GRAYMONT

April 20, 2018

Department of Natural Resources, Real Estate
Attn: Scott D. Goeman
Constitution Hall, 3rd Floor
525 West Allegan Street
Lansing, MI 48933

Re: Advance Designation Notice for an Operating Area

Graymont is submitting this "Advance Designation Notice" of an Operating Area #2, adjacent to Operating Area #1, and including the existing Hendricks Quarry in Tract A. Included in this Advance Designation Notice package are the documents required by Exhibit D to the Addendum to Land Transaction Agreement, dated March 19, 2015.

Standard Requirements

Description of Operating Area (map & legal)	Exhibit A
Mining Plan with outline of operations	Exhibit B
Mining Sequence	Exhibit B
Closing and Relocation of Trails	Exhibit B
Hydrology Report	Exhibit C
Archeology Report	Exhibit D
Reclamation Plan	Exhibit E
Estimate of Reclamation Costs	Exhibit F
Outline of Steps for the Process	Exhibit G

If you have any questions please feel free to contact me at my office 906 283-2900 x1486 or via my cell at 906 450-0553. We look forward to continuing our operations in the Eastern UP.

Kind Regards,

PJ Stoll
Plant Manager, Port Inland Plant

Paul "PJ" Stoll
181 W County Road 432
Gulliver, MI USA 49840
pstoll@graymont.com

OPERATING AREA ADVANCE NOTICE

GRAYMONT (MI) LLC, a Michigan limited liability company, of 181 W County Road 432, Gulliver, Michigan 49840 ("**Graymont**"), gives this Operating Area Advance Notice ("**Notice**") to the DEPARTMENT OF NATURAL RESOURCES for the STATE OF MICHIGAN, of P.O. Box 30448, Lansing, Michigan 48909 ("**State**"), pursuant to **Exhibit D** of that certain Land Transaction Agreement, with Addendum, between Graymont and State, dated May 26, 2015 ("**Acquisition Agreement**").

As required by the Acquisition Agreement, this Notice is accompanied by the following:

a. a description of the area proposed for designation, including a map and legal descriptions;

b. a mining plan proposed for the proposed Operating Area, which will provide an outline of the operations proposed for the Operating Area including:

   i. the proposed mining sequence for the extraction of limestone from the Operating Area;

   ii. the proposed closing and relocation of Recreational Trails and Named Trails (as defined in **Exhibit I** to the Acquisition Agreement) in the proposed area in accordance with the Acquisition Agreement;

   iii. a report prepared by a professional hydrologist identifying the hydrological conditions in the proposed Operating Area and proposing monitoring and mitigation measures appropriate to such conditions; and

   iv. a report prepared by a professional archaeologist identifying archaeologically significant sites, if any, located on or in close proximity to the proposed Operating Area and proposing appropriate measures for the protection and/or preservation of such sites or the culturally significant artifacts located on such sites;

c. a plan proposed for the completion of reclamation (as prescribed by **Exhibit D** to the Acquisition Agreement) in the proposed Operating Area;

d. an estimate of the cost that State would incur to complete reclamation as prescribed by **Exhibit D** to the Acquisition Agreement and in accordance with the proposed reclamation plan for the Operating Area at the point in

the proposed mining sequence at which those costs would be the highest; and

e. an outline describing the steps and schedule proposed for the consultation process to occur between the Advance Notice and the Designation Notice within the parameters set out in **Exhibit D** to the Acquisition Agreement.

Capitalized terms not defined in this Notice have the meanings set forth in the Acquisition Agreement.

Dated: April 19, 2018

GRAYMONT (MI) LLC, a Michigan limited Liability Company

By Wayne Kenefick
Vice President Business Development and Technical Services

Its

And by

Its CELIA JOHNSON
Vice President, General Counsel
and Corporate Secretary

16937696-1

Exhibit A

Advance Notice
Land Transaction Agreement

Description of Operating Area

For the:

Graymont Borgstrom Road Quarry
Operating Area 2
Graymont (MI) LLC
Mackinac County, Michigan

Submitted to:

Department of Natural Resources
State of Michigan

August 2018

GRAYMONT

Description of Graymont Borgstrom Road Quarry Operating Area

The purpose of this document is to describe Operating Area 2 designated in the Advance Notice and located adjacent to and partially contained within the existing Hendricks Quarry in Tract A (as defined in the Land Transaction Agreement). Operating Area 2 and each subsequent operating area designated within Tract A will be commonly referred to as the Graymont Borgstrom Road Quarry (GBRQ).

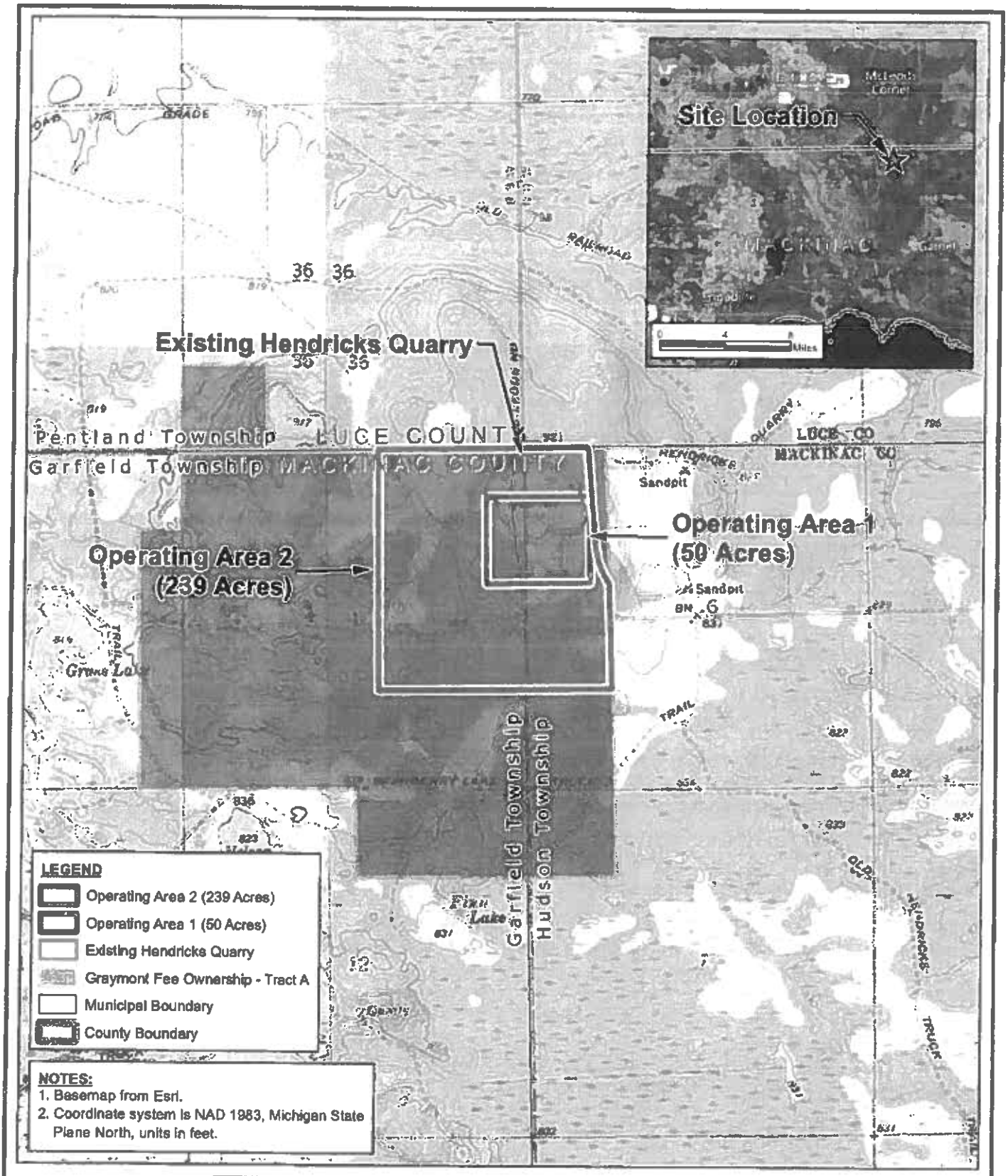
Operating Area 2 is located on property owned by Graymont (MI) LLC, from herein defined as "Graymont", located in the townships of Garfield and Hudson, in Mackinac County, Michigan (see **Figure A-1 – *Site Location Map, Operating Area 2)***. Operating Area 2 is comprised of approximately 239 acres with approximately 15 acres of which are encompassed in the existing Hendricks Quarry. **Figure A-2 – *Description of Operating Area 2*** shows Operating Area 2, the previously designated Operating Area 1, and the existing Hendricks Quarry.

Operating Area 2 is located within portions of the parcels described below which are owned by Graymont:

- Beginning at a point 505 feet north of the southeast corner of SW ¼, NW ¼, of Section 6, Township 44N, Range 8W, thence south 1,604 feet along the quarter-quarter section boundary, thence west 3,580 feet, thence north 3,679 feet, thence east 3,209 feet along the section boundary, thence 2,138 feet along a line trace located 50 feet from the centerline of Borgstrom Road (right of way of Borgstrom Road) to point at the beginning (289 acres).

- LESS
  Beginning at a point 270 feet west and 530 feet north of the southeast corner of the NW ¼, NW ¼ of Section 6, Township 44N, Range 8W, thence south 1,325 feet, thence west 1,605 feet, thence north 1,325 feet, thence east 1,605 feet to point at the beginning (also known as Operating Area 1, 50 acres).

Figures



GRAYMONT

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MRS5	DATE: APR.'18	
REVIEWED BY:	RWS3	DATE: APR.'18	
APPROVED BY:	RWS3	DATE: APR.'18	

GRAYMONT (MI) LLC

FIGURE A-1

SITE LOCATION MAP, OPERATING AREA 2
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet	Date: APRIL 2018	
Drafted by: BJW1	Project No: 14W777	

Path: X:\GB\E\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix A\Figure A-1 Site Location Map.mxd Date: 4/19/2018

NOTES:
1. Base Imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Graymont Fee Ownership - Tract A
- Tax Parcel
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MRS3			DATE: APR.'18
REVIEWED BY: RWS3			DATE: APR.'18
APPROVED BY: RWS3			DATE: APR.'18

GRAYMONT (MI) LLC

FIGURE A-2

DESCRIPTION OF OPERATING AREA 2
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet | Date: APRIL 2018
Drafted by: BJW1 | Project No: 14W777

Path: X:\GBY\E\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix A\Figure A-2 Site Layout Map.mxd Date: 4/19/2018

Exhibit B
Advance Notice
Land Transaction Agreement

Mine Plan

For the:

Graymont Borgstrom Road Quarry
Operating Area 2
Graymont (MI) LLC
Mackinac County, Michigan

Submitted to:

Department of Natural Resources
State of Michigan

August 2018

GRAYMONT

Graymont Borgstrom Road Quarry Mine Plan

The purpose of this document is to present the "Mine Plan, Outline of Operations, and Mining Sequence" for the limestone quarry defined as Operating Area 2 in the Advance Designation Notice Exhibit A. Operating Area 2 is located adjacent to and partially contained within the existing Hendricks Quarry in Tract A (as defined in the Land Transaction Agreement).

Operating Area 2 is located on property owned by Graymont located in the townships of Garfield and Hudson, in Mackinac County, Michigan. Operating Area 2 is comprised of approximately 239 acres, approximately 15 acres of which are located within the existing Hendricks Quarry. **Figure B-2 – *Quarry Plan - Pre-Quarrying Conditions General Cross Sections*** shows the quarry and operational extent of Operating Area 2 of the Graymont Borgstrom Road Quarry (GBRQ).

Designation Area Geology

The target limestone is part of the Hendricks Formation. This formation consists of gray and buff dolomitic and lime mudstone and wackestones. In the proposed 239-acre quarry area defined as Operating Area 2, the target limestone is found at the top of the Hendricks Formation. It is characterized as buff to grayish buff colored, high calcium lime mudstones and wackestones with some calcite crystals and is targeted for its suitability for industrial mineral uses. In the Operating Area 2 vicinity the target limestone is either exposed at the ground surface or overlain by thin mantle of glacial till.

Quarrying Sequence

Quarry development for production in Operating Area 2 will consist of a southerly and or westerly advance starting from the quarried portions of Operations Area 1 and extend to the south and west to the Operating Area 2 boundary. **Figure B-1 – *Phased Mining Sequence*** shows the proposed progression of the mine plan. Mining activities will utilize excavator/ truck/wheel loader operations. Overburden created throughout the quarrying sequence will also be used to construct sight/safety berms between the highwall and undisturbed portions of Operating Area 2 as the highwall advances. Once overburden is removed from a portion of the initial advance, the target limestone is blasted and transported via wheel loaders or trucks to the in-pit processing area where crushing, screening, stockpiling, and loading for off-site transportation occurs (see Figure B-1 for the location of the processing area during various phases).

The overburden will be stockpiled. Overburden will also be deposited on exposed quarry floor at a minimum depth of 12 inches when those areas are no longer required for processing, transportation, limestone stockpiling, as start points of future expansion. Stone that is not suitable for processing or sale will be mixed with stripped overburden and used as backfill or sight/safety/runoff berm construction. **Figure B-3 – *Quarry Plan – Intermediate General Cross Sections*** depicts the general cross-section profiles created during the mining sequence. The proposed phasing of the rolling reclamation plan is shown in the plan views

and cross sections in Appendix E.

Phase 1: The initial quarrying phase will primarily be activities surrounding the stockpiling of overburden in the northeast corner of the existing Hendricks pit that is not used for sight/safety/runoff berms from Operating Area 1.

Phase 2: The next quarrying phase will proceed west and south along an arched panel that will enlarge the mining area created by the existing Hendricks pit located in Operating Area 2 and the quarried portions of Operating Area 1. Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the western edge of the overburden stockpiled in Phase 1.

Phase 3: Similar to Phase 2, the next quarrying phase will proceed west and south along an arched panel that will enlarge the mining area created by the previous phases. Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the western edge of the overburden stockpiled in Phase 2 or used as backfill on the unused areas of the mined pit floor.

Phase 4: The next quarrying phase will create a north/south panel near the western edge of Operating Area 2 Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the southern edge of the overburden stockpiled in Phase 3 or used as backfill on the unused areas of the mined pit floor.

Phase 5: Similar to Phase 4, next quarrying phase will create an east/west panel near the southern edge of Operating Area 2. Overburden that is not used for sight/safety/runoff berms will be used as backfill on the unused areas of the mined pit floor.

Figure B-4 – *Quarry Plan - Final Advance General Cross Sections* shows the final pit panels and quarry configuration adjacent to the western and southern edges of Operating Area 2. Those future quarrying activities will be described and itemized in future Designation Notices.

Quarry Operations

Quarrying methods are expected to include drilling and blasting, excavator/truck/wheel-loader material handling, in-pit ore preparation (crushing and screening), certified on-site scales/weighing, and truck transport of target limestone to off-site facilities as follows:

- Removal of overburden from the initial advance quarry area and subsequent production panel areas and placement of overburden within Operating Area 2.

- Transportation of overburden to construct perimeter safety/sight berms, temporary material stockpiles, or directly to reclamation where the extraction of target limestone has been completed. The sight/safety/runoff berms would be constructed prior to pit advancement as per accepted industry standards and best management practices and

local, state, or federal requirements. Figure B-2 illustrates typical sight/safety/runoff berm construction.

- Sight/safety/runoff buffers will be employed as reasonable and practical along the boundaries of the quarrying operation.

- Establishment of a mobile/portable, self-contained crushing, screening, and truck loading facility within the Operating Area 2 pit. This processing facility will include conveyors for material handling and a certified on-site scale.

- Drilling and blasting will be managed by a licensed blaster in compliance with federal, state, and local requirements. Blasting may be conducted up to several times per week and a blasting schedule will be posted at quarry entrance and electronically to a publicly accessible website.

- Excavation and transportation of blasted rock to the crushing and screening plant.

- Processed stone from screening plant fed by conveyors to stockpiles for in-pit storage or to tractor-trailer trucks for transport off-site.

- Stone not suitable for sale and overburden may be used to construct safety/sight berms, mixed with overburden for quarry reclamation, or stockpiled in the pit.

Tailings ponds, or dedicated sediment ponds are not proposed for Operating Area 2 operations. Temporary overburden or product stockpiles may be located within Operating Area 2 as required to facilitate material handling. No permanent structures or equipment infrastructure will be constructed in Operating Area 2.

Quarry Equipment

Major quarrying equipment proposed for the GBRQ may include:

- Front end loader(s)
- Bulldozer
- Excavator
- Water truck(s)
- Drill(s)
- Off-Road haul trucks
- Tractor double-trailer haul trucks or similar
- Service and supervisory vehicles
- Mobile, self-contained crushing, screening, conveyor loading plant
- Certified truck/equipment scale

Noise and Dust Control

The location of and the type of quarry operation proposed will assist in the mitigation of noise and dust control. Based upon the proposed depth of the operation, and through the

construction of berm barriers, noise and dust will be primarily directed upward and contained within the quarry. If necessary, Graymont will utilize general controls, to reduce potential fugitive dust emissions and noise at the site. Controls may include:

- Truck Traffic Control – Vehicle speed may be reduced during dry weather periods to help minimize dust from equipment traffic within the operating area.

- Watering – If dust generation at the site is determined to be problematic, water will be utilized to suppress roadway dust. Watering may be suspended during low temperatures as needed for safety (icy roadways).

- Back-up Alarm Noise Reduction – Equipment back-up alarms may be configured to reduce noise levels or use air puff audible technology.

- Road Grading – Road grading will be performed as-needed to help minimize the potential for dust generation. When grading, water will be used if necessary to prevent excess dust generation.

- Processing Area Dust Suppression – The crushing and screening plants may utilize a water spray system to control fugitive dust as needed.

Blasting

Blasting activities will be conducted at the proposed quarry operation by a licensed blaster. The effects of blasting such as dust and fly rock generation will be minimized through proper blast design. All blasting activities will be controlled and monitored as required by MSHA regulations and per accepted industry standards and best management practices and local, state, or federal requirements.

Named Trails, Site Access and Access Management

The McLeod Truck Trail is a Named Trail as defined in the Land Transaction Agreement. McLeod Truck Trail is currently routed through the Operating Area 2 and will be rerouted as shown on Figure B-3. Two unnamed Recreational Trails enter and terminate in Operating Area 2 as shown on Figure B-3. These two Recreation Trails will be bermed and posted with signage to prohibit public access to active quarry operations.

Egress and ingress to the site will initially be primarily from the existing Hendricks Quarry entrance/exit ramp connected to Borgstrom Road. As mining progresses, an alternative egress and ingress will be developed about 1,800 feet to the south of the existing entrance as shown on Figure B-3. All entrances will be posted with signage regarding limitation of access, emergency contact information, operating hours, blasting schedule, and other appropriate information.

Toxic and Hazardous Materials Management

The target limestone and adjacent bedrock does not contain acid-forming materials or metals that can be released to the environment once exposed to oxidation. Conversely, limestone

and dolomite products are typically used to purify drinking water, treat wastewater, and neutralize acidic conditions. During quarrying operations, only minor, localized spills of fuels or lubricants would be categorized as potential contaminants. Fuels and lubricants will be handled and managed as per industry standards, best management practices, and established regulatory requirements. In the event of a minor spill, affects will be minimized by the nearly impermeable nature of the bedrock and the natural containment offered by the pit. Blasting will be designed for complete ignition of all explosives.

Site Drainage

Significant surface water runoff emanating from undisturbed areas will be diverted around disturbed areas and allowed to flow naturally within established drainage systems. This "undisturbed water" routing will minimize changes to the natural drainage system.

Water emanating from disturbed areas will be contained and allowed to settle, directed through engineered energy dissipation zones to remove sediment, or captured and used for dust suppression/quarry operations.

The lack of horizontal and vertical permeability is anticipated to naturally limit groundwater inflows into the quarry, mitigate effects to local surface water/wetland features, and negate effects to local domestic water supply wells.

Graymont will submit a Soil Erosion and Sedimentation Control (SESC) Plan to the Luce, Mackinac, Alger, Schoolcraft District Health Department. Part 91 of the Natural Resources and Environmental Protection Act requires the SESC submittal of the plan to address activities associated with the quarrying operation. The SESC Plan, once approved, will become part of the Storm Water Permit Application as required by the state of Michigan. Contact runoff from construction activities will be directed away from any surface water.

Public Utilities

No public utilities are planned for the GBRQ operation. The operation will utilize self-powered portable equipment and/or a portable generator plant. Any required supplemental water will be provided by truck delivery.

Permits

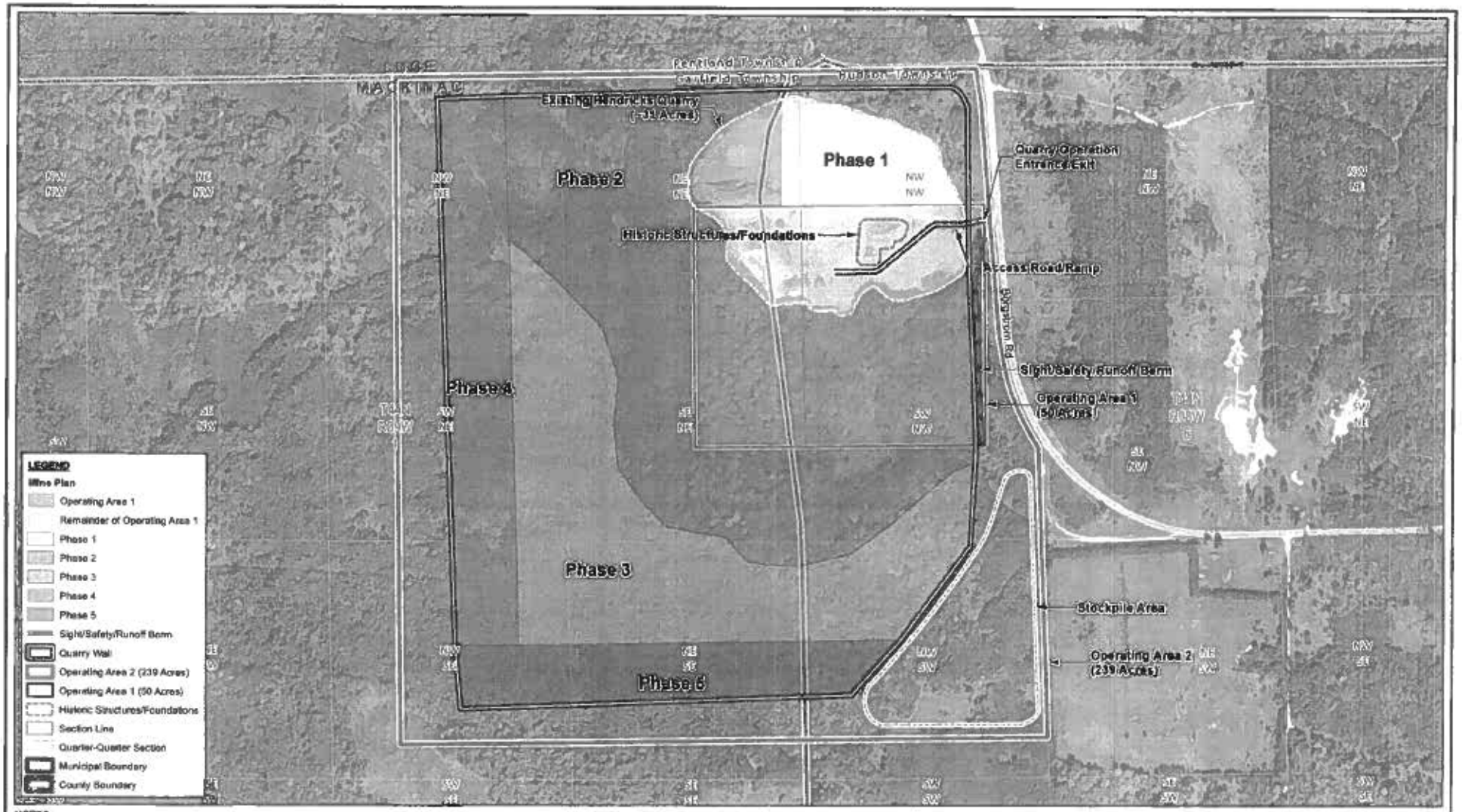
- LMAS DISTRICT HEALTH DEPARTMENT - Part 91, Soil Erosion & Sedimentation Control Plan, PA 451 of 1994, as amended.

- MDEQ portable crushing plant air permit.

Operational Schedule

The quarry will operate up to 12 months per year with product production dictated by market conditions. The quarry will operate up to 7 days-per-week, 24 hours-per-day. General hours of operation are anticipated to be from 7:00 a.m. to 8:00 p.m., however, certain conditions may require operational hours to be extended.

Figures



NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

GRAYMONT

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MRS5			DATE: APR.'18
REVIEWED BY: RWS3			DATE: APR.'18
APPROVED BY: RWS3			DATE: APR.'18

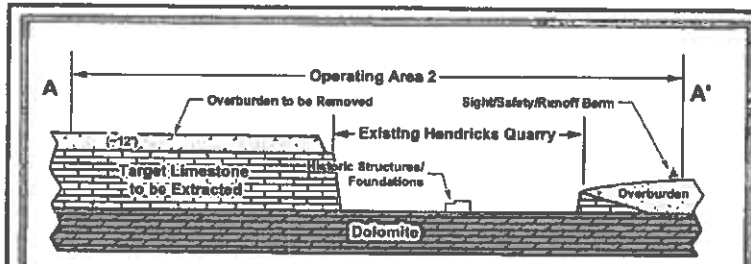
GRAYMONT (MI) LLC

FIGURE B-1

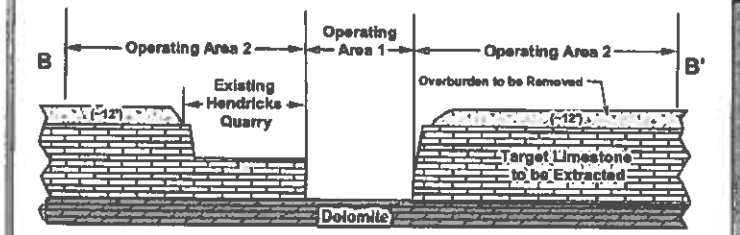
PHASED MINING SEQUENCE
OPERATING AREA 2
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 1" per		Date: APRIL 2018	
Drafted by: BJW1		Project No: 14W777	

Path: X:\GIS\B\2014\14W777-003\Shmxd\BRQ 2018 LTA Designation\Appendix B\Figure B-1 Phased Mining Sequence.mxd Date: 4/19/2018



Section A-A'
Not to Scale



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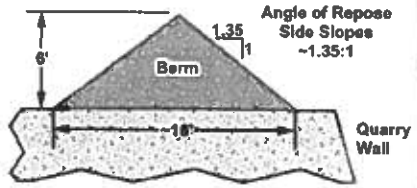
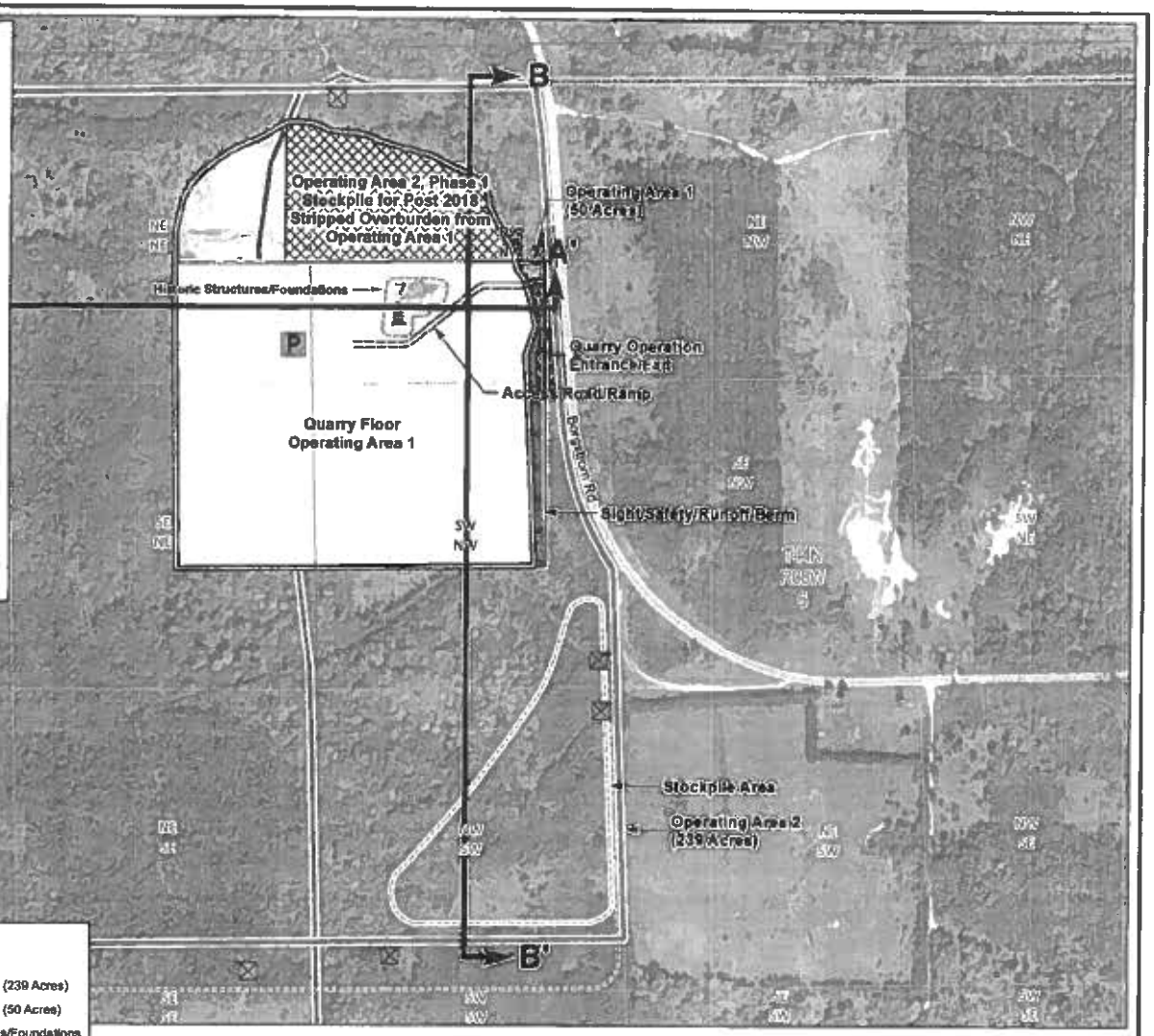


Safety/Sight/Runoff Berm Detail
Not to Scale



NOTES:
1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for quarry access.
5. Historic structures and foundations to be left in- place with no disturbance buffer.
6. Actual timing on activity in each phase is market dependent.

LEGEND
- Portable Crushing Spread
- Temporary Named Trail Closure
- Temporary Unnamed Trail Closure
- McLeod Truck Trail Reroute
- Sight/Safety/Runoff Berm
- Phase 1 Operating Area 1
- Phase 1 Overburden Stockpile
- Quarry Wall with Sight/Safety/ Runoff Berms Between Wall and Undisturbed Ground
- Stockpile Area
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Historic Structures/Foundations
- Section Line
- Quarter-Quarter Section
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

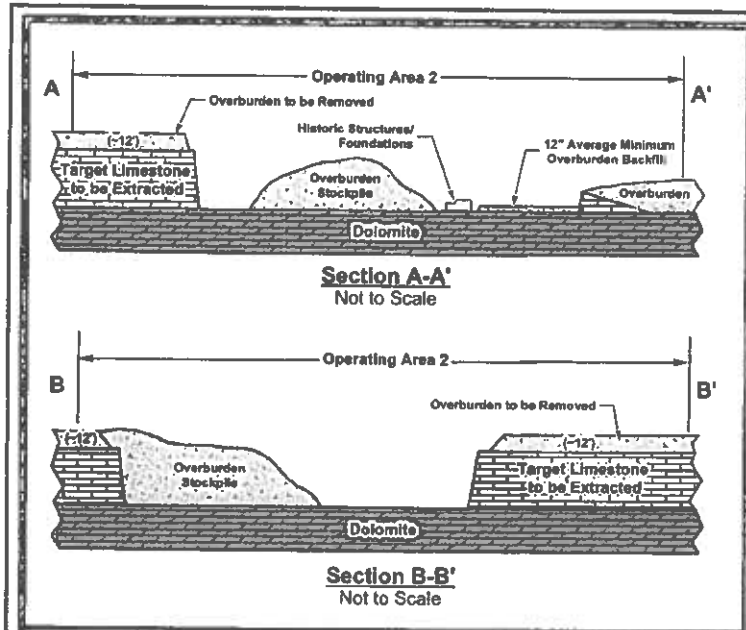
Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MRS5			DATE: APR.'18
REVIEWED BY: RWS3			DATE: APR.'18
APPROVED BY: RWS3			DATE: APR.'18

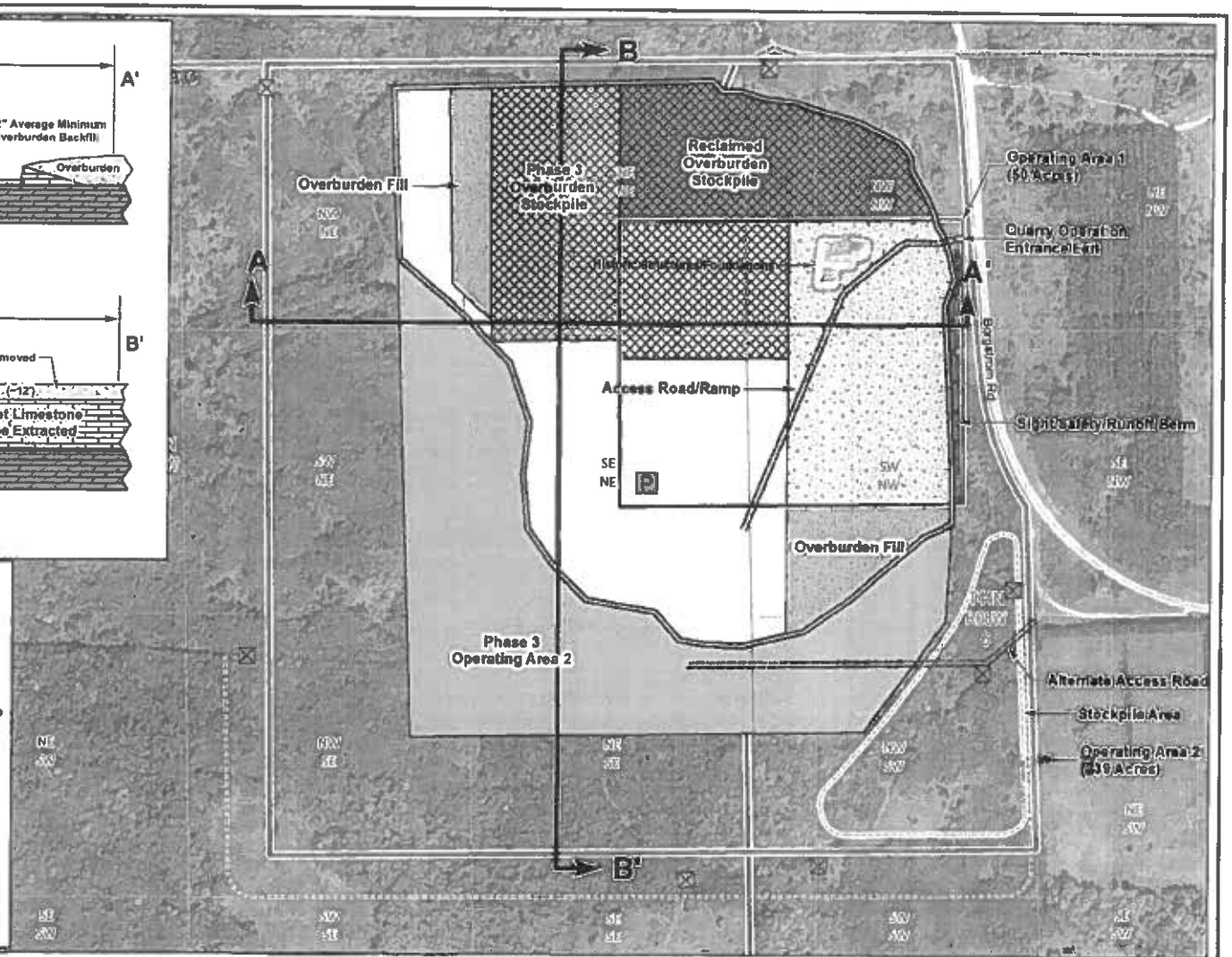
GRAYMONT (MI) LLC

FIGURE B-2
QUARRY PLAN - PRE-QUARRYING CONDITIONS
GENERAL CROSS SECTIONS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet | Date: APRIL 2018
Drafted by: BJW1 | Project No: 14W777

Path: X:\GIS\E\2014\1-4W777-00\MB\mxd\GBRQ 2018 LTA Designation\Appendix B\Figure B-2 Pre-Quarrying Cross Sections.mxd Date: 4/19/2018





LEGEND

- Portable Crushing Spread
- Temporary Named Trail Closure
- Temporary Unnamed Trail Closure
- McLeod Truck Trail Reroute
- Existing McLeod Truck Trail
- Sight/Safety/Runoff Berm
- Phase 3 Operating Area
- Phase 3 Overburden Stockpile
- Phase 3 Overburden Fill (12" Average Minimum)
- Bare Quarry Floor
- Overburden Fill Reclaimed Under Operating Area 1 Designation (12" Average Minimum)
- Overburden Stockpile Reclaimed Under Operating Area 1 Designation
- Reclaimed Overburden Stockpile
- Quarry Wall with Sight/Safety/ Runoff Berms Between Wall and Undisturbed Ground
- Stockpile Area
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Historic Structures/Foundations
- Section Line
- Quarter-Quarter Section
- Municipal Boundary
- County Boundary

NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for quarry access.
5. Historic structures and foundations to be left in- place with no disturbance buffer.
6. Actual timing on activity in each phase is market dependent.

GRAYMONT

Foth

Foth Infrastructure & Environment, LLC				GRAYMONT (MI) LLC	
REVISED	DATE	BY	DESCRIPTION	FIGURE B-3 QUARRY PLAN - INTERMEDIATE GENERAL CROSS SECTIONS GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI	
PREPARED BY: MRS5			DATE: APR.'18		
REVIEWED BY: RWS3			DATE: APR.'18	Scale: 0 250 500 Feet	Date: APRIL 2018
APPROVED BY: RWS3			DATE: APR.'18	Drafted by: BJW1	Project No: 14W777

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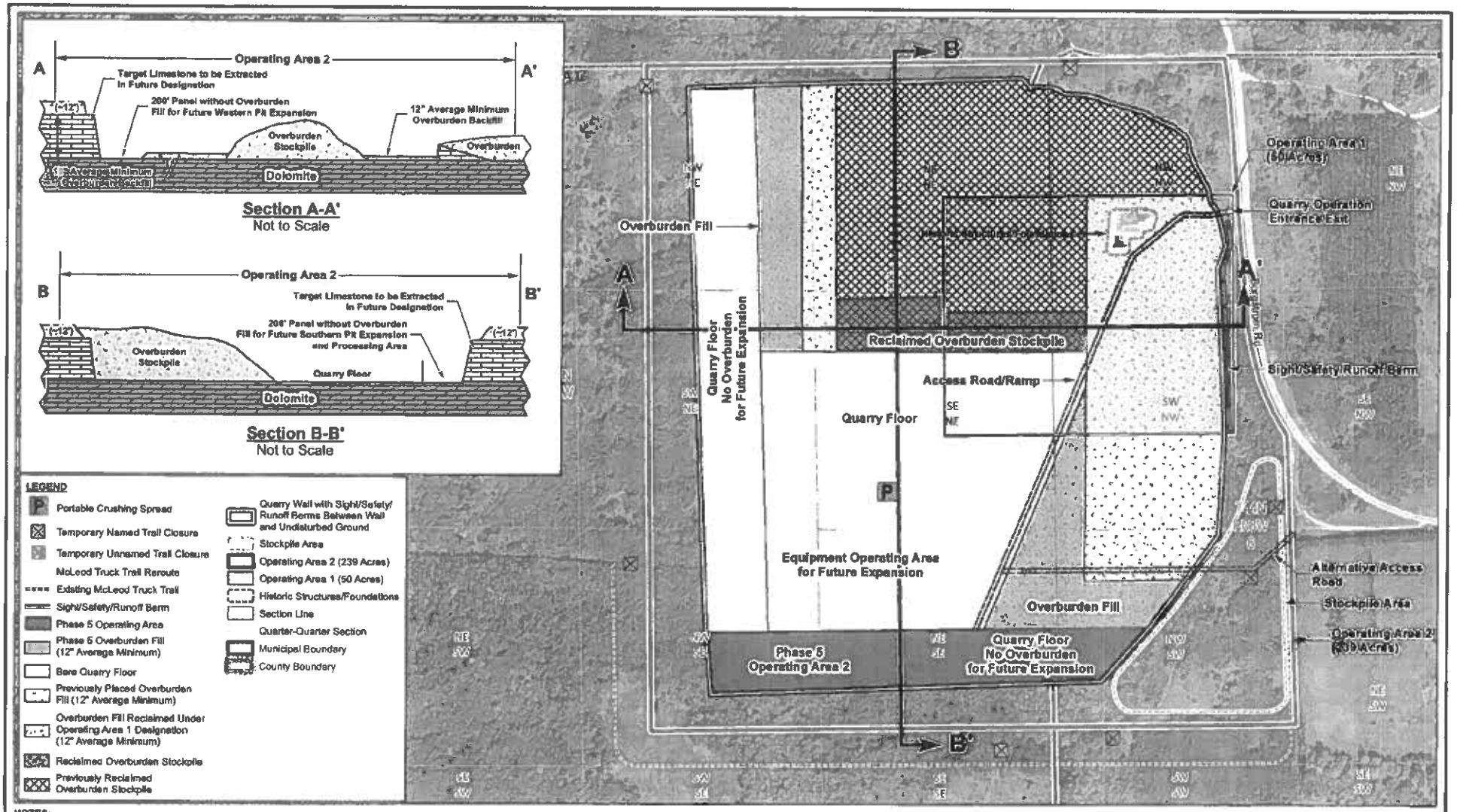

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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MRS5	DATE: APR.'18	
REVIEWED BY:	RWS3	DATE: APR.'18	
APPROVED BY:	RWS3	DATE: APR.'18	

GRAYMONT (MI) LLC

FIGURE B-4

QUARRY PLAN - FINAL ADVANCE
GENERAL CROSS SECTIONS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet

Date: APRIL 2018

Drafted by: BJW1

Project No 14W777

Path: X:\GBVE\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix B\Figure B-4 Final Advance Cross Sections.mxd Date: 4/19/2018

Exhibit C
Advance Notice
Land Transaction Agreement

Hydrology Report

For the:

Graymont Borgstrom Road Quarry
Operating Area 2
Graymont (MI) LLC
Mackinac County, Michigan

Submitted to:

Department of Natural Resources
State of Michigan

August 2018

GRAYMONT

Graymont Borgstrom Road Quarry
Operating Area 2

Hydrologic Evaluation

Graymont (MI) LLC

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Prepared for
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Graymont Borgstrom Road Quarry Hydrologic Evaluation
Graymont (MI) LLC

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Graymont Borgstrom Road Quarry
Hydrologic Evaluation – Operating Area 2
Graymont (MI) LLC

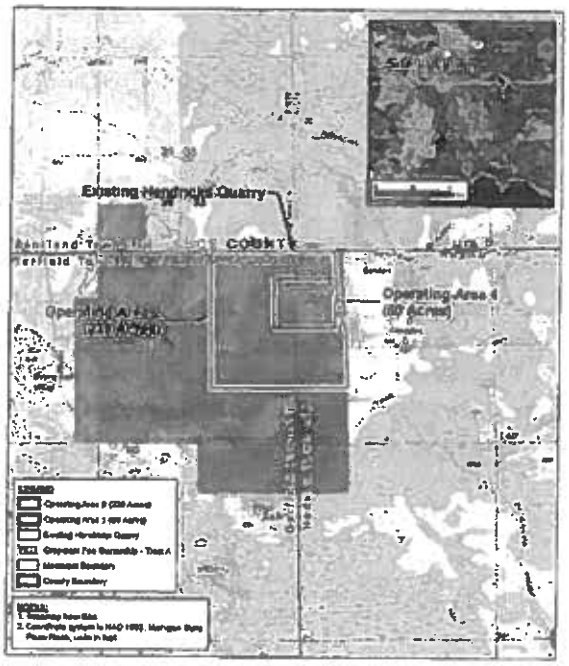
Executive Summary

The purpose of this document is to provide a report prepared by a professional hydrologist identifying the hydrological conditions in Operating Area 2 and recommend monitoring and mitigation measures appropriate for such conditions for the limestone quarry defined as Operating Area 2 designated in the Advance Notice and located adjacent to and partially contained within the existing Hendricks Quarry in Tract A (as defined in the Land Transaction Agreement).

The intent of this evaluation was to review the proposed quarry development and existing geologic, hydrologic, and hydrogeologic data to provide an independent assessment of the potential for surface quarrying activities associated with the proposed Quarry to affect adjacent hydrologic conditions.

The Graymont (MI) LLC Borgstrom Road Quarry is a proposed surface limestone extraction operation located in Mackinac County, Michigan.

The target limestone is part of the Hendricks Formation and this formation is typically 60-120 feet thick and consists of gray and buff dolomitic and lime mudstones and wackestones. The target limestone is typically is characterized by buff-colored, high calcium lime mudstones and wackestones with some calcite crystals. This zone is targeted for its high calcium content and suitability for industrial mineral needs.



The proposed quarry is situated in a topographically high area where the target limestone outcrops as a series of discontinuous ridges, and is exposed in the existing Hendricks Quarry.

The immediate vicinity can be characterized as an area of shallow glacial till overlaying several sequences of carbonate bedrock deposition. The general area contains several wetland areas and surface water features due to the presence of shallow groundwater

overlaying nearly impermeable, shallow bedrock. The regional system is recharged by significant quantities of annual precipitation. The proposed quarrying operation is situated at the top of the Tahquamenon Watershed which drains to Lake Superior.

Groundwater generally occurs at shallow depths within a few feet of ground surface with the exception of areas where the more-resistant target limestone outcrops as topographic highs or where a significant thickness of till exists where groundwater can be deeper. The groundwater table is situated below the base of the proposed Graymont Borgstrom Road Quarry. Carbonate bedrock formations generally exhibit very low permeability in the horizontal direction and virtually no permeability vertically due to the crystalline composition and the depositional bedding planes. Localized areas of enhanced permeability can be present as fractures, solution cavities, or along formation changes. Most water supply wells produce from the till and upper several feet of the first bedrock encountered and demonstrate low production rates.

The proposed quarrying operation is located outside of and topographically higher than wetland and surface water features.

The existing domestic water supply systems (wells) produce from outside the quarry footprint and laterally distant from the proposed quarry operation and it is unlikely that any wells will be affected due to the depth of groundwater, the fact that the quarry floor will be above the groundwater, and the distance of the wells from the quarry.

Existing water resources and water supplies are not expected to be materially affected from the proposed Graymont Borgstrom Road Quarry. Surface water bodies are expected to maintain their current functions. Groundwater will be below the base of proposed quarrying operations and is not expected to be impacted during quarrying activities or after quarrying and reclamation are complete.

List of Abbreviations, Acronyms, and Symbols

b	saturated aquifer thickness
bgs	below ground surface
BMP	Best Management Practices
E	east
FKP	Fiborn Karst Preserve
Foth	Foth Infrastructure & Environment, LLC
ft/day	feet per day
GBRQ	Graymont Borgstrom Road Quarry
gpm	gallons per minute
Graymont	Graymont (MI) LLC
K	hydraulic conductivity
LTA	Land Transaction Agreement
MDEQ	Michigan Department of Environmental Quality
MI	Michigan
msl	mean sea level
N	north
NWI	National Wetlands Inventory
Project	Graymont Borgstrom Road Quarry
Q	discharge or pumping rate in gpm
S	south
S_y	specific yield
t	duration
W	west

1 Project Overview

The proposed Graymont Borgstrom Road Quarry (GBRQ) (Project) Operating Area 2 is located on property owned by Graymont (MI) LLC (Graymont) located in the townships of Garfield and Hudson, in Mackinac County, Michigan (MI). Operating Area 2 is comprised of approximately 239 acres, approximately 15 acres of which are located within the existing Hendricks Quarry. Operating Area 2 is adjacent to the 50 acres within Operating Area 1. **Figure C-1 – *Site Location Map*** shows the quarry and operational extent of Operating Area 2. Graymont proposes to conduct limestone quarrying activities within the area shown on Figure C-1).

Foth Infrastructure & Environment, LLC (Foth) was contracted by Graymont to complete an independent review of geologic and hydrogeological conditions, as required by the Land Transaction Agreement between the state of Michigan and Graymont, using available existing information within the project area to address potential effects to hydrologic resources adjacent to the proposed development. This assessment is being completed for Operating Area 2.

The purpose of this evaluation is to review available project planning, geologic and hydrogeological information, and provide an independent assessment regarding the potential for surface quarrying activities to affect surrounding groundwater and surface water resources, including domestic water supplies.

This report provides an overview of the hydrologic environment and presents the findings of the subject hydrologic evaluation.

1.1 Target Resource

The target resource is contained in Hendricks Formation carbonate sequences which outcrop in or are present near the surface within the GBRQ Operating Area 2. The carbonate sequence is composed of high calcium limestone and occurs as deposits, which can be economically extracted via surface quarrying techniques. The target limestone has been identified for its suitability for industrial mineral use.

1.2 Project Location

The Project is located in the Upper Peninsula of MI approximately 7 miles north of Lake Michigan and 40 miles northwest of St. Ignace, MI. The Project is situated in Garfield and Hudson Townships within Mackinac County. Rexton and Garnet are the closest communities to the Project. Rexton and Garnet are both unincorporated communities within Hudson Township. Local residents proximal to Operating Area 2 obtain their water from individual private wells.

1.3 Project Operations

The Project area is shown on Figure C-1. The GBRQ, with the inclusion of Operating Area 2, will be approximately 289 acres in extent. It will encompass the entire existing Hendricks quarry. The existing Hendricks Quarry area will be used for equipment staging and to serve as an entry point for limestone resources to the south and west.

A generalized depiction of the aerial extent and the subsurface till/bedrock structure in the vicinity of Operating Area 2 is shown on **Figure C-2 – *Generalized GBRQ Area.*** The target limestone in this area outcrops or immediately underlies the till/overburden in discontinuous higher ridges. The limestone and adjacent dolomite bedrock dip to the south causing the target limestone to deepen southward. Regionally, as you move away from the more resistant (to weathering) outcrop, glacial erosive/deposition features, cause the ground surface level to decrease and shallow lakes and/or wetlands occur. Figure C-2 also conceptually shows typical quarrying industry Best Management Practices (BMP) such as buffer strips and barrier berms which would aide in the mitigation of hydrologic impacts, if necessary. Dewatering operations are not planned for Operating Area 2 as groundwater is not expected to be encountered, as discussed in Section 4.

2 Background Site Characterization

The following sections characterize the geologic and hydrogeological conditions in the vicinity of the GBRQ Operating Area 2.

2.1 Geology and Hydrogeology

A general Michigan stratigraphic section is provided on **Figure C-3 – *Michigan Stratigraphic Nomenclature***. The target limestone is a member of the Hendricks Formation within the Burnt Bluff group, in the Niagaran stage of the middle Silurian period. **Figure C-4 – *Local Sloped Dolomite and Limestone Bedding*** is a geologic bedrock map showing the local slopped dolomite and limestone formations. The Hendricks Formation is typically 60-120 feet thick and consists of gray and buff dolomitic and lime mudstones and wackestones. The target limestone is characterized by buff-colored, high calcium lime mudstones and wackestones with some calcite crystals. This zone is targeted for its suitability for industrial mineral needs and is found at the top of the Hendricks Formation.

A cross section location map is provided as **Figure C-5 – *Cross Section Location Map***. Two geologic cross sections; one, north (N) – south (S) and one, east (E) – west (W) were developed and are provided as **Figure C-6 – *Geological Cross Sections A-A'*** and **Figure C-7 – *Geological Cross Section B-B'*** which show the inferred subsurface geologic and hydrogeological conditions within and adjacent to Operating Area 2 and in the vicinity of the existing Hendricks Quarry from N-S and E-W.

The stratigraphy in the region consists of Quaternary glacial till overlying the Silurian Engadine, Manistique, and Burnt Bluff Groups.

2.1.1 Engadine Group

The Engadine Group consists of the Bushbay Formation, Rapson Creek Formation, and Rockview Formations. The Engadine is characterized as bluish to buff massive, hard, crystalline dolomite, almost free of impurities with poorly developed and irregular joints (Smith, 1916).

2.1.2 Manistique Group

The Manistique Group consists of the Cordell and Schoolcraft Formations. The Manistique is characterized by a thick succession of white to buff to brown colored, finely bedded or thinly laminated dolomites and high magnesium limestones with conchoidal fracturing. Some beds are extremely cherty and siliceous and it extends from the Engadine down to the Hendricks Formation. Joints are varied from regular to very irregular (Smith, 1916).

2.1.3 Hendricks Formation

The target limestone is present at the top of the Hendricks Formation. The target limestone is characterized as buff to grayish buff dense grained to lithographic limestone containing small crystals of calcite. The joint systems are very irregular and poorly developed and the stone is brittle and fractures conchoidally (Smith, 1916). The remainder of the Hendricks Formation is characterized by gray dolomitic and dolomitic lime mudstones, wackestones, and packstones.

2.1.4 Hydrogeology

Regionally, groundwater is relatively shallow and found within a few feet of the ground surface to about 60 feet below the ground surface. The topography of the region is relatively flat with subdued ridges exhibiting higher topography. The region is poorly drained and is characterized by many wetlands and shallow lakes. Water wells in the area are typically set at the till/bedrock interface or in the shallow bedrock and receive their water from the glacial till and top, irregularly fractured portion of the shallow bedrock. As evidenced by local hydrologic features such as the level of adjacent wetlands, streams, and lakes; the occurrence and level of groundwater in local domestic wells; and the level of the bottom of the proposed Operating Area 2 quarry floor, the groundwater table is expected to be positioned below the deepest extension of the quarry floor (see ***Figure C-13 – Cross Section Location Map*** and ***Figure C-14 – Operating Area 2 Cross Sections***). Given this contrast, groundwater is not expected to be encountered and potential impacts associated with quarrying are negligible.

Groundwater flow through the crystalline bedrock is expected to be very limited or non-existent. Groundwater flow (where present) through the bedrock comes primarily via secondary porosity from fracture flow within networks of joints and fractures. The flow predominantly occurs as irregular, non-continuous thin zones of low permeability rock (<1.9 feet per day [ft/day]) (Muldoon, 2005). The majority of the formation displays negligible permeability with virtually no vertical permeability due to bedding and crystalline deposition. Zones of potentially enhanced hydraulic conductivity can occur typically at the surface of the bed, which has been exposed to alteration from weathering. Secondary permeability can also be created by karst/cave mechanics and connected fractures. The carbonate sequences are largely a low permeability crystalline system and these secondary permeability features are not typically connected for substantial distances/areas.

Shallow groundwater contours are presented on ***Figure C-8 – Groundwater Contour Map.*** Groundwater levels were measured in March 2018 in boreholes advanced by Graymont in Operating Area 2. Estimates of groundwater levels are also included in the area surrounding Operating Area 2.

2.2 Surface Water Hydrology

The surface water hydrology of the area is characterized by small, shallow lakes, wetlands creeks, and rivers, which are likely connected to the groundwater system and recharged by the large amount of annual precipitation. Precipitation that falls into the quarry area is evaporated or drained to unconsolidated material, with a minor amount of precipitation draining to groundwater. Regional surface water is poorly drained due to low topographical relief, shallow/bedrock with low permeability, and high regional recharge rates.

2.2.1 Karst

Extensive karst features have not been documented in the immediate area of Operating Area 2 or within the exposed existing Hendricks Quarry. There is one notable karst feature in the region approximately 9½ miles from Operating Area 2. The Fiborn Karst Preserve (FKP) is a 480-acre preserve near the Fiborn Quarry. Hydrogeological and geologic conditions in the FKP are significantly different than those observed in the GBRQ. This difference is primarily due to the

crystalline nature of the target limestone, the absence of vertical fractures that allow surface water to migrate to groundwater, and the quarry floor position above the groundwater. Accordingly, dissolution of the limestone to create karst features are absent in Operating Area 2.

2.2.2 Drainage Network

The general project area is located at the conjunction of three sub-basins draining to Lake Michigan, Lake Huron, and Lake Superior. The Operating Area 2 is located in the Tahquamenon Watershed. The drainage basins and sub-watersheds are shown on **Figure C-9 – *Drainage Basins/Surface Water Bodies***. The Tahquamenon sub-basin drains surface water north primarily via the Tahquamenon River into Tahquamenon Bay in Lake Superior. The Brevort-Millecoquins sub-basin is positioned south of Operating Area 2 and drains to Lake Michigan.

2.2.3 Surface Water Bodies

There are a number of small lakes located near Operating Area 2, which are shown on Figure C-8. Finn Lake, Nelson Lake, Grass Lake and Goat Lake are the closest in proximity to the GBRQ but are all located at least 5,000 feet away from the Operating Area 2 southern boundary and associated quarrying activities. The level of these surface water bodies are well below the deepest extent Operating Area 2 quarrying operations.

2.2.4 Wetlands

As shown on **Figure C-10 – *National Wetlands Inventory Map***, wetland areas have been identified in the area characteristic of Quaternary glaciated areas. The wetlands nearest to Operating Area 2 are comprised of Freshwater Emergent Wetland and Freshwater Forested/Shrub Wetland. No wetlands have been mapped within the 239-acre Operating Area 2 parcel and the nearest National Wetlands Inventory (NWI) mapped wetlands occur within approximately 850 feet of the proposed quarry activities. Both the shallow lakes and wetlands in the region are the result of relatively flat topography and shallow, nearly impermeable bedrock which maintain a high water table. Graymont supplemented the NWI mapping in August 2014 via a site specific wetlands delineation effort conducted by a professional wetlands scientist (ASTI, 2014). The supplemental inventory effort generally conformed to the NWI mapping however extent of the delineated wetlands were reduced or found to be discontinuous in several areas as compared to the NWI boundaries. **Figure C-11 – *Site Specific Delineated Wetlands*** shows the results of the filed mapping effort. Similar to the lakes discussed above, the closest wetlands are situated well below the level of the operating floor of the proposed quarry.

3 Proposed Quarry Operations

The extent of proposed quarrying activities are depicted on **Figure C-12 – *Phased Mining Sequence Operating Area 2***. Operating Area 2 is adjacent to Operating Area 1 and is comprised of approximately 239 acres, approximately 15 acres of which are located within the existing Hendricks Quarry. Operating Area 2 will be up to 55 feet deep once target limestone is extricated.

3.1 Graymont Borgstrom Road Quarry

The GBRQ Operating Area 2 involves conducting limestone quarrying in Garfield and Hudson Townships within Mackinac County, Michigan. Operating Area 2 is located within portions of the parcels described below which are owned by Graymont:

- NE ¼ Section 1, T 44 N, R 9 W, Garfield Township
- North ½ SE ¼ Section 1, T 44 N, R 9 W, Garfield Township
- West ½ NW ¼ Section 6, T 44N, R 6 W, Hudson Township
- NW ¼ SW ¼ Section 6, T 44N, R 6 W, Hudson Township

The Hendricks Formation, which contains the target limestone, can be seen in the existing Hendricks Quarry. As shown on Figure C-12, it is anticipated that quarrying operations would initiate within the southern portion of the GBRQ and would progress southward into adjacent economic deposits, continuing south and west to the Operating Area 2 boundary.

As shown on Figures C-2, C-6, and C-7, the target limestone generally occurs continuously throughout the GBRQ and is locally thinned by depositional and surface erosional features. In addition, the target limestone in the vicinity of the GBRQ can be locally thinned and overlain by the occurrence of surface water bodies and wetlands as a result of glacial erosion and deposition (see Figures C-6, C-7, and C-11). The areas containing wetlands and surface water features are typically situated in topographically low elevation areas created by glacial activity and lie to the southeast of the Operating Area 2.

Accordingly, GBRQ quarry activities will be limited to high upland areas where the target limestone outcrops or is near the surface. The resulting quarry footprint is limited to an upland pit on a subtle, topographically high ridge where the target limestone is present (see Figures C-6 and C-7). The upland position of the actual proposed quarry expansion area is anticipated to be above the local water table (as illustrated by the lack of water within the existing Hendricks Quarry). Lower portions of the quarry floor or walls are not expected to intersect the water table as quarrying operations progress south (get deeper with the dip of the limestone) and influence to the groundwater system is expected to be negligible due to the upland position of the pit.

As quarry activity progresses from the GBRQ, rock not suitable for sale and overburden will be placed in the pit. Rock not suitable for sale and overburden may also be used for perimeter sight/safety/buffer berms or surface hydrologic feature buffer/control berms as shown on Figure C-2. Quarrying methods are expected to include typical drilling and blasting, excavator/ truck/wheel-loader material handling, in-pit ore preparation (crushing and screening), and truck transport of target limestone to off-site facilities for shipping and further processing. Runoff

from disturbed areas associated with quarrying activities will be routed to the pit. Pit flooding is unlikely to occur even in the deepest portions of the pit, however, if perched groundwater was intercepted it would be expected to be of limited extent and quality due the low permeability of the host rock and minor amount of hydraulic head expected.

4 Analysis of Potential Hydrological Effects Resulting from the Proposed Quarry Operations

Based on the extraction activities proposed for the GBRQ Operating Area 2 quarrying operation and the local hydrologic characteristics, potential effects on the hydrologic regime are presented in the following subsections. The current (pre-quarrying) geologic, hydrogeological, and surface water characteristics are described in Section 2 using available information. The proposed operations area presented in Section 3 is based on the current level of planning available. The intent of this section is to characterize potential effects on the hydrologic system utilizing the information currently available.

4.1 Graymont Borgstrom Road Quarry

The GBRQ will consist of an open pit surface quarry in an area where the Hendricks Formation target limestone outcrops or is near the surface in a topographically elevated position. Hydrologic features are not expected to be significantly influenced since:

- the surface disturbance will occur at the top of drainage basin;
- surface water bodies fall within topographic low areas located away from the pit;
- the water table is expected to be below the projected quarry floor;
- the host rock will not yield water quality contributions which will degrade background characteristics;
- the low permeability of the target limestone is generally expected to inhibit groundwater movement.

4.1.1 Watershed Position

The entire Operating Area 2 is positioned within the upper portion of the Tahquamenon Watershed as shown on Figure C-10.

Given this upland position located at the top of the watershed boundary, effects to stream channel and basin characteristics are not expected. Developed stream channels are well outside Operating Area 2 and any secondary or tertiary channels are located in low topographical positions well outside of active quarrying activities.

No stream channel alteration will be required as part of quarrying operations or associated with transportation aspects. The entire area of the GBRQ is considered a watershed contribution and recharge area and quarry activities do not alter this function.

4.1.2 Topographical Position – Proximity to Surface Water and Wetlands

Two recognized surface water bodies occur south of Operating Area 2: Finn Lake, approximately 1½ miles south; and Nelson Lake, approximately 1½ miles to the southwest. As shown on Figure C-8, two lakes are present south of Operating Area 2: Finn Lake and Nelson

Lake. Both of these lakes are over 5,000 feet away from the Operating Area 2 southern border and levels of the lakes are lower than the projected bottom of the Operation Area 2 quarry. Both of these lakes exhibit northwest/southeast oriented wetlands but are not connected based on the wetland delineation mapping conducted in 2014. Figures C-9, C-10, and C-11 shows the designated wetlands and surface water features.

The Operating Area 2 operation will not intersect any delineated wetland area (based on the NWI mapping and the site-specific wetland delineation mapping previously described) and is not expected to influence adjacent wetland systems due to the relative topography of the quarry. The closest mapped wetland is approximately 1,615 feet southeast of the Operating Area 2 boundary.

The precipitation recharge function and the connectivity of the surface water system are anticipated to continue to maintain the water supply that creates the existing surface water regime. Based on the aerial position and level of the nearest lakes and wetlands as compared to the Operating Area 2 quarry, adverse effects to the lakes and wetlands are not expected.

4.1.3 Water Table Depth and Shape

The GBRQ operation is not expected to encounter groundwater even at the furthest southern extent. In the area of the GBRQ, the structure and targeted limestone production area/depth is above the water table and well away and above the levels of the nearest wetlands and lakes. This is evidenced by the lack of water or seeps within the existing Hendricks Quarry. Groundwater levels have also been observed in boreholes advanced by Graymont in Operating Area 2 and are deeper than the planned depth of the quarry. Given the proposed GBRQ Operating Area 2 operation location and extent, the natural conditions are expected to minimize hydrologic effects.

Cross-sections through Operating Area 2 are provided on Figure C-13 and Figure C-14. The water table depth is shown on the cross sections as measured in boreholes drilled by Graymont within Operating Area 2. The water table is situated below the deposits to be extracted. The water table is higher in the northwest corner of Operating Area 2 near the HUC-12 watershed boundary, but is still expected to be below the bottom of the bottom of the quarry, therefore no water table decline is foreseen associated with the Operating Area 2 activities. Removal of surface materials from Operating Area 2 is not expected to significantly affect groundwater recharge given the low hydraulic conductivity of the limestone.

Given the expected lack of communication with the water table, the discontinuity of the target limestone in the outcrop area, the low intrinsic permeability of the limestone, and the prolific amount of precipitation recharge to the hydrologic system each year, effects to the water table surface are expected to be negligible.

4.1.4 Water Quality

Surface water chemical characteristics are a result of bedrock, shallow till and precipitation chemistry. Organic matter accumulations in lower, stagnant areas and carbonate influenced groundwater interactions further define the surface water chemical composition. Quarry activities are not anticipated to directly disturb the surface water system since quarrying activities are not proposed to intersect surface water bodies and wetlands.

Groundwater quality data is unavailable for the Borgstrom Road Quarry, however, water quality data from groundwater samples collected from monitoring wells at the Graymont Eastern Quarry approximately 12 miles east is expected to be similar to the groundwater in GBRQ. The data is presented in Table C-1.

Increased exposure to limestone and dolomite from rock stockpiles and quarry surfaces offers the potential to add carbonate rock constituents to the system. The carbonate constituents would largely be limited to calcium and magnesium cations and carbonate anions. These constituents are not associated with liberating unwanted metals and are buffering compounds typically used to treat acid conditions. In addition, the quantity of quarry discharge water loading will be insignificant as compared to the precipitation recharge component to the surface water system.

No effects are anticipated to background surface or groundwater quality associated with the proposed Operational Area 2 quarrying operations.

4.2 Analysis of Water Supplies in the Vicinity of the Quarry Operation

Well records for water supply systems in the vicinity of the GBRQ Operating Area 2 were researched to determine locations and pertinent well construction and production zone information. Wells within one mile of the proposed GBRQ operation boundary were further analyzed to determine if quarrying operations could be expected to influence the capability of the water supply well to continue to produce groundwater. The records were obtained from the Michigan Department of Environmental Quality's (MDEQ), Wellogic online database and supplemental scanned records. Pertinent information was reviewed and summarized on **Figure C-15 – *Domestic Water Supply Well Locations***. The information summarized includes:

- Well Location (coordinates MI GeoRef)
- Well Elevation (feet mean sea level [msl])
- Top of Bedrock (feet below ground surface [bgs] and feet msl) (if encountered)
- Total Drill Hole Depth (feet bgs and feet msl)
- Screened Interval (if installed) (feet bgs and feet msl)
- Static Water Level (feet bgs and feet msl)

Not all the well records are complete – portions of the data were either lacking or set to a default value that may not be representative of actual conditions. Any wells not reported to or entered into the MDEQ database or contained in the scanned well records have not been included in this analysis.

A total of ten wells were found to be present within one mile of the proposed quarry activities associated with the GBRQ and summarized and displayed on Figure C-15.

None of the ten wells are located within the proposed quarry operations and would not be physically damaged by quarry operations. The closest well (#1155) is approximately 1,520 feet from the quarry boundary (see Figure C-15). Quarry activities are not expected to affect groundwater levels, given that the water table is deeper than the planned bottom level of the quarry, as discussed in Section 4.1.3.

5 Quarry Design and Operational Mitigation

One of the objectives of the proposed Operating Area 2 quarry component locations, design, and operations is to economically extract limestone while minimizing adverse effects to natural resources and local domestic water supply systems.

5.1 Effective Utilization of Natural Conditions

The target limestone areas amenable for surface extraction generally coincide with topographic high points. Operating Area 2 is positioned at a topographic high area which avoids surface water features and wetlands.

Groundwater occurrence and flow is not anticipated to be affected by quarry activities associated with Operating Area 2 because the planned level of the bottom of the quarry is higher than the groundwater level observed in on-site boreholes. Surface water and groundwater chemistry are not expected to be materially affected due to the chemical composition of the local carbonate water bearing units and the dilution effect of the surface water/glacial till system. The target limestone does not contain constituents that would be considered to be harmful to the native system, as discussed in Section 4.1.4.

5.2 Surface Water Containment and Control

Surface water and runoff control is typically conducted in a three-tiered approach, as needed.

- Significant storm water runoff emanating from undisturbed areas is diverted around disturbed areas and allowed to flow naturally within the established drainage paths and systems. This "undisturbed water" routing will minimize changes to the natural drainage system.

- Disturbed runoff water would be expected to be contained within Operating Area 2.

- If excess water is encountered, runoff from disturbed areas is contained and allowed to settle prior to discharge via permitted discharges or captured and used for dust suppression/quarry operations.

- Non-contact storm water will be directed around the quarry area.

5.3 Pit Dewatering

Quarry dewatering is not expected to be required within Operating Area 2 as discussed in Sections 3 and 4. Precipitation contributions would typically be routed to a low point in the pit and used for dust suppression and operational needs or allowed to evaporate.

5.4 Operating Practices

Operational practices typical to standard industry practices may be utilized as needed to further contain and control potential effects associated with quarrying activities. Controls and operations typical of quarrying operations should be considered as appropriate and may include

accepted quarry Best Management Practices (BMP) such as diversion berms and ditches, use of rock rip rap, erosion control of exposed stockpiles, dust suppression, etc.

5.5 Barriers to Groundwater Flow

Groundwater should not be encountered in the quarry in Operating Area 2, based on the observed groundwater levels. The lack of horizontal and vertical permeability are anticipated to naturally limit infiltration of water from the quarry to groundwater. In the unlikely event that saturated, localized, high permeability zones are encountered within the unconsolidated materials or bedrock, several options are available to retard flow rates and manage water table levels adjacent to excavations and may be employed as necessary. These options include dewatering trenches, dewatering wells, and low permeability barrier walls.

5.6 Monitoring/Testing/Analysis

Groundwater will not be encountered in the quarry in Operating Area 2, based on the observed groundwater levels. Accordingly, a groundwater monitoring program will not be necessary. Graymont will regularly assess pit conditions within Operating Area 2 as the pit advances to evaluate the occurrence of groundwater.

5.7 Water Supply System Mitigation

As described in Section 4, the closest domestic water supply wells are located outside the quarry operations. Groundwater should not be encountered in the quarry in Operating Area 2, based on the observed groundwater levels. Due to the expected separation of the quarry floor above the groundwater and since operations will generally be moving further away from the existing, off-site water supply wells, no impacts to these nearby wells or any other wells are anticipated. Should it be determined that water quality in a domestic water supply was altered by Operating Area 2 activities, Graymont can mitigate the effect by drilling a new well.

6 Reclamation and Hydrologic Restoration

As required by the Land Transaction Agreement (LTA), quarry infrastructure will be removed following permanent completion of extraction and processing activities. Re-vegetation will be allowed to colonize naturally.

6.1 Hydrologic and Hydrogeological Restoration

The post-quarry topography will reflect a dampened expression of the pit extent with vegetated safety berms to promote public safety. The pit floor will exhibit a subdued hummocky topography based on the final distribution of the reclamation material. All areas within Operating Area 2 would be covered with an average minimum of 12 inches (with the exception of the defined historic foundations in the existing Hendricks Quarry) of overburden to serve as plant growth medium. Some areas within the 289-acre Operating Area 2 footprint would receive more than 12 inches of overburden. **Figure C-16 – *Post-Quarrying Conditions for Operating Area 2*** presents the reclaimed Operating Area 2 quarry.

Precipitation falling within the quarried/reclaimed area of Operating Area 2 will evaporate and/or seep into pit floor materials. Even during heavy precipitation events or snowmelt, meteoric water from precipitation is expected to be consumed within the reclaimed materials. As the reclaimed materials become vegetated, meteoric water is expected to be consumed via evapotranspiration and evaporation. Depending on final pit floor/residual bedrock levels, localized, temporary ponding may occur on the floor of the existing, exposed Hendricks Quarry outside of Operating Area 2 but would be expected to dry up as currently witnessed via evaporation. Precipitation occurring outside the pit and remaining safety barriers will infiltrate into surficial soils, concentrate as runoff away from the pit, or enter the pit depending on grade and precipitation intensity. Groundwater will not be encountered in the pit and sustainable hydrologic conditions for ponds or wetlands are not anticipated.

Water quality is not expected to be affected by surface quarrying operations. The host rock and aquifer material is composed of limestone and dolomite. Both source materials are soluble in water and their constituents will undoubtedly contribute to the constituency of the groundwater and surface water chemistry. As discussed in Section 4.1.4, the groundwater in the area is dominated by calcium, magnesium cations, and carbonate anions creating calcium/magnesium carbonate waters. This chemical composition constitutes oxidized, buffering characteristics and does not promote the creation of acid runoff or metals dissolution common with metallic quarrying operations. The surface water system receives such a large quantity of precipitation recharge that any influences would be readily diluted. Based on the chemistry of the host rock material and the prolific recharge characteristics, post-quarrying material, short or long-term effects to the surface and groundwater hydrologic regime are not expected.

Based on the upland position of the proposed quarry along with proposed quarrying and reclamation activities proposed, post-quarrying hydrologic and hydrogeological conditions are expected to maintain approximate pre-quarrying characteristics.

7 Authors

This report has been prepared by Richard Schowengerdt, Brooke Lund, and Heather Hallett, Foth.

Richard Schowengerdt

Richard Schowengerdt is a Principal Engineer and Hydrogeologist within the Foth Quarrying Group. He offers over 35 years of applied quarrying experience specializing in quarrying design and reclamation applications. Mr. Schowengerdt provides extensive experience in the, quarrying, synfuels, water supply development, and water control/treatment arena throughout the western and mid-western United States. Specific applications include quarry development and design, state and federal quarry permitting, baseline investigations and data analysis, dewatering analysis and design, and impacts analysis. Mr. Schowengerdt has been utilized as an expert associated with quarry design, permitting and, potential impacts to water supplies associated with limestone and dolomite quarry development and expansion in Illinois and Wisconsin as well as numerous quarry design support applications throughout the U.S. and internationally.

Brooke Lund

Brooke Lund is a Geologist within Foth. She offers over 6 years of applied geological experience specializing in complex bedrock hydrogeological investigations, field applications, and exploratory geology. She has extensive experience in drilling oversight, field program management, well construction oversight, extensive experience in surface and underground quarrying environments, reporting, data management, and regulatory compliance monitoring and reporting for quarrying clients in Nevada, Missouri, Alaska, Wisconsin, and Minnesota. Additionally, she spent time working for quarrying clients on managing and implementing field operations for deep bedrock hydrogeological investigations in Colombia and Mexico.

Heather Hallett

Heather Hallett is a Hydrogeologist within Foth. She is a professional geologist, licensed in Pennsylvania and Wisconsin. She has over 11 years of experience in hydrologic characterization in many applications, including surface mining.

8 References

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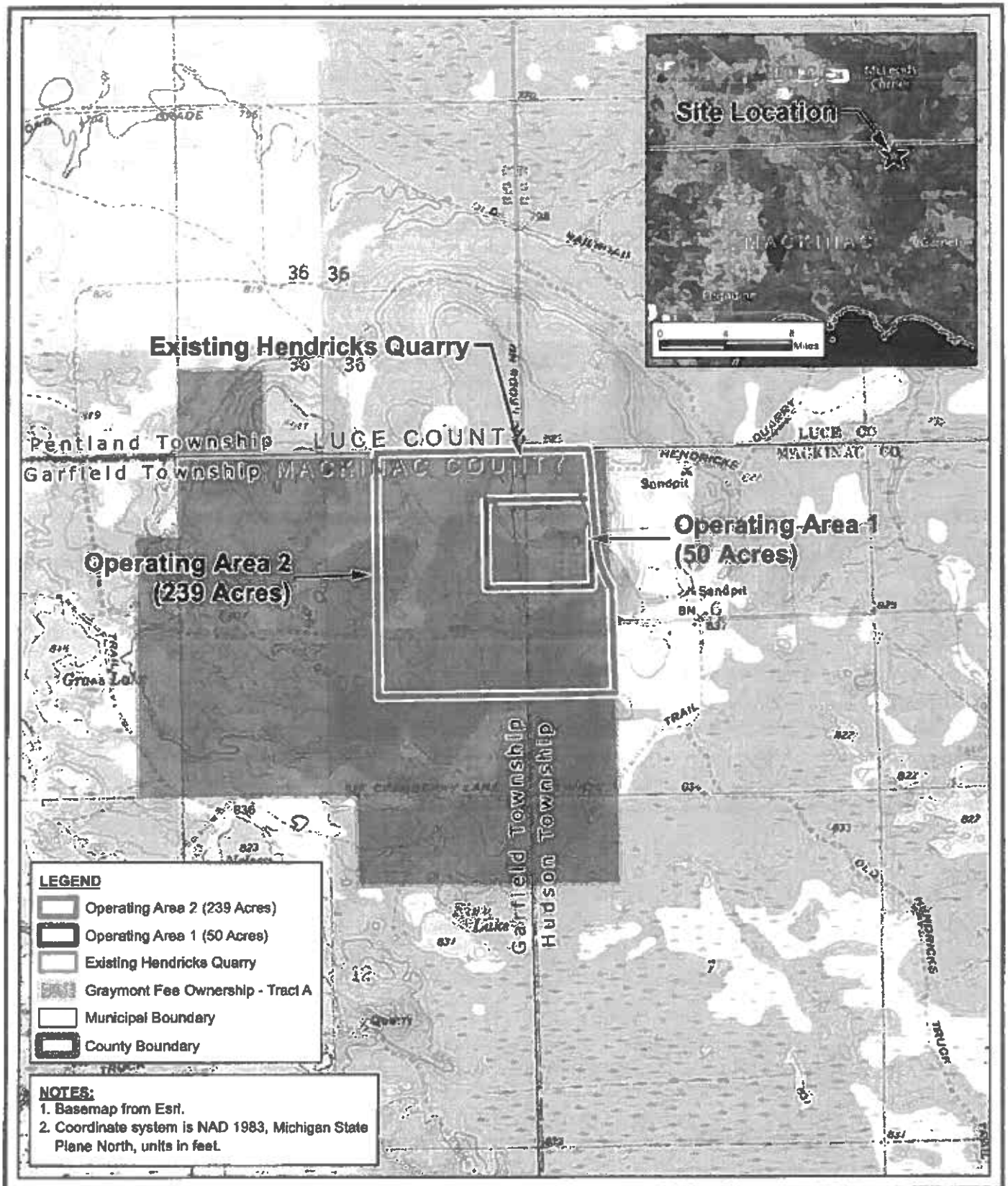
Figures



GRAYMONT

Foth

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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

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REVIEWED BY:	MRS5	DATE:	APR.'18
APPROVED BY:	RWS3	DATE:	APR.'18

GRAYMONT (MI) LLC

FIGURE C-1
SITE LOCATION MAP
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet		Date:	APRIL 2018
Drafted by:	BJW1	Project No:	14W777

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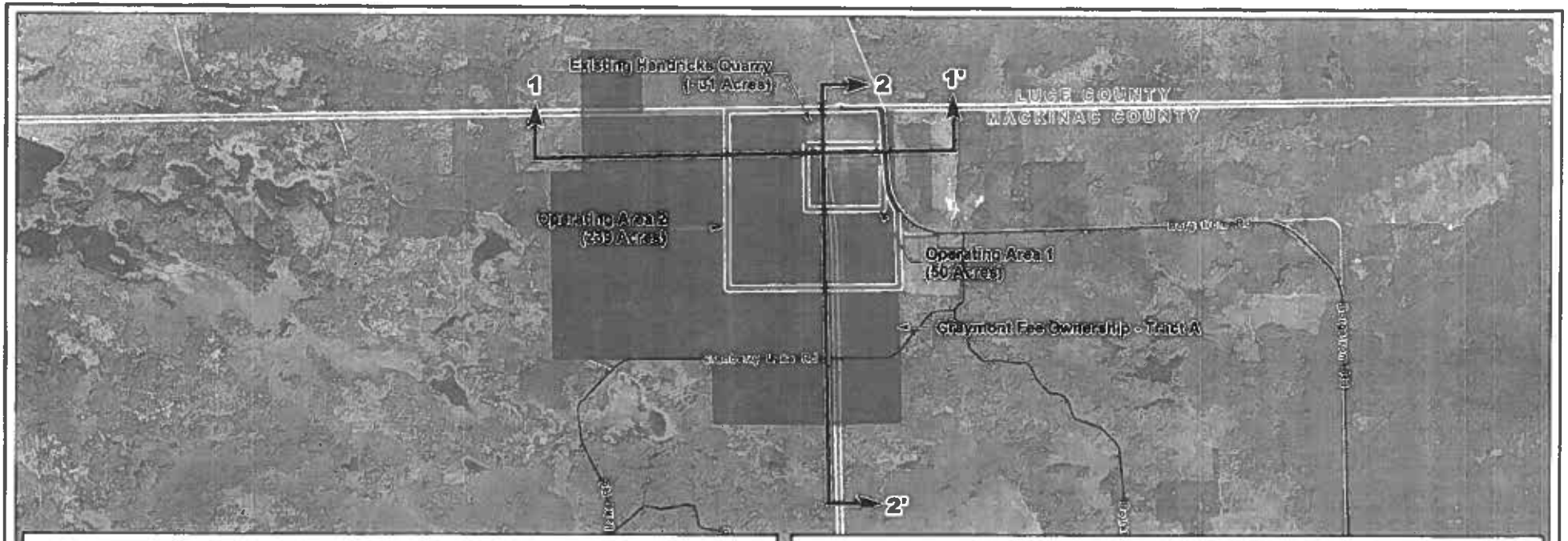

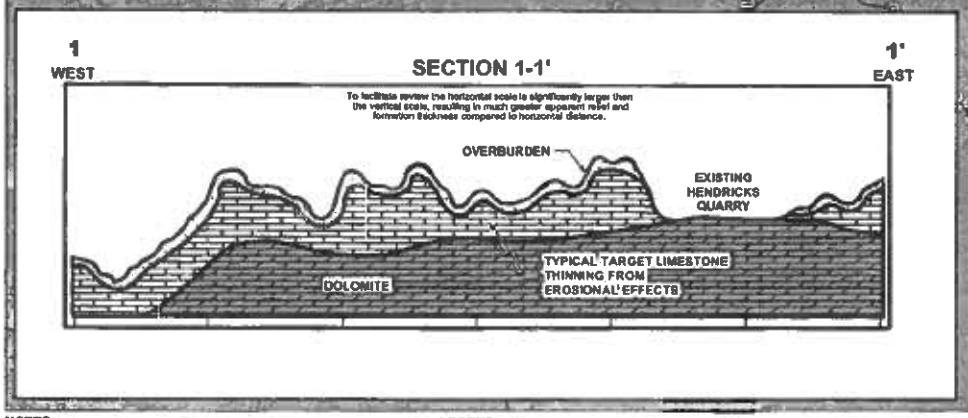

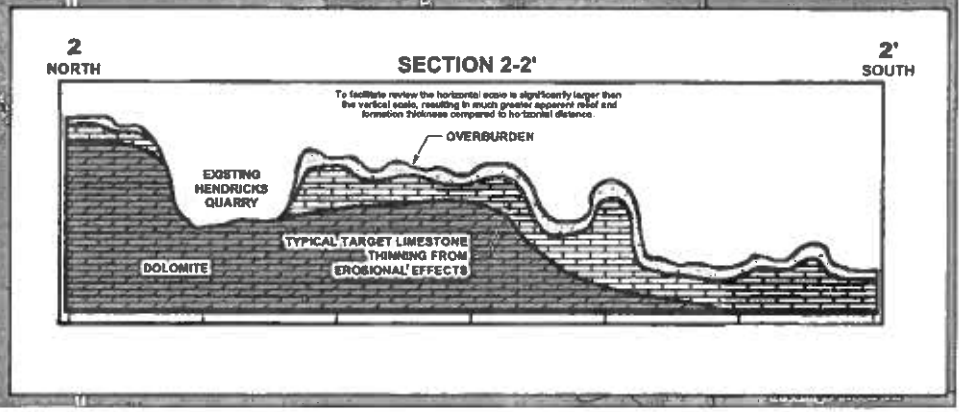

NOTES:

1. Base imagery from Earl.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.1
4. The quarry area boundaries lines of section and other details are preliminary, conceptual depictions for illustrative purposes. Final designs, locations and corresponding details will be defined based on supplemental information acquisition and final engineering.

LEGEND

- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Road
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY	HLH	DATE	APR.'18
REVIEWED BY:	MRS5	DATE:	APR.'18
APPROVED BY:	RWS3	DATE:	APR.'18

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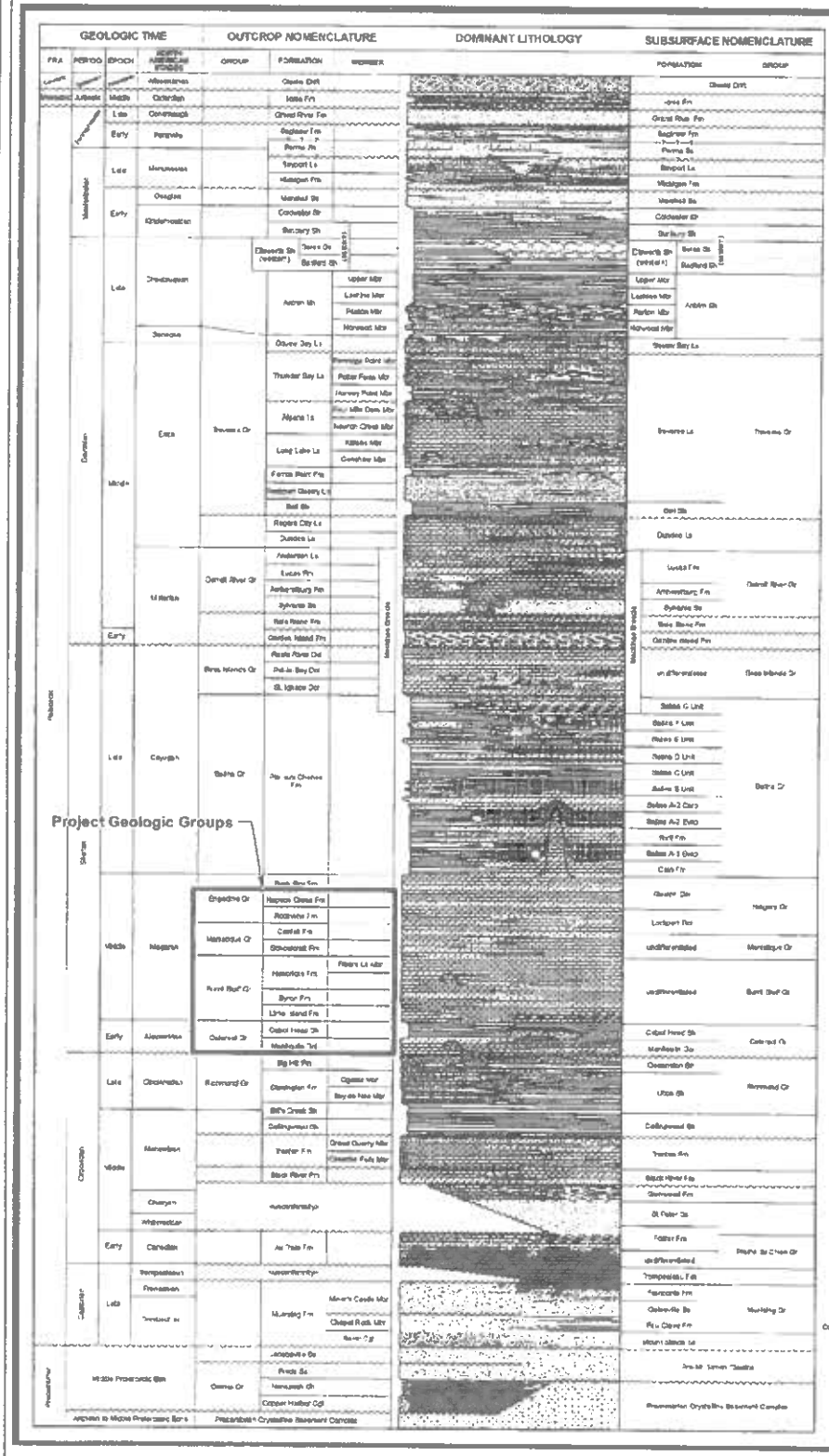
FIGURE C-2
GENERALIZED GBRQ AREA
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet		Date:	APRIL 2018
Drafted by:	BJW1	Project No:	14W777

Path: X:\GSWet\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix C\Figure C-2 Generalized GBRQ Area.mxd Date: 4/19/2018



STRATIGRAPHIC NOMENCLATURE FOR MICHIGAN

Michigan Dept. of Environmental Quality
Geological Survey Division
Harold Fitch, State Geologist
and
Michigan Basin Geological Society

Stratigraphic Nomenclature Project Committee:
Dr. Paul A. Catacosinos, Co-chairman
Mr. Mark S. Wollenzek, Co-chairman

Principle Authors
Dr. Paul A. Catacosinos
Dr. William B. Harrison III
Mr. Robert F. Reynolds
Dr. David B. Westjohn
Mr. Mark S. Wollenzek

2000

Acknowledgements

This work is the product of the combined efforts of the geological communities of Michigan and the surrounding states and provinces. Below are given just a fractional sample of the contributors.

Academia: Dr. Ardell J. Cross, Michigan State University; Dr. Robert H. Dott Jr. University of Wisconsin; Mr. William D. Everhart, Ph.D. Candidate Michigan Technological University.

Government: Dr. Terry R. Carter, Ontario Ministry of Natural Resources; Mr. John M. Koch, Michigan Department of Environmental Quality; Dr. Brian D. Keith Indiana Geological Survey; Mr. Lawrence H. Wickstrom, Ohio Geological Survey.

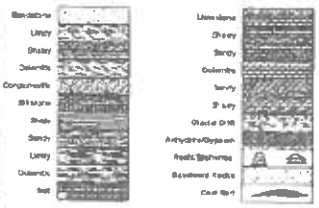
Industry: Mr. Dennis J. Bailey, Consultant; Mr. Jerry R. Myers, Bass Energy; Mr. Don E. Pfeifer, Pfeifer Exploration Services.

A complete listing of all contributors will be found in the Stratigraphic Lexicon for Michigan, of which this column is an integral part.

RELATED TERM CORRELATION

STRATIGRAPHIC POSITION	RELATED TERMS
Jurassic Fm	Jurassic Red Beds
Michigan Fm	Clare Dolomite, Brown Lime, Gray Dolomite, Gray Sandstone, Gray-Gray Sandstone, Gray-Gray-Gray Sandstone, Thale Gray
Coldwater Sh	Coldwater Red Beds, Standard Dolomite, Weir Sand
Marshall Ss	Charlton Black, Basic Member, Bilden, Chester Black, Shale Member, Upper Basic Shale, Light Arden, Lower Black, Lower Arden, Middle Arden, Middle Gray Arden, Dark Arden, Middle Gray Shale, Unit 1A, Unit 1 B, U-B 1C, Chapel Creek Gray Shale Member
Dundee Ls	Kalkaska City Member/Downeville Member
Lucas Fm	Finer Sandstone, Hamer Member, Mid Member, Mirror Sandstone, Blue Zone, Big Anhydrite, Richfield Zone/Mesaverde Anhydrite, Big Salt
Ambrosia Fm	Finer Sandstone, Medium Member, Black Lime
St. Ignace Dolomite	Salina H Unit
Salina B Unit	Big Salt, B Salt
Salina A-1 Carbonate	Salina A-1 Carbonate, Redwell Bars Anhydrite
Salina A-2 Carbonate	Salina A-2 Carbonate
Niagaran Series	Brown Niagara, Niagaran Reef, Pinnacle Reef, Engadine Dolomite
Lockport Dolomite	Gray Niagara, White Niagara
Burnt Bluff Gr	Cataract Formation
Manitoulin Fm	Cabot Dolomite
Black River Fm	Van Wert Zone, Sheetly Pool, Black River Shale
Glenwood Fm	Deckerville Unit, Zone of Unconformity
St. Peter Sandstone	Ringstone Sandstone, Jordan Sandstone, Knox Sandstone, Magnesia Sand
Prairie du Chien Gr	Foster Formation, Wise Mountain Sandstone, Lower Knox Carbonate, St. Lawrence Formation, T-POC, Oneota Dolomite, Shakopee Chert
Trempealeau Fm	Lodi Formation
Dresbach Ss	Dresbach Sandstone
Pre-Cambrian Crystalline	Precambrian "Red Beds"

LEGEND (See Note 2)



NOTES:

1. Michigan Stratigraphic Column supplied by MDEQ, Geological Survey Division.
2. Upper formations may not be present due to erosional activity.

GRAYMONT

Foth

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REVIEWED BY: MRS5			DATE: APR.'18
APPROVED BY: RWS3			DATE: APR.'18

GRAYMONT (MI) LLC

FIGURE C-3
MICHIGAN STRATIGRAPHIC NOMENCLATURE
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale:	NOT TO SCALE	Date:	APRIL 2018
Drafted by:	BJW1	Project No:	14W777

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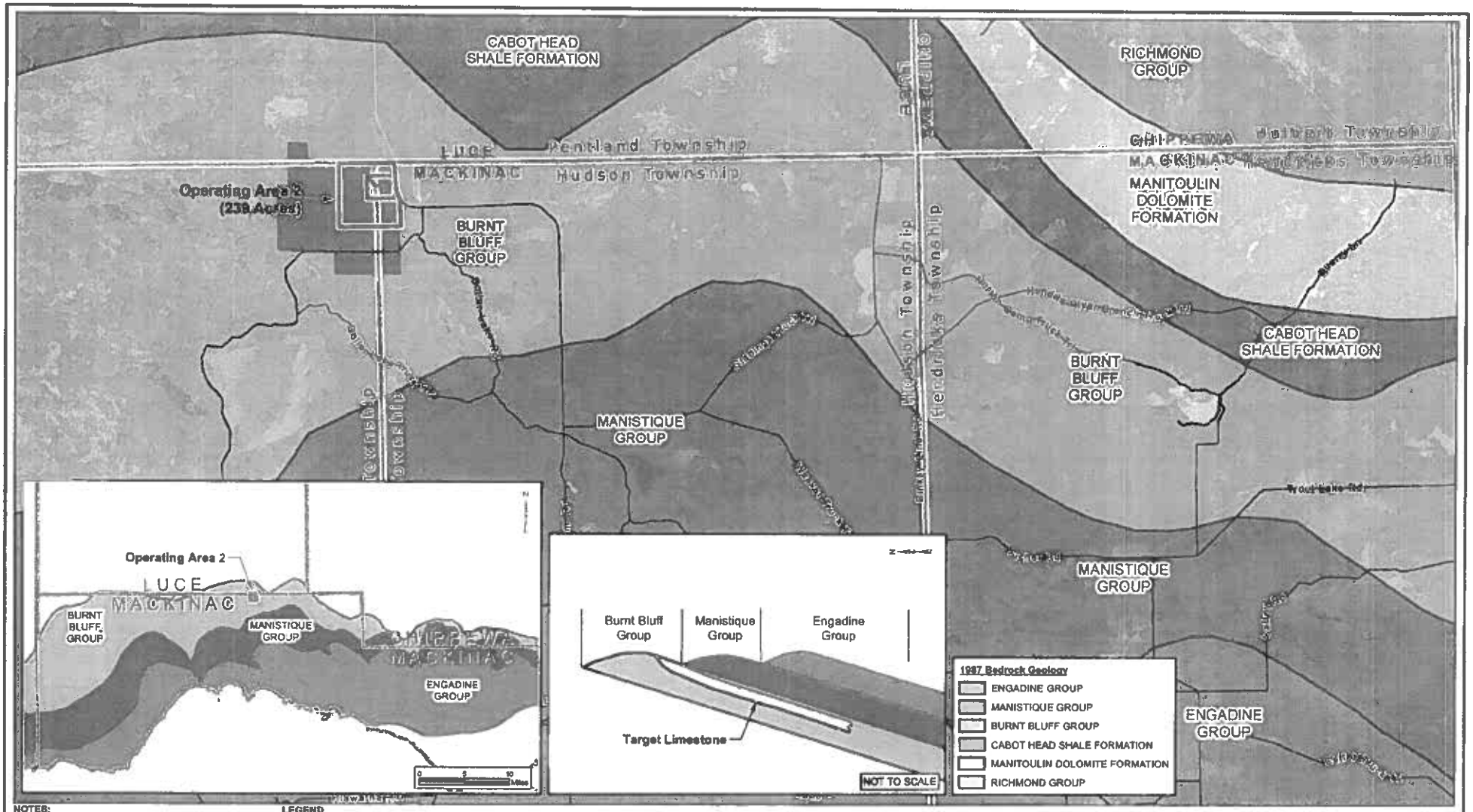

NOTES:

1. Base imagery from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
3. Road and boundary data from Michigan Center for Geographic Information.
4. 1987 Bedrock Geology supplied by Michigan Center for Geographic Information
5. Inset diagrams are approximate representations, are provided for illustrative purposes, and do not reflect actual locations and depths.

LEGEND

- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Road
- Municipal Boundary
- County Boundary

Middle Silurian Age

- Engadine Dolostone Group
- Manistique Group
- Burnt Bluff Group

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REVIEWED BY: MRS5		DATE APR.'18	
APPROVED BY: RWS3		DATE APR.'18	

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FIGURE C-4
LOCAL SLOPED DOLOMITE AND LIMESTONE BEDDING
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 0.5 1 Miles | Date: APRIL 2018
Drafted by: BJW1 | Project No: 14W777

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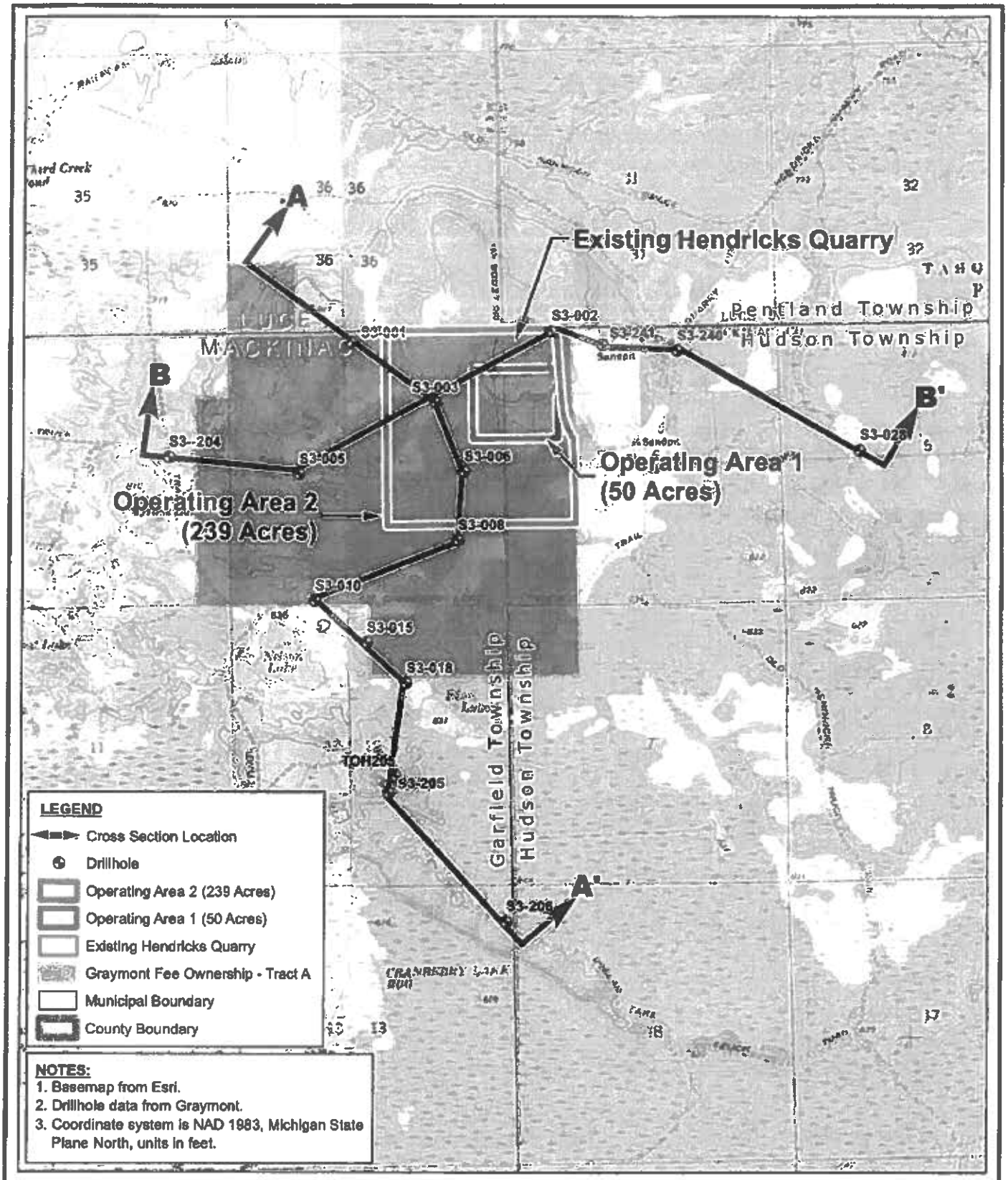

GRAYMONT

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Foth Infrastructure & Environment, LLC				GRAYMONT (MI) LLC	
REVISED	DATE	BY	DESCRIPTION	FIGURE C-5 CROSS SECTION LOCATION MAP GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI	
PREPARED BY: HLH			DATE: APR.'18		
REVIEWED BY: MRS5			DATE: APR.'18	Scale: 0 1,000 2,000 Feet	Date: APRIL 2018
APPROVED BY: RWS3			DATE: APR.'18	Drafted by: BJW1	Project No: 14W777

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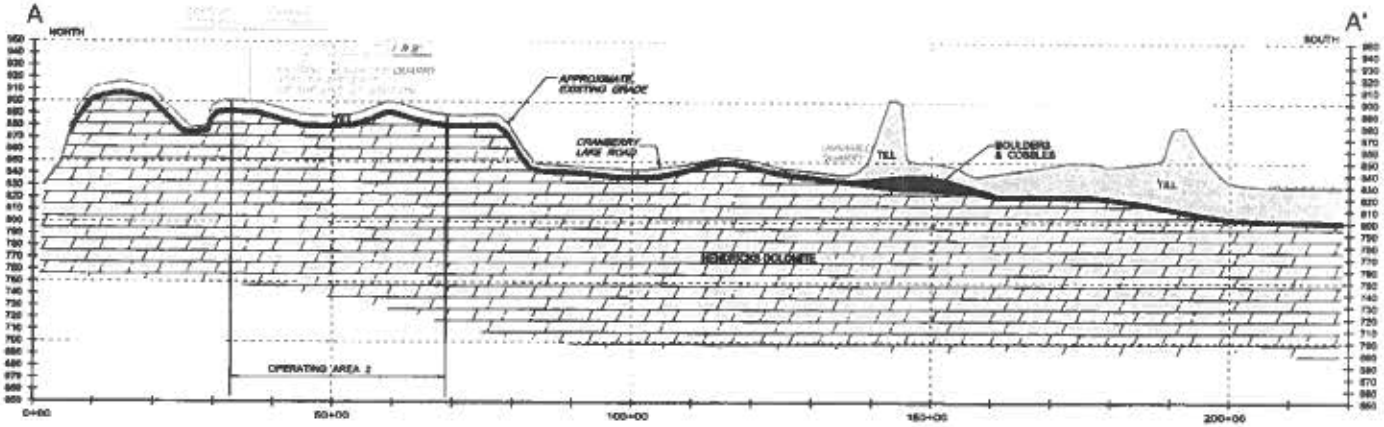
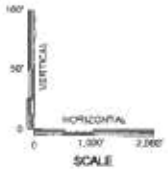




LEGEND

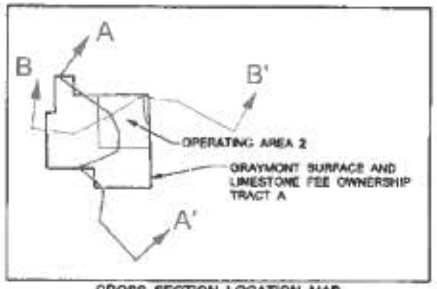
- WETLAND (FROM USGS TOPO)
- TILL / OVERBURDEN
- BOULDERS AND COBBLES
- HENDRICKS DOLOMITE

NOTE:

TO FACILITATE REVIEW, THE HORIZONTAL SCALE IS 20 TIMES LARGER THAN THE VERTICAL SCALE RESULTING IN AN EXAGGERATED SECTION INDICATING MUCH GREATER RELIEF AND FORMATION THICKNESS AS COMPARED TO THE HORIZONTAL DISTANCE.

NOTES:

1. CROSS-SECTIONS ARE INTERPOLATED FROM AVAILABLE GEOLOGIC DATA. SUBSURFACE CONDITIONS HAVE BEEN INFERRED.
2. SURFACE TOPOGRAPHY GENERATED FROM A COMBINATION OF LIDAR DATA AND USGS TOPO.
3. INFORMATION FOR WELL DATA FROM MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY ONLINE WELL DATABASE AND HAS BEEN PROJECTED ONTO THE SECTION FOR ILLUSTRATIVE PURPOSES ONLY.
4. HENDRICKS FORMATION CONTAINS THE TARGET LIMESTONE.



CROSS SECTION LOCATION MAP
NOT TO SCALE

GRAYMONT
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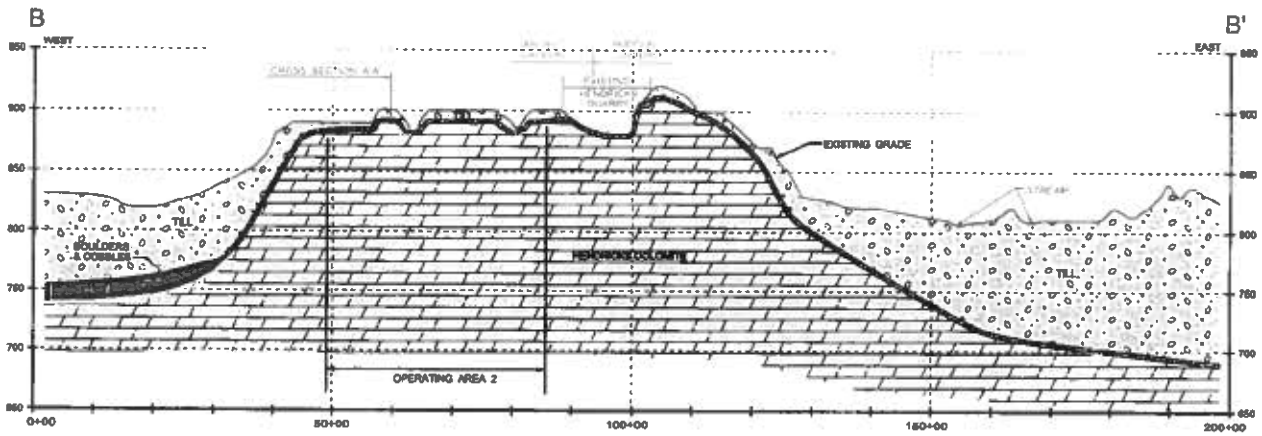
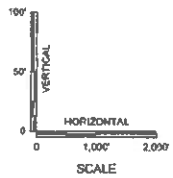
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: NLH		DATE: APR.'18	
REVIEWED BY: MRBS		DATE: APR.'18	
APPROVED BY: RWBS		DATE: APR.'18	

GRAYMONT (MI) LLC

FIGURE C-6
GEOLOGICAL CROSS SECTION A - A'
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale:	SEE BAR SCALE	Date:	APRIL 2018
Drafted By:	JDW	Project No.	14W777





LEGEND

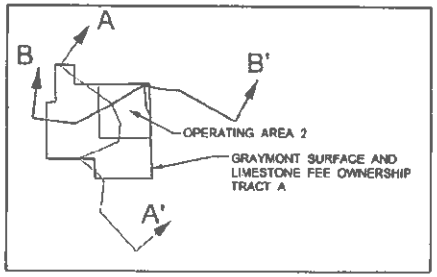
- TILL / OVERBURDEN
- BOULDERS AND COBBLES
- HENDRICKS DOLOMITE

NOTE:

TO FACILITATE REVIEW, THE HORIZONTAL SCALE IS 20 TIMES LARGER THAN THE VERTICAL SCALE RESULTING IN AN EXAGGERATED SECTION INDICATING MUCH GREATER RELIEF AND FORMATION THICKNESS AS COMPARED TO THE HORIZONTAL DISTANCE.

NOTES:

1. CROSS - SECTIONS ARE INTERPOLATED FROM AVAILABLE GEOLOGIC DATA. SUBSURFACE CONDITIONS HAVE BEEN INFERRED.
2. SURFACE TOPOGRAPHY GENERATED FROM A COMBINATION OF LIDAR DATA AND USGS TOPO.
3. HENDRICKS FORMATION CONTAINS THE TARGET LIMESTONE.



CROSS SECTION LOCATION MAP
NOT TO SCALE

GRAYMONT
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REVISED	DATE	BY	DESCRIPTION
PREPARED BY: HLH		DATE: APR.'18	
REVIEWED BY: MRS5		DATE: APR.'18	
APPROVED BY: RWS3		DATE: APR.'18	

GRAYMONT (MI) LLC

FIGURE C-7

GEOLOGICAL CROSS SECTION B - B'
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale:	SEE BAR SCALE	Date:	APRIL 2018
Drafted By:	JOW	Project No.	14W777

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NOTES:

1. Base imagery from Esri.
2. Site boundary data and delineated wetland data from Graymont.
3. National Wetland Inventory (NWI) data downloaded from the U.S. Fish and Wildlife Service. (https://www.fws.gov/wetlands/)
4. Topographic contours generated from USGS 10 meter digital elevation model (DEM).
5. Road and boundary data from Michigan Center for Geographic Information.
6. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND

- Drillhole with Groundwater Elevation (Feet)
- Private Well with Groundwater Elevation (Feet)
- Groundwater Contour
- Topographic Contour
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Existing Hendricks Quarry
- Delineated Wetland
- NWI Wetland
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

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Foth Infrastructure & Environment, LLC			
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PREPARED BY:	HLH	DATE: APR.'16	
REVIEWED BY:	MRS5	DATE: APR.'16	
APPROVED BY:	RWS3	DATE: APR.'16	

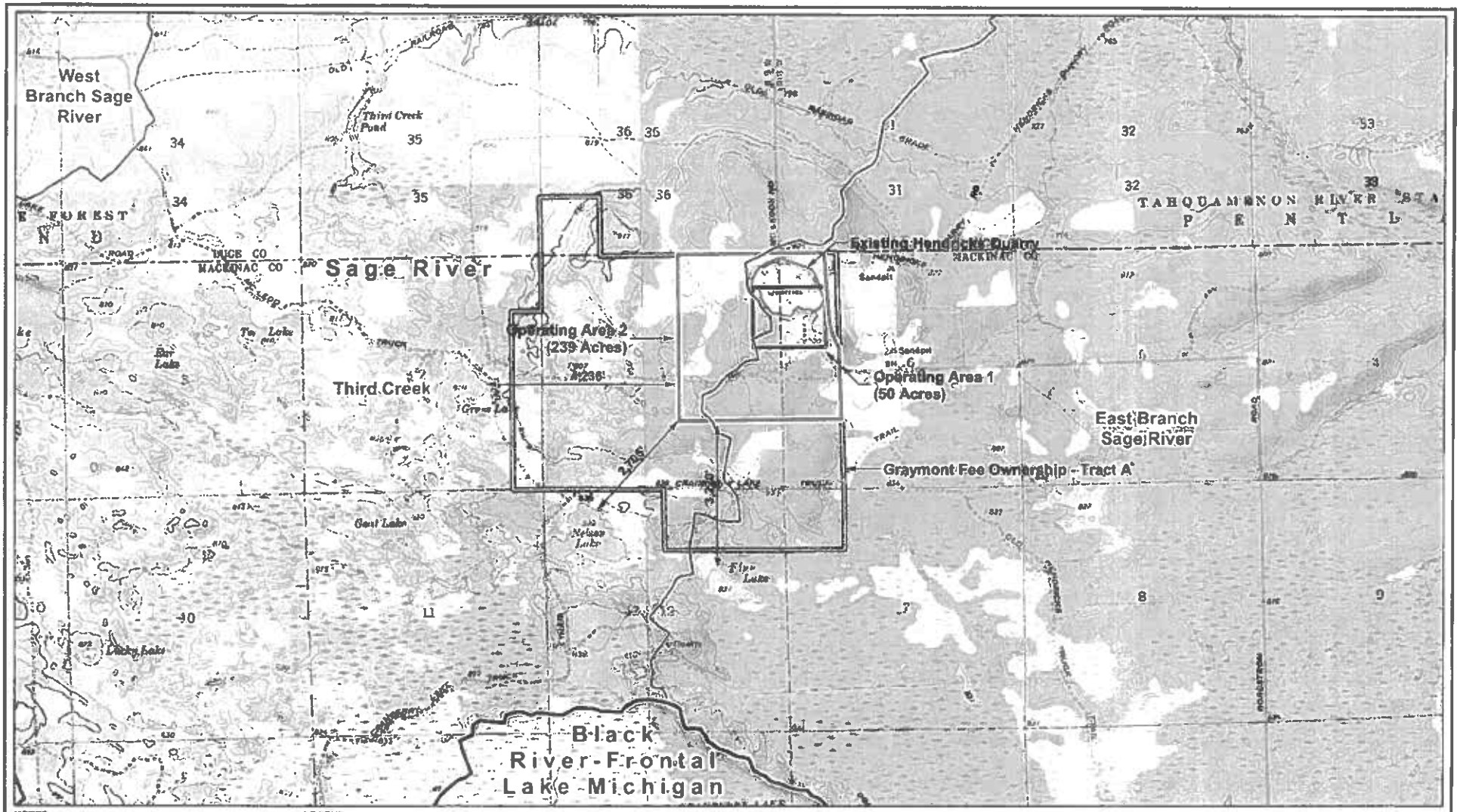
GRAYMONT (MI) LLC

FIGURE C-8

GROUNDWATER CONTOUR MAP
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 300 600 Feet | Date: APRIL 2016
Drafted by: BJW1 | Project No: 14W777

Path: X:\GBVD\2014\14W777-00\GIS\mxd\GBRQ 2016 EA Designation\Appendix C\Figure C-8 Groundwater Contour Map.mxd Date: 4/19/2016



NOTES:
1. Basemap from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
3. Watershed data from the USGS National Hydrography Dataset.

LEGEND
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Watershed Boundary (HUC-10)
- Watershed Boundary (HUC-12)

GRAYMONT

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Foth Infrastructure & Environment, LLC				GRAYMONT (MI) LLC	
REVISED	DATE	BY	DESCRIPTION	FIGURE C-9 DRAINAGE BASINS/SURFACE WATER BODIES GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI	
PREPARED BY:	HLH	DATE: APR.'18			
REVIEWED BY:	MRS5	DATE: APR.'18		Scale: 0 1,000 2,000 Feet	Date: APRIL 2018
APPROVED BY:	RWS3	DATE: APR.'18		Drafted by: BJW1	Project No: 14W777

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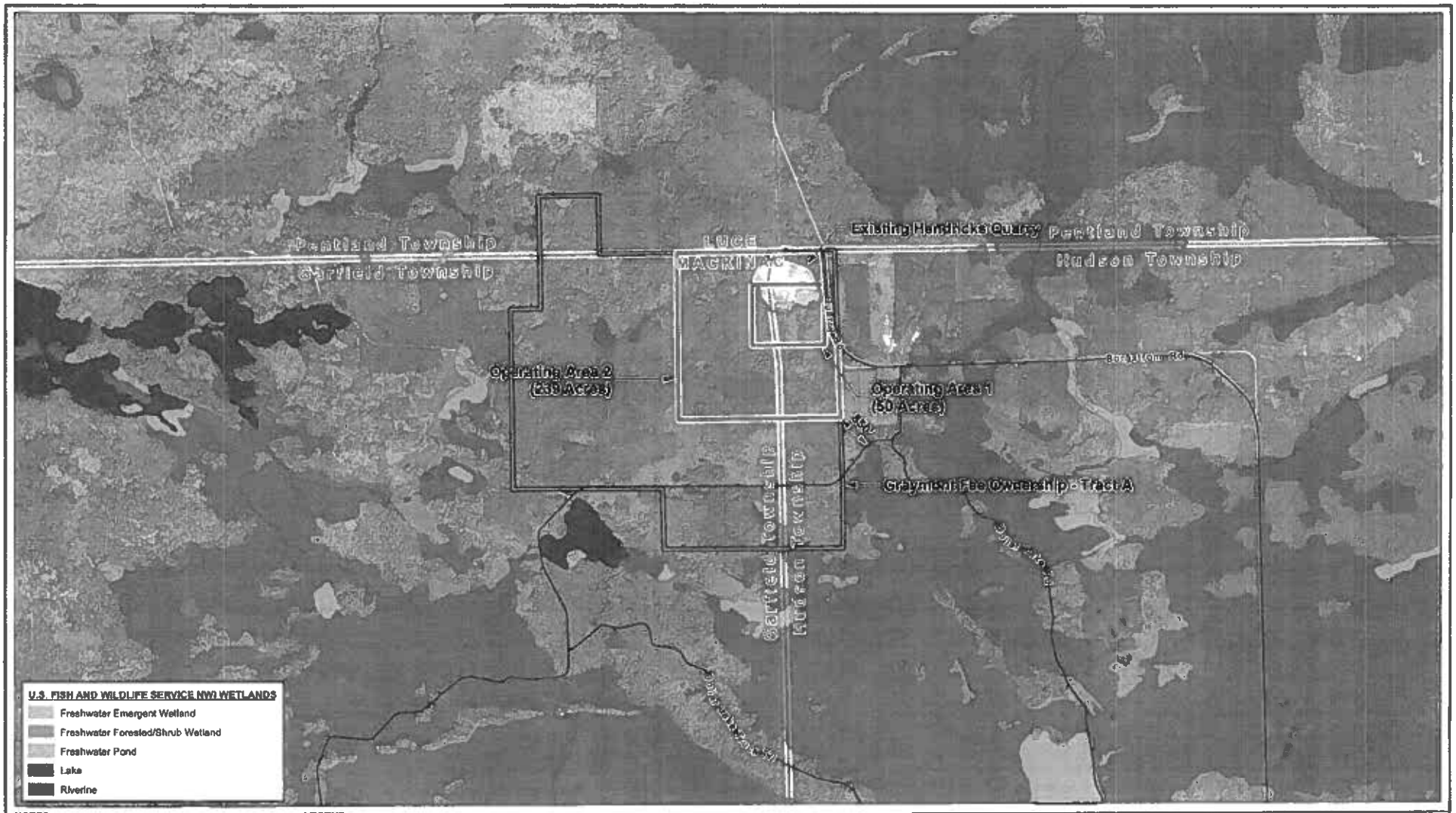


NOTES:
1. Base imagery from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Road and boundary data from Michigan Center for Geographic Information.
6. Wetlands data from U.S. Fish and Wildlife Service.

LEGEND
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Stream/River
- Road
- Municipal Boundary
- County Boundary

GRAYMONT
Foth

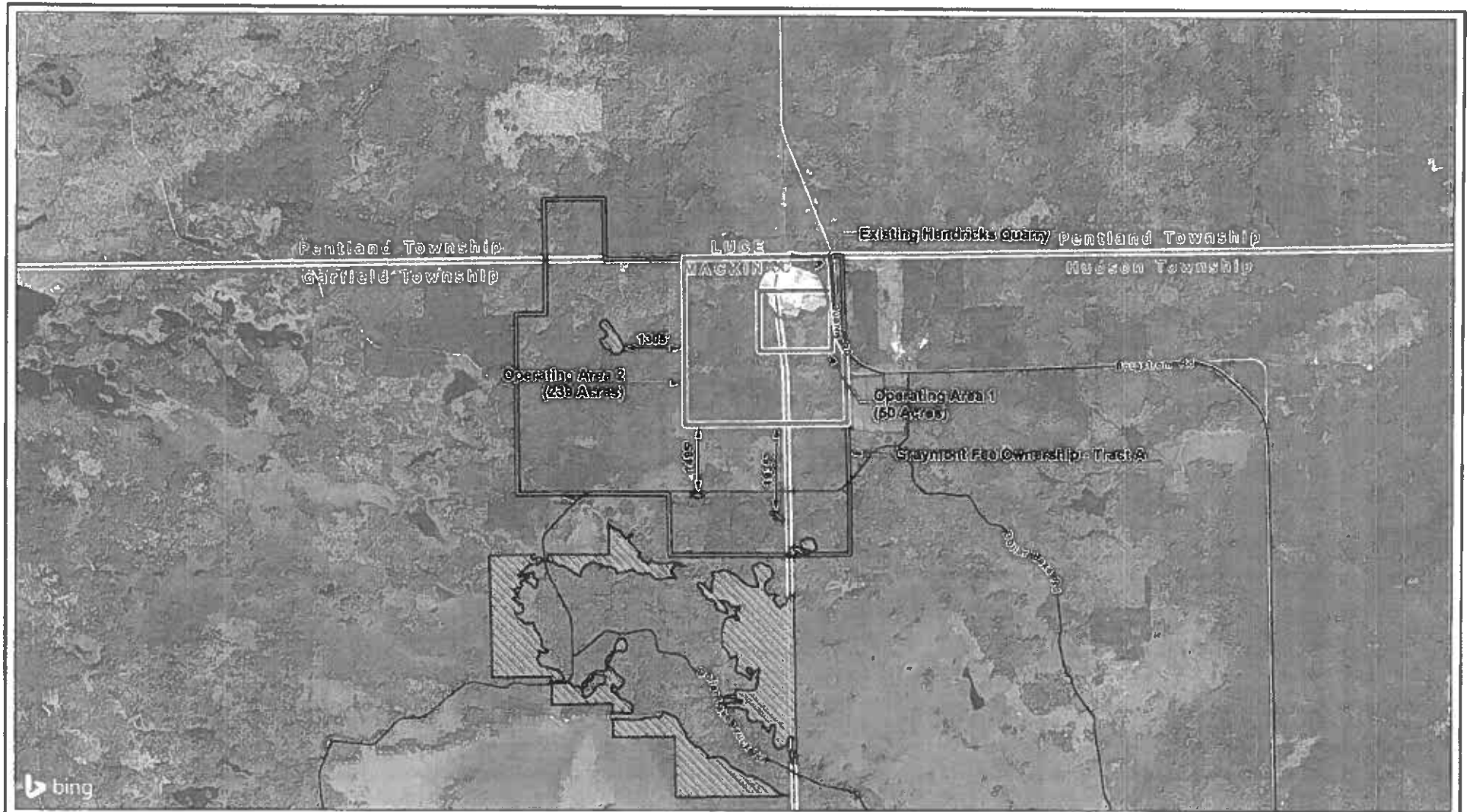
Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: HLH		DATE: APR.'18	
REVIEWED BY: MRS6		DATE: APR.'18	
APPROVED BY: RWS3		DATE: APR.'18	

GRAYMONT (MI) LLC

FIGURE C-10
NATIONAL WETLANDS INVENTORY MAP
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet
Date: APRIL 2018
Drafted by: BJW1
Project No: 14W777

Path: X:\GBVE\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix C\Figure C-10 NWI Wetlands Inventory Map.mxd Date: 4/19/2018



NOTES:

1. Base imagery from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Road and boundary data from Michigan Center for Geographic Information.
5. Delineated wetland data from ASTI Environmental.

LEGEND

- Delineated Wetlands
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Road
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

N

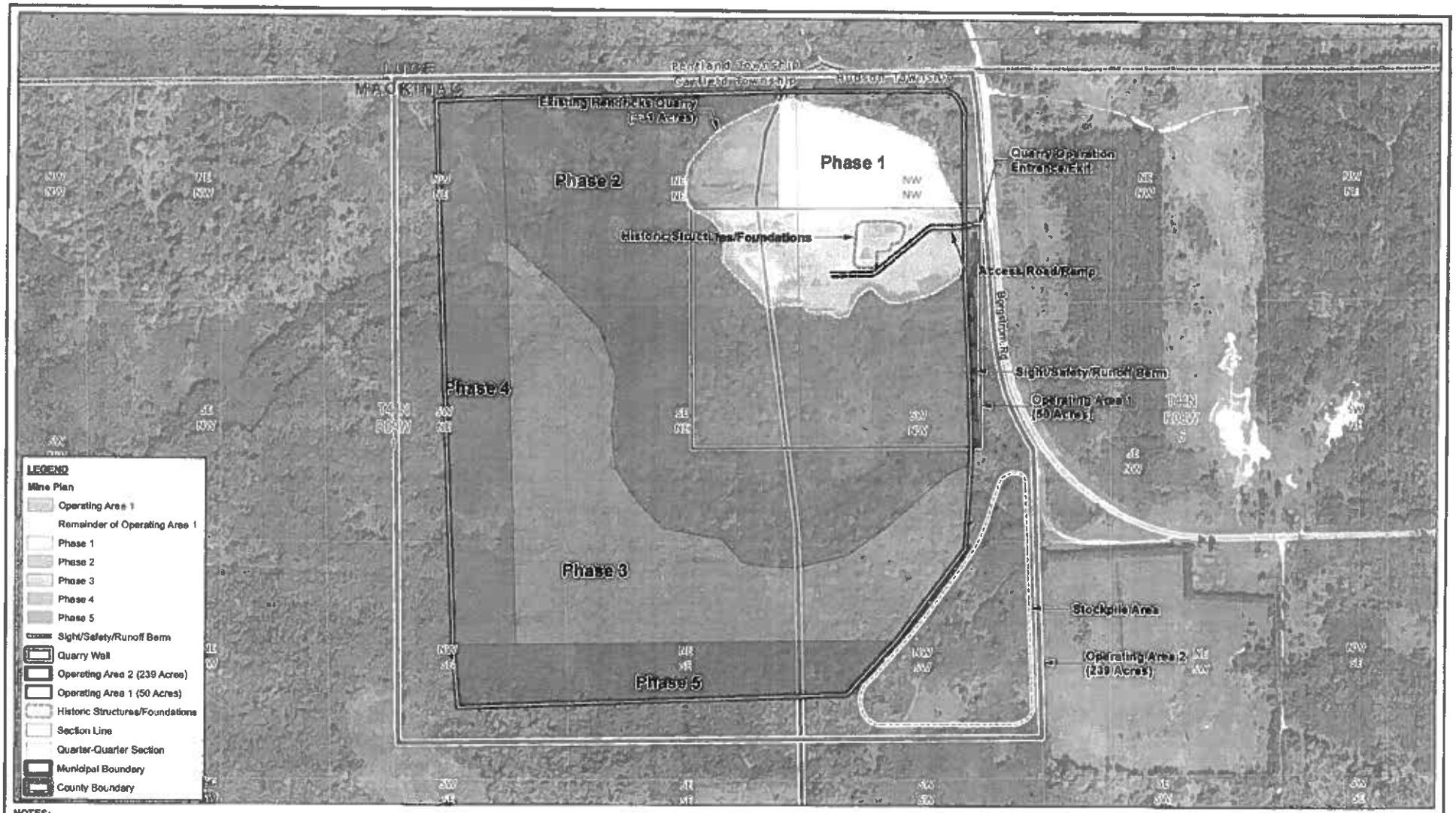
Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: HLH		DATE: APR.'18	
REVIEWED BY: MRS5		DATE: APR.'18	
APPROVED BY: RWS3		DATE: APR.'18	

GRAYMONT (MI) LLC

FIGURE C-11
SITE SPECIFIC DELINEATED WETLANDS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet
Date: APRIL 2018
Drafted by: BJW1
Project No: 14W777

Path: X:\GBVE\2014\14W777-00\GIS\mxd\GBRO 2018 LTA Designation\Appendix C\Figure C-11 Delineated Wetlands.mxd Date: 4/19/2018



NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

GRAYMONT

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Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	HLH	DATE: APR.'16	
REVIEWED BY:	MRS5	DATE: APR.'16	
APPROVED BY:	RWS3	DATE: APR.'16	

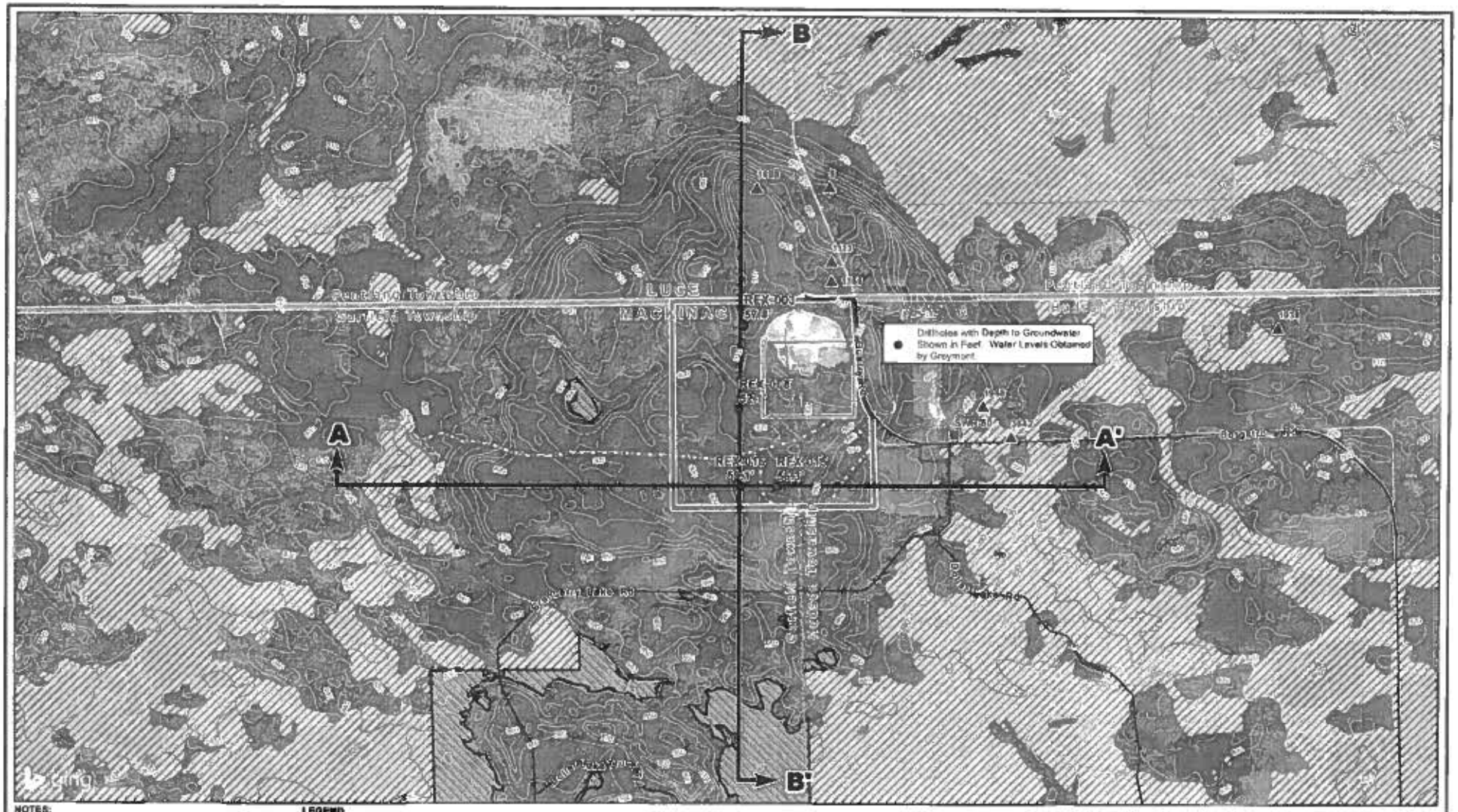
GRAYMONT (MI) LLC

FIGURE C-12

FHASED MINING SEQUENCE
OPERATING AREA 2
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet		Date: APRIL 2018	
Drafted by:	BJW1	Project No	14W777

Path: X:\GSVE\2014\14W777-00\GIS\mxd\GBRO 2018 LTA Designation\Appendix C\Figure C-12 Phased Mining Sequence.mxd Date: 4/19/2018



NOTES:

1. Base imagery from Esri.
2. Site boundary, drillhole and delineated wetland data from Graymont.
3. National Wetland Inventory (NWI) data downloaded from the U.S. Fish and Wildlife Service. (https://www.fws.gov/wetlands/)
4. Topographic contours generated from USGS 10 meter digital elevation model (DEM).
5. Road and boundary data from Michigan Center for Geographic Information.
6. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND

- Drillholes with Depth to Groundwater (Feet)
- MDEQ Digital Well Log
- MDEQ Scanned Well Log
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Existing Hendricks Quarry
- Delineated Wetland
- NWI Wetland
- Road
- McLeod Truck Trail
- Topographic Contour
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

Foth Infrastructure & Environment, LLC			
REVISION	DATE	BY	DESCRIPTION
PREPARED BY: HLH			DATE: APR.'18
REVIEWED BY: MRSS			DATE: APR.'18
APPROVED BY: RWS3			DATE: APR.'18

GRAYMONT (MI) LLC

FIGURE C-13

CROSS SECTION LOCATION MAP
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

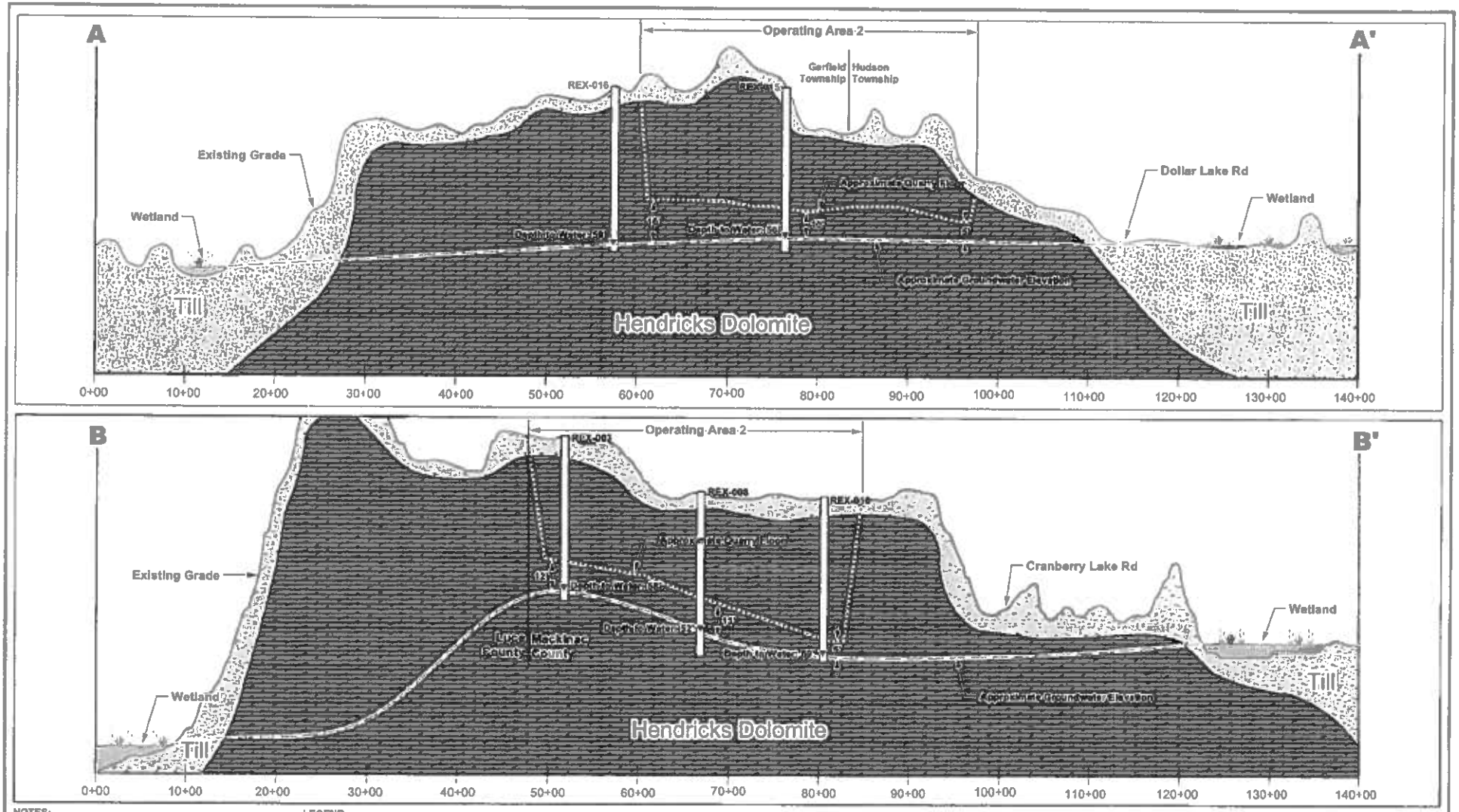
Scale: 0 400 800 Feet

Drafted by: BJW1

Date: APRIL 2018

Project No. 14W777

Path: X:\GBM\E2014\14W777-00\3 Sites\GIS\FIG 2018 LTA Designation\Appendix C\Figure C-13 Cross Section Location Map.mxd Date: 4/19/2018



NOTES:

1. Cross section and subsurface conditions should be considered approximate.
2. Existing grade generated from USGS 10 meter digital elevation model (DEM).
2. Site boundary data and delineated wetland data from Graymont.

LEGEND

- Existing Grade
- Approximate Groundwater Elevation
- Approximate Quarry Floor
- Till
- Hendricks Dolomite
- Wetland/Surface Water

GRAYMONT

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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: HLH		DATE: APR.'18	
REVIEWED BY: MRS5		DATE: APR.'18	
APPROVED BY: RWS3		DATE: APR.'18	

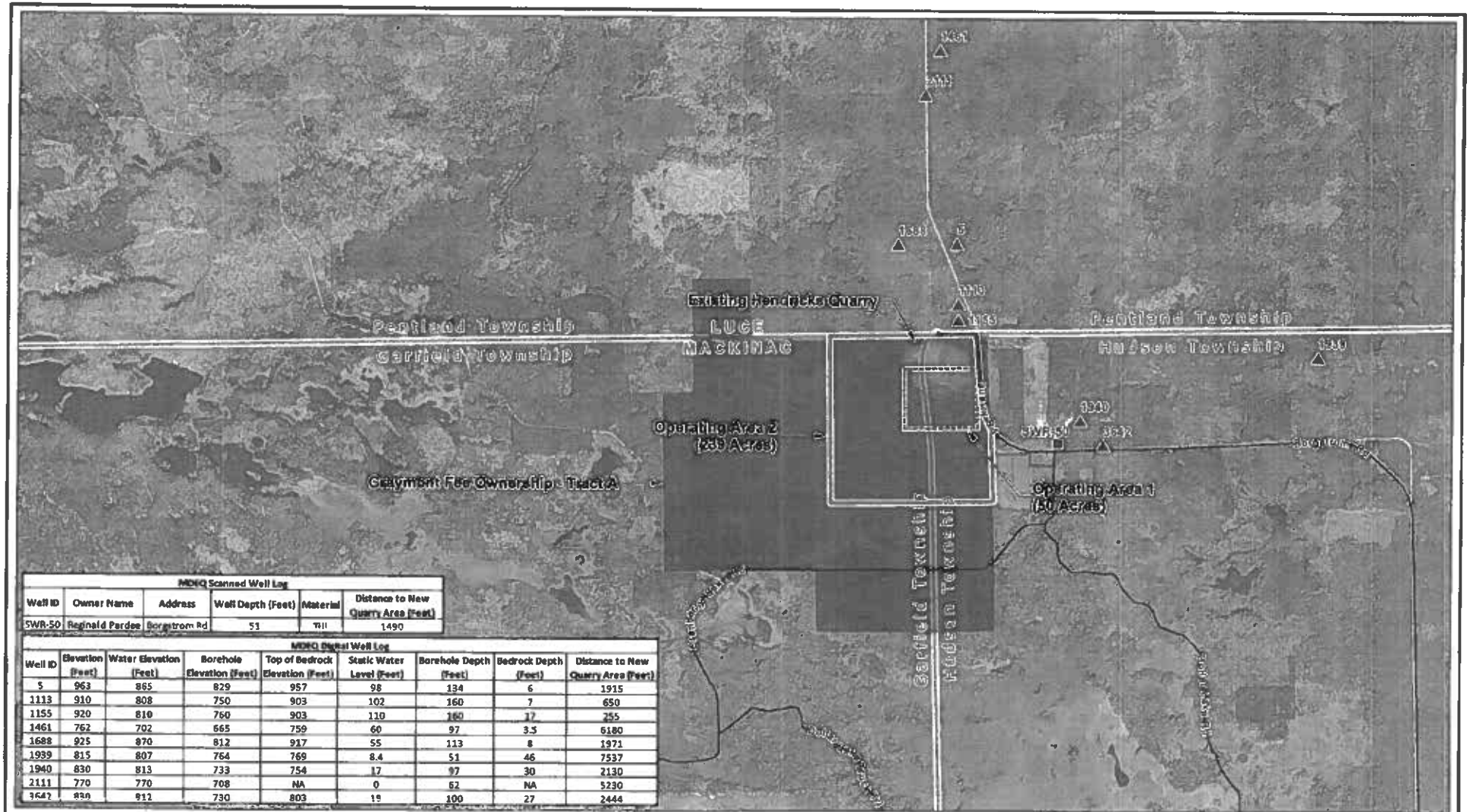
GRAYMONT (MI) LLC

FIGURE C-14

OPERATING AREA 2 CROSS SECTIONS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale	NONE	Date:	APRIL 2018
Drafted by:	BJW1	Project No:	14W777

Path: X:\GSVE\2014\14W777-00\GIS\mxd\GSRQ 2018 LTA Designation\Appendix C\Figure C-14 Operating Area 2 Cross Sections.mxd Date: 4/19/2018



MDEQ Scanned Well Log					
Well ID	Owner Name	Address	Well Depth (Feet)	Material	Distance to New Quarry Area (Feet)
SWR-50	Reginald Pardee	Borgstrom Rd	51	Till	1490

MDEQ Digital Well Log								
Well ID	Elevation (Feet)	Water Elevation (Feet)	Borehole Elevation (Feet)	Top of Bedrock Elevation (Feet)	Static Water Level (Feet)	Borehole Depth (Feet)	Bedrock Depth (Feet)	Distance to New Quarry Area (Feet)
5	963	865	829	957	98	134	6	1915
1113	910	808	750	903	102	160	7	650
1155	920	810	760	903	110	160	17	255
1461	762	702	665	759	60	97	3.5	6180
1688	925	870	812	917	55	113	8	1971
1939	815	807	764	769	8.4	51	46	7537
1940	830	813	733	754	17	97	30	2130
2111	770	770	708	NA	0	62	NA	5230
3642	830	812	730	803	19	100	27	2444

NOTES:
1. Base imagery from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
3. Mineral, surface and option areas should be considered approximate.
4. Road and boundary data from Michigan Center for Geographic Information.

LEGEND
- MDEQ Digital Well Log
- MDEQ Scanned Well Log
- Operating Area 2 (239 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Road
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: HLH		DATE: APR.'18	
REVIEWED BY: MRS5		DATE: APR.'18	
APPROVED BY: RWS3		DATE: APR.'18	

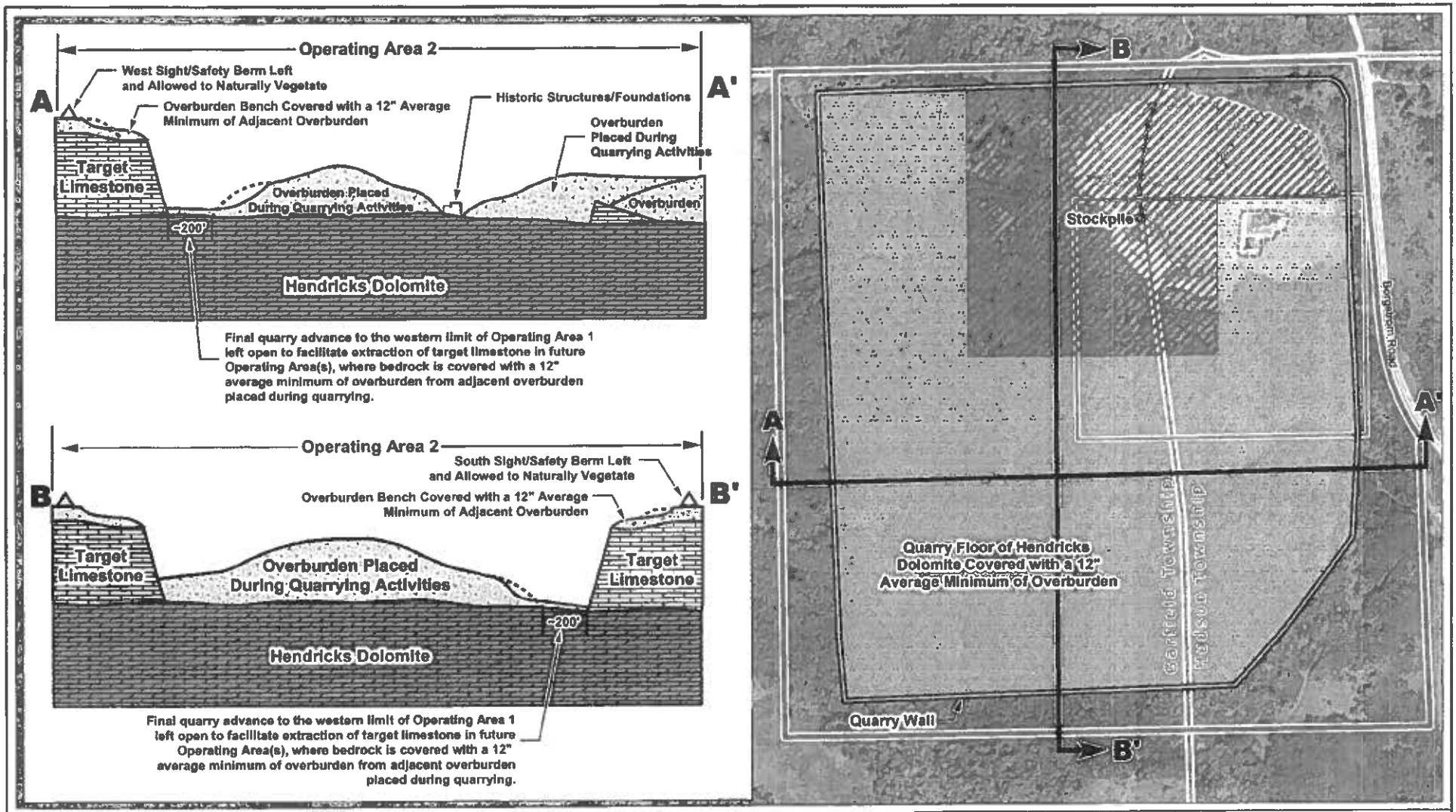
GRAYMONT (MI) LLC

FIGURE C-15

DOMESTIC WATER SUPPLY WELL LOCATIONS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet | Date: APRIL 2018
Drafted by: BJW1 | Project No: 14W777

Path: X:\GBME\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix C\Figure C-15 Domestic Water Supply Well Locations.mxd Date: 4/19/2018



NOTES:

1. The groundwater table is expected to be situated below the Graymont Borgstrom Road Quarry floor based on local topographic features and the lack of water or seeps in the existing Hendricks Quarry.
2. All overburden and permanent sight/safety berms to be re-vegetated via natural processes.
3. Base imagery from Esri.
4. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND

- Quarry Floor (Hendricks Dolomite) Covered with 12" Minimum Average of Overburden
- Stockpile Location
- Quarry Wall
- Historic Structures/Foundations
- Operating Area 2 (239 Acres)
- Operating Area 1 (50 Acres)
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

N

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: HLH		DATE: APR '18	
REVIEWED BY: MRS5		DATE: APR '18	
APPROVED BY: RWS3		DATE: APR '18	

GRAYMONT (MI) LLC

FIGURE C-16
POST-QUARRYING CONDITIONS FOR OPERATING AREA 2
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet | Date: APRIL 2018
Drafted by: BJW1 | Project No: 14W777

Path: X:\GBWE\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix C\Figure C-16 Post Quarry Conditions.mxd Date: 4/19/2018

Exhibit D

Advanced Notice
Land Transaction Agreement

Archeology Report

For the:

Graymont Borgstrom Road Quarry

Operating Area 2

Graymont (MI) LLC

Mackinac County, Michigan

Submitted to:

Department of Natural Resources
State of Michigan

April 2018

GRAYMONT

106 GROUP

GRAYMONT MINE ARCHAEOLOGY AND ARCHITECTURAL HISTORY LITERATURE REVIEW UPDATE AND ARCHAEOLOGICAL ASSESSMENT OF THE GRAYMONT BORGSTROM ROAD QUARRY OPERATING AREA 2

Mackinac County, Michigan

April 2018

GRAYMONT MINE ARCHAEOLOGY AND ARCHITECTURAL HISTORY LITERATURE REVIEW UPDATE AND ARCHAEOLOGICAL RESOURCES ASSESSMENT OF THE GRAYMONT BORGSTROM ROAD QUARRY OPERATING AREA 2

MACKINAC COUNTY, MICHIGAN

SHPO File No. Pending
106 Group Project No. 1990

SUBMITTED TO:
Graymont (MI) LLC
800 5th Ave
Box 110
Seattle, WA 98104-3102

SUBMITTED BY:
106 Group
1295 Bandana Blvd #335
St Paul, MN 55108

PRINCIPAL INVESTIGATOR:
Adam Kaeding, Ph.D., RPA

REPORT AUTHOR:
Kate Hunt, M.Sc.

April 2018

MANAGEMENT SUMMARY

In March and April of 2018, The 106 Group Ltd. (106 Group) conducted an archaeology and architectural history literature review update and an archaeological resources assessment for the Graymont Borgstrom Road Quarry Operating Area 2 for Graymont MI LLC (Graymont).

The study involved two components: 1) an update of a cultural resources (archaeology and architectural history) literature review conducted in 2014, and 2) a desktop assessment of archaeological potential of the Graymont Borgstrom Road Quarry Operating Area 2 (Assessment Area). The archaeological resources Assessment Area consists of approximately 239 acres (96.7 hectares) located in the northwest portion of the broader Graymont Project Area; more specifically located within Township 44N, Section 1 of Range 9W and Section 6 of Range 8W. The literature review update covers the Assessment Area as well as a one-mile buffer surrounding the Assessment Area.

To provide a broader cultural context and guide future planning, 106 Group personnel conducted a literature review (Halvorsen and Bring 2014) researching any previously identified archaeological sites and architectural history properties within the broader Graymont Project Area. This literature review did not identify any archaeological sites or architectural history properties in or within one mile of the current Assessment Area, and did not include a field survey component. In 2015, 106 Group personnel conducted a Phase I archaeological survey within the one mile context of the Assessment Area (Halvorsen). Communication with Graymont has confirmed that no additional cultural resources surveys have been conducted and no new archaeological sites or architectural history properties have been identified within the Assessment Area since the submittal of those previous reports (John Maitland, personal communication March 15, 2018). Communication with Dean Anderson, Michigan State Archaeologist, identified one additional archaeological site located within the one-mile buffer surrounding the Assessment Area (Dean Anderson, personal communication April 19, 2018).

The majority (222.9 acres [90.2 hectares]) of the Assessment Area is assessed as possessing moderate to high potential to contain intact archaeological resources. Accordingly, the 106 Group recommends that a Phase I archaeological survey be conducted in these areas in order to identify potential archaeological and architectural history resources, and to comply with applicable state and federal laws.

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1.0 INTRODUCTION

In March and April of 2018, The 106 Group Ltd. (106 Group) conducted an archaeology and architectural history literature review update and an archaeological resources assessment for the Graymont Borgstrom Road Quarry Operating Area 2 for Graymont MI LLC (Graymont). The study involved two components: 1) an update of a cultural resources (archaeological and architectural history) literature review conducted in 2014, and 2) a desktop assessment of archaeological potential of the Graymont Borgstrom Road Quarry Operating Area 2 (Assessment Area).

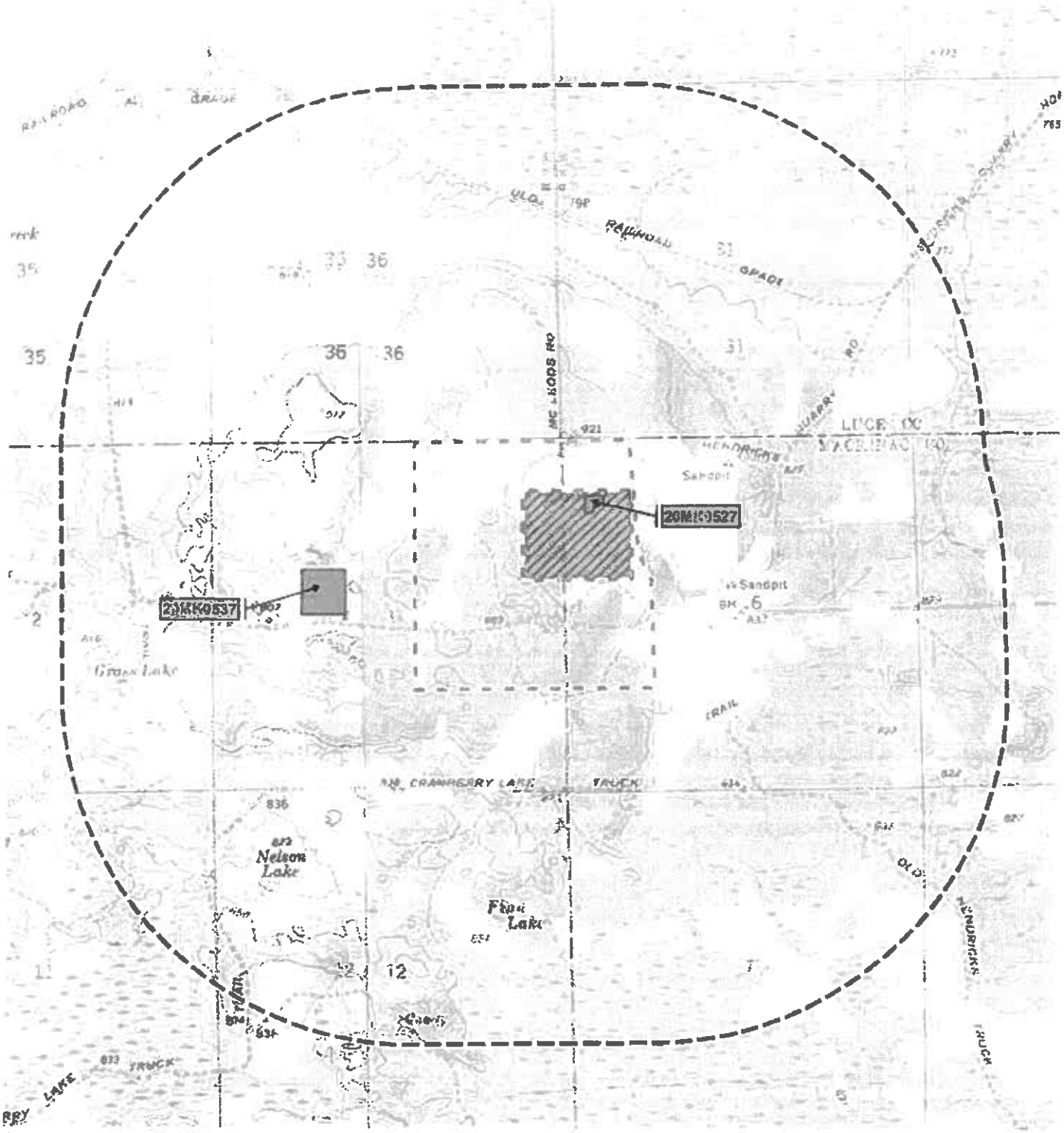
For the purposes of the archaeology and architectural history literature review update and archaeological assessment, the area studied consists of approximately 239 acres (96.7 hectares) located in the northwest portion of the broader Graymont Project Area. The literature review update covers the Assessment Area as well as a one-mile buffer surrounding the Assessment Area (Table 1). The Assessment Area is located approximately seven miles northwest of Rexton in Mackinac County, Michigan, abutting the west side of Borgstrom Road North and the south side of Quarry Road (Figure 1).

Table 1. Legal Descriptions of Sections Crossed by the Assessment Area

Area	County	Township	Range	Section
Borgstrom Road Quarry Assessment Area	Mackinac	44N	9W	S1
			8W	S6

To provide a broader cultural context and guide future planning, 106 Group personnel conducted a literature review (Halvorsen and Bring 2014) researching any previously identified archaeological sites and architectural history properties within the broader Graymont Project Area. This literature review did not identify any archaeological sites or architectural history properties in or within one mile of the current Assessment Area, and did not include a field survey component. In 2015, 106 Group personnel conducted a Phase I archaeological survey within the one mile context of the Assessment Area (Halvorsen). Communication with Graymont has confirmed that no additional cultural resources surveys have been conducted and no new archaeological sites or architectural history properties have been identified within the Assessment Area since the submittal of those previous reports (John Maitland, personal communication March 15, 2018). Communication with Dean Anderson, Michigan State Archaeologist, identified one additional archaeological site located within the one-mile buffer surrounding the Assessment Area (Dean Anderson, personal communication April 19, 2018).

The following report contains the results of the archaeology and architectural history literature review update and archaeological assessment and recommendations for further archaeological work. Adam Kaeding, Ph.D., RPA, served as principal investigator. Appendix A provides a list of project personnel.



Source: 106 Group

Map Produced by 106 Group 4/19/2018

Graymont Mine Borgstrom Road Quarry Operating Area 2 Archaeology and Architectural History Literature Review Update and Archaeological Assessment

Mackinac County, Michigan

Assessment Area Location and One Mile Context Area

- Assessment Area
- One Mile Context Area
- Previously Surveyed (Halvorsen 2015)
- Archaeological Site Boundary

0 480 Meters

0 1,100 Feet

1:24,500

106

Figure 1

2.0 METHODS

2.1 Objectives

The primary objective of the archaeology and architectural history literature review was to provide a preliminary understanding of what previously recorded cultural resources may be within the broader Graymont Project area, and to be a tool with which to inform further archaeological and architectural history surveys.

The primary objective of the archaeological assessment was to assess the potential of the Assessment Area to contain unknown archaeological resources that may be potentially eligible for listing in the National Register for Historical Places (NRHP). All work was conducted in accordance with *The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation* (48 *Federal Register* 44716-44740) (National Park Service [NPS] 1983).

2.2 Archaeology and Architectural History Literature Review Update

Background research was conducted by 106 Group personnel in June of 2014 at the Michigan State Historic Preservation Office (SHPO) and Michigan Office of the State Archaeologist (OSA) for information regarding previously identified archaeological sites and architectural history properties within one mile (1.6 kilometers [km]) of the 2014 Graymont Project Area, and on cultural resources surveys previously conducted within the area (Halvorsen and Bring 2014). Additionally, historical maps, plat maps, historical aerial photographs, and historical and archaeological literature were reviewed to provide an understanding of the historical context of the area. No archaeological field survey took place during the archaeology and architectural history literature review, and the results were compiled into a final literature review report (Halvorsen and Bring 2014). The area covered in the 2014 literature review encompasses the entirety of the Assessment Area and one mile context area discussed in this report and depicted in Figure 1.

In addition to the Halvorsen and Bring (2014) literature review, a Phase I Archaeological Survey Report (Halvorsen 2015) described an archaeological survey conducted within the Assessment Area and one mile context. Graymont confirmed that no further cultural resources surveys have been conducted within the Assessment Area since that time (John Maitland, personal communication March 15, 2018).

The Michigan State Archaeologist, Dean Anderson, was contacted on April 19, 2018 to update known sites within the project area and one mile buffer area surrounding the Assessment Area.

2.3 Archaeological Assessment

The Assessment Area was subject to a desktop assessment to identify which portions, if any, possess an increased potential for archaeological resources. Due to the nature of the project and previously conducted research most areas were assessed as possessing moderate to high potential. Areas assessed as possessing a relatively low potential to contain archaeological resources generally include:

- inundated areas;
- former or existing wetland areas;
- poorly drained areas;
- areas characterized by considerable subsurface ground disturbance; or
- areas with a 20 percent or greater slope.

3.0 RESULTS

3.1 Archaeology and Architectural History Literature Review Update

3.1.1 PREVIOUSLY IDENTIFIED RESOURCES AND STUDIES

The 2014 literature review conducted by Halvorsen and Bring (2014) presents a desktop review of background information related to any known archaeological sites or architectural history properties in the broader 2014 Graymont Project Area. Halvorsen and Bring's 2014 literature review indicated that no archaeological studies had been previously conducted within the current Assessment Area, and no previously identified archaeological sites or architectural resources were located within, or within one mile of the area (Figure 1). The area covered by the Halvorsen and Bring 2014 literature review encompasses the entirety of the Assessment Area presented here. The Halvorsen and Bring 2014 literature review did not include a field survey component.

In 2015, 106 Group conducted a Phase I archaeological survey of a 50 acres (20 hectares [ha]) area within and adjacent to the Hendricks Quarry (Graymont Borgstrom Road Quarry Operating Area 1), an area at the center of but not included as part of the Assessment Area (Figure 1). This survey identified the foundation remains of quarry structures designated Michigan Archaeological Site 20MK0527 (Halvorsen 2015).

The landowner, Graymont, confirmed that the Assessment Area has been in its possession since the completion of the previous investigations and that no further cultural resources surveys have been conducted since that time. Accordingly, the results presented in Halvorsen and Bring (2014) and Halvorsen (2015) are considered up-to-date for the purposes of the literature review within the Assessment Area (John Maitland, personal communication March 15, 2018).

The Michigan State Archaeologist, Dean Anderson, identified that one additional archaeological site is recorded within the one-mile buffer surrounding the Assessment Area (Figure 1) (Dean Anderson, personal communication April 19, 2018). This site, 20MK0537, is comprised of two structure foundations, both roughly the size of small cabins.

Table 2. Archaeological Sites Previously Identified within One Mile of the Assessment Area

Site No.	Site Name	T	R	S	Description
20MK0527	Hendricks Quarry Site	44N	8W	6	structural ruins
20MK0537	N/A	44N	9W	1	structural foundations

3.1.2 ENVIRONMENTAL HISTORY OVERVIEW

The Assessment Area is located in north central Mackinac County. Primary soil associations for the Assessment Area include the Amadon-Longrie sandy loams (56% of the area); Longrie-Battydoe stony

complex (18%), and Menominee loamy sand (11%). These soils are well drained. The area features little to no slope and rarely floods (National Resources Conservation Service [NRCS] 2018).

3.1.3 HISTORICAL CONTEXT

The literature review report by Halvorsen and Bring (2014) provides information on the historical context of the area, and is summarized below. Halvorsen and Bring (2014) consulted historical plat maps, current and historical aerial photographs and satellite images, and United States Geological Survey (USGS) topographical maps.

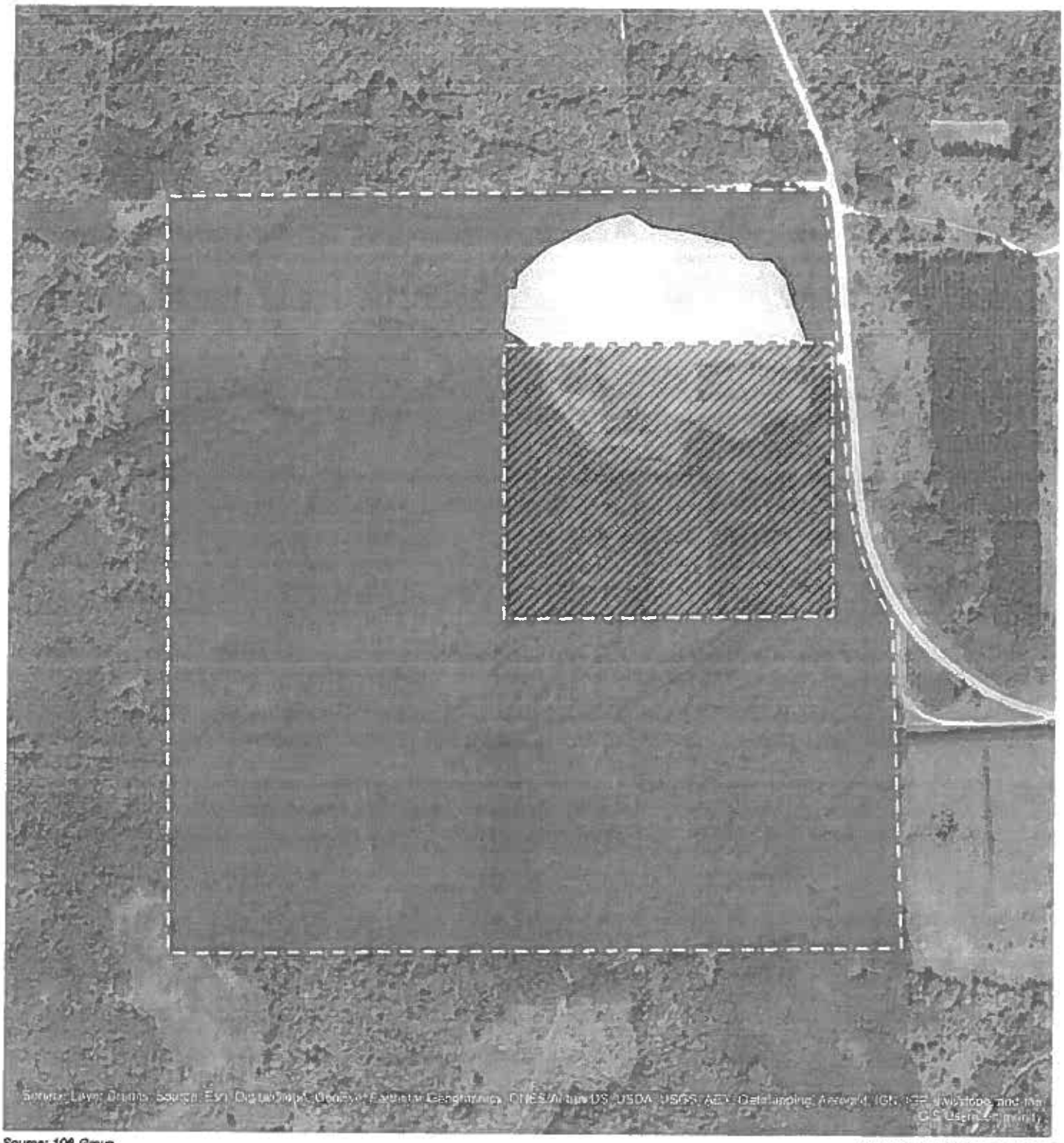
Michigan's developmental sequence is divided into three broad contexts: precontact (ca. 12,000 years before present [B.P.] to.250 B.P.), contact (ca. 320 B.P. to 130 B.P.), and post-contact (ca.130 B.P. to the present).

Research indicates that the first potential human presence within Michigan's Upper Peninsula might be as early as the Late Paleo-Indian/Early Archaic period (9,000 years before present [B.P.]) (Shott 1999) from a site situated in the Deer Lake basin approximately 100 miles to the northwest of the greater Graymont Project Area (Shott 1999). However, most precontact period sites within the region likely date from the Woodland Period. The Hiawatha National Forest has created a model for finding precontact period sites (particularly Woodland Period) in the Upper Peninsula, which provides a starting point for predicting the type and location of late precontact period sites within the region. This model has generally identified that late prehistoric sites will overall include large multi-family summer and fall season fishing villages near the Great Lakes and smaller winter and early spring sites in the inland areas (Franzen 1986). These inland sites are usually identified along rivers, interior lakes, and the edges of wetlands.

Land use in the region during the contact/post-contact period may have started with the arrival of the French in the seventeenth century. Fur traders frequented the missions and forts in the Upper Peninsula. Based on historical maps and aerial review, it appears that the region was primarily used for logging and rock quarrying and may contain archaeological resources from the contact and post-contact periods.

3.2 Archaeology Assessment

Within the Assessment Area, 16.1 acres (6.5 hectares) have low potential to contain intact archaeological resources while 222.9 acres [90.2 hectares) possess medium to high potential (Figure 2).



Source: 106 Group

Map Produced by 106 Group 4/13/2016

Graymont Mine Borgstrom Road Quarry Operating Area 2 Archaeology and Architectural History Literature Review Update and Archaeological Assessment

*Mackinac County, **Michigan***

Areas of Archaeological Potential

- Assessment Area
- Previously Surveyed (Halvorsen 2015)
- Low Archaeological Potential (No Further Work Recommended)
- Moderate to High Archaeological Potential (Phase I Recommended)

0 150 Meters

0 410 Feet

1:8,000

106

Figure 2

4.0 RECOMMENDATIONS

The archaeology and architectural history literature review update indicates that no previously identified archaeological sites or architectural history properties are located within the Assessment Area. No archaeological or architectural history surveys have been previously conducted within the Assessment Area. Two archaeological sites (20MK0527, 20MK0537) are located within the one mile context area.

The 106 Group recommends that a Phase I archaeological survey be conducted for the (222.9 acres [90.2 hectares) assessed as possessing moderate to high potential to contain intact archaeological resources within the Assessment Area (Figure 2). The 106 Group recommends a limited, targeted testing of a sample of the areas assessed as possessing low potential in order to confirm that assessment.

5.0 NEXT STEPS

The Phase I archaeology survey of the Borgstrom Road Quarry Operating Area 2 will be complete prior to any quarrying activities by the contracted project archaeologists. If any archaeological or architectural history sites are identified during construction activities, Graymont or personnel contracted by Graymont are expected to employ protective measures according to Exhibit J of the Land Transaction Agreement (LTA) as revised March 19, 2015 (available online at: rextonproject.com/asset-library/ and https://www.michigan.gov/documents/dnr/2015_LTA_Exh_Ato_F_Comb_no_check_510110_7.pdf).

REFERENCES CITED

Halvorsen, Peer
2015 *Phase I Archaeological Resources Survey for the Rexton Project – Graymont Borgstrom Road Quarry Area (Operating Area #1)*. Submitted to Graymont (MI) LLC, Naubinway, Michigan. On file at the Michigan Office of the State Archaeologist, Lansing, Michigan.

Halvorsen, Peer, and Jennifer Bring
2014 *Cultural Resources Literature Review for the Rexton Project MDNR Land Transaction.* Submitted to Graymont (MI) LLC, Naubinway, Michigan. On file at the Michigan Office of the State Archaeologist, Lansing, Michigan.

Franzen, John G.
1986 *Prehistoric Settlement on the Hiawatha National Forest, Michigan: A Preliminary Locational Model*. Hiawatha National Forest, Escanaba, Michigan. On file at the Michigan Office of the State Archaeologist, Lansing, Michigan.

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1983 Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation. *Federal Register* 48(190):44716-44740.

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2018 *Custom Soil Resource Report for Mackinac County, Michigan.* United States Department of Agriculture, March 21, 2018

Shott, Michael J.
1999 Early Archaic: Life after the Glaciers. Published in *Retrieving Michigan's Buried Past*. Cranbrook Institute of Science, Bloomfield Hills, Michigan.

APPENDIX A: PROJECT PERSONNEL

LIST OF PERSONNEL

Principal Investigator	Adam Kaeding, Ph.D., RPA
Researcher/ Report Author	Kate Hunt, M.Sc.
Graphics and GIS	Molly McDonald, M.GIS

Exhibit E

Advance Notice
Land Transaction Agreement

Reclamation Plan

For the:

Graymont Borgstrom Road Quarry

Operating Area 2

Graymont (MI) LLC

Mackinac County, Michigan

Submitted to:

Department of Natural Resources
State of Michigan

August 2018

GRAYMONT

Graymont Borgstrom Road Quarry Reclamation Plan

The purpose of this document is to present the "Reclamation Plan" for the limestone quarry defined as Operating Area 2 in the Advance Designation Notice Exhibit A. Operating Area 2 is located adjacent to and partially contained within the existing Hendricks Quarry in Tract A (as defined in the Land Transaction Agreement).

Operating Area 2 is located on property owned by Graymont located in the townships of Garfield and Hudson, in Mackinac County, Michigan. Operating Area 2 is comprised of approximately 239 acres, approximately 15 acres of which are located within the existing Hendricks Quarry. Operating Area 2 is also adjacent to the 50-acre Graymond Borgstrom Road Quarry (GBRQ) Operating Area 1 designation. **Figure E-5 – *Operating Area 2 Reclamation Plan Phase 5 (Year 5)*** shows the quarry and the final reclaimed surface at the completion of Operating Area 2 activities at the GBRQ.

Reclamation and Hydrologic Maintenance

All quarry infrastructure assembled and used by Graymont will be removed after permanent completion of quarrying and processing activities within Operating Area 2. Safety/sight berms will be employed throughout the quarrying process as sections of the quarry advance to restrict public access to the active quarry areas for public safety. Safety/sight berms, where appropriate, will be left in place and allowed to naturally and passively re-vegetate.

Graymont will place an average of at least 12 inches of overburden or rock not suitable for processing or sale to serve as a growth medium. Overburden placement/reclamation will occur both during active quarrying operations and as a final step once all limestone is extracted. The placement of rock and overburden will be designed to minimize erosion and slope instability by utilizing appropriate slopes and sufficiently sized materials. Other Best Management Practices (BMP) designed to reduce erosion may be applied to facilitate the establishment of natural vegetation. Measures will be taken to reduce the introduction of invasive plant species including avoiding the use of imported fill. In addition, mining equipment will be required to be inspected and cleaned prior to entry onto the site to minimize introduction of invasive plant species.

Hydrologic conditions are not expected to materially change during the operation or post-quarrying period due to the relative upland position of Operating Area 2, the relatively shallow depth of the quarry, the regional recharge to the adjacent till from precipitation, and the hydrologic characteristics adjacent to the quarry operation. Surface hydrologic characteristics are expected to return approximate pre-quarrying characteristics and functions. Quarrying activities are not expected to extend deep enough to intersect the local groundwater table.

The ongoing reclamation process is expected to achieve a "rolling" reclamation/quarrying sequence with sufficient margins for continued quarrying and related operations within the

GBRQ – as overburden is removed to expose target limestone. It is then used to reclaim areas where the target limestone had already been extracted.

Overburden Management

The overburden will be stockpiled. Overburden will also be deposited over the GBRQ Operating Area 2 at an average minimum depth of 12 inches when those areas are no longer required for processing, transportation, limestone stockpiling, or as start points of future expansion. Fines and off specification limestone may be mixed with stripped overburden and used as backfill or sight/safety/runoff berm construction. Silt fencing or other runoff control BMPs will be installed as necessary to minimize erosion. See **Figure E-6** – ***Intermediate General Cross Sections*** and **Figure E-7** – ***Final Advance General Cross Sections*** for generalized cross sectional information.

Phase 1: The initial quarrying phase will primarily be activities surrounding the stockpiling of overburden in the northeast corner of the existing Hendricks pit that is not used for sight/safety/runoff berms from Operating Area 1. See **Figure E-1** – ***Operating Area 2 Reclamation Plan Phase 1 (Year 1)***.

Phase 2: The next quarrying phase will proceed west and south along an arched panel that will enlarge the mining area created by the existing Hendricks pit located in Operating Area 2 and the quarried portions of Operating Area 1. Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the western edge of the overburden stockpiled in Phase 1. See **Figure E-2** – ***Operating Area 2 Reclamation Plan Phase 2 (Year 2)***.

Phase 3: Similar to Phase 2, the next quarrying phase will proceed west and south along an arched panel that will enlarge the mining area created by the previous phases. Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the western edge of the overburden stockpiled in Phase 2 or used as backfill on portions of the mined pit floor. See **Figure E-3** – ***Operating Area 2 Reclamation Plan Phase 3 (Year 3)***.

Phase 4: The next quarrying phase will create a north/south panel near the western edge of Operating Area 2. Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the southern edge of the overburden stockpiled in Phase 3 or used as backfill on portions of the mined pit floor. See **Figure E-4** – ***Operating Area 2 Reclamation Plan Phase 4 (Year 4)***.

Phase 5: Similar to Phase 4, next quarrying phase will create an east/west panel near the southern edge of Operating Area 2. Overburden that is not used for sight/safety/runoff berms will be used as backfill on portions of the mined pit floor. See Figure E-5.

Final Site Topography and Potential Water Features

The post-quarrying topography will reflect a dampened expression of the pit extent with localized areas of pit wall slope reductions and safety/sight berms. The quarry floor will

exhibit a subdued hummocky topography based on the final distribution of the reclamation material.

The reclaimed surface configuration at completion of Operating Area 2 quarry activities is expected to look like overburden-filled 50-acre footprint of the Operating Area 1, with the exception of three open panels along the west edge, south edge, and in the southwest corner of Operating Area 2. The two open panels along the edges would be about 200 feet wide and extend the entire length of the west and south boundaries to allow quarrying to continue to proceed to the west and south under future operating area designations. The southwest panel is approximately 50 acres and is reserved for a portable crushing spread for future operating area designations. Figure E-5 illustrates the position of the final Operating Area 2 panels.

If operations permanently terminate at the end of limestone extraction activities associated in Operating Area 2, overburden placed immediately behind the three panels would be pushed west and south onto the exposed quarry floor. The safety/sight berm along the west and southern boundaries would remain in place and allowed to naturally vegetate.

Precipitation falling within the quarried/reclaimed area of Operating Area 2 will evaporate and/or seep into the placed overburden. Even during heavy precipitation events or snowmelt, meteoric water from precipitation is expected to be consumed within the reclaimed materials. As the reclaimed materials become vegetated, meteoric water is expected to be consumed via evapotranspiration and evaporation. Depending on final pit floor/residual bedrock elevations, localized, temporary ponding may occur on the floor of the existing, but would be expected to dry up as currently witnessed via evaporation. Precipitation occurring outside the pit and remaining safety barriers will infiltrate into surficial soils, concentrate as runoff away from the pit, or enter the pit depending on grade and precipitation intensity. Groundwater is not expected to be encountered and sustainable hydrologic conditions for ponds or wetlands are not anticipated.

Surface Water

Operating Area 2 is situated in the upper portions of the drainage basin in a very flat topographical setting, so changes in watershed morphology are not expected. The proposed quarry in Operating Area 2 does not come into contact with any wetlands or shallow lakes/ponds. The nearest surface water feature is a National Wetlands Inventory (NWI) mapped freshwater emergent wetland located over 850 feet away, downgradient, to the southeast as shown on **Figure C-10 – *National Wetlands Inventory Map***. Site-specific wetland delineation studies conducted in 2014 and the nearest site-specific wetland delineation was about 1,300 feet as shown on **Figure C-11 – *Site Specific Delineated Wetlands***. Downstream channels and surface water basins are not expected to change as the surface quarry area does not materially influence the contributing drainage basins. The nearest lakes are over 3,300 feet to the south (see **Figure C-9 – *Drainage Basins/Surface Water Bodies***) and water levels in local surface water bodies are well below the bottom of the Operating Area 2 pit and should not be lowered by quarrying activities.

Groundwater

As previously described, the local groundwater table is expected to be well below the deepest portion of the quarry within Operating Area 2 and is not expected to be encountered. Given this characteristic, sustained pit seepage is not expected and hydrologically sustainable ponds and wetlands are unlikely to occur. Locally, groundwater can be encountered at the overburden/bedrock interface and this zone can be locally perched depending on bedrock geometry and till composition. However, any such encountered perched water is expected to be limited in extent and would drain/dissipate quickly. By its perched nature, such groundwater is generally limited by the bedrock geometry and is relatively isolated from other hydrologic features.

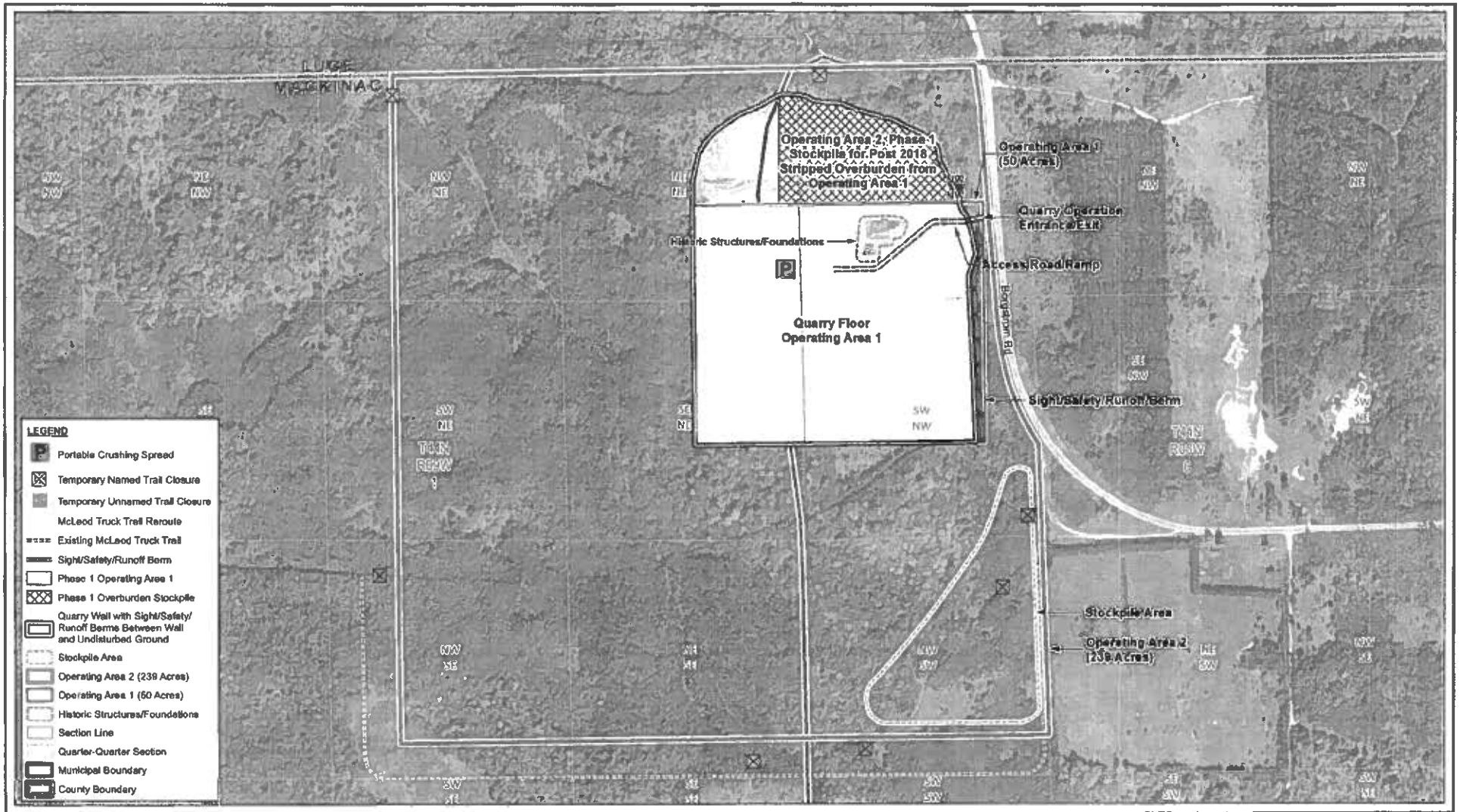
Toxic and Hazardous Materials Management

The target limestone and adjacent bedrock does not contain acid-forming materials or metals that can be released to the environment once exposed to oxidation. Conversely, limestone and dolomite products are typically used to purify drinking water, treat wastewater, and neutralize acidic conditions. During quarrying operations, only minor, localized spills of fuels or lubricants would be categorized as potential contaminants. Fuels and lubricants will be handled and managed as per industry standards, BMPs, and established regulatory requirements. If a spill were to occur, the spills will be minimized by the impermeable nature of the bedrock and the natural containment offered by the pit. Blasting will be designed for complete ignition of all explosives.

Reclamation Timetable

All GBRQ Operating Area 2 infrastructure and equipment will be removed after completion of all quarrying, processing, and transportation activities. Graymont will provide the state of Michigan "Confirmation" of the boundaries and acreage for "Reclamation Area(s)" within Operating Area 2 in which Graymont has completed all quarrying, processing, and transportation activities within an operating area or a designated portion of an operating area. Reclamation will be initiated within two years of Confirmation of a Reclamation Area. Reclamation of the Reclamation Area will be completed within four years of the corresponding Confirmation Notice. All reclamation designation definitions and time frames are set forth in the Land Transaction Agreement.

Figures



NOTES:
1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for quarry access.
5. Historic structures and foundations to be left in- place with no disturbance buffer.
6. Actual timing on activity in each phase is market dependent.

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Foth

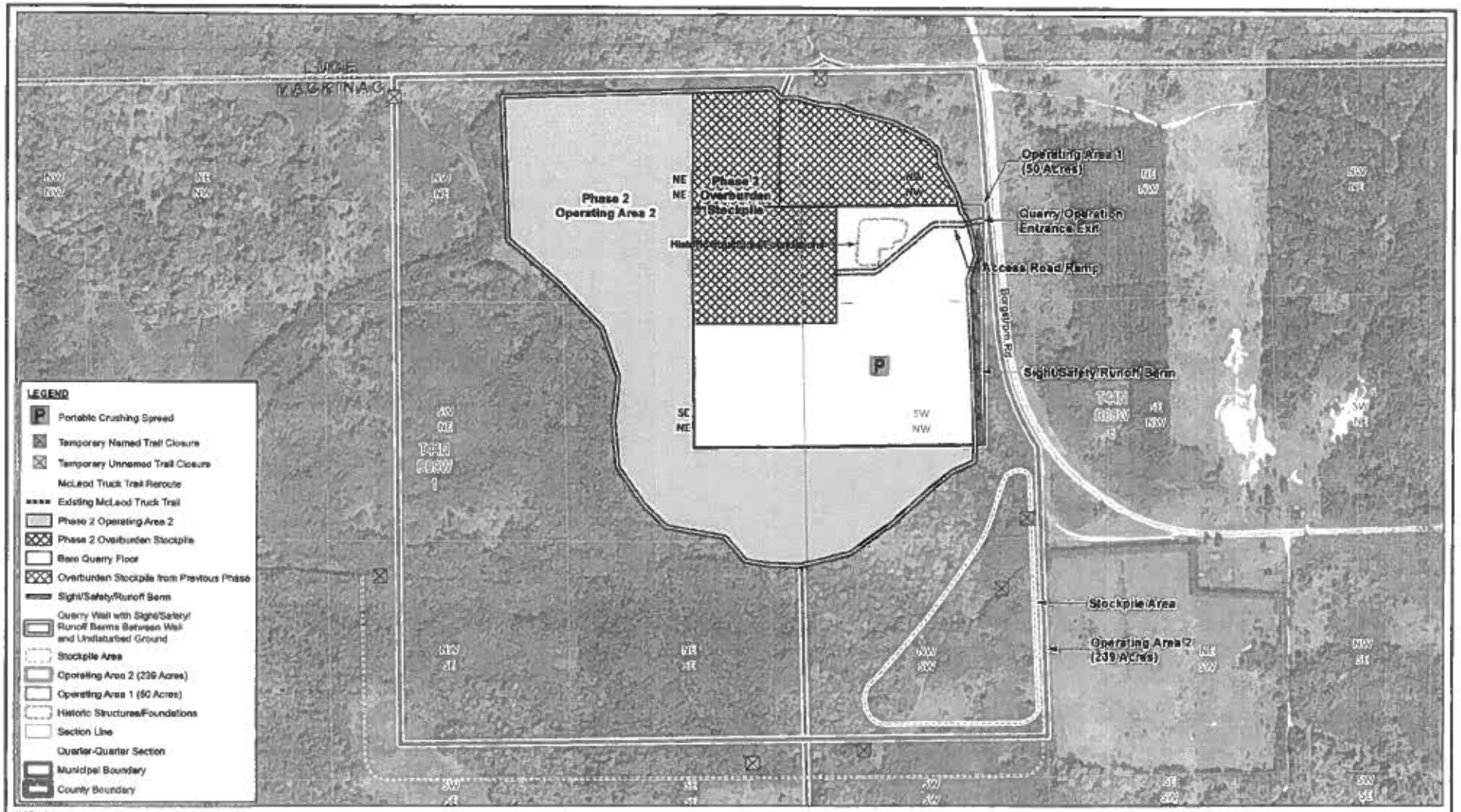
Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MRS5		DATE: APR.'18	
REVIEWED BY: RWS3		DATE: APR.'18	
APPROVED BY: RWS3		DATE: APR.'18	

GRAYMONT (MI) LLC

FIGURE E-1
OPERATING AREA 2 RECLAMATION PLAN
PHASE 1 (YEAR 1)
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet
Date: APRIL 2018
Drafted by: BJW1
Project No: 14W777

Path: X:\GBVE\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix E\Figure E-1 Reclamation Plan Phase 1.mxd Date: 4/19/2018



NOTES:

1. Base imagery from Esri.
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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MRSS			DATE: APR.'18
REVIEWED BY: RWS3			DATE: APR.'18
APPROVED BY: RWS3			DATE: APR.'18

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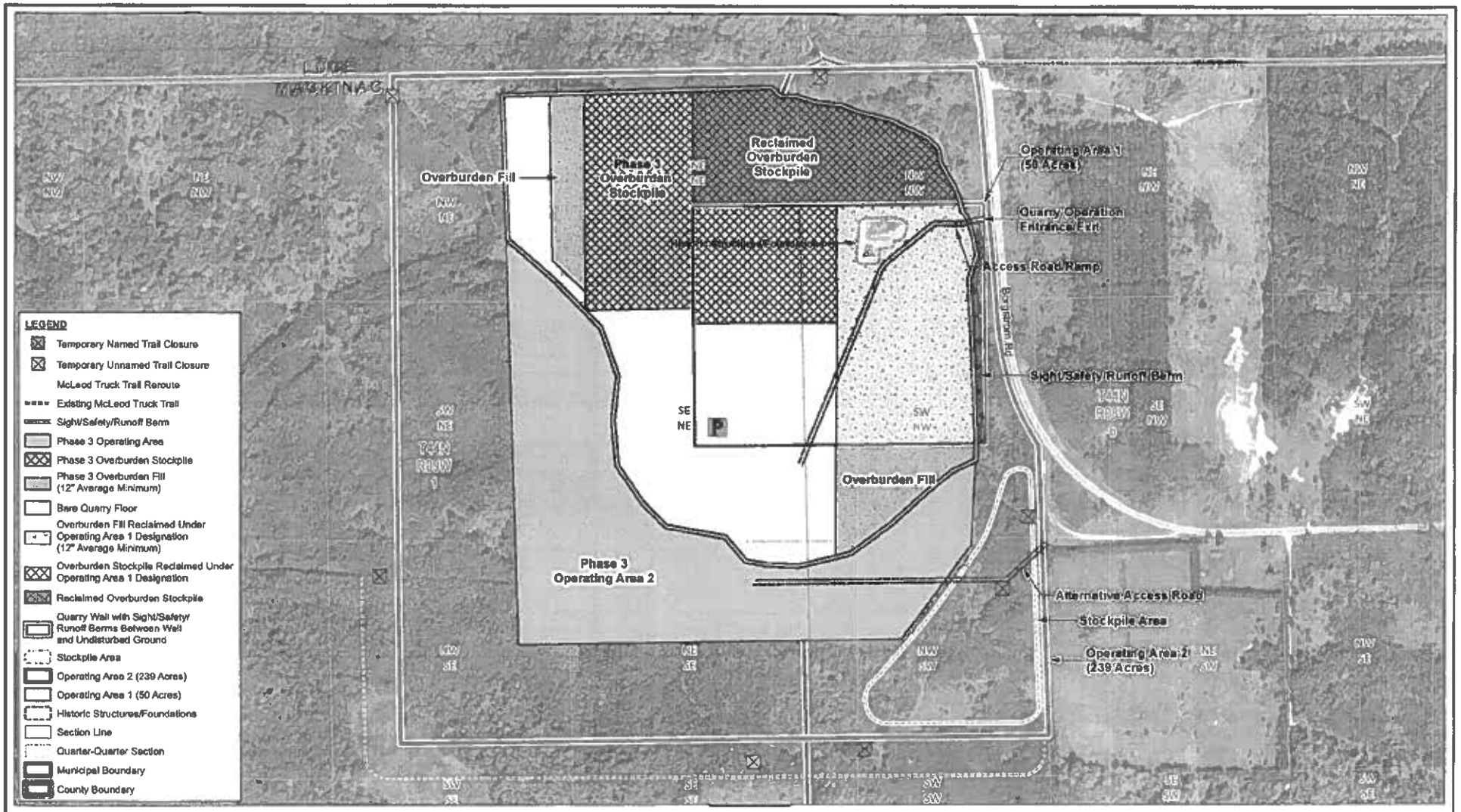
FIGURE E-2

OPERATING AREA 2 RECLAMATION PLAN
PHASE 2 (YEAR 2)
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet | Date: APRIL 2018
Drafted by: BJWI | Project No: 14W777

Path: X:\GBMI\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix E\Figure E-2 Reclamation Plan Phase 2.mxd Date: 4/18/2018



NOTES:
1. Base imagery from Earl.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
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REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MRS6	DATE: APR.'18	
REVIEWED BY:	RWS3	DATE: APR.'18	Scale 0 250 500 Feet
APPROVED BY	RWS3	DATE: APR.'18	Drafted by: BJW1

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FIGURE E-3
OPERATING AREA 2 RECLAMATION PLAN
PHASE 3 (YEAR 3)
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Date: APRIL 2018
Project No: 14W777

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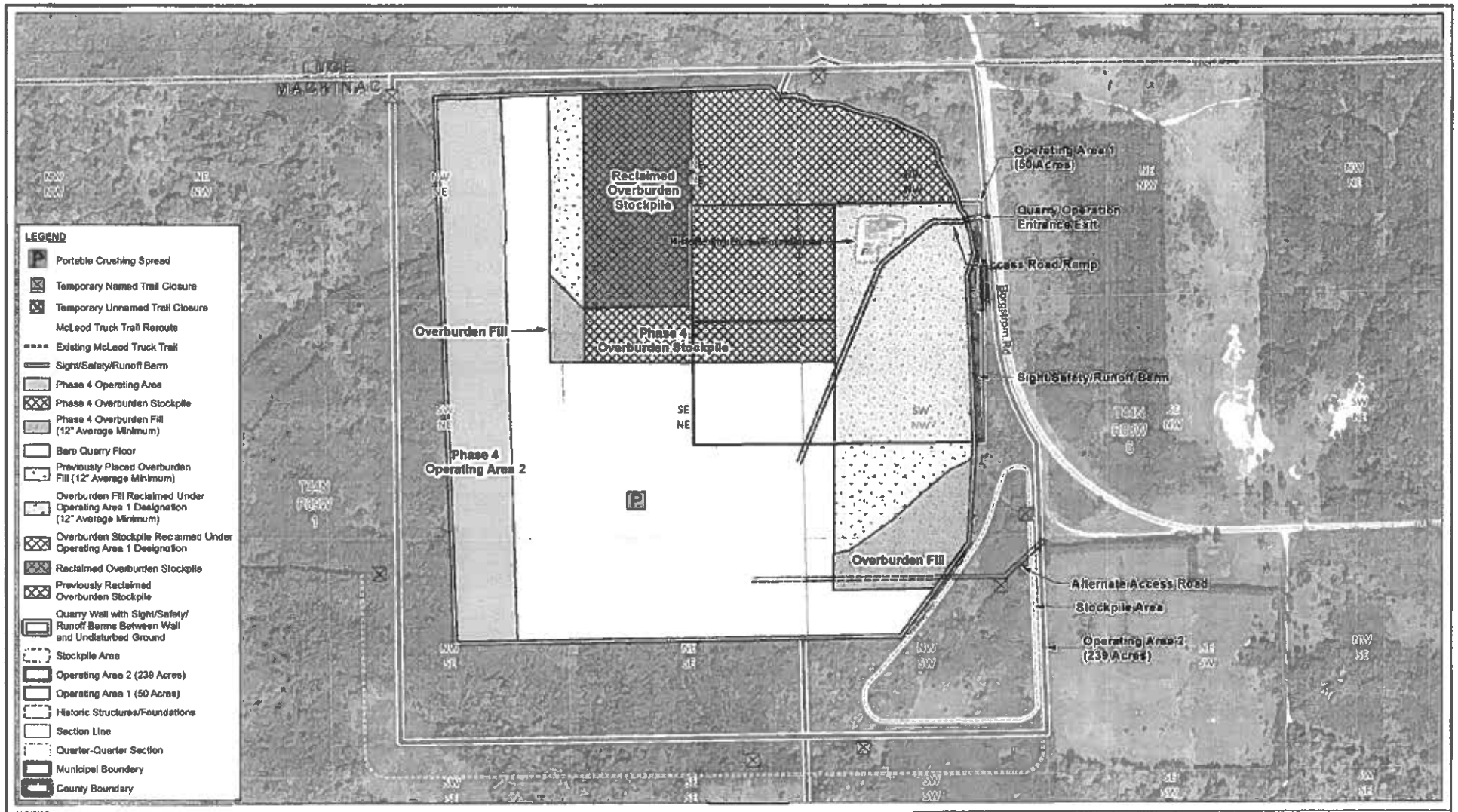

NOTES:

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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MRS5	DATE: APR.'18	
REVIEWED BY:	RWS3	DATE: APR.'18	
APPROVED BY:	RWS3	DATE: APR.'18	

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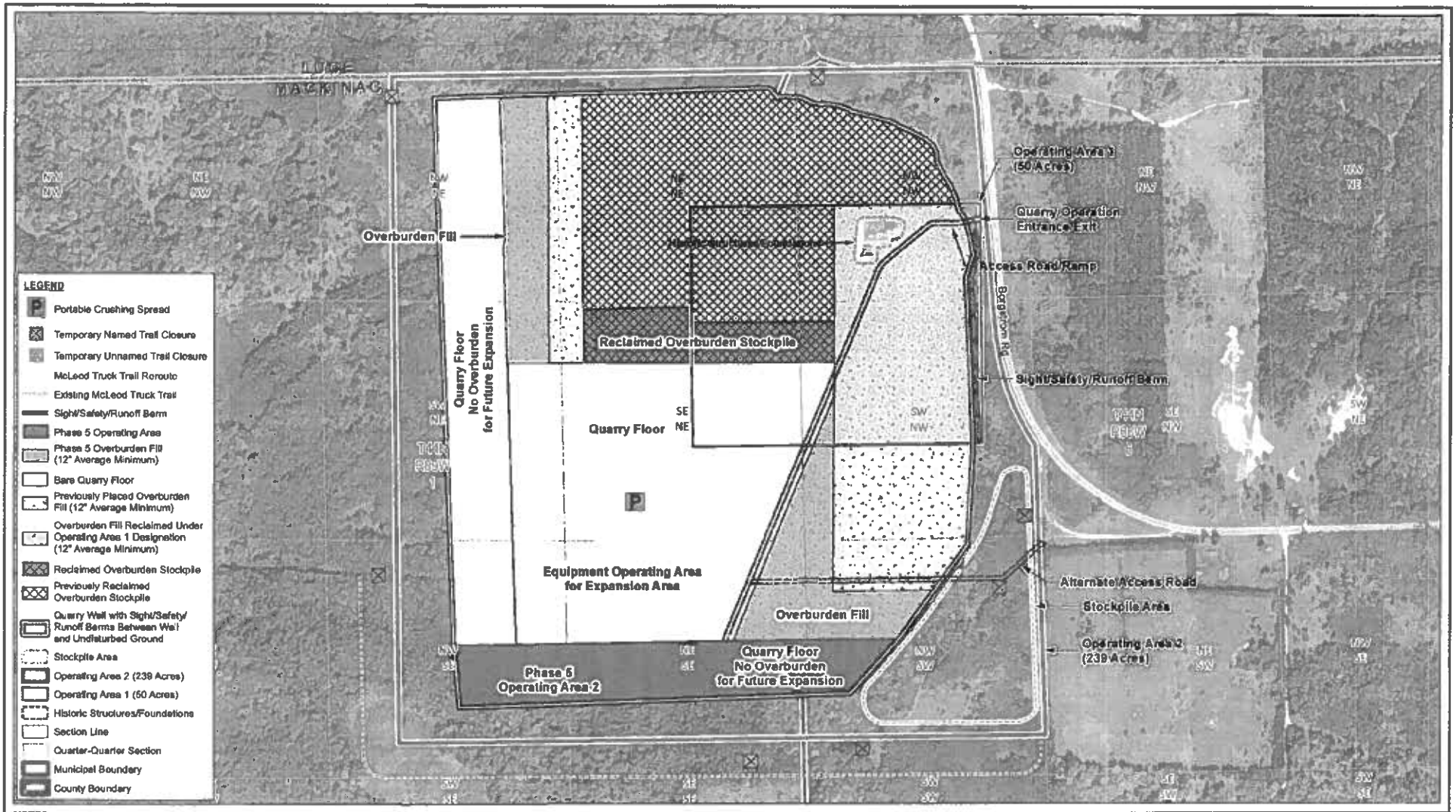
FIGURE E-4

OPERATING AREA 2 RECLAMATION PLAN
PHASE 4 (YEAR 4)
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet		Date: APRIL 2018	
Drafted by:	BJW1	Project No:	14W777

Path: X:\GBNE\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix E\Figure E-4 Reclamation Plan Phase 4.mxd Date: 4/19/2018



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REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MRS5		DATE: APR.'18	
REVIEWED BY: RWS3		DATE: APR.'18	
APPROVED BY: RWS3		DATE: APR.'18	

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FIGURE E-5
OPERATING AREA 2 RECLAMATION PLAN
PHASE 5 (YEAR 5)
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 250 500 Feet | Date: APRIL 2018
Drafted by: BJW1 | Project No: 14W777

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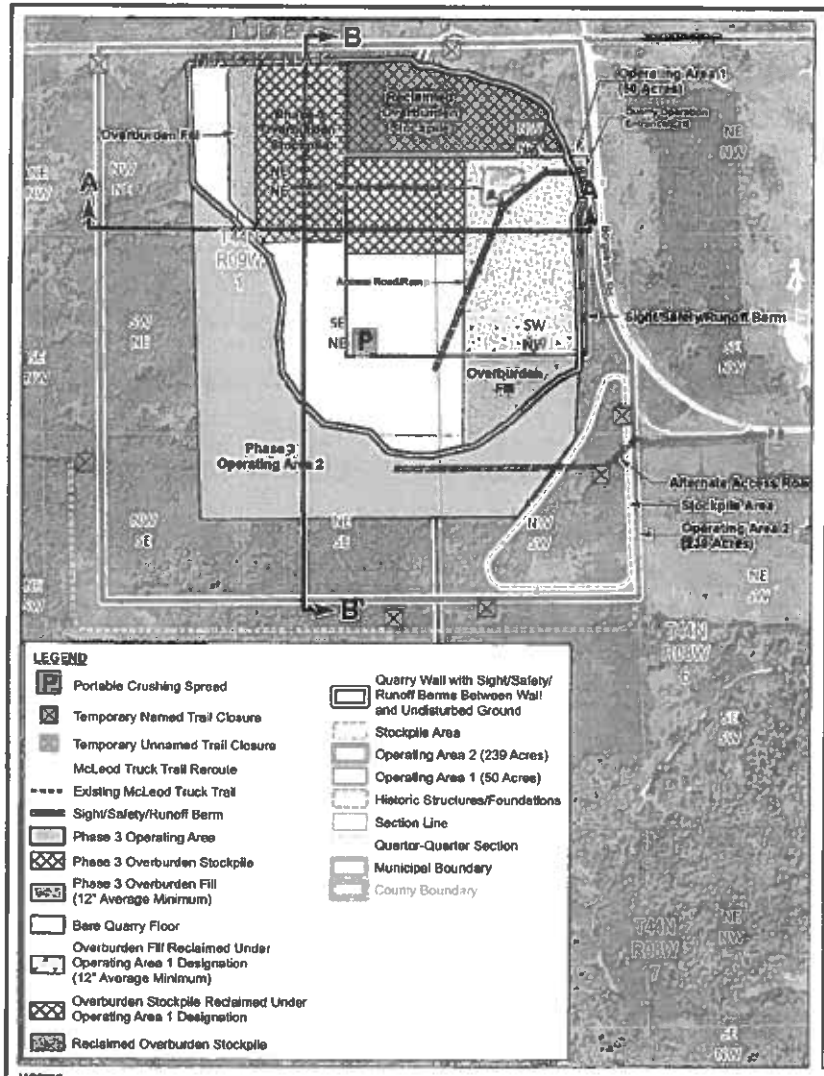

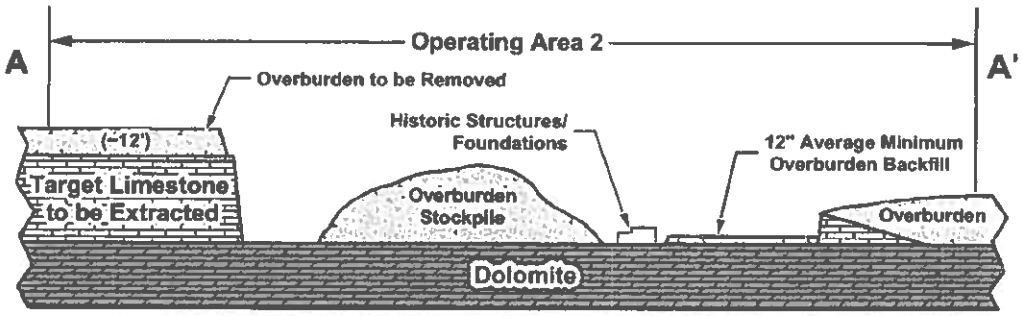

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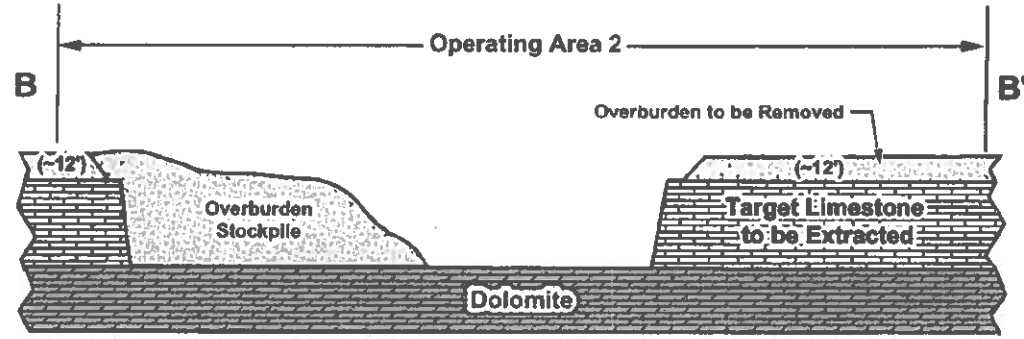
Not to Scale



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Not to Scale

NOTES:
1. Base Imagery from Esri.
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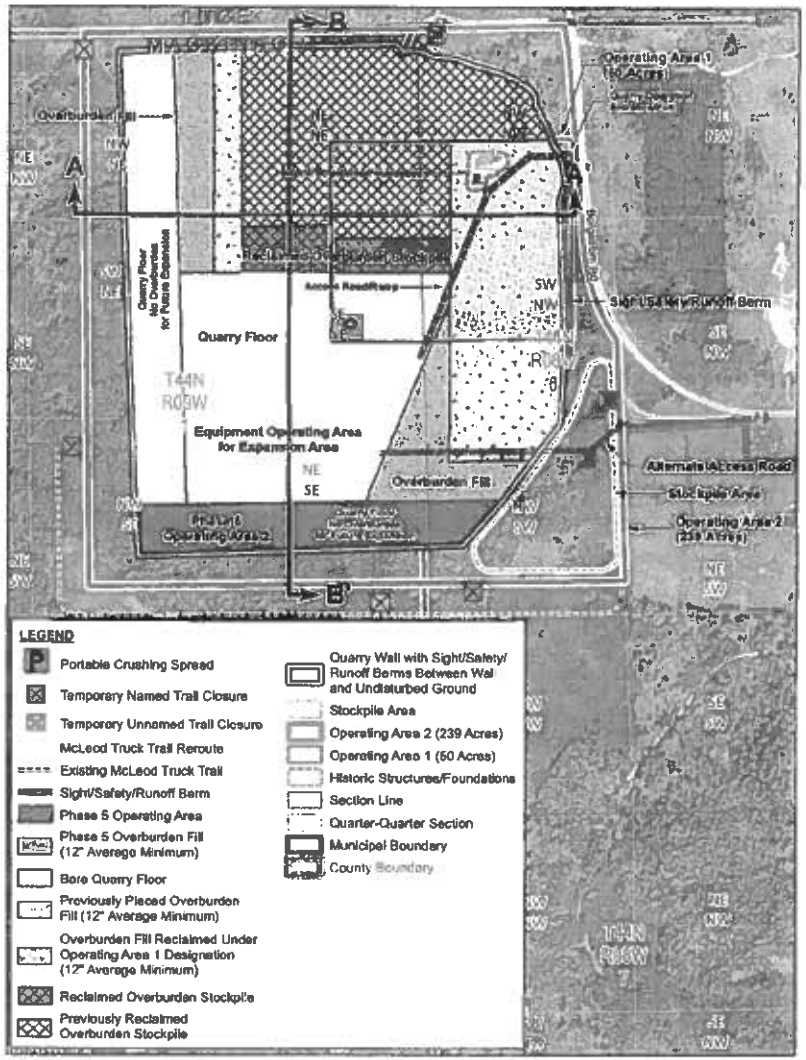
REVISED	DATE	BY	DESCRIPTION		
PREPARED BY:	MRS5			DATE: APR.'18	
REVIEWED BY:	RWS3			DATE: APR.'18	
APPROVED BY:	RWS3			DATE: APR.'18	

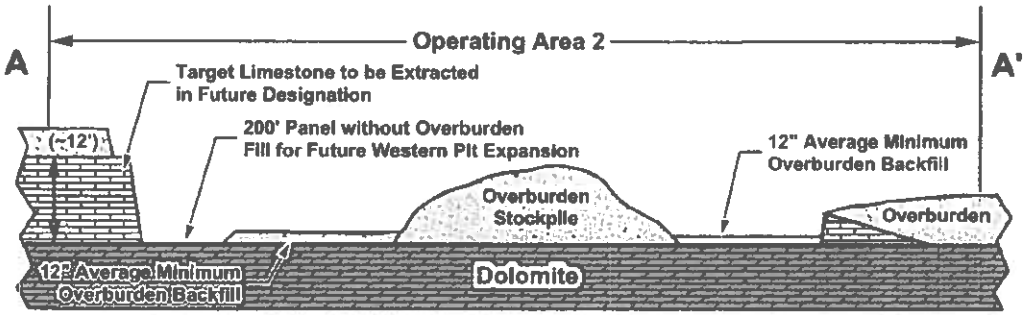
GRAYMONT (MI) LLC

FIGURE E-6
RECLAMATION PLAN - INTERMEDIATE
GENERAL CROSS SECTIONS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 400 800 Feet | Date: APRIL 2018
Drafted by: BJW1 | Project No. 14W777

Path: X:\GBNE\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix E\Figure E-6 Intermediate Cross Sections.mxd Date: 4/19/2018





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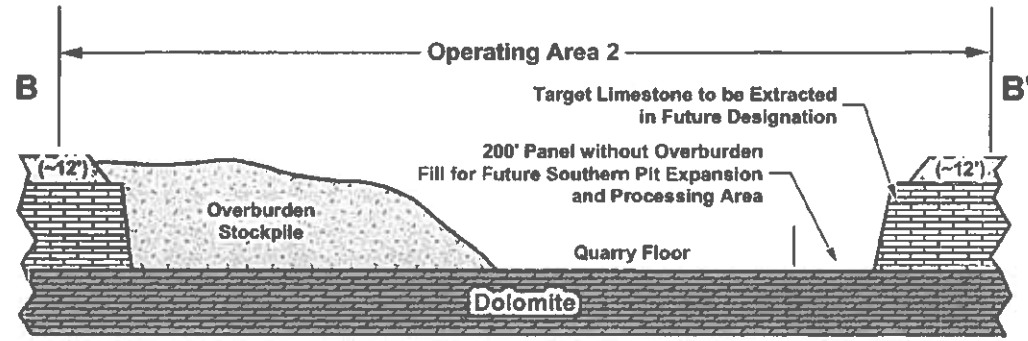

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NOTES:
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6. Actual timing on activity in each phase is market dependent.

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Foth Infrastructure & Environment, LLC				GRAYMONT (MI) LLC	
REVISED	DATE	BY	DESCRIPTION	FIGURE E-7 RECLAMATION PLAN - FINAL ADVANCE GENERAL CROSS SECTIONS GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI	
PREPARED BY: MRS5			DATE: APR.'18		
REVIEWED BY: RWS3			DATE: APR.'18	Scale: 0 400 800 Feet	Date: APRIL 2018
APPROVED BY: RWS3			DATE: APR.'18	Drafted by: BJW1	Project No: 14W777

Path: X:\GBWE\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix E\Figure E-7 Final Advance Cross Sections.mxd Date: 4/19/2018

Exhibit F

Advance Notice
Land Transaction Agreement

Estimate of Reclamation Costs

For the:

Graymont Borgstrom Road Quarry

Operating Area 2

Graymont (MI) LLC

Mackinac County, Michigan

Submitted to:

Department of Natural Resources
State of Michigan

August 2018

GRAYMONT

Memorandum

Foth Infrastructure & Environment, LLC

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April 2, 2018

TO: Paul E. Stoll Jr, Graymont (MI) LLC

CC: Kimberly Walsh, Graymont (MI) LLC
John Maitland, Graymont (MI) LLC
Rich Schowengerdt, Foth Infrastructure & Environment, LLC
Nick Glander, Foth Infrastructure & Environment, LLC

FR: Matt Schowengerdt, Foth Infrastructure & Environment, LLC

RE: Estimate of the Reclamation Costs for the Graymont Borgstrom Road Quarry – Operating Area 2

This Technical Memorandum presents an estimate of the cost ("Reclamation Cost") that the State of Michigan would incur to complete reclamation as prescribed in the Land Transaction Agreement (LTA) and in accordance with the Reclamation Plan (Exhibit E) for Operating Area 2 at the point in the quarrying sequence at which those costs would be the highest. The Graymont Borgstrom Road Quarry (GBRQ) - Operating Area 2 is located near Rexton, Michigan and is on property owned and proposed to be operated by Graymont (MI) LLC (Graymont). Utilizing standardized reclamation cost estimate templates and applicable references, the reclamation costs have been calculated and result in a bond requirement of $74,000 as presented on **Figure F-1 – *Reclamation Cost Analysis Operating Area 2*.**

The evaluation and calculation of reclamation liabilities associated with Operating Area 2 of the GBRQ presented herein are based on the current configuration and proposed advances of Operating Area 2 as shown on:

Figure E-1 – *Operating Area 2 Reclamation Plan Phase 1 (Year 1)*
Figure E-2 – *Operating Area 2 Reclamation Plan Phase 2 (Year 2)*
Figure E-3 – *Operating Area 2 Reclamation Plan Phase 3 (Year 3)*
Figure E-4 – *Operating Area 2 Reclamation Plan Phase 4 (Year 4)*
Figure E-5 – *Operating Area 2 Reclamation Plan Phase 5 (Year 5)*

Reclamation costs were calculated at various snap shots during the mining sequence to determine at which point in the quarrying process the reclamation costs would be the highest for a third party (state of Michigan) to complete reclamation activities as described in the Reclamation Plan (Exhibit E).

The following subsections summarize the reclamation activities and associated costs as required by the LTA and typically required for a third party Reclamation Plan financial assurance calculation.

GBRQ Reclamation Model Plan

The GBRQ operation parcel is approximately 290 acres with approximately 15 acres previously removed and remains as an open pit (part of the existing Hendricks Quarry). The Reclamation Plan for Operating Area 2 is presented in Exhibit E and generally consists of:

- All equipment and infrastructure is mobile/portable and will be removed at completion of quarrying activities.
- An average minimum of 12 inches of overburden (from Operating Area 1) will be spread across Operating Area 1 including the 16 acres of existing Hendricks Quarry pit floor within Operating Area 1. An approximate 1 acre portion of the existing Hendricks pit floor will not be subject to overburden placement to preserve the structural features associated with historic quarrying activities as described in Exhibit D.
- Sight/safety berms along Operating Area 1 edges will be left in place for to discourage access and promote public safety.
- Vegetation of backfilled overburden and sight/safety berms will be allowed to occur naturally.

The quarrying and associated reclamation will be conducted as described in the Mine Plan (Exhibit B) and the Reclamation Plan generally consisting of:

Phase 1: The initial quarrying phase will primarily be activities surrounding the stockpiling of overburden in the northeast corner of the existing Hendricks pit that is not used for sight/safety/runoff berms from Operating Area 1. Limited reclamation activities will be conducted during this phase as most of the activity is associated in the mining of Operating Area 1. See Figure E-1.

Phase 2: The next quarrying phase will proceed west and south along an arched panel that will enlarge the mining area created by the existing Hendricks pit located in Operating Area 2 and the quarried portions of Operating Area 1. Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the western edge of the overburden stockpiled in Phase 1. Limited reclamation activities will be conducted during this phase as most of the activity is associated in the mining of Operating Area 1 and opening up Operating Area 2 for processing and stockpiling. See Figure E-2.

Phase 3: Similar to Phase 2, the next quarrying phase will proceed west and south along an arched panel that will enlarge the mining area created by the previous phases. Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the western edge of the overburden stockpiled in Phase 2 or used as backfill on the unused areas of the mined pit floor.

Overburden stockpiles built in Phase 1 and Phase 2 will receive final grading and left to revegetate naturally and portions of the quarry floor will be reclaimed with at least 12 inches of overburden and left to revegetate naturally. Most of Operating Area 1, covered under a previous surety generated from the designation of Operating Area 1, will also be reclaimed. See Figure E-3.

Phase 4: The next quarrying phase will create a north/south panel near the western edge of Operating Area 2 Overburden that is not used for sight/safety/runoff berms will be stockpiled adjacent to the southern edge of the overburden stockpiled in Phase 3 or used as backfill on the unused areas of the mined pit floor.

Overburden stockpiles built in Phase 3 will receive final grading and left to revegetate naturally and portions of the quarry floor will be reclaimed with at least 12 inches of overburden and left to revegetate naturally. See Figure E-4.

Phase 5: Similar to Phase 4, next quarrying phase will create an east/west panel near the southern edge of Operating Area 2. Overburden that is not used for sight/safety/runoff berms will be used as backfill on the unused areas of the mined pit floor. Overburden stockpiles built in Phase 3 will receive final grading and left to revegetate naturally and portions of the quarry floor will be reclaimed with at least 12 inches of overburden and left to revegetate naturally. See Figure E-5.

The Reclamation Plan for Operating Area 1 is presented in Exhibit E and generally consists of:

- All equipment and infrastructure is mobile/portable and will be removed at completion of quarrying activities.
- An average minimum of 12 inches of overburden (from Operating Area 1) will be spread across Operating Area 1 including the 16 acres of existing Hendricks Quarry pit floor within Operating Area 1. An approximate 1-acre portion of the existing Hendricks pit floor will not be subject to overburden placement to preserve the structural features associated with historic quarrying activities as described in Exhibit D.
- Sight/safety berms along Operating Area 1 edges will be left in place for to discourage access and promote public safety.
- Vegetation of backfilled overburden and sight/safety berms will be allowed to occur naturally.

It is anticipated that the final open panels would be left open to provide access to future quarrying through new designated operating areas, should operations permanently terminate at the end of limestone extraction activities associated with Operating Area 1, overburden placed immediately behind the three final panels would be pushed west and south to cover the exposed pit floor with a minimum average of 12 inches of overburden to facilitate plant growth. The

sight/safety berm along the west and southern boundaries would remain in place and allowed to naturally vegetate.

Costs have been calculated for the five phases of reclamation to define the worst case reclamation cost.

Cost Estimate Spreadsheets

The cost estimate worksheets are presented in a standardized format as outlined in 49 CFR Part 23 used to calculate the financial assurance required for third party reclamation on public lands associated with mineral extraction.

Standardized direct cost estimate worksheets have been used to develop the cost of demolition, earthwork, and other support activities associated with site reclamation as required in the LTA. **Tables 1-1, 1-2, 1-3 – *Bond Calculation Tables***, summarize the direct costs for reclamation and then applies various indirect cost and escalation factors to determine the surety bond (or other approved financial assurance instrument) amount.

Demolition and Miscellaneous Costs

With only portable/mobile structures and equipment proposed for the GBRQ Operating Area 2 operation, the only demolition costs applicable is for a small crew of laborers (estimated at 3 laborers) to pick up/remove operational quarry debris from the site. **Table 2 - *Summary of Demolition and Miscellaneous Costs***, presents the cost build-up for the site for reclamation. The production rates were determined using the Caterpillar Performance Handbook Edition 45. The pricing for the labor crew was determined using Michigan's 2018 Prevailing Wage Rate Schedule for Laborers Class 1, Zone 3 and 4. The associated labor cost is $44.35 per hour labor rate for a one-week period. The pricing for the disposal fee was provided by Waste Management, Newberry, MI Landfill.

The cost for demolition and miscellaneous activities is approximately $8,500.

Earth Work Costs

An Earth Work Spreadsheet was completed for the three phases where earthwork is required for reclamation to determine the worst case reclamation cost. The Earth Work Spreadsheet follows the scope of work as described above and itemizes the earthwork associated with placing and grading overburden as generally outlined above.

Tables 3-1, 3-2, and 3-3 – *Summary of Earth Work* present the reclamation cost build-up for each reclamation phase. The production rates were determined using the Caterpillar Performance Handbook Edition 45. The equipment costs used for the earth moving were determined by using the Equipment Watch Rental Rate Blue Book, Volume 1 (1st half of 2018 rates).

The cost for earth work for each phase of reclamation scenario summarized in **Table 3-0** and below:

Phase 1	Limited
Phase 2	Limited
Phase 3	$49,000
Phase 4	$43,000
Phase 5	$74,000

Total Reclamation Cost

The total cost using the build-up of the Demolition/Miscellaneous and Earth Work Spreadsheets in 2018 dollars is totaled for each reclamation phase. After the application of 5 years of escalation, the Bond Amount (rounded to the nearest one thousand dollars) was plotted for each reclamation phase, the worst case reclamation scenario occurs after Operating Area 2 is Phase 5. As shown on Figure F-1, $74,000 represents the worst case reclamation costs and will be used to establish the financial assurance instrument.

Attachments:

Attachment 1	Bond Calculation Assumptions
Table 1-1	Bond Calculation – Phase 3
Table 1-2	Bond Calculation – Phase 4
Table 1-3	Bond Calculation – Phase 5
Table 2	Summary of Demolition Cost
Table 3-0	Summary of Earth Work Cost, all phases
Table 3-1	Summary of Earth Work Cost, Phase 3
Table 3-2	Summary of Earth Work Cost, Phase 4
Table 3-3	Summary of Earth Work Cost, Phase 5
Figure F-1	Reclamation Cost Analysis Operating Area 2

Attachment, Tables, and Figure

Attachment 1

Assumptions for Financial Assurance Calculations Graymont (MI) LLC

Graymont Borgstrom Road Quarry – Operating Area 2

April 2018

Base information

239 acres
50 acres adjacent to the parcel has already been or is scheduled to be quarried under Operating Area 1.
189 acres with Operating Area 2 scheduled to be quarried

Average Overburden (topsoil/till/unmarketable rock) depth 10 – 12'
Quarrying will be conducted in multiple advances.
All equipment and infrastructure is mobile/portable.
One Named Trails are intersected by the Quarry. Recreational Trails will be closed and posted prior to quarry advancement.

Reclamation – End of Phase 3

Placement of an average of at least 12 inches of overburden from in-pit stockpiles on exposed Borgstrom Quarry bedrock within Operating Unit 2 and on newly quarried exposed bedrock in Operating Unit 2.

1. Clean-up crew and disposal of residual quarry debris
2. Push overburden from existing in-pit stockpiles to adjacent exposed bedrock with the existing Borgstrom Rd Quarry within Operating Area -2 Phase 2 (dozer, 17,424 ft^2, an average of at least 12 inches thick. Average Push – 150 ft)
3. Push overburden from existing in-pit stockpiles adjacent to exposed bedrock from newly quarried areas within Operating Area 2 (wheel loader, 1,394 ft^3, an average of at least 12 inches thick, average distance 400 ft)
4. Grade and contour remaining overburden stockpile material (dozer, 17.9 acres)
5. Removal of all mobile/portable structures and equipment.

Reclamation – End of Phase 4

Placement of an average of at least 12 inches of overburden from in-pit stockpiles on exposed Borgstrom Quarry bedrock within Operating Unit 2 and on newly quarried exposed bedrock in Operating Unit 2.

1. Clean-up crew and disposal of residual quarry debris
2. Push overburden from existing in-pit stockpiles to adjacent exposed bedrock with the existing Borgstrom Rd Quarry within Operating Area -2 Phase 3 (dozer, 14,197 ft^2. an average of at least 12 inches thick. Average Push – 150 ft)

3. Push overburden from existing in-pit stockpiles adjacent to exposed bedrock from newly quarried areas within Operating Area 2 (wheel loader, 1,136 ft^3, an average of at least 12 inches thick, average distance 400 ft)
4. Grade and contour remaining overburden stockpile material (dozer, 16.5 acres)
5. Removal of all mobile/portable structures and equipment.

Reclamation – End of Phase 5

Placement of an average of at least 12 inches of overburden from in-pit stockpiles on exposed Borgstrom Quarry bedrock within Operating Unit 2 and on newly quarried exposed bedrock in Operating Unit 2.

1. Clean-up crew and disposal of residual quarry debris
2. Push overburden from existing in-pit stockpiles to adjacent exposed bedrock with the existing Borgstrom Road Quarry within Operating Area -2 Phase 4 (dozer, 31,783 ft^2, an average of at least 12 inches thick. Average Push – 200 ft)
3. Push overburden from existing in-pit stockpiles adjacent to exposed bedrock from newly quarried areas within Operating Area 2 (wheel loader, 2,543 ft^3, an average of at least 12 inches thick, average distance 400 ft)
4. Grade and contour remaining overburden stockpile material (dozer, 8.10 acres)
5. Removal of all mobile/portable structures and equipment.
6. Procure/install perimeter signs (14,000' perimeter, sign every 300 ft)

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Table 1-1

Bond Calculation - Phase 3

2018 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
April 2018

Reference	Cost Element	Cost	Factor
1	**Direct Costs**		
2	Subtotal Backfilling and Grading	$27,683.00	
3	Subtotal of Demolition and Miscellaneous Cost	$8,476.00	
5	Subtotal Direct Costs	$36,159.00	
6	**Indirect Costs**		
7	Mob/Demob	$3,616.00	10.0%
8	Contingency	$1,808.00	5.0%
9	Engineering Redesign	$904.00	2.5%
10	Main Office Expense	$2,459.00	6.8%
11	Project Management Fee	$904.00	2.5%
12	Subtotal Indirect Costs	$9,691.00	26.8%
13	**Total Cost 2018**	**$45,850.00**	
14	**Escalation**		
15	Number of years		5
16	Escalation factor		0.013
17	Escalation	$3,059.00	
18	Reclamation Cost Escalated	$48,909.00	
19	**Bond Amount (rounded to nearest $1,000) 2018 Dollars**	**$49,000.00**	

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Table 1-2

Bond Calculation - Phase 4

2018 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
April 2018

Reference	Cost Element	Cost	Factor
1	**Direct Costs**		
2	Subtotal Backfilling and Grading	$23,514.00	
3	Subtotal of Demolition and Miscellaneous Cost	$8,476.00	
5	Subtotal Direct Costs	$31,990.00	
6	**Indirect Costs**		
7	Mob/Demob	$3,199.00	10.0%
8	Contingency	$1,600.00	5.0%
9	Engineering Redesign	$800.00	2.5%
10	Main Office Expense	$2,175.00	6.8%
11	Project Management Fee	$800.00	2.5%
12	Subtotal Indirect Costs	$8,574.00	26.8%
13	**Total Cost 2018**	**$40,564.00**	
14	**Escalation**		
15	Number of years		5
16	Escalation factor		0.013
17	Escalation	$2,706.00	
18	Reclamation Cost Escalated	$43,270.00	
19	**Bond Amount (rounded to nearest $1,000) 2018 Dollars**	**$43,000.00**	

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Table 1-3

Bond Calculation - Phase 5

2018 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
April 2018

Reference	Cost Element	Cost	Factor
1	**Direct Costs**		
2	Subtotal Backfilling and Grading	$45,924.00	
3	Subtotal of Demolition and Miscellaneous Cost	$8,476.00	
5	Subtotal Direct Costs	$54,400.00	
6	**Indirect Costs**		
7	Mob/Demob	$5,440.00	10.0%
8	Contingency	$2,720.00	5.0%
9	Engineering Redesign	$1,360.00	2.5%
10	Main Office Expense	$3,699.00	6.8%
11	Project Management Fee	$1,360.00	2.5%
12	Subtotal Indirect Costs	$14,579.00	26.8%
13	**Total Cost 2018**	**$68,979.00**	
14	**Escalation**		
15	Number of years		5
16	Escalation factor		0.013
17	Escalation	$4,602.00	
18	Reclamation Cost Escalated	$73,581.00	
19	**Bond Amount (rounded to nearest $1,000) 2018 Dollars**	**$74,000.00**	

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Table 2

Summary of Demolition and Miscellaneous Cost - Scenario 2

2018 Bond Calculation
Graymont LLC - Bergstom Road Quarry
Graymont, LLC
December 2018

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
1	Miscellaneous Scrap																			
	Demolition Cost - Laborers	2 Person Crew	MI Prevailing Wage Rates	$44.35	HR									40	3			120	HR	$5,322.00
	Rubble's Weight (exclude steel)											8000						4	Tons	
	Truck's Capacity	18 CY																		
	Haulage	1 Load/ HR - 1 Truck	EQ. Watch Bluebook	$153.06	HR													3	Trips	$459.00
	Disposal Cost Non Steel	Miscellaneous Scrap	Note 1.	$172	Ton													4	Tons	$688.00
2	Installation of Site Signage																			
	Labors	2 Person Crew	MI Prevailing Wage Rates	$44.35	HR									10	2			20	HR	$887.00
		Signs	Note 2.	$22	ea.													40	Ea.	$880.00
		Sign Stakes	Note 3.	$6	ea.													40	Ea.	$240.00
	Total																			$8,476.00

Notes:

1. Disposal Cost based on 2018 current rates of the Waste Management (Newberry, MI) Landfill.
2. Cost for signage provided by local sign store.
3. General metal stake cost is provided based on local hardware store rates.

Table 3-0
Summary of Earth Work Costs
2018 Bond Calculation Update
Borgstrom Rd. Quarry - Operating Area- 2
Graymont, Inc.
April 2, 2018

Reference	Description	Notes	Cost
1	Operating Area 2 - Phase 3		$27,683.00
2	Operating Area 2 - Phase 4		$23,514.00
3	Operating Area 2 - Phase 5		$45,924.00
	Total		**$97,121.00**

Prepared by: NMGI
Checked by: MRS

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Table 3-1

Summary of Earth Work Reclamation Cost for End of Phase 3

2018 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
April 2018

Ref.		Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
	Phase 3 - Backfilling & Grading															
1	Dozer D-9T	$27,085.00	$113.20	0.1	$81.05	$374.85	1	$374.85	$/HR	17,424.00	CY	459	CY/HR	38.0	HR	$14,230.00
2	962K Loader	$8,385.00	$41.30	0.1	$81.05	$178.89	1	$178.89	$/HR	1,393.92	CY	150	CY/HR	9.3	HR	$1,662.00
3	Dump Truck 6x4 18 CY	$4,600.00	$50.00	0.1	$69.30	$153.05	2	$306.10	$/HR	1,393.92	CY	150	CY/HR	9.3	HR	$2,845.00
	Phase 3 - Grading Overburden Stockpile															
1	Dozer D-9T	$27,085.00	$113.20	0.1	$81.05	$374.85	1	$374.85	$/HR	17.90	Ac	0.76	Ac/HR	23.9	HR	$8,946.00
	Subtotal															$27,683.00

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Table 3-2

Summary of Earth Work Reclamation Cost for End of Phase 4

2018 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
April 2018

Ref.		Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
	Phase 4 - Backfilling & Grading															
1	Dozer D-9T	$27,085.00	$113.20	0.1	$61.05	$374.85	1	$374.85	$/HR	14,197.33	CY	469	CY/HR	30.9	HR	$11,594.00
2	962K Loader	$8,385.00	$41.30	0.1	$61.05	$176.89	1	$176.89	$/HR	1,135.79	CY	150	CY/HR	7.6	HR	$1,355.00
3	Dump Truck 6x4 18 CY	$4,600.00	$50.00	0.1	$69.30	$153.05	2	$306.10	$/HR	1,135.79	CY	150	CY/HR	7.6	HR	$2,318.00
	Phase 4 - Grading Overburden Stockpile															
1	Dozer D-9T	$27,085.00	$113.20	0.1	$61.05	$374.85	1	$374.85	$/HR	16.50	Ac	0.75	Ac/HR	22.0	HR	$8,247.00
	Subtotal															$23,514.00

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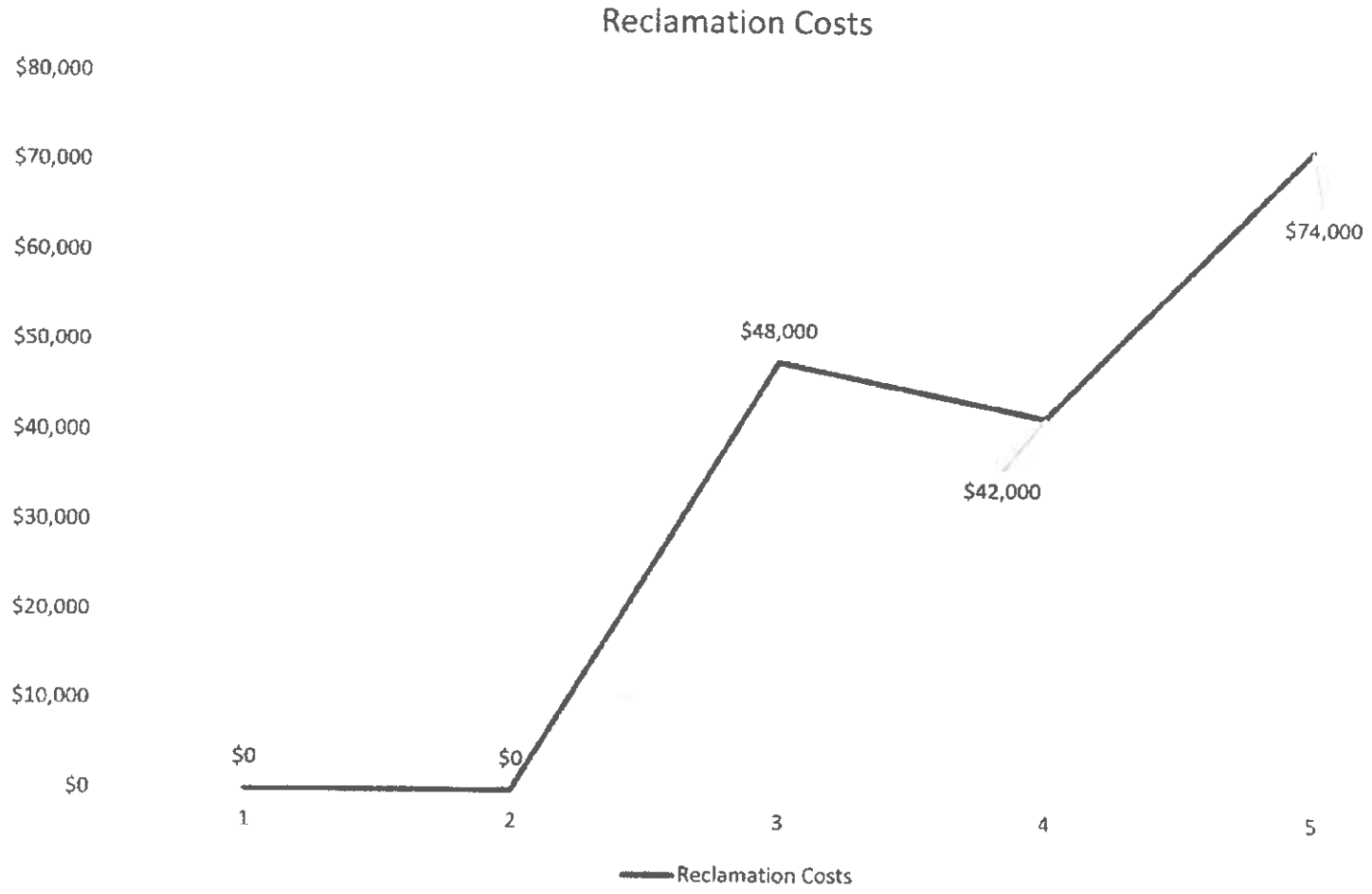
Table 3-3

Summary of Earth Work Reclamation Cost for End of Phase 5

2018 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
April 2018

Ref		Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
	Phase 5 - Backfilling & Grading															
1	Dozer D-9T	$27,065.00	$113.20	0.1	$81.05	$374.85	1	$374.85	$/HR	31,782.67	CY	354	CY/HR	89.8	HR	$33,655.00
2	962K Loader	$8,385.00	$41.30	0.1	$81.05	$178.89	1	$178.89	$/HR	2,542.61	CY	150	CY/HR	17.0	HR	$3,032.00
3	Dump Truck 6x4 18 CY	$4,600.00	$60.00	0.1	$68.30	$153.06	2	$306.10	$/HR	2,542.61	CY	150	CY/HR	17.0	HR	$5,189.00
	Phase 5 - Grading Overburden Stockpile															
1	Dozer D-9T	$27,065.00	$113.20	0.1	$81.05	$374.85	1	$374.85	$/HR	8.10	Ac	0.75	Ac/HR	10.8	HR	$4,048.00
	Subtotal															$45,924.00



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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MRS5	DATE:	APR.'18
REVIEWED BY:	RWS3	DATE:	APR.'18
APPROVED BY:	RWS3	DATE:	APR.'18

GRAYMONT (MI) LLC

FIGURE F-1
RECLAMATION COST ANALYSIS
OPERATING AREA 2
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale:	NOT TO SCALE	Date:	APRIL 2018
Drafted by:	BJW1	Project No:	14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\GBRQ 2018 LTA Designation\Appendix F\Figure F-1 Reclamation Cost Analysis.mxd Date: 7/18/2018