borehole Drilling for Bedrock Fractures	0	LF	$75.00	$0	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth
10.02	Grouting of Bedrock Fractures	0	CY	$70.79	$0	RS Means 3173 1310 0820	0
10.03	Leachate Discharge Piping	0	LF	$6.50	$0	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	0	VLF	$85.00	$0	Project Bids	0
11.00	**Turf and Grasses**				**$878,000**		
11.01	Hydroseed and Mulch	373,000	SY	$2.25	$839,000	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	0	SF	$2.44	$0	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	0	TON	$50.00	$0	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	0	TON	$341.00	$0	Past project experience	7 lbs/SF
11.05	Anchor Trench	0	LF	$9.27	$0	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	0	AC	$30,000.00	$0	Past project experience	In place of seeding
11.07	Soil Amendments	77	AC	$500.00	$39,000	Past project experience	To support vegetative growth
12.00	**SW Management Features - New Landfill**				**$0**		
12.01	Soil Excavation for Detention Basin	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.02	Basin Vegetation	0	SY	$2.25	$0	RS Means 3292 1913 1100	Bluegrass, hydro or air seeding, with mulch and fertilizer
12.03	Basin Outlet Structure	0	EA	$10,000.00	$0	Past project experience	Outlet structure and associated discharge piping
12.04	Culverts (30-inch)	0	EA	$387.00	$0	Past project experience	Includes Excavation, Pipe, Bedding, and Backfill
12.05	Perimeter Stormwater Ditch/Road Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.06	Perimeter Stormwater Ditch/Road Fill	0	LCY	$2.18	$0	RS Means 312323145440	Backfill, structural, clay, 300 H.P. dozer, 300' haul
12.07	Perimeter Stormwater Ditch Grading	0	LF	$0.40	$0	RS Means 312319100200	Cut Drainage Ditch, Clay and Till, 10' w x 3'-4' deep
12.08	Fine Grading of Perimeter Stormwater Ditch	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
12.09	Terrace Berms	0	CY	$3.50	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grades
12.10	Drainage Downchutes	0	LF	$25.00	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grade, Rip-Rap
13.00	**30-year Post-Closure**				**$5,085,000**		
13.01	Annual Care	30	YR	$169,500.00	$5,085,000	Past project experience	Includes monitoring, maintenance, inspections
				Sub Total	**$18,720,000**		

Geosyntec consultants

Project: Lincoln Stone Quarry Closure Alternatives
Task: Alternatives Cost Analysis
Client: Midwest Generation, LLC (MWG)
Proj. No. CHE8420
Date: September 30, 2021

Created By:	TWW	07/09/20
Reviewed By:	DK	07/21/20
Approved By:	JPV	10/13/21
Revised By:	JPV	02/17/21
Revised By:	REW	09/30/21

Contingency	**$5,616,000**	**30%**
Design and Engineering Fees	**$1,872,000**	**10%**
Owners Costs	**$936,000**	**5%**
Closure Scenario Total	**$27,144,000**	

Geosyntec consultants

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SCENARIO 4: Closure In-Place with Alternate Final Cover Design

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost ($)	Unit Cost Reference[1,2]	Notes / Assumptions
01.00	**Mobilization / Demobilization**				**$253,000**		
01.01	Mobilization	1	LS	$100,000	$100,000	Past project experience	0
01.02	Demobilization	1	LS	$100,000	$100,000	Past project experience	0
01.03	Construction Trailer	1	EA	$12,161	$12,000	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	31	MO	$1,000.00	$31,000	Past project experience	Utilities and maintenance
01.05	Construction Entrances	2	EA	$5,000.00	$10,000	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				**$518,000**		
02.01	Dewatering Sumps	3	EA	$25,000.00	$75,000	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	6	MO	$50,000.00	$286,000	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	6	MO	$5,000.00	$29,000	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	0	LF	$148.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	0	LF	$267.50	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	0	LF	$387.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	0	EA	$2,915.19	$0	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	3	YR	$50,000.00	$128,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				**$223,000**		
03.01	Erosion and Sediment Controls	1	LS	$75,000.00	$75,000	2020 project bids	0
03.02	Erosion Control Blankets	26,000	SY	$2.20	$57,000	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the
03.03	Silt Fence	8,900	LF	$2.19	$19,000	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	20	EA	$1,700.00	$34,000	Past project experience	Installation and Removal
03.05	EPSC Maintenance	25	MO	$1,500.00	$38,000	Past project experience	0
04.00	**Instrumentation**				**$26,000**		
04.01	Piezometer Installation	10	EA	$2,000.00	$20,000	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	10	EA	$500.00	$5,000	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	0	EA	$2,500.00	$0	N/A	0
04.04	Monitoring Well Extension	0	EA	$500.00	$0	N/A	0
04.05	Settlement Plates	2	EA	$500.00	$1,000	2020 project bids	1 per ~20 acres
05.00	**Demolition**				**$80,000**		
05.01	Piezometer Abandonment	10	EA	$3,000.00	$30,000	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	0	EA	$3,000.00	$0	Past project experience	Assumes monitoring wells will not be impacted
05.03	Sluice Pipelines	1	LS	$50,000.00	$50,000	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				**$48,000**		
06.01	Stripping Topsoil and Vegetation, Quarry	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	10	AC	$4,821.30	$48,000	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				**$6,521,000**		
07.10	**Dust Control**				**$0**		
07.11	Water Truck	0	MO	$14,101.86	$0	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental
07.20	**Coal Ash Excavation to Landfill**				**$0**		
07.21	Coal Ash Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
	Coal Ash Hauling to Existing Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
07.23	Coal Ash Spreading	0	LCY	$2.07	$0	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.26	Landfill Disposal Tipping Fee	0	TON	$58.29	$0	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf
07.30	**Landfill Bottom Liner**				**$0**		
07.31	Landfill Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor

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07.32	Landfill Excavation Soil Hauling	0	BCY	$2.90	$0	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle,
07.33	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.34	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$8.76	$0	RS Means 3123 1643 5500 + 3123 2320 3080	0
07.35	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				**$0**		
07.41	Clay Layer Borrow Pit Purchase	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Clay Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.44	Clay Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Protective Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.48	Protective Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				**$5,377,000**		
07.51	Excavation and Loading	511,000	BCY	$1.39	$710,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10%
07.52	Hauling	664,000	LCY	$4.14	$2,749,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
07.53	Spreading	664,000	LCY	$2.45	$1,627,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	511,000	ECY	$0.28	$143,000	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.55	Moisture Conditioning	25	MO	$5,903.51	$148,000	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				**$957,000**		
07.61	Borrow Soil	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	92,000	BCY	$1.39	$128,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	101,200	LCY	$4.14	$419,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Clay Layer Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.64	Clay Layer Spreading	101,200	LCY	$2.45	$248,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	92,000	ECY	$1.76	$162,000	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Protective Layer Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.68	Protective Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	Wet or Sediment Cap	0	CY	$130.00	$0	Project Costs	12-inch sand cap
07.70	**Soil Contouring Fill / Regrading**				**$0**		
07.71	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.73	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				**$187,000**		
07.81	Access Road - Closure	18,000	SY	$10.39	$187,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.82	Access Road - Borrow	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.83	Access Road - Landfill	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
08.00	**Geosynthetics**				**$0**		
08.10	**Landfill and Closure Cap Geosynthetic Components**				**$0**		
08.11	40-mil double sided textured LLDPE Geomembrane	0	SF	$0.81	$0	2020 project bids	0
08.12	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0

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08.13	Anchor Trench - Closure Cap	0	LF	$9.27	$0	2020 project bids	0
08.20	**Landfill Bottom Liner Geosynthetic Components**				**$0**		
08.21	60-mil double sided textured HDPE Geomembrane	0	SF	$0.85	$0	2020 project bids	0
08.22	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0
08.23	Anchor Trench - Landfill Bottom Liner	0	LF	$9.27	$0	2020 project bids	0
08.25	Geotextile - (Filter 4 oz/yd2)	0	SF	$0.25	$0	Project Bids	0
08.30	**Leachate Collection and Transmission System**				**$0**		
08.31	Leachate Collection System (1 foot thick)	0	CY	$16.00	$0	0	0
08.32	6-inch SDR 11 HDPE Pipe	0	LF	$9.50	$0	0	0
08.33	Gravel Trench for V-Trench	0	LF	$26.00	$0	0	Leachate Collection "V" Notch Drain "Burrito Wrap" - Includes Granular Fill, Geotextile Envelope (Nonwoven 4
08.34	Leachate Sumps	0	EA	$5,000.00	$0	20' x 20' x 3'	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	0	EA	$8,500.00	$0	0	0
08.36	Leachate Transmission Piping (2x4 HDPE)	0	LF	$4.50	$0	0	Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	0	LF	$78.00	$0	0	0
08.38	Leachate Vault and Control Panel	0	EA	$25,000.00	$0	0	0
08.39	Leachate Vault Utilities	0	LF	$24.55	$0	RS Means 337119175840	4 conduits in 5" diameter PVC conduit with backfill
08.40	Above Grade Leachate Storage Tank	0	EA	$500,000.00	$0	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	0	Gal	$0.00	$0	Project Costs	On-site discharge through NPDES permit (cost for pumps)
09.00	**Pond Closure - Ditch and Apron Construction**				**$157,000**		
09.01	Geotextile Fabric	4,500	SY	$2.55	$11,000	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	0	LCY	$71.19	$0	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	3,500	TON	$38.70	$135,000	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	2,300	LCY	$4.89	$11,000	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				**$0**		
10.01	Borehole Drilling for Bedrock Fractures	0	LF	$75.00	$0	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth
10.02	Grouting of Bedrock Fractures	0	CY	$70.79	$0	RS Means 3173 1310 0820	0
10.03	Leachate Discharge Piping	0	LF	$6.50	$0	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	0	VLF	$85.00	$0	Project Bids	0
11.00	**Turf and Grasses**				**$8,440,000**		
11.01	Hydroseed and Mulch	0	SY	$2.25	$0	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	2,979,600	SF	$2.44	$7,270,000	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	6,400	TON	$50.00	$320,000	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	2,280	TON	$341.00	$777,000	Past project experience	7 lbs/SF
11.05	Anchor Trench	7,900	LF	$9.27	$73,000	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	0	AC	$30,000.00	$0	Past project experience	In place of seeding
11.07	Soil Amendments	0	AC	$500.00	$0	Past project experience	To support vegetative growth
12.00	**SW Management Features - New Landfill**				**$0**		
12.01	Soil Excavation for Detention Basin	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.02	Basin Vegetation	0	SY	$2.25	$0	RS Means 3292 1913 1100	Bluegrass, hydro or air seeding, with mulch and fertilizer
12.03	Basin Outlet Structure	0	EA	$10,000.00	$0	Past project experience	Outlet structure and associated discharge piping
12.04	Culverts (30-inch)	0	EA	$387.00	$0	Past project experience	Includes Excavation, Pipe, Bedding, and Backfill
12.05	Perimeter Stormwater Ditch/Road Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.06	Perimeter Stormwater Ditch/Road Fill	0	LCY	$2.18	$0	RS Means 312323145440	Backfill, structural, clay, 300 H.P. dozer, 300' haul
12.07	Perimeter Stormwater Ditch Grading	0	LF	$0.40	$0	RS Means 312319100200	Cut Drainage Ditch, Clay and Till, 10' w x 3'-4' deep
12.08	Fine Grading of Perimeter Stormwater Ditch	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
12.09	Terrace Berms	0	CY	$3.50	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grades
12.10	Drainage Downchutes	0	LF	$25.00	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grade, Rip-Rap
13.00	**30-year Post-Closure**				**$3,639,000**		
13.01	Annual Care	30	YR	$121,300.00	$3,639,000	Past project experience	Includes monitoring, maintenance, inspections

Sub Total	**$16,266,000**	
Contingency	**$4,880,000**	**30%**
Design and Engineering Fees	**$1,627,000**	**10%**
Owners Costs	**$813,000**	**5%**
Closure Scenario Total	**$23,586,000**	

Geosyntec consultants

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Revised By:	JPV	02/17/21
Revised By:	REW	09/30/21

SCENARIO 5: Consolidate and Close In-Place

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost ($)	Unit Cost Reference[1,2]	Notes / Assumptions
01.00	**Mobilization / Demobilization**				**$243,000**		
01.01	Mobilization	1	LS	$100,000	$100,000	Past project experience	0
01.02	Demobilization	1	LS	$100,000	$100,000	Past project experience	0
01.03	Construction Trailer	1	EA	$12,161	$12,000	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	21	MO	$1,000.00	$21,000	Past project experience	Utilities and maintenance
01.05	Construction Entrances	2	EA	$5,000.00	$10,000	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				**$571,000**		
02.01	Dewatering Sumps	10	EA	$25,000.00	$250,000	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	3	MO	$50,000.00	$167,000	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	3	MO	$5,000.00	$17,000	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	0	LF	$148.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	0	LF	$267.50	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	0	LF	$387.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	0	EA	$2,915.19	$0	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	3	YR	$50,000.00	$137,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				**$220,000**		
03.01	Erosion and Sediment Controls	1	LS	$75,000.00	$75,000	2020 project bids	0
03.02	Erosion Control Blankets	26,000	SY	$2.20	$57,000	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the
03.03	Silt Fence	8,900	LF	$2.19	$19,000	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	20	EA	$1,700.00	$34,000	Past project experience	Installation and Removal
03.05	EPSC Maintenance	23	MO	$1,500.00	$35,000	Past project experience	0
04.00	**Instrumentation**				**$26,000**		
04.01	Piezometer Installation	10	EA	$2,000.00	$20,000	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	10	EA	$500.00	$5,000	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	0	EA	$2,500.00	$0	N/A	0
04.04	Monitoring Well Extension	0	EA	$500.00	$0	N/A	0
04.05	Settlement Plates	2	EA	$500.00	$1,000	2020 project bids	1 per ~20 acres
05.00	**Demolition**				**$80,000**		
05.01	Piezometer Abandonment	10	EA	$3,000.00	$30,000	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	0	EA	$3,000.00	$0	Past project experience	Assumes monitoring wells will not be impacted
05.03	Sluice Pipelines	1	LS	$50,000.00	$50,000	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				**$251,000**		
06.01	Stripping Topsoil and Vegetation, Quarry	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	10	AC	$4,821.30	$48,000	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	16,000	CY	$4.72	$76,000	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	20	AC	$6,366.48	$127,000	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				**$7,924,000**		
07.10	**Dust Control**				**$0**		
07.11	Water Truck	0	MO	$14,101.86	$0	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental
07.20	**Coal Ash Excavation to Landfill**				**$0**		
07.21	Coal Ash Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
	Coal Ash Hauling to Existing Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
07.23	Coal Ash Spreading	0	LCY	$2.07	$0	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.26	Landfill Disposal Tipping Fee	0	TON	$58.29	$0	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf
07.30	**Landfill Bottom Liner**				**$0**		
07.31	Landfill Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor

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07.32	Landfill Excavation Soil Hauling	0	BCY	$2.90	$0	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle,
07.33	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.34	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$8.76	$0	RS Means 3123 1643 5500 + 3123 2320 3080	0
07.35	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				**$0**		
07.41	Clay Layer Borrow Pit Purchase	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Clay Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.44	Clay Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Protective Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.48	Protective Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				**$4,084,000**		
07.51	Excavation and Loading	387,000	BCY	$1.39	$538,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10%
07.52	Hauling	503,000	LCY	$4.14	$2,082,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
07.53	Spreading	503,000	LCY	$2.45	$1,232,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	387,000	ECY	$0.28	$108,000	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.55	Moisture Conditioning	21	MO	$5,903.51	$124,000	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				**$3,630,000**		
07.61	Borrow Soil	228,000	BCY	$2.50	$570,000	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	76,000	BCY	$1.39	$106,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Clay Layer Hauling (Offsite)	83,600	LCY	$7.37	$616,000	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.64	Clay Layer Spreading	83,600	LCY	$2.45	$205,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	76,000	ECY	$1.76	$134,000	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	152,000	BCY	$1.39	$211,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Protective Layer Hauling (Offsite)	167,200	LCY	$7.37	$1,232,000	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.68	Protective Layer Spreading	167,200	LCY	$2.45	$410,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	152,000	ECY	$0.96	$146,000	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	Wet or Sediment Cap	0	CY	$130.00	$0	Project Costs	12-inch sand cap
07.70	**Soil Contouring Fill / Regrading**				**$0**		
07.71	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.73	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				**$210,000**		
07.81	Access Road - Closure	18,000	SY	$10.39	$187,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.82	Access Road - Borrow	2,222	SY	$10.39	$23,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.83	Access Road - Landfill	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
08.00	**Geosynthetics**				**$5,305,000**		
08.10	**Landfill and Closure Cap Geosynthetic Components**				**$5,305,000**		
08.11	40-mil double sided textured LLDPE Geomembrane	2,460,874	SF	$0.81	$1,993,000	2020 project bids	0
08.12	Double-Sided Tri-place Geocomposite	2,460,874	SF	$1.32	$3,239,000	2020 project bids	0

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08.13	Anchor Trench - Closure Cap	7,900	LF	$9.27	$73,000	2020 project bids	0
08.20	**Landfill Bottom Liner Geosynthetic Components**				**$0**		
08.21	60-mil double sided textured HDPE Geomembrane	0	SF	$0.85	$0	2020 project bids	0
08.22	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0
08.23	Anchor Trench - Landfill Bottom Liner	0	LF	$9.27	$0	2020 project bids	0
08.25	Geotextile - (Filter 4 oz/yd2)	0	SF	$0.25	$0	Project Bids	0
08.30	**Leachate Collection and Transmission System**				**$0**		
08.31	Leachate Collection System (1 foot thick)	0	CY	$16.00	$0	0	0
08.32	6-inch SDR 11 HDPE Pipe	0	LF	$9.50	$0	0	0
08.33	Gravel Trench for V-Trench	0	LF	$26.00	$0	0	Leachate Collection "V" Notch Drain "Burrito Wrap" - Includes Granular Fill, Geotextile Envelope (Nonwoven 4
08.34	Leachate Sumps	0	EA	$5,000.00	$0	20' x 20' x 3'	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	0	EA	$8,500.00	$0	0	0
08.36	Leachate Transmission Piping (2x4 HDPE)	0	LF	$4.50	$0	0	Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	0	LF	$78.00	$0	0	0
08.38	Leachate Vault and Control Panel	0	EA	$25,000.00	$0	0	0
08.39	Leachate Vault Utilities	0	LF	$24.55	$0	RS Means 337119175840	4 conduits in 5" diameter PVC conduit with backfill
08.40	Above Grade Leachate Storage Tank	0	EA	$500,000.00	$0	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	0	Gal	$0.00	$0	Project Costs	On-site discharge through NPDES permit (cost for pumps)
09.00	**Pond Closure - Ditch and Apron Construction**				**$157,000**		
09.01	Geotextile Fabric	4,500	SY	$2.55	$11,000	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	0	LCY	$71.19	$0	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	3,500	TON	$38.70	$135,000	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	2,300	LCY	$4.89	$11,000	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				**$0**		
10.01	Borehole Drilling for Bedrock Fractures	0	LF	$75.00	$0	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth
10.02	Grouting of Bedrock Fractures	0	CY	$70.79	$0	RS Means 3173 1310 0820	0
10.03	Leachate Discharge Piping	0	LF	$6.50	$0	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	0	VLF	$85.00	$0	Project Bids	0
11.00	**Turf and Grasses**				**$765,000**		
11.01	Hydroseed and Mulch	325,000	SY	$2.25	$731,000	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	0	SF	$2.44	$0	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	0	TON	$50.00	$0	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	0	TON	$341.00	$0	Past project experience	7 lbs/SF
11.05	Anchor Trench	0	LF	$9.27	$0	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	0	AC	$30,000.00	$0	Past project experience	In place of seeding
11.07	Soil Amendments	67	AC	$500.00	$34,000	Past project experience	To support vegetative growth
12.00	**SW Management Features - New Landfill**				**$0**		
12.01	Soil Excavation for Detention Basin	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.02	Basin Vegetation	0	SY	$2.25	$0	RS Means 3292 1913 1100	Bluegrass, hydro or air seeding, with mulch and fertilizer
12.03	Basin Outlet Structure	0	EA	$10,000.00	$0	Past project experience	Outlet structure and associated discharge piping
12.04	Culverts (30-inch)	0	EA	$387.00	$0	Past project experience	Includes Excavation, Pipe, Bedding, and Backfill
12.05	Perimeter Stormwater Ditch/Road Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.06	Perimeter Stormwater Ditch/Road Fill	0	LCY	$2.18	$0	RS Means 312323145440	Backfill, structural, clay, 300 H.P. dozer, 300' haul
12.07	Perimeter Stormwater Ditch Grading	0	LF	$0.40	$0	RS Means 312319100200	Cut Drainage Ditch, Clay and Till, 10' w x 3'-4' deep
12.08	Fine Grading of Perimeter Stormwater Ditch	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
12.09	Terrace Berms	0	CY	$3.50	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grades
12.10	Drainage Downchutes	0	LF	$25.00	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grade, Rip-Rap
13.00	**30-year Post-Closure**				**$5,085,000**		
13.01	Annual Care	30	YR	$169,500.00	$5,085,000	Past project experience	Includes monitoring, maintenance, inspections

Sub Total	**$15,542,000**	
Contingency	**$4,663,000**	**30%**
Design and Engineering Fees	**$1,554,000**	**10%**
Owners Costs	**$777,000**	**5%**
Closure Scenario Total	**$22,536,000**	

Geosyntec consultants

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SCENARIO 6: Closure In-Place with Hydraulic Control

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost ($)	Unit Cost Reference[1,2]	Notes / Assumptions
01.00	**Mobilization / Demobilization**				**$245,000**		
01.01	Mobilization	1	LS	$100,000	$100,000	Past project experience	0
01.02	Demobilization	1	LS	$100,000	$100,000	Past project experience	0
01.03	Construction Trailer	1	EA	$12,161	$12,000	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	23	MO	$1,000.00	$23,000	Past project experience	Utilities and maintenance
01.05	Construction Entrances	2	EA	$5,000.00	$10,000	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				**$553,000**		
02.01	Dewatering Sumps	3	EA	$25,000.00	$75,000	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	6	MO	$50,000.00	$286,000	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	6	MO	$5,000.00	$29,000	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	0	LF	$148.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	0	LF	$267.50	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	0	LF	$387.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	0	EA	$2,915.19	$0	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	3	YR	$50,000.00	$163,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				**$220,000**		
03.01	Erosion and Sediment Controls	1	LS	$75,000.00	$75,000	2020 project bids	0
03.02	Erosion Control Blankets	26,000	SY	$2.20	$57,000	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the
03.03	Silt Fence	8,900	LF	$2.19	$19,000	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	20	EA	$1,700.00	$34,000	Past project experience	Installation and Removal
03.05	EPSC Maintenance	23	MO	$1,500.00	$35,000	Past project experience	0
04.00	**Instrumentation**				**$26,000**		
04.01	Piezometer Installation	10	EA	$2,000.00	$20,000	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	10	EA	$500.00	$5,000	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	0	EA	$2,500.00	$0	N/A	0
04.04	Monitoring Well Extension	0	EA	$500.00	$0	N/A	0
04.05	Settlement Plates	2	EA	$500.00	$1,000	2020 project bids	1 per ~20 acres
05.00	**Demolition**				**$80,000**		
05.01	Piezometer Abandonment	10	EA	$3,000.00	$30,000	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	0	EA	$3,000.00	$0	Past project experience	Assumes monitoring wells will not be impacted
05.03	Sluice Pipelines	1	LS	$50,000.00	$50,000	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				**$251,000**		
06.01	Stripping Topsoil and Vegetation, Quarry	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	10	AC	$4,821.30	$48,000	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	16,000	CY	$4.72	$76,000	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	20	AC	$6,366.48	$127,000	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				**$9,970,000**		
07.10	**Dust Control**				**$0**		
07.11	Water Truck	0	MO	$14,101.86	$0	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental
07.20	**Coal Ash Excavation to Landfill**				**$0**		
07.21	Coal Ash Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
	Coal Ash Hauling to Existing Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
07.23	Coal Ash Spreading	0	LCY	$2.07	$0	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.26	Landfill Disposal Tipping Fee	0	TON	$58.29	$0	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf
07.30	**Landfill Bottom Liner**				**$0**		
07.31	Landfill Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor

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Revised By:	REW	09/30/21

07.32	Landfill Excavation Soil Hauling	0	BCY	$2.90	$0	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle,
07.33	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.34	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$8.76	$0	RS Means 3123 1643 5500 + 3123 2320 3080	0
07.35	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				**$0**		
07.41	Clay Layer Borrow Pit Purchase	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Clay Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.44	Clay Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Protective Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.48	Protective Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				**$5,365,000**		
07.51	Excavation and Loading	511,000	BCY	$1.39	$710,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10%
07.52	Hauling	664,000	LCY	$4.14	$2,749,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
07.53	Spreading	664,000	LCY	$2.45	$1,627,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	511,000	ECY	$0.28	$143,000	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.55	Moisture Conditioning	23	MO	$5,903.51	$136,000	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				**$4,395,000**		
07.61	Borrow Soil	276,000	BCY	$2.50	$690,000	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	92,000	BCY	$1.39	$128,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Clay Layer Hauling (Offsite)	101,200	LCY	$7.37	$746,000	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.64	Clay Layer Spreading	101,200	LCY	$2.45	$248,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	92,000	ECY	$1.76	$162,000	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	184,000	BCY	$1.39	$256,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Protective Layer Hauling (Offsite)	202,400	LCY	$7.37	$1,492,000	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.68	Protective Layer Spreading	202,400	LCY	$2.45	$496,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	184,000	ECY	$0.96	$177,000	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	Wet or Sediment Cap	0	CY	$130.00	$0	Project Costs	12-inch sand cap
07.70	**Soil Contouring Fill / Regrading**				**$0**		
07.71	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.73	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				**$210,000**		
07.81	Access Road - Closure	18,000	SY	$10.39	$187,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.82	Access Road - Borrow	2,222	SY	$10.39	$23,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.83	Access Road - Landfill	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
08.00	**Geosynthetics**				**$6,407,000**		
08.10	**Landfill and Closure Cap Geosynthetic Components**				**$6,407,000**		
08.11	40-mil double sided textured LLDPE Geomembrane	2,979,504	SF	$0.81	$2,413,000	2020 project bids	0
08.12	Double-Sided Tri-place Geocomposite	2,979,504	SF	$1.32	$3,921,000	2020 project bids	0

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08.13	Anchor Trench - Closure Cap	7,900	LF	$9.27	$73,000	2020 project bids	0
08.20	**Landfill Bottom Liner Geosynthetic Components**				**$0**		
08.21	60-mil double sided textured HDPE Geomembrane	0	SF	$0.85	$0	2020 project bids	0
08.22	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0
08.23	Anchor Trench - Landfill Bottom Liner	0	LF	$9.27	$0	2020 project bids	0
08.25	Geotextile - (Filter 4 oz/yd2)	0	SF	$0.25	$0	Project Bids	0
08.30	**Leachate Collection and Transmission System**				**$0**		
08.31	Leachate Collection System (1 foot thick)	0	CY	$16.00	$0	0	0
08.32	6-inch SDR 11 HDPE Pipe	0	LF	$9.50	$0	0	0
08.33	Gravel Trench for V-Trench	0	LF	$26.00	$0	0	Leachate Collection "V" Notch Drain "Burrito Wrap" - Includes Granular Fill, Geotextile Envelope (Nonwoven 4
08.34	Leachate Sumps	0	EA	$5,000.00	$0	20' x 20' x 3'	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	0	EA	$8,500.00	$0	0	0
08.36	Leachate Transmission Piping (2x4 HDPE)	0	LF	$4.50	$0	0	Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	0	LF	$78.00	$0	0	0
08.38	Leachate Vault and Control Panel	0	EA	$25,000.00	$0	0	0
08.39	Leachate Vault Utilities	0	LF	$24.55	$0	RS Means 337119175840	4 conduits in 5" diameter PVC conduit with backfill
08.40	Above Grade Leachate Storage Tank	0	EA	$500,000.00	$0	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	0	Gal	$0.00	$0	Project Costs	On-site discharge through NPDES permit (cost for pumps)
09.00	**Pond Closure - Ditch and Apron Construction**				**$157,000**		
09.01	Geotextile Fabric	4,500	SY	$2.55	$11,000	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	0	LCY	$71.19	$0	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	3,500	TON	$38.70	$135,000	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	2,300	LCY	$4.89	$11,000	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				**$345,000**		
10.01	Borehole Drilling for Bedrock Fractures	0	LF	$75.00	$0	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth
10.02	Grouting of Bedrock Fractures	0	CY	$70.79	$0	RS Means 3173 1310 0820	0
10.03	Leachate Discharge Piping	15,800	LF	$6.50	$103,000	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	2,850	VLF	$85.00	$242,000	Project Bids	43 wells (1 per acre) at 50 feet depth
11.00	**Turf and Grasses**				**$878,000**		
11.01	Hydroseed and Mulch	373,000	SY	$2.25	$839,000	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	0	SF	$2.44	$0	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	0	TON	$50.00	$0	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	0	TON	$341.00	$0	Past project experience	7 lbs/SF
11.05	Anchor Trench	0	LF	$9.27	$0	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	0	AC	$30,000.00	$0	Past project experience	In place of seeding
11.07	Soil Amendments	77	AC	$500.00	$39,000	Past project experience	To support vegetative growth
12.00	**SW Management Features - New Landfill**				**$0**		
12.01	Soil Excavation for Detention Basin	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.02	Basin Vegetation	0	SY	$2.25	$0	RS Means 3292 1913 1100	Bluegrass, hydro or air seeding, with mulch and fertilizer
12.03	Basin Outlet Structure	0	EA	$10,000.00	$0	Past project experience	Outlet structure and associated discharge piping
12.04	Culverts (30-inch)	0	EA	$387.00	$0	Past project experience	Includes Excavation, Pipe, Bedding, and Backfill
12.05	Perimeter Stormwater Ditch/Road Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.06	Perimeter Stormwater Ditch/Road Fill	0	LCY	$2.18	$0	RS Means 312323145440	Backfill, structural, clay, 300 H.P. dozer, 300' haul
12.07	Perimeter Stormwater Ditch Grading	0	LF	$0.40	$0	RS Means 312319100200	Cut Drainage Ditch, Clay and Till, 10' w x 3'-4' deep
12.08	Fine Grading of Perimeter Stormwater Ditch	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
12.09	Terrace Berms	0	CY	$3.50	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grades
12.10	Drainage Downchutes	0	LF	$25.00	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grade, Rip-Rap
13.00	**30-year Post-Closure**				**$7,763,000**		
13.01	Annual Care	30	YR	$258,773.86	$7,763,000	Past project experience	Includes monitoring, maintenance, inspections

Sub Total	**$19,132,000**	
Contingency	**$5,740,000**	**30%**
Design and Engineering Fees	**$1,913,000**	**10%**
Owners Costs	**$957,000**	**5%**
Closure Scenario Total	**$27,742,000**	

Geosyntec consultants

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SCENARIO 7: Closure In-Place with Hydraulic Containment

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost ($)	Unit Cost Reference[1,2]	Notes / Assumptions
01.00	**Mobilization / Demobilization**				**$245,000**		
01.01	Mobilization	1	LS	$100,000	$100,000	Past project experience	0
01.02	Demobilization	1	LS	$100,000	$100,000	Past project experience	0
01.03	Construction Trailer	1	EA	$12,161	$12,000	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	23	MO	$1,000.00	$23,000	Past project experience	Utilities and maintenance
01.05	Construction Entrances	2	EA	$5,000.00	$10,000	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				**$486,000**		
02.01	Dewatering Sumps	3	EA	$25,000.00	$75,000	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	6	MO	$50,000.00	$286,000	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	6	MO	$5,000.00	$29,000	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	0	LF	$148.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	0	LF	$267.50	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	0	LF	$387.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	0	EA	$2,915.19	$0	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	2	YR	$50,000.00	$96,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				**$220,000**		
03.01	Erosion and Sediment Controls	1	LS	$75,000.00	$75,000	2020 project bids	0
03.02	Erosion Control Blankets	26,000	SY	$2.20	$57,000	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the
03.03	Silt Fence	8,900	LF	$2.19	$19,000	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	20	EA	$1,700.00	$34,000	Past project experience	Installation and Removal
03.05	EPSC Maintenance	23	MO	$1,500.00	$35,000	Past project experience	0
04.00	**Instrumentation**				**$26,000**		
04.01	Piezometer Installation	10	EA	$2,000.00	$20,000	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	10	EA	$500.00	$5,000	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	0	EA	$2,500.00	$0	N/A	0
04.04	Monitoring Well Extension	0	EA	$500.00	$0	N/A	0
04.05	Settlement Plates	2	EA	$500.00	$1,000	2020 project bids	1 per ~20 acres
05.00	**Demolition**				**$80,000**		
05.01	Piezometer Abandonment	10	EA	$3,000.00	$30,000	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	0	EA	$3,000.00	$0	Past project experience	Assumes monitoring wells will not be impacted
05.03	Sluice Pipelines	1	LS	$50,000.00	$50,000	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				**$251,000**		
06.01	Stripping Topsoil and Vegetation, Quarry	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	10	AC	$4,821.30	$48,000	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	16,000	CY	$4.72	$76,000	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	20	AC	$6,366.48	$127,000	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				**$9,970,000**		
07.10	**Dust Control**				**$0**		
07.11	Water Truck	0	MO	$14,101.86	$0	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental
07.20	**Coal Ash Excavation to Landfill**				**$0**		
07.21	Coal Ash Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
	Coal Ash Hauling to Existing Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
07.23	Coal Ash Spreading	0	LCY	$2.07	$0	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.26	Landfill Disposal Tipping Fee	0	TON	$58.29	$0	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf
07.30	**Landfill Bottom Liner**				**$0**		
07.31	Landfill Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor

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07.32	Landfill Excavation Soil Hauling	0	BCY	$2.90	$0	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle,
07.33	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.34	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$8.76	$0	RS Means 3123 1643 5500 + 3123 2320 3080	0
07.35	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				**$0**		
07.41	Clay Layer Borrow Pit Purchase	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Clay Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.44	Clay Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
	Protective Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.48	Protective Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				**$5,365,000**		
07.51	Excavation and Loading	511,000	BCY	$1.39	$710,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10%
07.52	Hauling	664,000	LCY	$4.14	$2,749,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
07.53	Spreading	664,000	LCY	$2.45	$1,627,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	511,000	ECY	$0.28	$143,000	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.55	Moisture Conditioning	23	MO	$5,903.51	$136,000	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				**$4,395,000**		
07.61	Borrow Soil	276,000	BCY	$2.50	$690,000	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	92,000	BCY	$1.39	$128,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Clay Layer Hauling (Offsite)	101,200	LCY	$7.37	$746,000	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.64	Clay Layer Spreading	101,200	LCY	$2.45	$248,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	92,000	ECY	$1.76	$162,000	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	184,000	BCY	$1.39	$256,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 30%
	Protective Layer Hauling (Offsite)	202,400	LCY	$7.37	$1,492,000	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.68	Protective Layer Spreading	202,400	LCY	$2.45	$496,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	184,000	ECY	$0.96	$177,000	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	Wet or Sediment Cap	0	CY	$130.00	$0	Project Costs	12-inch sand cap
07.70	**Soil Contouring Fill / Regrading**				**$0**		
07.71	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle, 10%
07.73	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				**$210,000**		
07.81	Access Road - Closure	18,000	SY	$10.39	$187,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.82	Access Road - Borrow	2,222	SY	$10.39	$23,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.83	Access Road - Landfill	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
08.00	**Geosynthetics**				**$6,407,000**		
08.10	**Landfill and Closure Cap Geosynthetic Components**				**$6,407,000**		
08.11	40-mil double sided textured LLDPE Geomembrane	2,979,504	SF	$0.81	$2,413,000	2020 project bids	0
08.12	Double-Sided Tri-place Geocomposite	2,979,504	SF	$1.32	$3,921,000	2020 project bids	0
08.13	Anchor Trench - Closure Cap	7,900	LF	$9.27	$73,000	2020 project bids	0

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Approved By:	JPV	10/13/21
Revised By:	JPV	02/17/21
Revised By:	REW	09/30/21

08.20	**Landfill Bottom Liner Geosynthetic Components**				**$0**		
08.21	60-mil double sided textured HDPE Geomembrane	0	SF	$0.85	$0	2020 project bids	0
08.22	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0
08.23	Anchor Trench - Landfill Bottom Liner	0	LF	$9.27	$0	2020 project bids	0
08.25	Geotextile - (Filter 4 oz/yd2)	0	SF	$0.25	$0	Project Bids	0
08.30	**Leachate Collection and Transmission System**				**$0**		
08.31	Leachate Collection System (1 foot thick)	0	CY	$16.00	$0	0	0
08.32	6-inch SDR 11 HDPE Pipe	0	LF	$9.50	$0	0	0
08.33	Gravel Trench for V-Trench	0	LF	$26.00	$0	0	Leachate Collection "V" Notch Drain "Burrito Wrap" - Includes Granular Fill, Geotextile Envelope (Nonwoven 4
08.34	Leachate Sumps	0	EA	$5,000.00	$0	20' x 20' x 3'	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	0	EA	$8,500.00	$0	0	0
08.36	Leachate Transmission Piping (2x4 HDPE)	0	LF	$4.50	$0	0	Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	0	LF	$78.00	$0	0	0
08.38	Leachate Vault and Control Panel	0	EA	$25,000.00	$0	0	0
08.39	Leachate Vault Utilities	0	LF	$24.55	$0	RS Means 337119175840	4 conduits in 5" diameter PVC conduit with backfill
08.40	Above Grade Leachate Storage Tank	0	EA	$500,000.00	$0	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	0	Gal	$0.00	$0	Project Costs	On-site discharge through NPDES permit (cost for pumps)
09.00	**Pond Closure - Ditch and Apron Construction**				**$157,000**		
09.01	Geotextile Fabric	4,500	SY	$2.55	$11,000	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	0	LCY	$71.19	$0	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	3,500	TON	$38.70	$135,000	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	2,300	LCY	$4.89	$11,000	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				**$6,878,000**		
10.01	Borehole Drilling for Bedrock Fractures	52,667	LF	$75.00	$3,950,000	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth (USACOE, 2017)
10.02	Grouting of Bedrock Fractures	41,357	CY	$70.79	$2,928,000	RS Means 3173 1310 0820	100 feet depth, 12-inch diameter
10.03	Leachate Discharge Piping	0	LF	$6.50	$0	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	0	VLF	$85.00	$0	Project Bids	0
11.00	**Turf and Grasses**				**$878,000**		
11.01	Hydroseed and Mulch	373,000	SY	$2.25	$839,000	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	0	SF	$2.44	$0	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	0	TON	$50.00	$0	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	0	TON	$341.00	$0	Past project experience	7 lbs/SF
11.05	Anchor Trench	0	LF	$9.27	$0	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	0	AC	$30,000.00	$0	Past project experience	In place of seeding
11.07	Soil Amendments	77	AC	$500.00	$39,000	Past project experience	To support vegetative growth
12.00	**SW Management Features - New Landfill**				**$0**		
12.01	Soil Excavation for Detention Basin	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.02	Basin Vegetation	0	SY	$2.25	$0	RS Means 3292 1913 1100	Bluegrass, hydro or air seeding, with mulch and fertilizer
12.03	Basin Outlet Structure	0	EA	$10,000.00	$0	Past project experience	Outlet structure and associated discharge piping
12.04	Culverts (30-inch)	0	EA	$387.00	$0	Past project experience	Includes Excavation, Pipe, Bedding, and Backfill
12.05	Perimeter Stormwater Ditch/Road Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.06	Perimeter Stormwater Ditch/Road Fill	0	LCY	$2.18	$0	RS Means 312323145440	Backfill, structural, clay, 300 H.P. dozer, 300' haul
12.07	Perimeter Stormwater Ditch Grading	0	LF	$0.40	$0	RS Means 312319100200	Cut Drainage Ditch, Clay and Till, 10' w x 3'-4' deep
12.08	Fine Grading of Perimeter Stormwater Ditch	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
12.09	Terrace Berms	0	CY	$3.50	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grades
12.10	Drainage Downchutes	0	LF	$25.00	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grade, Rip-Rap
13.00	**30-year Post-Closure**				**$5,085,000**		
13.01	Annual Care	30	YR	$169,500.00	$5,085,000	Past project experience	Includes monitoring, maintenance, inspections
				Sub Total	**$25,598,000**		
				Contingency	**$7,679,000**	**30%**	
				Design and Engineering Fees	**$2,560,000**	**10%**	
				Owners Costs	**$1,280,000**	**5%**	
				Closure Scenario Total	**$37,117,000**		

Geosyntec consultants

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SCENARIO 8: Closure In-Place Wet Closure

	Task	Quantity	Unit	Unit Rate ($/unit)	Cost ($)	Unit Cost Reference[1,2]	Notes / Assumptions
01.00	**Mobilization / Demobilization**				**$232,000**		
01.01	Mobilization	1	LS	$100,000	$100,000	Past project experience	0
01.02	Demobilization	1	LS	$100,000	$100,000	Past project experience	0
01.03	Construction Trailer	1	EA	$12,161	$12,000	RS Means 0152 1320 0020	Office trailer, furnished, 20'x8'
01.04	Construction Facilities	10	MO	$1,000.00	$10,000	Past project experience	Utilities and maintenance
01.05	Construction Entrances	2	EA	$5,000.00	$10,000	Past project experience	Installation and removal
02.00	**Dewatering and Temp. SW Management**				**$280,000**		
02.01	Dewatering Sumps	1	EA	$25,000.00	$25,000	2020 project bids	Include sump excavation and installation
02.02	Dewatering and Maintenance	3	MO	$50,000.00	$150,000	2020 project bids	Includes pump operation, piping, etc.
02.03	Temporary Stormwater Management Controls	3	MO	$5,000.00	$15,000	2020 project bids	Ditching, diversion berms, ponds, lagoons, maintenance
02.04	18-Inch DR17 HDPE Storm Drain Pipe	0	LF	$148.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.05	24-Inch DR17 HDPE Storm Drain Pipe	0	LF	$267.50	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.06	30-Inch DR17 HDPE Storm Drain Pipe	0	LF	$387.00	$0	0	Includes Excavation, Pipe, Bedding, and Backfill
02.07	Culvert Inlet Headwall	0	EA	$2,915.19	$0	RS Means 3342 1313 0540	Concrete, 30 degree skewed wingwall, 24"
02.08	GW Extraction System Operation	2	YR	$50,000.00	$90,000	Assume cost covered under current operation	12 wells are in place along southern boundary
03.00	**Erosion and Sediment Controls**				**$30,000**		
03.01	Erosion and Sediment Controls	1	LS	$15,000.00	$15,000	2020 project bids	0
03.02	Erosion Control Blankets	0	SY	$2.20	$0	RS Means 3125 1416 0020	Just mesh, stapled, 100 SY, 4' wide, assumes 30-ft of the
03.03	Silt Fence	0	LF	$2.19	$0	RS Means 3125 1416 1000/1305	3-ft high, slope (less than 3H:1V)
03.04	Rock Check Dams	0	EA	$1,700.00	$0	Past project experience	Installation and Removal
03.05	EPSC Maintenance	10	MO	$1,500.00	$15,000	Past project experience	0
04.00	**Instrumentation**				**$0**		
04.01	Piezometer Installation	0	EA	$2,000.00	$0	Past project experience	Assume 10 piezometers
04.02	Piezometer Extension	0	EA	$500.00	$0	Past project experience	Raising piezometers for filling operations
04.03	Monitoring Well Installation	0	EA	$2,500.00	$0	N/A	0
04.04	Monitoring Well Extension	0	EA	$500.00	$0	N/A	0
04.05	Settlement Plates	0	EA	$500.00	$0	2020 project bids	1 per ~20 acres
05.00	**Demolition**				**$50,000**		
05.01	Piezometer Abandonment	0	EA	$3,000.00	$0	Past project experience	Assumes piezometers can be pulled
05.02	Monitoring Well Abandonment	0	EA	$3,000.00	$0	Past project experience	Assumes monitoring wells will not be impacted
05.03	Sluice Pipelines	1	LS	$50,000.00	$50,000	Limited data available	Existing buried sluice pipelines
06.00	**Site Clearing**				**$48,000**		
06.01	Stripping Topsoil and Vegetation, Quarry	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.02	Clear and Grub, Quarry	10	AC	$4,821.30	$48,000	RS Means 3111 1010 0020	Clear and grub up to 6-inch trees
06.03	Stripping Topsoil and Vegetation, Borrow Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.04	Clear and Grub, Borrow Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
06.05	Stripping Topsoil and Vegetation, New Landfill Site	0	CY	$4.72	$0	RS Means 3114 1323 1430	300' haul w/200HP dozer, remove and stockpile onsite
06.06	Clear and Grub, New Landfill Site	0	AC	$6,366.48	$0	RS Means 3111 1010 0160	Clear and grub brush and stumps
07.00	**Earthwork**				**$10,366,000**		
07.10	**Dust Control**				**$0**		
07.11	Water Truck	0	MO	$14,101.86	$0	RS Means 0154 3340 6950	2 6,000 gallon capacity water truck rental
07.20	**Coal Ash Excavation to Landfill**				**$0**		
07.21	Coal Ash Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, 200,000 CY plus
07.22	Coal Ash Hauling to New Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
	Coal Ash Hauling to Existing Landfill	0	LCY	$4.21	$0	RS Means 3123 2320 3078	16.5 CY Truck, 15 min. wait, 40 MPH speed, 10 mile cycle,
07.23	Coal Ash Spreading	0	LCY	$2.07	$0	RS Means 3123 2317 0020	spread dumped material with dozer, no compaction
07.24	Coal Ash Compaction	0	ECY	$0.28	$0	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.25	Coal Ash Moisture Conditioning	0	MO	$5,903.51	$0	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.26	Landfill Disposal Tipping Fee	0	TON	$58.29	$0	Analysis of MSW Landfill Tipping Fees-April 2019, Published 2019, rev. 10/31/19, EREF-D&P/TIP FEES (2018 Illinois average in Table 3 + Midwest Annual Avg. Incr. % in Table 2)	Assumes average tipping fee with average annual increase and an in place unit weight of 90 pcf

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07.30	**Landfill Bottom Liner**				**$0**		
07.31	Landfill Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.32	Landfill Excavation Soil Hauling	0	BCY	$2.90	$0	RS Means 3123 2320 3028	16.5 CY Truck, 15 min. wait, 20 MPH speed, 1 mile cycle,
07.33	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
07.34	Clay Layer Borrow Excavation and Loading (On-site)	0	LCY	$8.76	$0	RS Means 3123 1643 5500 + 3123 2320 3080	0
07.35	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.36	Clay Layer Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes
07.37	Clay Layer Fine-Finish Grading	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
07.40	**Landfill Final Cover**				**$0**		
07.41	Clay Layer Borrow Pit Purchase	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.42	Clay Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.43	Clay Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
	Clay Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.44	Clay Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.45	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.46	Protective Layer Borrow Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.47	Protective Layer Borrow Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
	Protective Layer Borrow Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.48	Protective Layer Borrow Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.49	Protective Layer Borrow Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.50	**Coal Ash Recontouring**				**$1,160,000**		
07.51	Excavation and Loading	100,000	BCY	$1.39	$139,000	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor, assumes 10%
07.52	Hauling	130,000	LCY	$4.14	$538,000	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
07.53	Spreading	130,000	LCY	$2.45	$319,000	RS Means 3123 2317 0020	Dumped and spread by dozer
07.54	Compaction	100,000	ECY	$0.28	$28,000	RS Means 3123 2323 5060	12" lifts, 2 passes, riding, vibrating roller, 30% shrink
07.55	Moisture Conditioning	23	MO	$5,903.51	$136,000	RS Means 0154 3320 1500/0154 3340 7300	Rental/Operating cost of tractor and disc attachment
07.60	**Closure Cap**				**$9,019,000**		
07.61	Borrow Soil	0	BCY	$2.50	$0	acrevalue.com, doubled cost for development	Common earth, assume purchase land, 5 ft/AC
07.62	Clay Layer Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.63	Clay Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
	Clay Layer Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.64	Clay Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.65	Clay Layer Borrow Compaction	0	ECY	$1.76	$0	RS Means 3123 2323 5640	Sheepsfoot roller, 6-inch lifts, 4 passes, 10% shrink
07.66	Protective Layer Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.67	Protective Layer Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
	Protective Layer Hauling (Offsite)	0	LCY	$7.37	$0	RS Means 3123 2320 3080	16.5 CY Truck, 15 min. wait, 40 MPH speed, 20 mile cycle,
07.68	Protective Layer Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.69	Protective Layer Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.70	Wet or Sediment Cap	69,373	CY	$130.00	$9,019,000	Project Costs	12-inch sand cap
07.70	**Soil Contouring Fill / Regrading**				**$0**		
07.71	Excavation and Loading	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
07.72	Hauling (Onsite)	0	LCY	$4.14	$0	RS Means 3123 2320 6040	34 CY Truck, 15 min. wait, 5 MPH speed, 1 mile cycle,
07.73	Spreading	0	LCY	$2.45	$0	RS Means 3123 2317 0020	Dumped and spread by dozer
07.74	Compaction	0	ECY	$0.96	$0	RS Means 3123 2323 5600	Sheepsfoot roller, 6-inch lifts, 2 passes, 10% shrink
07.80	**Access Roads**				**$187,000**		
07.81	Access Road - Closure	18,000	SY	$10.39	$187,000	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.82	Access Road - Borrow	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
07.83	Access Road - Landfill	0	SY	$10.39	$0	RS Means 3132 1916 1510/3211 2323 0100	6-inch base coarse, 600-lb. woven geotextile, 20-ft wide /
08.00	**Geosynthetics**				**$0**		
08.10	**Landfill and Closure Cap Geosynthetic Components**				**$0**		
08.11	40-mil double sided textured LLDPE Geomembrane	0	SF	$0.81	$0	2020 project bids	0
08.12	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0
08.13	Anchor Trench - Closure Cap	0	LF	$9.27	$0	2020 project bids	0
08.20	**Landfill Bottom Liner Geosynthetic Components**				**$0**		
08.21	60-mil double sided textured HDPE Geomembrane	0	SF	$0.85	$0	2020 project bids	0
08.22	Double-Sided Tri-place Geocomposite	0	SF	$1.32	$0	2020 project bids	0
08.23	Anchor Trench - Landfill Bottom Liner	0	LF	$9.27	$0	2020 project bids	0

Project: Lincoln Stone Quarry Closure Alternatives
Task: Alternatives Cost Analysis
Client: Midwest Generation, LLC (MWG)
Proj. No. CHE8420
Date: September 30, 2021

Created By:	TWW	07/09/20
Reviewed By:	DK	07/21/20
Approved By:	JPV	10/13/21
Revised By:	JPV	02/17/21

08.25	Geotextile - (Filter 4 oz/yd2)	0	SF	$0.25	$0	Project Bids	0
08.30	**Leachate Collection and Transmission System**				**$0**		
08.31	Leachate Collection System (1 foot thick)	0	CY	$16.00	$0	0	0
08.32	6-inch SDR 11 HDPE Pipe	0	LF	$9.50	$0	0	0
08.33	Gravel Trench for V-Trench	0	LF	$26.00	$0	0	Leachate Collection "V" Notch Drain "Burrito Wrap" - Includes Granular Fill, Geotextile Envelope (Nonwoven 4
08.34	Leachate Sumps	0	EA	$5,000.00	$0	20' x 20' x 3'	Double Lined with Rock
08.35	Leachate Sump Pumps (2 per sump)	0	EA	$8,500.00	$0	0	0
08.36	Leachate Transmission Piping (2x4 HDPE)	0	LF	$4.50	$0	0	Woven, heavy duty, 600 lb. tensile strength
08.37	Leachate Riser Pipe (18" SDR 17 HDPE)	0	LF	$78.00	$0	0	0
08.38	Leachate Vault and Control Panel	0	EA	$25,000.00	$0	0	0
08.39	Leachate Vault Utilities	0	LF	$24.55	$0	RS Means 337119175840	4 conduits in 5" diameter PVC conduit with backfill
08.40	Above Grade Leachate Storage Tank	0	EA	$500,000.00	$0	MIG Project Costs	50,000 gallon tank
08.41	Leachate Treatment (On-site)	0	Gal	$0.00	$0	Project Costs	On-site discharge through NPDES permit (cost for pumps)
09.00	**Pond Closure - Ditch and Apron Construction**				**$144,000**		
09.01	Geotextile Fabric	4,100	SY	$2.55	$10,000	RS Means 3132 1916 1510	Woven, heavy duty, 600 lb. tensile strength, perimeter length x 4-ft, 4 aprons, 1 borrow apron, 4 landfill aprons
09.02	Riprap	0	LCY	$71.19	$0	RS Means 3137 1310 0100	Machine placed for slope protection
09.03	Riprap	3,200	TON	$38.70	$124,000	RS Means 3137 1310 0370	300 lb. average, dumped, perimeter length x 4-ft, 20x50 ft aprons
09.04	Riprap Hauling	2,100	LCY	$4.89	$10,000	RS Means 3123 2320 3066	16.5 CY Truck, 15 min. wait, 35 MPH speed, 10 mile cycle
10.00	**Hydraulic Control / Containment**				**$0**		
10.01	Borehole Drilling for Bedrock Fractures	0	LF	$75.00	$0	Project Costs	one-line grout curtain on 5-foot spacing, 100 foot depth
10.02	Grouting of Bedrock Fractures	0	CY	$70.79	$0	RS Means 3173 1310 0820	0
10.03	Leachate Discharge Piping	0	LF	$6.50	$0	Project Bids	2"x4" buried in common earth
10.04	Vertical Leachate Extraction Wells	0	VLF	$85.00	$0	Project Bids	0
11.00	**Turf and Grasses**				**$0**		
11.01	Hydroseed and Mulch	0	SY	$2.25	$0	RS Means 3292 1913 1100	includes lime, fertilizer, seed, & fiber mulch
11.02	Closure Turf	0	SF	$2.44	$0	Past project experience	Engineered Synthetic Turf (CT), 40 mil MicroSpike
11.03	Manufactured Sand - Typical Infill	0	TON	$50.00	$0	Past project experience	120 Tons/AC
11.04	HydroBinder - Downchutes Infill	0	TON	$341.00	$0	Past project experience	7 lbs/SF
11.05	Anchor Trench	0	LF	$9.27	$0	2020 project bids	Perimeter trench
11.06	Sod, Temp Irrigation and Maintenance	0	AC	$30,000.00	$0	Past project experience	In place of seeding
11.07	Soil Amendments	0	AC	$500.00	$0	Past project experience	To support vegetative growth
12.00	**SW Management Features - New Landfill**				**$0**		
12.01	Soil Excavation for Detention Basin	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.02	Basin Vegetation	0	SY	$2.25	$0	RS Means 3292 1913 1100	Bluegrass, hydro or air seeding, with mulch and fertilizer
12.03	Basin Outlet Structure	0	EA	$10,000.00	$0	Past project experience	Outlet structure and associated discharge piping
12.04	Culverts (30-inch)	0	EA	$387.00	$0	Past project experience	Includes Excavation, Pipe, Bedding, and Backfill
12.05	Perimeter Stormwater Ditch/Road Excavation	0	BCY	$1.39	$0	RS Means 3123 1643 5500	4.5 CY Excavator, 90% fill factor
12.06	Perimeter Stormwater Ditch/Road Fill	0	LCY	$2.18	$0	RS Means 312323145440	Backfill, structural, clay, 300 H.P. dozer, 300' haul
12.07	Perimeter Stormwater Ditch Grading	0	LF	$0.40	$0	RS Means 312319100200	Cut Drainage Ditch, Clay and Till, 10' w x 3'-4' deep
12.08	Fine Grading of Perimeter Stormwater Ditch	0	SY	$0.25	$0	RS Means 3122 1610 3300	gentle slope grading
12.09	Terrace Berms	0	CY	$3.50	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grades
12.10	Drainage Downchutes	0	LF	$25.00	$0	Past project experience	Borrow/Load, Haul, Place, Fine Grade, Rip-Rap
13.00	**30-year Post-Closure**				**$5,085,000**		
13.01	Annual Care	30	YR	$169,500.00	$5,085,000	Past project experience	Includes monitoring, maintenance, inspections

Sub Total	**$11,150,000**	
Contingency	**$3,345,000**	**30%**
Design and Engineering Fees	**$1,115,000**	**10%**
Owners Costs	**$558,000**	**5%**
Closure Scenario Total	**$16,168,000**	