Brine Well Cavity Investigation Program
Technical Report

The Detroit River International Crossing Study

Michigan Department of Transportation

February 2008

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SUMMARY

The Detroit River International Crossing (DRIC) Study is a bi-national effort to complete the environmental study processes for the border crossing between Detroit, Michigan and Windsor, Ontario for the United States, Michigan, Canada and Ontario governments. The study will identify solutions that support the region, state, provincial and national economies while addressing civil defense, national defense, and homeland security needs of the busiest trade corridor between the United States and Canada (Figure S-1).

Figure S-1
Detroit River International Crossing Study
Existing Detroit River International Crossings

Source: The Corradino Group of Michigan, Inc

The purpose of the DRIC Project for the foreseeable future (at least 30 years) is to:

- Provide safe, efficient, and secure movement of people and goods across the U.S-Canadian border in the Detroit River area to support the economies of Michigan, Ontario, Canada, and the U.S.

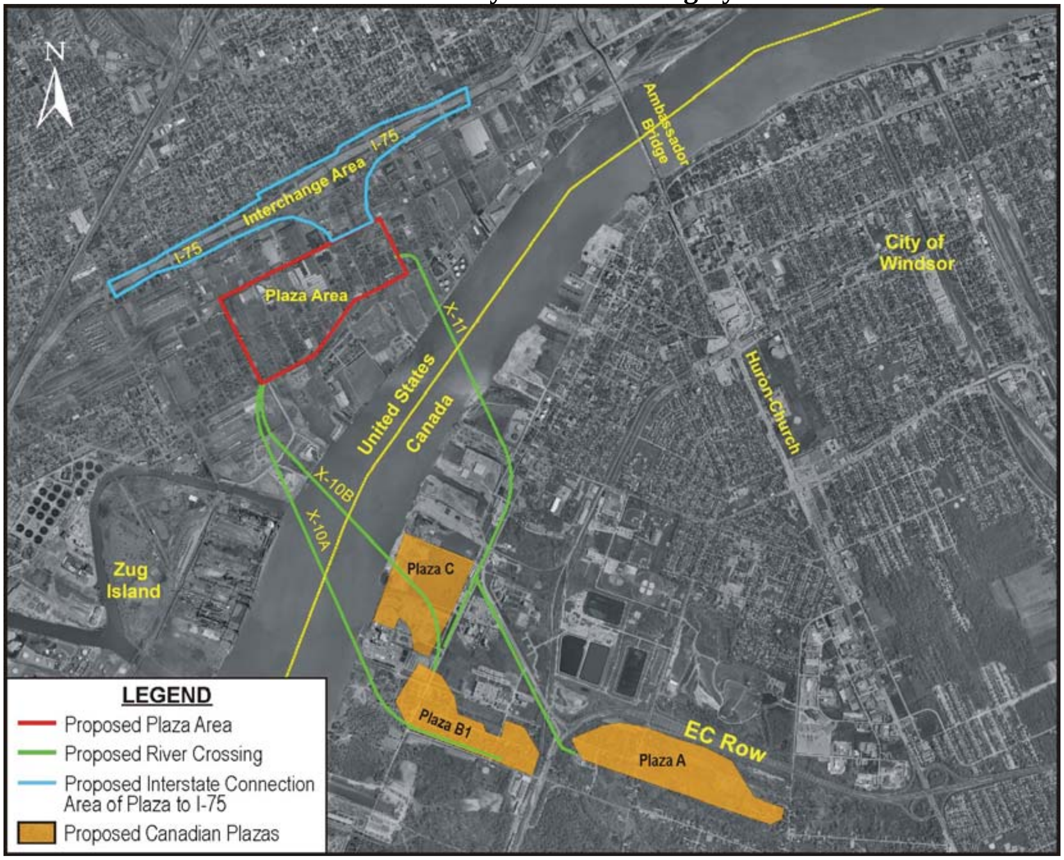
- Support the mobility needs of national and civil defense to protect the homeland.

To address future mobility requirements (i.e., at least 30 years) across the U.S-Canadian border, there is a need to:

- Provide new border crossing capacity to meet increased long-term demand;
- Improve system connectivity to enhance the seamless flow of people and goods;
- Improve operations and processing capability;
- Provide reasonable and secure crossing options in the event of incidents, maintenance, congestion, or other disruptions.

The DRIC Study Draft Environmental Impact Statement (DEIS) analyzes issues/impacts on the U.S. side of the crossing system over the Detroit River between Detroit, Michigan, and Windsor, Ontario, Canada. The alternatives are comprised of three components: the crossing, plaza (where tolls are collected), and interchange connecting the plaza to I-75 (Figure S-2).

Figure S-2
Detroit River International Crossing Study
U.S. Area of Analysis for Crossing System

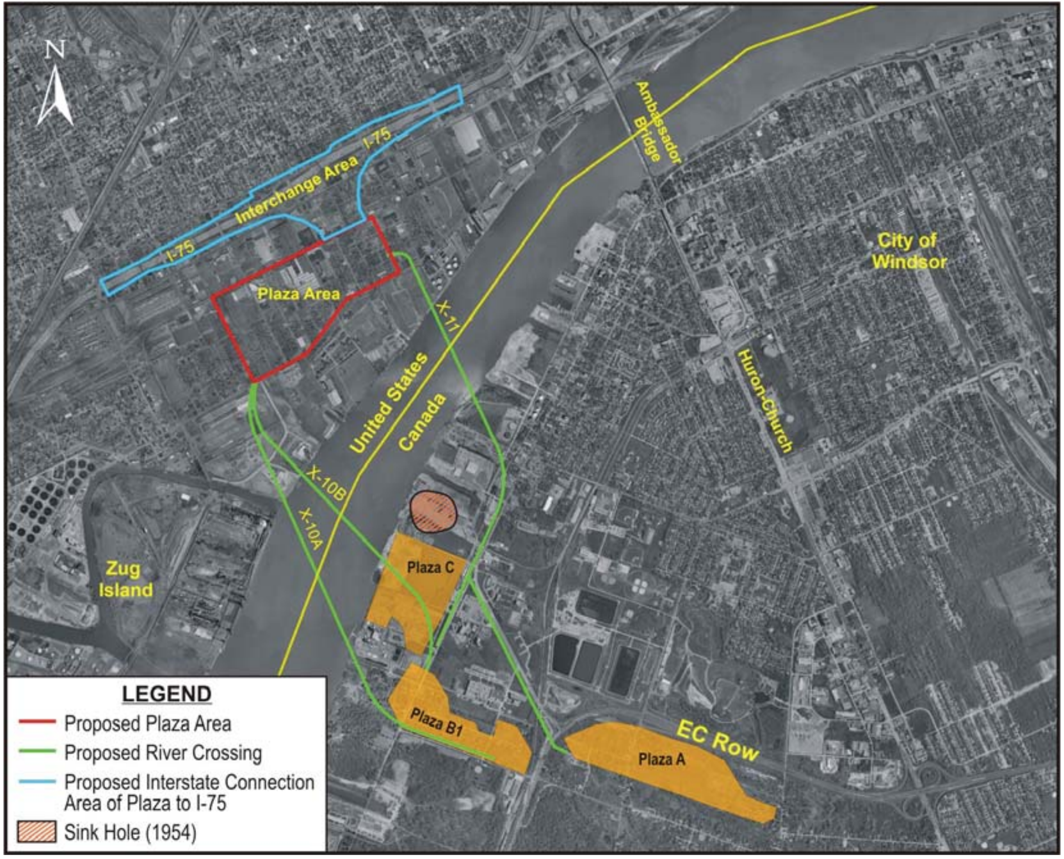


Source: The Corradino Group of Michigan, Inc.

Purpose of the Report

Salt (halite) has historically been solution mined in the area of the DRIC Practical Alternatives. As part of this solution mining process, fresh water was injected into the ground, natural salt beds were dissolved, and the resulting brine was brought to surface and evaporated to make salt. The solution mining of salt layers ranging from 275 to 490 m (900 to 1,600 feet) below the ground surface was typically conducted in an uncontrolled method before standardized record keeping was common practice. This created underground cavities of unknown location, size, and dimension. A solution mining cavity collapsed to the surface and formed a sinkhole on the Windsor side of the study area in 1954 (Figure S-3). At least two additional sinkholes occurred at Point Hennepin (on Grosse Isle) south of the DRIC crossing site on the U.S. side of the river.

Figure S-3
Detroit River International Crossing Study
Sinkhole in Windsor, Canada



Source: URS Canada

Also, settlement of up to several meters were observed near the Wyandotte, MI brinefield.

After consideration of the available data, a Brine Well Cavity Investigation program was developed to delineate the size, locations, and shape of potential brine well cavities in the two proposed crossing corridors on the U.S. side of the crossings. Approval was obtained from Michigan Department of Transportation (MDOT) for a combined geophysical and geotechnical program, which included the drilling of multiple deep-rock borings in combination with Cross-well seismic imaging. “Forward modeling,” borehole gravity, vertical seismic profiling (VSP), and downhole wireline logging were also included in the program. This report presents a summary of the data obtained on the U.S. side during the investigation program.

Geotechnical Analysis Overview

In early 2006, an intensive literature search of historical brine well operations in the X-10 and X-11 corridors was completed. The results were presented in a report entitled "Preliminary Report on Historical Solution Mining Activities, Crossing X-10 and X-11 Corridors," dated March 24, 2006 and presented under separate cover. The results of this report are summarized herein. A program to then investigate the location, size, and geometry of potential brine well cavities in the proposed crossing location areas was developed by NTH Consultants, Ltd. and the DRIC Team.

As part of the program, a panel of international experts, known as the Geotechnical Advisory Group, was assembled to examine the program's intended plan and conclusions. Members of the Advisory Group, listed alphabetically, are:

Jerry DiMaggio, U.S. Federal Highway Administration
Chantale Doucet, Natural Resources Canada
Dave Dundas, Ontario Ministry of Transport
Dick Endres, Michigan Department of Transportation[1]
Peter Gerabek, Public Works and Government Services Canada
Khamis Haramy, U.S. Federal Highway Administration
Dave Juntunen, Michigan Department of Transportation
Tae C. Kim, Ontario Ministry of Transport
Stephen McKinnon, Queens University
Richard Miller, University of Kansas
Pat O'Rourke, Michigan Department of Transportation[1]
Leo Rothenburg, University of Waterloo
Richard Woods, University of Michigan

The Group met four times in the Detroit-Windsor area and five times by teleconference between June 2006 and February 2008.

U.S. Project Criteria

Based on criteria established by MDOT in January 2006 and further defined at a June 2006 Geotechnical Advisory Group Meeting, the proposed bridge in Corridors X-10 and X-11 requires: 1) foundations be located outside of the influence of any rock cavities that could have impact on the foundations, including those produced by solution mining activities; and, 2) foundations be built on competent bedrock. The brine well investigation program was developed and implemented to define conditions in the corridors to determine if these criteria could be satisfied.

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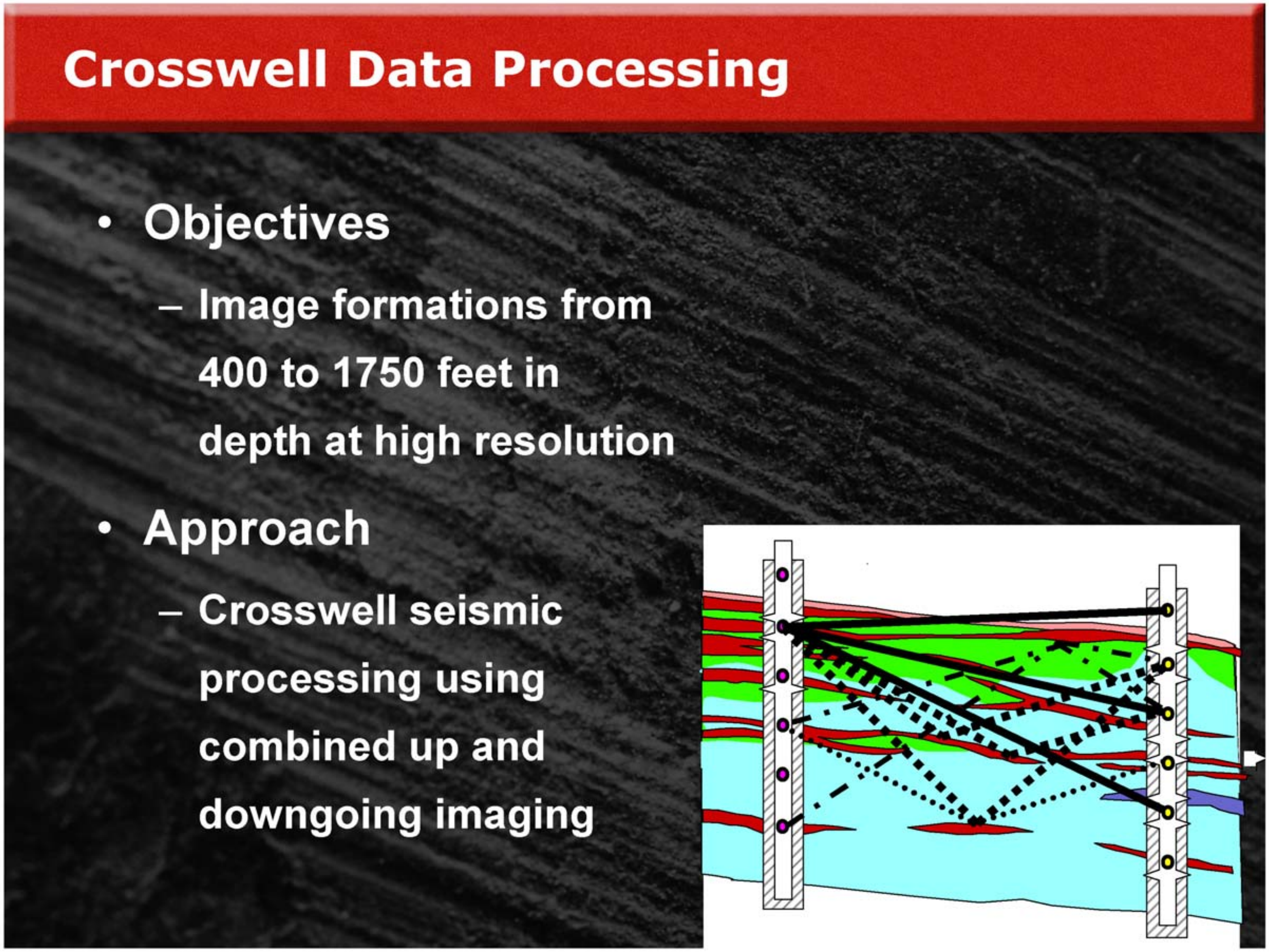
[1] In 2007, Dick Endres of MDOT replaced Pat O'Rourke upon his retirement.

Figure S-4
Detroit River International Crossing Study



Crosswell Data Processing

- Objectives
  - Image formations from 400 to 1750 feet in depth at high resolution
- Approach
  - Crosswell seismic processing using combined up and downgoing imaging

Source: Z-Seis Reservoir Seismic

Final Results

A total of 12 cross-well seismic imaging profiles were performed for the X-10 corridor and 16 profiles for the X-11 corridor. A general schematic of the cross-well seismic imaging objectives and approach is presented in Figure S-4. The final processed images have vertical resolution of about two to three meters (seven to ten feet) in both corridors, together with horizontal resolution of approximately 6 to 8 m (20 to 25 feet) in the X-10 corridor and 9 to 11 m (30 to 35 feet) in the X-11 corridor.

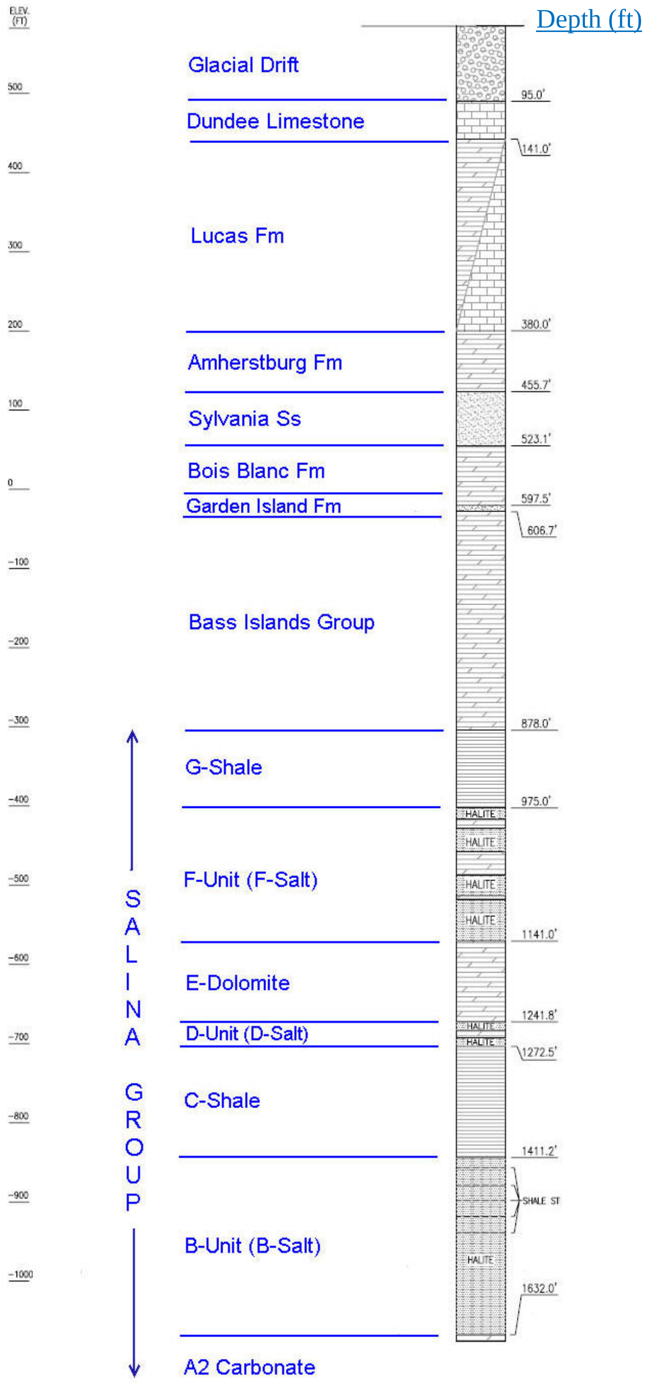
Analysis of the cross-well images provides evidence that the upper contacts of the F, D, and B-Salt layers are generally unbroken and continuous in both corridors. Some images underwent additional processing and interpretation to provide further clarity and resolution, due to ambient seismic and electrical noise .The general lithology of the bedrock in the subject area, including the relative depths of the various salt layers, is presented for reference in Figure S-5.

The processed cross-well images and other geophysical data show two anomalies of interest, neither of which is of significant concern. At approximately 107 m (350 feet) from the borehole labeled TB-6, at a relative depth of 338 m (1,110 feet), a feature is visible in the data. It is approximately 38 m (125 feet) wide and 6 to 8 m (20 to 25 feet) high (Anomaly A on Figure S-6). The feature is observed in the top of the F-Unit of the Salina Group (F2 bed) and the roof appears to be at the contact with the overlying shaley rock. A “crooked” stem can be viewed directly below the main portion of the feature, ending at the underlying E-Dolomite. The seismic reflectors associated with the underlying D and B-Units are unbroken below this feature, indicating that if the feature is the result of historical solution mining, the mining was not performed in the lower salt units. Most notably, the shale and carbonate stringers in the B-Salt are visible and continuous.

The profile from the boreholes labeled TB-6 to TB-4 was reprocessed using true-amplitude seismic processing techniques to provide some insight into whether the observed feature is brine or rubble-filled. The results illustrate the feature is potentially filled with material ranging from bulked debris fallen from the roof (most likely), possible limited debris flow from above (through the initial well), and the recrystallization of salt.

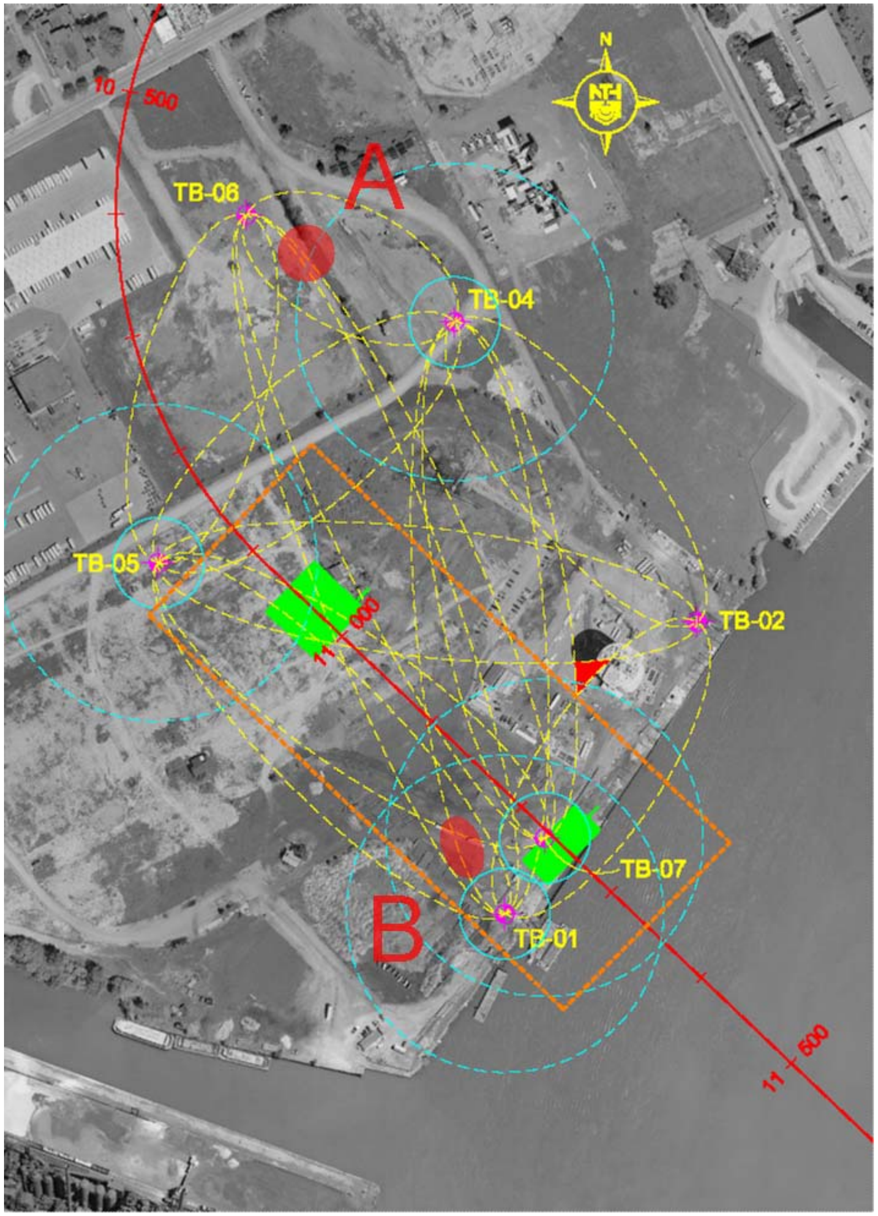
A second and relatively small anomaly is present in cross-well profiles TB-1 to TB-4 and TB-1 to TB-6. It is observed at the top of the B-Salt/C-Shale contact (Anomaly B on Figure S-6). The anomaly is approximately 37 to 52 m (120 to 170 feet) wide and 6 to 8 m (20 to 25 feet) high. The feature appears to have a tabular (i.e., “hockey-puck”) shape. Upon initial review, it appeared the anomaly could have been caused by natural solutioning (and possibly natural recrystallization), artificial solutioning (mining), or was simply a naturally-occurring variation in the B-Salt. Reprocessing the data using true-amplitude techniques indicates this feature is apparently filled with material (not brine).

Figure S-5
Detroit River International Crossing Study
Generalized Bedrock Lithology



Source: NTH Consultants, Ltd.

Figure S-6
Detroit River International Crossing Study
Apparent Anomalies (Crossing X-10)



Source: NTH Consultants, Ltd.

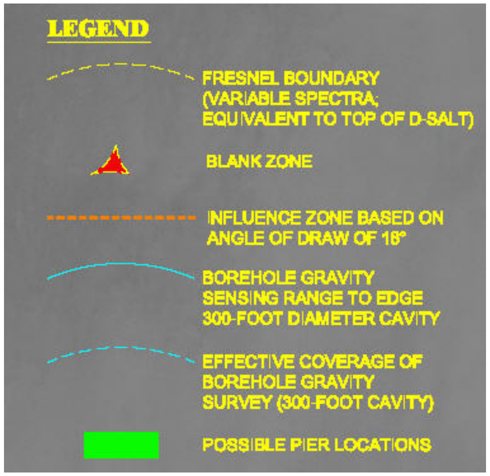
Anomaly "A":

- Size: About 20 to 25 feet high, about 125 ft diameter.
- Depth: Centered at about 1100 feet BGS.
- Shape: Round in Plan, "Morning Glory" in Profile.
- Probably fully or partially "bulked-up," possible limited recrystallization**.**

Anomaly "B":

- Size: About 6.1 to 7.6 m (20 to 25 feet) high, about 36.6 to 51.8 m (120 to 170 feet) in diameter.
- Depth: Centered at about 429.8 m (1410 feet) BGS.
- Shape: Elliptical in Plan, Hockey Puck in profile.
- Most likely a density anomaly within the B-Salt, where density is lower due to geological deposition (recrystallization, high purity, etc.)

Note: No anomalies greater than those illustrated in this figure were detected in the X-11 Crossing area investigated.



As this anomaly is very close to a borehole, it was also examined using Borehole Gravity techniques (BHGM), which indicate a very small feature or less-dense zone. A more-refined estimate of the B-Salt density has been obtained to re-calculate apparent-density values for the TB-1 BHGM survey. Utilizing this value in the apparent-density calculations, the anomaly coincides with measured noise levels within the borehole, essentially making it a non-detectable feature. This further supports the conclusion that this feature is infilled, or simply a naturally occurring deviation in the top of the B-Salt. Because the roof rock appears to be intact (although arched slightly), it appears that if infilling has occurred into a naturally-occurring solution feature, it is the result of recrystallization or limited silt/mud infilling through joints or fractures. Because such infilling would generally be expected over hundreds of thousands to millions of years, this anomaly is likely naturally occurring.

Rock Mechanics Investigation Results

A preliminary model of geotechnical rock mass characteristics has been completed to evaluate the potential instability of possible solution cavities of similar shape and size of anomalies discovered during the geophysical investigation program. The evaluation is also based on review of the historical instability of existing solution cavities in the Detroit-Windsor vicinity and on the results of a three-dimensional, distinct-element (3DEC) analysis of suspected or potential solution cavity geometry.

For this analysis, two types of cavity geometries and characteristics were considered. With the first type, in which cavities are completely contained within the respective salt layers, the salt that remains in the roof contains the internal overburden pressure and provides a stabilizing effect. The roof of salt acts as a confinement layer for the saturated brine and provides support for the salt and bedded layers above. In this case, cavities are small, and do not allow for loosening or excessive breaking of the overlying bedded deposits.

The second type of cavity features a roof in bedded deposits above the salt. In this case, the fluid pressure acts on all sides of the roof above the salt layers and does not provide stability. However, the buoyant effect of the brine does reduce the effective weight of the roof and provides a slight measure of stability. In this case, loosening and localized fallout of roof rock occur where rock is thinly bedded, shaley, or where solution cavity spans are significant to allow sag and corresponding tension in the roof rock. Roofs developing in this manner often form arched geometry and continue to propagate upwards until a bed with sufficient thickness and strength is encountered to arrest further movement.

Combined Geophysical Investigation and Rock Mechanics Results

Based on the observations made during the deep drilling and subsequent geophysical investigations, potential cavities were modeled with a width of 37 to 52 m (125 to 170 feet) in diameter, a height of 6 m (20 feet) and in a “morning-glory” shaped geometry. Using core data from the TB-7 and TB-11 cores and downhole geophysical data from the other borings, overlying rock bed thickness and strength were input into the model. Based on the evaluations, such geometries are likely to exhibit the characteristics mentioned above for small isolated cavities, and, in the worst case, cavities where roof fallout is stabilized by overlying bedded roof rock.

In both cases, roof spans are considered small, and analysis indicates little to no localized break or fallout of the roof. Cavities such as these would be arrested quickly as thicker bedded formations are encountered. Furthermore, if thicker bedded formations were not encountered, bulking (i.e., filling of the cavity with fallen debris) would occur, which due to the high width-to-height ratios in the localized fallout, would arrest upward movement. The height and width of the isolated cavity is small with respect to the depth of the cavity, so roof collapse would not approach (or even come near) the top of rock and would not cause subsidence or sinkholes at the surface.

The angle of draw in rock is estimated to be 15 degrees or less from the edge of large brine fields to the top of the rock surface where subsidence would occur. The angle of draw is steeper (or even negative) for cavities whose width is small with respect to the depth. The combined geophysical and rock mechanics evaluations indicate that there is no potential for significant settlement and, thus, no angle of draw for a solution cavity of the size and shape of the detected anomalies at the depth of the salt units at the X-10 and X-11 crossing corridors.

Conclusions

Based on the data gathered and analyzed to date, there is no evidence of cavities in either X-10 or X-11 corridors larger than Anomalies A and B shown on Figure S-6, nor evidence of potential instability of the rock mass. In fact, the analysis shows that the observed anomalies have probably been filled by one or a combination of several mechanisms. In addition, even for the largest of the anomalies located, and assuming an unfilled cavity, the analysis shows the anomaly is stable and will not progress upward any significant distance.

1. INTRODUCTION

The Detroit River International Crossing (DRIC) Study is a bi-national effort to complete the environmental study processes for the border crossing between Detroit, Michigan and Windsor, Ontario for the United States, Michigan, Canada and Ontario governments. The study proposes solutions that support the region, state, provincial and national economies while addressing civil national defense and homeland security needs of the busiest trade corridor between the United States and Canada (Figure 1-1).

Figure 1-1
Detroit River International Crossing Study
Existing Detroit River International Crossings

The purpose of the DRIC Project for the foreseeable future (i.e., at least 30 years) is to:

- Provide safe, efficient and secure movement of people and goods across the U.S.-Canadian border in the Detroit River area to support the economies of Michigan, Ontario, Canada and the U.S.

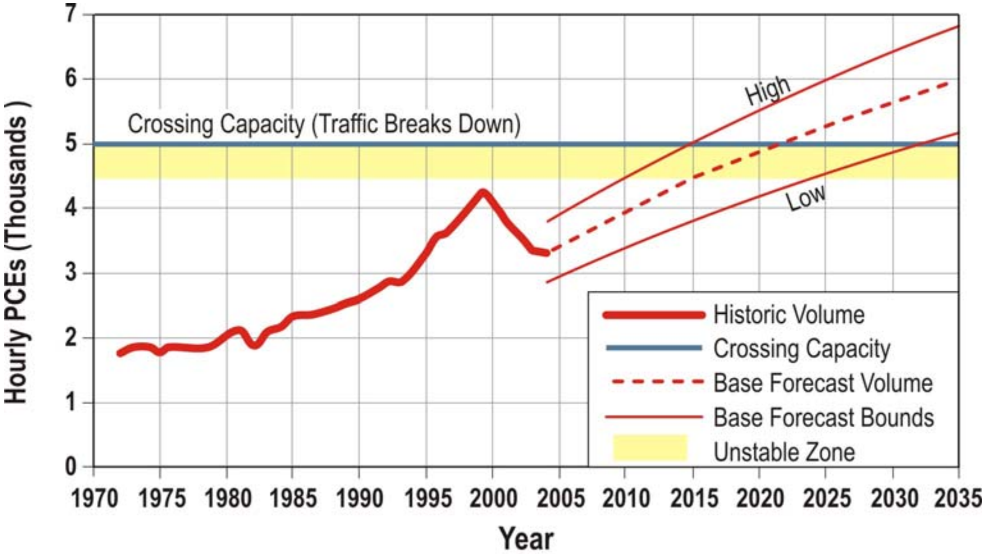
- Support the mobility needs of national and civil defense to protect the homeland.

To address future mobility requirements (i.e., at least 30 years) across the U.S.-Canada border, there is a need to:

- Provide new border crossing capacity to meet increased long-term demand;
- Improve system connectivity to enhance the seamless flow of people and goods;
- Improve operations and processing capability; and
- Provide reasonable and secure crossing options in the event of incidents, maintenance, congestion, or other disruptions.

Over the next 30 years, the Detroit River area cross-border passenger car traffic is forecast to increase by approximately 57 percent, with movement of trucks increasing by 128 percent. Traffic demand could exceed the "breakdown" cross-border roadway capacity as early as 2015 under high growth scenarios. Even under "low" projections of cross-border traffic, the "breakdown" roadway capacity of the existing Detroit River border crossings (bridge and tunnel combined) will be exceeded by 2033 (Figure 1-2). Additionally, the capacity of the connections and plaza operations will be exceeded in advance of capacity constraints of the roadway. Without improvements, this will result in a deterioration of operations, increased congestion and unacceptable delays to the movement of people and goods in this strategic international corridor.

Figure 1-2
Detroit River International Crossing
Travel Demand vs. Capacity:
Combined Detroit River Crossings



Note: Figure 1-2 is from the DRIC Travel Demand Forecast Working Paper (September 2005), prepared by the IBI Group. The Passenger Car Equivalent factor (PCE) used in that report, and in Figure 1-2, is 3.0 cars per truck. SEMCOG calculates PCEs at a rate of 2.5 cars per truck in its regional roadway system. The DEIS calculates, on the ramps, the interstate system and other roadways, PCEs at 2.5 cars per truck.

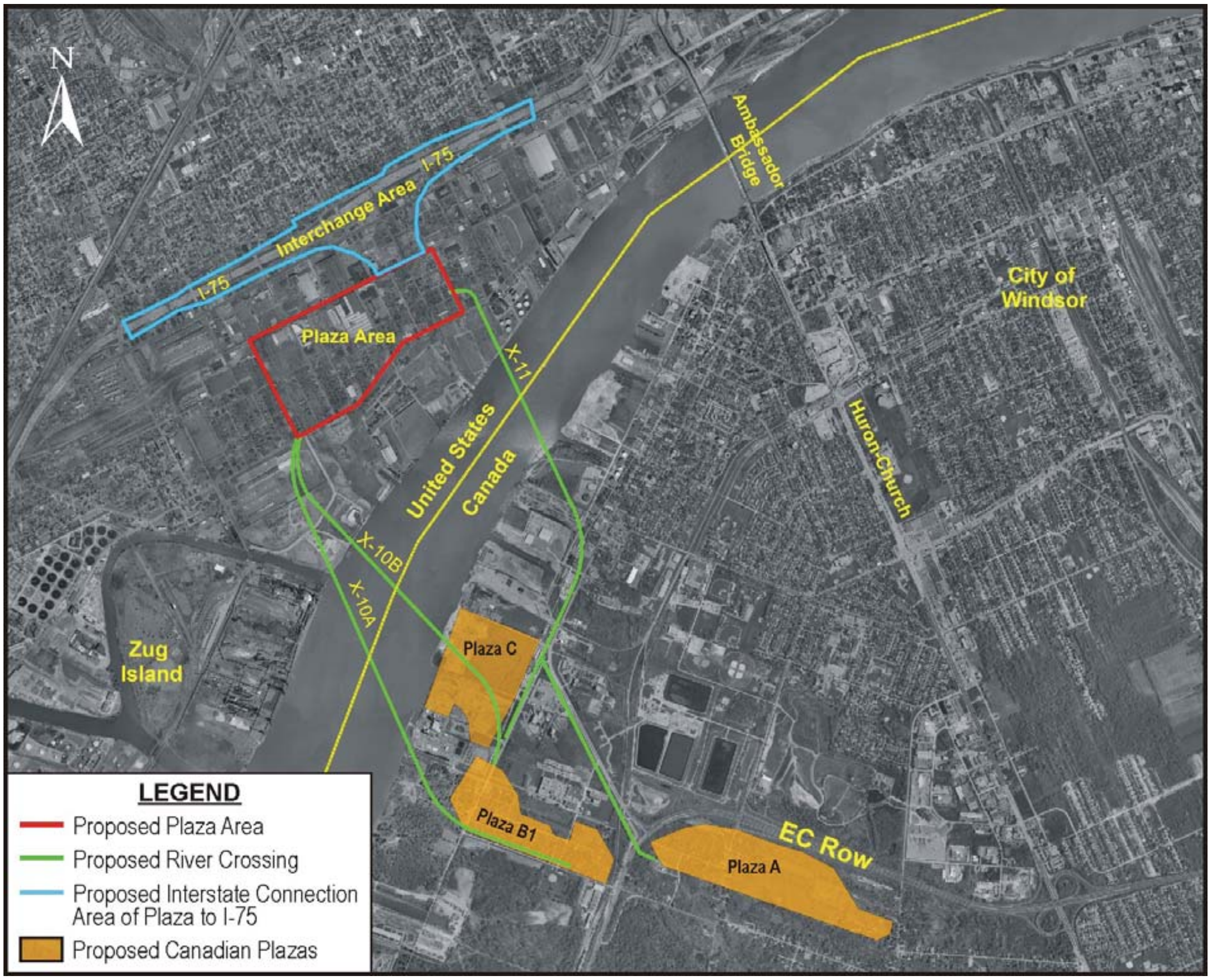
Source: IBI Group

The forecast of capacity indicates that there will be inadequacies in: 1) the roads leading to the existing bridge and tunnel; 2) the ability to process vehicles through customs and immigration; and 3) the capacities (number of lanes) of the existing Ambassador Bridge and Detroit-Windsor Tunnel themselves. Therefore, even though incremental adjustments can and will be made to the plazas, and even though there is adequate border crossing capacity today (bridge and tunnel combined), the planning, design and construction of any major international crossing takes time.

Therefore, it is prudent to address, at this time, how and when the capacity needs are to be satisfied at the crossing itself, as well as the connecting roads.

The DRIC Draft Environmental Impact Statement (DEIS) analyzes issues/impacts on the U.S. side of the border of the end-to-end crossing system over the Detroit River between Detroit, Michigan, and Windsor, Ontario, Canada. The alternatives are comprised of three components: The crossing, plaza (where tolls are collected and Customs inspections take place), and interchange connecting the plaza to I-75 (Figure 1-3). Nine alternatives exist in the U.S and are listed on Table 1-1 and presented schematically in Figures 1-4 and 1-5.

Figure 1-3
Detroit River International Crossing Study
U.S. Area of Analysis for Crossing System



Source: The Corradino Group of Michigan, Inc.

Table 1-1
Detroit River International Crossing Study
Crossing Systems Included in DRIC DEIS

Alternative	Interchange	Plaza	Crossing	Proposed Status
#1	A	P-a	X-10	Analyzed in DEIS
#2	B	P-a		Analyzed in DEIS
#3	C	P-a		Analyzed in DEIS
#5	E	P-a		Analyzed in DEIS
#14	G	P-a		Analyzed in DEIS
#16	I	P-a		Analyzed in DEIS
#7	A	P-c	X-11	Analyzed in DEIS
#9	B	P-c		Analyzed in DEIS
#11	C	P-c		Analyzed in DEIS

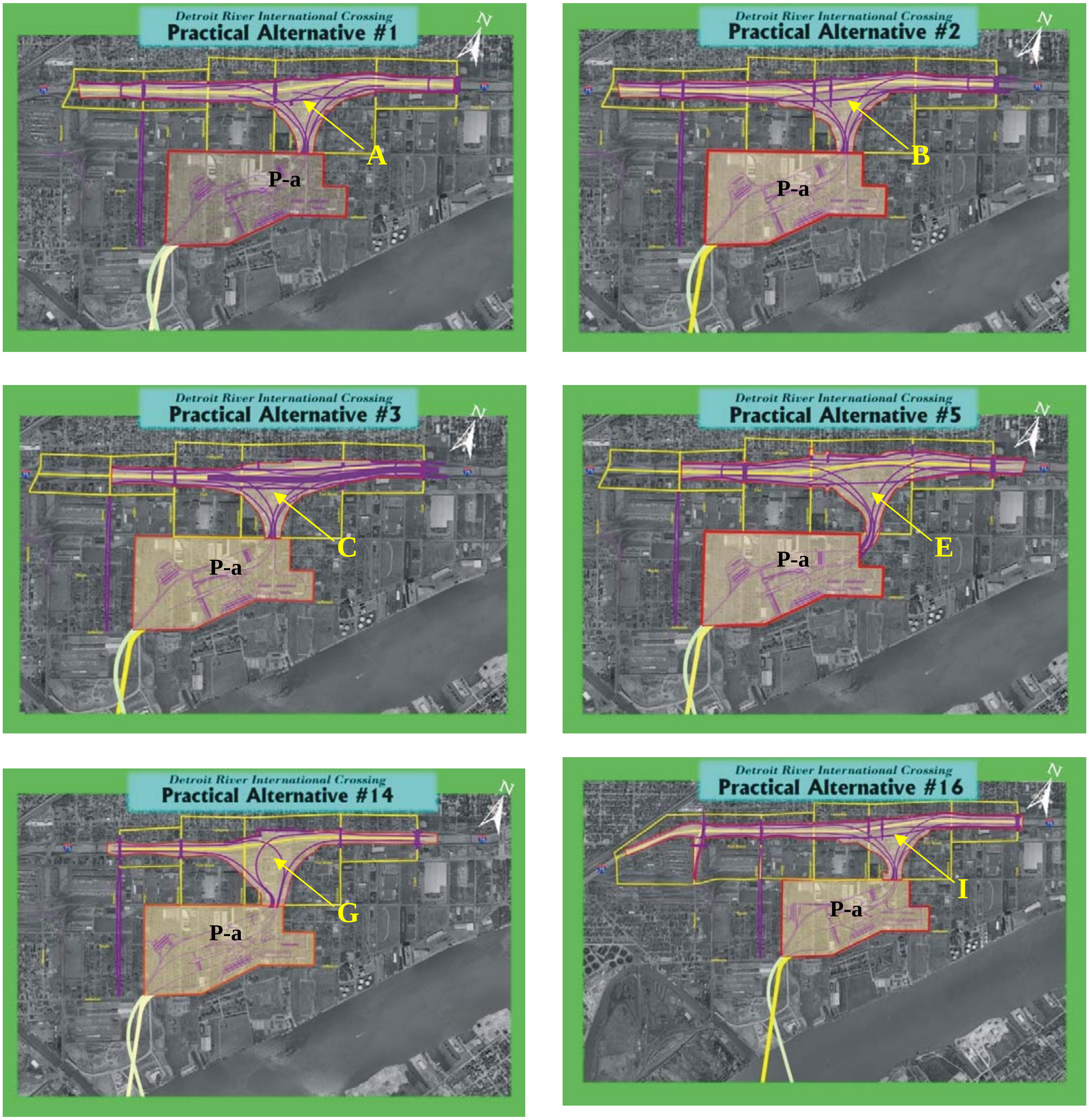
Source: The Corradino Group of Michigan, Inc.

1.1 Purpose of the Report

Salt (halite) has been mined historically in the form of solution mining in the area of the DRIC Practical Alternatives. As part of this solution mining process, fresh water was injected into the ground, natural salt beds were dissolved, and the resulting brine was brought to surface and evaporated to make salt. The solution mining from salt layers ranging from 275 to 490 m (900 to 1,600 feet) below the ground surface was typically conducted in an uncontrolled method before standardized record keeping was common practice. This created underground cavities of unknown location, size, and dimension. A solution mining cavity collapsed in the mid-1950s to the surface and formed a sinkhole on the Windsor side of the study area in 1954 (Figure 1-6). At least two additional sinkholes occurred at Point Hennepin (on Grosse Isle) south of the DRIC crossing site on the U.S. side of the river.

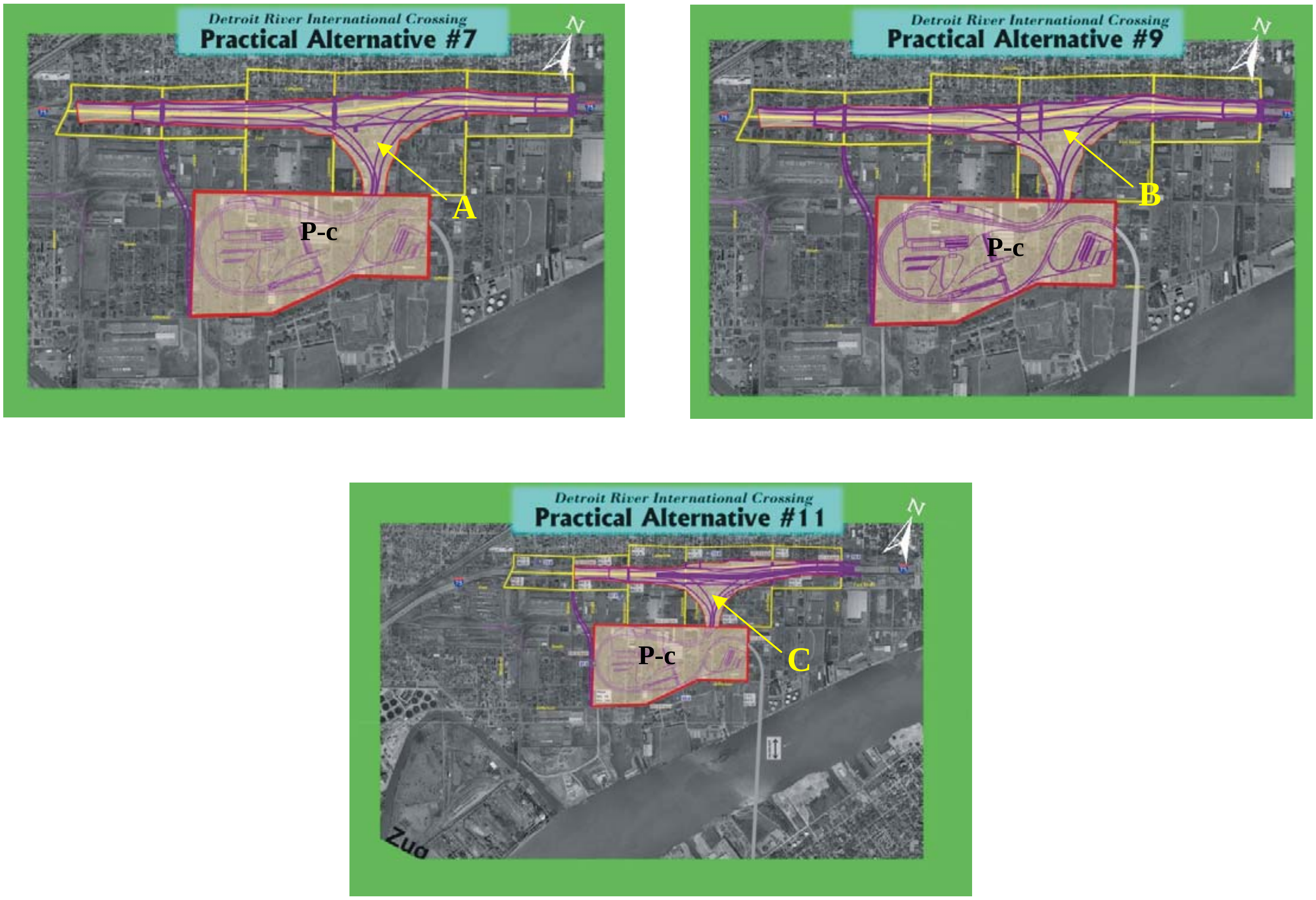
After consideration of the available data, NTH Consultants, Ltd. (NTH), a member of the DRIC consultant team, developed a Brine Well Cavity Investigation program to delineate the size, locations, and shape of potential brine well cavities in the two proposed crossing corridors on the U.S. side of the crossings. NTH proposed a combined geophysical and geotechnical program which included the drilling of multiple deep rock borings, in combination with cross-well seismic imaging. “Forward modeling,” borehole gravity, vertical seismic profiling (VSP), and downhole wireline logging were also included in the program. This report presents a summary of the preliminary data obtained and preliminary evaluations preformed during the drilling operations.

Figure 1-4
Detroit River International Crossing Study
Schematic Representation
of
X-10 Crossing Alternatives #1 through #3, #5, #14 and #16



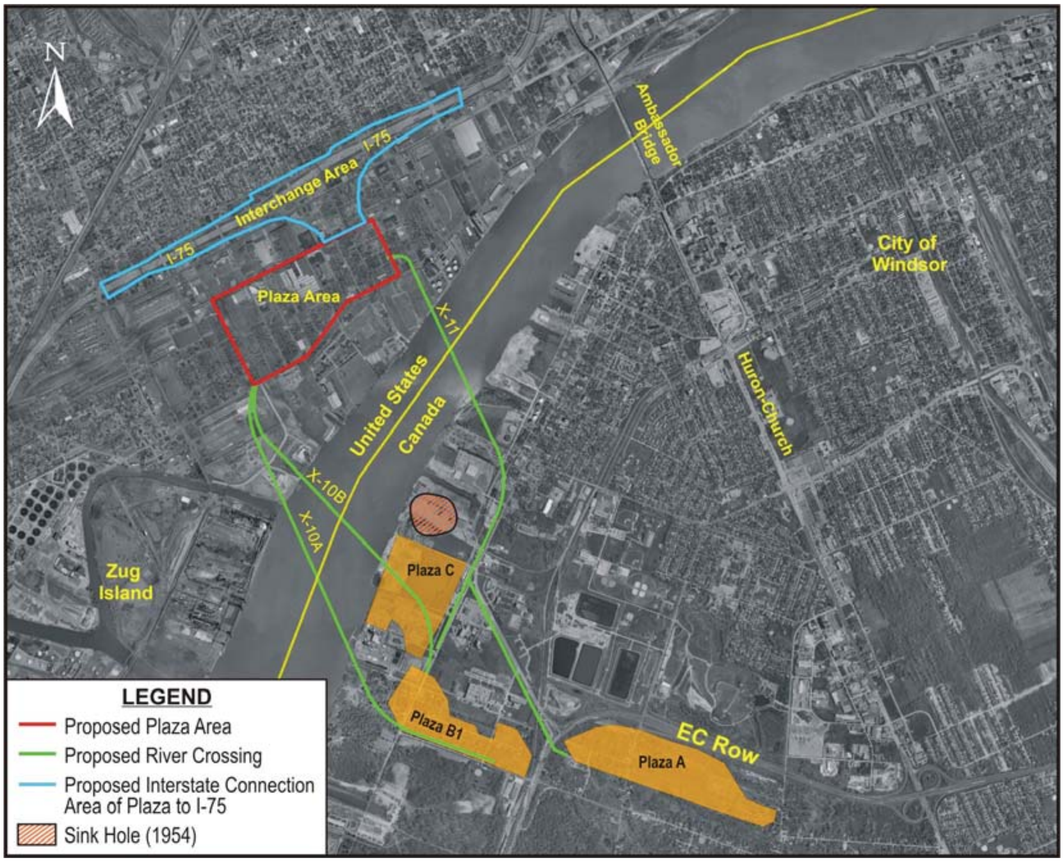
Source: The Corradino Group of Michigan, Inc. and Parsons Transportation Group

Figure 1-5
Detroit River International Crossing Study
Schematic Representation
of
X-11 Crossing Alternatives #7, #9, #11



Source: The Corradino Group of Michigan, Inc. and Parsons Transportation Group

Figure 1-6
Detroit River International Crossing Study
Canadian Sinkhole



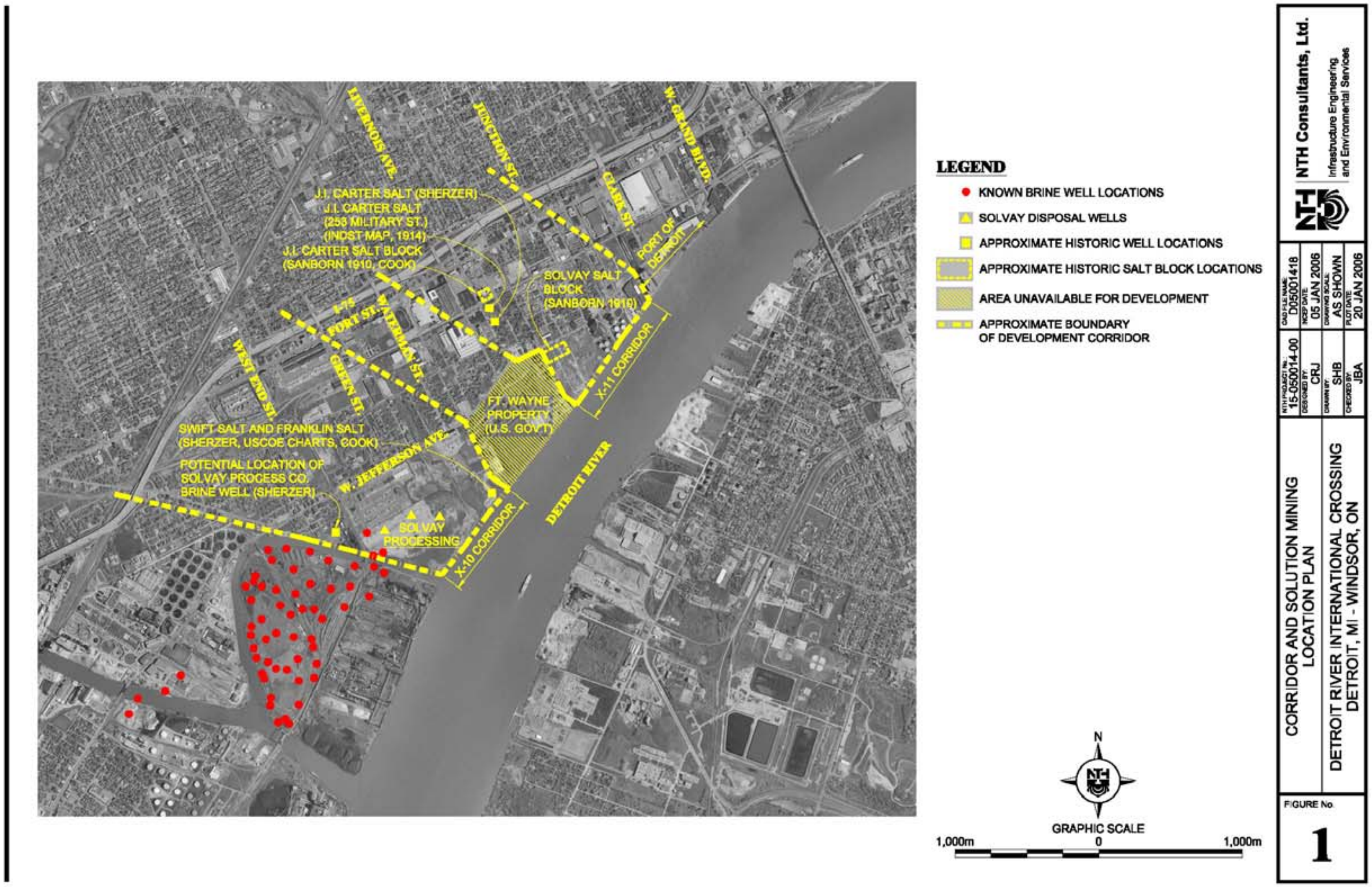
Source: URS Canada

1.2 Geotechnical Analysis Overview

In early 2006, the DRIC consultant team performed an intensive literature search involving brine well operations in the vicinity of the X-10 and X-11 corridors. The results were presented in a report entitled “Preliminary Report on Historical Solution Mining Activities, Crossing X-10 and X-11 Corridors,” dated March 24, 2006 and presented under separate cover. The material derived from this report is summarized herein and a graphic from the report showing historical salt mining activities revealed during the search is presented as Figure 1-7.

After review of the report, the potential for brine well cavities to compromise the stability of the future bridge foundations in the areas under consideration was recognized. This led to preparation and funding in December 2006, of the Brine Well Cavity Investigation program noted above to investigate the locations, sizes, and geometry of potential brine well cavities in the proposed crossing location areas.

Figure 1-7
Detroit River International Crossing Study
Corridor and Historic Solution Mining Location Plan



Source: NTH Consultants, Ltd.

As part of the program development, two reports were prepared by Dr. Edward Cording, entitled "Stability of Caverns in Salt, Detroit Area; A Rock Mechanics Study for Bridge Foundations for Proposed Detroit River International Crossing," dated December 28, 2006; and, "Interim Report: Characteristics of Subsidence and Sinkholes in Salt, Detroit Area – A Study for the Proposed Detroit River International Crossing," dated May 27, 2006. These documents provide a background of the expected subsurface conditions, review of previous sinkhole mechanisms that have occurred over other brine well fields in the Detroit area, and recommendations for the field investigation effort. The contents of those reports are summarized herein.

A panel of international experts known as the Geotechnical Advisory Group was also assembled to review the programs plan and results. Members of the Advisory Group, listed alphabetically, are:

Jerry DiMaggio, U.S. Federal Highway Administration
Chantale Doucet, Natural Resources Canada
Dave Dundas, Ontario Ministry of Transport
Dick Endres, Michigan Department of Transportation[2]
Peter Gerabek, Public Works and Government Services Canada
Khamis Haramy, U.S. Federal Highway Administration
Dave Juntunen, Michigan Department of Transportation
Tae C. Kim, Ontario Ministry of Transport
Stephen McKinnon, Queens University
Richard Miller, University of Kansas
Pat O'Rourke, Michigan Department of Transportation[2]
Leo Rothenburg, University of Waterloo
Richard Woods, University of Michigan

The Group met five times in the Detroit-Windsor area and five times by teleconference between June 2006 and February 2008.

1.3 U.S. Project Criteria

Based on criteria established by MDOT in January 2006 and further defined at the June 2006 Geotechnical Advisory Group Meeting, the proposed bridge in both corridors X-10 and X-11 requires: 1) foundations be located outside of the influence of any rock cavities that could have impact on the foundations, including those produced by solution mining activities; and, 2) foundations be built on competent bedrock. The brine well investigation program was developed and implemented to define conditions in the corridors so it could be determined if these criteria could be satisfied.

1.4 Crossing Descriptions

The two crossings that were examined as part of this study are proposed to be located between the existing Ambassador Bridge and Zug Island in southwest Detroit. These crossings are described as follows:

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[2] In 2007, Dick Endres replaced Pat O'Rourke upon his retirement.

1.4.1 X-10 Crossing Corridor

This corridor generally consists of the area immediately north of Zug Island to historic Fort Wayne (Figure 1-3). The area is generally flat with a slight drop in elevation at the river, with large vacated areas, parking lots, and paved/unpaved roads. Current land use includes light-to-moderate industrial areas, including a cement terminal, a major trucking terminal, a truck ferry operation, and aggregate storage areas. Residential areas exist north of Jefferson Avenue, but are generally intermingled with light commercial and industrial areas.

Historic land use includes light-to-heavy industrial areas, including a major chemical processing plant and power plant, along with two suspected salt solution mining well operations. Known solution mining wells exist adjacent to the Rouge River, along the west portion of the corridor, as well as possible undocumented solution mining wells adjacent to the current Fort Wayne property. Historic maps indicate the original shoreline of the Detroit River to be set back approximately 5 to 24 m (16 to 80 feet) from its current position, with possible docks and former boat slips prevalent throughout.

1.4.2 X-11 Crossing Corridor

The X-11 corridor generally consists of the area along the banks of the Detroit River immediately east of historic Fort Wayne to just east of the existing Mistersky Power Station (Figure 1-3). The area is generally flat with a slight drop in elevation at the river, with large vacated areas between the river and Jefferson Avenue. Current land use includes light-to-moderate industrial regions, power generation facilities, and a large vacant area adjacent to the river. Residential areas exist north of Jefferson Avenue, but are generally intermingled with light commercial and industrial areas. Historic land use includes light-to-heavy industrial areas, including a major copper and brass fabrication operation, along with two suspected solution well operations.

Historic maps indicate the potential solution mining operations occurred directly to the east of a historic copper and brass fabrication facility and the eastern portion of the corridor, in what are now intermingled residential and commercial areas. Historic maps also indicate the original shoreline of the Detroit River in the X-11 corridor to be set back approximately 3.0 to 15.2 m (10 to 50 feet) from its current position, with possible docks and former boat slips prevalent throughout.

2. REGIONAL GEOLOGIC SUMMARY

The generalized subsurface geology for the area is summarized in this section of the report.

2.1 Overburden

The bedrock in the project corridors is overlain by soils (glacial drift), which have been deposited either directly by glacial ice (till), glacial meltwater streams (glaciofluvial deposits), or impounded glacial lakes (lacustrine deposits). The upper soil formations along the alignment generally consist of a relatively thick mantle of Wisconsin-aged lacustrine clays (10,000 to 50,000 years ago) that with the exception of the near-surface deposits, are typically very soft to soft in consistency. The lacustrine soils were deposited as sediments from a series of glacial lakes impounded between the ice front and the Inner Defiance Moraine located near the northwest corner of Wayne County. The upper 3 to 6 m (10 to 20 feet) of these deposits where still present have been desiccated during historical low-water periods, resulting in soils of very stiff to hard consistency near the surface. The clay soils frequently contain intermittent sand and gravel layers that were produced from glacial rivers carrying coarser sediments as lake levels fluctuated. Localized alluvial soils are present along existing rivers and streams that drain the inland areas. In some locations, lake shorelines are identified by relatively thick layers of sand and gravel.

The lacustrine deposits are typically underlain by a thin layer of highly over-consolidated glacial till, generally consisting of sand, silt, and gravel within a matrix of clay. This formation is locally termed “hardpan” and usually overlies the bedrock formation. Depending on the amount of clay binder contained in the hardpan, the material may range in nature from cohesive to granular. The hardpan is generally believed to be from the Illinoian Ice Age (200,000 years ago) and can also contain calcium carbonate producing a cemented condition. Given the glacial origins of the hardpan layer, occasional cobbles and large boulders are typically present in this layer. Methane and hydrogen sulfide may also be encountered in this layer.

The total glacial drift thickness along the X-10 and X-11 corridors varies from approximately 27 to 30 m (90 to 100 feet). The surface topography was formed during the Wisconsin stage (youngest) of Pleistocene Series glaciations of the Cenozoic Era, and has been somewhat modified by surface erosion since that time.

2.2 Bedrock

The proposed crossing corridor is located at the geologically-termed southeast margin of the Michigan Basin geomorphic province and within the Erie-Huron glacial lowland. The Michigan Basin is termed as such due to the structural basin shape of the bedrock, in which layers of Paleozoic era sedimentary rock that overlay the Precambrian Basement Complex, dip inwards to the center of the Lower Peninsula of Michigan from each direction as a series of bowls. The youngest layers of bedrock are located in the center of the state, with older rock layers progressing outwards to the outer margins.

The Michigan Basin was initially formed during the early Cambrian Period, when the remnants of the mountains formed during the Cambrian-Penokean Orogeny remained in a belt extending from Ontario, Canada, across the central part of the Upper Peninsula to present-day Wisconsin. The erosion of these “northern highlands” began the series of depositions and erosions that constitute the modern basin. The later effects of the Appalachian Orogeny likely caused the structural deformation and localized downward movement in what had been a relatively stable interior continental region.

As a result, several intracratonic structural basins were formed throughout the central lowland areas of North America creating arches and domes. The Michigan Basin is bounded on the west by the Wisconsin Arch and Wisconsin Dome; on the north and northeast by the Canadian Shield; on the east and southeast by the Algonquin Arch in Ontario and the Findlay Arch in Ohio; and by the Kankakee Arch in northern Indiana and Illinois.

The Michigan Basin has undergone several periods of deposition and erosion during the Paleozoic Era, creating a complex deposition of conformable and unconformable layers of sedimentary rocks. During the early Paleozoic Era, the remnants of the Cambrian highlands began to wash into the lowlands to the north and south.

During the subsequent Ordovician Period, shallow seas covered most of the basin, except to the north where an erosional unconformity or non-deposition is noted. The shallow seas returned during the Middle Ordovician Period to the entire basin and were again fully established. Erosional sediment from the Taconic Mountains to the east during the late Ordovician Period began deposition in the deltaic regions of the basin.

The shallow seas during Ordovician Period continued into Silurian times and were beyond the reach of all but the most fine-grained clastic sediments. Due to the sediment size and transport mechanisms, the rocks deposited during this time are mostly chemical precipitates and evaporates (salts) formed in shallow clear seas. Barrier reefs formed around the margins of the basin during the Silurian when the basin was subjected to massive down-warping as evidenced by the many thousands of meters of deposition in the central portion of the basin. During the close of the Silurian, the shallow seas withdrew from the basin. During this period of erosion, or non-deposition, a gap or unconformity, is evidenced in the geologic record.

Carbonate deposits of limestone and dolomite again occurred during the Middle Epoch of the Devonian Period as the shallow salty seas returned for the remainder of the Devonian Period. Also during the Devonian Period, occasional isolation (regression and transgression of the seas) of the basin led to renewed deposition of evaporate rocks, such as salt, gypsum, and anhydrite.

During the late Devonian/Early Mississippian Periods, the uplift of the Appalachian region (later Acadian Orogeny) to the east supplied clastic sediments which were eroded from the emerging ancestral Appalachian Mountains and deposited in the basin to form shale with some sandstone and siltstone. The deposition of black mud (shale) during this time continues well into the Mississippian Period. Toward the close of the Early Mississippian time, the shallow seas regressed and caused much of the basin to become a deltaic, near shore, and beach deposition zone.

The seas returned again in the Pennsylvanian Period, where the end of the Paleozoic Era is marked by the last deposits of stream-lain sandstones as the basin was uplifted. The geologic record in the basin is then almost completely unrepresented from the end of the Pennsylvanian Period until the last stretch of the Pleistocene (Wisconsin Age), with the exception of the Jurassic “red beds” which have only been discovered in the central portion of the basin.

Based on the position of Detroit, Michigan, along the southeast rim of the Michigan Basin, the Paleozoic rocks that comprise the basin in this area typically dip to the northwest, with each formation being buried by successive younger formations in the direction of the dip. The regional dip is slight, and is estimated at approximately 6 to 10 meters per kilometer (30 to 50 feet per mile).

The topography of the bedrock surface within the area is somewhat variable and characterized by numerous irregular features in the bedrock surface. These features include many syncline and anticlinal structures believed to have developed before the Pleistocene Epoch and subsequently modified by repetitive glacial action. The bedrock features also include the existence of ancient stream valleys and possible healed faults that cut the bedrock surface. Based on historical information, the bedrock features are understood to be fairly broad, and become narrow as they reach the terminus of the Erie/Huron Lowlands.

Due to the movement of the earth’s crust, these strata (especially in the Middle Devonian Lucas Formation) are seamed and fissured with vertical and horizontal joints that permit movement of ground water. Where carbon dioxide dissolved within these groundwater-filled cracks, solution cavities typically developed within the limestone and to some degree dolomite. Both the limestone and dolomite formations are known to contain dissolved sulfides, which can produce hydrogen sulfide gas upon exposure to atmospheric conditions. Hydrogen sulfide gas in the Detroit area has a history of causing nuisances and toxic conditions during tunneling operations and deep excavations, causing great bodily harm and even death to construction workers. The natural decay of organic compounds that also existed within the ancient seas became trapped within cavities formed in the limestone and dolomites and is evident today as petroleum, carbon monoxide, and methane. Small amounts of petroleum found within the limestone and dolomite tend to cause discoloring, staining, and associative odors.

2.3 Groundwater

Groundwater in the X-10 and X-11 Crossing corridors can typically be distinguished according to its chemical constituency and can be sub-divided into fresh, mineral, and brine waters.

2.3.1 Fresh Groundwater

Fresh water is water that is free of any deleterious, naturally-occurring chemicals or dissolved salts or solids that otherwise would make it inconsumable. Fresh water aquifers generally exist in the upper glacial drift, as well as the lower Middle Devonian rocks (Sylvania Sandstone, Bois Blanc, Garden Island, and Bass Islands Group). In the project area, the fresh water aquifer is discontinuous, and often contaminated as a result of human activities. Where the fresh water aquifer is present in the glacial drift, groundwater generally flows toward the Detroit River, which generally behaves as a regional discharge/recharge feature.

2.3.2 Mineral Groundwater

Mineral water is any water that contains dissolved minerals or constituents that may alter to gas upon being exposed to the atmosphere. The dissolved compounds of interest expected for this investigation consisted of hydrogen sulfide, methane and carbon monoxide, which exist naturally in some mineral ground waters. Mineral waters are common in the lower glacial drift (hardpan) and upper Middle Devonian bedrock (Dundee, Lucas, and possible Amherstburg Formations). In the project area, mineral waters typically exhibit flowing artesian conditions when penetrated.

2.3.3 Brackish Groundwater (Brine)

Brine waters are those that contain a significant amount of dissolved salts, having been formed during the historical solutioning of rocks with higher-than-normal natural salt levels (i.e. sodium, potassium, etc. ions). Brine may naturally occur in the deeper formations of the project area, including the lower portions of the Salina Group.

3. HISTORICAL INFORMATION

3.1 Salt Mining

The Michigan Basin is one of the largest areas of halite (rock salt-NaCl) deposition in the world. Salt has historically been mined either directly in solid form as rock salt or as natural or artificial brine pumped through solution mining wells. The area beneath Detroit and Windsor within the Michigan Basin is currently mined using both solution mining techniques and conventional room-and-pillar excavation methods. Generally, the solution wells extended to depths of 335 to 490 m (1,100 to 1,600 feet).

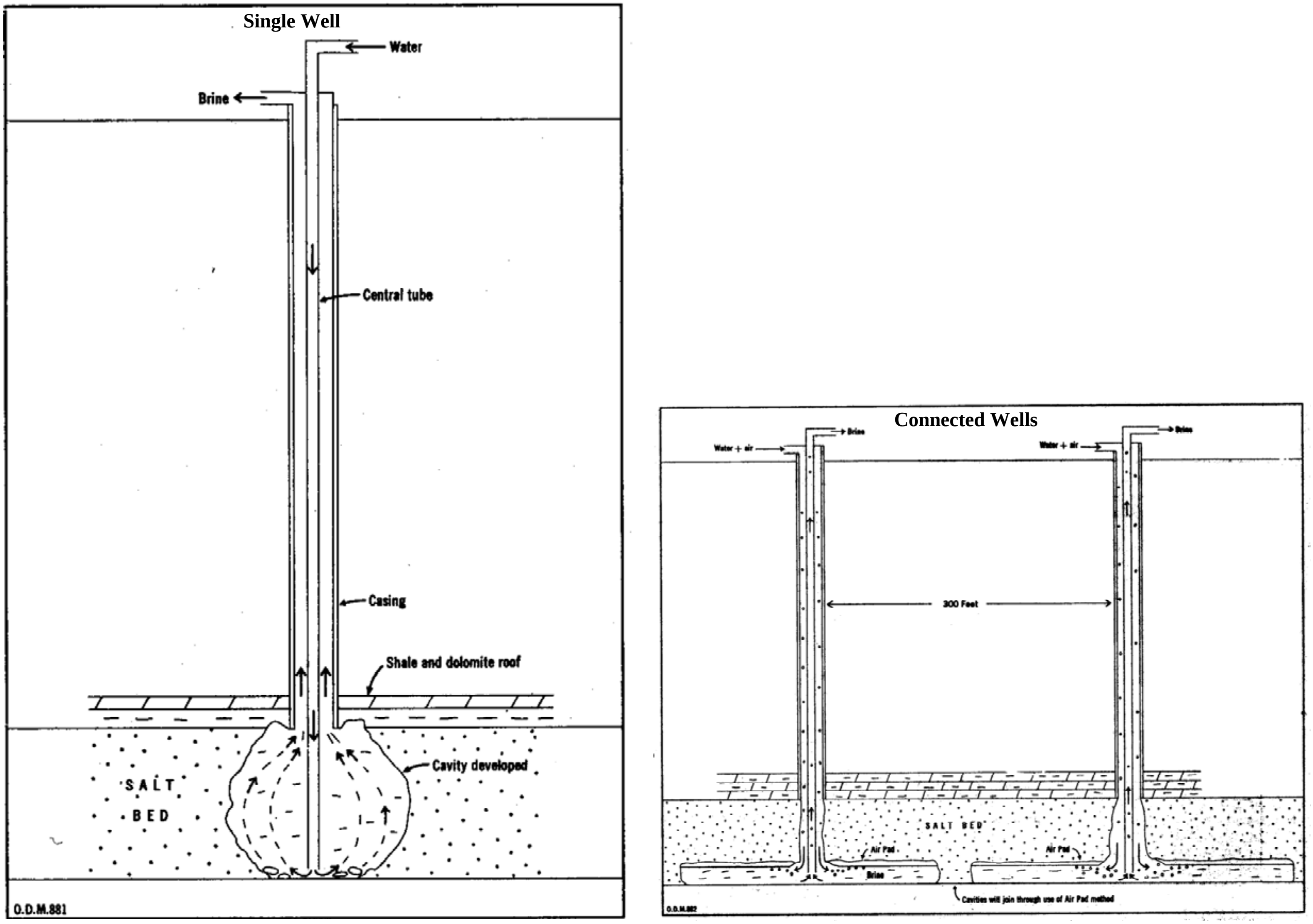
Solution mining consists of introducing fresh water from the surface down a well casing between an outer casing and a central tube (Figure 3-1). The brine produced from the salt dissolving in the water is recovered through the central tube. Cavities using this method are usually larger at the top of the stratum than at the bottom, because the fresh water tends to stratify above the denser salt brine in the cavity. The fresh water dissolves salt more rapidly near cavity roofs than at the base of the cavities which are in contact with saturated brine. This results in an inverted cone-shaped or “morning glory” shaped cavity.

Solution cavities often coalesce with adjacent cavities to form composite cavities called “galleries.” When this occurred historically, one or more of the wells were then converted to water inlet wells and the brine was pumped out through other wells in the interconnected system (Figure 3-1). As production continued in the gallery, large spans of unsupported roofs were sometimes created, which, in turn, could cause sagging, downward flexure, and local delamination of rock units resulting in local roof collapse and eventual surface subsidence in some instances. This surface subsidence is commonly known as a “sinkhole.”

Subsidence and/or collapse often progresses upwards as a “chimney effect” on a relatively steep angle (generally 15-degrees or steeper) from the outside edges of the brinefield (Figure 3-2). Several theories have been published on the subsidence progression to the surface, the more notable of which attributes surface “daylighting” to failure of the Sandstone Sylvania Formation at a depth of approximately 152 to 183 m (500 to 600 feet). According to the theory, the sandstone disintegrates under the induced compression from rock mass sagging, and the fragments filter downwards as granular material into cavities below. This results in a cavity at a depth at approximately 152 m (500 feet) instead of the original cavity depth. This mechanism would explain why theoretical “bulking” of broken rock pieces would not be sufficient to fill the cavities before daylighting occurs.

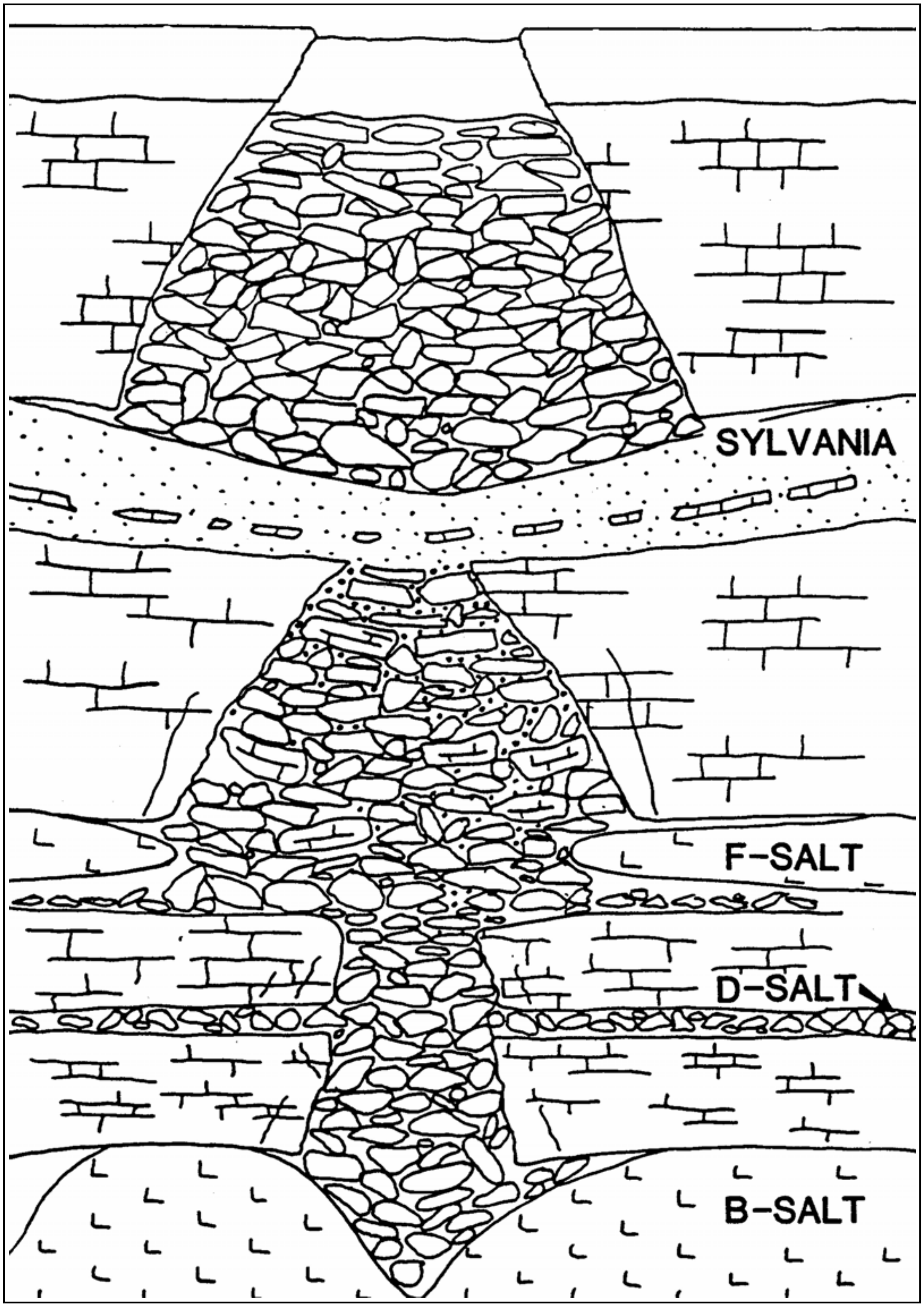
The solution mining areas are of concern for this project, as they present the potential for future ground collapse and related adverse effects on elements of the proposed crossing structure. Additionally, at least two previous collapses have occurred in the region: at Point Hennepin near Grosse Ile, Mich., and in Windsor, Canada, in the X-10 crossing zone as shown in Figure 1-1. Significant settlements have also occurred beneath a known well field in Wyandotte, Mich. Both Grosse Ile and Wyandotte are several miles downriver from the DRIC crossing corridors. All of the known collapses have been in large interconnected brine fields (galleries).

Figure 3-1
Detroit River International Crossing Study
Solution Salt Mining/Brine Wells



Source: Professional Paper

Figure 3-2
Detroit River International Crossing Study
Conceptual Representation of Sinkhole Propagation to Surface



Source: Ontario Geological Survey

While no solution mining activities were identified in the U.S. bridge foundation zones in earlier DRIC work, it can be reasonably concluded that, if salt cavities exist, they were created before record keeping was standardized. Therefore, it is suspected that mining would have been of the older, uncontrolled methods and most likely before circa 1940. These early solution mines generally were of the uncontrolled type, mining salt from the F and D Units of the Salina Group , with formation tops at approximate depths of 274 to 305 m and 375 to 393 m (900 to 1,000 feet and 1,230 to 1,290 feet), respectively. Some mining may also have occurred in the lower B Unit of the Salina Group at depths of 427 to 503 m (1,400 to 1,650 feet), Specific records indicate this having occurred in the general area of crossing corridors X-10 and X-11, but mainly in the downstream locations. Nonetheless, it is not expected that mining would have occurred in the B Unit without mining in the upper F and D layers. For mining to be accomplished exclusively in the B (lower) unit, the brine well would need to be entirely cased through the D and F (upper) units, which is doubtful for that period based on historical evidence gathered for the region.

3.2 Solution Mining Overview

3.2.1 X-10 Corridor

At least six probable brine well locations are documented within the 800 to 1,400 meter (2,500 to 4,500 feet) wide X-10 corridor. Three of these wells are documented by specific solution mining company records, which are considered reasonably reliable. At least three other brine well locations are documented through reference on historical maps and figures, which are considered somewhat less reliable. These locations are shown on the aforementioned Figure 1-7.

The three better-documented wells are within the parcel formerly owned by the Solvay Processing Company (Solvay), and are located toward the southern end of the corridor, adjacent to the existing Rouge River cut channel. The extreme southern Solvay parcel along the Rouge may be indirectly affected by the known solution mining wells that blanket Zug Island, immediately to the south.

Historic information indicates that Franklin Salt, also known as Swift Salt, performed solution mining activities within the corridor. The location of this company’s solution mining wells is thought to be adjacent to the Fort Wayne Parcel on the northeastern edge of the corridor on the parcel that contained the former Edison Illuminating Company. Franklin Salt is thought to have drilled at least two solution mining wells, likely operating at a distance of approximately 100 to 120 meters (300 to 400) feet apart from one another. Information obtained after release of the “Preliminary Report on Historical Solution Mining Activities, Crossing X-10 and X-11 Corridors,” dated March 24, 2006, indicates Franklin Salt drilled at least one well in 1901 and subsequently produced 72,618, 53,939, and 16,662 barrels of brine from 1902 through 1904, respectively. The same source also indicated the Edison Illuminating company had at least two wells commonly referred to as the “Edison-Ft. Wayne Wells.” It is not known if the later Edison wells were simply the original Franklin-Swift wells or newly drilled wells. As the exact locations and existence of these wells are not known, the area surrounding this location (as shown on Figure 1-7) may be considered as containing at least two solution mining wells. Lithologic logs of the Franklin (Swift) solution mining wells have not been located, although historical lithology and formation references to the wells in other area well logs have been found in sources reviewed during this study. The well log commonly referred to as the Edison-Ft. Wayne #2, believed to be one of the Franklin wells has been located, subsequently evaluated, and documents bedrock lithology similar to that determined during this investigation.

Historic information indicates that prior to 1916, at least one solution mining well was located to the west of the better-documented Solvay wells, also on the Solvay parcel (near the edge of the X-10 corridor). This well is documented on only one relatively early historic map, so the location is not considered as reliable as the other documented locations on the site. Further, it is certainly possible that more than one brine well existed at this location.

Research for this project has also uncovered the existence of three previously-operated deep disposal wells on the former Solvay parcel. The wells were drilled from 1969 to 1978 to depths of greater than 1,200 meters (4,000 feet). The wells were used to inject hazardous waste into permeable rock formations (Munising Formation) deep within the ground. The wells are thought to have been plugged in 2004 based on court proceedings in which the operators of the hazardous waste injection operation were prosecuted for illegal activities. Disposal Well #2 was subsequently plugged in December 2007. Available lithologic logs do not indicate the existence of solution cavities encountered during drilling of any of these wells, one of which is apparently about 120 meters (400 feet) from a documented Solvay brine well. From this information, it appears that, at least in this location, the brine mining activities did not create cavities more than 120 meters (400 feet) from the actual brine well. However, it should also be noted that the logs of the injection wells do not contain great detail, and may not have documented small cavities that were encountered during drilling. Some loss of circulation is also noted in these logs in the upper Devonian strata, indicating that natural solutioning of the limestone and dolomites may have taken place historically (as later concurred in the drilling program).

3.2.2 X-11 Corridor

At least four brine well locations and/or solution mining areas are documented within the approximately 900-meter-wide (3,000-foot-wide) X-11 corridor. All are documented through relatively older sources, which may be less reliable with respect to exact location or existence of the wells. All of the documented brine wells and/or processing areas are reported to have been located in the western half of the X-11 corridor (as shown on Figure 1-7).

Historic information indicates that both JI Carter Salt Company (Carter Salt) and Solvay may have participated in solution mining operations within the corridor. Carter Salt is thought to have operated a salt block (brine processing) plant between present day Dragoon and Military Avenues, on the north side of the existing railroad tracks. The exact numbers and locations of potential solution mining wells are not known, although various records appear to locate wells and/or brine processing in at least three locations. In any case, it is likely the wells would have been drilled to approximately 350 to 375 meters (1,100 to 1,200 feet) and located adjacent to or in close proximity to the block location.

Other early maps show Solvay maintained a salt block (brine processing) plant near present-day Campbell and Cavalry Streets, just south of Jefferson Avenue. Although exact numbers and locations of potential solution mining wells are not known, they would have likely been located adjacent to or in close proximity to the salt block location.

4. THE INVESTIGATION APPROACH

4.1 Program Concept Development

Based on the estimated bridge corridor locations, expected depth of brine well cavities, and estimated angle of cavity propagation to the bedrock surface, an investigation zone width was established. The zone was established such that, if a cavity/gallery were present immediately outside the investigation zone, it could not propagate to the surface location of the bridge foundations. Using a maximum angle for cavity propagation established through forward modeling, a cavity depth of 390 to 520 m (1,200 to 1,600 feet), and a bridge foundation width of less than 35 m (100 feet), an investigation zone width of approximately 320 m (1,000 feet) centered on the bridge foundation was established. This approach for establishing the cross-well seismic imaging spacing is presented Figure Nos. 1 and 2, in Appendix E. In addition, a corridor length extending about 640 m (2,000 feet) inland from the Detroit River edge was established.

Based on the required investigation zone and the limitations of current technology, a plan was developed to investigate the required zone for brine well cavities relying mainly on geophysical investigation methods combined with rock mechanics analysis. Physical investigation of the entire area was determined to be impractical, as boreholes to search for cavities could only be drilled at point locations, while brine wells potentially exist anywhere in the investigation zone. Therefore, several geophysical investigation methods were evaluated, with cross-well seismic imaging as the primary basis for the investigation. The cross-well method generally consists of drilling boreholes at selected locations to an engineered depth below the investigation depth/zone of interest, in the range of 480 to 560 m (1,500 to 1,750 feet) in this case. Seismic source and receivers are then installed in the boreholes and profiles are then acquired between boreholes.

The investigation was designed to search for both existing cavities and “rubbleized” zones, which indicate ongoing collapse of cavities. The issue of future potential for instability of a given cavity or rubbleized zone that might be discovered is addressed in terms of evaluating for potential propagation of existing cavities to the ground surface. The stability of the cavities is evaluated using numerical methods for rock mechanics analysis and determination of whether existing cavities have potential to propagate to the surface or result in settlement or sagging at the ground surface.

Combining this information with the cross-well seismic data to detect the existence of cavities within the zones under study confirmed whether a specific alignment will be subject to instability from the future collapse of existing salt cavities.

Solution mining activities in the area on the U.S. side ended approximately 50 years ago. Because the brine cavities are already filled with salt-saturated solution, and there is no known source of fresh water to the cavities, any salt cavities are considered very stable in terms of lateral spread. Because any future mineral mining or other man-made introduction of fresh water to this depth would require a permit from the Michigan Department of Environmental Quality or Michigan Department of Natural Resources and would be subject to public review, such activities would be prevented if a new crossing is built in the area.

4.2 Forward Modeling

During the early stages of this project, an extensive forward modeling program was initiated to assist in the development of the program and in particular to provide confidence with respect to the investigation methods being used. "Forward modeling" is defined as using numerical methods to estimate physical rock mass behavior and the detection capabilities of geophysical exploration methods within the rock mass. This modeling is without the benefit of physical data from the field in this region. It is based heavily on historical geophysical data under similar geologic and urban characteristics. These evaluations were presented in the "Draft Technical Report on Comparison of Pseudo 3-Dimensional (3-D) Surface Seismic, Vertical Seismic Profiling (VSP/RVSP) and Cross-Well Reflection Tomography Geophysical Methods", dated March 21, 2006 (previously transmitted under separate cover and summarized herein). Both a Phase I and Phase II program were conducted as a part of this modeling program.

Rock mass modeling was initially performed to provide a sense of rock mass behavior above and adjacent to a solution mining cavity or series of interconnected cavities. Using historical data obtained for the Detroit/Windsor area, geometries and characteristics of regional geology and solution mine cavities were evaluated. The geometries and characteristics of the brine well cavities were evaluated for the potential angle of draw as well. The "angle of draw" is defined as the incidence angle between the edge of an underground cavern or gallery and the edge of the area on the bedrock surface where impacts from the cavity are detectible (i.e., ground subsidence). Finally, propagation characteristics given selected geometries and dimensions were modeled. The results of this investigation are summarized below.

A comprehensive geophysical forward modeling program was developed to inform the process in preparing and implementing the physical investigation and the analysis that followed with respect to three potential geophysical methods being considered. Modeled images included normal unaltered lithology, 30.5 m (100-foot) diameter brinewell cavities, and 91.4 m (300-foot) brinewell cavities. During Phase I modeling (surface seismic, vertical seismic profiling (VSP) / reverse vertical seismic profiling (RVSP), and cross-well methods), the pre-mentioned cavities were further modeled as open (containing brine) and filled with rubblized material. During the Phase II Modeling, cross-well seismic imaging techniques were modeled to produced data sets with three probable orientations/geometries, namely normal lithology, cavity directly imaged by the cross-well technique, and a cavity outside the direct image plane, but within the first Fresnel zone. A Fresnel zone is simply stated as the amount (1/4 λ) of constructive energy that is reflected from am impinging spherical wavefront striking an interface.

To account for the lateral resolution of each imaging method, a lateral smoothing filter was applied to both the velocity and the density model with a length of ½ the Fresnel diameter. The smoothing filter was applied as the synthetic seismogram generation method computes seismic reflectivity in a point-by-point manner and does not account for the fact that real-world seismic responses are the combination of responses within the Fresnel zone of the particular seismic method. The lateral smoothing filter approximates this effect by averaging the responses from model points that are within the Fresnel zone.

The relevance and importance of the Fresnel zone in the forward modeling as well as in the planning of the program is presented in Appendix J.

4.2.1 Forward Modeling of Surface Seismic Techniques

Surface seismic techniques refer to the method of data gathering whereby the seismic source and receivers are located at or near the ground surface. A seismic image is produced by integrating the source-receiver arrival times over a series of data gathers. A set of logs was extracted for each offset in the 2-D velocity/density models to produce the forward modeling seismic section representative of the surface seismic method. These logs were used as input to a seismic generation program that produces a synthetic amplitude versus angle (AVA) gather. A band-pass wavelet was then used and the resulting AVA gather was stacked over a selected range of incidence angles to produce a single seismic trace representative of that offset. Surface seismic data sets were produced using 15 to 55 Hz, which is typical for surface methods in this type and quantity of glacial till, with angle stacking equivalent to 10 to 30 degrees. The resulting section was smoothed laterally to emulate the lateral resolution of the imaging (migration) operation by applying a smoothing filter of length 0.75 X wavelength. Random noise was then added with peak amplitude equal to the peak reflectivity amplitude in the section to model real-world urban conditions.

The results of the surface seismic modeling indicated moderate-to-severe noise present within the same frequency content bands as expected during the actual survey. In the lithology-only model, select formation tops were resolvable, but clear contacts were indistinguishable. The model of the 91.4 m (300-foot) brine filled cavity was not resolvable (although a slight anomaly existed) in terms of size and geometry, but provided only slight indication that an anomaly existed in the image. The 91.4 m (300-foot) diameter rubble-filled cavity and a 30.4 m (100-foot) diameter (brine and rubble filled) cavity were not detectable in the modeled images.

4.2.2 Forward Modeling for VSP/RVSP Seismic Techniques

Vertical seismic profiling (VSP) refers to the geophysical data gathering technique where the seismic source is located on the ground surface and receivers are located within a borehole. Reverse vertical seismic profiling (RVSP) refers to the method where the source is located in the borehole and the receivers are located on the ground surface. A seismic image is produced for both methods in a similar manner as surface seismic techniques by integrating the source-receiver arrival times over a series of data gathers. A set of logs was extracted for each offset in the 2-D velocity/density models to produce the forward modeling seismic section representative of the VSP/RVSP seismic methods. These logs were used as input to a seismic generation program that produces a synthetic AVA gather. A band-pass wavelet was then used and the resulting AVA gather was stacked over a selected range of incidence angles to produce a single seismic trace representative of that offset. VSP/RVSP data sets were produced using 15 to 80 Hz, with angle stacking equivalent to 10 to 45 degrees. The resulting section was smoothed laterally to emulate the lateral resolution of the imaging (migration) operation by applying a smoothing filter of length 0.75 X wavelength. Random noise was then added with peak amplitude equal to the peak reflectivity amplitude in the section to model real-world urban conditions.

The results of the VSP/RVSP forward modeling indicated moderate noise present within the same frequency content bands as expected during the actual survey. In the lithology-only model, select formation tops were resolvable, but clear contacts were indistinguishable. The model of the 91.4 m (300-foot) brine-filled cavity was not resolvable in terms of size and geometry, but provided only slight indication that an anomaly existed in the image. The 91.4 m (300-foot) diameter rubble-filled cavity and the 30.4 m (100-foot) diameter (brine and rubble filled) cavity were not detectable in the modeled images.

4.2.3 Forward Modeling for the Cross-well Seismic Imaging Technique

Cross-well seismic imaging refers to the geophysical method whereby the seismic source is located in one borehole (well) and a series of receivers are located in another borehole. A seismic image is produced by integrating the source-receiver arrival times over a series of data gathers at various depths.

4.2.3.1 Phase I Modeling for the Cross-well Seismic Imaging Technique

A set of logs was extracted for each offset in the 2-D velocity/density models for the Phase I forward modeling of a seismic section representative of the cross-well seismic imaging technique. These logs were used as input to a seismic generation program that produces a synthetic amplitude versus angle gather. A band-pass wavelet was used and the resulting AVA gather was stacked over a selected range of incidence angles to produce a single seismic trace representative of that offset. Cross-well data sets were produced using 100 to 2000 Hz, with angle stacking equivalent to 45 to 60 degrees. The resulting section was smoothed laterally to emulate the lateral resolution of the imaging (migration) operation by applying a smoothing filter of length 0.75 X wavelength. Because cross-well uses a downhole sensor and a frequency band above 100 Hz, near-surface attenuation was determined to remove most of the surface noise from the cross-well seismic records. Noise was then added to produce a post-stack signal-to-noise ratio (SNR) in the cross-well data of 20 dB relative to the peak reflectivity amplitude.

The results of the cross-well seismic imaging modeling indicated that the modeled anomalies identified during Phase I were detectable and resolvable (higher frequency equals greater resolution). Additionally, the slight bump on the top of the B-Salt was also resolvable in the images (specific to cross-well imaging modeling), as B-Salt unconformity is known in the region.

4.2.3.2 Phase II Modeling for the Cross-well Seismic Imaging Technique

Phase II forward modeling of a cavity and/or absence of a cavity was performed in two dimensions (2-D), relevant to field data acquisition procedures. A 2-D finite difference model with 5 or more model cells per wavelength to avoid dispersion affects was created. For 2 kHz data at 18,000 feet per second, a 2.7 m (9 foot) wavelength was anticipated in the DRIC project corridor, with each cell approximately 0.61 m by 0.61 m (2 feet by 2 feet). For the cross-well program, with borings spaced approximately 305 m (1,000 feet) apart and about 60 percent padding to avoid edge effects, an 800 by 800 cell model was anticipated. A cross-well data set was then produced and processed to produce velocity/reflection images for use in data acquisition.

The second portion of the Phase II forward modeling program consisted of a 3-D model of a cavity outside the image plane but within the first Fresnel zone in the cross-well seismic imaging profile. The number of cells was limited to reduce the size of the model in the 3rd dimension, both by reducing the upper frequency below 2kHz and allowing greater dispersion of the data. Several common shot gathers from the 3-D model were produced and inspected by hand because the computer resources to generate a complete cross-well data set in a reasonable timeframe were not feasible. The results indicated a cavity could be resolved if acquired outside the direct image plane, but within the first Fresnel zone as indicated.

4.2.4 Rock Mechanics Forward Modeling

The rock mechanics task was performed largely through the work of Dr. Edward Cording. A forward modeling program was created to yield useful data that advised the overall field investigation program through knowledge of the project and subsurface conditions. The desired outcome of the rock mechanics forward modeling effort was to predict the size, geometry, and location of brine well cavities of concern for our project (i.e., what size cavity might potentially propagate to, or have impact on, the bearing surface for the bridge foundations). In addition, the rock mechanics forward modeling was to provide insight into an appropriate angel of draw, for the purposes of spacing the test borings to provide for an appropriate offset from the cleared corridor (see Section 4.1, above). The field effort and/or cross-well seismic program was then adjusted, as appropriate, in consideration of the target void of concern as determined both through the forward modeling process (through peer discussions and discussions between the project team, MDOT, and other parties also as appropriate) and early field results.

The proposed modeling plan consisted of evaluating the rock stability above solution-mined cavities using existing data and assumed rock mass-over-void conditions, similar to those known for coal mining. Conclusions and evaluations were based on parametric analysis and logic-based conclusions. The next portion included computer analysis that advanced the work using 2-D finite element analysis for more refined conclusions. Once suspected geometries and lithology were determined, a 3-D model was produced using the computer program 3DEC, which produces a computational model for rock fractures, movements, etc. The analysis was then calibrated with known stable and unstable conditions for the brine well cavities in the Detroit area. Later, the model was also calibrated with respect to feature geometry observed during the cross-well investigation.

4.2.4.1 Rock Mechanics Modeling Phase I: Characteristics of Subsidence and Sinkholes in Salt, Detroit Area

During the initial modeling phase, a report entitled "Interim Report: Characteristics of Subsidence and Sinkholes in Salt, Detroit Area – A Study for the Proposed Detroit River International Crossing," dated May 27, 2006 and presented under separate cover, was produced by Dr. Edward Cording to evaluate rock stability above solution mined cavities using existing historical and lithologic data. The characteristics of subsidence and sinkholes above solution mined cavities and room-and-pillar mines in salt deposits in the Detroit Area were reviewed, with references made to experience with tunnels in soil, room-and-pillar mines in coal and other bedded rocks, and long-wall mines in coal. The primary focus of this report was to evaluate the lateral extent of the near-surface subsidence and sinkhole effects with respect to the locations of the wells, cavities, and brine fields. The gathered information was intended to aid in the development of guidelines for bridge foundation elements and establishing safe stand-off distances from known or suspected solution mining cavities in the salt. Specifically, the modeling predicted that for larger caverns or brine well galleries, an "angle of draw" of approximately 15 to 20 degrees would be appropriate for use in planning the investigation.

4.2.4.2 Rock Mechanics Modeling Phase II: Stability of Cavities in Salt, Detroit Area

During the second phase of rock mechanics modeling, a report entitled "Stability of Caverns in Salt, Detroit Area; A Rock Mechanics Study for Bridge Foundations for Proposed Detroit River International Crossing," dated December 28, 2006 and presented under separate cover, was produced by Dr. Edward Cording to focus on the stability of cavities in salt and the size of stable cavities extending into overlying bedded deposits. This report commented on the stability of the roof of individual solution cavities and the condition which would allow large roof falls to initiate and progress upward without being arrested by overlying thicker beds. The evaluation was based on the review of existing solution cavities in the Detroit-Windsor area and analysis of cavity stability conducted using three-dimensional (3-D) distinct element methods. The results of the modeling indicated that the cross-well seismic imaging technique would be applicable for detecting cavities that are much smaller than any existing cavities that would be potentially unstable.

4.3 Geotechnical Advisory Group

The Geotechnical Advisory Group (Group) met five times in the Detroit-Windsor area and five times by teleconference between June 2006 and February 2008.

The Group was formed and initially met over a span of three days in late June 2006 to discuss the planned investigations and work that had been completed to that point. Topics discussed included an overview of the project, the purpose and mission of the group, status of the investigation thus far including a history of brine wells in the Detroit-Windsor area, description and objectives of the geotechnical program, planning and development of the program (including consideration of risk), decision making protocol for the investigation, and schedule. The Group also discussed the required criteria for placement of bridge foundations in the subject corridors, including size of voids of concern, angle of draw, the concept of void mitigation, and relative certainty of the void detection program. The Group also took a tour of the project alignments in Windsor and Detroit.

In consideration of the risk of potentially being unable to detect a cavity within certain "shadow areas" based on the cross-well investigation alone, vertical seismic profiling and borehole gravity surveys were recommended by the Group and were later formally added to the program. These additional measures were intended to provide independent methods to confirm the findings based on the cross-well investigation, as well as to provide a greater level of detection in the vicinity of the primary foundation elements for the proposed bridge alignments.

The Group met in Windsor in March 2007 to discuss results-to-date from the ongoing investigation. Both the U.S. and Canadian DRIC Teams presented a summary of progress and results with respect to the drilling and data gathering. The meeting ended with discussion of project goals and schedule.

The Group also met in Windsor in December 2007 to discuss the preliminary results and conclusions from the completed investigation. Both the U.S. and Canadian DRIC Teams presented a summary of investigation, results, conclusions, and recommendations with respect to the drilling and data gathering. The meeting ended with the group addressing a set of questions derived from the results presented by both DRIC Teams.

The Group also teleconferenced five times during the drilling and data acquisition processes, to discuss progress, and to provide insight on proposed changes to the program that were initiated because of encountered field conditions. These changes are discussed in subsequent sections of this report.

4.3.1 Decision Protocol

A decision-making protocol was developed at the first Group meeting. The protocol was refined and presented in a memorandum entitled "Decision Process in Brine Well Cavity Program", as summarized herein. The memorandum presented a flow chart to define the decision criteria concentrating on the drilling, initial geophysics, and final geophysics analysis, with the day-to-day technical decisions being made by the respective DRIC teams on each side of the border.

4.4 Final Program Details

Development of the final brine cavity investigation program was an iterative process that involved research, forward modeling, consultation with various experts (including the Group), and practical issues such as site access, right of entry, etc. Based on these efforts, the final program was developed with boreholes to be generally 480 m (1,500 feet) deep, with selected holes to be as much as about 560 m (1,750 feet) deep. Imaging coverage, resolution, angle of draw, and signal-to-noise ratio were considered in determining the intended boring spacing and depth, as well as proposed piezoelectric source and frequency sweep selection. The final program was bolstered based on specific team member experience in similar deeper rock conditions at the Michigan Technological University test site, using the same equipment as proposed for this investigation. At that site, a higher frequency was used (3khz) with borehole spacing of 2,000 feet. A conservatively lower frequency was proposed for this investigation, for the purpose of allowing an increase in the allowable borehole spacing, if actual site conditions required such.

Figure 4-1
Detroit River International Crossing Study
Final Test Boring Location Plan – Site X-10

Source: NTH Consultants, Ltd.

Figure 4-2
Detroit River International Crossing Study
Final Test Boring Location Plan – Site X-11

Source: NTH Consultants, Ltd.

The final borehole configurations for each crossing are shown on Figures 4-1 and 4-2, which include six boreholes for the X-10 crossing corridor and seven boreholes in the X-11 crossing corridor. The program included gyroscopic deviation surveys within each borehole, to be performed before the cross-well profiles were imaged. The logs were run to establish a very accurate borehole azimuth and dip. The final investigation program included two boreholes on each crossing to be cored, at least partially. The remaining boreholes were rotary drilled and logged based on drill cuttings, combined with an extensive suite of downhole geophysical logging.

The proposed investigation was planned with an understanding of the practical limitations on the size and resolution of solution cavities or other natural cavities in the investigation zone, as only the area directly between the boreholes was to be investigated by a cross-well profile. Based on the forward modeling effort, the profiles were initially estimated (for program planning purposes) to have an effective width (Fresnel zone) of approximately 50 to 65 m (150 to 200 feet) at 1,000Hz, essentially thinning as the spectral frequency increases. Based on later analysis, using the actual data acquired in the field, the Fresnel zone was estimated to be about 65 to 75 m (200 to 225 feet), creating an investigation zone of at least about 30 m (100 feet) on each side of the profile.

Because the profiles can only detect cavities within a given Fresnel zone width (assumed to be about 50 m (150 feet) during the initial planning), the probability of missing a given cavity was examined in terms of cavity diameter (assumed circular) for a constant Fresnel width, and ignoring “thinning” effects of the Fresnel zone in close proximity to the boreholes. Given a random placement of that circle within the study area, the probability of any part of that circle being intersected by one of the 2-D profiles was examined. The problem can be simplified by recognizing that the centerpoint of any circle that would be missed by the cross-well profiles would be at least one radius away from the edge of the 50 m (150 foot) effective width of the cross-well profile. The issue is further simplified in terms of a ratio of the total area within the perimeter of the interconnected boreholes to the area of a swath of width equal to one diameter plus 50 m (150 feet) along each profile.

Based on the boring configuration and cross-well profile width of about 65 m (200 feet), the effective cavity size that could be missed by the investigation for the X-10 crossing was determined to be about 30 m (98 feet), with the coverage of the clear zone estimated at about 97.6 percent (Figure 4-3). Likewise, the effective cavity size that could be possibly missed by the investigation for the X-11 crossing was determined to be about 55 m (170 feet), although this large shadow zone was located outside the zone that could impact the proposed bridge foundations. Within the influence zone (determined based on angle of draw and depicted in Figures 4-3 and 4-4 by an orange dashed line), the effective cavity size that could be possibly missed by the investigation for the X-11 crossing was determined to be about 28 meters (90 feet), with the coverage of the clear zone estimated at about 94.9 percent.

Final cross-well and gravity coverage based on actual spectra obtained during the investigation are presented as Figures 4-5 and 4-6. It is observed that near complete coverage of both crossing corridors was obtained. The cross-well fresnel zone widths are representative at the top of the D-Salt, where the wavelengths are the longest (approximately 100 feet at 200 Hz). The source and receiver depths are approximately 335 m (1,100 feet). The gravity detection limits are representative of the radius detection zone around a borehole to the edge of a potential cavity. In this case, a 91.4 m (300 foot) diameter cavity was used, with a detection zone away from the borehole of approximately 37 m (120 feet). This provides a theoretical detection radius of approximately 128 m (420 feet) from the borehole.

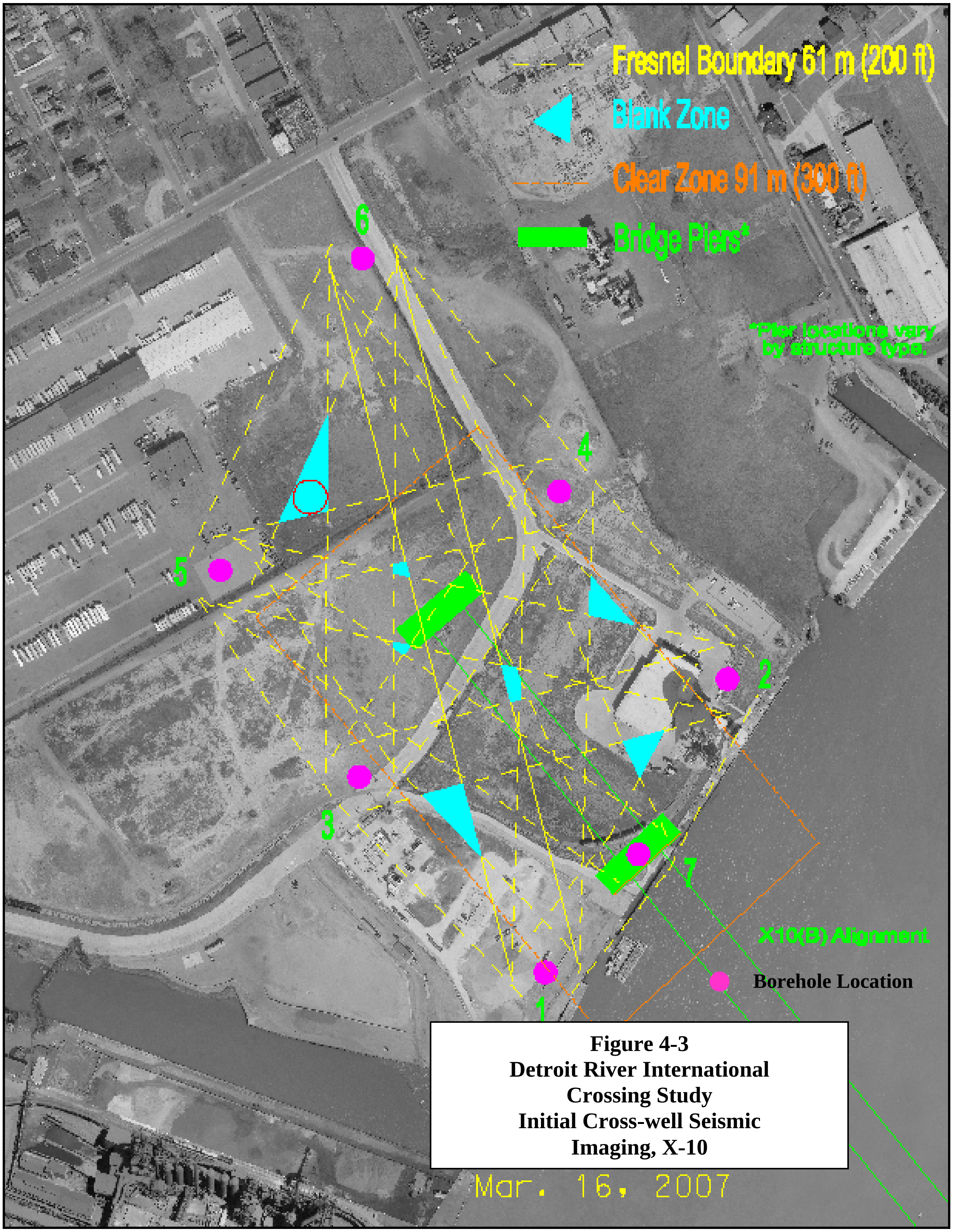


Figure 4-3
Detroit River International Crossing Study
Initial Cross-well Seismic Imaging, X-10

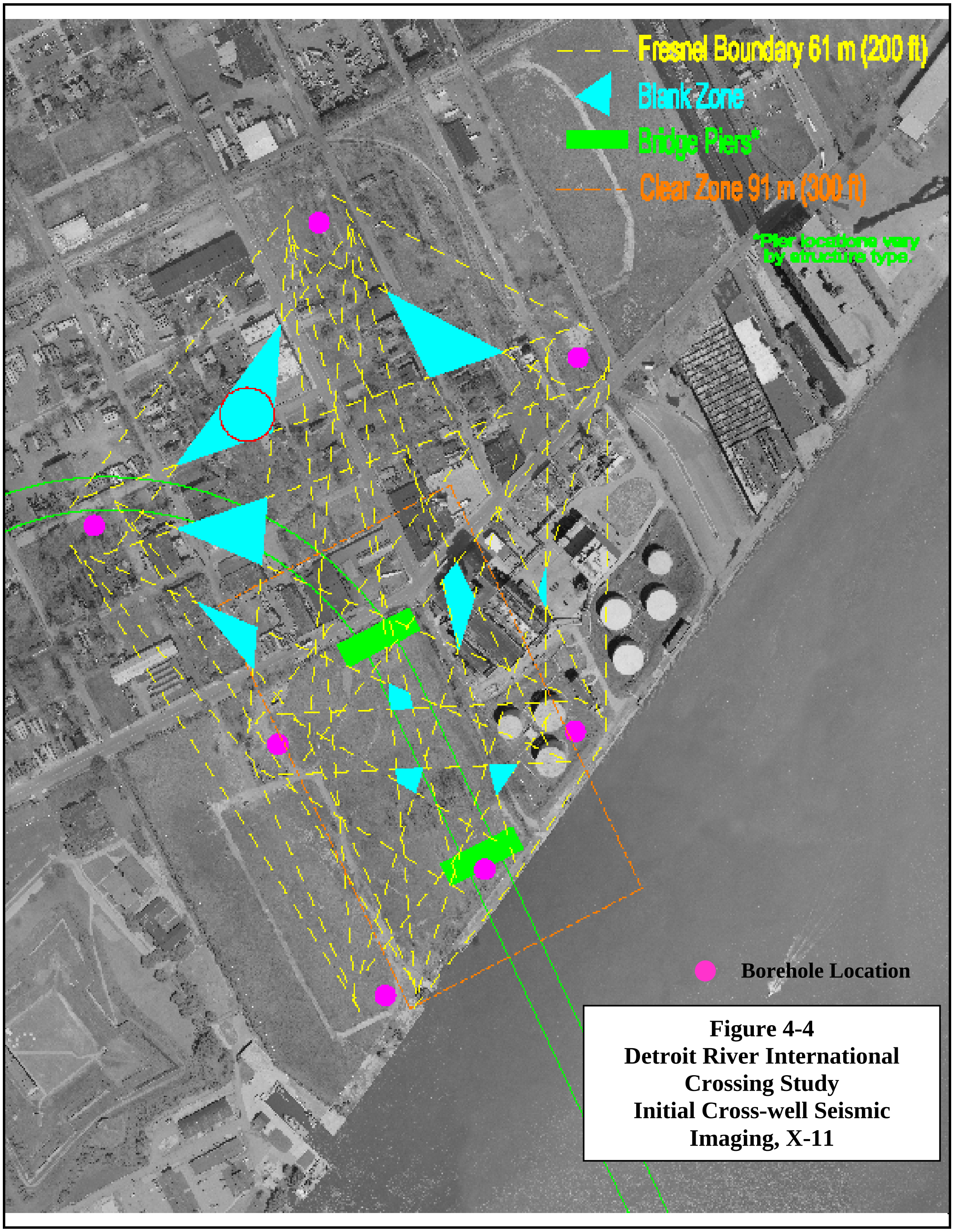
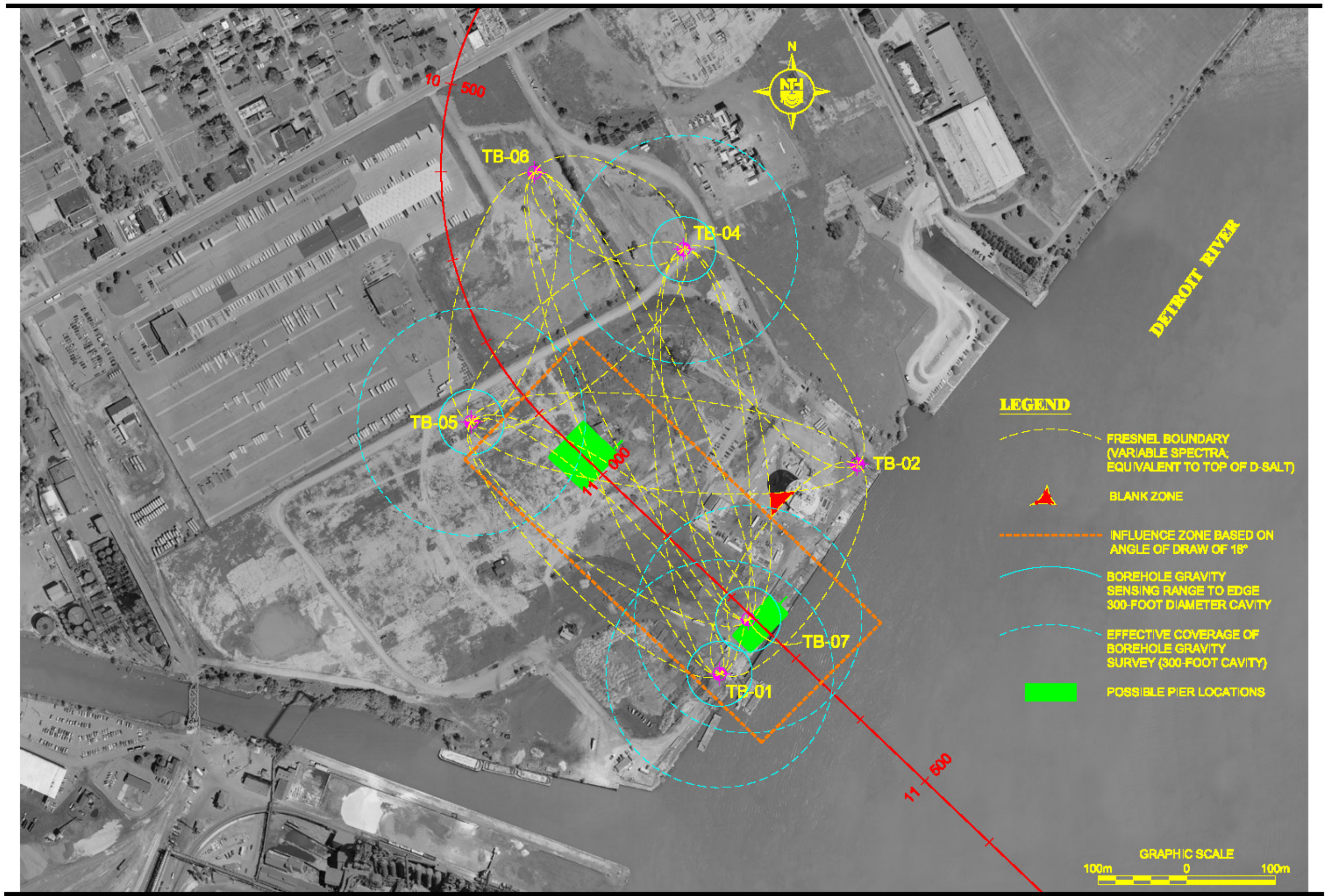
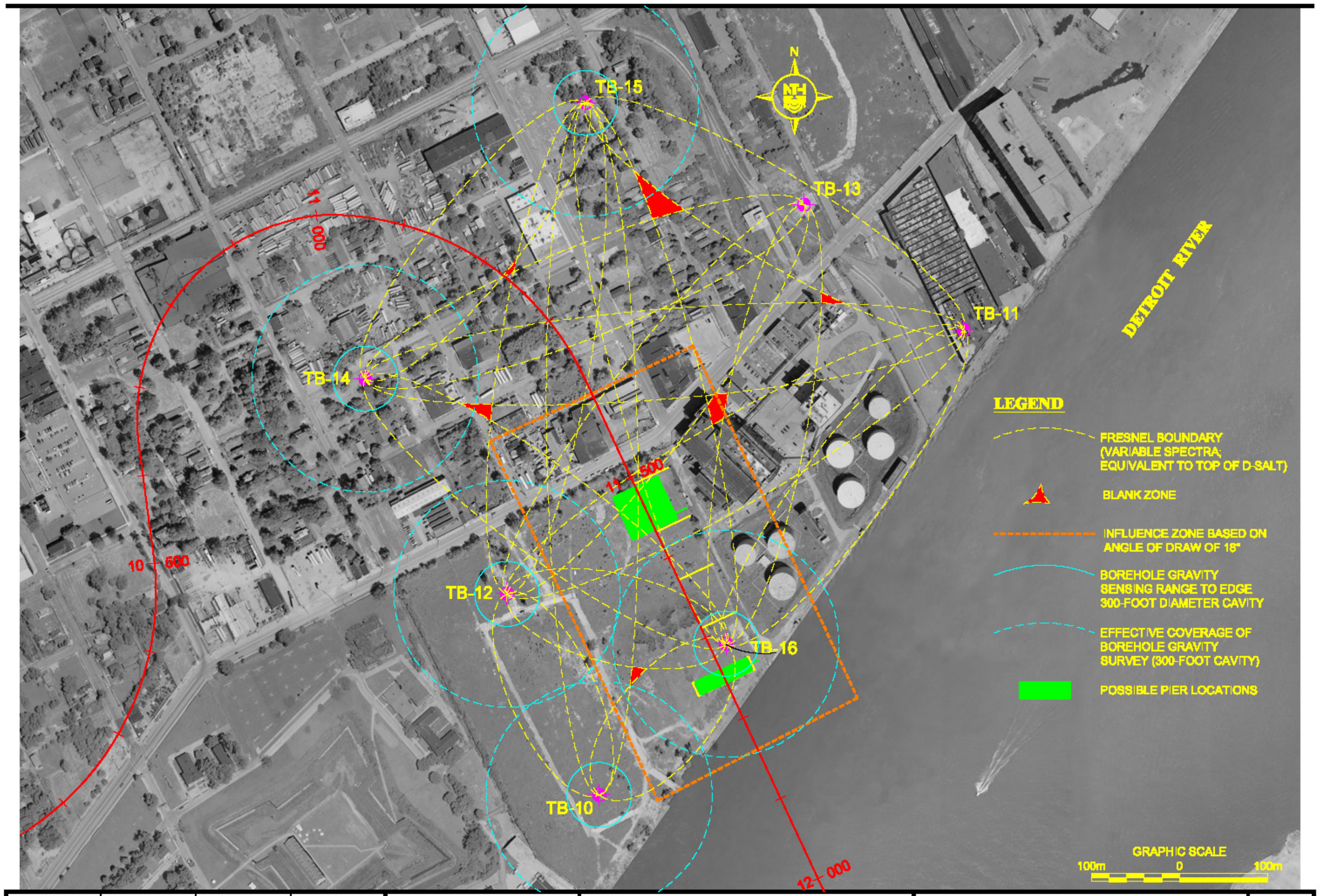


Figure 4-4
Detroit River International Crossing Study
Initial Cross-well Seismic Imaging, X-11

Source: NTH Consultants, Ltd.



NTH PROJECT No.: 15-050014-01	DESIGNED BY: CRJ	CHECKED BY: RJK	DRAWING SCALE: AS SHOWN	NTH Consultants, Ltd. Infrastructure Engineering and Environmental Services	DETROIT RIVER INTERNATIONAL CROSSING DETROIT, MICHIGAN	FRESNEL ZONES SITE X-10	FIGURE No. 4-5
CAD FILE NAME: TH FRESNEL C	DRAWN BY: SHB	DATE: 06 NOV 2007	PLOT DATE: 21 JAN 2008				



NTH PROJECT No.:	DESIGNED BY:	CHECKED BY:	DRAWING SCALE:	NTH Consultants, Ltd. Infrastructure Engineering and Environmental Services	DETROIT RIVER INTERNATIONAL CROSSING DETROIT, MICHIGAN	FRESNEL ZONES SITE X-11	FIGURE No.
15-050014-01	CRJ	RJK	AS SHOWN				4-6
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5. FIELD INVESTIGATION

The field investigation was conducted beginning February 1, 2007, and continued 7 days per week, 24 hours per day until completed in early April 2007 (drilling). The subsequent geophysical investigation (cross-well seismic, BHGM, and VSP surveys) were also conducted 24/7, and were completed in early August 2007. As the field investigation program was implemented, the actual individual property conditions and restrictions were integrated with the program, resulting in an evolution of the actual borehole coverage and depth, boring configurations, drilling procedures, etc. These issues are discussed in the following section of the report.

5.1 Site Conditions

Site conditions and borehole locations as they evolved into the final program for both crossings are summarized as follows.

5.1.1 X-10 Corridor

The investigation sites for the X-10 crossing corridors may be generally characterized as former industrial lots, with the exception of boreholes TB-1, TB-2 and TB-7, which were drilled in current industrial areas. The locations of the boreholes were typically on vacant land.

The original X-10 borings (TB-1, TB-2, TB-3, TB-4, TB-5, TB-6 and TB-7) were located on the former Detroit Coke site (Figure 4-1).

The former Detroit Coke property, used for coke oven and coke oven gas by-products operations from early 1900 until 1991, has been the subject of environmental investigations performed by others not related to this project. Due to the presence of regulated deep-underground injection wells on the property, it was identified as a Resource Conservation and Recovery Act (RCRA) facility. Associated environmental impacts with the coke oven and coke oven gas by-products operations included tar, free-phase hydrocarbons (free product), and soil and groundwater contamination. The entire Detroit Coke site has been reportedly impacted by former industrial operations.

Site soils are reportedly contaminated with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), ammonia, cyanide and metals at concentrations exceeding the MDEQ industrial criteria for indoor and ambient air, direct contact, particulate inhalation and surface water protection. Likewise, site groundwater is reportedly contaminated with VOCs, SVOCs, ammonia, cyanide and metals at concentrations exceeding the MDEQ industrial criteria for indoor air, direct contact and surface water protection.

Honeywell, the primary responsible party, has installed a demarcation membrane in certain areas, and approximately 15.2 to 30.5 cm (6 to 12 inches) of clean fill material has been placed over the membrane to prevent contact with the impacted soil. However, this membrane and clean fill layer may not be present throughout the entire site. Honeywell has also installed groundwater collection trenches and an associated force main that runs parallel to West Jefferson Avenue to limit impacted groundwater from discharging to the Rouge and Detroit Rivers. Section 5.3 of this report explains special measures taken at this site.

Boring TB-1 was drilled on what is now the McCoig Aggregate property located at 1441 Springwells Court along the Detroit River northeast of its confluence with the Rouge River. The McCoig property is currently used for receiving, storing, and shipping aggregate for concrete production. The work area was located adjacent to aggregate stockpiles on the property, with the final borehole location shifted about 45 meters (150 feet) from its originally planned location, dictated by operational considerations within the property itself.

Boreholes TB-2 and TB-7 were located on the Lafarge North America Detroit Cement Terminal facility located at 1301 Springwells Court along the Detroit River northeast of the McCoig Aggregate facility. The Lafarge property consists primarily of open land with a storage silo and related structures adjacent to the Detroit River. Similar to the McCoig property, the boring locations for TB-2 and TB-7 were adjusted up to about 30 meters (100 feet) from the originally planned locations to accommodate existing infrastructure and operational considerations at the Lafarge facility.

Boring TB-6 was drilled on the Yellow Transportation Detroit Terminal property located at 7701 West Jefferson, and was also adjusted to allow for minimal disruption of Yellow's facility. The remaining X-10 boreholes, TB-4 and TB-5, were drilled on property that is currently vacant land owned by the Detroit Economic Growth Corporation (DEGC). Due to the various modifications to the locations of borings TB-5 and TB-3,[3] and in consideration of the existing railroad tracks, overhead power lines, and underground utilities on the DEGC property, the locations of these two borings had incrementally changed such that the final locations were less than 90 m (300 feet) from each other. At this spacing, the relative value of drilling TB-3 was reduced such that it provided very little in terms of coverage within the overall program. After consideration by the Geotechnical Advisory Group, boring TB-3 was eliminated from the program.

5.1.2 X-11 Corridor

The X-11 borings (TB-10, TB-11, TB-12, TB-13, TB-14, TB-15 and TB-16) were drilled both north and south of Jefferson Avenue between South McKinstry Street and Cavalry Street (Figure 4-2).

Test borings TB-10, TB-12, and TB-16 were drilled on the former Revere Copper and Brass site located at 5851 West Jefferson Avenue. The Revere site exists as vacant, unoccupied land with some lightly wooded areas south of West Jefferson, to the southeast of the Mistersky Power Plant. Previous environmental investigations conducted by others not related to this project have identified the Revere site as impacted with the byproducts of former industrial use.

In addition to the environmental issues, a Detroit Water and Sewerage Department (DWSD) triple-barrel outfall sewer runs from a 4.9 m (16-foot) diameter interceptor sewer under Jefferson Avenue to the Detroit River, extending through the center of the Revere property. The outfall sewer in this section is approximately 1.8 m (6 feet) tall, 5.5 m (18 feet) wide, 366 m (1,200 feet) long, at an average depth of approximately 3 m (10 feet) below ground. Piling supports the last third of the outfall before the river. The current easement alignment, together with the size and shallow depth of the outfall, limit potential development opportunities for the site.

Test borings TB-11 and TB-13 were drilled on parcels currently owned by Renaissance Logistics/Motor City Building Materials. These sites are located at 4738 West Jefferson, northeast of the Mistersky Power Plant. The work areas are vacant, former industrial property.

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[3] Identified when the program was initially laid out.

Borehole TB-14 was drilled on City of Detroit properties at 5851, 5857, 5861, and 5867 Harvey Street, between Campbell and Cavalry Streets. The area is characterized as vacant residential property in a mixed residential and industrial neighborhood. These properties are generally vacant and unoccupied with scarce vegetation.

Test boring TB-15 was drilled at 125 Junction Street on property owned by PVS Chemicals. The PVS site is vacant with several building foundations evident on parts of the site.

5.2 Site Preparation Activities

The existing conditions at each drilling location were modified to accommodate drilling equipment. A level pad was built at each boring location, using crushed stone to create a stable platform on which to place the drill rigs and support equipment. Existing conditions were protected to the degree possible at each site in order to facilitate site restoration at the completion of the DRIC Brine Well Investigation Program.

5.2.1 MDEQ Permitting

To conduct the geotechnical analysis, the Michigan Department of Environmental Quality (MDEQ) required a Natural Resources and Environmental Protection Act, Act 451, Part 625 Mineral Wells permit for each of the boring locations. The borings were permitted as test wells with stringent regulations for site preparation, drilling methods, fluid management, casing, well abandonment, restoration, and a hydrogen sulfide contingency plan, which will be discussed in later sections of this report. The MDEQ also required the permit locations to be bonded until completion of abandonment and restoration activities.

5.2.2 Right of Entry

Drilling operations were conducted on sites owned by six separate entities. Because none of the sites were under MDOT ownership, the DRIC team was required to secure Right-of-Entry agreements prior to starting the work. Agreements were reached with each landowner to allow time for drilling operations, downhole testing, borehole abandonment, and site restoration. The agreements were made with specific requirements as detailed by each of the individual owners.

5.2.2.1 Communications Planning

A plan was developed to document communications protocol for the field activities of the DRIC Brine Well Investigation Program. The procedures outlined in the protocol governed all communications among the project team, governmental agencies, the media, and the public during the time at which field activities were conducted. The protocol addressed the communications guidelines that would be used for everyday communications through emergency situations and a possible evacuation of workers and the general public. The plan covered topics such as individual personnel responsibilities, site access protocol (including site limits, safety requirements, and project orientation), media and public relations, and emergency procedures. The protocol is subdivided into several sections as discussed below.

Hydrogen Sulfide Contingency Plan – Based on historical information, the lower glacial drift and bedrock to be investigated, beginning with the Illionoian “hardpan” and Dundee Limestone, respectively, at approximately 29.0 to 30.5 meters (90 to 100 feet) below ground surface, is known to contain hydrogen sulfide dissolved in groundwater. It was considered possible that significant hydrogen sulfide could have been encountered and released to the atmosphere during drilling operations. As such, the borings were subject to Michigan's Oil and Gas Regulations, Natural Resources and Environmental Protection Act No. 451 of the Public Acts of 1994, Rules 324.1101 through 324.1130. These rules required preparation of a Hydrogen Sulfide Contingency Plan that provided a "plan of action for alerting and protecting personnel at the well site and the public in the event of an emergency involving release of hydrogen sulfide gas." This contingency plan was in place until the drilling program was completed. It was not necessary to enact the contingency plan, as no releases of H_2S covered by the plan were observed.

Project Safety Training and Orientation – This plan and document were prepared and utilized during the field investigation to provide a summary of the procedures and content of the DRIC Project Safety Orientation Program, which was established and utilized during the deep drilling program. Site personnel and visitors were required to take this orientation prior to entering the drilling sites. Topics covered during this orientation included site access and security, health and safety plans, personal protective equipment, hydrogen sulfide management, first aid, housekeeping, illumination, drilling safety, fall protection, flammable hazards, hot work permits, confined space entry, excavations, lock out/tag out, hazard communication, weekly safety briefings, and accident reporting.

Fifteen safety orientation training sessions at multiple sites were conducted involving 300 people with the Detroit Fire Department, Police Department, Department of Homeland Security, Department of Environmental Affairs, Mistersky Power Plant, and other City of Detroit agencies. The Mistersky Power Station Emergency Procedures checklist was included in the communications protocol to familiarize project personnel and first responders with the evacuation procedures of the adjacent Mistersky Power Station.

Evacuation Checklist – An evacuation checklist for hydrogen sulfide exposure was produced to streamline the decision making process should an accidental release be detected during the drilling. The checklist provided communications protocol and evacuation guidelines for actions to be taken given specific hydrogen sulfide concentrations.

5.2.2.2 SCBA Training for City of Detroit

Special equipment and training was provided as follows: 1) 8-hour SCBA respirator training for 28 Mistersky Power Plant personnel in two sessions; 2) SCBA fit tests and medical evaluations of all Mistersky Power Plant personnel; 3) nine self-contained breathing units, together with associated tanks and other equipment and a detailed respirator protection program; 4) two gas meters and training for Mistersky personnel; and 5) three gas meters and training to Fire Department personnel.

5.2.2.3 Evacuation Planning

An evacuation plan for the surrounding area was prepared. An automated telephone evacuation system was at the ready throughout the drilling operation. The consultant and multiple City of Detroit and public agencies were required to gain approval of the plan from the Detroit Fire Department, Police Department, Homeland Security, Department of Environmental Affairs, Emergency Dispatch, hospital representatives, and the Michigan Humane Society. A "mock disaster" drill was conducted where potential real-world situations were addressed. Evacuation plans for site personnel, local business personnel, residents, and pets (cats and dogs) were adopted.

5.2.2.4 Special Insurance Requirements for Right-of-Entry

In order to obtain right of entry on selected parcels, the team was required to have the driller, Advanced Energy Services, obtain $10 million of pollution liability, additional contractor's general liability, and control-of-well insurance for the project.

5.3 Additional Protocol for Investigation Program

A number of protocols were developed and implemented as part of the field investigation program, including environmental protocols for drilling, noise monitoring and control, vibration monitoring and control, and environmental contingency plans.

5.3.1 Environmental Protocol for Drilling

A specific plan detailing the potential contaminants present at the site and work procedures for limiting exposure and potential for exacerbation of contaminants was prepared for each drilling location. Each worker was required to read, sign, and abide by the overall health and safety plan.

5.3.1.1 Detroit Coke Site (TB-1 through TB-7)

As mentioned previously, environmental contamination had been previously identified at the former Detroit Coke site boring locations (X-10 Crossing). Based on the existing conditions, it was necessary to prevent migration of contaminated near-surface groundwater through the boreholes into uncontaminated aquifers and exposure of clean soils to contaminated near-surface soils displaced during drilling. To address the near-surface contamination, an additional environmental casing was employed. Drilling equipment was steam cleaned and the environmental casing was cleaned prior to advancing the boring.

Borings on the Detroit Coke site resulted in contaminated waste generated during environmental casing installation. Cuttings and drilling fluid from these borings were placed in half-tanks on site and solidified. The solidified waste was then shipped to a Class II landfill for disposal. Liquid generated during environmental casing cleaning was pumped into a frac tank at the site and disposed at both hazardous and non-hazardous liquid disposal facilities, as appropriate. Waste generated from installing the conductor casing, which will be described in following sections, was solidified in a half-tank and shipped to a Class II landfill for disposal.

5.3.1.2 Crossing X-11 City of Detroit Parcels (TB-10, 12, 14, and 16)

Environmental contamination had been previously identified on the City of Detroit property at Crossing X-11. As part of the environmental protocol for these borings, a single conductor casing was installed to bedrock, in the manner discussed above for the Detroit Coke property. Soil cuttings and drilling fluid were also placed in a half-tank on site and solidified. The material was then shipped to a Class II landfill.

5.3.1.3 Crossing X-11 Private Owners (TB-11, 13, and 15)

Environmental contamination had not been identified on the X-11 crossing private properties (TB-11, TB-13, and TB-15), and near-surface fill soils on these properties were not characterized. Borings on these properties were drilled to a depth of 1.5 meters (5 feet) into the native clay layer as an initial step. Drilling fluid and cuttings were then replaced, with the initial material pumped to a pit on site, which was then stabilized and capped. Drilling resumed with fresh drilling fluid to a depth of 1.5 meters (5 feet) into bedrock prior to installing the conductor casing. Fluid and cuttings from this second interval were placed in a half-tank and stabilized prior to shipment to a Class II landfill.

5.3.2 Noise Monitoring and Control

Requirements to control sound levels were implemented during drilling. The drillers installed hospital-type sound mufflers on the drilling rig and generators to limit sound. Noise threshold levels were established per MDOT specifications. Sound monitoring was conducted during the field operations by measuring the sound intensity at various intervals around the drilling site. If values over 66 dBa were detected for more than ten minutes, the readings were then taken adjacent to the nearest residence. During the investigation, sound levels exceeding 66 dBa were not recorded adjacent to any structures used for business or residential purposes.

5.3.3 Vibration Monitoring and Control

An assessment of vibration levels at nearby structures was performed during the field investigation by monitoring vibration levels at the outer limits of each drilling site. BlastMates II and III seismographs were used during the drilling to monitor vibration levels on a per shift basis. The setup consisted of geophones placed on the ground surface and connected to a microprocessor within the seismograph. The devices recorded peak particle velocity and velocity time history, with a threshold value set at 2.54 cm/s (1.0 in/s). Vibration levels recorded during the investigation did not exceed the threshold value at the confines of the site.

A structure condition survey was incorporated into the field investigation procedure, should threshold values have been exceeded, as a tool for mitigating and resolving potential claims. Structure condition surveys were not performed during the field investigation because the vibration threshold was not exceeded.

5.3.4 Environmental Contingency Plan and Procedures

As a byproduct of the drilling activities, drilling fluids were produced with a potentially high pH (above 12), which would technically classified them as liquid industrial waste. A high pH was maintained during drilling to inhibit dissolved hydrogen sulfide gas present in the groundwater from becoming volatilized upon being exposed to the atmosphere. Testing was conducted during drilling activities to monitor the pH. Specific procedures were developed to minimize the potential for generation of hazardous waste and are discussed as follows:

5.3.4.1 Training Requirements

At least one person was on site who had received training equivalent to 40 CFR 265.16 for the duration of drilling activities that could potentially produce hazardous waste. The training was provided to ensure that hazardous waste generator requirements, including personnel training, and contingency plan and emergency procedures were in place before commencement of field activities, in case of hazardous waste production. Records were kept onsite for verification.

5.3.4.2 Preparedness and Prevention

The drill site was maintained in such a manner that there were no releases of hazardous waste to the soil or surface water. This was completed by directly transferring waste from boreholes to tanker trucks for transportation to an approved disposal facility. Communication between the shift supervisor and the project team was maintained by cellular telephone. Detroit Police and Fire Department personnel were briefed on the operations numerous times and were aware of the activities. As previously mentioned, staff from the police and fire department received project safety orientation prior to beginning field activities. Security was also maintained at the drilling sites at all times.

5.3.4.3 Contingency Plan

A Contingency Plan was created to address the potential release of hazardous waste as a result of the drilling process. It complemented the existing Hydrogen Sulfide Contingency Plan, as previously discussed. An emergency coordinator (and alternates) were selected who were familiar with the operation and had received the proper training. An emergency responder was also contracted in the event an unattended release were to happen. Emergency procedures were developed that specifically detailed the steps to be taken in the event of a release, with respect to notification protocol, identification, assessment, reporting, containment, monitoring, clean-up, ensurance that equipment and procedure are online before resuming activities, and submittal of documentation to the Environmental Protection Agency.

6. DRILLING PROGRAM

The drilling program for the DRIC Brine Well Cavity Investigation Program consisted of advancing thirteen test borings from the ground surface to total depths (TD) ranging from 457.2 to 533.4 meters (1,500 to 1,750 feet) below ground surface. The borings were advanced using a combination of rotary drilling and coring methods.

As borehole drilling was subject to Michigan Department of Environmental Quality permitting rules cited previously, the boreholes were designed for each stage of drilling: 1) borehole diameters to be used to certain depths; 2) casing requirements for each section of the boring; 3) casing cementing requirements; and 4) drilling fluid weights necessary for each stage. The permits also required that the borings comply with the Hydrogen Sulfide Rules of Act 451, as previously discussed.

Drilling through the overburden to approximately 1.5 meters (5 feet) into the bedrock for conductor casing installation was performed using an Ingersoll-Rand TH-55 truck-mounted top-drive water well drilling rig. Following conductor casing installation (discussed in the following section), each drilling location was prepared for rock drilling rig by placing a crushed stone pad at the boring location to provide a level and stable platform for drilling operations. A cellar was then excavated around the conductor casing to provide space to position a Blowout Prevention Device (BOP) required for drilling operations. Access roads were constructed as necessary and fencing was installed around the drilling sites that were not already secured by the property owner. Surface soils were isolated from drilling operations for their duration using an HDPE liner under the equipment. After installation of the cellar, a Walker-Neer Apache 150-25 top-drive, hydraulically-operated rotary drill rig was mobilized to the site and set up along with the necessary pumps and tanks to perform drilling operations. Both types of drill rigs operated continuously during drilling operations were underway.

Daily Field Reports (DFRs) were prepared that describe the site activities as the investigation program progressed and are presented on CD-1, attached to this report.

6.1 Casing Program

Steel casings were installed and cemented in the borings in order to keep the boreholes open during drilling and subsequent downhole work, and to prevent cross-contamination of the various aquifers present in the investigation zones. Four separate casing types were used during the investigation.

6.1.1 Environmental Casing

Soil and groundwater contamination identified on the former Detroit Coke site necessitated the use of an environmental casing as the first stage of the casing program. A 508-mm (20-inch) outside diameter (O.D.) steel casing weighing 142.9 kg/m (96 lb/feet) was socketed into a gray silty clay layer below the contaminated zone to prevent exacerbation and contaminant migration. Environmental casing was installed in boreholes TB-1, TB-2, TB-4, TB-5, TB-6, and TB-7.

6.1.2 Conductor Casing

The initial casing for sites other than the former Detroit Coke locations and the second casing for Detroit Coke sites consisted of a 340-mm (13 3/8-inch) O.D. steel casing weighing 71.4 kg/m (48 lb/feet). This casing, also referred to as conductor casing, extended from the ground surface to a minimum of 1.5 meters (five feet) into bedrock. This casing was installed to protect groundwater aquifers and to prevent potential exacerbation and cross-contamination of any contaminants in the overburden (drift).

6.1.3 Surface Casing

Surface casing was also installed during the drilling process. This 244-mm (9 5/8-inch) O.D. steel casing weighing 53.6 kg/m (36 lb/feet) was installed from the ground surface to a depth of approximately 30.5 m (100 feet) into bedrock. The surface casing was installed to protect the lowest (potentially) freshwater aquifer, which in this investigation corresponds to the bottom of the glacial drift.

6.1.4 Final Casing

Sloughing and localized swelling of the shale bedrock in some horizons was noted during downhole testing at TB-1 and TB-6. A removable packer assembly, in combination with a 140-mm (5 1/2-inch) O.D. steel casing weighing 25.3 kg/m (17 lb/feet) was installed in TB-1 and TB-6 to prevent further gauging (borehole restriction or enlargement) issues within the borehole. Steel casing was used to limit the effect on the cross-well data acquisition that was to follow, as the final casing was not cemented into place.

6.1.5 Casing Cementing Methods

Each casing installation was cemented in place using Class A cement and was fully cemented to surface with the exception of the 140-mm (5 ½-inch) casing. Prior to cementing, a fitting and valve were installed on the top of the casing, cellophane flake (Cello Flake) and cement were then pumped into the interior of the casing. Pressurized water was then used to displace the cement into the annular space between the borehole and the outside of the casing, leaving a plug of cement at the bottom of the interior of the casing. The cellophane flake was pumped as a spacer ahead of the cement to better gauge cement return to the surface and partially act as a lost circulation additive.

At TB-10, TB-13, and TB-16, cement or flake return to the surface was not observed during displacement. In order to ensure that the casing was fully cemented, additional cement was then placed into the annular space from the outside of the casing following displacement (backside grouting). When cement was observed to be lost into the rock formation during this process, a mechanical device called a cement basket was then placed in the annular space to facilitate cementing in the proper horizon.

Schematics illustrating well construction have been prepared and are included in Appendix A.

6.1.6 Blowout Prevention (BOP) Device

A BOP was used on each borehole during drilling to ensure and maintain pressure control of the wells, as required by the MDEQ permit. The BOP used during drilling was considered “full stack” and included one set of pipe rams, blind rams, and an annular preventer. The stack configuration used for this project had the pipe rams and blind rams configured and bolted to the 244-mm (9 5/8-inch) O.D. steel surface casing. The pipe and blind rams were configured to clamp, secure, and shear the drill string (hang) in the case of a downhole pressure situation. An annular BOP was then placed on the top of the stack to control a wide variety of tubing, casing, core barrels, etc., that were used in the construction of the well.

The MDEQ also required pressure testing of the BOP units prior to advancing the borehole beyond surface casing. After the surface casing had been cemented and the cement had cured for the required time, the pipe and blind rams were tested to 20.68 Mpa (3,000 pounds per square inch (psi)) for a period of 30 minutes. Pressure on the backside of the conductor casing was monitored, as well as the BOP connections. When the BOP maintained the required pressure for the required time frame, the pressure test was concluded. The drill string was then dropped into the hole to tag the cement column inside the casing in preparation for the annular BOP pressure test. The annular BOP was then tested with the drill string in the hole to 6.895 Mpa (1,000 psi) for 20 minutes. When the annular BOP maintained pressure for required time frame, the pressure test was also concluded.

6.2 Drilling Fluids

Boring operations required the use of drilling fluids to lubricate and cool the drill bit, promote borehole stability, and remove cuttings from the borehole. Drilling fluid minimum requirements were outlined in the MDEQ permits for each boring, but were substantially changed during drilling based on environmental field conditions.

For environmental casing installation on the former Detroit Coke site, drilling fluid, commonly known as “spud mud,” was formulated to have a density significantly higher than water (between 1.2 to 1.6 kg/L (10 to 13 lb/gal)) and sufficient viscosity in order to prevent fluid and groundwater migration into and out of the borehole. These characteristics were also desired in order to remove cuttings from the borehole while maintaining low annular velocities, allowing the borehole to be cut to true diameter and minimize washout. The drilling fluid was composed of chlorinated fresh water mixed with bentonite clay and then flocculated with lime. Additives to compensate for naturally occurring calcium and to adjust the pH of the drilling fluid were also used during environmental casing installation.

Drilling fluid used during conductor casing installation was comprised of chlorinated, potable, fresh water mixed with bentonite clay (spud mud). Permit requirements for this fluid weight were 1.08 kg/L (9.0 lb/gal), with the mud weight typically above 1.20 kg/L (10 lb/gal) during drilling operations. From the top of the hardpan to the top of the bedrock, the fluid was enhanced with barite to provide additional weight to control potential artesian groundwater conditions at the soil/rock interface and granular zones within the hardpan.

Once drilling operations reached bedrock, fully-saturated brine (1.22 kg/L, 10.2 lb/gal) with drilling additives was used to well completion. Several additives were also used to control fluid loss into the rock formation, such as Kwik Seal and bentonite gel. Lost Circulation Material (LCM-coarse, medium, and fine) sweeps, or pills, consisting of paper, cellophane, and ground pecan shells mixed in with the drilling fluid, were pumped where fluid loss was observed in the fluid stream. The use of lime to effectively raise the pH and hydrogen sulfide scavengers, i.e. zinc oxide and zinc sulfide, were used to treat the gas-laden groundwater. Hydrogen sulfide escapes to the atmosphere less readily in high pH environments and hydrogen sulfide scavengers effectively react with the three noxious sulfurous compounds (H2S, H-2, and HS-) to change them to neutral inert compounds. Salt gel was also added to increase viscosity when the pump was crippled during partial lost circulation episodes.

6.3 Rotary Drilling Methods

Rock borings were generally advanced from the bottom of the 340-mm (13 3/8-inch) conductor casing (socketed and cemented 5 feet into rock) to the designated total depth (TD) using rotary drilling methods. However, borings TB-7 and TB-11 were performed using a combination of rotary drilling and coring methods. Rotary drilling was performed using tri-cone roller bits of various sizes to drill through the rock formations. A 311 mm (12 1/4-inch) diameter Smith bit was used to drill to the required depth for the surface casing. A 222 mm (8 3/4-inch) Smith bit was then used to drill out the surface casing. Some borings were advanced to TD using this bit. At other boring locations, the drillers changed to a 200 mm (7 7/8-inch) Hughes bit at approximately 360 meters (1,180 feet) below ground surface (BGS) to complete the boring. The bit change correlated to advancing the boring out of the last salt bed of the upper salt horizons. Below this depth, known anhydrite beds required the change to the 200 mm (7 7/8-inch) bit, which was a harder bit (Type 2) with smaller buttons to better handle the anhydrite.

The rig's drill string initially consisted of a combination of 203 mm (8-inch) and 152 mm (6-inch) diameter drill collars, each nominally 9.1 meters (30 feet) in length. Drill collars provided additional weight relative to drill pipe to advance the boring, as no pull-down pressure was applied by the rig to advance the bit. As the boring was advanced, additional drill collars and 114 mm (4 ½-inch) diameter drill rods were added to the drill string. The rate at which the boring was advanced depended primarily on the weight of the drill string (weight on bit) and the characteristics of the rock formation being drilled. For optimal drilling efficiency, the drillers maintained a "drill string pendulum" where the weight on the bit equaled approximately 9,070 kilograms (20,000 pounds), while maintaining little to no pull-down from the rig. Typically, advance rates averaged 10 to 26 minutes per meter (3 to 8 minutes per foot) throughout the borings.

Drilling fluid was circulated through the drill string, out of the bit, and up the annular space between the sidewall of the borehole and the drill string. Samples collected during rotary boring consisted of drill cuttings (rock chips) produced during the drilling process. Rock chips broken off the formation as the bit progressed downward were brought to the surface in the drilling fluid. The field engineer collected cuttings from the drill rig's shale shaker as the cuttings came to the surface. Samples were collected for each ten-foot interval and logged by the field engineer (See Logs of Rotary Boring in Appendix B). Field logging consisted of identifying the constituents of the sample, as well as describing the color, particle size, and grain size of these constituents. A full description of the terminology used to classify and log rock core samples is included in Appendix E. The samples were bagged and labeled with the boring and depth interval at which they were collected. Lithology was determined by the field engineer based on drilling fluid annular velocity, drilling fluid weight, depth of the borehole, cutting size, and particle density, and the lag between the production of the cuttings and return at the surface, which typically increased as the borehole depth increased. The depth of origin of samples as logged is therefore approximate, and where applicable, has been checked against downhole logging to develop the subsurface profile.

Bagged samples of the cuttings were delivered to a warehouse in Detroit, Mich., for additional examination and description. Geologists then performed secondary logging of the samples at the warehouse to verify field identification. The sample logs were then checked against previously-developed formation and group descriptions.

6.4 Coring Methods

Sampling by cutting rock cores was performed in TB-7 and TB-11. Coring was performed continuously from 31.4 to 448.4 meters (103 to 1,471 feet) below ground surface (BGS) in TB-7. Rock coring in TB-11 was performed: 1) from 150.9 to 169.2 meters (495 to 555 feet) BGS to provide a representative sample of the Sylvania Sandstone; 2) from 281.9 to 315.5 meters (925 to 1,035 feet) BGS to sample the potential roof rock above the Salina F-Salt unit (F4 Bed) and to identify the top of the Salina F-Salt; and 3) from 376.4 to 395.0 meters (1,235 to 1,296 feet) BGS to sample the potential roof rock above the Salina D-Salt (D3 Bed)and identify the top of the Salina D-Salt. A total of 70.4 meters (231 feet) of coring was performed in TB-11.

Continuous rock core samples were obtained in general accordance with ASTM D2113. Rock coring was performed with 20.0-centimeter O.D./10.2-centimeter I.D. (7 7/8" O.D./4" I.D.) core tooling. A double-tube, solid core barrel with diamond-impregnated matrix bottom-discharge bits capable of obtaining a core run length of 9.1 meters (30 feet) was used. The bit and barrel were attached to the rig's drill string, used to turn the bit and barrel and supply the bit with drilling fluid. As with rotary drilling, the drill string was comprised of drill collars and drill pipe to provide the required weight to advance the boring. The average rate of advancement during coring was approximately 114 minutes per meter (35 minutes per foot). During the advance of the core run, the field engineer recorded the elapsed time required to complete the core run, rate of advancement, and other pertinent drilling information.

Each core run consisted of tripping the bit, barrel, and drill string into the boring, performing coring operations, and then tripping the drill string back out of the borehole. The core was then removed from the barrel and placed in boxes. Core boxes were three feet in length, generally necessitating 10 to 11 boxes for the average core run, based on natural and mechanical (handling-induced or intentional) breaks in the core occurring at irregular intervals.

The field engineer then field logged the recovered core. Logging consisted of calculating the percent recovery, fractures per foot of run, and the Rock Quality Designation (RQD) value for each core run, as well as documenting the rock type and the location and type of discontinuities present in the core run. The recovery is defined as the total length of core retrieved from the barrel divided by the total distance the barrel was advanced during coring. The RQD is defined as the total length of rock core pieces greater than four inches in length divided by the total advanced distance of the core run. Fractures-per-foot measurements were determined by the field engineer immediately after sampling by counting fractures that appeared natural and were not obviously caused by handling of the core or by intentional breakage. Potential test samples were selected by the field engineer and were immediately wrapped with plastic wrap and the ends taped to delay moisture loss.

The core boxes were then delivered to the warehouse for secondary logging by geologists and for final test sample selection. The Logs of Core Boring are presented in Appendix C. The logs include information for each core run, including a detailed rock description, lithology marker beds noted by the geologist, a description of fractures and mechanical breaks noted by the field engineer at the time of sampling, results of sampling for hydrogen sulfide gas and methane during sampling. Photographs of Rock Cores are presented in Appendix D (CD-2 for this report).

6.5 Downhole Logging Program

As a basis for correlation between test borings and lithology determination, an extensive and supplemental downhole geophysical logging program (i.e., wireline logs, electric logs, downhole logs) was developed and implemented to better document borehole conditions and lithology. The results of the downhole investigation have been included on CD-1. A description of the logging program is detailed in the following paragraphs.

6.5.1 Directional/Deviation Surveys

Directional borehole deviation surveys (gyroscopic) were performed to determine borehole dip and azimuth. Boreholes as they progress downward through the earth are not typically straight and some lateral variation is expected. This log determines the deviation from a straight path at depth intervals along the borehole. The actual path of the borehole is critically important when performing subsequent cross-well seismic surveys, as any deviation from vertical, i.e. horizontal position from well to well, can cause artifacts in the processing phase. Borehole deviation surveys were conducted in each of the DRIC test borings.

6.5.2 Natural Gamma Logging

Natural gamma logs are run in combination with each of the other downhole logs. The gamma logs measure the natural radioactivity of the bedrock formations. Rock units that contain argillaceous (clayey) or shale portions in their rock matrix will exhibit a naturally higher gamma reading. Rock units such as clean sandstones, clean limestone/dolomite, and salt layers will exhibit very low natural gamma readings. Gamma logs were also run by the cross-well contractor before acquisition to “tie-in” the downhole logging with the eross-well equipment for correlation of formation/depth information in the borehole. Gamma ray logs provide a relatively inexpensive way to correlate bedrock information among boreholes and were run in each of the DRIC test borings in conjunction with the other types of downhole logs that were performed.

6.5.3 Digital Acoustic Logging (Delta-t)

Digital Acoustic Logs (DAL) were performed to determine the acoustic properties of the bedrock formations as a function of seismic velocity change over a two-foot interval (delta-t). These logs provide the cross-well seismic program with a foundation for expected travel times through the rock units during cross-well seismic acquisition. They also provide the direct information for the tomography (travel time/velocity) portion of the cross-well seismic survey (background). These logs were run in TB-2, TB-6, TB-7, TB-10, TB-11, and TB-14 prior to the acquisition of the cross-well seismic data.

6.5.4 Photoelectric (PEF)/Density Logging (Z-Densilog)

Z-Densilogs or a combination of PEF and density logs, are performed to evaluate the natural bulk density of the rock formation, which, in turn, aids lithological classification. The wireline density tool uses a Ce-137 source that emits gamma rays. The formation density is, therefore, based on the reduction in gamma ray flux between the source and the detector due to Compton Scattering. The density logs performed during this investigation were compensated, i.e., having multiple receptors to correct for the effects of drilling mud and potential mudcake in the borehole. Halite or rock salt will typically have a bulk density of approximately 2.0 grams per cubic centimeter (g/cc) (124.8 pcf), while anhydrite will approach 3.0 g/cc (187.3 pcf). Limestone, dolomites, sandstones, and shale will typically have bulk densities of approximately 2.4 to 2.8 g/cc (149.8 to 174.8 pcf).

Photoelectric logging, or PEF, is another sensor that is run on the density sonde. The PEF log records the photoelectric absorption factor of the rock matrix. When the energy transferred from a gamma ray being fully absorbed by a bound electron exceeds the binding energy to the atom, the electron is ejected. Typically, the ejected electron is then replaced within the material and a unique X-ray will be emitted with energy that corresponds to the atomic number of the material. Typical values for PEF include sandstone (1.7), dolomite (3.0), salt (4.6), and limestone (5.0). Lithologies exhibiting higher PEF values (>5) are typical of matrices that contain heavier atoms, such as barium, iron, etc. The combination of PEF and density values is used to aid in lithological classification of individual beds and formation properties.

Compensated Z-Densilogs were performed in test boring numbers TB-1, TB-2, TB-4, TB-5, TB-7, TB-10, TB-11, TB-14, TB-15, and TB-16 prior to the acquisition of the cross-well seismic and borehole gravity data.

6.5.5 Circumferential Borehole Imaging Log (Acoustic Televiewer - CBIL)

The CBIL log provides a visual "image" of the borehole wall by scanning with a narrow-pulsed acoustic beam from a rotating transducer while the tool is pulled up the hole. The transducer rotates to scan the entire circumference of the borehole wall, providing sharp images and boundary delineation. CBIL logs were run within TB-2, TB-7, and TB-10 to better delineate naturally-occurring fractures, improve borehole wall knowledge (i.e. wash-outs and lost-circulation zones), and fracture delineation.

6.6 Geophysical Investigation

6.6.1 Cross-well Seismic Imaging Investigation

For the cross-well seismic imaging, a high-power, variable frequency piezoelectric seismic source was placed in pre-determined wellbores, with receivers located in adjacent wellbore(s) to provide high resolution reflection and tomographic images of the bedrock between wells. The direct seismic wave arrivals were used in travel time tomography to estimate the formation velocity in the interwell region at the depths logged. The reflected rays, both downgoing and upgoing, were used to provide a seismic reflection image in the same region as the tomographic image, as well as above and below the depths logged for each of the subject images between boreholes (termed “profiles”).

Typically, the multiple-level receiver string (TARS Receiver Array) was positioned in the receiver wellbore(s). The source was then activated while in motion, making a traverse through the selected logging interval past the receivers. The receivers were then moved to the next position (or fan) in the data acquisition plan and the source again was activated. Each fan that was acquired produced several common receiver gathers that were correlated. Quality control was checked on site to assure that adequate data had been recorded.

Raw field records for swept-source acquisition were cross-correlated with a reference sweep and the data was then edited and organized into a cross-well data set. The direct arrival travel times were measured in first-break picking to provide input for the initial travel time tomographic inversion. The initial result was a velocity image between boreholes.

The initial velocity image from travel time tomography was then the starting point to produce a velocity model for the mapping operation. Mapping then transformed wave field-separated data from a time-domain representation to a depth-domain reflection image. Wave field separation was then used to separate other coherent arrivals present in the data from the primary reflection events needed in the mapped image. To produce interpretable images, the mapped data were then sorted by reflection incidence angles and stacked over a limited range of angles. The resulting stacks were then enhanced and produced for interpretation. Composite images from these data are included in a report by Dr. Roger Turpening and Carol Asiala, entitled “Final Report, Detroit River International Crossing, United States Side, Cross-Well Seismic Imaging”, dated January 18, 2008, and included herewith in Appendix G.

Once cross-well images were processed and prepared, they were interpreted for signs of bedrock distress, as well as documentation of lithological anomalies. Anomalies important to this study include unconformities, formation top reflectivity, formation top continuity, formation dip, potential cavities and localized rubblized zones. The images are evaluated singly, as well as combined to form a composite subsurface bedrock profile.

6.6.2 Vertical Seismic Profiling

Two vertical seismic profiles (VSP) were planned as part of the investigation for the following reasons: 1) investigation within shadow zones not covered well by the cross-well imaging; 2) to provide redundancy and confirmation of the cross-well imaging; or 3) to investigate apparent anomalies detected from the cross-well imaging.

After obtaining the initial cross-well and downhole information, two VSP profiles were gathered. A VSP profile was acquired into TB-2 to provide an image through the adjacent shadow zone as shown in Figure 4-3 (considered a concern because it is so near the anticipated main pier location). VSP was also conducted into TB-4 to investigate a suspected anomaly between TB-4 and TB-6, as well as to provide redundancy and confirmation of the cross-well results.

For the VSP imaging, a high power, variable-range frequency seismic source (vibrator truck) induced seismic energy at the ground surface at a selected offset, with receivers in a nearby wellbore to provide high resolution images and estimates of selected bedrock structure between the source and the well. The reflected energy was used to provide a seismic reflection image in the structure of interest. The source location for the VSP was chosen to optimize coverage of the upper salt layers in the above-mentioned anomalies.

Single-offset VSPs were performed for this project, with a source offset of approximately 215 to 275 m (700-900 feet) in the X-10 Crossing Corridor. A vibrator sweep of 10 to 150 Hz was utilized, but the attenuation in the glacial till yielded a bandwidth of approximately 20 to 90Hz (20db down points).

Composite images for the two VSP profiles are presented in Section 8.4.4 of this report

6.6.3 Borehole Gravity Investigation

The Borehole Gravity (BHGM) technique is a method of determining subsurface densities over discreet vertical intervals in a drill hole. BHGM measurements are not influenced by conditions around the hole, such as washouts, mud cake, etc. Therefore, the BHGM logging tool gives more reliable density estimates than standard density logs, as the method samples a larger volume of the rock mass. The BHGM measurements, therefore, provide a better estimate of density that is more representative of the formation. The difference in densities measured by the standard density log and calculated by the BHGM method can be used to infer nearby 3-D structures, e.g. solution cavities in salt (or elsewhere in the formation).

Typically, BHGM remote sensing applications require a remote body with sufficient contrast in density to be detected by the BHGM no farther from the wellbore than one or two times the height of the body. A spherical brine filled solution cavity 91.4 m (300 feet) in diameter may be detectable by a BHGM survey about 36.6 m (120 feet) from the edge of the cavity, effectively clearing an area approximately 128 m (420 feet) from the borehole. Local geology, and in particular the thickness of local density units, may also influence the effective radius of investigation of the BHGM.

Computer modeling of BHGM measurements was used to develop a relatively detailed model giving rise to the BHGM anomaly. Modeling has been particularly effective where seismic data can be integrated into the modeling process. As such, a model was used that is consistent with both data sets. The underlying assumption in computing apparent density is that of an earth model made up of a “layer cake” of horizontal infinite slabs. For such a model, the density of any slab is exactly given by the gravity gradient through that slab; the gradient measured at any point within the slab is constant; and, the slabs above and below it have no effect on the gradient within it.

BHGM measurements were acquired in 9 of the 13 holes drilled in the X-10 and X-11 areas. This represents a total of 1,800 measurements for the nine holes. In the X-11 corridor, BHGM measurements were acquired in boreholes TB-10, TB-12, TB-16, TB-13, and TB-15. Measurements in holes TB-10, TB-16, and TB-12 were needed to evaluate whether solution cavities exist in the region of the main pier for the bridge. Special attention was given to these three boreholes because of the observation of only 1.83m (6 feet) of B-salt in TB-10. BHGM measurements in TB-13 and TB-15 form a basis to explore for cavities underlying the location of several piers supporting the approach to the bridge.

In the X-10 corridor, BHGM measurements were acquired in holes TB-1,TB-4, TB-5, and TB-7. The measurements for TB-1and TB-7 were necessary to evaluate possible solution cavities underlying the proposed main pier, while TB-4 and TB-5 will help determine whether cavities lie beneath the location of the secondary piers.

To increase the signal to noise ratio, 4 measurements per level were taken at each borehole between 243.8m (800 feet) below ground surface and total depth (TD) using a measurement interval of 6.1m (20 feet). This provides excellent coverage through the 3 salt units (F, D and B) and through the Salina G roof rock above the F-Salt. From 243.8 to 76.2m (800 to 250 feet below ground surface), a 15.24m (50 feet) measurement interval with 2 measurements per level was utilized.

Details of the BHGM survey and results are presented in a report produced by Dr. Jimmy F. Diehl of Michigan Technological University, under subcontract to NTH Consultants, Ltd. This report is entitled “Final Report, Detroit River International Crossing, Borehole Gravimeter Surveys” dated January 18, 2007. Dr. Diehl’s report provides a characterized explanation of the procedures for borehole gravity data collection, theory, and the relation to the structural geology characterized by the deep borings and downhole geophysical logging program. Dr. Diehl’s report is provided in Appendix H.

6.7 Site Restoration

After completing field activities in the boreholes, each site has subsequently been (or is currently in the process of being) restored to original (before site activities) condition. Roads, drilling pads, and associated surface materials are currently being removed. The borings have been plugged and abandoned per MDEQ specifications. Associative repair of demarcation layers/membranes, topsoil, and grass seed will be spread were appropriate or as desired by the property owner, in the spring of 2008.

7. ROCK CORE HANDLING AND TESTING

7.1 Rock Testing

A total of 27 representative rock core samples (17 from TB-7 and 10 from TB-11), obtained during the investigation, were subjected to an array of laboratory tests including: Uniaxial Compressive Strength (UCS), Indirect (Brazilian) Tensile Strength (BTS), and Slake Durability Index (SDI). As part of the UCS tests, the static elastic constants (Young's Modulus and Poisson's Ratio) were determined as well as the density. The UCS test measures the intact compressive strength of the rock. A total of 27 UCS tests were performed generally covering the major formations encountered. The BTS test evaluates the tensile (indirect) shear of intact rock core. A total of six BTS tests were performed on selected shale and sandstone samples. The SDI test evaluates the durability of weaker/softer rock such as shale and sandstone when subjected to cycles of wetting and drying. A total of nine SDI tests were performed on selected shale and sandstone samples.

The tests were performed at the Earth Mechanic Institute (EMI) of the Colorado School of Mines, Golden, Colorado, in general accordance with ASTM D2938, ASTM D2845 ASTM D3967, and ASTM D4644. The samples were tested at their "as-received" moisture content. The tests were performed on a limited number of selected rock core samples and were intended to determine the general nature of intact properties for the formations encountered. The results of the rock tests are presented in EMI reports included in Appendix F. The EMI report also includes detailed test results, sample measurements, procedures, and photographs of the specimens after testing. A table, included in Appendix F as Table F-1, has been provided to correlate test specimen identification (i.e. depth and formation) with reference to TB-7 and TB-11.

7.2 Rock Core Storage

7.2.1 Short Term

Rock core recovered from TB-7 and TB-11 during the field portion of this investigation was temporarily stored in a climate-controlled warehouse located near the drilling sites. The core was transported to the warehouse facility after being initially logged in the field. Once arriving at the storage facility, the core was archived, stratigraphically arranged, and descriptively logged by project personnel. Final testing samples were then selected and sent to EMI.

7.2.2 Long Term

After being fully logged and evaluated by project personnel, the rock core was transported to the Michigan Geological Repository for Research and Education (MGRRE), a division of the Michigan Basin Core Repository located at Western Michigan University (Kalamazoo, Michigan) for long term storage. Ownership of the core has been retained by NTH Consultants, Ltd. and MDOT.

8. SUBSURFACE CONDITIONS AND EVALUATIONS

Based on the information gathered during this investigation, subsurface conditions within the explored areas are generally consistent, with a few exceptions. Subsoils generally consist of fill soils overlying a thick layer of generally medium-to-soft lacustrine silty clay. The silty clay soils are then underlain by a highly over-consolidated glacial till, which is underlain by bedrock. Soil, groundwater, and bedrock conditions encountered are detailed in the following sections.

8.1 Soil Overburden

The test boring locations selected for this project are, generally, previously-developed, but now-vacant areas. This previous use has resulted in a typical near-surface profile of fill and some abandoned foundation elements. While the extent and types of foundation elements are highly variable from site to site, the fill present typically consists of sand, frequently mixed with some percentage of clay, ranging from approximately 0.5 to approximately 5 meters (1.6 to 16.4 feet) in depth. The fill type and depth can, therefore, be expected to vary considerably over the project area.

Native materials underlying the fill generally consist of glacially deposited soils. The upper layers of native soil at the X-10 crossing were characterized by borings performed during previous projects. Based on this information, the soils at the X-10 corridor typically consist of sand to a depth of approximately 16.7 meters (55 feet), with clay layers occasionally present at some locations. Underlying the sand, soft to medium-gray silty clay is generally present to the depth at which hardpan is encountered, typically around 25.9 to 30.5 meters (85 to 100 feet). At the X-11 crossing, the upper layers of native soil were generally observed to be silty clay during the conductor casing installation. Some sand and gravel seams or layers can be expected in various locations based on local experience.

Hardpan consisting of hard gray silty clay was encountered at a depth of approximately 25.9 meters (85 feet) during conductor casing installation at the X-10 crossing. At the X-11 crossing, hardpan was typically encountered at depths ranging from 27.4 to 30.5 meters (90 to 100 feet). A thin (0.3 meter/1 foot) gravel layer was also encountered between hardpan and bedrock at the TB-13 location. In general, bedrock was encountered directly below the hardpan and will be discussed in the following sections.

8.2 Hydrogeologic Conditions

The use of drilling fluids during installation of casing through the glacial overburden precluded groundwater measurement during the drilling program. During rock drilling, the use of brine based drilling fluids generally precluded observations and measurements of known or suspected artesian groundwater conditions. However, flowing artesian conditions were observed during several periods of drilling after loss of circulation or brine shortages.

Lost circulation zones (partial and full) were encountered in almost all of the borings. Significant loss zones were generally encountered in the upper layers of the bedrock. Zones expected to produce artesian groundwater flow may be encountered during any future drilling at depths below ground surface of approximately 35.1 meters (115 feet), 64.0 to 67.1 meters (210 to 220 feet), 76.2 to 79.2 meters (250 to 260 feet), 83.8 to 91.4 (275 to 300 feet), 97.5 to 102.1 meters (320 to 335 feet), and 103.6 to 104.2 meters (340 to 342 feet).

During drilling, artesian conditions at TB-16 were measured after completion using a pressure gauge fitted to the well casing. Artesian pressures equivalent to a static water level at 4.3 meters (14 feet) above ground surface were recorded. After completing the drilling, the water level in this boring was initially measured at 4.6 meters (15 feet) below ground surface due to the drilling fluid that remained in the hole. Several other borings were observed after drilling to have static water levels greater than 3 meters (10 feet) above ground surface. At the end of the investigation, the observed artesian groundwater level in each of the borings ranged from 3.0 to 6.4 meters (10 to 21 feet) above ground surface.

8.3 Gas Conditions

Hydrogen sulfide gas is typically dissolved in the groundwater encountered during drilling at both the X-10 and X-11 areas. Atmospheric levels of hydrogen sulfide from gas escaping from the groundwater during drilling operations were generally undetectable with gas meters at the ground surface. The drill rods were typically stained black when tripped out of the borehole, indicating the presence of dissolved H_2S in the formation waters. Slight hydrogen sulfide odors were noted in the drilling area at times, but were not detected when measured using a quad-gas meter that has a detection level of 1 ppm. Hydrogen sulfide gas was measured directly at the borehole after completion of drilling when riser pipes were installed to control artesian conditions. Measured concentrations during riser installation were low to not detectable; however, during bleeding off of accumulated gas within the risers (prior to cross-well seismic acquisition), hydrogen sulfide and carbon monoxide levels exceeding 20 and 35 parts per million (ppm), respectively, were measured. Based on this, and on the understanding of historical construction efforts in the area, it should be expected that major construction operations may release significant volumes of gas from the groundwater, which will need to be considered for the final design and construction.

8.4 Bedrock Conditions

Based on the information gathered during this investigation, the overburden (drift) is generally conformably underlain by non-clastic sedimentary rocks of the Middle Devonian Period (Dundee Limestone and Detroit River Group). Conformably underlying the non-clastic rocks is a clastic sedimentary formation (Sylvania Sandstone) of the same period, which, in turn, unconformably overlies the oldest non-clastic sedimentary bed of the period (Bois Blanc Formation). The Bois Blanc Formation is then generally underlain by a non-conformable clastic sedimentary formation of Early Devonian time (Garden Island Formation).

As the transition is continued into the Late Silurian Period, the massive, undifferentiated non-clastic sedimentary beds of the Bass Islands Group then underlie the Garden Island Formation. The successive clastic and non-clastic beds of the Salina Group, in which non-clastic members of this group include both chemical and evaporate formations, then underlie the Bass Islands Group to the explored depths of the DRIC drilling program. The encountered depths in the following sections are referenced to meters (feet) above/below mean sea level (BMSL). Mean sea level is the equivalent of 0 m (0 feet) elevation. Ground surface elevations for the borings range from 176.6 to 180.6 m (579.4 to 592.5 feet), and average 178.4 m (585.3 feet) above mean sea level (AMSL).

8.4.1 Direct Investigation Results

8.4.1.1 Dundee Limestone

The Middle Devonian Dundee Limestone (Dundee) is encountered at EL 146.3 to 152.5m (EL 480 to 500.4 feet) AMSL directly below the glacial drift in each of the thirteen borings performed for this investigation. The Dundee was observed as a non-clastic sedimentary rock consisting of laminated to massive interbedded light-gray-to-gray limestone and dolomitic limestone. Carbonaceous partings are common between the laminated beds as styolites. The Dundee was also noted to be petroliferous, fossiliferous, and vuggy. Fossils of brachiopods, crinoids, and horn corals were noted.

During rotary drilling operations, the Dundee typically drilled at 3.3 to 9.8 minutes per meter of advancement (mpm) (which equates to approximately one to three minutes per foot (mpf)). Rotary drilling produced rock cuttings (chips) on the order of 3 to 6 mm (1/8 to ¼-inch). During coring operations, typical advancement rates on the order of 32.81 to 114.8 mpm (10 to 35 mpf) were noted. In several of the rotary borings, penetration into the formation allowed a slight sheen to appear on the surface of the drilling fluid circulation pits (frac tanks), indicative of very small pockets of naturally occurring petroleum. The 1 to 3 mm (1/32 to 1/8-inches) pockets of petroleum correlate with those observed in the core recovered from TB-7.

The Dundee has an abbreviated thickness of approximately 8 to 30 meters (26 to 98 feet). Conformably underlying the Dundee are the clastic and non-clastic formations of the Detroit River Group (DRG). The DRG is detailed in the section below.

8.4.1.2 Detroit River Group

The rocks of the overlying Dundee grade conformably into the older non-clastic rocks of the DRG. These formations begin the rock sequence otherwise known as the Mackinac Breccia. The individual formations and members of the DRG are described below.

> **<u>Lucas Formation</u>** - The Middle Devonian Lucas Formation (Lucas) is the youngest of the Detroit River Group series of rocks (encountered during this investigation) and is encountered at EL 120.2 to 138.5m (394.3 to 454.4 feet) AMSL directly below the Dundee in all thirteen borings performed for this investigation. The Lucas was observed as a non-clastic sedimentary rock consisting of laminated to finely-interbedded light-gray-to-gray limestone, dolomitic limestone, and dolomite. The Lucas was also noted to be pitted, vuggy, and sometimes argillaceous. Fossils of brachiopods and corals were noted.
>
> During rotary drilling operations, the Lucas typically drilled 3.3 to 9.8 mpm (1 to 3 mpf) and produced rock cuttings (chips) on the order of 3 to 6 mm (1/8 to ¼-inch). During coring operations, typical advancement rates on the order of 32.81 to 114.8 mpm (10 to 35 mpf) were noted. Several lost circulation zones were noted during drilling within this formation, most notably in TB-2, TB-4, TB-5, TB-6, TB-14, and TB-15. TB-2 and TB-4 were drilled completely blind (without fluid/cutting return) below this formation as circulation through multiple loss circulation material (LCM) sweeps and cementing operations were unsuccessful in regaining circulation. The transition from the overlying Dundee was not easily discernable from rock chip size, color, or rate of advancement as the contact is conformable and gradual.

From the wireline logging, a very small stringer of halite is apparent in TB-14 from approximately 85.6 to 86.6m (281.0 to 284.0 feet) depth. Salt is common in the DRG rocks in other portions of the basin, but not thought to generally exist in this region.

At a depth of approximately 57.4 m (188.4 feet), an apparent ash layer (bentonite) is present within the core sample. The deposit is believed to be the Kawkawlin Bentonite, otherwise known as the Tioga Bentonite in other adjacent sedimentary basins. The ash deposit is thought to have been formed by eruption of an ancient volcano near present day West Virginia at or near the beginning of the Erian North American Geologic Stage.

The Lucas has an observed thickness of approximately 61.3 to 89 m (201.1 to 292.0 feet). Conformably underlying the Lucas are the non-clastic beds of the Amherstburg Formation (Amherstburg). The Amherstburg is detailed in the section below.

Amherstburg Formation - The Middle Devonian Amherstburg Formation (Amherstburg) is the middle of the Detroit River Group series of rocks and is encountered at EL 104.2 to 132.9m (341.9 to 436.0 feet) AMSL directly below the Lucas in each of the thirteen borings performed for this investigation. The Amherstburg was observed as a non-clastic sedimentary rock consisting of laminated to thinly-bedded buff to buff-brown dolomitic limestone and dolomite. The Amherstburg was also noted to be occasionally fossiliferous and sometimes pitted. Fossils of small corals were sometimes noted.

During rotary drilling operations, the Amherstburg typically drilled 6.5 to 19.7 mpm (3 to 6 mpf) and produced rock cuttings (chips) on the order of 0.4 to 1.6 mm (1/64 to 1/16-inch). During coring operations, typical advancement rates on the order of 32.81 to 114.8 mpm (10 to 35 mpf) were noted. The transition from the overlying Lucas was not easily discernable from rock chip size, color, and rate of advancement. However, in borings where wireline density and natural gamma logs were completed, the contact between the Amherstburg and upper Lucas Formation is easily discernable.

The Amherstburg has an observed thickness of approximately 14 to 36 m (45.9 to 118.1 feet). Conformably underlying the Amherstburg are the clastic beds of the Sylvania Sandstone (Sylvania). The Sylvania is detailed in the section below.

Sylvania Sandstone - The Middle Devonian Sylvania Sandstone is the oldest formation of the Detroit River Group series of rocks and is encountered at EL 25.3 to 43.0 m (83.0 to 141.2 feet) AMSL directly below the Amherstburg in each of the thirteen borings performed for this investigation. The Sylvania was observed as a clastic sedimentary rock consisting of white to light gray fine-grained sandstone, dolomitic sandstone, and sandy dolomite. The sand grains (quartz) are noted to be sub-rounded, sometimes frosted, and generally very well sorted (saccharoidal). The Sylvania was also noted to be fairly-well to well-cemented in the case of the non-dolomitized horizons.

During rotary drilling operations, the Sylvania typically drilled 1.6 to 3.3 mpm (0.5 to 1 mpf) and produced cuttings (sand grains) on the order of 0.4 mm (1/64-inch). During coring operations, typical advancement rates on the order of 16.41 to 32.81 mpm (5 to 10 mpf) were noted. The transition from the overlying Lucas was easily discernable from rate of advancement and characteristics of the cuttings (change in rock facies).

The Sylvania has an observed thickness of approximately 15.2 to 25.6 m (49.9 to 84.0 feet). Conformably underlying the Sylvania are the non-clastic beds of the Bois Blanc Formation (Bois Blanc). The Bois Blanc is detailed in the section below.

8.4.1.3 Bois Blanc Formation

The Middle Devonian Bois Blanc Formation is encountered at EL 23.5 to -0.34m (77.1 to – 1.1 feet) AMSL directly below the Sylvania in each of the thirteen borings performed for this investigation. The Bois Blanc was observed as a non-clastic sedimentary rock consisting of light-gray-to-gray amorphous to fine-grained cherty dolomite and dolomite. The cherty inclusions were typically 5 to 20 cm (1.97 to 7.87 inches) in diameter, vitreous, and characterized by conchoidal fracture and rounded (nodular). Anhydrite was also noted filling the vugs in the cored portions and was also encountered in the chips recovered during rotary drilling.

During rotary drilling operations, the Bois Blanc typically drilled 9.8 to 32.8 mpm (3 to 10 mpf) and produced chips on the order of 0.4 to 1.6 mm (1/64 to 1/16-inch). During coring operations, typical advancement rates on the order of 131.2 to 196.9 mpm (40 to 60 mpf) were noted. The transition from the overlying Sylvania was easily discernable from rate of advancement and characteristics of the cuttings (change in rock facies).

The Bois Blanc has an observed thickness of approximately 14.0 to 25.9 meters (45.9 to 85.0 feet). Unconformably underlying the Bois Blanc is the clastic bed of the older Garden Island Formation (Garden Island), and is described as follows.

8.4.1.4 Garden Island Formation

The Early Devonian Garden Island Formation is encountered at EL 9.5 to -19.5m (31.2 to -64.1 feet) AMSL, directly below the Bois Blanc in each of the thirteen borings performed for this investigation. The Garden Island was observed as a clastic sedimentary bed consisting of white to light gray fine-grained dolomitic sandstone and is believed by some to be a separate facies of the overlying Bois Blanc or underlying Bass Islands Group. The sand grains were noted to consist almost predominately of bleached and frosted quartz grains. They were also observed to be well-rounded and contain little discernable bedding structure.

During rotary drilling operations, the Garden Island typically drilled 1.6 to 3.3 mpm (0.5 to 1 mpf) where discernable. Rock chips produced during rotary drilling operations were not discernable. During coring operations, typical advancement rates on the order of 16.4 to 32.8 mpm (5 to 10 mpf) were noted. The upper contact with the Bois Blanc was easily discernable in TB-7 (core samples), but was indistinguishable in the rotary borings, except for a noted increase on the drill-o-graph (which measures penetration in feet versus time) on the drill rig. However, in borings where wireline density and natural gamma logs were completed, the contact between the upper Bois Blanc and Garden Island formations is easily discernable.

The Garden Island has an observed thickness of approximately 0.6 to 2.8 m (1.9 to 9.2 feet). Unconformably underlying the Garden Island are the non-clastic beds of the older Bass Islands Group (Bass Islands). The Bass Islands are detailed in the section below.

8.4.1.5 Bass Islands Group

The rocks of the overlying Garden Island (Early Devonian) lie unconformably on the older non-clastic rocks of the Bass Islands Group (Late Silurian). The individual formations of this group (Raisin River Dolomite, Put-in-Bay Dolomite, and St. Ignace Dolomite) are typically undifferentiated in the subsurface and are presented as such in this report.

The Bass Islands are encountered at EL 7.7 to –22.3m (25.3 to –73.1 feet) AMSL, directly below the Garden Island in each of the thirteen borings performed for this investigation. The Bass Islands were observed as non-clastic sedimentary rocks consisting of light gray, gray, and buff-brown amorphous to fine-grained inter-bedded dolomite, cherty dolomite, and minor dolomitic limestone. Secondary anhydrite, calcite, and selenite are commonly observed as infilling in some of the vuggy portions. In the basal beds, anhydrite and shaley anhydrite layers become dominant as the transition is approached to the underlying Salina Group.

During rotary drilling operations, the Bass Islands typically drilled 13.1 to 39.4 mpm (4 to 12 mpf) and produced chips on the order of 0.4 to 6.4 mm (1/64 to 1/4-inch). During coring operations, typical advancement rates on the order of 196.9 to 295.3 mpm (60 to 90 mpf) were noted. The upper contact with the Garden Island was easily discernable in TB-7 (core samples), but was indistinguishable in the rotary borings, except for a noted decrease on the drill-o-graph on the drill rig. However, in borings where wireline density and natural gamma logs were completed, the contact between the overlying Garden Island and Bass Islands is easily discernable.

The Bass Islands have an observed thickness of approximately 76.2 to 85.0m (250.0 to 278.9 feet). Conformably underlying the Bass Islands are the highly variable and clastic and non-clastic sedimentary formations of the Salina Group.

8.4.1.6 Salina Group

The rocks of the overlying Bass Islands lie conformably on the older sedimentary rocks of the Salina Group (Late Silurian). Rocks of the Salina Group are generally described as dolomites and shaley dolomites with shale interbedding in the upper units. Evaporative rocks (halite, gypsum, and anhydrite in thin to massive bedded formations) generally appear and are separated by exceptionally pure limestone and dolomitic shales in the lower formations. The individual formations of this group are highly variable and well differentiated in the subsurface and are presented separately by unit in the following paragraphs.

> **Salina G-Unit** - The Salina G-Unit (G-Shale) is encountered at EL 71.57 to 98.48 m (234.8 to 323.1 feet) BMSL, directly below the Bass Islands in each of the thirteen borings performed for this investigation. The G-Shale was observed as both a clastic and non-clastic sedimentary rock consisting mainly of green, reddish green, and greenish black carboniferous shale. The bedding is mostly indistinct and massive, with characteristics of high-horizontal stress at or soon after deposition (cupping). Near the bottom of the formation, anhydrite and shaley anhydrite beds become dominant as the transition is approached to the underlying Salina F-Unit.
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> During rotary drilling operations, the Salina G-Shale typically drilled 13.1 to 39.4 mpm (4 to 12 mpf) and produced chips on the order of 0.4 to 6.4 mm (1/64 to 1/4-inch). During coring operations, typical advancement rates on the order of 32.81 to 114.8 mpm (10 to 35 mpf) were noted. The transition from the overlying Bass Islands was discernable from the characteristics of the cuttings (change in rock facies). In borings where wireline density and natural gamma logs were completed, the contact between the upper Bass Islands and the G- Shale is easily discernable.
>
> The G-Shale has an observed thickness of approximately 26.2 to 34.75 m (86.0 to 114.0 feet) and marks the end of the sequence previously referred to as the Mackinac Breccia. Conformably underlying the G- Shale are the beds of the Salina F-Unit.

Salina F-Unit - The Salina F-Unit (F-Unit, F-Salt) marks the uppermost formation where massive beds of evaporative rocks, including halite (rock salt) are encountered in this investigation. The salt beds are typically interbedded with layers of dolomite, shaley limestone, and dolomitic shales. The F-Unit salt beds encountered in this investigation are typically present in four distinct layers, commonly referred to as the F1, F2, F3, and F4 beds, although younger beds (F5 and F6) also are observed in some borings. The beds are numbered in accordance with their age, where F1 to F6 is the oldest to youngest in succession, respectively.

During rotary drilling operations, the F-Salt typically drilled 1.6 to 3.3 mpm (0.5 to 1 mpf) and 6.5 to 19.7 mpm (3 to 6 mpf) for the salt and chemical precipitate beds respectively, and produced chips on the order of 3.2 to 6.4 mm (1/8 to 1/4-inch). During coring operations, typical advancement rates on the order of 16.41 to 32.81 mpm (5 to 10 mpf) and 32.81 to 114.8 mpm (10 to 35 mpf) were noted for the salt and chemical precipitate beds respectively. The transition from the overlying G-Shale and between the layers in the F-Unit are discernable from the characteristics of the cuttings (change in rock facies) and based on drilling advancement rates. In borings where wireline density and natural gamma logs were completed, the contacts between these facies are easily discernable. The overall thickness of the F-Unit (not including the anomalous borings where F5 and F6 salt beds are encountered) is approximately 33.7 to 40.5m (110.0 to 133.0 feet).

F6 Salt Bed – The F6 bed was encountered in boreholes TB-5, TB-6, TB-14, and TB-15. The top of the F6 bed was typically encountered from EL 97.8 to 113.3m (320.8 to 371.6 feet) BMSL and had an average thickness of 7.6 to 13.7m (25 to 44.9 feet). Underlying the F6 bed in the above referenced boreholes was approximately 1.2 to 3.1m (4 to 10 feet) of dolomitic limestone and shaley dolomite. The F6 bed was not encountered in either of the wells with core recovery (TB-7 or TB-11).

F5 Salt Bed – The F5 bed was encountered in boreholes TB-5, TB-6, TB-13, TB-14, and TB-15. The top of the F5 bed was typically encountered from EL 111.6 to 126.6m (366.3 to 415.3 feet) BMSL and had an average thickness of 1.8 to 4.3 m (6.0 to 14.0 feet). Underlying the F5 bed in the above referenced boreholes was approximately 4.9 to 5.2 m (16 to 17 feet) of dolomitic limestone and shaley dolomite. The F5 bed was not encountered in either of the wells with core recovery (TB-7 or TB-11).

F4 Salt Bed - The top of the F4 bed was typically encountered from EL 118.6 to 133.2m (389.0 to 437.0 feet) BMSL and had an average thickness of approximately 2.6 to 13.7m (8.9 to 44.9 feet). The halite layers were typically interbedded with trace anhydrite and gypsum, causing banding in the depositional structure. Small limestone and anhydrite interbeds were also observed within the TB-7 core samples. The salt was generally dark in color indicating a purity of approximately 85%, based on visual samples. Underlying the F4 bed was approximately 3.1m (10 feet) of dolomitic limestone and shaley dolomite.

F3 Salt Bed - The top of the F3 bed was typically encountered from EL 126.8 to 141.9m (416.0 to 465.4 feet) BMSL and had an average thickness of approximately 8.5 to 10.4m (27.9 to 34.0 feet). The halite layers were typically interbedded with trace anhydrite and gypsum, causing banding in the depositional structure. Small limestone and anhydrite interbeds were also observed within the TB-7 core samples. The salt was generally dark in color indicating a purity of approximately 98%, based on visual samples. Underlying the F3 bed was approximately 10m (32.8 feet) of shaley limestone, dolomitic limestone, and massive anhydrite.

F2 Salt Bed - The top of the F2 bed was typically encountered from EL 144.2 to 159.5m (473.0 to 523.4 feet) BMSL and had an average thickness of approximately 4.3 to 8.5m (14.1 to 27.9 feet). The halite layers were typically interbedded with trace anhydrite, causing very distinct banding in the depositional structure. Small limestone and anhydrite interbeds were not observed within the TB-7 core samples, indicating a purity approaching 100% based on visual samples. Underlying the F2 bed was approximately 1 to 2m (3.2 to 6.4 feet) of shaley dolomite.

F1 Salt Bed - The top of the F1 bed was typically encountered from EL 153.6 to 167.5m (504.0 to 549.6 feet) BMSL and had an average thickness of approximately 13.7 to 15.9m (44.9 to 52.2 feet). The halite layers were typically interbedded with trace anhydrite and gypsum, causing banding in the depositional structure. Small limestone and anhydrite interbeds were also observed within the TB-7 core samples. The salt was generally dark in color indicating a purity of approximately 85 to 90%, based on visual samples. The F1 bed is underlain by the dolomitic rocks of the Salina E-Unit in all of the borings performed for this investigation.

Salina E-Unit - The Salina E-Unit (E-Dolomite) is encountered at EL 168.9 to 183.0m (554.2 to 600.3 feet) BMSL, directly below F-Unit in each of the thirteen borings performed for this investigation. The E-Dolomite was observed as a non-clastic sedimentary rock consisting mainly of competent gray and tan amorphous to fine-grained dolomite and shaley dolomite. The bedding is mainly laminated to massive, with occasional anhydrite stringers prevalent throughout. The rock shows indications of pitting and vugs that are commonly filled with secondary anhydrite, selenite, and gypsum. A volcanic episode, recorded as an ash deposit, is noted in the core from approximately EL 182.37 to 182.46m (598.4 to 598.7 feet) BMSL.

During rotary drilling operations, the E-Dolomite typically drilled 26.2 to 39.4 mpm (8 to 12 mpf) and produced chips on the order of 0.4 to 3.2 mm (1/64 to 1/8-inch). During coring operations, typical advancement rates on the order of 196.9 to 295.3 mpm (60 to 90 mpf) were noted. The transition from the F-Unit was easily discernable from the characteristics of the cuttings (change in rock facies) and rate of drilling advancement. In borings where wireline density, sonic, and natural gamma logs were completed, the contact between the upper F-Unit and the E-Dolomite is easily discernable. The E-Dolomite exhibits the fastest acoustic formation velocity of the rock units, with P-Wave velocities in excess of 7,000 meters per second (23,000 feet per second) measured.

The E-Dolomite has an observed thickness of approximately 27.1 to 37.8 m (88.9 to 124.0 feet). Conformably underlying the E-Dolomite are the beds of the Salina D-Unit.

Salina D-Unit - The Salina D-Unit (D-Unit, D-Salt) marks the second formation where massive beds of evaporative rocks, including halite (rock salt) are present in this investigation. The D-salt beds are typically interbedded with layers of dolomite, shaley limestone, and dolomitic shales. The D-Unit salt beds in this investigation are typically present in two to three distinct layers, commonly referred to as the D3 and D2 beds. The beds are numbered in accordance with their age, where D1, D2 and D3 is the oldest to youngest in succession, respectively.

During rotary drilling operations, the D-Salt typically drilled 1.6 to 3.3 mpm (0.5 to 1 mpf) and 6.5 to 19.7 mpm (3 to 6 mpf) for the salt and chemical participate beds respectively, and produced chips on the order of 3.2 to 6.4 mm (1/8 to 1/4-inch). During coring operations, typical advancement rates on the order of 16.41 to 32.81 mpm (5 to 10 mpf) and 32.81 to 114.8 mpm (10 to 35 mpf) were noted for the salt and chemical participate beds respectively. The transition from the overlying E-Dolomite and the D-Unit is easily discernable from the characteristics of the cuttings (change in rock facies) and based on drilling advancement rates. In borings where wireline density and natural gamma logs were completed, the contacts between these facies are also easily discernable. The overall thickness of the D-Unit (not including where the D-1 beds is encountered) is approximately 5.2 to 12.3m (17.0 to 40.5 feet).

> **D3 Salt Bed** - The top of the D3 bed was typically encountered in each boring from EL 199.9 to 217.7 m (656.0 to 714.1 feet) BMSL and had an average thickness of approximately 2.7 to 6.4m (8.9 to 21.0 feet). The halite layers were typically interbedded with trace anhydrite and gypsum, causing banding in the depositional structure. Small irregular banding consisting of limestone and anhydrite interbeds were also observed within the TB-7 core samples. The salt was generally dark in color indicating a purity of approximately 80 percent, based on visual samples. Underlying the D3 bed was approximately 3.1m (10 feet) of dolomitic limestone and shaley dolomite.
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> **D2 Salt Bed** - The top of the D2 bed was typically encountered from EL 204.8 to 225.7m (672.0 to 740.6 feet) BMSL and the bed had an average thickness of approximately 0.9 to 7.3m (3.0 to 24.0 feet). The halite layers were typically interbedded with trace anhydrite and gypsum, causing banding in the depositional structure. Small irregular banding consisting of limestone and anhydrite interbeds were also observed within the TB-7 core samples. The salt was generally dark in color indicating a purity of approximately 80%, based on visual samples. Underlying the D2 bed was approximately 3.1m (10 feet) of dolomitic limestone and shaley dolomite, where the D1 Salt Bed was encountered. In borings where the D1 bed was absent, the D2 Salt Bed was underlain by rocks of the Salina C-Unit.
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> **D1 Salt Bed** - The top of the D1 bed was encountered in TB-11 and TB-15 from EL 224.7 to 227.8m (731.7 to 747.4 feet) BMSL and the bed had an average thickness of approximately 0.6 to 1.5m (2.0 to 5.0 feet). Underlying the D1 bed, where present, are the rocks of the Salina C-Unit.

Salina C-Unit - The Salina C-Unit (C-Shale) is encountered at EL 208.2 to 229.1 m (683.1 to 751.7 feet) BMSL, directly below D-Unit in each of the all thirteen borings performed for this investigation. The C-Shale was observed as both a clastic and non-clastic sedimentary rock consisting mainly of green and greenish brown sometimes carboniferous shale. The bedding is mostly indistinct and massive, with characteristics of high-horizontal stress at or soon after deposition (cupping). In the basal beds of the C-

Shale, anhydrite and shaley anhydrite beds become dominant as the transition is approached to the underlying Salina B-Unit.

During rotary drilling operations, the C-Shale typically drilled 13.1 to 39.4 mpm (4 to 12 mpf) and produced chips on the order of 0.4 to 6.4 mm (1/64 to 1/4-inch). During coring operations, typical advancement rates on the order of 32.8 to 114 mpm (10 to 35 mpf) were noted. The transition from the overlying D-Unit was easily discernable from the characteristics of the cuttings (change in rock facies) and rate of advancement. In borings where wireline density and natural gamma logs were completed, the contact between the upper D-Unit and the C-Shale is also easily discernable.

The rock core cut from the TB-7 well indicated large vertical fractures present within this unit extending upward of 19.8 to 21.3 m (65 to 70 feet) from the top of the underlying Salina B-Unit. The vertical fractures varied from 0.64 to 5.1 cm (1/4-inch to greater than 2 inches) in width and were in filled with halite and anhydrite of varying purity.

The C-Shale has an observed thickness of approximately 41.5 to 60.4 m (136.2 to 198.2 feet), with the exception of TB-10 and where the borings did not fully penetrate the unit (TB-12 and TB-16). The C-Shale at TB-10 had an increased thickness of 89.6 m (294 feet.)

Salina B-Unit - The Salina B-Unit (B-Unit, B-Salt) marks the lowermost formation where massive beds of evaporative rocks, including halite, are present in this investigation. The B-Salt beds are typically interbedded with shale stringers present in four to eight distinct horizons. The stringers can be used as marker beds from well to well and as indications of cavity development in the Cross-well imaging.

During rotary drilling operations, the B-Salt typically drilled 1.6 to 3.3 mpm (0.5 to 1 mpf) and produced chips on the order of 3.2 to 6.4 mm (1/8 to 1/4-inch). During coring operations, typical advancement rates on the order of 16.4 to 32.8 mpm (5 to 10 mpf) were noted. The transition from the overlying C-Shale to the B-Unit is discernable from the characteristics of the cuttings (change in rock facies) and based on drilling advancement rates. However, in borings where wireline density and natural gamma logs were completed, the contacts between these facies are easily discernable. The overall aggregate thickness of the B-Unit is approximately 44 to 66 m (144.4 to 216.5 feet), not including the anomalous borings (as mentioned below) or those that did not fully penetrate the formation.

The B-Salt is fairly uniform within the X-10 Corridor, but varies considerably in the X-11 Corridor, and also varies widely between corridors. An anomaly also was observed in the depositional history of this unit at TB-10 in the X-11 corridor. For the purposes of this report, the B-Salt will be discussed in three distinct categories, namely the X-10 Corridor, the X-11 Corridor, and the B-Salt Anomaly at TB-10, which are presented as follows.

> **B-Salt in the X-10 Corridor** - The top of the B-Salt in the X-10 Corridor was typically encountered from EL 250.5 to 256.1 m (821.9 to 840.0 feet) BMSL and the unit had an average thickness of approximately 61.0 to 66.0 m (200.1 to 216.5 feet) where the borings fully penetrated this formation. The halite layers were typically interbedded with trace anhydrite and gypsum, causing banding in the depositional structure. Small irregular banding consisting of limestone and

anhydrite interbeds were also observed within the TB-7 core samples. The salt was generally light to dark in color indicating a purity of approximately 85 to 95 percent, based on visual samples.

B-Salt in the X-11 Corridor - The top of the B-Salt in the X-11 Corridor was typically encountered from EL 270.8 to 282.4 m (888.5 to 926.6 feet) BMSL and the unit had an average thickness of approximately 35.7 to 56.0 m (117.1 to 183.7 feet) where the borings fully penetrated this formation (TB-11,13, 14, and 15). The halite layers were typically interbedded with layers identified in cuttings that contain trace anhydrite and gypsum, causing banding in the depositional structure. The salt was generally light to dark in color indicating a purity of approximately 90 to 95 percent, based on visual samples.

B-Salt Anomaly - At TB-10, an anomaly exists in the depositional history of the B-Salt where only 1.83m (6 feet) of salt was encountered. From the rotary logs, in conjunction with extensive wireline logging, this feature appears to be conformable as solutioning and re-deposition does not appear to have occurred. The lack of salt deposition is balanced by the earlier and increased deposition of transgressive/regressive cycle rocks very similar to those of the overlying C-Shale. An anomaly similar to this is noted in historical documents and is believed to have occurred to the south at Pt. Hennepin and in the Trenton, Michigan area. The additional “pinch-outs” may be the fingers of an ancient deltaic environment where water was eroding sediment from the east (Algonquin or Findlay Arch) and was flowing into the basin from the east.

B-Salt Shale Stringers - As observed in the wireline logging, several very distinct shale stringers are present in the main salt bed with the B-Unit. The shale stringers are typically 1 to 3 m (3 to 10 feet) in thickness and are sometimes continuous as discussed later in the cross-well interpretation section of this report. There are predominantly 4 to 8 stringers that appear in borings that contain the full B-Salt thickness of at least 45m (150 feet). The stringers can and will be used later in the imaging portion of this work to potentially document cavity formation or propagation.

Data from the wireline logging in TB-11 and TB-13 also indicate that the shale stringers within the upper portion of the B-Salt are not present at these two boring locations, indicating a natural erosional or non-depositional event in the geologic record.

Salina A2 Carbonate - The Salina A2 Carbonate (A2 Carb) is encountered at EL 317.1 to 330.9 m (1,040.4 to 1,085.7 feet) BMSL, directly below B-Unit in eight of the thirteen borings performed for this investigation. The A2 Carb was observed as a non-clastic sedimentary rock consisting mainly of very competent gray and tan amorphous to fine-grained dolomite.

During rotary drilling operations, the A2 Carb typically drilled 26.2 to 39.4 mpm (8 to 12 mpf) and produced chips on the order of 0.4 to 3.2 mm (1/64 to 1/8-inch). Core of the A2 Carb was not recovered during this investigation. The transition from the overlying B-Unit was easily discernable from the characteristics of the cuttings (change in rock facies) and rate of drilling advancement. In borings where wireline density, sonic, and natural gamma logs were completed, the contact between the upper B-Unit and the A2 Carb is also easily discernable. A large anhydrite stringer (also referred to as the False A2) was present and visible in most of the downhole logs and marked the transition from the Salina B to underlying A2 Unit.

The A2 carbonate was not fully penetrated in this investigation, but exhibited an observed thickness of at least 10.4 m (34.1 feet) based on the results of TB-10. However, historical information in this area indicates the A2 Carb is approximately 30.5 m (100 feet) thick.

8.4.2 Cross-Well Seismic Imaging Evaluation

The cross-well images are of excellent quality with vertical resolution of 2.1 to 3.0 m (seven to ten feet) and horizontal resolution of approximately 6.1 to 10.7 m (20 to 35 feet). Details of the cross-well processing and evaluation, along with the actual cross-well images are included in a report entitled “Final Report, Detroit River International Crossing, United States Side, Cross-Well Seismic Imaging”, by Dr. Roger Turpening and Carol Asiala, dated January 18, 2008., included for reference in Attachment G. In a broad sense, these data are exceptional because they provide the first-ever images in Michigan of detailed structure, beneath glacial till, that geologists previously had only inferred from widely-separated well logs or very poor resolution surface seismic reflection data.

When looking for cavities in the upper salt layers, namely the Salina F and D-Units, the investigation focused on the occurrence of broken, discontinuous reflectors that indicate that the integrity of the roof rock has been compromised. A clear indication of brine cavities would be the subsequent migration of the cavity upwards into the rock as the roof becomes wide and unstable.

When looking for salt cavities in the B-Unit structure, the investigation focused on many of the small shale stringers, as previously discussed, to be broken in a systematic manner, i.e. a vertical “column” of broken stringers with a bright reflection (the top of the “morning glory”) at the top of the column. If the image plane does directly not cut the salt cavity, but is within the Fresnel zones of several stringers, then the vertical column “feature” would still be noted in the image, but, instead of completely breaking each stringer, it would reduce the amplitude of each stringer. The reflector on top would still exist but, again, not be as bright. In summary, the investigation focused on a “vertical feature” with a seismically brighter top.

8.4.2.1 X-10 Corridor Cross-well Imaging

The 12 cross-well profiles obtained within the X-10 corridor have been processed and interpreted. The tops of the F-Salt layers are continuous and not broken in the seismic profiles and are clearly evident for the F5 through F1 salt layers. Seismically, the F4 and F3 layers are viewed as one continuous bed, therefore only five layers are recognized in the profiles. The tops of the D-Salt layers also appear to be continuous and not broken in the seismic profiles and are clearly evident for the D3 through D2 salt layers. The D1-Salt layer, where encountered in the drilling program, is not observed in the cross-well data.

The top of the B-Salt appears to be continuous and not broken in the seismic profiles. From the information derived from the direct and downhole geophysical investigation, the conclusion is that approximately 61 m (200 feet) of B-Salt exists in the X-10 corridor. In both profiles TB-4 to TB-2 and TB-4 to TB-5 (4-2 and 5-4 respectively), the top of the B-Salt is noted at a depth of approximately 445 m (1,460 feet). Furthermore, the wireline logs show that six or seven stringers exist in the B-Salt and, again, six or seven (or more) clear reflectors in the B-Salt in images 4-5 and 4-2. In fact, one of those stringers is observed in both images to be continuous and several others are nearly continuous.

X-10 Bedrock Unconformity - In the case of the TB-1 to TB-5 and TB-4 to TB-5 profiles, a relative thinning of the G-Shale toward the north is observed, corresponding to the same relative dip of the overlying strata in the same direction. The dipping G-Shale corresponds to the thinning or pinching of the F5 and F6 salt layers as observed in the borehole TB-5 lithology. This event is apparently naturally occurring and occurred at or very near the deposition of the overlying rocks.

TB-6 to TB-4 Profile - In the TB-6 to TB-4 profile, there are two different events that warrant increased discussion. These items are presented in the following sections.

Potential Morning Glory Shaped Feature

At approximately 107 m (350 feet) from TB-6 toward TB-4 at a relative depth of 338 m (1,110 feet), an anomaly appears in the data. It is approximately 38 m (125 feet) wide and 3 to 6 m (10 to 20 feet) high (Figure 8-1). The feature is observed in the top of the F2 bed and appears to have migrated upwards and ends in the overlying shaley roof rock. A possible "crooked" stem can be viewed below the main portion of the feature, ending at the underlying E-Dolomite.

The reflectors associated with the underlying D and B-Units are unbroken below this anomaly, indicating that if the feature is the result of historical solution mining, that mining was not performed in the lower salt units. Most notably, the shale and carbonate stringers in the B-Salt are visible and continuous.

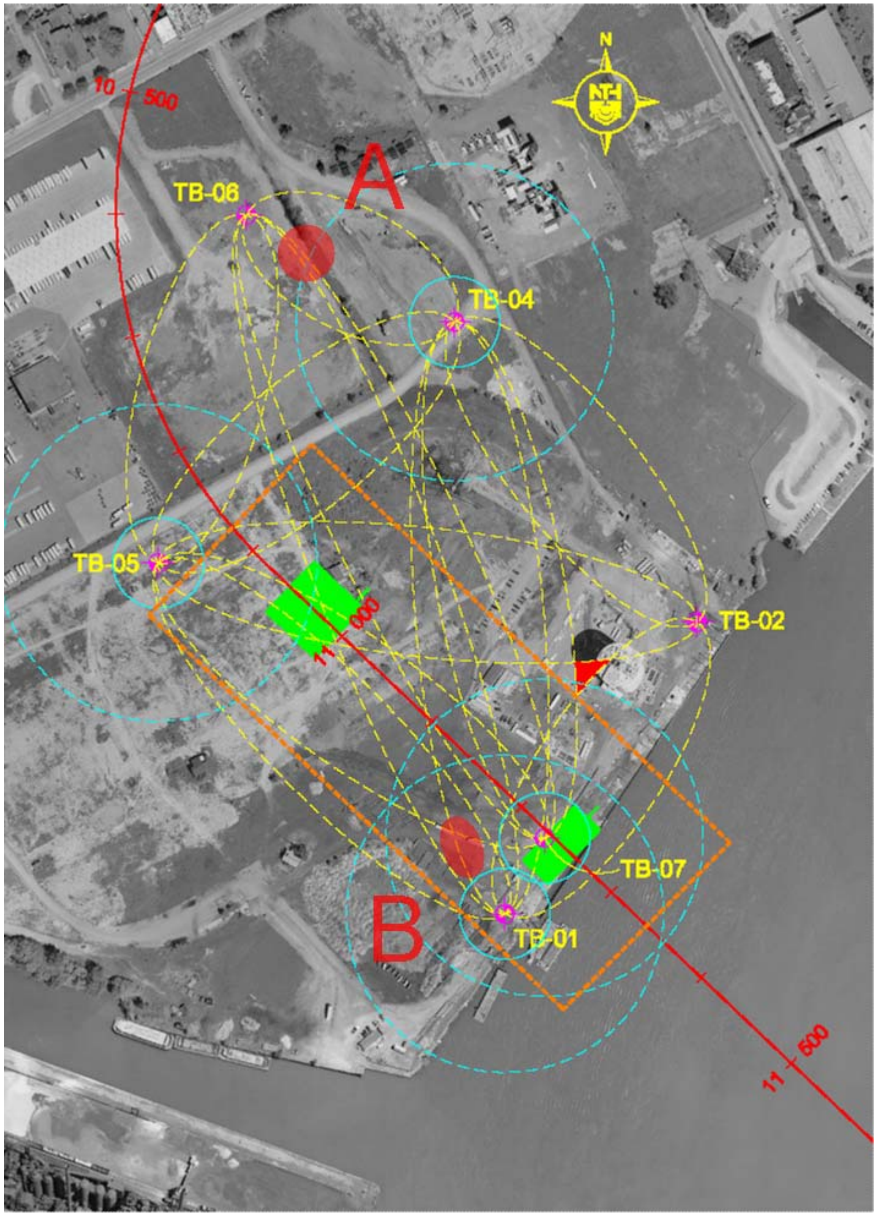
The profile from TB-6 to TB-4 was reprocessed using true-amplitude techniques to determine if the observed feature is brine or rubble filled. For this analysis, the true-amplitude processing produced data displays with an initial gain on a trace-by-trace basis prior to the mapping, migration, and stacking of traces. The data were then plotted with an overall section normalization and as a post-migration trace by trace normalization. The trace-amplitude method produced data displays with an applied initial gain to balance the "noise level," calculated on a deep window below the lowest data arrivals, i.e., ambient noise. The results illustrate the amplitude at the upper contact of the feature and overlying roof rock is not bright, which appears to indicate the feature is probably partially (maybe fully) filled. Such probable partial filling may have occurred through several processes, such as filling with bulked debris fallen from the roof, and, to a much lesser extent, from silt or mud from above through the original well opening (or through natural fissures), or through crystallization of brine.

Solution Features Adjacent to TB-4 - As viewed in the TB-6 to TB-4 profile, several features adjacent to the TB-4 borehole are of geophysical interest. Initial observation indicates the G-Shale in TB-6 at a depth of approximately 284 m (930 feet), is dipping towards TB-4, together with an associated pinching-out of the underlying F6 and F5 beds.

At depths of approximately 296 m (970 feet), 314 m (1,030 feet), 325 m (1,065 feet), and 338 m (1,110 feet), directly adjacent to the TB-4 borehole, many relatively small anomalies exist that could potentially be interpreted as cavities, but may also be features associated with disturbance in the nearby rock from the drilling itself (wash-out and borehole rugosity) . The potential anomalies have been examined with the BHGM method and true-amplitude processing techniques, as addressed later in this report.

TB-1 B-Salt Anomaly - A second, and relatively small anomaly with a downward concave roof is present in cross-well profiles TB-1 to TB-4 and TB-1 to TB-6. It is at the top of the B-Salt/C-Shale contact (Anomaly B on Figure 8-1). The anomaly is approximately 37 to 52 m (120 to 170 feet) wide and 6 to 8 m (20 to 25 feet) high. The feature appears to have a tabular (i.e., "hockey-puck”) shape. Upon initial examination, it was unclear if the anomaly has been caused by natural solutioning (and possibly natural recrystallization), artificial solutioning (mining), or is simply a naturally-occurring variation in the roof rock above the B-Salt. Reprocessing the data using true-amplitude techniques indicates this feature is apparently filled with material. As this anomaly is very close to a borehole, it was also examined using Borehole Gravity techniques (BHGM), which indicates a very small feature, or less-dense zone. A more-refined estimate of the B-Salt density has been obtained to re-calculate apparent density values for the TB-1 BHGM survey. This value in the apparent-density calculations makes the anomaly coincide with measured noise levels within the borehole, essentially making it a non-detectable feature. This further supports the conclusion that this feature is in-filled, or simply a naturally-occurring deviation in the top of the B-Salt. Because the roof rock appears to be intact (although sagged slightly), it appears that infilling into a naturally-occurring solution feature is the result of recrystallization or the result of silt/mud infilling through joints. Because such infilling would generally be expected over hundreds of thousands to millions of years, this anomaly is likely naturally occurring and not solution mining related.

Figure 8-1
Detroit River International Crossing Study
Proposed Anomalies



Source: NTH Consultants, Ltd.

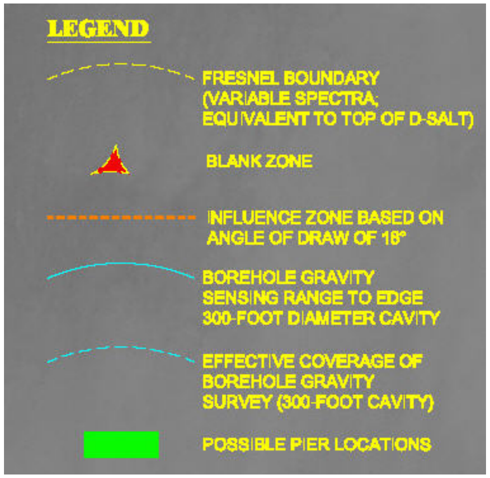
Anomaly “A”:

- Size: About 20 to 25 feet high, about 125 ft diameter.
- Depth: Centered at about 1100 feet BGS.
- Shape: Round in Plan, “Morning Glory” in profile.
- Probably fully or partially “bulked-up,” Possible limited recrystallization

Anomaly “B”:

- Size: About 20 to 25 feet high, about 120 by 170 feet in diameter.
- Depth: Centered at about 1410 feet BGS.
- Shape: Elliptical in Plan, Hockey Puck in profile.
- Most likely a density anomaly within the B-Salt, where density is lower due to geological deposition (recrystallization, high purity, etc.)

Note: No anomalies greater than those illustrated in this figure were detected in the X-11 Crossing area investigated.



8.4.2.2 X-11 Corridor

The 16 profiles obtained within the X-11 crossing corridor have been processed and interpreted. For this report, the focus is directly on the Salina F, D, and B-Salt layers and the corresponding roof rock.

The tops of the F-Salt layers appear to be continuous and not broken in the seismic profiles and are clearly evident for the F5 through F1 salt layers. The tops of the D-Salt layers also appear to be continuous and not broken in the seismic profiles and are clearly evident for the D3 through D2 salt layers.

Contrasting the X-10 images with the surveys from profiles 10-16 and 10-12 illustrates how the rock strata has changed. The density log in borehole TB-10 shows that there is only 1.8 m (6 feet) of B-Salt present with a thin layer of anhydrite overlying it. Directly beneath the B-Unit is the A2 Carbonate. The individual impedance contrasts provided by the dense anhydrite and the light salt in a shale background produces strong reflections that are easily observed in the images. However, the B-Salt is not flat and is not a strong reflector everywhere between the boreholes. The overlying anhydrite is not flat and dips down towards TB-10.

This alludes to the possible deltaic environment, mentioned previously. Another indication in the literature states that the B-Salt was possibly dissolved in small regions by water flowing through fractures. The dipping anhydrite layer here also supports that assertion.

The investigation also looked directly above this area, adjacent to TB-10, for any indication of a massive salt cavity. No such indications are evident. The anhydrite layer is continuous as well as all of the layers in the C-Shale and D-Salt.

8.4.3 Borehole Gravity Evaluation

Borehole gravity meter (BHGM) surveys are used to determine subsurface formation density values over minute intervals within a borehole. BHGM values differ from standard wireline density logs with respect to obtaining a measurement of formation density at distances of tens, or potentially hundreds, of meters (feet) from the borehole (depending on the size of the density anomaly). Wireline density logging samples the area close to the borehole. As a result, BHGM measurements are not affected by conditions within the borehole that may affect the readings on a standard density log, such as drilling fluid invasion, mud cake, or washout zones. The differences in the standard density log and the BHGM values are then used to determine nearby formation structure away from the borehole. Structural geology, or a variation in blocky structure, as well as the thickness of local density units, also affect the way a BHGM survey is utilized. The precision of the gravity equipment, and the vertical separation between density units, can also affect the BHGM results.

8.4.3.1 Results of BHGM Modeling

When computing gravity values from BHGM observations, it is assumed the earth is made up of horizontal slabs of infinite length. The density of individual slabs is exactly given by the density gradient through the slab, which is assumed constant throughout and not affected by slabs above or below. Deviation from this assumption occurs when a 3-D structure is present adjacent to the borehole, but can be recognized by plotting differences from standard density logs run in the same borehole. Due to the overlying assumptions and the possibility of a nearby structure(s) within the surrounding formation, the density determined by the BHGM method is termed “apparent density.”

Using the modeling software, Hol-o-grav®, synthetic apparent-density logs and corresponding density-difference profiles were generated to model several magnitude and shapes of prospective solution cavity geometries. The types of modeled cavities included multiple geometric variations of "morning-glory" and tabular-shaped bodies. The models assumed geology similar to that of TB-1, which corresponds fairly well to the average geological cross-section of both corridors. Previous modeling indicated that morning-glory shaped cavities were detectable if the distance from the borehole to the center of the cavity was less than the overall diameter of the cavity.

Two additional models have been prepared that include both tabular and morning-glory shaped geometries. Both assume a location in the F-Salt, with the roof extending into the overlying G-Shale, and are 91.4 m (300 feet) wide. The morning-glory shaped cavity extends downward to the contact of the underlying E-Dolomite, while the tabular shaped cavity has an assumed thickness of 18.3 m (60 feet), entirely within the F-Unit. Based on the modeling, the apparent density differences are large in both cases and easily recognizable when the edge of the cavity is in close proximity to the borehole, but less recognizable as the cavity is moved away from the relative borehole location. However, the negative-density anomaly increases, i.e. negative density differences are apparent over a larger number of measurement intervals. Previous detectability estimates are further enforced when random observation error is added to the data. It remains true that cavities are still likely detectable near the borehole, but likely become undetectable as the cavity diameter becomes less than that of the distance between the borehole and the edge of the cavity.

8.4.3.2 BHGM Data Analysis

Gravity measurements were taken every 6.1 m (20 feet) at selected boreholes from the total depth to a depth of 243.8 m (800 feet), with each location being re-sampled four (4) times to give four (4) independent values for observed gravity. From 243.8m (800 feet) to the bottom of surface casing, the measurements were taken at 15.2m (50 feet) intervals, with each location being re-sampled two (2) times to give two (2) independent values for observed gravity. Average uncertainty in observed gravity readings, which are used to correlate data quality, ranged from 0.009 mgals at TB-16 to 0.027 mgals at TB-7. As standard density logs tend to underestimate salt density, salt densities used in the analysis where adjusted to 2.2 grams per cubic centimeter (g/cm^3) (137.3 pounds per cubic foot (pcf)).

General Crossing X-10/X-11 Observations - BHGM measurements show a prominent swing in positive to negative density differences, which tend to occur when a cavity is present near the borehole. In fact, most of the processed borings in the X-10 and X-11 corridors show this relationship at or near the contact with the F-Salt and G-Shale units. Further evaluation indicated that most of these readings correspond to increase Z-Scores and larger uncertainties in observed gravity. Z-Scores are defined as the standardized misfit from the inversion between the mean of the observed gravity and the calculated gravity.

It is surmised from further analysis that the inversion used to calculate the density differences was responsible for the erroneous density swings (data noise), due to the blocky nature of the local geology (anhydrite-salt-shale). The density differences were then recalculated using equations that were not affected by the blocky nature of the geology. Computed density differences in the re-calculated data have diminished the noise significantly, except in the case of TB-7 and TB-10, where noisy data remain, and could not be improved though reprocessing.

The density difference plots show little to no correlation to the results that would be anticipated in the presence of either the tabular or morning-glory shaped geometries developed during the modeling portion of this investigation (refer to Appendix I).

8.4.4 Vertical Seismic Profile Evaluation

8.4.4.1 General Method Evaluation

Vertical Seismic Profiling (VSP) was added to this investigation program to provide for checks and balances of the cross-well seismic reflection data and to provide a secondary method to help image any shadow zones developed during the cross-well imaging portion of the investigation. In the VSP profile design for this project, receivers (hydrophones) were placed in the boreholes with a large vibratory source located an engineered distance away (offset). Two single-offset VSPs were performed for this project with a source offset of approximately 215 to 275 m (700-900 feet) in the X-10 Crossing Corridor. A vibrator sweep of 10 to 150 Hz was utilized, but the attenuation in the glacial till provided a bandwidth of approximately 20Hz to 90Hz (20db down points). The VSPs are discussed below.

8.4.4.2 Imaging the TB-2 Shadow Zone

During the cross-well program, due to subsequent modifications of final boring locations, a shadow zone was created near the location of TB-2, which is near the location of a potential future bridge foundation. A single offset VSP was performed at this location to image the upper salt layers. During the initial VSP data collection, a large “tube wave” was evident in the raw data gathers. The tube wave was caused by the large vibratory source creating a large surface wave (Rayleigh Wave), which traveled through the drift and contacted the installed casing in the borehole. This event was then transferred to the fluid within the borehole and translated to the hydrophone receivers. This effectively limited the receivers’ ability to measure reflected arrivals from the formations of interest. The tube-wave event had massive amplitude and corresponded to the desired and expected frequency content of the data, thus making the data suspect. The issue was resolved by re-installing clamped receivers within the borehole, which were then clamped to the formation. The clamped receivers then measured actual particle movement within the rock, corresponding to the reflected wave arrivals from the formations of interest.

The migrated VSP image is shown in Figure 8-2. We see the top of the F-Salt at 305 m (1,000 feet) dipping toward TB-2. This is also observed in great detail in cross-well surveys TB-1 to TB-5 and TB-5 to TB-4. More precisely, an additional layer of salt in the F-Salt formation has been deposited there as previously discussed.

Figure 8-2
Detroit River International Crossing Study
Offset, P-wave VSP Shot into Borehole TB-2[a]

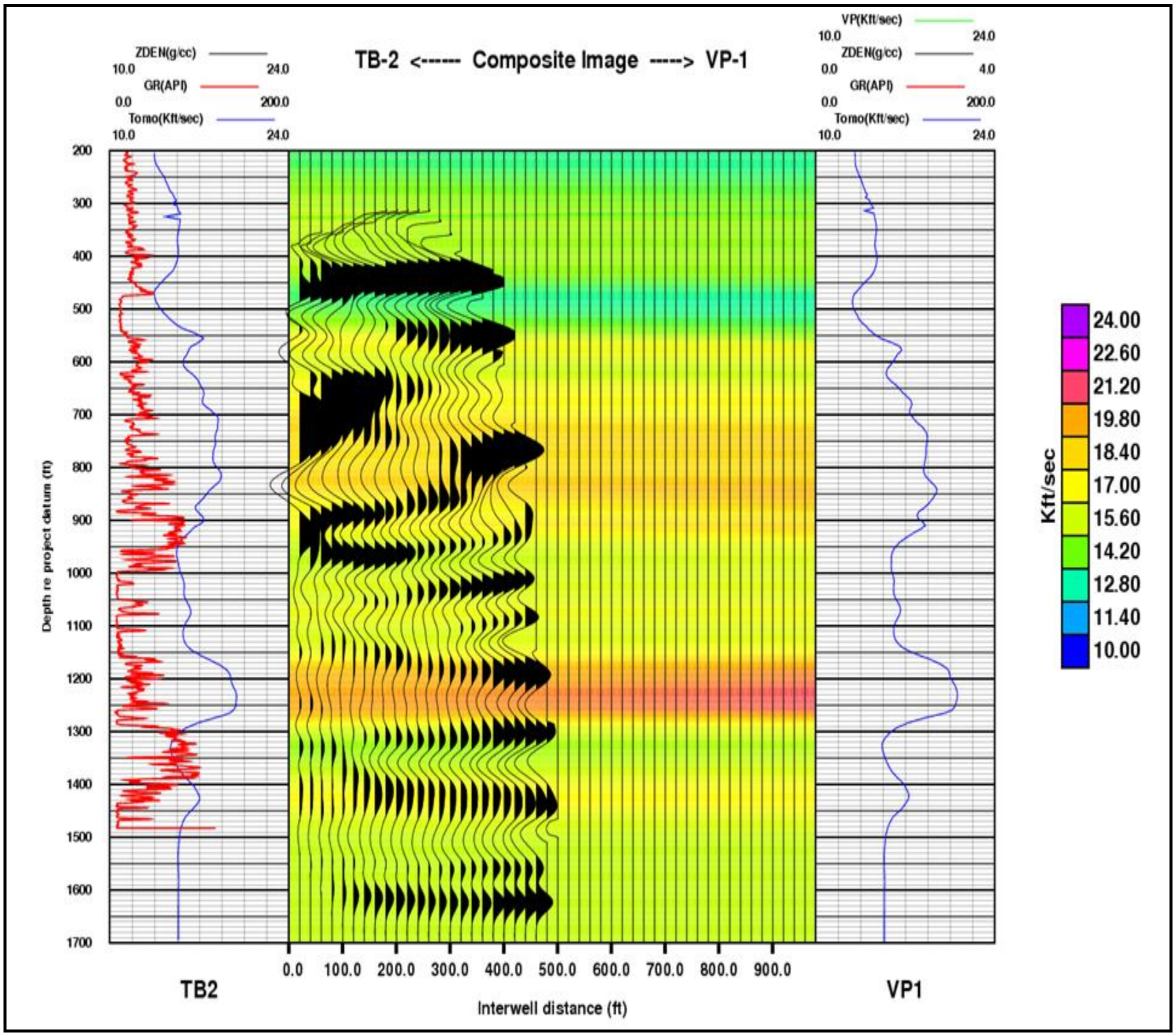


Figure 8-2 [a] The A2 Carbonate is observed at 487.7 m (1,600+ feet). The high velocity base of the C-Shale, overlying the B-Salt, is noted at 426.7m (1,400 feet) and the top and bottom of the E-Dolomite is noted on either side of the light red, high velocity tomographic band at 365.8 m (1,200 feet). The top of the F-Salt is noted at approximately 304.8m (1,000 feet).

Source: Z-Seis / NTH Consultants, Ltd.

At a depth of approximately 244 m (800 feet) and a distance of 91 m (300 feet) from TB-2, the reflection takes a step upward, corresponding to the G-Shale/Bass Islands interface moving up to overlie the additional layer of F-Salt. The downhole logs in the X-10 area also show this (Figure 8-3) as indicated below.

Figure 8-3
Detroit River International Crossing Study
Logs from the X-10 Corridor[a]

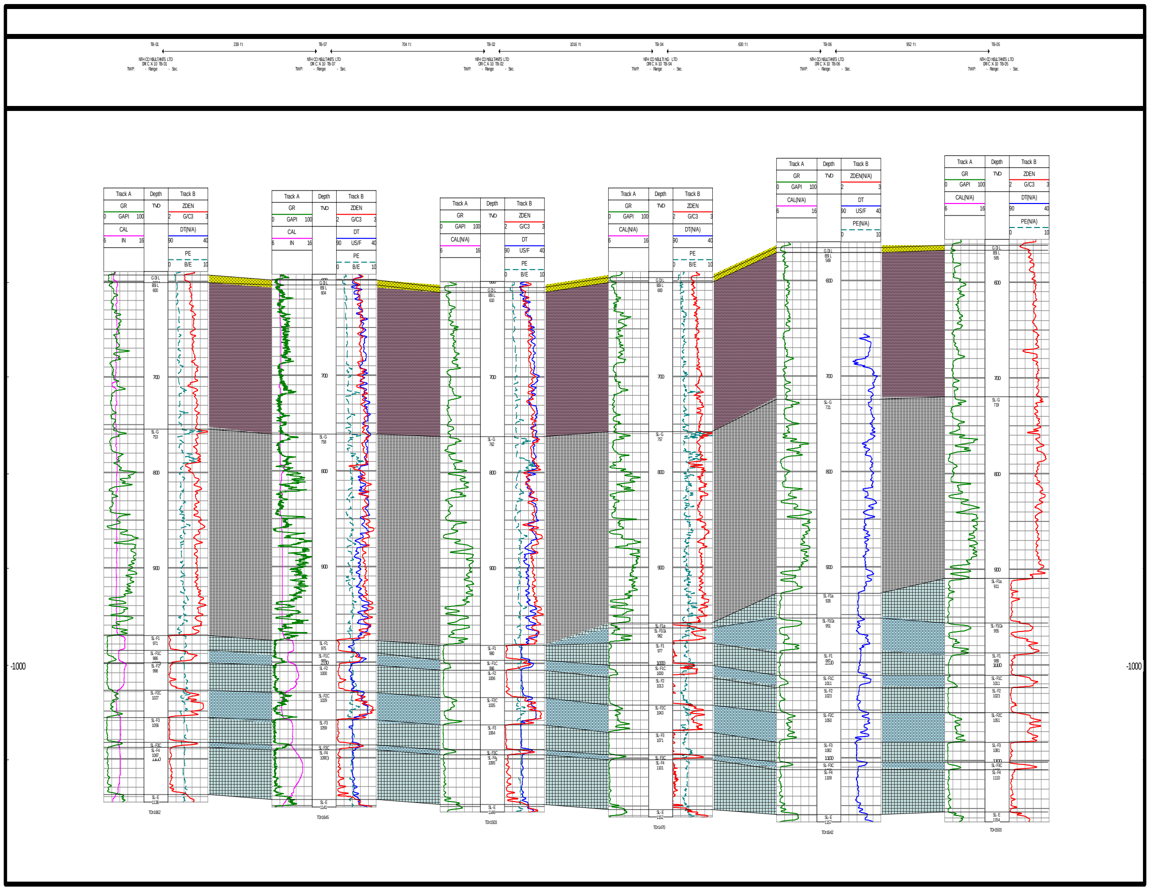


Figure 8.3 [a] From the left they are boreholes TB-1, TB-7, TB-2, TB-4, TB-6, TB-5. The C-Shale and Bass Islands Dolomite are 9.14 m (30 feet) higher in hole TB-5 when compared to TB-1 and TB-7. The vertical seismic profile was shot between holes TB-5 and holes TB-1 and TB-7. The VSP shows this step.

Source: Michigan Technological University.

The frequency content of the VSP is low (Figures 8-4 and 8-5) compared to the spectral content of the cross-well reflection surveys. No variation in the amplitudes along the F-Salt reflection was observed, nor were reflections from the base of the E-Dolomite (top of the D-Salt), or the reflection from the base of the C-Shale (top of the B-Salt). The smooth change in amplitude that each reflection shows is merely the change in fold improving as you move away from the borehole.

Figure 8-4 displays the spectra of the downgoing first arrivals for the TB-2 VSP. The first arrivals have the highest frequency content because they have traveled the direct path (shortest distance) from source to receiver. The peak can be observed at approximately 30 Hz with 150Hz being nearly 40 db down.

Figure 8-4
Detroit River International Crossing Study
Raw Spectrum of Direct, First Arrivals in the VSP[a]

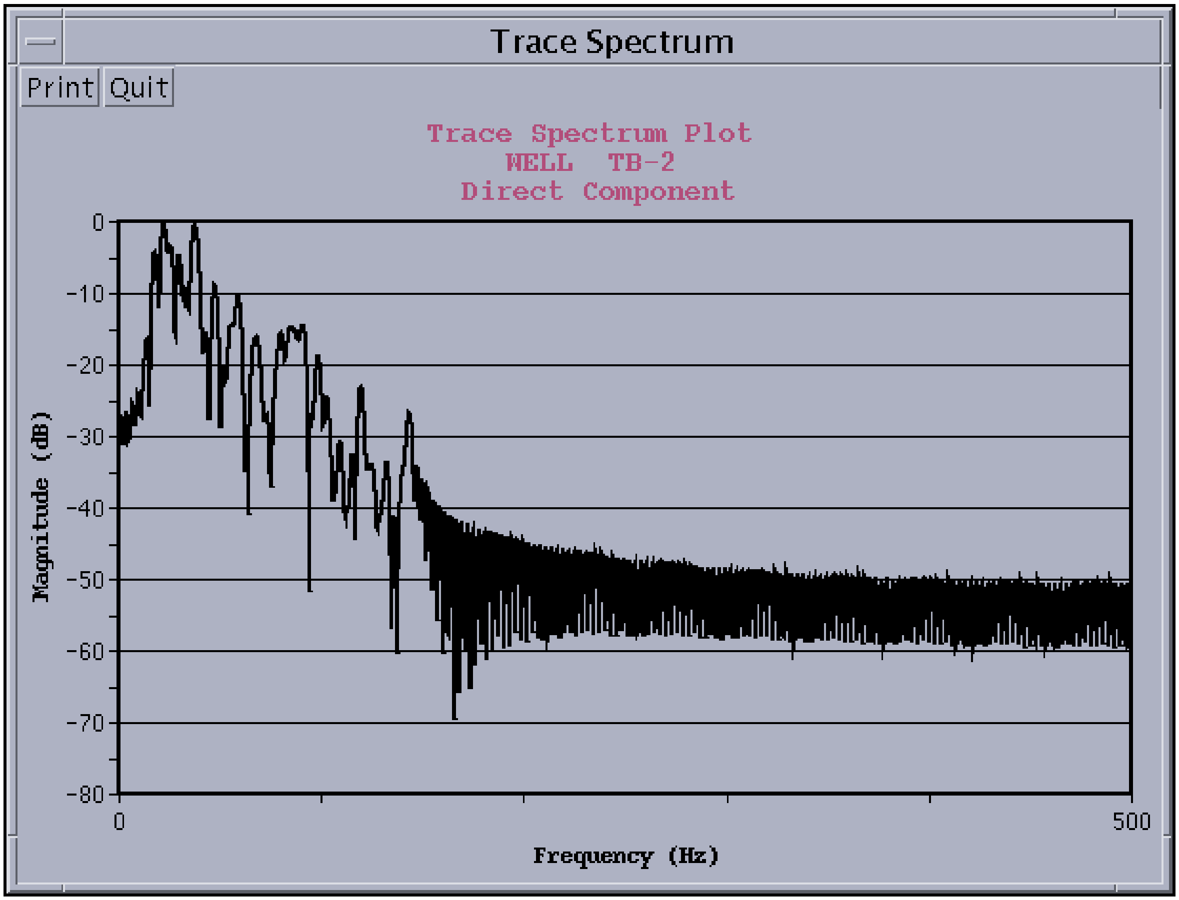


Figure 8-4 [a] Vibrator sweep was 10Hz. to 150Hz. The 150Hz portion of the spectrum is approximately 40 db down from the peak at approximately 30Hz. Deconvolution has not been applied to this signal.

Source: NTH Consultants, Ltd.

Figure 8-5 is the spectra of a reflected arrival after deconvolution. The deconvolution operator flattens the spectrum between 10Hz and 150Hz but that does not mean that the upper portion of that band is necessarily signal.

The VSP shot into TB-2 was intended to search for anomalies along the tops of the B-Salt and the F-Salt. No anomalous feature was observed along these two reflections, nor elsewhere in the image.

Figure 8-5
Detroit River International Crossing Study
Spectrum of Reflections, After Deconvolution, for the TB-2 VSP[a]

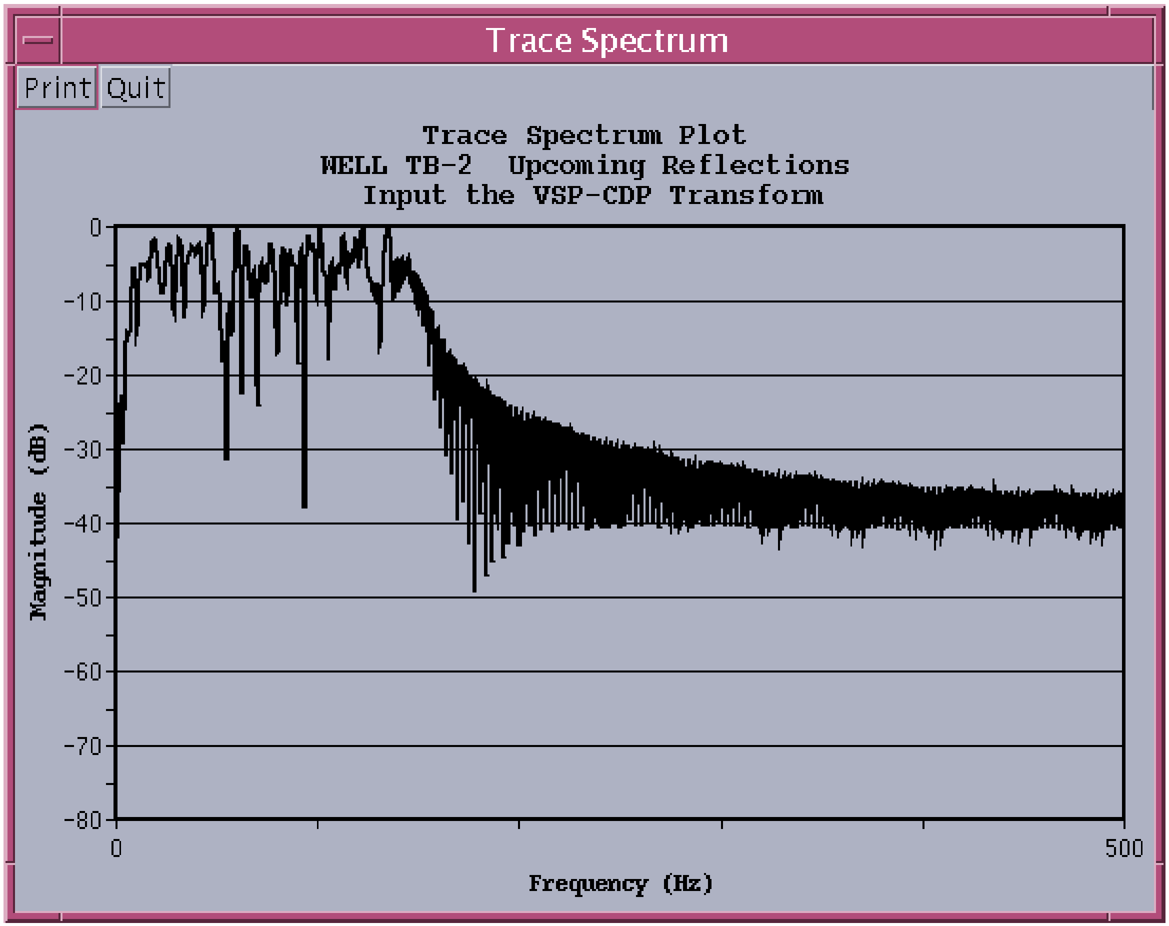


Figure 8-5 [a] *Because this spectrum was obtained after the deconvolution operator was run the flat band of energy does not imply that the entire band is signal.*

Source: NTH Consultants, Ltd.

8.4.3.3 Imaging the TB-4 Cross-well Anomaly

Figure 8-6 displays the migrated image for the VSP that was shot into borehole TB-4. Here the effort was directed towards imaging the small "morning-glory" feature that was observed in the TB-4 to TB-6 cross-well survey at the major, thick stringer approximately 332 m (1,090 feet) deep in the F-Salt near TB-4. The F-Salt event is at approximately 305 m (1,000 feet).

In Figure 8-6, no anomalous features are present in the image, within the range of resolution of the VSP technology (due to the low frequency nature of the VSP data). This was expected because the feature detected by the cross-well imaging was identified as being only about 125 feet across. However, the VSP data appear to rule out a feature in this area much larger than that indicated by the cross-well data.

Figure 8-6
Detroit River International Crossing Study
Offset P-wave VSP Shot into Borehole TB-4[a]

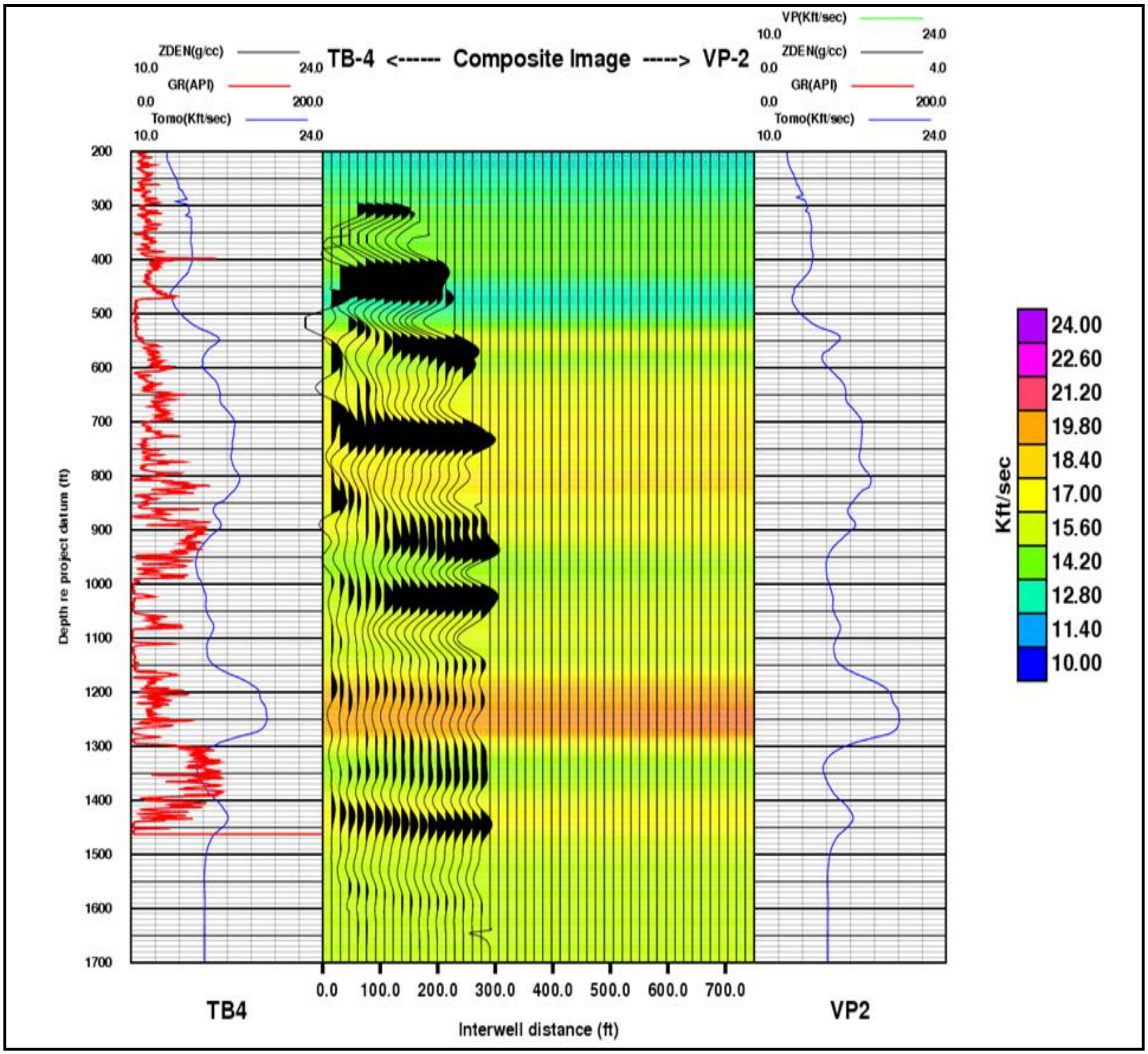


Figure 8-6 [a] Note that all interfaces are flat. The top of the F-Salt at TB-4 is at approximately 301.7 m (990 feet) and the top of the B-Salt is at 435.9 m (1,430 feet). The "morning glory" shaped feature observed in the Cross-well reflection is 61.0 to 91.4 m (200 to 300 feet) away from TB-4 at a depth of 332.2 m (1,090 feet). No indication of that feature is observed here either in depth or amplitude.

Source: Z-Seis / NTH Consultants, Ltd.

8.5 Combined Geophysical Investigation (Cross-well Seismic, BHGM, and VSP)

There is excellent correlation between the core and rotary drilling information, the downhole geophysical logs, and the geophysical data. There are no large features (possible cavities) observed in either crossing corridor greater than 37 m (120 feet) wide, on average, by 6 to 9 m high (20 feet to 30 feet).

Two specific cases are presented here that illustrate how the BHGM and cross-well surveys were used to compliment and establish correlation between observations drawn from both methods.

8.5.1 BHGM Check on Suspected Solution Features

Several anomalies are observed in the TB-6 to TB-4 cross-well profile. These anomalies, due to their size and geometry, could potentially be interpreted (without the benefit of other data) as possible interconnected morning-glory type solution cavities/structures adjacent to the TB-4 borehole. The anomalies, as observed on the cross-well profile, could be interpreted in the worst case (again, without benefit of considering all the data), to range from 61 t 91 m (200 to 300 feet) in diameter, assuming circular dimension in plan view. Based on the results of the modeling, a solution cavity near the edge of the borehole would provide a large negative density difference when compared to the standard density log. The density differences in this case are all positive. Therefore, it is highly unlikely that such cavities exist. However, when all the data are considered, it is concluded that it is likely that a smaller feature exists in this area, probably in the top of the F2 bed and about 38 m (125 feet) wide and 3 to 6 m (10 to 20 feet) high as described in Figure 8-1.

8.5.2 TB-1 to TB-4 and TB-1 to TB-6 Anomaly

A downward concave anomaly is observed on the top of the B-Salt at a depth of 427 m (1,400 feet). A corresponding negative-density difference is also observed at the same interval in the BHGM data. However, this calculated density difference is only –0.04 g/cm^3 (2.5 pcf). As such, it is considered likely that this feature is probably not a cavity and most likely a naturally occurring anomaly in the rock density at this location.

8.5.3 Ground Truthing the Cross-well Results

The process of ground truthing geophysical data often involves verifying assumptions made during the initial modeling (see Section 4.2 for more details), data acquisition, processing, or interpretation phases of a project. The collection of ground-truth data enables calibration of final images with known subsurface parameters (in this case lithology), and aids in the interpretation and analysis of what is being detected, e.g. bedrock structure. Ground truthing is important in the final interpretation of an image, when the identity and location of specific bedrock lithology, e.g. suspected anomalies, are thought to exist. To effectively ground truth the cross-well results in this program, two methods were selected to ground truth the results obtained from the TB-1 to TB-2 cross-well profile in Crossing X-10. TB-7 was drilled inline in this profile during the original investigation with continuous cored rock recovery and a complete suite of downhole geophysical logging (wireline). This allowed for ground truthing the seismic profile with the actual core data and downhole geophysical results. The TB-7 location is approximately 68.6 meters (225 feet) from TB-1. The results to correlate the cross-well profile with the wireline and direct data results (drilling) are discussed as follows:

8.5.3.1 Ground Truthing the TB-1 to TB-2 Profile

The first method for ground truthing the cross-well profile performed from TB-1 to TB-2 used the data obtained from TB-7. The wireline logs performed during the initial investigation of TB-7 were superimposed on the cross-well profile at the scaled location of TB-7, analyzed for consistency, and then combined with the direct information obtained during the coring of the borehole. Prominent reflections or events were noted on the cross-well profile and then evaluated against the other data for continuity and general accordance.

The truthing points (A through V) that were chosen for analysis are presented in Appendix E, as Figure Nos. E-4 and E-5. The reference points were selected from the cross-well image and then compared with events on the core log, density, and sonic logs and generally fell into three categories. The categories consisted of:

1. Change in bedrock formation/ rock facies within the core log (i.e. truth point C, D, M, etc.),
2. Velocity change noted on sonic log with no direct variation noted in core (i.e. truth point A, B, H, etc.), and
3. Velocity / Density change noted on sonic and density logs respectively (i.e. truth point G, I, T, etc.).

The results of the analysis are presented in Appendix E as Table No. E-1, and are discussed below. As noted in Table No. E-1, the referenced truthing points (column I) are consistent at each reflection with differences (column VI) of 0 to 2.8 meters (0 to 9.3 feet) noted. Truthing distances are defined as the distance the reflection event in the cross-well profile differs with the event's occurrence in the core, density, or sonic logs.

For reference, a depth normalization constant (Column V) is subtracted from the cross-well event elevation before it is compared with that of the core, sonic or density logs. The subtraction of this constant normalizes the depths/elevations referenced on the cross-well profiles to that of the other logs (core, density, etc.). During cross-well processing, all top of well elevations are adjusted to the same datum to ease data migration and processing, in our case 182.9 meters (600 feet above mean sea level). In the case of TB-7, the actual elevation of the ground surface was subtracted from the normalized cross-well elevation to obtain 5.3 meters (17.3 feet).

8.5.3.2 Synthetic Seismograms

Synthetic seismograms were produced using the compressional and bulk density well log data from wells TB-7 and TB-2. The synthetics were then correlated with the refection image for the profile performed between TB-1 and TB-2. Zoeppritz equations are considered to predict the angle-dependent reflectivity for AVA gathers, but the synthetics produce for this analysis do not consider vertical incidences.

The synthetic AVA gather incorporates the effect of Zoeppritz equations on amplitude as a function of angle, with the reflectivity computed in depth from the logs. The compressional, shear velocity, and density are available and extracted from the wireline logs. The reflectivity amplitude in depth is converted to time with a cos2 compression factor for imaging stretch as the function of the incidence angle, which results in a translation of the frequency spectrum. The data is then convolved in time with a selected wavelet and returned to depth with the cos2 stretch factor. The synthetics also simulate the wavelet stretch due to wide angle imaging methods as a function of angle. The effect of ray propagation through the velocity field is not computed.

The crosswell synthetic seismograms, presented as Figures E-6 and E-7 in Appendix E are stacked over a range of angles (50-60 degrees) to generate the synthetics stacks. Also shown are a comparison of synthetic seismograms generated using well information and the reflection image for the profile performed from TB-1 to TB-2. The figure includes relevant well log data such as sonic, gamma ray, and density curves.

Wells TB-1 and TB-2 are separated by approximately 295 meters (970 ft), with Well TB-7 located approximately 70 meters (230 ft) from well TB-1. TB-1 did not have a sonic log performed during the original investigation; therefore, the TB-7 and TB-2 synthetics were correlated with the reflection image for the profile performed between TB-1 and TB-2 (same AGC window and plot parameters). By comparing the “synthetic” seismic events in the seismogram with the major reflections on the reflection image; considering that sonic is acquired with distinctly more frequency range, we observed a relatively good tie, with a better performance in and near TB-2. A Vp/Vs ratio of 1.82 was selected for the analysis based on results of the same rocks at the Michigan Technological Test Site. The analysis was completed when the synthetics achieved a relatively close match to the existing data, with the Vp/Vs ratio held constant.

8.5.4 Cross-Well Seismic Profile Quality Evaluation

As cross-well profile image quality varied from the X-10 to X-11 Crossing Corridors, a numerical analysis was performed to assign a numerical quality indicator for use in comparing specific profiles. Cross-well reflection image quality is a function of many factors and is discussed as follows.

8.5.4.1 Signal Power

Although the strongest possible source signal would be gained by specifying many long sweeps, overall project schedule dictated that we use a value designed to maximize signal power, while maintain project schedule (i.e. eight sweeps per level and a sweep length of 1.1 seconds). To make the comparison of images possible, these acquisition parameters were used for all acquired cross-well profiles. With the source strength remaining constant, the strength of the signal impinging on a receiver is then a function of the distance between source and receiver boreholes.

8.5.4.2 Noise, Ambient and Electrical

Two distinct types of seismic noise intruded on the cross-well imaging in this project and are discussed in the following paragraphs.

The first type, or ambient seismic noise, was typically very low in the boreholes due to the highly attenuative properties of the overlying glacial till. When the boreholes are relatively close together, the signal strength is strong enough that ambient noise is not observed to have an effect on the raw data. However, at large borehole distances and without the ability to increase sweep length and the number of sweeps in a stack, the ambient noise becomes noticeable.

The second type of seismic noise observed in the cross-well data consisted of electrical noise (60Hz and harmonics), which radiated from the electrical power plant and transmission lines in the survey region. Electrical noise can be reduced in the signal spectrum by passing the data through a low cut filter (200Hz in our case), and was done for several profiles in the X-11 Corridor. Passing the signal spectrum through the filter harms the spectra by narrowing the bandwidth and more importantly eliminating the low frequency portion of the signal, which propagates long distances with relatively little attenuation. Thus, the distance between the two boreholes in any given survey is an excellent proxy for signal strength. Furthermore, location of the boreholes relative to the Mistersky Power Plant is a direct measure of the amount of electrical noise encountered in the profiles in the X-11 Corridor. Visual examination of each of the cross-well images confirms this relationship.

8.5.4.3 Signal to Noise Ratio

The signal to noise ratio is controlled by the signal strength, amplitude, and nature of the noise. Analyzing them separately, it is observed that signal strength at a seismic receiver is a function of the distance the seismic energy must travel to illuminate the image plane (i.e. total ray path length of reflected energy) and the "strength" of the source. The strength of the source is therefore a function of its intrinsic strength (i.e. the power in a single sweep or "pop") and the number of activations of the source, (number of sweeps in this project) summed in a stack. A swept source, as used in this project, has an additional parameter, i.e. length of sweep. For a given source, the greater the length of the sweep combined in conjunction with a greater number of sweeps produces a higher signal to noise ratio.

8.5.4.4 Angle of Incidence

The angle the impinging seismic energy makes with a given interface is a critical parameter in cross-well profile quality. Rapid phase changes occur in the reflected energy (compared to the incident energy) when the angle of incidence, measured from the normal to the interface, is greater than approximately 45 degrees. When the interfaces of interest all lie at the same depth over the entire extent of the project, i.e. 305 to 460 meters (1,000ft. to 1,500ft.) in depth, this angle also becomes a function of the distance between the source and receiver boreholes.

8.5.4.5 Index of Image Quality

For each profile, we examined the angle of incidence, the signal to noise ratio, and electrical noise; and assigned "quality index" between 0 and 5, with the lower end representing poor quality, and the upper end representing excellent quality. The combined average of these three indices was computed for each profile to produce a measure of the overall image quality. For overall image quality falling in the lower third (corresponding to an index in the range of zero to 1.7), the profile was considered somewhat poor, with some confidence that the image could detect an anomaly within the size range of 100 feet or less. For overall image quality falling in the middle third (from 1.8 to 3.4), the profile was considered acceptable, with good confidence that the image could detect an anomaly 100 feet in size. For overall image index in the upper third (from 3.5 to 5.0), the image was considered excellent, with very high confidence of detecting such an anomaly. Although somewhat subjective, this method was used to examine the relative quality of the images as compared to each other, and to allow for overall comparison of the confidence of our overall conclusions with respect to the image quality. A table and related summary of image quality figures have been produced and are included as Table No. E-2 and Figure Nos. E-8 and E-9 in Appendix E.

Within the X-10 corridor, ten of the twelve profiles are considered excellent quality with two images considered good quality. Based on this exercise alone, our confidence that we would detect an anomaly within one Fresnel zone of the image plane for the combined cross-well image pattern in the corridor is considered excellent. This confidence is further increased after considering the combined program, including the drilling and coring data, downhole geophysics, VSP, and gravity surveys.

Within the X-11 corridor, six of the sixteen profiles are considered excellent quality; eight are considered good quality; and two are considered somewhat poor quality. By examination of the cross-well image quality summary in the plan view, it is apparent that the proximity of the Mistersky Power plant is a primary influence in producing the poorer quality images, and that a secondary factor appears to be related to the distance between boreholes (and related large incidence angles). However, when combining the cross-well data with the drilling and coring data, downhole geophysics, and gravity surveys, we have a high level of confidence that the program is robust, and could detect an anomaly 100 feet in size within the X-11 corridor.

8.6 Confirmation of Rock Mechanics Model

Final evaluations of the geotechnical conditions in the various boreholes have been completed, a geotechnical model of the rock mass has been completed, and results are provided below.

8.6.1 Geotechnical Rock Mass Simulations

A model of geotechnical rock mass characteristics has been completed and is presented in a report by Dr. Edward Cording, included in Appendix I. The results presented there are based on derived borehole lithology, direct observations of rock mass discontinuities from the TB-7 and TB-11 core samples, and modeled solution cavity characteristics. For this evaluation, cavities of the size and geometry similar to the Anomalies A and B described above in this report were used. This was conservative, since it is believed that Anomaly A is probably fully or partially filled, and that Anomaly B is probably a natural geologic feature, and almost certainly filled.

On these bases, an evaluation for the potential instability of such assumed solution cavities has been performed. The evaluation of the instability of solution cavities has also included a review of existing solutions in the vicinity and the results of a three-dimensional, distinct-element analysis (3DEC) of suspected solution cavity geometry.

8.6.1.1 Stability of Existing Solution Cavities in the Vicinity of Crossing Corridors X-10 and X-11

For this analysis, two types of cavity geometry and characteristics were considered, namely cavities that have propagated into overlying rock layers and those completely contained within the respective salt layers. These are discussed as follows:

Stable Cavities with Roofs Contained in Salt - Modern solution cavities in this area were engineered and produced to meet a criterion, i.e., to leave salt in the top of the cavity and to prevent cavity migration into the roof rock. In this case, the overlying salt in the roof contains the internal pressure and provides a stabilizing effect. The roof of salt acts as a confinement layer for the saturated brine and provides support for the salt and bedded layers above. In this case (where there is no upward propagation), surface settlements are very small and can be calculated using elastic theory.

Cavities with Roofs in Bedded Deposits Above the Salt - For solution cavities subject to this characteristic, the fluid pressure acts on all sides of the roof blocks and does not provide stability. However, the buoyant effect of the brine does reduce the effective weight of the roof blocks and does provide a slight measure of stability.

Upward Propagation of Solution Mining Cavities - Locally, only settlements and large sags have occurred over areas where large, interconnected brinefields have been operated. These wells were often interconnected as fresh water was injected with brine being removed from other wells at significant distances across the brine well field. Wells and fields developed in this manner had little to no vertical or horizontal control of solutioning within the fields.

In order for surface settlements or large sags to occur, the solutioning must reach the bedded layers above the salt formation and cause localized roof collapse and progressive failure of overlying bedded formations until reaching the surface. The overlying rock layers begin to sag as localized pillar failure occurs in the remaining salt horizon. Bulking of rock fragments in this case is not enough to arrest the progression towards the surface. Eventual failure at the surface occurs.

8.6.2 Preliminary Lithology and Cavity Geometry Failure Model

The report by Dr. Cording also addresses distinct types of solution cavities of the size and geometry similar to the features identified as “Anomaly A” and “Anomaly B”. These geometries and conditions were evaluated using the 3DEC computer program to evaluate the potential for impacts at the ground surface. The cases examined are discussed as follows:

8.6.2.1 Small Isolated Cavities

In this case, small cavities do not allow for loosening or excessive overbreak of the overlying bedded deposits. The 3DEC modeling, as well as closed beam and linear arch solutions, are used to estimate the stable cavity spans for bedding thicknesses observed in the TB-7 and TB-11 core samples.

8.6.2.2 Cavity Roof is Stabilized Against an Overlying Bed

In this case, loosening and localized fallout of roof blocks occur where rock is thinly bedded, shaley, or where cavity spans are significant to allow sag and corresponding tension in the roof rock. Roofs developing in this manner often form arched geometry and continue to propagate upwards until a bed with sufficient thickness and strength is encountered to arrest further movement.

8.6.2.3 Cavity Where Bulking of Rock is Sufficient to Arrest Upward Propagation

The roof span in this case is large enough that bedded layers above the salt are not thick enough to resist upward propagation. In this case, the bulked material falling from the roof is sufficient to fill the cavity and arrest upward propagation.

8.6.2.4 Cavities Where Collapse Progresses to Surface

This case is similar to that mentioned immediately above, but bulking is not sufficient to arrest the upward propagation of the cavity. The upward propagation reaches the surface of the rock until a sinkhole is formed at the surface. In the modeling, cavities approaching 91 to 244 m (300 to 800 feet) in diameter are needed to form a sinkhole at the surface.

8.6.3 Results of Rock Mechanics Modeling

Based on the observations made during the deep drilling and subsequent geophysical investigations, potential cavities were modeled with sizes of 37 to 52 m (120 and 170 feet) in diameter, 3 to 6 m (10 to 20 feet) high, and in a “morning-glory” shape. On the basis of the evaluations, such shapes are likely to exhibit the characteristics mentioned above for small, isolated cavities and, in the worst case, cavities where fallout is stabilized by roof rock.

In both cases, roof spans are estimated to be small with little-to-no localized overbreak or fallout of roof blocks. Cavities meeting these criteria, even if upward progression were to occur, would be arrested quickly as thicker bedded formations are encountered. Furthermore, due to the high width-to-height ratios, bulking would occur in the localized fallout and would arrest upward movement.

As an additional evaluation based on the actual data, the angle of draw was re-examined using the actual rock test and core data, to confirm the basis of the borehole spacing for the program. Based on the analysis, the angle of draw was further refined and estimated to be 15 degrees or less. More importantly, it was determined that for isolated brine cavities as small as 37 m to 52 m (120 to 170 feet), the concept of angle of draw does not apply because such cavities would be stable and could not possibly progress any significant distance upward to the ground surface.

A further evaluation included in the analysis involves an examination of the potential impacts of seismic activity in the Detroit area on potential brine cavities. The analysis indicates that seismic impacts would be insignificant to the stability of any brine cavities that may exist in the U.S. project area.

9. CONCLUSIONS

9.1 Presence of Brine Cavities

Based on the data gathered and analyzed, there is no evidence of cavities larger than those discussed as Anomalies A and B shown on Figure 8-1, nor is there evidence of potential instability of the rock mass within the crossing corridors. In fact, the analysis shows that the observed anomalies have probably been, at least partly, filled by one or a combination of several mechanisms. More specific conclusions for each of the crossings are presented in the following sections.

9.1.1 Crossing X-10 Corridor

There are two noticeable anomalies within the area studied for the X-10 crossing. One (previously identified as “Anomaly A”) is approximately 38 m (125 feet) wide and 3 to 6 m (10 to 20 feet) high that appears to be morning-glory shaped and located between TB-4 and TB-6 at a depth of 338 m (1,110 feet). The feature is observed in the top of the F2 salt bed and appears to have migrated upwards slightly and terminates in the overlying shaley roof rock. It is concluded that this feature represents the remains of a historic brine well that is probably partially or fully filled, either by bulking, or to a much lesser extent by silt infilling or recrystallization of salt. A Franklin-Swift Salt well may have been located in the vicinity of this anomaly according to historic documents, and reportedly produced approximately 150,000 barrels of brine from 1901 through 1904. The apparent size of this anomaly is generally consistent with the volume of brine that was reported to have been removed.

A second anomalous feature is located northeast of TB-1 (identified previously as “Anomaly B”). It is located at the top of the B-Salt/C-Shale contact, and is approximately 37 to 52 m (120 to 170 feet) wide and 6 to 8 m (20 to 25 feet) high. The feature appears to have a tabular (i.e., “hockey-puck”) shape. Based on the available data, it is concluded that this feature is probably a naturally occurring density anomaly, possibly formed during initial deposition or another naturally-occurring variation in the roof rock above the B-Salt. Based on the bulk of the geophysical evidence, the feature does not appear to be a cavity by any means. It is noted that no historical brine wells are known to be located in the immediate vicinity of this feature. Further, there is no evidence of solutioning in the salt beds above or below the anomaly. This would be expected if the features were related to solution mining, given the solution mining methods that were in use in the period when records were not well kept.

It should also be noted that there is no evidence that this feature is related in any way to the known solution mining that has occurred to the nearby west, on and near Zug Island. In addition to the previously discussed evidence, we offer several other points of evidence that the feature is not related to the Zug Island interconnected brine well galleries.

- The closest known solution well that is part of the Zug Island brine well gallery system is approximately 320 m (1,050 feet) to the west of Anomaly B. Based on historical records of various modern solution mining operations in the vicinity (particularly evidenced from the solution mining operations of Canadian Salt), it does not appear that there is evidence of solutioning having extended more than about 95 meters (300 feet) away from a gallery or singular brine well.
- There is no historical record of any other isolated wells in the vicinity of Anomaly B that could have connected to the Zug Island system or extended solutioning further

than the normal distance that could be expected (about 95 meters (300 feet) as indicated above). Further, there is no evidence in the cross-well profiles intersecting Anomaly B of solutioning in the salt beds above the anomaly, which would be expected if Anomaly B were due to brine extraction, given the solution mining methods that were in use in the period when records were not well kept (before 1940).

- Anomaly B is less than 30 meters (100 feet) from TB-1, and about 45.7 meters (150 feet) from TB-7. However, there was no loss of wash water from either of the test borings as they extended through the salt beds or potential roof rock, which would be expected if the feature were a cavity related to brine well solutioning and would almost certainly occur if the feature were connected so a brine well gallery system as extensive as the Zug Island system.

9.1.2 Crossing Corridor X-11

In the X-11 profiles, there is a greater amount of seismic "noise" in the data, most likely the result of electrical interference (60 Hz and harmonics) from the Mistersky Power plant. The plant lies directly in the center of most of the cross-well profiles for X-11. Several of the cross-well profiles are further degraded due to longer than planned distances between the boreholes, which resulted because of site access and right-of-entry issues.

However, the tops of the F-Salt layers appear to be continuous and not broken in the seismic profiles and are clearly evident for the F4 through F1 salt layers (also F6 and F5, where they occur). The tops of the D-Salt layers also appear to be continuous and not broken in the seismic profiles and are clearly evident for the D3 through D2 salt layers. Although some of the images have relatively poor resolution, several small anomalies are present in the data which could possibly represent small features of interest. However, these anomalies are most likely the result of large angle of incidence and general reduced resolution of the images due to borehole spacing distance (when compared to the excellent resolution for the X-10 profiles). In any case, it can be stated that no significant cavities or other anomalies (i.e., greater than the size of anomalies discussed for the X-10 crossing) are evident in the X-11 seismic cross-well profiles.

9.2 Stability of Anomalies

As discussed in earlier sections of this report, the investigation and analysis performed for the X-10 and X-11 crossings indicates that there are no anomalies in either crossing greater than 120 to 170 feet in diameter, and that for the larger end of this size range (Anomaly B), the anomaly is almost certainly not a void and not related to historical brine mining. For both cases however, analysis was performed, conservatively modeling the anomalies as open cavities with sizes of 37 to 52 m (120 and 170 feet) in diameter, 3 to 6 m (10 to 20 feet) high, and in a "morning-glory" shape.

For both cases, the analysis concludes that there would be little-to-no localized overbreak or fallout of roof blocks, and that is any upward progression were to occur, it would be arrested quickly as thicker bedded formations are encountered, and/or bulking of the rock fallout occurs.

On this basis, it can be stated that the combined analysis indicates that any of the size of anomalies that are potentially present in the X-10 and X-11 crossings (based on the investigation), would not propagate to the surface nor could they have impact at the surface in the foreseeable future.

REFERENCES

Bays, C.A, The Extraction of Rock Salt by Solution Particularly as Applied to the Conditions in the Michigan Basin, 1957.

Bays, C.A., Investigation of Subsurface Conditions relative to the Stability of the River Rouge Plant, The Detroit Edison Company, November 1960.

Bays, C. A., Significant Uncertainties in Salt Solution Extraction Operations. Proceedings, 1st. Symposium of Salt, Northern Ohio Geological Society, Cleveland, Ohio, 1962.

Bays, C.A., Subsurface Conditions with Reference to the Effects of Salt Solution at the Detroit Edison River Rouge Plant, December 1955.

Brady, B.H.G. and Brown, E.T., Rock Mechanics for Underground Mining, Third Edition, Springer, 626 pp, 2006.

Brown, M.L., Detroit's Western Suburbs, 1892.

Coates, C.A., Lee, C.A., McClain, W.C., and Semseny, P.E., Failure of Man Made Cavities in Salt and Surface Subsidence Due to Sulfer Mining, Topical Report RSI-0131, January 30, 1981.

Cook, C.W., Brine and Salt Deposits of Michigan, Their Origin, Distribution, and Exploitation, Board of Geological and Biological Survey, 188 pp., 1913.

Cording, E.J., Interim Report: Characteristics of subsidence and sinkholes in salt, Detroit Area. A study for the proposed Detroit River International Crossing, May 27, 2006.

Cording, E.J., Stability of Caverns in Salt, Detroit Area; a rock mechanics analysis study for the proposed Detroit River International Crossing, December 28, 2006.

Demeter, C.S., An Archeological Evaluation of the West Riverfront Study Area, July 1984.

Dorr, J.A, Jr. and Eschman, D.F., Geology of Michigan, The University of Michigan Press, 476 pp, 1970.

Ege, J.R., Surface Subsidence and Collapse in Relation to Extraction of Salt and other Soluble Evaporates, United States Department of the Interior, Geological Survey Open File Report 79-1666, 1979.

Hoek, E., and Brown, E.T., Underground Excavations in Rock, London: Institution of Mining and Metallurgy, 527 pp.

Famer, S., City and Environs of Detroit, dated 1895.

Fernandez, G. and Castro, A., Structural Stability Evaluations of Expansion Alternatives for Solution Mining Operations at Windsor, Ontario, SMRI Fall 1996 Meeting, 1996.

Historic Archives of US Steel (National Steel), Zug Island Operations, Detroit, Michigan.

Historical Atlas of the County of Wayne, Michigan, H. Beldon and Company, 1876.

Historical Detroit River Navigation Charts, War Department, Corps of Engineers, dated 1903, 1904, and 1934.

History of Wayne County and the City of Detroit, MI, edited by C. and M. Burton, 1930.

Insurance Maps of Detroit, Sanborn Map Company, 1884, 1910, 1921, 1923, 1946, 1950, 1991, and 1992.

Landes, K.K. and Piper, T.B., Effect Upon Environment of Brine Cavity Subsidence at Grosse Ile, Michigan, 1971. Solution Mining Research Institute, Inc. and BASF Wyandotte Corporation, 52 pp.

Mair, J.D., The Canadian Brine Limited Brine Field at Windsor, Ontario, Canadian Salt Company Ltd., Windsor Ontario.

Map of Harbor Lines and River Front of the City of Detroit, Mich and Vicinity, Corp of Engineers, 1892.

Mozola, A.J., Geology For Land and Ground-Water Development In Wayne County, Michigan, State of Michigan, Department of Natural Resources Geological Survey, Report on Investigation 3, 1969.

National Coal Board, Subsidence Engineer's Handbook, National Coal Board Production Department, United Kingdom, 1966.

Nieto, A.S. and Ege, J., An Alternative Hypothesis for sinkhole Development Above Salt Cavities in the Detroit Area, 1982.

Nieto-Pescetto, A. and Hendron, A., Jr., Study of Sinkholes Related to Bedded Salt Production in the Area of Detroit, Michigan, November 1977.

Nieto, A.S. and Stump, D., An Alternative Hypothesis for the Craters at the Detroit/Windsor Area. Joint Research Project USGS/SMRI. Paper presented at the Toronto SMRI Meeting, 1979.

Nieto, A.S., Stump, D., and Russel, D.G., A Mechanism for sinkhole development above brine well cavities in the Windsor-Detroit Area. In Proc. 6th Symposium on Salt, Toronto, Ontario, Canada, May 1983, volume I., pp 351-367. The Northern Ohio Geological Society, Inc., 1985.

Personal communications with the Solvay Library in New York and Rhode Island Historical Society Library (Semet-Solvay Records).

Robinson, E. and Pidgeon, R.H., Atlas of the City of Detroit and Suburbs, 1885.

Rothenburg, L., Dusseault, M., and Mraz, D., A Methodology for rock mechanics design of brine fields based on case histories of sinkhole formation in Windsor, Detroit area., Basic and Applied Salt Mechanics, Proceedings of the Fifth Conference on Mechanical Behavior of Salt, Macasalt 5th, Budacharest, Romania, pp 389-392.

Rothenburg, L. and Dusseault, M.B., A Methodology for Rock Mechanics Design of brine fields based on case histories of sinkhole formation in Windsor, Detroit Area., Basic and Applied Salt Mechanics, Cristescu, H., Jr. and Simionescu, 2002.

Russel, D.J., Role of the Sylvania Formation in Sinkhole Development, Essex County, Ontario Geological Survey, Open File Report 5861. Ministry of Northern Development and Mines, 1993.

Russel, D.J., A Re-examination of the Processes of Sinkhole Formation, Windsor (Canada) Brinefield, SMRI Meeting, 1996.

Schleicher, J., Tygel, M., and Hubral, P., Seismic True Amplitude Imaging, SEG Geophyscial Developments Series No. 12, 354 pp, 2007.

Sherzer, W.H., Geologic Atlas of the United States – Detroit Folio, by, U.S. Geological Survey, 1916.

Sherzer, W.H., Geological Report upon the Region adjacent to the Water Works Park and Head of Belle Isle, Prepared for the Department of Water Supply, City of Detroit, March 1926.

Society of Exploration Geophysicists, Applied Seismic Anistrophy: Theory, Background, and Field Studies, Edited by MacBeth, C. and Lynn, H.B., Geophysics Reprint Series, No. 20, 725 pp, 2000.

Stump, D., Nieto, A.S., and Ege, J.R., An Alternative Hypothesis for Sink Development Above Salt Cavities in the Detroit Area, United States Department of the Interior, Geological Survey Open File Report 82-297, 1982.

Terzaghi, R., Brinefield Subsidence at Windsor, Ontario, Proc. 3rd. Symposium on Salt, Cleveland, Ohio, pp 298-307, The Northern Ohio Geological Society, Inc., 1969.

Unpublished reports of BASF Corporation, Wyandotte, MI, Facilities.

Unpublished files of NTH Consultants, Ltd.

Appendix A

Detroit River International Crossing Study
Detailed Well Schematic Samples

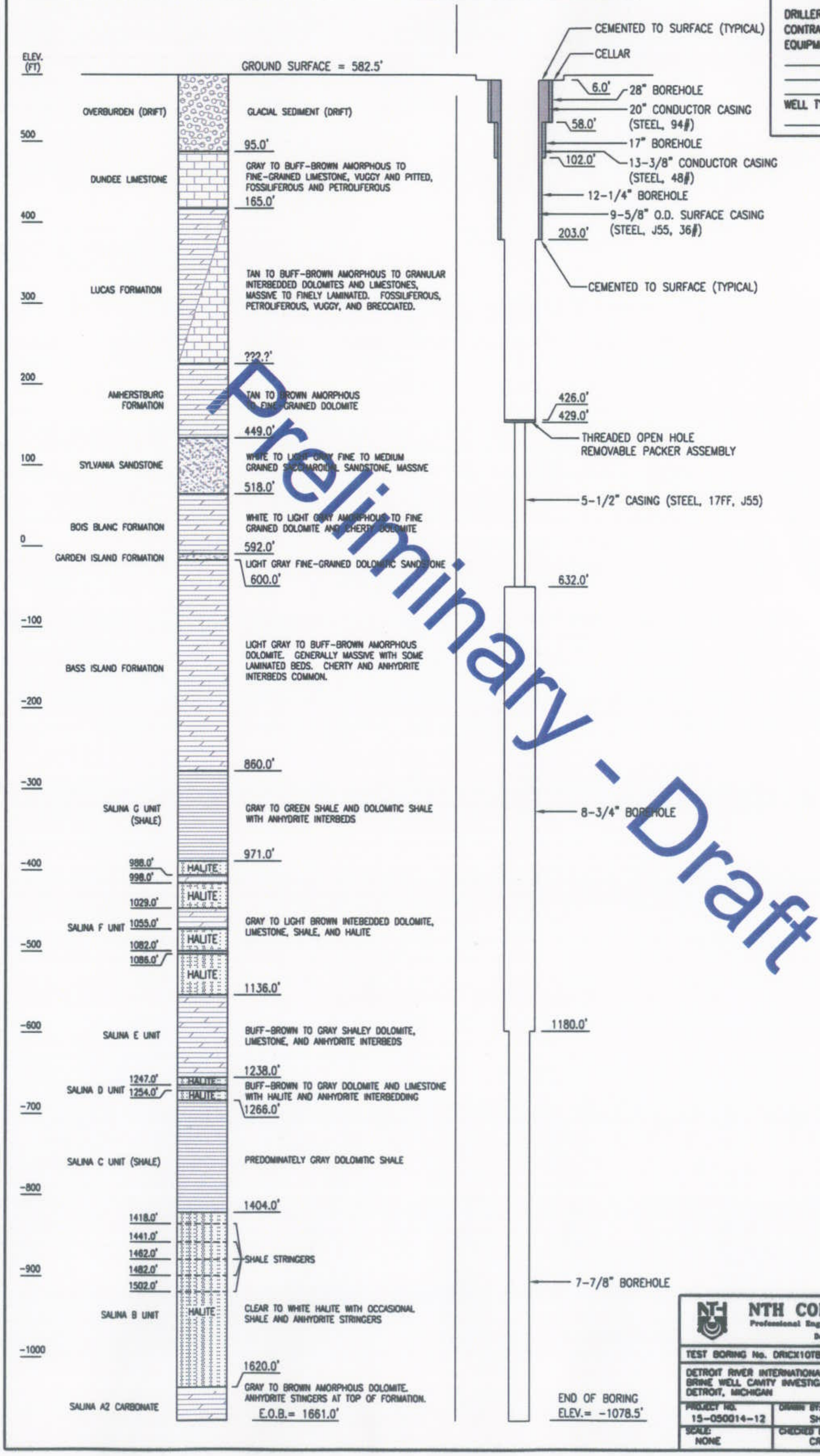
D050014TB1 25 MAY 2007

LOG TEST BORING No. DRICX10TB1 (TB-1)

CLASSIFIED BY:
NTH CONSULTANTS, LTD.

GENERALIZED SUBSURFACE PROFILE	SCHEMATIC

STARTED: 31 JAN 2007
COMPLETED: 01 MAY 2007
TEST BORING: TB-1
INSPECTORS: M. FIRESTONE
S. GOLE
K. WARNING
DRILLERS: B. YAKLIN, R. THATCHER
CONTRACTOR: ADVANCED ENERGY SERVICES
EQUIPMENT: INGERSOLL-RAND TH-55/
WALKER-NEER APACHE
150-25 ROTARY RIG
WELL TYPE: MINERAL WELL



NTH CONSULTANTS, LTD.
Professional Engineering & Environmental Services
Detroit, Michigan

TEST BORING No. DRICX10TB1 (TB-1)

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO.	DRAWN BY:	DATE:	FIGURE NO.
15-050014-12	SHB	25 MAY 2007	
SCALE: NONE	CHECKED BY: CRJ	SHEET 1 OF 1	

D050014TB2 25 MAY 2007

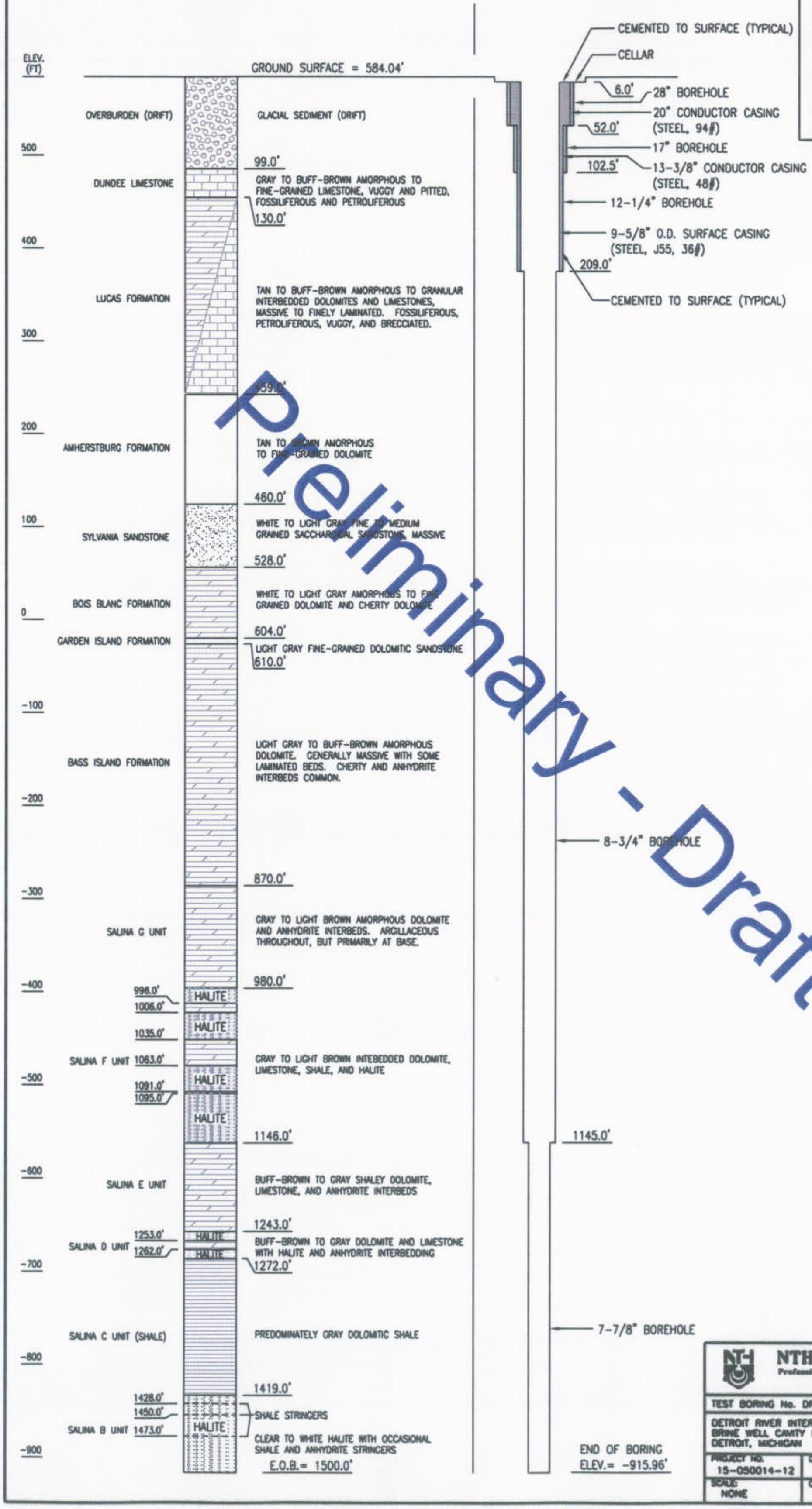
LOG TEST BORING No. DRICX10TB2 (TB-2)

CLASSIFIED BY:
NTH CONSULTANTS, LTD.

GENERALIZED SUBSURFACE PROFILE	SCHEMATIC

STARTED: 02 FEB 2007
COMPLETED: 08 MAR 2007
TEST BORING: TB-2
INSPECTORS: M. FIRESTONE
S. GOLE
K. WARNING
DRILLERS: B. YAKLIN, R. THATCHER
CONTRACTOR: ADVANCED ENERGY SERVICES
EQUIPMENT: INGERSOLL-RAND TH-55/
WALKER-NEER APACHE
150-25 ROTARY RIG

WELL TYPE: MINERAL WELL



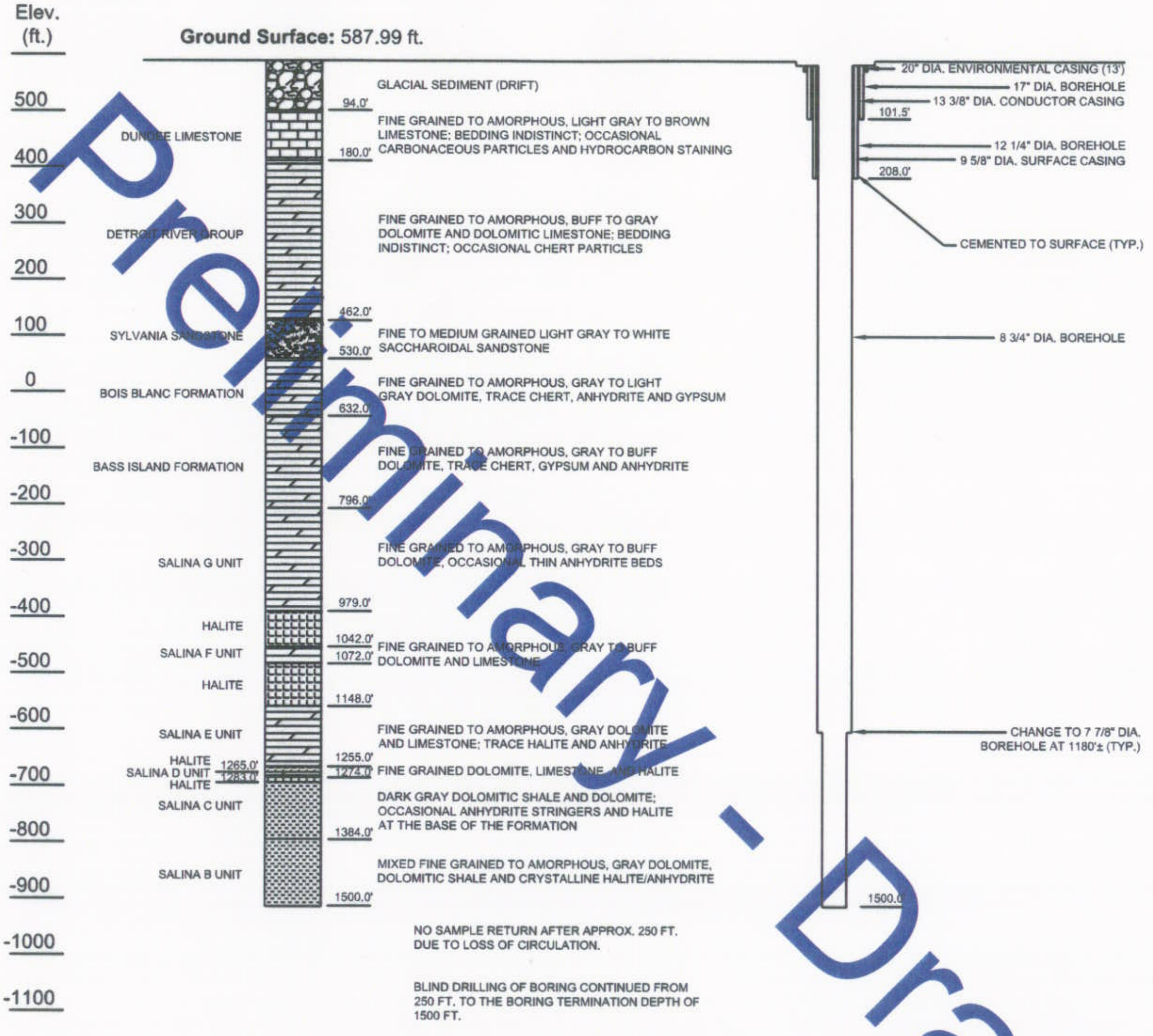
NTH CONSULTANTS, LTD.
Professional Engineering & Environmental Services
Detroit, Michigan

TEST BORING No. DRICX10TB2 (TB-2)

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO.	DRAWN BY:	DATE:	FIGURE NO.
15-050014-12	SHB	25 MAY 2007	
SCALE: NONE	CHECKED BY: CRJ	SHEET 1 OF 1	•

Boring Log: TB-4	
Boring Classified By: SOMAT Engineering, Inc.	


Generalized Subsurface Profile

Schematic

Test Boring No.:	TB-4
Contractor:	Advanced Energy Services
Inspectors:	D. Goeddeke J. Lukasik
Start Date:	3/9/07
Completion Date:	3/13/07

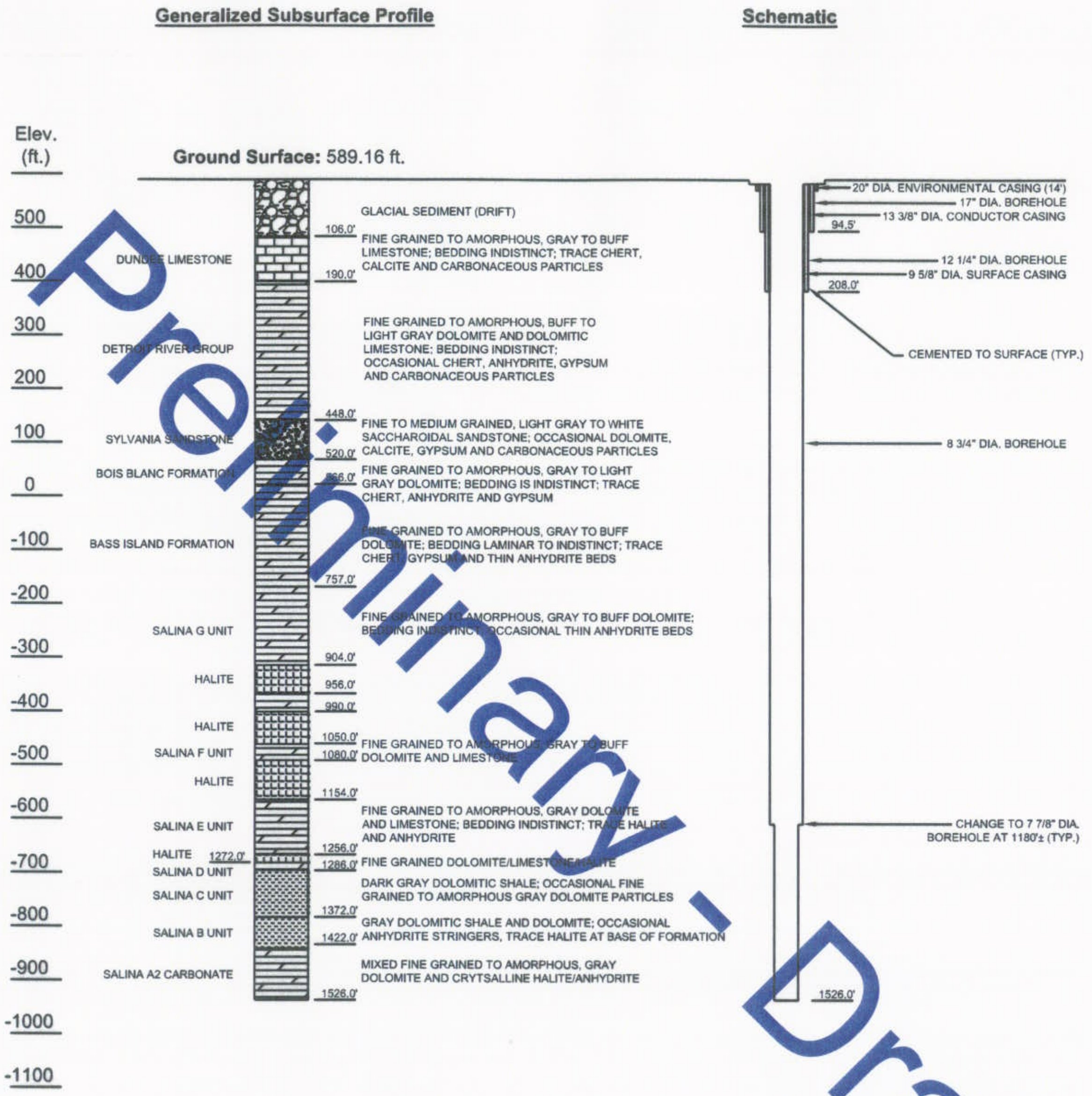
SOMAT Engineering, Inc.
Detroit - Taylor

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO.	C05002A	DATE	9/7/07	SHEET	
DRAWN BY	C. Switonowski	CHECKED BY	SC		

Boring Log: TB-5

Boring Classified By: SOMAT Engineering, Inc.



Generalized Subsurface Profile

Schematic

Test Boring No.:	TB-5
Contractor:	Advanced Energy Services
Inspectors:	D. Goeddeke J. Lukasik
Start Date:	3/14/07
Completion Date:	3/17/07

SOMAT Engineering, Inc.
Detroit - Taylor

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

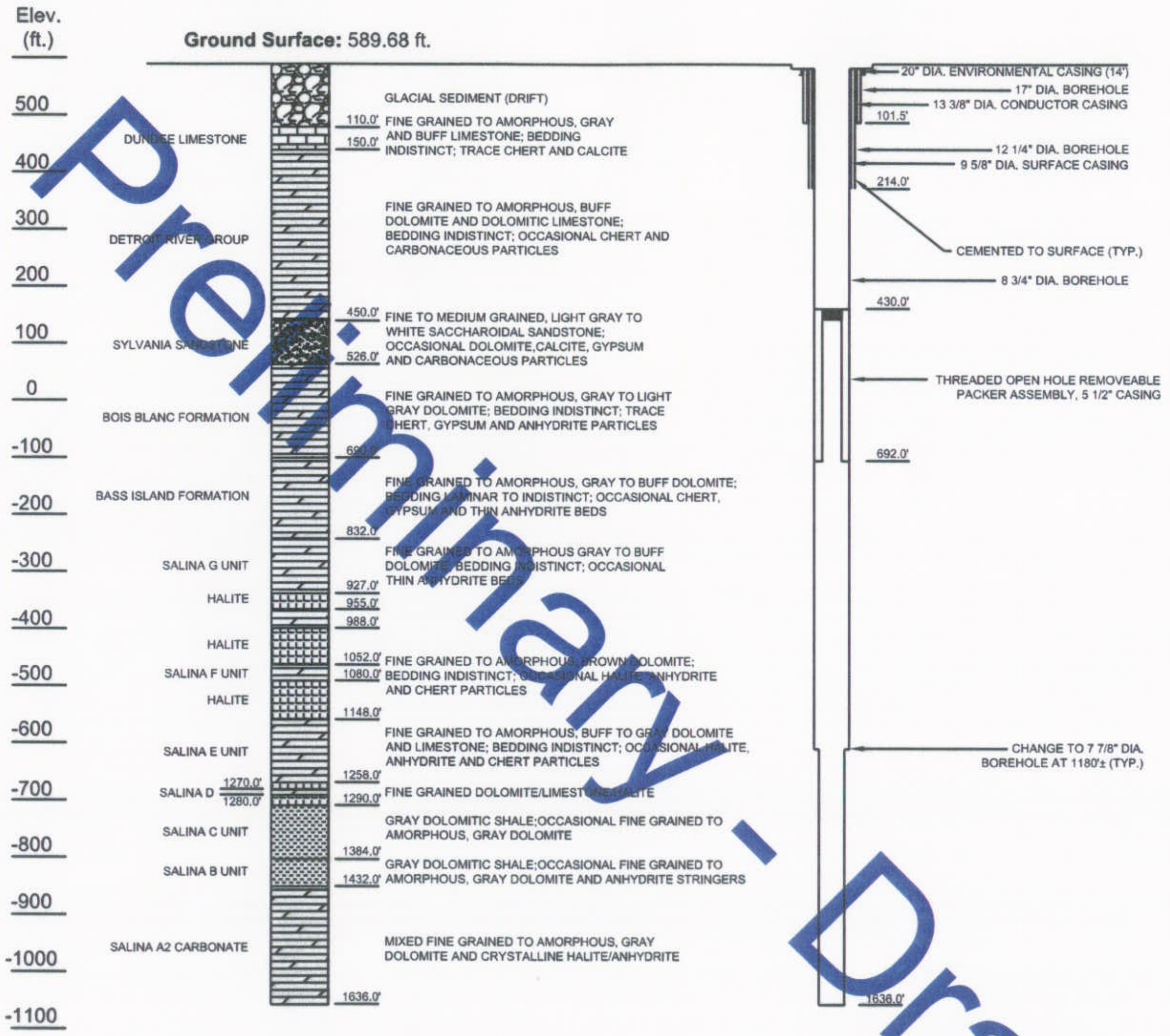
PROJECT NO.	C05002A	DATE	9/7/07	SHEET	
DRAWN BY	S. Coscodden	CHECKED BY	CRS		

Boring Log: TB-6

Boring Classified By: SOMAT Engineering, Inc.

Generalized Subsurface Profile

Schematic



GLACIAL SEDIMENT (DRIFT)

FINE GRAINED TO AMORPHOUS, GRAY AND BUFF LIMESTONE; BEDDING INDISTINCT; TRACE CHERT AND CALCITE

FINE GRAINED TO AMORPHOUS, BUFF DOLOMITE AND DOLOMITIC LIMESTONE; BEDDING INDISTINCT; OCCASIONAL CHERT AND CARBONACEOUS PARTICLES

FINE TO MEDIUM GRAINED, LIGHT GRAY TO WHITE SACCHAROIDAL SANDSTONE; OCCASIONAL DOLOMITE,CALCITE, GYPSUM AND CARBONACEOUS PARTICLES

FINE GRAINED TO AMORPHOUS, GRAY TO LIGHT GRAY DOLOMITE; BEDDING INDISTINCT; TRACE CHERT, GYPSUM AND ANHYDRITE PARTICLES

FINE GRAINED TO AMORPHOUS, GRAY TO BUFF DOLOMITE; BEDDING LAMINAR TO INDISTINCT; OCCASIONAL CHERT, GYPSUM AND THIN ANHYDRITE BEDS

FINE GRAINED TO AMORPHOUS GRAY TO BUFF DOLOMITE; BEDDING INDISTINCT; OCCASIONAL THIN ANHYDRITE BEDS

FINE GRAINED TO AMORPHOUS, BROWN DOLOMITE; BEDDING INDISTINCT; OCCASIONAL HALITE, ANHYDRITE AND CHERT PARTICLES

FINE GRAINED TO AMORPHOUS, BUFF TO GRAY DOLOMITE AND LIMESTONE; BEDDING INDISTINCT; OCCASIONAL HALITE, ANHYDRITE AND CHERT PARTICLES

FINE GRAINED DOLOMITE/LIMESTONE/HALITE

GRAY DOLOMITIC SHALE;OCCASIONAL FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE

GRAY DOLOMITIC SHALE;OCCASIONAL FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE AND ANHYDRITE STRINGERS

MIXED FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE AND CRYSTALLINE HALITE/ANHYDRITE

Test Boring No.: TB-6
Contractor: Advanced Energy Services
Inspectors: J. Lukasik
J. Cunningham
Start Date: 3/18/07
Completion Date: 3/22/07

SOMAT Engineering, Inc.
Detroit - Taylor

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO. C05002A	DATE 9/7/07	SHEET
DRAWN BY S. Coscodden	CHECKED BY CRS	

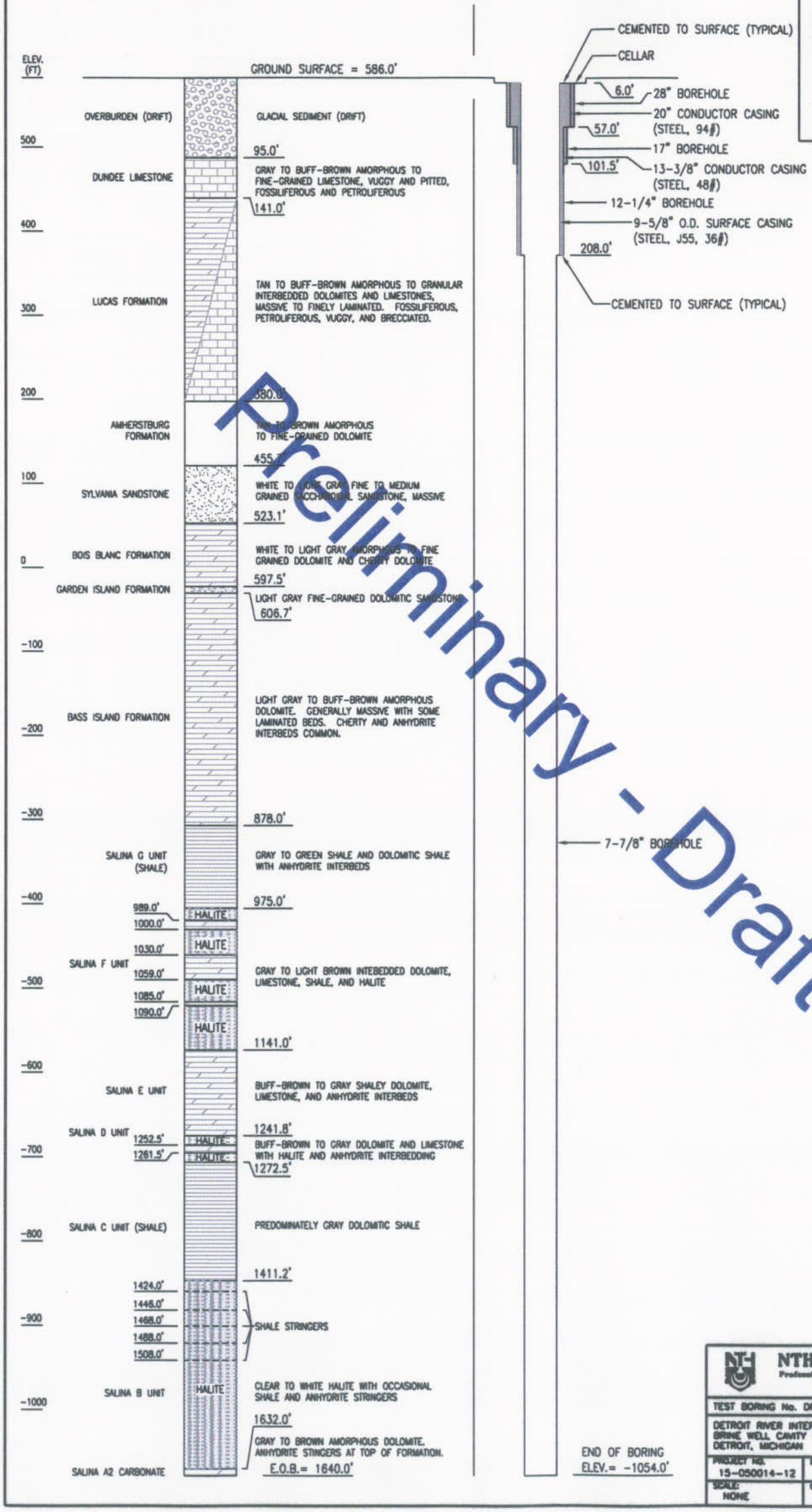
D050014TB7 25 MAY 2007

LOG TEST BORING No. DRICX10TB7 (TB-7)

CLASSIFIED BY:
NTH CONSULTANTS, LTD.

GENERALIZED SUBSURFACE PROFILE	SCHEMATIC

STARTED:	28 FEB 2007
COMPLETED:	09 APR 2007
TEST BORING:	TB-7
INSPECTORS:	H. AUDET D. ADLER J. ROSS
DRILLERS:	B. YAKLIN, R. THATCHER
CONTRACTOR:	ADVANCED ENERGY SERVICES
EQUIPMENT:	INGERSOLL-RAND TH-55/ WALKER-NEER APACHE 150-25 ROTARY RIG
WELL TYPE:	MINERAL WELL



NTH CONSULTANTS, LTD.
Professional Engineering & Environmental Services
Detroit, Michigan

TEST BORING No. DRICX10TB7 (TB-7)

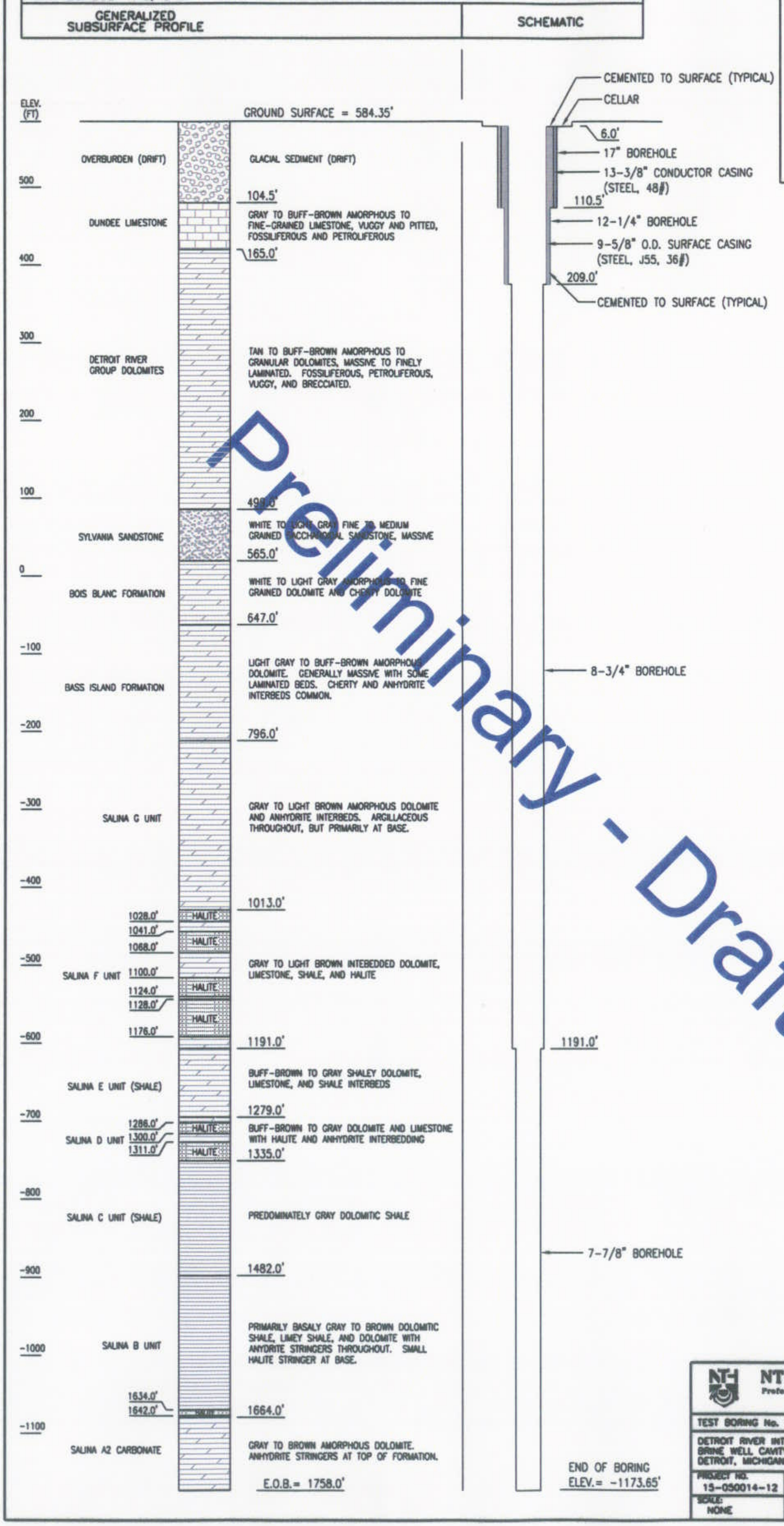
DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO.	DRAWN BY:	DATE:	FIGURE NO.
15-050014-12	SHB	25 MAY 2007	
SCALE: NONE	CHECKED BY: CRJ	SHEET 1 OF 1	•

LOG TEST BORING No. DRICX11TB10 (TB-10)

CLASSIFIED BY:
NTH CONSULTANTS, LTD.

STARTED: 16 JAN 2007
COMPLETED: 09 FEB 2007
TEST BORING: TB-10
INSPECTORS: M. FIRESTONE
S. GOLE
K. WARNING
DRILLERS: B. YAKLIN, R. THATCHER
CONTRACTOR: ADVANCED ENERGY SERVICES
EQUIPMENT: TOP-DRIVE ROTARY
WATER WELL RIB / TOP-
DRIVE ROTARY ROCK RIG
WELL TYPE: MINERAL WELL



NTH CONSULTANTS, LTD.
Professional Engineering & Environmental Services
Detroit, Michigan

TEST BORING No. DRICX11TB10 (TB-10)

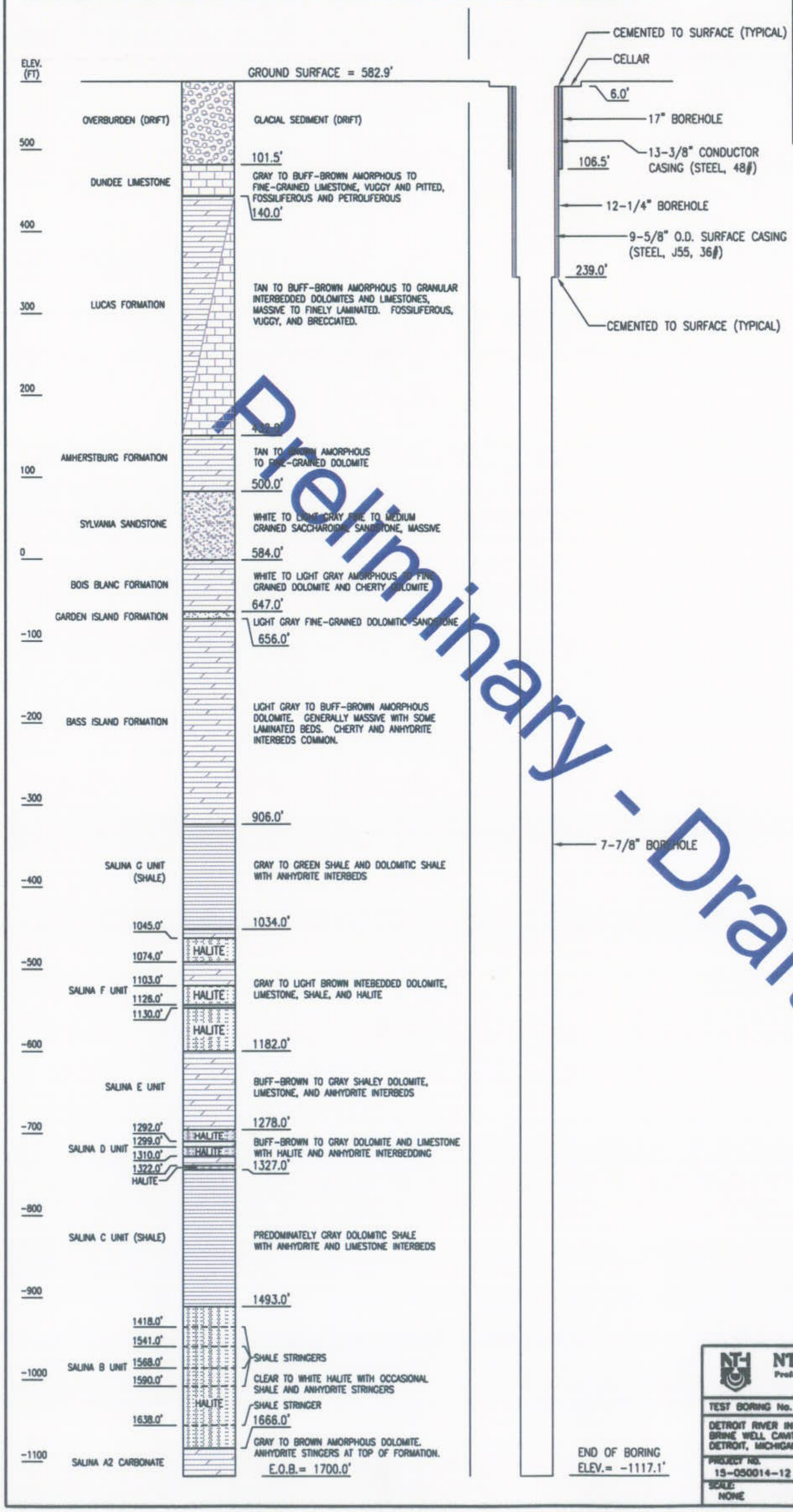
DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO. 15-050014-12	DRAWN BY: SHB	DATE: 19 MAR 2007	FIGURE NO. •
SCALE: NONE	CHECKED BY: CRJ	SHEET 1 OF 1	

LOG TEST BORING No. DRICX11TB11 (TB-11)

CLASSIFIED BY:
NTH CONSULTANTS, LTD.

STARTED:	22 JAN 2007
COMPLETED:	16 APR 2007
TEST BORING:	TB-11
INSPECTORS:	D. ADLER H. AUDET K. WARNING
DRILLERS:	P. CHOJNACKI, K. VESSTAL
CONTRACTOR:	ADVANCED ENERGY SERVICES
EQUIPMENT:	INGERSOLL-RAND TH-55/ WALKER-NEER APACHE 150-25 ROTARY RIG
WELL TYPE:	MINERAL WELL



GROUND SURFACE = 582.9'

OVERBURDEN (DRIFT)	GLACIAL SEDIMENT (DRIFT)	101.5'
DUNDEE LIMESTONE	GRAY TO BUFF-BROWN AMORPHOUS TO FINE-GRAINED LIMESTONE, VUGGY AND PITTED, FOSSILIFEROUS AND PETROLIFEROUS	140.0'
LUCAS FORMATION	TAN TO BUFF-BROWN AMORPHOUS TO GRANULAR INTERBEDDED DOLOMITES AND LIMESTONES, MASSIVE TO FINELY LAMINATED. FOSSILIFEROUS, VUGGY, AND BRECCIATED.	432.0'
AMHERSTBURG FORMATION	TAN TO BROWN AMORPHOUS TO FINE-GRAINED DOLOMITE	500.0'
SYLVANIA SANDSTONE	WHITE TO LIGHT GRAY FINE TO MEDIUM GRAINED SACCHAROIDAL SANDSTONE, MASSIVE	584.0'
BOIS BLANC FORMATION	WHITE TO LIGHT GRAY AMORPHOUS TO FINE GRAINED DOLOMITE AND CHERTY DOLOMITE	647.0'
GARDEN ISLAND FORMATION	LIGHT GRAY FINE-GRAINED DOLOMITIC SANDSTONE	656.0'
BASS ISLAND FORMATION	LIGHT GRAY TO BUFF-BROWN AMORPHOUS DOLOMITE. GENERALLY MASSIVE WITH SOME LAMINATED BEDS. CHERTY AND ANHYDRITE INTERBEDS COMMON.	906.0'
SALINA G UNIT (SHALE)	GRAY TO GREEN SHALE AND DOLOMITIC SHALE WITH ANHYDRITE INTERBEDS	1034.0'
SALINA F UNIT 1045.0' 1074.0' 1103.0' 1126.0' 1130.0'	GRAY TO LIGHT BROWN INTEBEDDED DOLOMITE, LIMESTONE, SHALE, AND HALITE	1182.0'
SALINA E UNIT	BUFF-BROWN TO GRAY SHALEY DOLOMITE, LIMESTONE, AND ANHYDRITE INTERBEDS	1278.0'
SALINA D UNIT 1292.0' 1299.0' 1310.0' 1322.0' HALITE	BUFF-BROWN TO GRAY DOLOMITE AND LIMESTONE WITH HALITE AND ANHYDRITE INTERBEDDING	1327.0'
SALINA C UNIT (SHALE)	PREDOMINATELY GRAY DOLOMITIC SHALE WITH ANHYDRITE AND LIMESTONE INTERBEDS	1493.0'
SALINA B UNIT 1418.0' 1541.0' 1568.0' 1590.0' 1638.0'	SHALE STRINGERS CLEAR TO WHITE HALITE WITH OCCASIONAL SHALE AND ANHYDRITE STRINGERS SHALE STRINGER	1666.0'
SALINA A2 CARBONATE	GRAY TO BROWN AMORPHOUS DOLOMITE. ANHYDRITE STINGERS AT TOP OF FORMATION.	E.O.B.= 1700.0'

END OF BORING
ELEV.= -1117.1'

NTH CONSULTANTS, LTD.
Professional Engineering & Environmental Services
Detroit, Michigan

TEST BORING No. DRICX11TB11 (TB-11)

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO. 15-050014-12	DRAWN BY: SHB	DATE: 25 MAY 2007	FIGURE NO.
SCALE: NONE	CHECKED BY: CRJ	SHEET 1 OF 1	•

D050014TB12 15 MAR 2007

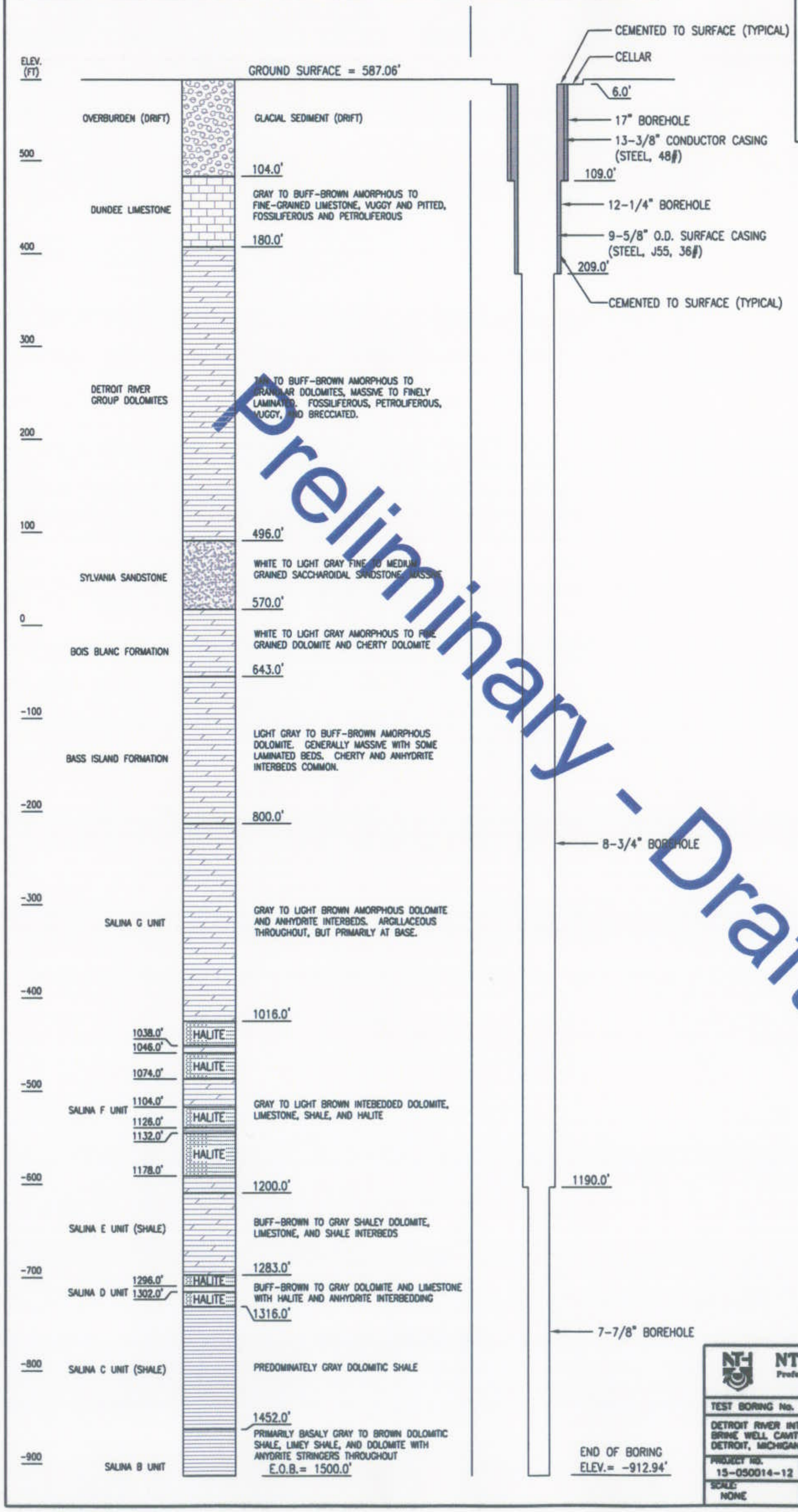
LOG TEST BORING No. DRICX11TB12 (TB-12)

CLASSIFIED BY:
NTH CONSULTANTS, LTD.

STARTED:	16 JAN 2007
COMPLETED:	14 FEB 2007
TEST BORING:	TB-12
INSPECTORS:	M. FIRESTONE S. GOLE K. WARNING
DRILLERS:	B. YAKLIN, R. THATCHER
CONTRACTOR:	ADVANCED ENERGY SERVICES
EQUIPMENT:	TOP-DRIVE ROTARY WATER WELL RIG / TOP-DRIVE ROTARY ROCK RIG
WELL TYPE:	MINERAL WELL

GENERALIZED SUBSURFACE PROFILE

SCHEMATIC



OVERBURDEN (DRIFT)	GLACIAL SEDIMENT (DRIFT)
DUNDEE LIMESTONE	GRAY TO BUFF-BROWN AMORPHOUS TO FINE-GRAINED LIMESTONE, VUGGY AND PITTED, FOSSILIFEROUS AND PETROLIFEROUS
DETROIT RIVER GROUP DOLOMITES	TAN TO BUFF-BROWN AMORPHOUS TO GRANULAR DOLOMITES, MASSIVE TO FINELY LAMINATED. FOSSILIFEROUS, PETROLIFEROUS, VUGGY, AND BRECCIATED.
SYLVANIA SANDSTONE	WHITE TO LIGHT GRAY FINE TO MEDIUM GRAINED SACCHAROIDAL SANDSTONE, MASSIVE
BOIS BLANC FORMATION	WHITE TO LIGHT GRAY AMORPHOUS TO FINE GRAINED DOLOMITE AND CHERTY DOLOMITE
BASS ISLAND FORMATION	LIGHT GRAY TO BUFF-BROWN AMORPHOUS DOLOMITE. GENERALLY MASSIVE WITH SOME LAMINATED BEDS. CHERTY AND ANHYDRITE INTERBEDS COMMON.
SALINA G UNIT	GRAY TO LIGHT BROWN AMORPHOUS DOLOMITE AND ANHYDRITE INTERBEDS. ARGILLACEOUS THROUGHOUT, BUT PRIMARILY AT BASE.
SALINA F UNIT	GRAY TO LIGHT BROWN INTEBEDDED DOLOMITE, LIMESTONE, SHALE, AND HALITE
SALINA E UNIT (SHALE)	BUFF-BROWN TO GRAY SHALEY DOLOMITE, LIMESTONE, AND SHALE INTERBEDS
SALINA D UNIT	BUFF-BROWN TO GRAY DOLOMITE AND LIMESTONE WITH HALITE AND ANHYDRITE INTERBEDDING
SALINA C UNIT (SHALE)	PREDOMINATELY GRAY DOLOMITIC SHALE
SALINA B UNIT	PRIMARILY BASALY GRAY TO BROWN DOLOMITIC SHALE, LIMEY SHALE, AND DOLOMITE WITH ANYDRITE STRINGERS THROUGHOUT

E.O.B.= 1500.0'

NTH CONSULTANTS, LTD.
Professional Engineering & Environmental Services
Detroit, Michigan

TEST BORING No. DRICX11TB12 (TB-12)

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

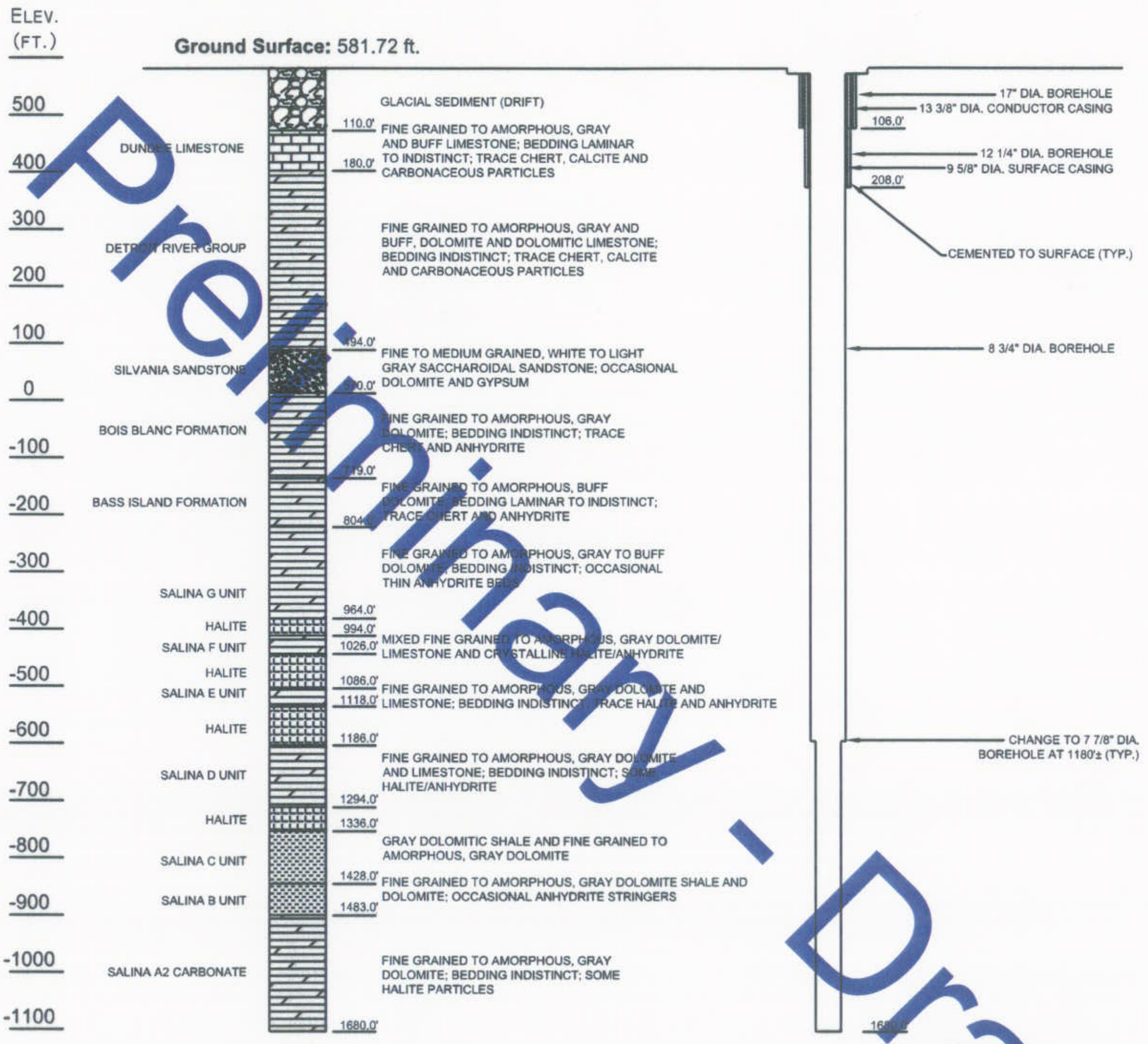
PROJECT NO. 15-050014-12	DRAWN BY: SHB	DATE: 15 MAR 2007	FIGURE NO.
SCALE: NONE	CHECKED BY: CRJ	SHEET 1 OF 1	•

Boring Log: TB-13	
Boring Classified By: SOMAT Engineering, Inc.	

Generalized Subsurface Profile

Schematic

Ground Surface: 581.72 ft.



GLACIAL SEDIMENT (DRIFT)

FINE GRAINED TO AMORPHOUS, GRAY AND BUFF LIMESTONE; BEDDING LAMINAR TO INDISTINCT; TRACE CHERT, CALCITE AND CARBONACEOUS PARTICLES

FINE GRAINED TO AMORPHOUS, GRAY AND BUFF, DOLOMITE AND DOLOMITIC LIMESTONE; BEDDING INDISTINCT; TRACE CHERT, CALCITE AND CARBONACEOUS PARTICLES

FINE TO MEDIUM GRAINED, WHITE TO LIGHT GRAY SACCHAROIDAL SANDSTONE; OCCASIONAL DOLOMITE AND GYPSUM

FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE; BEDDING INDISTINCT; TRACE CHERT AND ANHYDRITE

FINE GRAINED TO AMORPHOUS, BUFF DOLOMITE; BEDDING LAMINAR TO INDISTINCT; TRACE CHERT AND ANHYDRITE

FINE GRAINED TO AMORPHOUS, GRAY TO BUFF DOLOMITE; BEDDING INDISTINCT; OCCASIONAL THIN ANHYDRITE BEDS

MIXED FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE/ LIMESTONE AND CRYSTALLINE HALITE/ANHYDRITE

FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE AND LIMESTONE; BEDDING INDISTINCT; TRACE HALITE AND ANHYDRITE

FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE AND LIMESTONE; BEDDING INDISTINCT; SOME HALITE/ANHYDRITE

GRAY DOLOMITIC SHALE AND FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE

FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE SHALE AND DOLOMITE; OCCASIONAL ANHYDRITE STRINGERS

FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE; BEDDING INDISTINCT; SOME HALITE PARTICLES

Test Boring No.:	TB-13
Contractor:	Advanced Energy Services
Inspectors:	J. Lukasik
	J. Cunningham
Start Date:	3/23/07
Completion Date:	3/28/07

SOMAT Engineering, Inc.
Detroit - Taylor

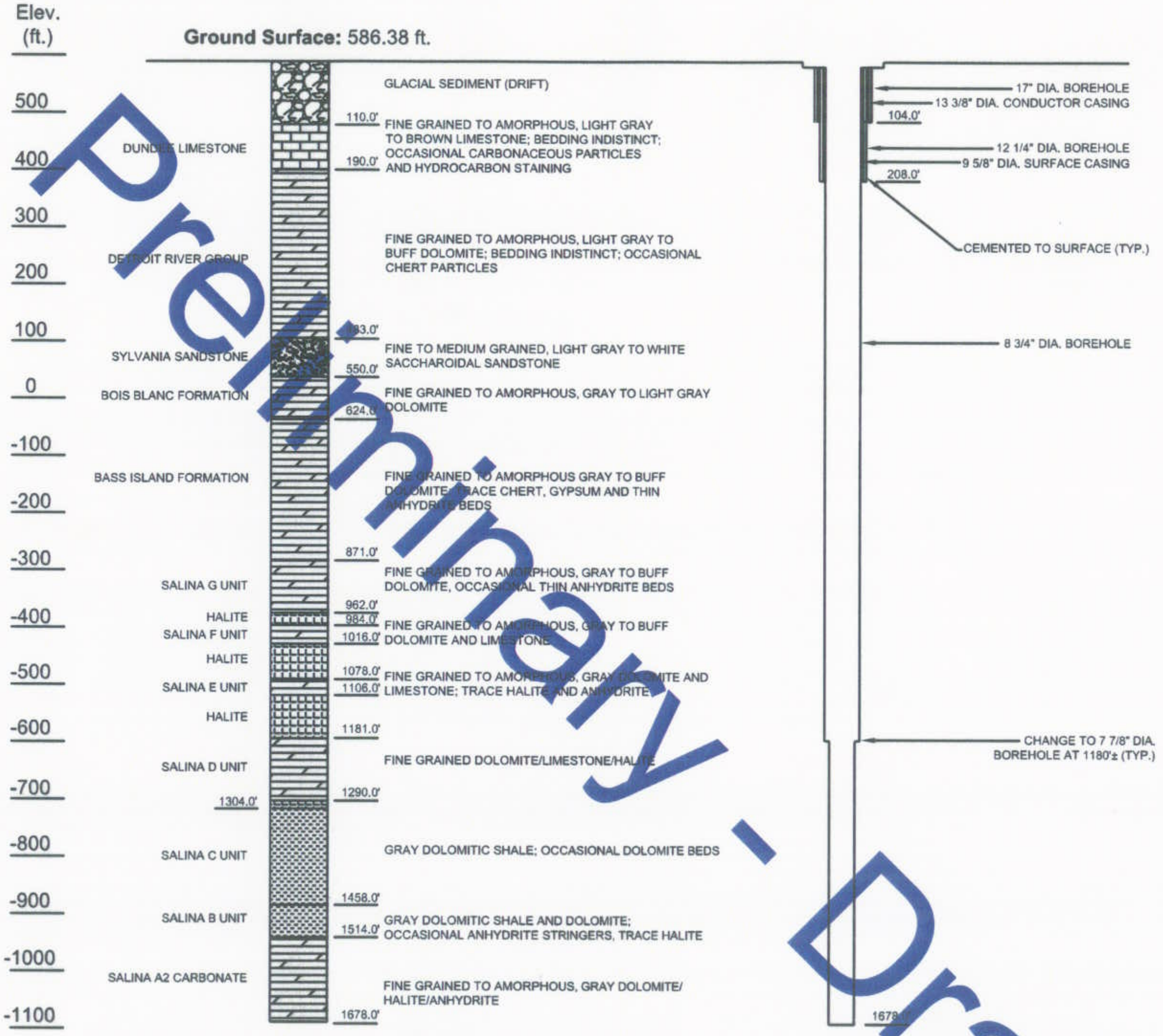
DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO. C05002A	DATE 9/7/07		SHEET
DRAWN BY S. Coscodden		CHECKED BY CRS	

Boring Log: TB-14

Boring Classified By: SOMAT Engineering, Inc.

Generalized Subsurface Profile



NO SAMPLE RETURN AFTER APPROX. 290 FT. DUE TO LOSS OF CIRCULATION.

BLIND DRILLING OF BORING CONTINUED FROM 290 FT. TO THE BORING TERMINATION DEPTH OF 1678 FT.

Test Boring No.: TB-14
Contractor: Advanced Energy Services
Inspectors: J. Lukasik
J. Cunningham
Start Date: 3/29/07
Completion Date: 4/5/07

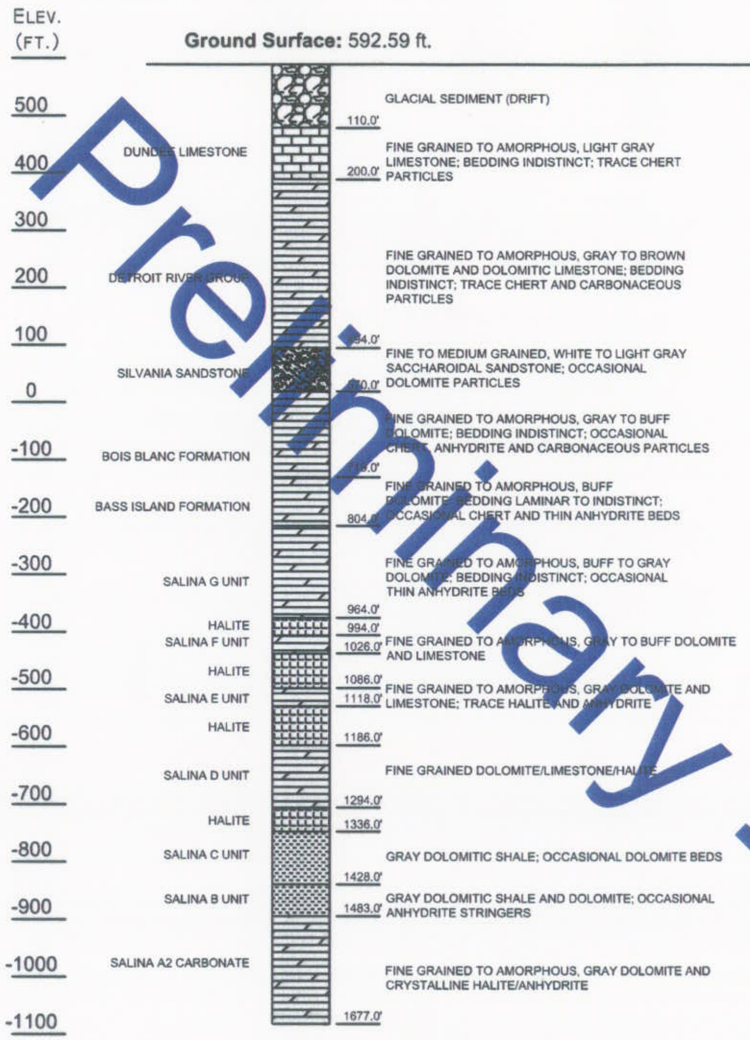
SOMAT Engineering, Inc.
Detroit - Taylor

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO.	C05002A	DATE	9/7/07	SHEET	
DRAWN BY	C. Switonowski	CHECKED BY	SC		

Boring Log: TB-15
Boring Classified By: SOMAT Engineering, Inc.

Generalized Subsurface Profile



GLACIAL SEDIMENT (DRIFT)

FINE GRAINED TO AMORPHOUS, LIGHT GRAY LIMESTONE; BEDDING INDISTINCT; TRACE CHERT PARTICLES

FINE GRAINED TO AMORPHOUS, GRAY TO BROWN DOLOMITE AND DOLOMITIC LIMESTONE; BEDDING INDISTINCT; TRACE CHERT AND CARBONACEOUS PARTICLES

FINE TO MEDIUM GRAINED, WHITE TO LIGHT GRAY SACCHAROIDAL SANDSTONE; OCCASIONAL DOLOMITE PARTICLES

FINE GRAINED TO AMORPHOUS, GRAY TO BUFF DOLOMITE; BEDDING INDISTINCT; OCCASIONAL CHERT, ANHYDRITE AND CARBONACEOUS PARTICLES

FINE GRAINED TO AMORPHOUS, BUFF DOLOMITE; BEDDING LAMINAR TO INDISTINCT; OCCASIONAL CHERT AND THIN ANHYDRITE BEDS

FINE GRAINED TO AMORPHOUS, BUFF TO GRAY DOLOMITE; BEDDING INDISTINCT; OCCASIONAL THIN ANHYDRITE BEDS

FINE GRAINED TO AMORPHOUS, GRAY TO BUFF DOLOMITE AND LIMESTONE

FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE AND LIMESTONE; TRACE HALITE AND ANHYDRITE

FINE GRAINED DOLOMITE/LIMESTONE/HALITE

GRAY DOLOMITIC SHALE; OCCASIONAL DOLOMITE BEDS

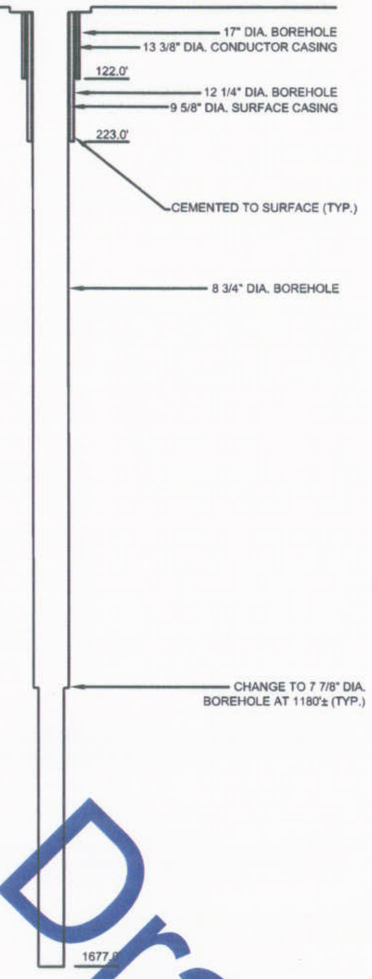
GRAY DOLOMITIC SHALE AND DOLOMITE; OCCASIONAL ANHYDRITE STRINGERS

FINE GRAINED TO AMORPHOUS, GRAY DOLOMITE AND CRYSTALLINE HALITE/ANHYDRITE

NO SAMPLE RETURN AFTER APPROX. 960 FT. DUE TO LOSS OF CIRCULATION.

BLIND DRILLING OF BORING CONTINUED FROM 960 FT. TO THE BORING TERMINATION DEPTH OF 1677 FT.

Schematic



Test Boring No.:	TB-15
Contractor:	Advanced Energy Services
Inspectors:	J. Lukasik J. Cunningham
Start Date:	4/12/07
Completion Date:	4/15/07

SOMAT Engineering, Inc.
Detroit - Taylor

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

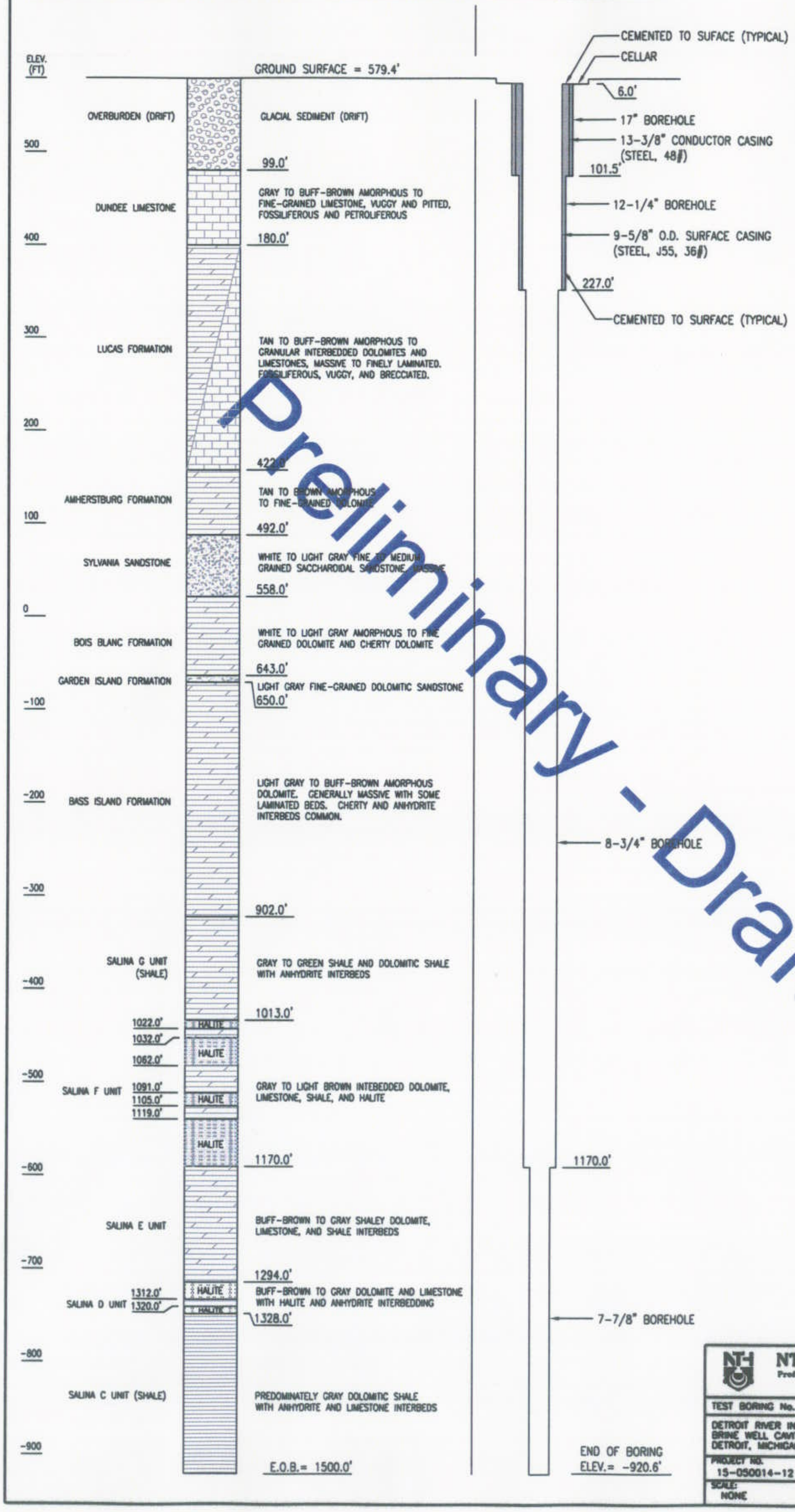
PROJECT NO.	C05002A	DATE	9/7/07	SHEET	
DRAWN BY	S. Coscodden	CHECKED BY	CRS		

LOG TEST BORING No. DRICX11TB16 (TB-16)

CLASSIFIED BY:
NTH CONSULTANTS, LTD.

GENERALIZED SUBSURFACE PROFILE	SCHEMATIC

STARTED: 18 JAN 2007
COMPLETED: 21 FEB 2007
TEST BORING: TB-16
INSPECTORS: M. FIRESTONE
S. GOLE
K. WARNING
DRILLERS: B. YAKLIN, R. THATCHER
CONTRACTOR: ADVANCED ENERGY SERVICES
EQUIPMENT: INGERSOLL-RAND TH-55/
WALKER-NEER APACHE
150-25 ROTARY RIG
WELL TYPE: MINERAL WELL



NTH CONSULTANTS, LTD.
Professional Engineering & Environmental Services
Detroit, Michigan

TEST BORING No. DRICX11TB16 (TB-16)

DETROIT RIVER INTERNATIONAL CROSSING
BRINE WELL CAVITY INVESTIGATION
DETROIT, MICHIGAN

PROJECT NO.	DRAWN BY:	DATE:	FIGURE NO.
15-050014-12	SHB	25 MAY 2007	
SCALE: NONE	CHECKED BY: CRJ	SHEET 1 OF 1	

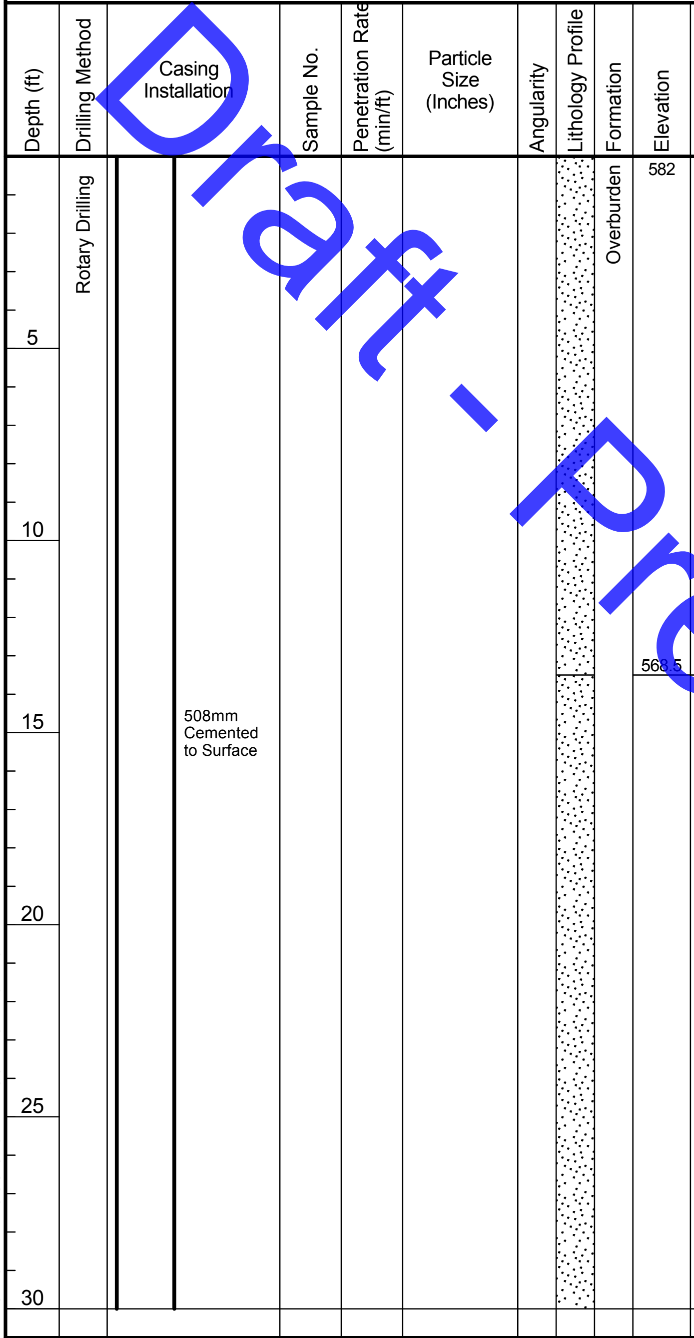
Appendix B

Detroit River International Crossing Study
Logs of Rotary Boring

LOG OF ROTARY BORING NO:
DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

		Inspector	NTH
Project Name:	DRIC Brine Well Investigation	Contractor:	Advanced Energy Services
Project Location:	Detroit, Michigan	Driller:	Rig 7, R. Thatcher, R. Yaklin
NTH Proj. No:	15-050014-12	Drilling Equipment	Walker-Neer Apache 150-25
Drilling Date:	1/31/2007 to 2/27/2007	Checked By:	Z. Carr, P.E., C. Johnson
Borehole Size:	27, 12 1/4, 8 3/4, 7 7/8 inches	Lat/Long. Location:	Lat. 42.2896 Long. -83.1022



Subsurface Profile

Ground Surface Elevation: 582.0

Elevation	Subsurface Profile	Notes
582	FILL: SAND with Varying Amounts of Silt, Clay, Gravel, Concrete and Asphalt Debris, and Organic Material	
568.5	SAND with Trace Clay, Silt and Gravel	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
35 40 45 50	Rotary Drilling	508mm Cemented to Surface					⁘	Overburden		SAND with Trace Clay, Silt and Gravel	
55 60		Elev 524 Depth 58 339.7mm Cemented to Surface					▨		527	Soft gray SILTY CLAY with Trace Sand and Gravel	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling						▨	Overburden		Soft gray SILTY CLAY with Trace Sand and Gravel	
70							▨				
75							▨				
80		339.7mm Cemented to Surface					▨		502	HARDPAN: Hard Gray SILTY CLAY with Trace Sand and Gravel	
85							▨				
90							▨				
95							▦	Dundee Limestone	487	LIMESTONE (Weathered)	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
100	Rotary Drilling	339.7mm Cemented to Surface Elev 480 Depth 102						Dundee Limestone	480	LIMESTONE (Weathered)	
105			BS-1	5	1/64 to 3/8	A			472	White and Brown Amorphous to Fine Grained LIMESTONE with Occasional Carbonaceous Banding and Chert Nodules	Petroleum Odor Noted.
110											
115		244.5mm Cemented to Surface Open-hole Below 203'	BS-2	7.8	1/64 to 3/8	A			462	Light Brown Fine Grained LIMESTONE with Occasional Fossils	Occasional Cement Present in Sample.
120											
125			BS-3	6.7	1/64 to 3/8	A			452	Light Brown and Gray Fine Grained LIMESTONE	
130										Light Brown, Tan, and Gray Fine Grained LIMESTONE with Occasional Fossils	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
135	Rotary Drilling		BS-4	5.8	1/64 to 3/8	A		Dundee Limestone		Light Brown, Tan, and Gray Fine Grained LIMESTONE with Occasional Fossils	
140									442	Tan and Brown Amorphous to Fine Grained LIMESTONE with Occasional to Frequent Carbonaceous Banding	
145			BS-5	6.2	1/64 to 1/3	A					Mild Petroleum Odor Noted.
150		244.5mm Cemented to Surface Open-hole Below 203'							432	Tan and Brown Fine Grained LIMESTONE with Occasional Carbonaceous Banding and Anhydrite	
155			BS-6	5.9	1/64 to 2/3	A					
160									422	Brown and Gray Fine Grained LIMESTONE and Tan Fine Grained DOLOMITE with Occasional Carbonaceous Banding	
165			BS-7	4.7	1/64 to 1/2	A				DRG - Lucas Formation Top EL 417.0	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
170	Rotary Drilling							DRG - Lucas Formation	412	Tan, Brown, and Gray Fine Grained DOLOMITE with Occasional Carbonaceous Banding	
175			BS-8	5.4	1/64 to 2/3	A					
180									402	Light Brown, Tan, and Gray Fine to Medium Grained DOLOMITE with Occasional Carbonaceous Banding and Anhydrite	
185		244.5mm Cemented to Surface Open-hole Below 203'	BS-9	5.1	1/64 to 2/3	A					
190									392	Tan, Brown, and Gray Fine to Medium Grained DOLOMITE with Occasional Carbonaceous Banding	
195			BS-10	6.1	1/64 to 2/3	A					
200									382	Light Brown and Tan Fine Grained DOLOMITE with Occasional Carbonaceous Banding and Anhydrite DRG - Amherstburg Formation Top EL 202.0	
		Elev 379 Depth 203									

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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LOG OF ROTARY BORING NO:

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
205	Rotary Drilling		BS-11	6.6	1/64 to 2/3	A		DRG - Lucas Formation		Light Brown and Tan Fine Grained DOLOMITE with Occasional Carbonaceous Banding and Anhydrite	Occasional Cement Present in Sample.
210									372	Massive Interbedded ANHYDRITE (210' to 212') (EL 372 to 370) Light Brown, Tan, and Gray Fine-Grained DOLOMITE with Occasional Anhydrite	
215			BS-12	5.1	1/64 to 3/8	A					Occasional Cement Present in Sample.
220									362	Light Brown and Tan Fine Grained DOLOMITE With Occasional Shale Partings, Carbonaceous Banding, and Anhydrite	
225			BS-13	4.9	1/64 to 2/3	A					Occasional Cement Present in Sample.
230									352	Light Brown and Tan Fine to Coarse Grained DOLOMITE with Occasional Carbonaceous Banding	
235			BS-14	5	1/64 to 1/2	A				Tan and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE (236' to 242') (EL 346 to 340)	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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LOG OF ROTARY BORING NO:

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
240	Rotary Drilling							DRG - Lucas Formation	342		
245			BS-15	3.3	1/64 to 1/2	A				Brown Fine Grained DOLOMITE with Occasional Shale Stringers and Carbonaceous Banding	Mild Hydrocarbon Odor Noted. Occasional Cement Present in Sample.
250									332	Brown Fine Grained DOLOMITE with Occasional Shale Partings, Carbonaceous Banding, and Trace Anhydrite	
255			BS-16	3.2	1/64 to 1/2	A					
260									322	Brown Fine Grained DOLOMITE and DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding, Anhydrite, and Fossils	
265			BS-17	3.5	1/64 to 3/8	A					
270									312	Brown Fine to Coarse Grained DOLOMITE and DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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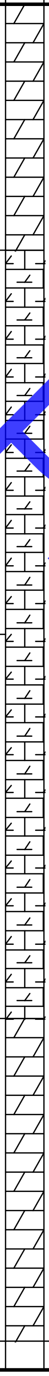
Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
275	Rotary Drilling		BS-18	3	1/64 to 3/8	A	DRG - Lucas Formation		Brown Fine to Coarse Grained DOLOMITE and DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding	Hydrocarbon Odor Noted.
280								302	Tan and Brown Fine to Coarse Grained DOLOMITIC LIMESTONE with Occasional Shale Partings	
285			BS-19	6.9	1/64 to 3/8	A				
290								292	Brown and Gray Fine Grained DOLOMITE with Occasional Shale Stringers and Anhydrite	
295			BS-20	3.3	1/64 to 1/2	A				
300								282	Brown and Gray Fine Grained DOLOMITIC LIMESTONE with Occasional Shale Partings and Anhydrite	
305			BS-21	4.3	1/64 to 1/2	A				



NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
310	Rotary Drilling							DRG - Lucas Formation	272	Brown and Gray Amorphous to Fine Grained DOLOMITE with Occasional Shale Partings	
315			BS-22	2	1/64 to 1/2	A					
320									262	Light Brown and Tan Fine Grained Interbedded DOLOMITE and LIMESTONE with Occasional Shale Partings	
325			BS-23	1.5	1/64 to 3/8	A					
330									252	Light Brown and Gray Fine Grained Interbedded DOLOMITE and LIMESTONE with Occasional Shale Partings	
335			BS-24	2.2	1/64 to 3/8	A					
340									242	Brown and Gray Amorphous to Fine Grained Interbedded DOLOMITE and LIMESTONE with Occasional Shale Partings and Trace Anhydrite	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
345 350	Rotary Drilling		BS-25	2.6	1/64 to 1/2	A		DRG - Lucas Formation	232	Brown and Gray Amorphous to Fine Grained Interbedded DOLOMITE and LIMESTONE with Occasional Shale Partings and Trace Anhydrite	
355 360			BS-26	2.2	1/64 to 3/8	A			222	Brown and Gray Amorphous to Fine Grained DOLOMITE with Occasional Shale Partings and Trace Anhydrite	
365 370			BS-27	2.7	1/64 to 3/8	A			212	Light Brown and Gray Amorphous to Fine Grained DOLOMITE with Occasional Carbonaceous Banding and Anhydrite	
375			BS-28	2.8	1/64 to 1/2	A				Light to Medium Brown and Gray Amorphous to Fine Grained DOLOMITE with Trace Anhydrite Tan LIMESTONE (372' to 374') (EL 210 to 208) Light to Medium Brown and Gray Amorphous to Fine Grained DOLOMITE with Anhydrite Tan LIMESTONE (376' to 378') (EL206 to 204)	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							DRG - Amherstburg Formation		Light to Medium Brown and Gray Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
380									202	Light to Medium Brown and Gray Amorphous to Fine Grained DOLOMITE with Anhydrite	
385			BS-29	2.5	1/64 to 1/2	A					
390									192	Brown and Gray Amorphous to Fine Grained DOLOMITE with Anhydrite	
395			BS-30	1.8	1/64 to 2/3	A					
400									182	Brown and Gray Amorphous to Fine Grained DOLOMITE with Anhydrite	
405			BS-31	2.2	1/64 to 1/2	A					
410									172	Gray and Brown Amorphous to Fine Grained DOLOMITE	

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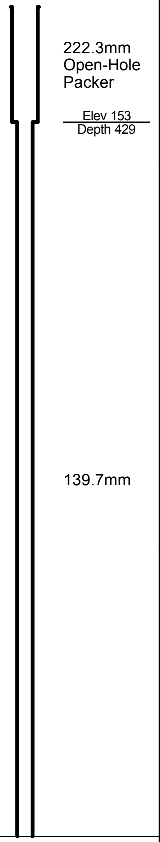

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
415 420	Rotary Drilling		BS-32	2.1	1/64 to 3/8	A		DRG - Amherstburg Formation	162	Gray and Brown Amorphous to Fine Grained DOLOMITE	
425 430		222.3mm Open-Hole Packer Elev 153 Depth 429	BS-33	2.8	1/64 to 3/8	A			152	Gray and Brown Amorphous to Fine Grained DOLOMITE with Anhydrite	Threaded Open-Hole Removable Packer Installed 426.0 to 429.0 Feet BGS.
435 440		139.7mm	BS-34	2.4	1/64 to 3/8	A			142	Brown and Gray Amorphous to Fine Grained DOLOMITE with Anhydrite	
445			BS-35	2	1/64 to 3/8	A				Brown and Gray Amorphous to Fine Grained DOLOMITE with Anhydrite	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
450	Rotary Drilling								132	Brown and Gray Amorphous to Fine Grained DOLOMITE with Anhydrite DRG - Sylvania Sandstone Top EL 133.00	
455 460			BS-36	1.1	1/64 to 3/8	A		DRG - Sylvania Sandstone	122	White Fine Grained to Medium SANDSTONE	
465 470		139.7mm	NR	1					112	SANDSTONE (from wireline logs)	No Recovery.
475 480			NR	1					102	SANDSTONE (from wireline logs)	No Recovery.
										SANDSTONE (from wireline logs)	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
485	Rotary Drilling		NR	1.2				DRG - Sylvania Sandstone		SANDSTONE (from wireline logs)	No Recovery.
490									92	White Fine Grained SANDSTONE with Little Chert (from wireline logs)	
495			BS	1.2							Low Recovery, No Bag Sample Collected.
500		139.7mm							82	SANDSTONE (from wireline logs)	
505			NR	1.1							No Recovery.
510									72	SANDSTONE (from wireline logs)	
515			NR	1.3							No Recovery.

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Bois Blanc Formation		SANDSTONE (from wireline logs) Bois Blanc Formation Top EL 64.0	
520									62	SANDY DOLOMITE (from wireline logs)	
525			NR	1.8							No Recovery.
530									52	Gray Amorphous to Fine Grained DOLOMITE with Anhydrite	
535		139.7mm	BS-37	1.9	1/64 to 1/3	A					
540									42	Light to Medium Gray Amorphous DOLOMITE	
545			BS-38	2.2	1/64 to 1/3	A					
550									32	Light to Medium Gray Amorphous to Fine Grained DOLOMITE with Interbedded Brown Amorphous LIMESTONE	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Bois Blanc Formation		Light to Medium Gray Amorphous to Fine Grained DOLOMITE with Interbedded Brown Amorphous LIMESTONE	
555			BS-39	2.6	1/64 to 1/3	A					
560									22	Light to Medium Gray Amorphous DOLOMITE with Interbedded Brown LIMESTONE	
565			BS-40	3	1/64 to 3/8	A					
570		139.7mm							12	Light to Medium Gray and Tan Amorphous DOLOMITE	
575			BS-41	3.4	1/64 to 1/3	A					
580									2	Gray and Brown Amorphous DOLOMITE with Occasional Carbonaceous Banding and Trace Anhydrite	
585			BS-42	4	1/64 to 3/8	A					Downhole Survey Performed.

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
590	Rotary Drilling								-8	Gray and Brown Amorphous DOLOMITE with Occasional Carbonaceous Banding and Trace Anhydrite	
595 600			BS-43	1.9	1/64 to 1/3	S		Garden Island Formation	-18.1	Garden Island Formation Top EL -9.0 White to Light Gray Fine Grained Saccharoidal SANDSTONE	Grains Rounded and Frosted
605 610		139.7mm	BS-44	2	1/64 to 1/3	A		Bass Island Formation	-28	Bass Islands Formation Top EL -18.0 Gray and Brown Fine Grained DOLOMITE with Trace Chert and Anhydrite	
615 620			BS-45	2.9	1/64 to 1/5	A			-38	Gray and Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
										Gray and Brown Amorphous to Fine Grained DOLOMITE with Gray Chert	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
625	Rotary Drilling	139.7mm	BS-46	2.8	1/64 to 1/3	A		Bass Island Formation	-48	Gray and Brown Amorphous to Fine Grained DOLOMITE with Gray Chert	
630 635			BS-47	3.2	1/64 to 3/8	A			-58	Gray and Brown Amorphous to Fine Grained DOLOMITE with Gray Chert	
640 645			BS-48	3.2	1/64 to 3/8	A			-68	Gray and Brown Amorphous to Fine Grained DOLOMITE with Trace Chert and Anhydrite	
650 655			BS-49	2.5	1/64 to 3/8	A				Tan and Gray Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	Low Recovery.

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
660	Rotary Drilling							Bass Island Formation	-78	Tan and Gray Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
665			BS-50	2.9	1/64 to 1/3	A				Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	Low Recovery.
670									-88		
675			BS-51	3.4	1/64 to 1/5	A				Tan Amorphous to Fine Grained DOLOMITE	Low Recovery.
680									-98		
685			BS-52	2.5	1/64 to 1/10	A				Tan Amorphous to Fine Grained DOLOMITE	No Recovery at Shale Shaker. Sample Collected from Wellhead.
690									-108	Tan Amorphous to Fine Grained DOLOMITE	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
695	Rotary Drilling		BS-53	2.9	1/64 to 1/10	A		Bass Island Formation		Tan Amorphous to Fine Grained DOLOMITE	Low Recovery.
700									-118	Tan Amorphous to Fine Grained DOLOMITE	
705			BS-54	3.2	1/64 to 1/10	A					Low Recovery.
710									-128	Tan Amorphous to Fine Grained DOLOMITE with Shale Partings	
715			BS-55	3.3	1/64 to 1/10	A					Low Recovery.
720									-138	Tan Amorphous to Fine Grained DOLOMITE with Trace Shale	
725			BS-56	4.4	1/64 to 1/10	A					Low Recovery.

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Bass Island Formation		Tan Amorphous to Fine Grained DOLOMITE with Trace Shale	
730									-148	Gray and Tan Amorphous to Fine Grained DOLOMITE	
735			BS-57	4.4	1/64 to 1/10	A					Low Recovery.
740									-158	Gray Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
745			BS-58	3.9	1/64 to 1/10	A					Low Recovery.
750									-168	Medium to Dark Gray Amorphous to Fine Grained DOLOMITE	
755			BS-59	3.2	1/64 to 1/5	A					
										Massive Interbedded ANHYDRITE (758' to 760') (EL -176 to -178)	
760									-178		

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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LOG OF ROTARY BORING NO:

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NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Bass Island Formation		Brown and Gray Amorphous to Fine Grained DOLOMITE with Trace Anhydrite and Shale	
765			BS-60	3.7	1/64 to 1/5	A					
770									-188	Gray Amorphous to Fine Grained DOLOMITE and SHALE	
775			BS-61	3.1	1/64 to 1/5	A					
780									-198	Gray and Brown Amorphous to Fine Grained DOLOMITE and ANHYDRITE with Trace Shale	
785			BS-62	3.1	1/64 to 1/5	A					
790									-208	Gray Amorphous to Fine Grained DOLOMITE with Anhydrite	
795			BS-63	2.3	1/64 to 1/5	A					

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Bass Island Formation		Gray Amorphous to Fine Grained DOLOMITE with Anhydrite	
800									-218	Dark Gray Fine Grained DOLOMITE with Anhydrite and Shale Partings	
805			BS-64	3	1/64 to 1/5	A					
810									-228	Dark Gray and Light Brown Amorphous to Fine Grained DOLOMITE with Anhydrite and Shale Partings	
815			BS-65	2.9	1/64 to 1/3	A					
							▨			Massive Interbedded ANHYDRITE (816' to 818') (EL -234 to -236)	
820									-238	Dark Gray and Brown Fine Grained DOLOMITE with Anhydrite	
825			BS-66	7.1	1/64 to 3/8	A					Downhole Survey Performed.
830									-248		

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Bass Island Formation		Brown and Dark Gray Amorphous to Fine Grained DOLOMITE and Anhydrite	
835			BS-67	3.8	1/64 to 3/8	A					
840									-258	Dark Gray and Brown Amorphous to Fine Grained DOLOMITE with Anhydrite	
845			BS-68	3.6	1/64 to 1/3	A					
850									-268	Gray Amorphous DOLOMITE with Anhydrite	
855			BS-69	3.9	1/64 to 3/8	A					
										Massive Interbedded ANHYDRITE (856' to 860') (EL -274 to -278)	
860									-278	Salina Group - G Unit (G-Shale) Top EL -278.0 Gray and Brown Amorphous to Fine Grained DOLOMITIC SHALE with Anhydrite	
865			BS-70	3.2							

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling				1/64 to 1/3	A		Salina Group - G Unit (G Shale)		Gray and Brown Amorphous to Fine Grained DOLOMITIC SHALE with Anhydrite	
870									-288	Medium to Dark Gray Amorphous to Fine Grained DOLOMITIC SHALE with Anhydrite	
875			BS-71	3.1	1/64 to 3/8	A					
880									-298	Gray Amorphous to Fine Grained DOLOMITIC SHALE with Anhydrite	
885			BS-72	2.9	1/64 to 3/8	A					
890									-308	Medium to Dark Gray Amorphous to Fine Grained DOLOMITIC SHALE with Anhydrite	
895			BS-73	2.5	1/64 to 3/8	A					
900									-318		

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Salina Group - G Unit (G Shale)		Gray Fine Grained DOLOMITIC SHALE with Occasional Anhydrite	
905			BS-74	2.8	1/64 to 3/8	A					
910									-328	Gray Fine Grained DOLOMITIC SHALE with Occasional Anhydrite	
915			BS-75	2.7	1/64 to 3/8	A					
920									-338	Gray Fine Grained DOLOMITIC SHALE with Occasional Anhydrite	
925			BS-76	2.7	1/64 to 1/3	A					
930									-348	Gray Fine Grained DOLOMITIC SHALE with Occasional Anhydrite	
							▨			Massive Interbedded ANHYDRITE (932' to 934') (EL -350 to -352)	

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling		BS-77	3.3	1/64 to 1/3	A		Salina Group - G Unit (G Shale)		Gray Fine Grained DOLOMITIC SHALE with Occasional Anhydrite	
940									-358	Massive Interbedded ANHYDRITE (939' to 941') (EL -357 to -359)	
										Gray Fine Grained DOLOMITIC SHALE with Occasional Anhydrite	
945			BS-78	3.1	1/64 to 1/3	A					
950									-368	Massive Interbedded ANHYDRITE (949' to 951') (EL -367 to -369)	
										Gray and Brown Fine Grained DOLOMITIC SHALE with Occasional Anhydrite	
955			BS-79	3.2	1/64 to 1/3	A					
										Massive Interbedded ANHYDRITE (956' to 962') (EL -374 to -380)	
960									-378		
										Gray and Brown Fine Grained DOLOMITIC LIMESTONE with Occasional Anhydrite	
965			BS-80	2.9	1/64 to 3/8	A					

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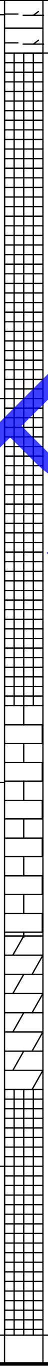
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
970	Rotary Drilling							Salina Group - F Unit (F-Salt)	-388	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F4 Bed) Salina Group - F Unit (F-Salt) Top EL -389.0	
975			BS-81	0.8	1/64 to 1/3	A					
980									-398	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F4 Bed)	
985			BS-82	1.9	1/64 to 1/3	A					
990									-408	Tan and Brown Fine Grained LIMESTONE with Occasional Shale and Anhydrite	
995			BS-83	2.2	1/64 to 1/3	A				Brown and Gray amorphous to Fine Grained DOLOMITE (994' to 998') (EL -412 to -416)	
1000									-418	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F3 Bed)	

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1005	Rotary Drilling		BS-84	0.8	1/64 to 3/8	A	▦	Salina Group - F Unit (F-Salt)	-428	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F3 Bed)	
1010 1015			BS-85	1.6	1/64 to 1/2	A	▦		-438	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F3 Bed)	
1020 1025			BS-86	2.6	1/64 to 3/8	A	▦		-448	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F3 Bed)	
1030 1035			BS-87	4	1/64 to 1/3	A	▨			Tan and Gray Interbedded DOLOMITE and LIMESTONE	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1040	Rotary Drilling							Salina Group - F Unit (F-Salt)	-458	Tan and Brown Amorphous to Fine Grained DOLOMITE with Some Anhydrite Massive Interbedded ANHYDRITE (1042' to 1050') (EL -460 to -468)	
1045			BS-88	4.1	1/64 to 1/5	A					
1050									-468	Tan and Gray Amorphous to Fine Grained DOLOMITE with Shale (1050' to 1055') (EL -468 to -473) Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F2 Bed)	
1055			BS-89	1.3	1/64 to 1/5	A					
1060									-478	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F2 Bed)	
1065			BS-90	1.2	1/64 to 1/3	A					
1070									-488	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F2 Bed)	

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1075	Rotary Drilling		BS-91	1.9	1/64 to 1/3	A		Salina Group - F Unit (F-Salt)		Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (F2 Bed)	
1080									-498	Brown to Gray Opaque HALITE with Anhydrite (F2 Bed) Dark Gray Amorphous DOLOMITIC SHALE (1082' to 1086') (EL -500 to -504)	
1085			BS-92	1.4	1/64 to 1/5	A					
1090									-508	Clear HALITE with Some Dolomite and Anhydrite (F1 Bed)	
1095			BS-93	1.5	1/64 to 1/5	A					
1100									-518	Clear HALITE with Some Dolomite and Anhydrite (F1 Bed)	
1105			BS-94	1.2	1/64 to 1/5	A					

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1110	Rotary Drilling							Salina Group - F Unit (F-Salt)	-528	Clear HALITE with Little Dolomite and Anhydrite (F1 Bed)	
1115			BS-95	1.2	1/64 to 1/3	A					
1120									-538	Clear HALITE with Little Dolomite and Anhydrite (F1 Bed)	
1125			BS-96	1.8	1/64 to 1/5	A					
1130									-548	Clear HALITE with Dolomite and Anhydrite (F1 Bed)	
1135			BS-97	3.1	1/64 to 1/3	A				Salina Group - E Unit (E-Dolomite) Top EL -554.0	
1140									-558	Gray Fine Grained DOLOMITE with Trace Anhydrite	

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Subsurface Profile

Ground Surface Elevation: 582.0

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1145	Rotary Drilling		BS-98	2.5	1/64 to 1/5	A		Salina Group - E Unit (E - Dolomite)		Gray Fine Grained DOLOMITE with Trace Anhydrite	
1150									-568	Gray and Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
1155			BS-99	2.8	1/64 to 1/5	A					
1160									-578	Gray and Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
1165			BS-100	2.5	1/64 to 1/5	A					
1170									-588	Gray and Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
1175			BS-101	3.3	1/64 to 1/5	A					

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Salina Group - E Unit (E - Dolomite)		Gray and Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
1180									-598	Gray and Brown Amorphous DOLOMITE with Trace Anhydrite	
1185			BS-102	5.5	1/64 to 1/5	A					
1190									-608	Brown Amorphous DOLOMITE with Trace Anhydrite	
1195			BS-103	3.2	1/64 to 1/5	A					
1200									-618	Brown Amorphous DOLOMITE with Trace Anhydrite	
1205			BS-104	3.3	1/64 to 1/3	A					Low Recovery.
1210									-628	Brown Amorphous DOLOMITE with Shale and Trace Anhydrite	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Salina Group - E Unit (E - Dolomite)		Brown Amorphous DOLOMITE with Shale and Trace Anhydrite	
1215			BS-105	3.1	1/64 to 1/3	A					
1220									-638	Brown Amorphous DOLOMITE	
1225			BS-106	1.8	1/64 to 1/3	A					
										Massive Interbedded ANHYDRITE (1227' to 1228') (EL -645 to -646)	
1230									-648	Brown Amorphous DOLOMITE with Anhydrite	
1235			BS-107	1.3	1/64 to 1/5	A					
								Salina Group - D Unit (D-Salt)		Salina group - D unit (D-Salt) Top EL -656.0	
1240									-658	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (D3 Bed)	
1245			BS-108	1.3	1/64 to 1/5	A					
										Brown and Gray SHALEY DOLOMITE with	

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Subsurface Profile

Ground Surface Elevation: 582.0

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1250	Rotary Drilling							Salina Group - D Unit (D-Salt)	-668	Anhydrite (1247' to 1254') (EL -665 to -672)	
1255 1260			BS-109	1.7	1/64 to 1/5	A			-678	Brown and Gray Opaque HALITE with Anhydrite and Shaley Banding (D2 Bed)	
1265 1270			BS-110	2.1	1/64 to 1/5	A		Salina Group - C Unit (C-Shale)	-688	Brown to Gray Opaque HALITE with Anhydrite and Shaley Banding (D2 Bed) Salina Group - C Unit (C-Shale) Top EL -684.0	
1275 1280			BS-111	2.3	1/64 to 1/10	A			-698	Gray DOLOMITIC SHALE with Trace Anhydrite	
										Gray DOLOMITIC SHALE with Trace Anhydrite	

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Project Location: Detroit, Michigan

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1285 1290	Rotary Drilling		BS-112	2.2	1/64 to 1/10	A		Salina Group - C Unit (C-Shale)	-708	Gray DOLOMITIC SHALE with Trace Anhydrite Opaque to Gray GYPSUM (1283' to 1285') (EL -701 to -703) Gray SHALE with Trace Anhydrite	
1295 1300			BS-113	2.3	1/64 to 1/5	A			-718	Gray SHALE with Trace Anhydrite	
1305 1310			BS-114	2.7	1/64 to 1/5	A			-728	Gray SHALE with Occasional Anhydrite and Dolomite	
1315			BS-115	2.2	1/64 to 1/5	A				Gray SHALE and Brown and Gray DOLOMITE with Anhydrite	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
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Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1320	Rotary Drilling							Salina Group - C Unit (C-Shale)	-738	Gray SHALE and Brown and Gray DOLOMITE with Anhydrite Massive Interbedded ANHYDRITE (1319' to 1322') (EL -737 to -740)	
										Gray SHALE with Little Dolomite and Anhydrite	
1325			BS-116	2.7	1/64 to 3/8	A					
1330									-748	Gray SHALE and Fine Grained DOLOMITE with Anhydrite	
1335			BS-117	2.7	1/64 to 3/8	A				Massive Interbedded GYPSUM (1336' to 1339') (EL -754 to -757)	
1340									-758	Gray SHALE and Amorphous DOLOMITE with Anhydrite	
1345			BS-118	2.7	1/64 to 3/8	A					
1350									-768	Gray SHALE and Amorphous DOLOMITE with Anhydrite	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1355	Rotary Drilling		BS-119	3	1/64 to 1/5	A		Salina Group - C Unit (C-Shale)		Gray SHALE and Amorphous DOLOMITE with Anhydrite	
1360									-778		
1365			BS-120	2.9	1/64 to 1/5	A				Gray SHALE and DOLOMITE with Anhydrite Massive Interbedded ANHYDRITE (1362' to 1364') (EL -780 to -782)	
1370									-788		
1375			BS-121	2.7	1/64 to 1/5	A				Gray SHALE and DOLOMITE with Occasional Anhydrite	
1380									-798		
1385			BS-122	2.8	1/64 to 1/5	A				Gray SHALE and DOLOMITE with Anhydrite Massive Interbedded ANHYDRITE (1382' to 1382') (EL -800 to -802)	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1390	Rotary Drilling							Salina Group - C Unit (C-Shale)	-808	Gray SHALE and DOLOMITE with Anhydrite	
1395 1400			BS-123	2.7	1/64 to 1/5	A			-818	Massive Interbedded ANHYDRITE (1390' to 1394') (EL -808 to -812) Gray and Brown Fine Grained SHALE and DOLOMITE with Anhydrite (1394' to 1398') (EL -812 to -816) Massive Interbedded ANHYDRITE (1398' to 1404') (EL -816 to -822)	
1405 1410			BS-124	1.7	1/64 to 1/5	A		Salina Group - B Unit (B-Salt)	-828	Gray and Brown Fine Grained SHALE and DOLOMITE with Trace Anhydrite Salina Group - B Unit (B-Salt) Top EL -822.0	
1415 1420			BS-125	1.5	1/64 to 1/5	A			-838	Gray Fine Grained SHALE and Clear and White HALITE Light Gray SHALE with Trace Anhydrite (1416' to 1419') (EL -834 to -837)	
										Clear and White HALITE	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Salina Group - B Unit (B-Salt)		Clear and White HALITE	
1425			BS-126	1.3	1/64 to 1/5	A					
1430									-848	Clear and White HALITE and Brown DOLOMITE	
1435			BS-127	1.4	1/64 to 1/5	A					
										Light Gray SHALE with Trace Gypsum (1438' to 1443') (EL -856 to -861)	
1440									-858	Gray SHALE and Clear HALITE with Trace Anhydrite	Shale Appears Weathered or Muddy.
1445			BS-128	1.7	1/64 to 1/5	A					
1450									-868	Clear and White HALITE with Little Gray Dolomite and Gypsum	
1455			BS-129	1.4	1/64 to 1/5	A					

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Salina Group - B Unit (B-Salt)	-878	Clear and White HALITE with Little Gray Dolomite and Gypsum	
1460										Clear HALITE Light Gray DOLOMITIC SHALE (1461' to 1463') (EL -879 to -881) White HALITE (1463' to 1469') (EL -881 to -887)	
1465			BS-130	1.7	1/64 to 1/5	A					
1470									-888	Light Gray DOLOMITE with Trace Limestone (1469' to 1474') (el -887 to -892)	
1475			BS-131	1.6	1/64 to 1/3	A				Clear and White HALITE (1474' to 1481') (EL -892 to -899)	
1480									-898	Clear and White HALITE with Trace Gray Shale Light Gray SHALE (1481' to 1483') (EL -899 to -901) Clear and White HALITE	
1485			BS-132	1.5	1/64 to 1/3	A					
1490									-908	Clear and White HALITE with Trace Gray Shale	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1495 1500	Rotary Drilling		BS-133	1.1	1/64 to 3/8	A		Salina Group - B Unit (B-Salt)	-918	Clear and White HALITE with Trace Gray Shale	
1505 1510			BS-134	2.3	1/64 to 1/3	A			-928	Clear HALITE with Trace Gray Shale Light to Dark Gray DOLOMITIC SHALE (1501' to 1507') (EL -919 to -925) Clear and White HALITE with Trace Brown and Gray Shale	
1515 1520			BS-135	1.1	1/64 to 1/3	A			-938	Clear and White HALITE with Trace Brown and Gray Shale	Trace Amounts of Orange Halite.
1525			BS-136	1.1	1/64 to 1/3	A				White and Clear HALITE with Little Brown Gypsum	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1530	Rotary Drilling						▦ ▤	Salina Group - B Unit (B-Salt)	-948	White and Clear HALITE with Little Brown Gypsum Dark Gray LIMESTONE (1528' to 1532') (EL -946 to -950)	
1535 1540			BS-137	1.2	1/64 to 1/3	A	▤ ▦		-958	White and Clear HALITE with Trace Brown and Gray Shale and Anhydrite (1532' to 1540') (EL -950 to -958)	
1545 1550			BS-138	1.4	1/64 to 1/3	A	▨ ▦		-968	Light Gray ANHYDRITE with Trace Dolomite 91540' to 1545') (EL -958 to -963) White and Clear HALITE	
1555 1560			BS-139	1	1/64 to 1/3	A	▦		-978	White and Clear HALITE	
							▦			White and Clear HALITE	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Salina Group - B Unit (B-Salt)		White and Clear HALITE	
1565			BS-140	1.3	1/64 to 1/3	A					
										Brown and Gray DOLOMITE with Trace Gypsum (1567' to 1574') (EL -985 to -992)	
1570									-988		
1575			BS-141	1	1/64 to 1/3	A				White and Clear HALITE with Occasional Brown Dolomite and Trace Gypsum (1574' to 1580') (EL -992 to -998)	
1580									-998	Brown and Gray DOLOMITE with Trace Gypsum (1580' to 1584') (EL -998 to -1002)	
1585			BS-142	1	1/64 to 1/5	A				White and Clear HALITE with Little Brown Dolomitic Limestone (1584' to 1588') (EL -1002 to -1006)	
										Massive Interbedded ANHYDRITE (1588' to 1593') (EL-1006 to -1011)	
1590									-1008		
1595			BS-143	1.8	1/64 to 1/5	A				White and Clear HALITE with Little Brown Dolomitic Limestone (1593' to 1598') (EL -1011 to -1016)	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
	Rotary Drilling							Salina Group - B Unit (B-Salt)		Gray interbedded DOLOMITE and ANHYDRITE	
1600									-1018	Gray Interbedded DOLOMITE and ANHYDRITE	
1605			BS-144	1.4	1/64 to 1/5	A					
1610									-1028	Gray to Opaque HALITE with Trace Anhydrite	
1615			BS-145	1.6	1/64 to 1/5	A					
										Massive Interbedded ANHYDRITE (1618' to 1626') (EL -1036 to -1044)	
1620									-1038		
1625			BS-146	2.6	1/64 to 1/5	A					
										Salina Group - A2 Carbonate Top EL -1044.0 Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite	
1630									-1048		

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/12/07

LOG OF ROTARY BORING NO:

DRICX10TB1 (TB-1)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.0	Notes
1635 1640	Rotary Drilling		BS-147	2.4	1/64 to 1/3	A		Salina Group - A2 Carbonate	-1058	Dark Brown Fine Grained DOLOMITIC LIMESTONE and LIMEY DOLOMITE	
1645 1650			BS-148	2.9	1/64 to 1/4	A			-1068	Light to Dark Brown Amorphous to Fine Grained DOLOMITE and LIMEY DOLOMITE	
1655 1660			BS-149	2.9	1/64 to 1/5	A				Light to Dark Brown Fine Grained DOLOMITE and LIMEY DOLOMITE	
1665										End of Boring at 1661 feet.	

NOTES: NTH Inspectors: D. Adler, M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

		Inspector	NTH
Project Name:	DRIC Brine Well Investigation	Contractor:	Advanced Energy Services
Project Location:	Detroit, Michigan	Driller:	Rig 8, K. Vestal, R. Ward
NTH Proj. No:	15-050014-12	Drilling Equipment	Walker-Neer Apache 150-25
Drilling Date:	2/28/2007 to 3/8/2007	Checked By:	Z. Carr, P.E., C. Johnson
Borehole Size:	28, 17, 12 1/4, 8 3/4, 7 7/8 in.	Lat/Long. Location:	Lat. 42.2918 Long. -83.1004

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling							Overburden	584	FILL: SAND with Varying Amounts of Silt, Clay, Gravel, Concrete and Asphalt Debris, and Organic Material	
5											
10											
15		508mm Cemented to Surface							569	SAND with Trace Clay and Silt	
20											
25											
30											

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

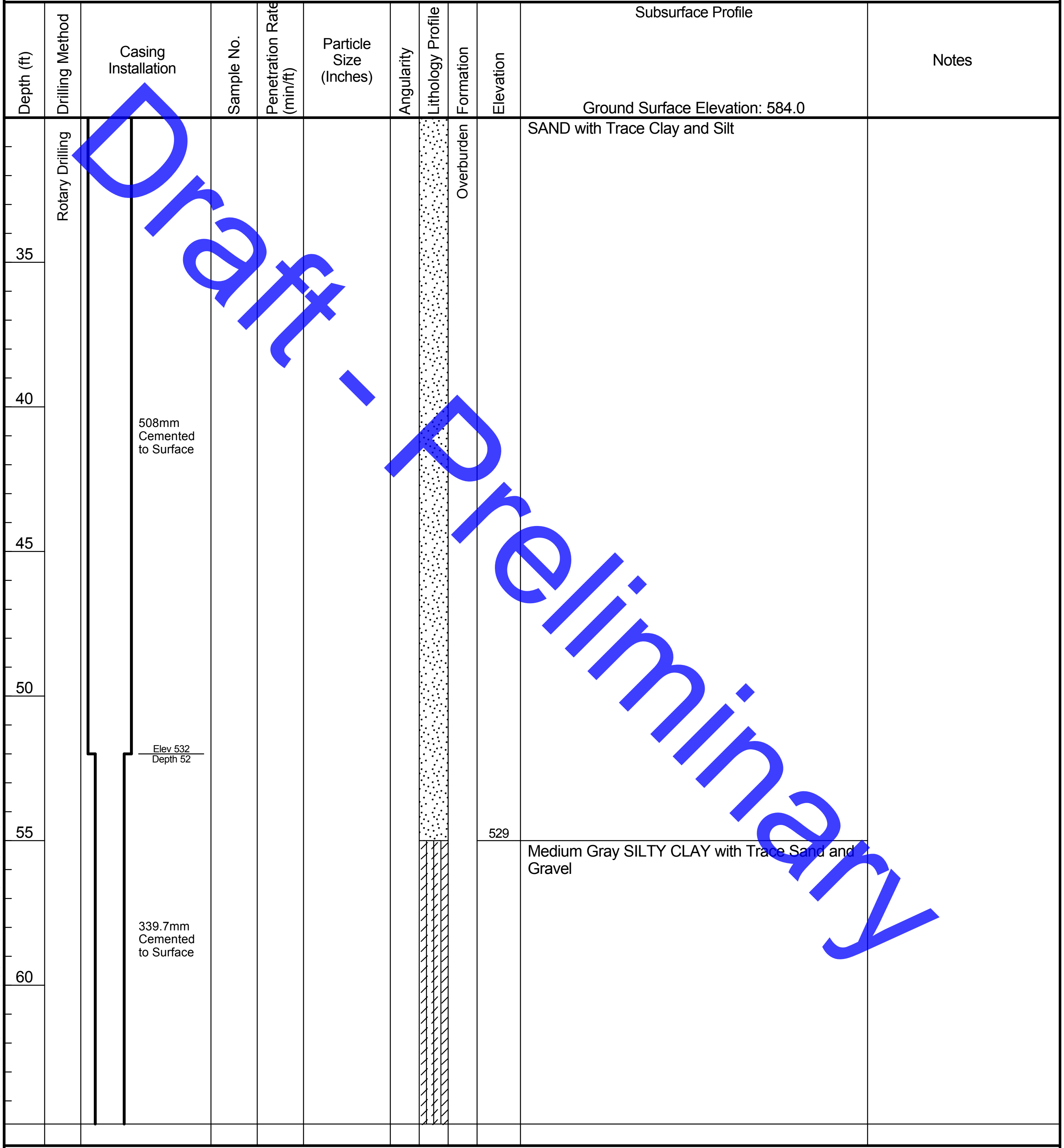
NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson



Ground Surface Elevation: 584.0

508mm Cemented to Surface

339.7mm Cemented to Surface

SAND with Trace Clay and Silt

Medium Gray SILTY CLAY with Trace Sand and Gravel

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/14/07

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling							Overburden		Medium Gray SILTY CLAY with Trace Sand and Gravel	
70											
75											
80									504	HARDPAN: Hard Gray SILTY CLAY with Trace Sand and Gravel	
		339.7mm Cemented to Surface									
85											
90											
95											
									484.99	LIMESTONE (Weathered)	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
100	Rotary Drilling	339.7mm Cemented to Surface Elev 481.5 Depth 102.5						Dundee Limestone Formation		LIMESTONE (Weathered)	
105			BS-1		1/64 to 3/8	A to SR			479	Light Gray and Tan Fine Grained LIMESTONE	
110									473	Light Gray and Tan LIMESTONE	
115		244.5mm Cemented to Surface, Open Hole Below 209'	BS-2		1/64 to 3/8	A to SR					
120									464	Light Gray and Tan Fine Grained LIMESTONE	
125			BS-3		1/64 to 1/2	SA to SR					
130									453.99	Light Gray and Tan Fine Grained DOLOMITIC LIMESTONE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 584.0

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
135	Rotary Drilling		BS-4		1/64 to 1/2	A to SR		DRG - Lucas Formation		Light Gray and Tan Fine Grained DOLOMITIC LIMESTONE	
140									444	No Recovery	
145			NR								No Recovery
150		244.5mm Cemented to Surface, Open Hole Below 209'							434	Gray Fine Grained DOLOMITIC LIMESTONE	
155			BS-5		1/64 to 1/2	A to SR					
160									424	Gray Fine Grained DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding	
165			BS-6		1/64 to 1/2	A to SR					

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
170	Rotary Drilling							DRG - Lucas Formation	414	Gray and Tan Fine Grained DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding	
175			BS-7		1/64 to 1/2	A to SR					
180									404	No Recovery	
185		244.5mm Cemented to Surface, Open Hole Below 209'	NR		NR	-					No Recovery Partial loss of circulation
190									394	Light Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
195			BS-9		1/64 to 3/8	A to SR					
200									384	Light Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
205	Rotary Drilling	244.5mm Cemented to Surface, Open Hole Below 209'	BS-10		1/64 to 3/8	A to SR		DRG - Lucas Formation		Light Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
210									374	Light Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding and Anhydrite Highly Fractured LIMESTONE and DOLOMITE	Complete loss of circulation below 211' (EL 373.0)
215			BS-11	1.7	1/64 to 3/8	A to SR					
220			NR	1.8						Highly Fractured LIMESTONE and DOLOMITE	All lithology shown was derived from wireline logs
225											
230			NR	2.7						DOLOMITE	
235										NOTE: Lithology could not be determined from 235' to 260' (EL 349 to 324) due to sonde error (Z-corr)	Very Fractured

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
240	Rotary Drilling		NR	1.7				DRG - Lucas Formation			All lithology shown was derived from wireline logs Very Fractured
245											
250			NR	1.1							
255											Very Fractured
260									324	DOLOMITE with Trace Limestone and Chert	Apparent Void from 259' to 260' (EL 325 to 324)
265			NR	2.1							
270									314		

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
275	Rotary Drilling		NR	4.2				DRG - Lucas Formation		Highly Fractured DOLOMITE (277' to 280') (EL 307 to 304)	All lithology shown was derived from wireline logs
280			NR	1.4							Apparent void from 280' to 284' (EL 304 to 300)
285										Interbedded DOLOMITIC LIMESTONE Grading to DOLOMITE (284' to 295') (EL 300 to 289)	Very Fractured
290									294		
295			NR	0.7						NOTE: Lithology could not be determined from 295' to 300' (EL 289 to 284) due to sonde error (Z-corr)	
300									284	Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	Very Fractured Large Washouts Very Fractured Partial circulation regained at 300' (EL 284)
305			BS-12	0.8	1/64 to 1/8	SA to SR					

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
310	Rotary Drilling							DRG - Lucas Formation	274	Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
										Light Gray and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	All lithology shown was derived from wireline logs
315											
			BS-13	1.8	1/64 to 3/8	A to SR					
320											
325											
										Lithology could not be determined from 328' to 341' (EL 256 to 243) due to sonde error (Z-corr)	Complete loss of circulation at 328' (EL 256) Remainder of borehole drilled without circulation (blind)
330			NR	0.1							
335											Highly Fractured
340				3.8							

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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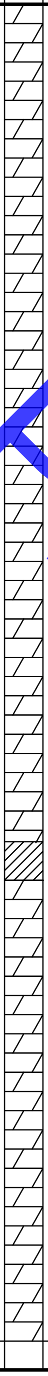
NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
345	Rotary Drilling							DRG - Lucas Formation			All lithology shown was derived from wireline logs
350				0.1						DOLOMITE with Trace Cherty and Limey Laminae	
355											
360				3.1							
365										Massive Interbedded ANHYDRITE (365' to 366') (EL 219 to 218)	
370									214	Interbedded DOLOMITE and DOLOMITIC LIMESTONE with Trace Chert and Shale	
375				3						DOLOMITE (377' to 380') (EL 207 to 204)	



NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling									Interbedded DOLOMITE and DOLOMITIC LIMESTONE with Trace Chert and Shale	
380									204	LIIMESTONE (380' to 383') (EL 204 to 201)	All lithology shown was derived from wireline logs
								DRG - Amherstburg Formation		DRG - Amherstburg Formation Top EL 201 Interbedded DOLOMITE and DOLOMITIC LIMESTONE	
385				4.3							
390									194	Interbedded DOLOMITE and DOLOMITIC LIMESTONE	
395				2.6							
400									184	DOLOMITE	
405				3.8							
410									174	DOLOMITE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
415 420	Rotary Drilling			2.5				DRG - Amherstburg Formation	164	DOLOMITE	All lithology shown was derived from wireline logs
425 430				11.5					154	DOLOMITE	
435 440				2.1					144	DOLOMITE	
445				1.1						DOLOMITE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 584.0

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
450	Rotary Drilling							DRG - Amherstburg Formation	134	DOLOMITE	
455 460				1.9					124	DOLOMITE SANDY DOLOMITE Grading to SANDSTONE (456' to 459') (EL 128 to 125) SANDSTONE with Trace Chert	All lithology shown was derived from wireline logs
465 470				1.2				DRG - Sylvania Sandstone	114	SANDSTONE with Trace Chert	
475 480				1					104	SANDSTONE with Trace Chert	
										SANDSTONE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling							DRG - Sylvania Sandstone		SANDSTONE	
485				1.2							All lithology shown was derived from wireline logs
490									94	SANDSTONE with Trace Dolomite	
495				1.4							
500									84	SANDSTONE with Trace Dolomite and Chert	
505				1.1							
510									74	SANDSTONE with Trace Dolomite and Chert	
515				1							

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 584.0

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
520	Rotary Drilling							DRG - Sylvania Sandstone	64	SANDSTONE with Trace Dolomite and Chert	
525 530				1.2					54	SANDSTONE Bois Blanc Formation Top EL 56.0 CHERTY DOLOMITE	All lithology shown was derived from wireline logs
535 540				1.4				Bois Blanc Formation	44	CHERTY DOLOMITE	
545 550				5.3					34	CHERTY DOLOMITE DOLOMITE (542' to 546') (EL 42 to 38) DOLOMITE with Trace Cherty and Limey Laminae	
										DOLOMITE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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LOG OF ROTARY BORING NO:

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
555	Rotary Drilling			1.5				Bois Blanc Formation		DOLOMITE	All lithology shown was derived from wireline logs
560									24		
										DOLOMITE	
565				1.9							
570									14		
										DOLOMITE	
575				2.2						CHERT (576' to 577') (EL 8 to 7) DOLOMITIC LIMESTONE and DOLOMITE (577' to 580') (EL 7 to 4)	
580									4		
										DOLOMITE	
585				1.9							

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 584.0

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
	Rotary Drilling							Bois Blanc Formation		DOLOMITE	
590									-6	DOLOMITE	All lithology shown was derived from wireline logs
595				1.9							
600									-16	DOLOMITE	
605				1.4				Garden Island Formation		Garden Island Formation Top EL -20.0 SANDSTONE	
610								Bass Islands Group	-26	DOLOMITE with Trace Chert Bass Islands Group Top EL -26.0	
615				2							
620									-36	DOLOMITE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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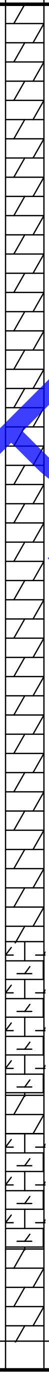
Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
625 630	Rotary Drilling			1.7				Bass Islands Group	-46	DOLOMITE	All lithology shown was derived from wireline logs
635 640				1.9					-56	DOLOMITE	
645 650				2.1						DOLOMITE DOLOMITIC LIMESTONE with Some Shale (646' to 650') (EL -62 to -66)	
655				1.7						DOLOMITE (650' to 651') (EL -66 to -67) DOLOMITIC LIMESTONE with Some Shale	



NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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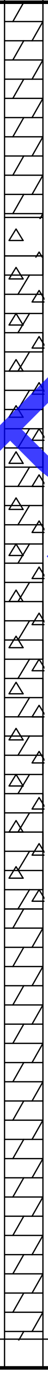
Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
660	Rotary Drilling			1.8				Bass Islands Group			All lithology shown was derived from wireline logs
										CHERT (662' to 663') (EL -78 to -79)	
										Interbedded CHERTY DOLOMITE and DOLOMITIC LIMESTONE (663' to 680') (EL -79 to -96)	
665											
670									-86		
675				2.3							
680				1.9						DOLOMITE	
685											
										Interbedded DOLOMITE and DOLOMITIC LIMESTONE with Some Shale (688' to 703') (EL -104 to -119)	
690				1.6							



NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
695	Rotary Drilling							Bass Islands Group			All lithology shown was derived from wireline logs
700				1.8							
										DOLOMITE (703' to 715') (EL -119 to -126)	
705											
710				1.7							
715										Interbedded DOLOMITE and DOLOMITIC LIMESTONE	
720									-136	Interbedded DOLOMITE and DOLOMITIC LIMESTONE	
725				1.9							

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling							Bass Islands Group		Interbedded DOLOMITE and DOLOMITIC LIMESTONE	
730									-146	Interbedded DOLOMITE and DOLOMITIC LIMESTONE	All lithology shown was derived from wireline logs
735				1.9							
740									-156	CHERTY DOLOMITE (740' to 742') (EL -156 to -158) DOLOMITE	
745				4.1							
750									-166	DOLOMITE	
755				2.3							
760				2						DOLOMITE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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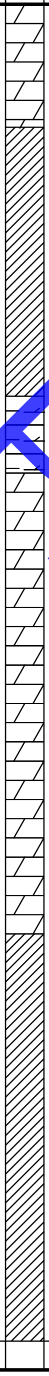
	Rotary Drilling							Bass Islands Group			
765										Massive Interbedded ANHYDRITE with Some Shale (764' to 771') (EL -180 to -187)	All lithology shown was derived from wireline logs
770									-186		
										SHALEY DOLOMITE (771' to 773') (EL -187 to -189)	
										DOLOMITE (773' to 776') (EL -189 to -192)	
775				1.6							
										DOLOMITE with Interbedded LIMESTONE Layers	
780				1.8						DOLOMITE with Interbedded LIMESTONE Layers	
785										Interbedded ANHYDRITE and SHALEY DOLOMITE Layers (785' to 797') (EL -201 to -213)	
790				1.5							
795											



NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling							Bass Islands Group		DOLOMITIC SHALE (797' to 801') (EL -213 to -217)	
800				1.6							All lithology shown was derived from wireline logs
										DOLOMITE (801' to 803') (EL -217 to -219)	
										DOLOMITIC SHALE (803' to 818') (EL -219 to -234)	
805											
810									-226		
815				1.6							
										LIMEY SHALE (818' to 820') (EL -234 to -236)	
820									-236	DOLOMITIC and LIMEY SHALE	
825				2.6							
										massive Interbedded ANHYDRITE (827' to 830') (EL -243 to -246)	
830											

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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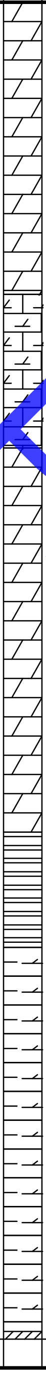
Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling			5.5				Bass Islands Group		DOLOMITE (830' to 838') (EL -246 to -254)	
835											All lithology shown was derived from wireline logs
										DOLOMITIC LIMESTONE (838' to 842') (-254 to --258)	
840				2							
845											
										DOLOMITE (842' to 852') (EL -258 to -268)	
850				2.2							
										SHALE (852' to 855') (EL -268 to -271)	
855										SHALEY DOLOMITE 9855' to 865') (EL -271 to -281)	
860									-276	Interbedded SHALE and DOLOMITIC SHALE	
865				4.6							

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Project Location: Detroit, Michigan
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Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
870	Rotary Drilling						▨	Bass Islands Group	-286	Massive Interbedded ANHYDRITE (865' to 870') (EL -281 to -286) Interbedded SHALE and DOLOMITIC SHALE	
875 880				1.5			▤		-296		All lithology shown was derived from wireline logs
							▨			Massive Interbedded ANHYDRITE (880' to 884') (EL -296 to -300)	
885 890				1.4			▤	Salina Group - G Unit (G Shale)	-306	Salina Group - G Unit (G-Shale) Top EL -300.0 SHALE	
895 900				1.5			▤		-316	SHALE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling							Salina Group - G Unit (G Shale)		SHALE	
905				1.3							All lithology shown was derived from wireline logs
910									-326	SHALE	
915				1.4							
920									-336	SHALE	
925				2.1							
930									-346	SHALE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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	Rotary Drilling			1.7			▤	Salina Group - G Unit (G Shale)		SHALE	
940							▨		-356	Massive Interbedded ANHYDRITE	All lithology shown was derived from wireline logs
945				1.7			▤			SHALE (945' to 947') (EL -361 to -363)	
							▨			Massive Interbedded ANHYDRITE (947' to 950') (EL -363 to -366)	
950							▤		-366	SHALE	
955				1.9			▤			SHALE with Increasing Anhydrite (955' to 958') (EL -371 to -374)	
							▨			Massive Interbedded ANHYDRITE (958' to 960') (EL -374 to -376)	
960				2			▤			SHALE	
965							▤				
							▨			Massive Interbedded ANHYDRITE (966' to 971') (EL -382 to -387)	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
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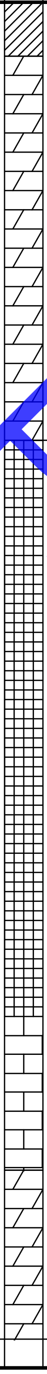
NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
970	Rotary Drilling			1.1				Salina Group - G Unit (G Shale)		DOLOMITE with Shale and Anhydrite (971' to 981') (EL -387 to -397)	
975											All lithology shown was derived from wireline logs
980				1.1				Salina Group - F Unit (F-Salt)		Salina Group - F Unit (F-Salt) Top EL -397.0 HALITE (F4 Bed) (981' to 996') (EL -397 to -412)	
985											
990									-406		
995				2.6						LIMESTONE (996' to 1000') (EL -412 to -416)	
1000				1.1						DOLOMITE with Increasing Halite	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 584.0

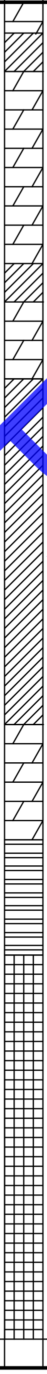
Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1005	Rotary Drilling							Salina Group - F Unit (F-Salt)		HALITE (F3 Bed)	
1010									-426	HALITE (F3 Bed)	All lithology shown was derived from wireline logs
1015				1.2							
1020									-436	HALITE (F3 Bed)	
1025				1.5							
1030									-446	HALITE (F3 Bed)	
1035				2.5						DOLOMITE (1035' to 1040') (EL -451 to -456)	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson



Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1040	Rotary Drilling							Salina Group - F Unit (F-Salt)	-456	HALITE (F3 Bed)	
										Massive Interbedded ANHYDRITE (1040' to 1041') (EL -456 to -457) DOLOMITE (1041' to 1046') (EL -457 to -462)	
1045				3.2							All lithology shown was derived from wireline logs
										Massive Interbedded ANHYDRITE (1046' to 1047') (EL -462 to -463) DOLOMITE (1047' to 1049') (EL -463 to -465)	
										Massive Interbedded ANHYDRITE	
1050				1.8						Massive Interbedded ANHYDRITE	
1055											
										DOLOMITE (1058' to 1061') (El -474 to -477)	
1060									-476		
										SHALE (1061' to 1064') (EL -477 to -480)	
										HALITE (F2 Bed)	
1065				1.1							
1070									-486	HALITE (F2 Bed)	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1075	Rotary Drilling			1.9				Salina Group - F Unit (F-Salt)		HALITE (F2 Bed)	
1080									-496	HALITE (F2 Bed)	All lithology shown was derived from wireline logs
1085				1.7							
1090									-506	SHALEY DOLOMITE	
1095				1.3						HALITE (F1 Bed)	
1100									-516	HALITE (F1 Bed)	
1105				1							

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling						▦	Salina Group - F Unit (F-Salt)		HALITE (F1 Bed)	All lithology shown was derived from wireline logs
1110				1.6					-526	HALITE with Some Gypsum (F1 Bed)	
1115											
1120				1.8					-536	HALITE with Some Anhydrite (F1 Bed)	
1125											
1130				2.7					-546	HALITE with Some Anhydrite (F1 Bed)	
1135											
1140				3.3						HALITE with Some Anhydrite (F1 Bed)	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

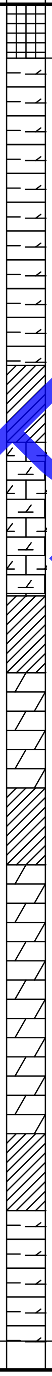
NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson



Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1145	Rotary Drilling							Salina Group - E Unit (E - Dolomite)		Salina Group - E Unit (E-Dolomite) Top EL -561.0 SHALEY DOLOMITE (1145' to 1153') (EL -561 to -569)	
1150				2.5							All lithology shown was derived from wireline logs
1155										Massive Interbedded ANHYDRITE (1153' to 1155') (EL -569 to -571) DOLOMITIC LIMESTONE (1155' to 1159') (EL -571 to -575)	
1160				2.6						Massive Interbedded ANHYDRITE (1159' to 1161') (EL -575 to -577) DOLOMITE (1161' to 1164') (EL -577 to -580)	
1165										Massive Interbedded ANHYDRITE (1164' to 1166') (EL -580 to -582) DOLOMITE (1166' to 1173') (EL -582 to -589)	
1170									-586		
1175				3.1						Massive interbedded ANHYDRITE (1173' to 1175') (EL -589 to -591) SHALEY DOLOMITE (1175' to 1180') (EL -591 to -596)	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1180	Rotary Drilling							Salina Group - E Unit (E - Dolomite)	-596		
1185				3.3						DOLOMITE Massive Interbedded ANHYDRITE (1184' to 1187') (EL -600 to -603) DOLOMITE with Shale and Anhydrite	
1190									-606		
1195				3.1						DOLOMITE with Shale and Anhydrite	
1200									-616		
1205				3.2						DOLOMITE with Shale and Anhydrite	
1210											

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

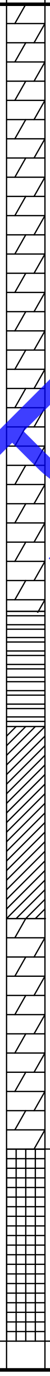
NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson



Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1215	Rotary Drilling						Salina Group - E Unit (E - Dolomite)			
1220				2.4					DOLOMITE with Shale and Anhydrite	All lithology shown was derived from wireline logs
1225										
1230				1.6					SHALE (1229' to 1232') (EL -645 to -648)	
									Massive Interbedded ANHYDRITE (1232' to 1237') (EL -648 to -653)	
1235										
									DOLOMITE (1237' to 1243') (EL -653 to -659)	
1240				1.8						
									Salina Group - D Unit (D-Salt) Top EL -659.0 HALITE (D3 Bed)	
1245										

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1250	Rotary Drilling			2.6				Salina Group - D Unit (D-Salt)			
										DOLOMITIC LIMESTONE with Increasing Shale (1253' to 1262') (EL -669 to -678)	
1255											All lithology shown was derived from wireline logs
1260				2.5							
										HALITE (D2 Bed) (1262' to 1272') (EL -678 to -688)	
1265											
1270									-686		
								Salina Group - C Unit (C-Shale)		Salina Group - C Unit (C-Shale) Top EL -688.0 SHALE	
1275				2.6							
1280									-696	SHALE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1285 1290	Rotary Drilling			2.6				Salina Group - C Unit (C-Shale)	-706	SHALE	
1295 1300				4.4					-716	SHALE with Trace Anhydrite	All lithology shown was derived from wireline logs
1305 1310				2.6					-726	SHALE with Trace Anhydrite	
1315				4.1						SHALE with Trace Anhydrite	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling						▤	Salina Group - C Unit (C-Shale)		SHALE with Trace Anhydrite	
1320				2.6			▤			SHALE with trace Anhydrite	
1325							▤				All lithology shown was derived from wireline logs
1330				2.5			▤		-746	Massive Interbedded ANHYDRITE (1331' to 1333') (EL -747 to -749)	
							▨			SHALE with Trace Anhydrite	
1335							▤				
1340				2.3			▤		-756	SHALE with Trace Anhydrite	
1345							▨			Massive Interbedded ANHYDRITE (1345' to 1346') (EL -761 to -762) SHALE with Trace Anhydrite	
1350							▤		-766	SHALE with Trace Anhydrite	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
	Rotary Drilling							Salina Group - C Unit (C-Shale)		SHALE with Trace Anhydrite	
1355				2.6							
										Massive Interbedded ANHYDRITE (1356' to 1357') (EL -772 to -773) SHALE with Trace Anhydrite	
1360				5.5						SHALE with Trace Anhydrite	All lithology shown was derived from wireline logs
1365											
										Massive Interbedded ANHYDRITE (1369' to 1371') (EL -785 to -787)	
1370				1.9							
										SHALE with Increasing Anhydrite (1371' to 1374') (EL -787 to -790)	
										Massive Interbedded ANHYDRITE (1374' to 1377') (EL -790 to -793)	
1375											
										DOLOMITIC LIMESTONE (1377' to 1382') (EL -793 to -798)	
1380				2.6							
										SHALE (1382' to 1386') (EL -798 to -802)	
1385											
										Massive Interbedded ANHYDRITE (1386' to 1387') (EL -802 to -803)	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

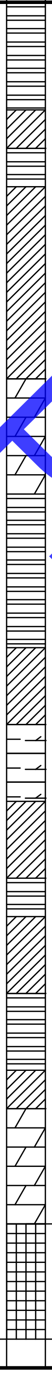
Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 584.0

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1390	Rotary Drilling							Salina Group - C Unit (C-Shale)	-806	Massive Interbedded ANHYDRITE (1390' to 1391') (EL -806 to -807) SHALE (1391' to 1393') (EL -807 to -809)	
										Massive Interbedded ANHYDRITE (1393' to 1397') (EL -809 to -813)	
1395				2							All lithology shown was derived from wireline logs
										DOLOMITE (1397' to 1400') (EL -813 to -816)	
1400									-816	SHALE Grading to Anhydrite	
										Massive Interbedded ANHYDRITE (1404' to 1406') (EL -820 to -822)	
1405				1.9						SHALEY DOLOMITE (1406' to 1408') (EL -820 to -822)	
										Massive Interbedded SHALEY ANHYDRITE (1408' to 1410') (EL -824 to -826)	
1410				1.6						SHALE	
										Massive Interbedded ANHYDRITE (1411' to 1413') (EL -827 to -829)	
										SHALE (1413' to 1415') (EL -829 to -831)	
1415										Massive Interbedded ANHYDRITE (1415' to 1416') (-831 to -832) DOLOMITE with decreasing Shale (1416' to 1419') (EL -832 to -835)	
1420									-836	Salina Group - B Unit (B-Salt) Top EL -835.0 HALITE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1425 1430	Rotary Drilling			0.9				Salina Group - B Unit (B-Salt)	-846	SHALE Stringer (1427' to 1429') (EL -843 to -845) HALITE	
1435 1440				0.9						HALITE	All lithology shown was derived from wireline logs
1445 1450				0.9					-866	HALITE SHALE Stringer (1448' to 1451') (EL -864 to -867) HALITE	
1455				0.9							

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 584.0

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
	Rotary Drilling						▦	Salina Group - B Unit (B-Salt)			
1460				1			▦		-876	HALITE	
1465							▦				All lithology shown was derived from wireline logs
1470				4			▦		-886	HALITE	
1475							▦				
1480				1.7			▦		-896	HALITE	Possible Shale Stringer 1481' to 1483' (EL -897 to -899)
1485							▦				
1490							▦		-906	HALITE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX10TB2 (TB-2)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.0	Notes
1495	Rotary Drilling			0.8			▦	Salina Group - B Unit (B-Salt)		HALITE	All lithology shown was derived from wireline logs
1500										End of Boring at 1500 feet.	
1505											
1510											
1515											
1520											
1525											

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, J. Wahlstrom, K. Warning, Z. Kiefer
Elevations noted are above mean-sea level (AMSL)

PROJECT NO. C05002A **LOG OF TEST BORING** TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
				80				
		498.0	GLACIAL SEDIMENT (DRIFT)	90				
	DUNDEE LIMESTONE	494.0	Fine grained to amorphous, light gray to brown LIMESTONE; bedding indistinct; subrounded to angular grains; occasional subrounded to subangular carbonaceous particles, occasional hydrocarbon staining, strong to moderate reaction with HCl					4.3
				100	BS-1	3–20	Light Gray	
				110	BS-2	3–20	Light Gray	
			120.0-196.0' - Abundant hydrocarbon staining	120	BS-3	3–15	Brown/Light Gray	
				130	BS-4	2–10	Brown/Light Gray	
				140	BS-5	2–10	Brown/Light Gray	
				150	BS-6	2–15	Brown/Gray	
			160.0-180.0' - Particles becoming more subrounded	160	BS-7	3–15	Buff/Light Gray	
				170	BS-8	3–15	Buff/Gray	
				180				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-4

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)
				180
	DETROIT RIVER GROUP (LUCAS FORMATION)	398.0	Fine grained to amorphous, buff to gray DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subangular to angular chert particles, little reaction to HCl	190
				200
				210
			200.0-246.0' - Grain size increases	220
				230
				240
			**No sample return after about 250 ft. Information obtained from geophysical logs.	250
				260
				270
				280

ROCK SAMPLE DATA

SAMPLE NO.	PARTICLE SIZE (mm) Smallest	PARTICLE SIZE (mm) Largest	COLOR	DRILLING RATE (min/ft)
BS-9	3	15	Buff/Light Gray	2.8
BS-10	3	15	Buff/Gray	
BS-11	5	35	Light Gray	
BS-12	5	35	Light Gray	
BS-13	5	35	Buff/Gray	
BS-14	5	35	Buff/Gray	
BS-15	5	15	Buff	

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟵ ⟶ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, buff to gray DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subangular to angular chert particles, little reaction to HCl	280 290 300 310 320 330 340 350 360 370 380				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

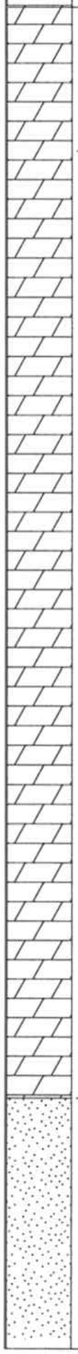
Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (AMHERSTBURG FORMATION)		Fine grained to amorphous, buff to gray DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subangular to angular chert particles, little reaction to HCl	380 390 400 410 420 430 440 450 460				
	SYLVANIA SANDSTONE	126.0	Fine to medium grained, light gray to white SACCHAROIDAL SANDSTONE	470 480				



BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SYLVANIA SANDSTONE		Fine to medium grained, light gray to white SACCHAROIDAL SANDSTONE	480				
				490				
				500				
				510				
				520				
	BOIS BLANC FORMATION	62.0	Gray to light gray, fine grained to amorphous DOLOMITE					
				530				
				540				
				550				
				560				
				570				
				580				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BOIS BLANC FORMATION		Gray to light gray, fine grained to amorphous DOLOMITE	580				
				590				
	BASS ISLAND FORMATION	-12.0	Gray to buff, fine grained to amorphous DOLOMITE	600				
				610				
				620				
				630				
				640				
				650				
				660				
				670				
				680				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE	680				
				690				
				700				
				710				
				720				
				730				
				740				
				750				
				760				
				770				
				780				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE	780				
				790				
				800				
				810				
				820				
				830				
				840				
				850				
				860				
				870				
		-291.0		880				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA G UNIT		Gray to buff, fine grained to amorphous DOLOMITE	880				
				890				
				900				
				910				
				920				
				930				
				940				
				950				
				960				
				970				
		-389.0						
				980				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

PROJECT NO. C05002A

LOG OF TEST BORING TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	F4 SALT	-413.0	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	980 990 1000				
	SALINA F UNIT	-424.0	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1010				
	F3 SALT	-456.0	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1020 1030 1040				
	SALINA F UNIT	-483.0	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1050 1060 1070				
	F2 SALT		Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1080				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

PROJECT NO. C05002A **LOG OF TEST BORING** TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	F2 SALT		Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1080 1090				
		-508.0	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE					
	F1 SALT	-512.0	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1100 1110 1120 1130 1140 1150				
	SALINA E UNIT	-564.0	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1160 1170 1180				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA E UNIT	-665.0	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1180 1190 1200 1210 1220 1230 1240 1250				
	D3 SALT	-677.0	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1260				
	SALINA D UNIT	-685.0	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1270				
	D2 SALT		Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1280				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
				1280				
			Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE					
	SALINA C UNIT	-696.0	Dark gray DOLOMITIC SHALE					
				1290				
				1300				
				1310				
				1320				
				1330				
				1340				
				1350				
				1360				
				1370				
				1380				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-4

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA C UNIT		Dark gray DOLOMITIC SHALE	1380 1390 1400 1410 1420				
	SALINA B UNIT	-838.0	Mixed HALITE/ANHYDRITE with occasional shale stringers	1430 1440 1450 1460 1470 1480				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ↔ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA B UNIT	-912.0	Mixed HALITE/ANHYDRITE with occasional shale stringers	1480				
				1490				
			End of Boring at 1500 ft. (No sample return after approx. 250 ft. due to loss of circulation. Blind drilling of boring cont'd from 250 ft. to boring termination depth of 1500 ft.)	1500				
				1510				
				1520				
				1530				
				1540				
				1550				
				1560				
				1570				
				1580				

BORING COORDINATES
N (y) Coordinate 4684546.46
E(x) Coordinate 326649.42

Remarks:
Ground Surface Elevation: 587.99 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-09-07
Date Completed: 03-13-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest	COLOR	DRILLING RATE (min/ft)
			GLACIAL SEDIMENT (DRIFT)	80				
		500.2						
	DUNDEE LIMESTONE		Fine grained to amorphous, gray to buff LIMESTONE; bedding indistinct; angular to subrounded grains up to 3/4-inch; occasional black subangular to subrounded carbonaceous particles, occasional angular chert particles, occasional calcite particles, strong to moderate reaction with HCl	90				
				100	BS-1	1–15	Light Gray	
								3.4
				110	BS-2	1–20	Buff/Gray	
				120	BS-3	1–8	Buff/Gray	
				130	BS-4	1–13	Buff/Light Gray	
				140	BS-5	1–8	Buff/Gray	
			150.0-160.0' - Increase in hydrocarbon staining	150	BS-6	1–10	Brown/Gray	
		429.2						
			Fine grained to amorphous, buff to light gray, DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains up to 1-3/4-inch, occasional black subangular to subrounded black carbonaceous particles, occasional angular chert particles, occasional subrounded to subangular anhydrite particles and subrounded gypsum particles, little to no reaction to HCl	160	BS-7	1–8	Gray	
			170.0-180.0' - Increase in hydrocarbon staining	170	BS-8	1–10	Buff/Brown	
				180				

PARTICLE SIZE (mm) scale: 10, 20, 30, 40

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE

Formation / Geologic Units: DETROIT RIVER GROUP (LUCAS FORMATION)

DEPTH (ft)	LITHOLOGICAL DESCRIPTION
180	Fine grained to amorphous, buff to light gray, DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains up to 1-3/4-inch, occasional black subangular to subrounded black carbonaceous particles, occasional angular chert particles, occasional subrounded to subangular anhydrite particles and subrounded gypsum particles, little to no reaction to HCl
220	220.0-250.0' - Occasional large limestone particles
250	250.0-350.0' - Occasional to frequent subrounded gypsum particles and subangular to subrounded anhydrite particles
260	260.0-350.0' - Occasional dolomite particles with "micro" pitting. Very thin to laminar bedding visible
270	270.0' - Decrease in overall grain size

ROCK SAMPLE DATA

SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest	COLOR	DRILLING RATE (min/ft)
BS-9	10	Buff/Brown/Gray	
BS-10	10	Light Gray/Buff	2.4
BS-11	12	Light Gray/Buff	
BS-12	30	Gray/Buff	
BS-13	20	Buff	
BS-14	20	Buff/Gray	
BS-15	16	Buff/Gray/White	
BS-16	18	Buff/Gray/White	
BS-17	18	Buff	

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE

FORMATION | GEOLOGIC UNITS | ELEVATION (ft) | LITHOLOGICAL DESCRIPTION

GEOLOGIC UNITS: DETROIT RIVER GROUP (LUCAS FORMATION)

Fine grained to amorphous, buff to light gray, DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains up to 1-3/4-inch, occasional black subangular to subrounded black carbonaceous particles, occasional angular chert particles, occasional subrounded to subangular anhydrite particles and subrounded gypsum particles, little to no reaction to HCl

340.0' - Decrease in the amount of gypsum and anhydrite particles

350.0-390.0' - Grain size decrease, no grains larger than 5mm

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest	COLOR	DRILLING RATE (min/ft)
280	BS-18	1 44	Buff/Gray	
290	BS-19	1 14	Buff/Gray	
300	BS-20	1 14	Buff	
310	BS-21	1 25	Buff	
320	BS-22	1 18	Buff	
330	BS-23	1 19	Buff	
340	BS-24	1 18	Buff	
350	BS-25	1 5	Buff/Gray	
360	BS-26	1 5	Buff/Gray	
370	BS-27	1 5	Buff/Gray	
380				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE				ROCK SAMPLE DATA				
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (AMHERSTBURG FORMATION)		Fine grained to amorphous, buff to light gray, DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains up to 1-3/4-inch, occasional black subangular to subrounded black carbonaceous particles, occasional angular chert particles, occasional subrounded to subangular anhydrite particles and subrounded gypsum particles, little to no reaction to HCl 390.0-450.0' - Color change to brown and buff. No particles larger than 9mm	380	BS-28	5	Buff/Gray	
				390	BS-29	9	Brown/Buff	
				400	BS-30	5	Brown/Buff	
				410	BS-31	5	Brown/Buff	
				420	BS-32	5	Brown/Buff	
				430	BS-33	9	Brown/Buff	
		143.2		440	BS-34	9	Brown/Gray	
	SYLVANIA SANDSTONE		Fine to medium grained, light gray to white SACCHAROIDAL SANDSTONE; grains are subangular to rounded, occasional dolomite, calcite, gypsum and carbonaceous particles, low reaction to HCl 450.0' - Trace light gray sandstone particles	450	BS-35	9	Brown/Gray	1.3
				460	BS-36	9	White/Light Gray	
				470	BS-37	15	White/Light Gray	
				480				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-5

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SYLVANIA SANDSTONE		Fine to medium grained, light gray to white SACCHAROIDAL SANDSTONE; grains are subangular to rounded, occasional dolomite, calcite, gypsum and carbonaceous particles, low reaction to HCl	480	BS-38	1–9	White/Light Gray	
				490	BS-39	1–14	White/Light Gray	
				500	BS-40	1–9	White/Light Gray	
		73.2		510	BS-41	1–6	White/Light Gray	
	BOIS BLANC FORMATION		Gray to light gray, fine grained to amorphous DOLOMITE; bedding is indistinct; subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction to HCl	520	BS-42	1–5	White/Light Gray	2.2
				530	BS-43	1–5	Gray/Light Gray	
				540	BS-44	1–6	Gray/Light Gray	
				550	BS-45	1–6	Gray/Light Gray	
		25.2		560	BS-46	1–6	Gray/Light Gray	
			Gray to buff, fine grained to amorphous DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction with HCl 570.0-580.0' - Mixed dolomite and sandstone, occasional gypsum and calcite particles	570	BS-47	1–6	Gray/White/Light Gray	3.2
				580				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASSISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction with HCl	580	BS-48	6	Gray/Light Gray	
				590	BS-49	10	Gray/Light Gray	
				600	BS-50	10	Gray/Light Gray	
				610	BS-51	7	Buff	
				620	BS-52	7	Buff	
			630.0-650.0' - Particle size is mostly 1mm (1/16") with a few large particles (up to 12mm (1/2")) particles change to a buff color. Very little anhydrite and gypsum present.	630	BS-53	12	Buff	
				640	BS-54	4	Buff	
				650	BS-55	7	Buff	
				660	BS-56	6	Buff	
				670	BS-57	6	Buff	
				680				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
	BASSISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction with HCl 710.0-716.0' - Occasional large particles, up to 35mm (1-1/2") 720.0' - Occasional small anhydrite particles and an increase in chert particles and carbonaceous particles

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest	COLOR	DRILLING RATE (min/ft)
680	BS-58	1-5	Buff	
690	BS-59	1-10	Buff/Gray	
700	BS-60	1-10	Buff/Gray	
710	BS-61	1-7	Buff/Gray	
720	BS-62	1-7	Buff/Gray	
730	BS-63	1-9	Buff/Gray	
740	BS-64	1-7	Buff/Gray	
750	BS-65	1-7	Buff/Gray	
760	BS-66	1-9	Buff/Gray	2.9
770	BS-67	1-6	Gray	
780				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)
	BASSISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction with HCl	780
			810.0-816.0' - Occasional large particles, up to 15mm (5/8") and a color change to buff	810
	SLAINA G UNIT	-251.8	Gray to buff, fine grained to amorphous DOLOMITE; bedding indistinct; subrounded to subangular grains; occasional anhydrite particles, low to very low reaction to HCl	840
			860.0-910.0' - Decrease in anhydrite particles	860

Depth scale: 780, 790, 800, 810, 820, 830, 840, 850, 860, 870, 880

ROCK SAMPLE DATA

SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest (10 20 30 40)	COLOR	DRILLING RATE (min/ft)
BS-68	6	Gray	
BS-69	7	Gray	
BS-70	5	Gray	
BS-71	6	Buff	
BS-72	5	Gray	
BS-73	5	Buff/Gray	
BS-74	5	Buff/Gray	
BS-75	6	Buff/Gray	
BS-76	6	Gray	
BS-77	10	Gray	

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
	SLAINA G UNIT	-320.8	Gray to buff, fine grained to amorphous DOLOMITE; bedding indistinct; subrounded to subangular grains; occasional anhydrite particles, low to very low reaction to HCl 910.0' - Increase in anhydrite particles
	F6 SALT	-365.8	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles
	SALINA F UNIT	-375.8	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE; subrounded to angular grains, occasional angular chert particles, very low reaction to HCl
	F5 SALT	-382.8	Crystalline, white HALITE/ANHYDRITE; trace fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles
			Fine grained to amorphous DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subangular to angular particles, occasional halite particles, low to very low reaction to HCl

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
880	BS-78	6	Gray	
890	BS-79	6	Gray	
900	BS-80	5	Gray	0.8
910	BS-81	6	Gray	
920	BS-82	7	Gray	
930	BS-83	8	Gray/White	
940	BS-84	8	Gray/White	
950	BS-85	9	Gray/White	
960	BS-86	9	Gray/White	2.7
970	BS-87	10	Gray/White	
980				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
	SALINA F UNIT	-399.8	Fine grained to amorphous DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subangular to angular particles, occasional halite particles, low to very low reaction to HCl
	F4 SALT	-422.8	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles
	SALINA F UNIT	-433.8	Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; occasional halite particles, low reaction to HCl
	F3 SALT	-461.8	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles
	SALINA F UNIT	-490.8	Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; occasional halite particles, low reaction to HCl 1080.0-1090.0' - Sandy texture

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
980	BS-88	1 – 8	Buff/Gray	
990	BS-89	1 – 6	Buff/Gray	1.4
1000	BS-90	1 – 9	Gray/White	
1010	BS-91	1 – 9	Gray/White	
1020	BS-92	1 – 8	Gray/White	
1030	BS-93	1 – 9	Gray	
1040	BS-94	1 – 7	Gray/White	
1050	BS-95	1 – 8	Gray/White	2.0
1060	BS-96	1 – 8	Gray/White	
1070	BS-97	1 – 9	Buff	
1080				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	F2 SALT		Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles	1080	BS-98	1–6	Buff/Gray	1.1
				1090	BS-99	1–9	Gray	
		-514.8		1100	BS-100	1–8	Gray/White	
		-518.8	Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; occasional halite particles, low reaction to HCl					
	F1 SALT		Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles	1110	BS-101	1–7	Gray/White	
				1120	BS-102	1–7	Gray/White	
				1130	BS-103	1–7	Gray/White	
				1140	BS-104	1–8	Gray/White	
				1150	BS-105	1–10	Gray/White	2.7
	SALINA E UNIT	-568.8	Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; occasional halite particles, low reaction to HCl	1160	BS-106	1–8	Gray/White	
				1170	BS-107	1–7	Gray	
				1180				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA E UNIT		Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; occasional halite particles, low reaction to HCl	1180	BS-108	1 ↔ 6	Gray	
				1190	BS-109	1 ↔ 7	Gray	
				1200	BS-110	1 ↔ 7	Gray	
				1210	BS-111	1 ↔ 7	Gray	
				1220	BS-112	1 ↔ 6	Gray	
				1230	BS-113	1 ↔ 6	Gray	
				1240	BS-114	1 ↔ 6	Gray	
				1250	BS-115	1 ↔ 6	Gray	
	D3 SALT	-667.8	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles	1260	BS-116	1 ↔ 5	Gray	0.9
	SALINA D UNIT			1270	BS-117	1 ↔ 6	Gray/White	
				1280				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

SE Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	D2 SALT	-696.8	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles	1280	BS-118	1 ↔ 6	Gray/White	
	SALINA C UNIT		Dark gray DOLOMITIC SHALE; occasional fine grained to amorphous, gray dolomite particles; subrounded to angular grains, low reaction to HCl 1290.0' - Increasing dolomite content	1290	BS-119	1 ↔ 6	Gray/White	2.4
				1300	BS-120	1 ↔ 4	Gray	
				1310	BS-121	1 ↔ 4	Gray	
				1320	BS-122	1 2	Dark Gray	
				1330	BS-123	1 2	Dark Gray	
				1340	BS-124	1 2	Dark Gray	
				1350	BS-125	1 2	Dark Gray	
				1360	BS-126	1 2	Dark Gray	
				1370	BS-127	1 2	Dark Gray	2.6
				1380				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
				1380				
	SALINA C UNIT		Dark gray DOLOMITIC SHALE; occasional fine grained to amorphous, gray dolomite particles; subrounded to angular grains, low reaction to HCl		BS-128	1 2	Dark Gray	
			1390.0-1410.0' - Increase in dolomite pieces	1390	BS-129	1 5	Gray	
				1400	BS-130	1 5	Gray	
				1410	BS-131	1 5	Gray	
		-832.8		1420				
	SALINA B UNIT		Mixed HALITE/ANHYDRITE with occasional shale stringers		BS-132	1 5	Gray	
				1430	BS-133	1 4	Gray/White	
				1440	BS-134	1 4	Gray/White	
				1450	BS-135	1 4	Gray/White	
				1460	BS-136	1 4	Gray/White	
				1470	BS-137	1 4	Gray/White	
		-885.8						
				1480				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-5

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA A2		Mixed fine grained to amorphous, gray DOLOMITE and crystalline HALITE/ANHYDRITE; subrounded to subangular grains, low reaction to HCl	1480	BS-138	1 ↔ 4	Gray/White	
				1490	BS-139	1 ↔ 4	Gray/White	
				1500	BS-140	1 ↔ 4	Gray/White	
				1510	BS-141	1 ↔ 4	Gray/White	
		-936.8		1520	BS-142	1 ↔ 4	Gray/White	
			End of Boring at 1526 ft.	1530				
				1540				
				1550				
				1560				
				1570				
				1580				

BORING COORDINATES
N (y) Coordinate 4684354.54
E(x) Coordinate 326407.76

Remarks:
Ground Surface Elevation: 589.16 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: D. Goeddeke/J. Lukasik
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-14-07
Date Completed: 03-17-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE / **ROCK SAMPLE DATA**

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟵⟶ Largest (10 20 30 40)	COLOR	DRILLING RATE (min/ft)
		495.7	GLACIAL SEDIMENT (DRIFT)	90				
	DUNDEE LIMESTONE		Fine grained to amorphous, gray and buff LIMESTONE; bedding indistinct; particles are subrounded to subangular; occasional calcite particles, occasional angular chert particles, moderate reaction to HCl	100				
				110	BS-1	1 – 25	Gray/Buff	3.8
			120.0-150.0' - Particles are mostly buff in color	120	BS-2	2 – 14	Buff	
				130	BS-3	3 – 14	Buff	
				140	BS-4	3 – 14	Buff	
				150	BS-5	3 – 14	Buff	2.7
		429.7	Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indisticnt; particles are subrounded to subangular; occasional angular chert particles, occasional carbonaceous particles, low reaction to HCl	160	BS-6	3 – 14	Buff	
				170	BS-7	3 – 14	Buff	
			180.0-210.0' - Particles become more angular	180	BS-8	2 – 14	Buff	
				190				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indisticnt; particles are subrounded to subangular; occasional angular chert particles, occasional carbonaceous particles, low reaction to HCl	190	BS-9	2 – 14	Buff	
				200	BS-10	2 – 8	Buff	
			210.0-400.0' - Occasional large dolomite particles up to 52mm (2") in size. Color changes to gray and buff.	210	BS-11	2 – 20	Gray/Buff	
				220	BS-12	2 – 20	Gray/Buff	
				230	BS-13	1 – 20	Gray/Buff	
			240.0-460.0' - Occasional anhydrite particles	240	BS-14	1 – 15	Gray/Buff	
				250	BS-15	2 – 15	Gray/Buff	
				260	BS-16	2 – 15	Buff	
				270	BS-17	2 – 15	Gray/Buff	
				280	BS-18	1 – 15	Gray/Buff	
				290				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indisticnt; particles are subrounded to subangular; occasional angular chert particles, occasional carbonaceous particles, low reaction to HCl	290–390

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest	PARTICLE SIZE (mm) Largest	COLOR	DRILLING RATE (min/ft)
290	BS-19	1	15	Gray/Buff	
300	BS-20	1	15	Gray/Buff	
310	BS-21	1	10	Buff	
320	BS-22	1	10	Buff	
330	BS-23	1	10	Gray/Buff	
340	BS-24	1	10	Gray/Buff	
350	BS-25	1	15	Gray/Buff	
360	BS-26	1	18	Gray/Buff	
370	BS-27	1	20	Gray/Buff	
380	BS-28	1	18	Gray/Buff	
390					

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

PROJECT NO. C05002A

LOG OF TEST BORING TB-6

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)
Dolomite	DETROIT RIVER GROUP (AMHERSTBURG FORMATION)		Fine grained to amorphous, buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indisticnt; particles are subrounded to subangular; occasional angular chert particles, occasional carbonaceous particles, low reaction to HCl 400.0-460.0' - Occasional medium particles up to 10mm (1/2") in size 410.0-460.0' - Particles size decreases and becomes brown and buff in color	390
		139.7		450
Sandstone	SYLVANIA SANDSTONE		Light gray to white, fine to medium grained SACCHAROIDAL SANDSTONE; grains are subangular to rounded; occasional dolomite, calcite, gypsum and carbonaceous particles, low reaction to HCl	450
				490

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest	PARTICLE SIZE (mm) Largest	COLOR	DRILLING RATE (min/ft)
390	BS-29	1	15	Gray/Buff	
400	BS-30	1	15	Gray/Buff	
410	BS-31	1	5	Buff/Brown	
420	BS-32	1	7	Buff/Brown	
430	BS-33				
440	BS-34	1	5	Buff/Brown	
450	BS-35	1	4	Buff/Brown	1.2
460	BS-36	1	8	White/Gray	
470	BS-37	1	3	White/Gray	
480	BS-38	1	2	White/Gray	

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SYLVANIA SANDSTONE		Light gray to white, fine to medium grained SACCHAROIDAL SANDSTONE; grains are subangular to rounded; occasional dolomite, calcite, gypsum and carbonaceous particles, low reaction to HCl	490	BS-39	1 2	White/Gray	
				500	BS-40	1 10	White/Gray	
		75.7		510	BS-41			
	BOIS BLANC FORMATION		Fine grained to amorphous, gray DOLOMITE; bedding indistinct to laminar; subrounded to subangular particles, occasional cherty dolomite particles, low to no reaction to HCl	520	BS-42	1 2	White/Gray	
				530	BS-43	1 5	White/Gray	2.4
				540	BS-44			
				550	BS-45	1 3	Gray	
				560	BS-46	1 3	Gray	
		19.7	570.0-576.0' - Trace to some light gray sandstone particles					
	BASS ISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE; bedding laminar to indistinct, subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction to HCl	570	BS-47	1 5	Gray	
				580	BS-48	1 5	Gray	
				590				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE; bedding laminar to indistinct, subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction to HCl	590	BS-49	5	Gray	
				600	BS-50	5	Gray	
				610	BS-51	10	Gray	
				620	BS-52	7	Buff	
			620.0-696.0' - Color changes from gray to buff	630	BS-53	7	Buff	
				640	BS-54	7	Buff	
				650	BS-55	7	Buff	
				660	NR			
				670	NR			
				680	NR			
				690				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
	BASS ISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE; bedding laminar to indistinct, subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction to HCl 700.0-736.0' - Particles become more angular

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ↔ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
690	BS-56	1↔4	Buff	4.5
700	BS-57	1↔7	Gray	
710	BS-58	1↔5	Gray	
720	BS-59	1↔5	Gray	
730	BS-60	1↔5	Gray	
740	BS-61	1↔5	Brownish Gray	
750	BS-62	1↔5	Brownish Gray	
760	BS-63	1↔5	Brown	
770	BS-64	1↔7	Gray	
780	BS-65	1↔5	Gray	
790				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE; bedding laminar to indistinct, subrounded to subangular grains; occasional angular chert particles, subrounded gypsum and anhydrite particles, low to very low reaction to HCl	790	BS-66	1–5	Gray	
				800	BS-67	1–5	Gray	
				810	BS-68	1–7	Buff/Gray	
		-242.3		820	BS-69	1–10	Buff/Gray	
	SALINA G UNIT		Gray to buff, fine grained to amorphous DOLOMITE, bedding indistinct; subrounded to subangular grains, occasional anhydrite particles, low to very low reaction to HCl	830	BS-70	1–7	Gray	3.8
				840	BS-71	1–5	Gray	
				850	BS-72	1–5	Gray	
				860	BS-73	1–7	Gray	
				870	BS-74	1–7	Gray	
				880	BS-75	1–5	Gray	
				890				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA G UNIT		Gray to buff, fine grained to amorphous DOLOMITE, bedding indistinct; subrounded to subangular grains, occasional anhydrite particles, low to very low reaction to HCl	890	BS-76	4	Gray	
				900	BS-77	7	Gray	
				910	BS-78	5	Gray	
		-334.3		920	BS-79	5	Gray	
		-336.3	Fine grained to amorphous, brown DOLOMITE; bedding indistinct; occasional halite, anhydrite and chert particles, low reaction to HCl					
	F6 SALT		Crystalline HALITE/ANHYDRITE; occasional fine grained, gray DOLOMITE; particles are subangular, no reaction to HCl	930	BS-80	5	Gray	0.9
				940	BS-81	5	Gray	
		-361.3		950	BS-82	5	Gray	
	SALINA F UNIT	-366.3	Fine grained to amorphous, brown DOLOMITE; bedding indistinct; occasional halite, anhydrite and chert particles, low reaction to HCl					
	F5 SALT		Crystalline, white HALITE/ANYHDRITE and fine grained to amorphous, gray DOLOMITE; subrounded to subangular particles	960	BS-83	6	Gray	2.5
		-380.3	970.0-976.0' - Overal particles size decreases	970				
	SALINA F UNIT		Fine grained to amorphous, buff to gray DOLOMITE; bedding indistinct; occasional chert, halite and anhydrite particles, low reaction to HCl 980.0-986.0' - Occasional halite and anhydrite particles. Color changes to brown.		BS-84	4	Gray	
		-394.3		980	BS-85	4	Brown/Gray	
	F4 SALT			990				1.2

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	F4 SALT		Crystalline, white HALITE/ANHYDRITE; occasional fine grained to amorphous DOLOMITE; occasional carbonaceous particles; subrounded to angular grains 1000.0-1010.0' - Increase in small halite and anhydrite particles. Increase in chert particles.	990	BS-86	5	Brownish Gray	
		-420.3		1000	BS-87	5	Gray	
	SALINA F UNIT	-432.3	Fine grained to amorphous, buff to gray DOLOMITE; bedding indistinct; occasional chert, halite and anhydrite particles, low reaction to HCl	1010	BS-88	4	Gray	
	F3 SALT		Crystalline, white HALITE/ANHYDRITE; occasional fine grained to amorphous DOLOMITE; occasional carbonaceous particles; subrounded to angular grains	1020	BS-89	5	White/Light Gray	
				1030	BS-90	5	White/Light Gray	
		-460.3		1040	BS-91	5	White/Light Gray	
	SALINA F UNIT		Gray DOLOMITIC SHALE; occasional fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains, low reaction to HCl	1050	BS-92	6	White/Light Gray	4.3
				1060	BS-93	4	Brown	
		-488.3		1070	BS-94	6	Brown	
	F2 SALT		Crystalline, white HALITE/ANHYDRITE; occasional fine grained to amorphous DOLOMITE; occasional carbonaceous particles; subrounded to angular grains	1080 1090	BS-95	6	Brown	0.9

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE

GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
F2 SALT		Crystalline, white HALITE/ANHYDRITE; occasional fine grained to amorphous DOLOMITE; occasional carbonaceous particles; subrounded to angular grains
	-514.3	Gray DOLOMITIC SHALE; occasional fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains, low reaction to HCl
F1 UNIT	-518.3	Crystalline, white HALITE/ANHYDRITE; occasional fine grained to amorphous DOLOMITE; occasional carbonaceous particles; subrounded to angular grains
SALINA E UNIT	-566.3	Gray DOLOMITIC SHALE; occasional fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains, low reaction to HCl

DEPTH (ft): 1090, 1100, 1110, 1120, 1130, 1140, 1150, 1160, 1170, 1180, 1190

ROCK SAMPLE DATA

SAMPLE NO.	PARTICLE SIZE (mm) Smallest ↔ Largest (10, 20, 30, 40)	COLOR	DRILLING RATE (min/ft)
BS-96	1–5	Brown	
BS-97	1–5	Brown	
BS-98	1–6	Brown	
BS-99	1–5	White/Light Gray	
BS-100	1–4	White/Light Gray	
BS-101	1–6	White/Light Gray	
BS-102	1–5	White/Light Gray	2.8
BS-103	1–6	White/Light Gray	
BS-104	1–6	White/Light Gray	
BS-105	1–7	White/Light Gray	

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA E UNIT		Gray DOLOMITIC SHALE; occasional fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains, low reaction to HCl	1190	BS-106	5	Buff/Gray	
				1200	BS-107	4	Gray	
				1210	BS-108	5	Gray	
				1220	BS-109	5	Gray	
				1230	BS-110	5	Gray	
				1240	BS-111	5	Gray	
		-668.3		1250	BS-112	7	Buff/Gray	
	D3 SALT	-680.3	Crystalline, white HALITE/ANHYDRITE; occasional fine grained to amorphous DOLOMITE; occasional carbonaceous particles; subrounded to angular grains	1260	BS-113	7	Gray	2.6
	SALINA D UNIT	-689.3	Gray DOLOMITIC SHALE; occasional fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains, low reaction to HCl	1270	BS-114	7	Gray	
	D2 SALT	-700.3	Crystalline, white HALITE/ANHYDRITE; occasional fine grained to amorphous DOLOMITE; occasional carbonaceous particles; subrounded to angular grains	1280	BS-115	7	Gray	
				1290				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟵⟶ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA C UNIT		Gray, DOLOMITIC SHALE; bedding indistinct; subrounded to subangular grains	1290	BS-116	1 5	White/Light Gray	2.8
				1300	BS-117	1 3	Gray	
				1310	BS-118	1 4	Gray	
				1320	BS-119	1 4	Gray	
				1330	BS-120	1 2	Gray	
				1340	BS-121	1 2	Gray	
				1350	BS-122	1 2	Gray	
				1360	BS-123	1 5	Gray	
				1370	BS-124	1 2	Gray	
				1380	BS-125	1 2	Gray	3.2
				1390				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA C UNIT		Gray, DOLOMITIC SHALE; bedding indistinct; subrounded to subangular grains	1390	BS-126	1 2	Gray	
				1400	BS-127	1 3	Gray	
				1410	BS-128	1 3	Gray	
		-840.3		1420	BS-129	1 5	Gray	
	SALINA B UNIT		Mixed HALITE/ANHYDRITE with occasional shale stringers	1430	BS-130	1 10	Gray	
				1440	BS-131	1 8	Gray	
				1450	BS-132	1 8	Gray/White	
				1460	BS-133	1 7	Gray/White	
				1470	BS-134	1 7	Gray/White	
				1480	BS-135	1 5	Gray/White	
				1490				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA B UNIT		Mixed HALITE/ANHYDRITE with occasional shale stringers	1490	BS-136	5	Gray/White	
				1500	BS-137	5	Gray/White	
				1510	BS-138	5	Gray/White	
				1520	BS-139	5	Gray/White	
				1530	BS-140	5	Gray/White	
				1540	BS-141	5	Gray	
				1550	BS-142	5	Gray/White	
				1560	BS-143	5	Gray/White	
				1570	BS-144	5	Gray/White	
				1580	BS-145	5	Gray/White	
				1590				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-6

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA B UNIT	-1040.3	Mixed HALITE/ANHYDRITE with occasional shale stringers	1590	BS-146	5	Gray/White	
				1600	BS-147	5	Gray/White	
				1610	BS-148	5	Gray/White	
				1620	BS-149	4	Gray/White	
	SALINA A2	-1046.3	Mixed fine grained to amorphous, gray DOLOMITE and crystalline HALITE/ANHYDRITE; subrounded to subangular grains, low reaction to HCl	1630	BS-150	4	Gray/White	
			End of Boring at 1636 ft.	1640				
				1650				
				1660				
				1670				
				1680				
				1690				

BORING COORDINATES
N (y) Coordinate 4684633.76
E(x) Coordinate 326481.72

Remarks:
Ground Surface Elevation: 589.68 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-18-07
Date Completed: 03-22-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

LOG OF ROTARY BORING NO:
DRICX10TB7 (TB-7)

NTH CONSULTANTS, LTD.

		Inspector	NTH
Project Name:	DRIC Brine Well Investigation	Contractor:	Advanced Energy Services
Project Location:	Detroit, Michigan	Driller:	Rig 7, R. Thatcher, R. Yaklin
NTH Proj. No:	15-050014-12	Drilling Equipment	Walker-Neer Apache 150-25
Drilling Date:	2/7/2007 to 4/8/2007	Checked By:	Z. Carr, P.E., C. Johnson
Borehole Size:	7 7/8-inch	Lat/Long. Location:	Lat. 42.2901 Long. -83.1018

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.7	Notes
	Rotary Drilling							Salina Group - B Unit (B-Salt)	-887.8	Boring Advanced as Core Boring to 1470.5 Feet Below Ground Surface (EL -887.8)	
										Clear and White HALITE with Occasional Gray Shale	
1475											
										Anhydrite Interbed	
1480									-897.3	Clear and White HALITE with Occasional Gray Shale	
1485			BS-1		1/64 to 1/10	A to SA					
1490									-907.3	SHALE STRINGER (1489' to 1491"0 (EL -906.3 to -908.3)	
										Clear and White HALITE with Occasional Gray Shale	
1495			BS-2		1/64 to 1/10	A to SA					
1500			BS-3		1/64 to 1/32	A to					

NOTES: NTH Inspectors: M. Firestone, J. Ross
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.7	Notes
	Rotary Drilling					SA		Salina Group - B Unit (B-Salt)		Clear and White HALITE with Gray Shale	
1505											
										SHALE STRINGER (1508' to 1511') (EL -925.3 to -928.3)	
1510									-927.3		
										Interbedded HALITE and ANHYDRITE (1511' to 1516') (EL -928.3 to -933.3)	
1515			BS-4		1/64 to 1/10	A to SA					
										Clear and White HALITE with Trace Gray Shale	
1520									-937.3		
										Clear and White HALITE with Trace Gray Shale	
1525			BS-5		1/64 to 1/32	A to SA					
1530									-947.3		
										Clear and White HALITE with Trace Gray Shale	
1535			BS-6		1/64 to 1/10	A to					

NOTES: NTH Inspectors: M. Firestone, J. Ross
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.7	Notes
	Rotary Drilling					SA	▦	Salina Group - B Unit (B-Salt)		Clear and White HALITE with Trace Gray Shale	
							▨			Massive Interbedded ANHYDRITE (1537' to 1540') (EL -954.3 to -957.3)	
1540			BS-7		1/64 to 1/10	A to SA	▦			Clear and White HALITE with Trace Gray Shale	
1545							▦				
1550							▨		-967.3	Massive Interbedded ANHYDRITE (1549' to 1553') (EL -966.3 to -970.3)	
1555			BS-8		1/64 to 1/5	A to SA	▦			Clear and White HALITE with Trace Brown Shale	
1560							▦		-977.3	Clear and White HALITE with Trace Brown Shale and Tan Dolomite	
1565			BS-9		1/64 to 1/5	A to SA	▦				
1570							▦				

NOTES: NTH Inspectors: M. Firestone, J. Ross
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX10TB7 (TB-7)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.7	Notes
	Rotary Drilling		BS-10		1/64 to 1/5	A to SA	▦	Salina Group - B Unit (B-Salt)		Clear and White HALITE with Trace Brown Shale and Tan Dolomite	
1575							▨			Massive Interbedded ANHYDRITE (1575' to 1581') (EL -992.3 to -998.3)	
1580									-997.3		
							▦			Clear and White HALITE with Trace Brown Shale and Tan Dolomite	
1585			BS-11		1/64 to 1/5	A to SA					
							▨			Massive Interbedded ANHYDRITE (1587.5' to 1589') (EL -1004.8 to -1006.3)	
1590							▦		-1007.3	Clear and White HALITE with Trace Brown Shale and Tan Dolomite	
1595			BS-12		1/64 to 1/5	A to SA					
							▨			Massive Interbedded ANHYDRITE (1598' to 1600') (EL -1015.3 to -1017.3)	
1600			BS-13		1/64 to 1/5	A to SA	▦			Clear and White HALITE with Trace Brown Shale and Tan Dolomite	

NOTES: NTH Inspectors: M. Firestone, J. Ross
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX10TB7 (TB-7)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.7	Notes
	Rotary Drilling						▨	Salina Group - B Unit (B-Salt)		Massive Interbedded ANHYDRITE (1605' to 1609') (EL -1022.3 to -1026.3)	
1610							▦		-1027.3	Clear and White HALITE with Little Brown Shale and Trace Tan Dolomite	
							▨			Massive Interbedded ANHYDRITE (1611' to 1614') (EL -1028.3 to -1031.3)	
1615			BS-14		1/64 to 1/5	A to SA	▦			Clear and White HALITE with Little Brown Shale and Trace Tan Dolomite	
1620			BS-15		1/64 to 1/5	A to SA	▦			White HALITE with Trace Brown and Tan Dolomite	
							⊿			DOLOMITE (1623' to 1626') (EL -1040.3 to -1043.3)	
1625							▨			Massive Interbedded ANHYDRITE "False A2" (1626' to 1632') (EL -1043.3 to -1049.3)	
1630			BS-16		1/64 to 1/10	A to SR	▨		-1047.3		
1635							⊿	Salina Group - A2 Carbonate		Brown Amorphous SHALE and Tan Amorphous DOLOMITE with Little Clear and White Halite	
			BS-17		1/64 1/10	A to	⊿		-1055.3	Brown Amorphous SHALE and Tan Amorphous DOLOMITE with Little Clear and White Halite	

NOTES: NTH Inspectors: M. Firestone, J. Ross
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX10TB7 (TB-7)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.7	Notes
	Rotary Drilling					SA				End of Boring at 1640 feet.	
1645											
1650											
1655											
1660											
1665											
1670											

NOTES: NTH Inspectors: M. Firestone, J. Ross
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

		Inspector	NTH
Project Name:	DRIC Brine Well Investigation	Contractor:	Advanced Energy Services
Project Location:	Detroit, Michigan	Driller:	Rig 7, R. Thatcher, R. Yaklin
NTH Proj. No:	15-050014-12	Drilling Equipment	Walker-Neer Apache 150-25
Drilling Date:	1/16/2007 to 2/8/2007	Checked By:	Z. Carr, P.E., C. Johnson
Borehole Size:	17, 12 1/4, 8 3/4, 7 7/8 inches	Lat/Long. Location:	Lat. 42.2999 Long. -83.0925

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
0	Rotary Drilling							Overburden	584.4	FILL: SAND with Varying Amounts of Silt, Clay, Gravel, Concrete and Asphalt Debris, and Organic Material	
5											
10											
15		339.7mm Cemented to Surface							569.4	SAND and GRAVEL with Trace Caly and Silt	
20									564.4	SILTY CLAY with Trace Sand and Gravel	
25											
30											

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Overburden		SILTY CLAY with Trace Sand and Gravel	
35											
40											
45		339.7mm Cemented to Surface									
50											
55											
60											

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Overburden		SILTY CLAY with Trace Sand and Gravel	
70											
75											
80		339.7mm Cemented to Surface									
85											
90											
95											
									486.4	HARDPAN: Hard Gray SILTY CLAY with Trace Sand and Gravel	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
100	Rotary Drilling	339.7mm Cemented to Surface						Overburden	479.89	HARDPAN: Hard Gray SILTY CLAY with Trace Sand and Gravel	
105		Elev 473.9 Depth 110.5						Dundee Limestone Formation	473.9	Dundee Limestone Formation Top (EL 479.9) LIMESTONE (Weathered)	
110			BS-1	13	1/64 to 4/5	A to SR			471.4	Light to Dark Gray Amorphous to Fine Grained LIMESTONE	
115 120 125		244.5mm Cemented to Surface Open-hole Below 209' (EL 375.4)	BS-2	6					454.4	Light to Dark Gray Amorphous to Fine Grained LIMESTONE	Some Loss of Circulation
130										Light to Dark Gray Amorphous to Fine Grained LIMESTONE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
135 140	Rotary Drilling	244.5mm Cemented to Surface Open-hole Below 209' (EL 375.4)	BS-3	5.3				Dundee Limestone Formation		Light to Dark Gray Amorphous to Fine Grained LIMESTONE	
145 150 155 160			BS-4	5.3					439.4	Light to Dark Gray Amorphous to Fine Grained LIMESTONE	
165			BS-5	5.9	1/64 to 1/32	A			422.4	Light Gray and Brown Amorphous to Fine Grained LIMESTONE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
170	Rotary Drilling	244.5mm Cemented to Surface Open-hole Below 209' (EL 375.4)	BS-6	5	1/64 to 3/8	A		DRG - Lucas Formation	414.3	DRG - Lucas Formation Top EL 414.4 Light to Dark Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE	
175			BS-7	3.9	1/64 to 1/3	A			408.4	Light to Dark Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE	
180											
185											
190											
195											
200									384.4	Light to Dark Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
205 210	Rotary Drilling	244.5mm Cemented to Surface Open-hole Below 209' (EL 375.4)	BS-8	3.5				DRG - Lucas Formation	369.4	Light to Dark Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE	
215 220 225			BS-9	2.8					354.4	Light Brown Amorphous DOLOMITE	
230 235			BS-10	3.3	1/64 to 3/8	A				Light Gray and Brown Amorphous to Fine Grained DOLOMITE Tan LIMESTONE (231' to 232') (EL 353.4 to 352.4) Light Gray and Brown Amorphous to Fine Grained DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
240	Rotary Drilling							DRG - Lucas Formation	344.4	Light Gray and Brown Amorphous to Fine Grained DOLOMITE	
245			BS-11	2.5	1/64 to 3/8	A to SR					
250									334.4	Light Brown Fine Grained DOLOMITE with Carbonaceous Banding	
255			BS-12	2.8	1/64 to 5/8	A					
260									324.4	Tan LIMESTONE Light Brown Fine Grained DOLOMITE with Carbonaceous Banding	
265			BS-13	2.5	1/64 to 5/8	A					
270									314.4	Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Carbonaceous Banding and Trace Anhydrite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
275	Rotary Drilling		BS-14	2.3	1/64 to 1/2	A		DRG - Lucas Formation	304.4	Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Carbonaceous Banding and Trace Anhydrite	Possible Anhydrite in Bedding Planes
280 285			BS-15	3	1/64 to 1/2	A			294.4	Tan LIMESTONE Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite (281' to 285') (EL 303.4 to 299.4) Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (285' to 290') (EL 299.4 to 294.4)	
290 295			BS-16	2.1	1/64 to 3/8	A			284.4	Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Carbonaceous Banding and Trace Anhydrite	
300 305			BS-17	2	1/64 to 3/8	A				Light Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite and Carbonceous Banding Tan LIMESTONE (303' to 304') (EL 281.4 to 280.4)	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
310	Rotary Drilling							DRG - Lucas Formation	274.4	Light Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite and Carbonceous Banding	
315 320			BS-18	2.3	1/64 to 3/8	A			264.4	Light Brown and Tan Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite	
325 330			BS-19	3.1	1/64 to 1/2	A			254.4	Light Brown and Tan Fine Grained DOLOMITIC LIMESTONE with Carbonaceous Banding and Anhydrite	
335 340			BS-20	2.1	1/64 to 1/5	A			244.4	Light Brown and Tan Fine Grained DOLOMITIC LIMESTONE with Carbonaceous Banding and Anhydrite	
										Light Tan and Gray Amorphous to Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite (340' to 341') (EL 244.4 to 243.4) Tan and Gray Interbedded DOLOMITE and LIMESTONE (341' to 344') (EL 243.4 to 240.4)	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
345	Rotary Drilling		BS-21	2.4	1/64 to 1/3	A		DRG - Lucas Formation		Light Tan and Gray Amorphous to Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite (344' to 350') (EL 240.4 to 234.4)	
350									234.4	Light Brown and Tan Fine Grained Interbedded DOLOMITE and LIMESTONE with Little Anhydrite	
355			BS-22	2.2	1/64 to 3/8	A				Tan and Gray Amorphous to Fine Grained DOLOMITE (354' to 360') (EL 230.4 to 224.4)	
360			BS-23	2.6	1/64 to 1/3	A				Light Brown and Tan Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite	
365										Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (366' to 369') (EL 218.4 to 215.4)	
370									214.4	Light Brown and Tan Fine Grained LIMESTONE with Anhydrite (369' to 376') (EL 215.4 to 208.4)	
375			BS-24	4.3	1/64 to 1/3	A				Tan LIMESTONE (376' to 377') (EL 208.4 to 207.4)	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
380	Rotary Drilling							DRG - Lucas Formation	204.4	Light Brown and Tan Fine Grained DOLOMITE with Anhydrite	
385			BS-25	2	1/64 to 1/3	A					
390									194.4	Tan LIMESTONE (389' to 390') (EL 195.4 to 194.4) Light Brown and Tan Fine Grained DOLOMITE with Anhydrite Tan LIMESTONE (391' to 392') (EL 193.4 to 192.4) Light Brown and Tan Fine Grained DOLOMITE with Anhydrite	
395			BS-26	2.4	1/64 to 1/3	A					
400									184.4	Massive Interbedded ANHYDRITE (400' to 401') (EL 184.4 to 183.4) Light Brown and tan Fine Grained DOLOMITE with Carbonaceous Banding (401' to 406') (EL 183.4 to 178.4)	
405			BS-27	2.9	1/64 to 1/32	A				Tan LIMESTONE (406' to 407') (EL 178.4 to 177.4)	
410									174.4	Light Brown and Tan Fine Grained DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 584.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
415 420	Rotary Drilling		BS-28	1.9	1/64 to 1/5	A		DRG - Lucas Formation	164.4	Light Brown and Tan Fine Grained DOLOMITE Tan LIMESTONE (413' to 417') (El 171.4 to 167.4) Light Brown and tan Fone Grained DOLOMITE	
425 430			BS-29	1.8	1/64 to 1/3	A		DRG - Amherstburg Formation	154.4	Light Brown and Tan Fine Grained DOLOMITE with Carbonaceous Banding Tan LIMESTONE (424' to 425') (EL 160.4 to 159.4) DRG - Amherstburg Formation Top (EL 159.4) Light Brown and Tan Fine Grained DOLOMITE with Carbonaceous Banding	
435 440			BS-30	1.9	1/64 to 3/8	A			144.4	Light Gray and Tan Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite	
445			BS-31	1.3	1/64 to 1/3	A				Light Brown and Tan Fine Grained DOLOMITE with Carbonaceous Banding	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
450	Rotary Drilling							DRG - Amherstburg Formation	134.4	Light Brown and Tan Fine Grained DOLOMITE with Carbonaceous Banding	
455 460			BS-32	2.6	1/64 to 3/8	A			124.4	Light Brown and Tan Fine Grained DOLOMITE with Carbonaceous Banding	
465 470			BS-33	2.5	1/64 to 1/3	A			114.4	Light Brown and Tan Fine Grained DOLOMITE with Carbonaceous Banding	
475 480			BS-34	1.6	1/64 to 1/5	A			104.4	Light Gray and Tan Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite	
										Light Gray and Tan Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 584.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
	Rotary Drilling							DRG - Amherstburg Formation		Light Gray and Tan Fine Grained DOLOMITE with Carbonaceous Banding and Anhydrite	
485			BS-35	1.8	1/64 to 1/5	A					
490									94.4	Tan and Gray Amorphous to Fine Grained DOLOMITE	
								DRG - Sylvania Sandstone		DRG - Sylvania Sandstone Top EL 90.4 White Fine Grained SANDSTONE	
495			BS-36	1.6	1/64 to 1/10	A					
500									84.4	White Fine Grained SANDSTONE	
505			BS-37	1.5	1/64 to 1/10	A					
510									74.4	White Fine Grained SANDSTONE with Occasional Dolomite	
515			BS-38	1.1	1/64 to 1/10	A					

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							DRG - Sylvania Sandstone		White Fine Grained SANDSTONE with Occasional Dolomite	
520									64.4	White Fine Grained SANDSTONE with Dolomite	
525			BS-39	1.9	1/64 to 1/10	A					
530									54.4	White Fine Grained SANDSTONE	
535			BS-40	1	1/64 to 1/10	A					
540									44.4	White Fine Grained SANDSTONE	
545			BS-41	1.4	1/64 to 1/10	A					
550									34.4	White Fine Grained SANDSTONE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

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Project Location: Detroit, Michigan

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Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
555	Rotary Drilling		BS-42	1.4	1/64 to 3/8	A				White Fine Grained SANDSTONE Bois Blanc Formation Top EL 28.4 Light Gray and tan Amorphous DOLOMITE with Trace Chert	
560								Bois Blanc Formation	24.4		
565			BS-43	1.6	1/64 to 3/8	A				Light Gray and tan Amorphous DOLOMITE with Trace Chert	
570									14.4		
575			BS-44	1.6	1/64 to 3/8	A to R				Light Gray and Tan Amorphous DOLOMITE with Trace Chert	
580									4.3999999999999998		
585			BS-45	2	1/64 to 3/8	A to R				Tan and Brown Fine Grained DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Bois Blanc Formation		Tan and Brown Fine Grained DOLOMITE	
590									-5.60000000000002	Light Gray Fine Grained DOLOMITE	
595			BS-46	2.4	1/64 to 1/3	A to R					
600									-15.6	Brown CHERTY DOLOMITE	
605			BS-47	2.8	1/64 to 1/5	A					
610									-25.6	Brown and Gray DOLOMITE with Trace Limestone	
615			BS-48	3.2	1/64 to 3/8	A					
620									-35.6	Light Gray Fine Grained DOLOMITE with Occasional Chert	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Bois Blanc Formation		Light Gray Fine Grained DOLOMITE with Occasional Chert	
625			BS-49	3.5	1/64 to 1/5	A					
630									-45.6	Gray Amorphous to Fine Grained DOLOMITE with Occasional Chert	
635			BS-50	3.4	1/64 to 1/5	A to R					Very Fine Cuttings
640			BS-51	4.3	1/64 to 1/5	A					
645								Garden Island Formation		Garden Islands Formation =Top EL -60.6 SANDSTONE	
650								Bass Islands Formation	-65.6	Bass Islands Group Top EL -64.6 Light gray and Tan Fine Grained DOLOMITE with Occasional Fossils Light Gray and Tan Fine Grained DOLOMITE with Occasional Fossils	
655			BS-52	5.1	1/64 to 3/8	A					

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Bass Islands Formation		Light Gray and Tan Fine Grained DOLOMITE with Occasional Fossils	
660									-75.6	Gray Fine Grained DOLOMITE	
665			BS-53	5.8	1/64 to 1/5	A					
											Moderate Loss of Circulation
670									-85.6	Gray and Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite	
675			BS-54	5.9	1/64 to 1/5	A					
680									-95.6	Light Gray and Tan Fine Grained DOLOMITE with Occasional Anhydrite	
685			BS-55	5.8	1/64 to 1/5	A					
690									-105.6	Light Tan Fine Grained DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Bass Islands Formation		Light Tan Fine Grained DOLOMITE	
695			BS-56	3.8	1/64 to 1/3	A					
700									-115.6	Light Gray and Brown Fine Grained DOLOMITE	
705			BS-57	5.4	1/64 to 1/5	A					
710									-125.6	Tan and Gray Fine Grained DOLOMITE	
715			BS-58	5.3	1/64 to 1/5	A					
720									-135.6	Light Tan and Brown Fine Grained DOLOMITE	
725			BS-59	6	1/64 to 1/5	A					

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
730	Rotary Drilling							Bass Islands Formation	-145.6	Light Tan and Brown Fine Grained DOLOMITE	
735 740			BS-60	4.6	1/64 to 3/8	A			-155.6	Light Brown Fine Grained DOLOMITE with Occasional Chert and Anhydrite	
745 750			BS-61	5.5	1/64 to 1/10	A			-165.6	Light Brown Fine Grained DOLOMITE with Occasional Anhydrite	
755 760			BS-62	6.8	1/64 to 3/8	A			-175.6	Light Brown and Gray Fine Grained DOLOMITE Tan and Gray Fine Grained SHALEY DOLOMITE (753' to 755') (EL -168.6 to -170.6) Light Brown and Gray Fine Grained DOLOMITE	
										Light Brown and Gray Fine Grained DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

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NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 584.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
765	Rotary Drilling		BS-63	6.5	1/64 to 1/4	A		Bass Islands Formation		Light Brown and Gray Fine Grained DOLOMITE	
770									-185.6	Gray Amorphous to Fine Grained DOLOMITE	
775			BS-64	9.3	1/64 to 1/3	A				Gray LIMESTONE (777' to 779') (EL -192.6 to -194.6) Gray Fine Grained DOLOMITE	
780									-195.6	Gray Fine Grained DOLOMITE	
785			BS-65	6.8	1/64 to 1/3	A					
790			BS-66	6.8	1/64 to 1/3	A				Gray Fine Grained DOLOMITE with Occasional Chert	
795											Slight Loss of Circulation

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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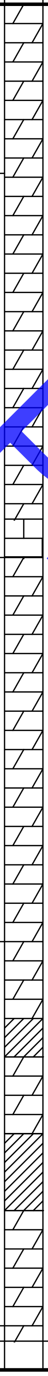
Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 584.4



Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile	Notes
800	Rotary Drilling						Bass Islands Formation	-215.6	Gray Fine Grained DOLOMITE and Massive Interbedded ANHYDRITE (797' to 802') (EL -212.6 to -218.6)	
805			BS-67	5.4	1/64 to 1/5	A			Gray Fine Grained DOLOMITE with Occasional Chert (802' to 809') (EL -217.6 to -224.6)	
810								-225.6	Gray LIMESTONE (809' to 810') (EL -224.6 to -225.6) Gray Fine Grained DOLOMITE with Occasional Chert	
815			BS-68	6.1	1/64 to 1/3	A				
820								-235.6	Gray Fine Grained DOLOMITE with Anhydrite Massive Interbedded ANHYDRITE (822' to 823') (EL -237.6 to -238.6) Gray Fine Grained DOLOMITE with Anhydrite (823' to 825') (EL -238.6 to -240.6)	
825			BS-69	4.9	1/64 to 1/3	A			Massive Interbedded ANHYDRITE 9825' to 827') (EL -240.6 to -242.6) Gray Fine Grained DOLOMITE with Anhydrite	Slight Loss of Circulation
830								-245.6		

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

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NTH CONSULTANTS, LTD.

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
835 840	Rotary Drilling		BS-70	4	1/64 to 1/3	A		Bass Islands Formation	-255.6	Gray and Brown Amorphous to Fine Grained DOLOMITE with Anhydrite Massive Interbedded ANHYDRITE (834' to 837') (EL -249.6 to -252.6) Gray and Brown Amorphous to Fine Grained DOLOMITE with Anhydrite	
845 850			BS-71	3.9	1/64 to 1/5	A			-265.6	Gray and Brown Amorphous to Fine Grained DOLOMITE with Anhydrite	
855 860			BS-72	3.6	1/64 to 1/3	A			-275.6	Gray and Brown Fine Grained DOLOMITE with Anhydrite Massive Interbedded ANHYDRITE (852' to 857') (EL -267.6 to -272.6) Gray and Brown Fine Grained DOLOMITE with Anhydrite	
865			BS-73	6.1						Gray and Brown Fine Grained DOLOMITE with Anhydrite Massive Interbedded ANHYDRITE (862' to 865') (EL -277.6 to -280.6)	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

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NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

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Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 584.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
870	Rotary Drilling				1/64 to 3/8	A		Bass Islands Formation	-285.6	Gray and Brown Fine Grained DOLOMITE with Anhydrite	
875 880			BS-74	5	1/64 to 3/8	A			-295.6	Gray and Brown Fine Grained DOLOMITE with Anhydrite Tan and Gray Interbedded DOLOMITE and LIMESTONE (874' to 878') (EL -289.6 to -293.6) Gray and Brown Fine Grained DOLOMITE with Occasional Anhydrite	
885 890			BS-75	3.8	1/64 1/5	A			-305.6	Gray and Brown Fine Grained DOLOMITE with Occasional Anhydrite	
895 900			BS-76	4	1/64 to 1/3	A to R			-315.6	Gray and Brown Fine Grained DOLOMITE and ANHYDRITE Massive interbedded ANHYDRITE (898' to 901') (EL -313.6 to -316.6)	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
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Project Name: DRIC Brine Well Investigation
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NTH Proj. No: 15-050014-12
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Bass Islands Formation		Gray and Brown Fine Grained DOLOMITE	
905			BS-77	2.9	1/64 to 1/5	A					
910								Salina Group G Unit (G Shale)	-325.61	Salina Group - G Unit (G-Shale) Top EL -325.6 Gray and Green SHALE	
915			BS-78	3.8	1/64 to 1/5	A				Massive Interbedded ANHYDRITE (915' to 917') (EL -330.6 to -332.6) Gray and Green SHALE	
920									-335.6	Gray SHALE with Occasional Dolomite and Anhydrite	
925			BS-79	4.3	1/64 to 1/5	A					
930									-345.6	Gray SHALE with Occasional Dolomite and Anhydrite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling		BS-80	3.2	1/64 to 1/10	A		Salina Group - G Unit (G Shale)		Gray SHALE with Occasional Dolomite and Anhydrite	Slight Loss of Circulation
940									-355.6	Gray SHALE with Occasional Dolomite and Anhydrite	
945			BS-81	3.9	1/64 to 1/5	A					
950									-365.6	Gray SHALE with Occasional Dolomite and Anhydrite	
955			BS-82	3.6	1/64 to 1/5	A					
960									-375.6	Light to Dark Gray SHALE with Occasional Anhydrite	
965			BS-83	3.3	1/64 to 1/5	A					

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
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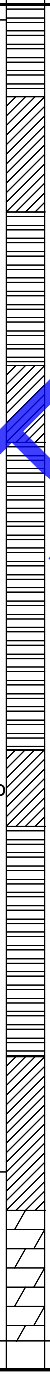
NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 584.4



Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile	Notes
970	Rotary Drilling		BS-84	4.2	1/64 to 1/5	A	Salina Group - G Unit (G Shale)			
									Massive Interbedded ANHYDRITE (972' to 975') (EL -387.6 to -390.6)	
975									Gray Fine Grained SHALE with Occasional Anhydrite	
980			BS-85	5.5	1/64 to 1/5	A			Massive Interbedded ANHYDRITE (979' to 981') (EL -394.6 to -396.6) Gray Fine Grained DOLOMITE with Occasional Tan Shale, Halite, and Anhydrite Gray Fine Grained SHALE with Occasional Anhydrite	
985										
990			BS-86	5.6	1/64 to 1/10	A to R			Massive Interbedded ANHYDRITE (989' to 991') (EL -404.6 to -406.6) Brown and Gray SHALE with Occasional Dolomite	
995										
									Massive Interbedded ANHYDRITE (997' to 1001') (EL -416.6 to -416.6)	
1000								-415.6	Dark Gray DOLOMITE and SHALEY DOLOMITE Dark Gray DOLOMITE and SHALEY DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1005	Rotary Drilling		BS-87	2.9	1/64 to 1/10	A to R		Salina Group - G Unit (G Shale)		Dark Gray DOLOMITE and SHALEY DOLOMITE Dark Gray DOLOMITE and SHALEY DOLOMITE	
1010									-425.6		
								Salina Group - F Unit (F-Salt)		Salina Group - F Unit (F-Salt) Top EL -427.6 Clear and White HALITE with Occasional Gray Shale (F4 Bed)	
1015			BS-88	1.1	1/64 to 1/5	A					
1020									-435.6	Clear and White HALITE with Occasional Gray Shale (F4 Bed)	
1025			BS-89	2.4	1/64 to 1/5	A					
1030									-445.6	Tan LIMESTONE (1029' to 1034') (EL -444.6 to -449.6)	
1035			BS-90	2	1/64 to 1/5	A				Tan and Gray Amorphous to Fine Grained DOLOMITE (1034' to 1040') (El -449.6 to -455.6)	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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DRG - Detroit River Group

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1040	Rotary Drilling							Salina Group - F Unit (F-Salt)	-455.6	Clear to Gray HALITE with Occasional Tan Dolomite and Trace Shale (F3 Bed)	
1045			BS-91	1.1	1/64 to 1/5	A					
1050									-465.6	White HALITE with Tan, Brown, and Gray Shale (F3 Bed)	
1055			BS-92	1.4	1/64 to 1/5	A					
1060									-475.6	HALITE and Brown and Tan SHALE with Occasional Anhydrite (F3 Bed)	
1065			BS-93	3.3	1/64 to 1/5	A					
1070									-485.6	Brown Amorphous to Fine Grained DOLOMITE and LIMESTONE with Occasional Anhydrite and Trace Halite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
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Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1075	Rotary Drilling		BS-94	4.9	1/64 to 1/3	A		Salina Group - F Unit (F-Salt)		Brown Amorphous to Fine Grained DOLOMITE and LIMESTONE with Occasional Anhydrite and Trace Halite	
1080			BS-95	4.2	1/64 to 1/3	A				Brown and Gray Fine Grained SHALEY DOLOMITE	
1085										Massive Interbedded ANHYDRITE (1085' to 1093') (EL -500.6 to -508.6)	
1090									-505.6		
										Brown and Gray Fine Grained SHALEY DOLOMITE with Occasional Anhydrite and Halite (1093' to 1098') (EL -508.6 to -513.6)	
1095			BS-96	1.7	1/64 to 1/4	A					
										Massive Interbedded ANHYDRITE (1098' to 1100') (EL -513.6 to -515.6)	
1100									-515.6	Clear HALITE with Trace Gray Shale (F2 Bed)	
1105			BS-97	1.4	1/64 to 1/5	A					

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1110	Rotary Drilling							Salina Group - F Unit (F-Salt)	-525.6	Clear HALITE with Trace Gray Shale (F2 Bed)	
1115 1120			BS-98	2.6	1/64 to 1/5	A			-535.6	Clear HALITE with Trace Gray Shale (F2 Bed)	
1125 1130			BS-99	1.2	1/64 to 1/3	A			-545.6	Clear HALITE with Trace Gray Shale (F2 Bed) Gray and Brown Amorphous to Fine Grained DOLOMITE (1124' to 1128') (EL -539.6 to -543.6) Clear HALITE with Trace Anhydrite (F1 Bed)	
1135 1140			BS-100	1	1/64 to 1/4	A			-555.6	Clear HALITE with Trace Anhydrite (F1 Bed)	
										Clear HALITE with Trace Anhydrite (F1 Bed)	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1145	Rotary Drilling		BS-101	0.8	1/64 to 1/4	A		Salina Group - F Unit (F-Salt)		Clear HALITE with Trace Anhydrite (F1 Bed)	
1150									-565.6	Clear HALITE with Trace Anhydrite (F1 Bed)	
1155			BS-102	0.8	1/64 to 1/4	A					
1160									-575.6	Clear HALITE with Trace Anhydrite (F1 Bed)	
1165			BS-103	1.5	1/64 to 1/4	A					
1170									-585.6	Clear HALITE with Trace Anhydrite (F1 Bed)	
1175			BS-104	1.2	1/64 to 1/3	A					
										Salina Group - E unit (E-Dolomite) Top EL -592.6	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1180	Rotary Drilling							Salina Group - E Unit (E - Dolomite)	-595.6	Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE with Halite Clear HALITE with Trace Anhydrite (F1 Bed)	
1185			BS-105	4	1/64 to 1/3	A				Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE with Halite	
1190									-605.6		
1195			BS-106	4.8	1/64 to 1/3	A				Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE with Clear Halite Massive Interbedded ANHYDRITE (1192' to 1194') (EL -607.6 to -609.6) Gray Amorphous to Fine Grained DOLOMITE Massive Interbedded ANHYDRITE (1197' to 1199') (EL -612.6 to -614.6) Gray Amorphous to Fine Grained DOLOMITE	
1200									-615.6		
1205			BS-107	5	1/64 to 1/5	A				Gray Amorphous to Fine Grained DOLOMITE	
1210									-625.6	Gray and Brown Amorphous to Fine Grained DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1215 1220	Rotary Drilling		BS-108	6	1/64 to 1/5	A		Salina Group - E Unit (E - Dolomite)	-635.6	Massive Interbedded ANHYDRITE (1213' to 1214') (EL -628.6 to -629.6) Gray and Brown Amorphous to Fine Grained DOLOMITE	
1225 1230			BS-109	8.5	1/64 to 1/3	A			-645.6	Gray Amorphous to Fine Grained DOLOMITE Massive Interbedded ANHYDRITE (1225' to 1226') (EL -640.6 to -641.6) Gray Amorphous to Fine Grained DOLOMITE	
1235 1240			BS-110	10.1	1/64 to 1/5	A			-655.6	Gray and Brown Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite	
1245			BS-111	9	1/64 to 1/3	A				Brown and Gray Amorphous to Fine Grained DOLOMITE with Some Anhydrite Tan and Gray Interbedded DOLOMITE and LIMESTONE (1242' to 1247') (EL --657.6 to -662.6)	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1250	Rotary Drilling							Salina Group - E Unit (E - Dolomite)	-665.6	Brown and Gray Amorphous to Fine Grained DOLOMITE with Some Anhydrite	
1255			BS-112	7.7	1/64 to 3/8	A				Tan and Light Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
1260									-675.6		
1265			BS-113	6.4	1/64 to 1/5	A				Tan and Light Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
1270									-685.6		
1275			BS-114	4.4	1/64 to 1/5	A				Massive Interbedded ANHYDRITE (1270' to 1271') (EL -685.6 to -686.6) Tan and Light Brown Fine Grained DOLOMITE with Trace Anhydrite Massive Interbedded ANHYDRITE and DOLOMITIC LIMESTONE	
1280									-695.6		
										Gray and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/16/07

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1285	Rotary Drilling		BS-115	1.3	1/64 to 1/5	A		Salina Group - D Unit (D-Salt)		Gray and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite Salina Group - D Unit (D-Salt) Top EL -701.1 Clear and Opaque HALITE with Trace Anhydrite and Shale (D3 Bed)	
1290			BS-116	2.8	1/64 to 1/5	A				Clear and Opaque HALITE with Trace Anhydrite and Shale (D3 Bed)	
1295											
1300			BS-117	1.7	1/64 to 1/5	A				Tan Fine Grained LIMESTONE with Anhydrite (1301' to 1304') (EL -716.6 to 719.6) Tan Fine Grained DOLOMITE with Anhydrite (1304' to 1311') (EL -719.6 to -726.6)	
1305											
1310									-725.6	Clear HALITE with Dolomite and Anhydrite (D2 Bed)	
1315			BS-118	1	1/64 to 1/10	A					

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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DRG - Detroit River Group

ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/16/07

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Salina Group - D Unit (D-Salt)			
1320									-735.6	Clear HALITE with Dolomite and Anhydrite (D2 Bed)	
1325			BS-119	2.1	1/64 to 1/5	A					
1330									-745.6	Clear, Brown, and Orange HALITE with Some Dolomite and Anhydrite (D2 Bed)	
1335			BS-120	2.3	1/64 to 1/5	A					
								Salina Group - C Unit (C-Shale)		Salina Group - C Unit (C-Shale) Top EL -751.6 Gray Amorphous to Fine Grained SHALE with Anhydrite	
1340									-755.6	Gray Amorphous to Fine Grained SHALE with Anhydrite	
1345			BS-121	2.4	1/64 to 1/5	A to R					
1350									-765.6	Gray Amorphous to Fine Grained SHALE with Halite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Salina Group - C Unit (C-Shale)		Gray Amorphous to Fine Grained SHALE with Halite	
1355			BS-122	2.9	1/64 to 1/5	A to R					Sample Appears Clayey/Weathered
1360									-775.6	Gray Fine Grained SHALE with Orange Halite	
1365			BS-123	2.2	1/64 to 1/5	A to R					
1370									-785.6	Gray Fine Grained SHALE	
1375			BS-124	2.4	1/64 to 1/5	A to R					
1380									-795.6	SHALE (from wireline logs)	
1385			BS-125	2.7	-	-					

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1390	Rotary Drilling							Salina Group - C Unit (C-Shale)	-805.6	SHALE (from wireline logs)	
1395			BS-126	2.3						SHALE (from wireline logs)	
1400									-815.6		
1405			BS-127	2.3	1/64 to 3/8	A				Gray Amorphous SHALE with Trace Anhydrite	
1410									-825.6		
1415			BS-128	2.3	1/64 to 1/10	A				Red and Gray Amorphous SHALE with Little Gray Dolomite, Anhydrite, and Trace Halite	Sample Appears Clayey/Weathered
1420									-835.6		
										Gray and Red Amorphous SHALE with Trace Orange Halite and Anhydrite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Salina Group - C Unit (C-Shale)		Gray and Red Amorphous SHALE with Trace Orange Halite and Anhydrite	
1425			BS-129	2.3	1/64 to 1/5	A					
1430									-845.6	Gray and Red Amorphous SHALE with Trace Orange Halite and Anhydrite	
1435			BS-130	2.3	1/64 to 1/5	A					
1440									-855.6	Gray and Red Amorphous SHALE with Trace Orange Halite	
1445			BS-131	2.3	1/64 to 1/5	A					
1450									-865.6	Gray Amorphous SHALE with Occasional Orange Halite	
1455			BS-132	2.5	1/64 to 1/5	A					

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling							Salina Group - C Unit (C-Shale)		Gray Amorphous SHALE with Occasional Orange Halite	
1460									-875.6	Gray Amorphous SHALE with Occasional Trace Orange Halite	
1465			BS-133	2.3	1/64 to 1/5	A					
1470									-885.6	Gray Amorphous SHALE with Occasional Trace Orange Halite	
1475			BS-134	2.6	1/64 to 1/10	A					Sample Appears Clayey/Weathered
1480									-895.6	Gray Amorphous SHALE with Occasional Trace Orange Halite Massive Interbedded ANHYDRITE (1483' to 1485') (EL -898.6 to -900.6) Gray Amorphous SHALE with Trace Orange Halite	
1485			BS-135	2.5	1/64 to 1/5	A					
1490									-905.6	Gray Amorphous SHALE with Occasional Trace Shale and Anhydrite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

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Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling						▤	Salina Group - C Unit (C-Shale)		Gray Amorphous SHALE with Occasional Trace Shale and Anhydrite	
1495			BS-136	2.8	1/64 to 1/5	A	▤				
1500			BS-137	2.7	1/64 to 1/10	A	▤			Gray Amorphous SHALE with Trace Halite	
1505							▤				
1510							▨		-925.6	Massive Interbedded ANHYDRITE (1509' to 1511') (EL -924.6 to -926.6) Gray Amorphous SHALE with Occcasional Halite	
1515			BS-138	3.1	1/64 to 1/10	A	▤				Sample Appears Clayey/Weathered
1520							▤		-935.6	Gray Amorphous SHALE with Trace Halite	
							▨			Massive Interbedded ANHYDRITE (1523' to 1524') (EL -938.6 to 939.6) Gray Amorphous SHALE with Trace Halite	
1525			BS-139	2.3	1/64 to 1/5	A	▤				

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling						▤	Salina Group - C Unit (C-Shale)		Gray Amorphous SHALE with Trace Halite	
1530							▤		-945.6	Gray Amorphous SHALE with Trace Orange HALITE	
1535			BS-140	2.4	1/64 to 1/5	A to R	▤			LIMEY SHALE	
1540							▤		-955.6	Gray Amorphous LIMEY SHALE with Trace Halite	
1545			BS-141	2	1/64 to 1/3	A to R	▤				
1550							▤		-965.6	Gray Amorphous SHALE with Trace Halite	
1555			BS-142	2.2	1/64 to 1/3	A to R	▨			Massive interbedded ANHYDRITE (1554' to 1556') (EL -969.6 to -971.6) Gray Amorphous SHALE with Trace Halite	
1560			BS-143	2.9	1/64 to 1/5	A to R	▤			Gray Amorphous SHALE with Trace Clear and Brown Halite and Anhydrite	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1565	Rotary Drilling							Salina Group - C Unit (C-Shale)		Massive Interbedded ANHYDRITE (1563' to 1568') (EL -978.6 to -983.6)	
1570									-985.6	Brown and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (1568' to 1575') (EL -983.6 to -990.6)	
1575			BS-144	1.7	1/64 to 1/5	A				Gray and Brown SHALE with Trace Halite (1575' to 1582') (EL -990.6 to -997.6)	
1580									-995.6	Gray and Brown SHALE with Trace Halite	
1585			BS-145	2.3	1/64 to 1/3	A				Gray and Brown SHALE with Trace Halite	
1590			BS-146	2.4	1/64 to 1/5	A				Gray and Brown SHALE with Little Halite	
1595											

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling						▨	Salina Group - C Unit (C-Shale)		Massive Interbedded ANHYDRITE (1597' to 1603') (EL -1012.6 to -1018.6)	
1600			BS-147	3.1	1/64 to 1/5	A					
							▤			Gray and Brown Amorphous SHALE with Trace Halite (1603' to 1606') (EL -1018.6 to -1021.6)	
1605											
							▨			Massive Interbedded ANHYDRITE (1606' to 1608') (EL -1021.6 to -1023.6)	
							▤			Gray and Brown Amorphous SHALE with Trace Halite (1608' to 1609') (EL -1023.6 to -1024.6)	
							▨			Massive Interbedded ANHYDRITE (1609' to 1611') (EL -1024.6 to -1026.6)	
1610									-1025.6	Gray and Brown Amorphous SHALE with Little Halite	
							▤			Gray and Brown Amorphous SHALE with Trace Halite	
1615			BS-148	2.5	1/64 to 1/5	A					
1620									-1035.6	Gray and Brown Amorphous SHALE with Trace Halite	
1625			BS-149	1.9	1/64 to 1/5	A	▤				Sample Appears Clayey/Weathered
1630			BS-150	1.7	1/64 to 1/5	A	▤			Massive Interbedded ANHYDRITE (1630' to	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

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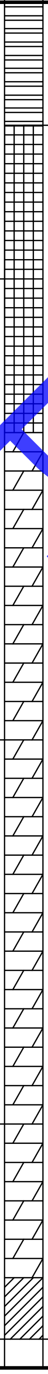

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling								1634') (EL -1045.6 to -1049.6)	
1635							Salina Group - B Unit (B-Salt)		Salina Group - B Unit (B-Salt) Top EL -1049.6 Brown HALITE with Trace Dolomite and Anhydrite	
								-1053.6	Brown HALITE with Trace Dolomite and Anhydrite	
1640										
									Dark Gray Interbedded DOLOMITE and LIMESTONE with Trace Shale and Halite	
			BS-151	2.2	1/64 to 1/3	A				
1645										
1650								-1065.6	Dark Gray Interbedded DOLOMITE and LIMESTONE with Trace Shale and Halite	
			BS-152	2.7	1/64 to 1/3	A				
1655										
									Gray and Brown Fine Grained DOLOMITE with Trace White and Clear Halite	Possibe Halite from 1658' to 1660' (EL -1073.6 to -1075.6)
1660								-1075.6	Gray and Brown Fine Grained DOLOMITE with Trace White and Clear Halite	
									Massive Interbedded ANHYDRITE (1664' to 1668') (EL -1079.6 to -1083.6)	
1665			BS-153	3.9	1/64 to 1/3	A				

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
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NTH CONSULTANTS, LTD.

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Project Location: Detroit, Michigan

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1670	Rotary Drilling							Salina Group - A2 Carbonate	-1085.6	Gray and Brown Fine Grained DOLOMITE with Trace White and Clear Halite Salina Group - A2 Carbonate Top EL -1083.6 Brown and Gray DOLOMITE with Occasional Anhydrite and Shale	False "A2"
1675 1680			BS-154	3.5	1/64 to 1/5	A			-1095.6	Brown and Gray DOLOMITE with Occasional Anhydrite and Shale	
1685 1690			BS-155	3.9	1/64 to 3/8	A			-1105.6	Brown SHALEY DOLOMITE with Occasional Anhydrite	
1695 1700			BS-156	4.5	1/64 to 1/5	A			-1115.6	Brown SHALEY DOLOMITE Massive Interbedded ANHYDRITE (1696' to 1697') (EL -1111.6 to -1112.6) Brown SHALEY DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
1705 1710	Rotary Drilling		BS-157	3.3	1/64 to 1/5	A		Salina Group - A2 Carbonate	-1125.6	Brown SHALEY DOLOMITE with Gray Shale Gray LIMESTONE (1705' to 1707') (EL -1120.6 to -1122.6) Gray DOLOMITE	
1715 1720			BS-158	3.8	1/64 to 1/5	A			-1135.6	Gray DOLOMITE	
1725 1730			BS-159	3.3	1/64 to 1/4	A			-1145.6	Gray SHALEY DOLOMITE	
1735			BS-160	3.9						Gray SHALEY DOLOMITE	

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB10 (TB-10)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 584.4	Notes
	Rotary Drilling				1/64 to 1/3	A		Salina Group - A2 Carbonate		Gray SHALEY DOLOMITE	
1740									-1155.6	Gray SHALEY DOLOMITE	
1745			BS-161	5.2	1/64 to 1/32	A					
1750										End of Boring at 1750 feet.	
1755											
1760											
1765											
1770											

NOTES: NTH Inpsectors: M. Firestone, S. Gole, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

		Inspector	NTH
Project Name:	DRIC Brine Well Investigation	Contractor:	Advanced Energy Services
Project Location:	Detroit, Michigan	Driller:	Rig 8, K. Vestal, R. Ward
NTH Proj. No:	15-050014-12	Drilling Equipment	Walker-Neer Apache 150-25
Drilling Date:	1/23/2007 to 4/16/2007	Checked By:	Z. Carr, P.E., C. Johnson
Borehole Size:	17, 12 1/4, 7 7/8-inch	Lat/Long. Location:	Lat. 42.3048 Long. -83.0876

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling							Overburden	582.9	FILL: SAND with Varying Amounts of Silt, Clay, Gravel, Concrete and Asphalt Debris, and Organic Material	
5											
10											
15		339.7mm Cemented to Surface									
									566.9	Medium SILTY CLAY with Trace Sand and Gravel	
20											
25											
30											

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
35 40 45 50 55 60	Rotary Drilling with Zones of Core Drilling	339.7mm Cemented to Surface						Overburden		Medium SILTY CLAY with Trace Sand and Gravel	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling							Overburden		Medium SILTY CLAY with Trace Sand and Gravel	
70											
75											
80		339.7mm Cemented to Surface									
85									496.9	HARDPAN: Hard Gray SILTY CLAY with Trace Sand and Gravel	
90											
95											

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile	Notes
100	Rotary Drilling with Zones of Core Drilling	339.7mm Cemented to Surface						481.399	HARDPAN: Hard Gray SILTY CLAY with Trace Sand and Gravel	
							Dundee Limestone Formation	478.9	Dundee Limestone Formation Top EL 481.4 LIMESTONE (Weathered)	
105		Elev 476.4 Depth 106.5								
110										
115			BS-1	9.2	1/64 to 2/3	A to SR		460.9	Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
120		244.5mm Cemented to Surface, Open-hole below 239' (EL 343.9)								
125			BS-2	8.5	1/64 to 1/2	A to SR		452.9	Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
130									Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
135	Rotary Drilling with Zones of Core Drilling	244.5mm Cemented to Surface, Open-hole below 239' (EL 343.9)	BS-3	7.3	1/64 to 1/2	A to SR				Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
140								DRG - Lucas Formation	442.89	DRG - Lucas Formation Top EL 442.9	
145			NR	4.9							
150									432.9	Light to Dark Gray Fine Grained DOLOMITIC LIMESTONE	
155			BS-4	5.1	1/64 to 2/3	A to SR					
160									422.9	Light Gray Fine Grained DOLOMITIC LIMESTONE	
165			BS-5	2.9	1/64 to 1/5	A to SR					

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
170	Rotary Drilling with Zones of Core Drilling	244.5mm Cemented to Surface, Open-hole below 239' (EL 343.9)						DRG - Lucas Formation	412.9		
175			BS-6	2.4	1/64 to 1/5	A to SR				Gray Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
180									402.9		
185			BS-7	4	1/64 to 1/2	A to SR				Gray and Brown Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
190									392.9		
195										Gray and Brown Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
200											Complete loss if circulation below 202' (EL 380.9). Drilled without

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
205	Rotary Drilling with Zones of Core Drilling							DRG - Lucas Formation		Gray and Brown Fine Grained LIMESTONE with Occasional Carbonaceous Banding	circulation (blind) to 239' (EL 343.9).
210											
215			NR	3.2							NR - due to blind drilling
220		244.5mm Cemented to Surface, Open-hole below 239' (EL 343.9)									
225											
230											
235											Cement basket and plug placed to resume circulation at surface.

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
240	Rotary Drilling with Zones of Core Drilling							DRG - Lucas Formation	342.9	Brown and Gray Amorphous to Fine Grained DOLOMITE	Circulation returned after cementing surface casing at 239' (EL 343.9).
245			BS-9	3.6	1/64 to 2/3	SA to SR					
250									332.9	Buff Brown to Gray Amorphous to Fine Grained DOLOMITE with Little Limestone and Trace Anhydrite and Shale	
255			BS-10	2.3	1/64 to 1/2	SA to SR				Massive Interbedded ANHYDRITE (256' to 259') (EL 326.9 to 323.9)	
260									322.9	Buff Brown to Gray Amorphous to Fine Grained DOLOMITE with Little Limestone and Trace Anhydrite and Shale	
265			BS-11	2	1/64 to 1/2	SA to SR					
270									312.9	Brown and Gray Amorphous to Fine Grained LIMESTONE Tan and Gray Amorphous to Fine Grained	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
275	Rotary Drilling with Zones of Core Drilling		BS-12	1.9	1/64 to 3/8	A to SR		DRG - Lucas Formation		DOLOMITIC LIMESTONE (273' to 278') (EL 309.9 to 304.9) Brown and Gray Amorphous to Fine Grained LIMESTONE Tan LIMESTONE (278' to 280') (EL 304.9 to 302.9)	
280									302.9	Interbedded DOLOMITE and LIMESTONE (Lithology from wireline logs)	
285			NR	1.8							
290									292.9	Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE	
295			BS-13	1.7	1/64 to 1/32	A to SA				Amorphous to Fine Grained DOLOMITE with Trace Anhydrite and Limestone (296' to 300') (EL 286.9 to 282.9)	
300									282.9	Amorphous to Fine Grained DOLOMITE with Some Anhydrite and Little Limestone, Occasional Carbonaceous Banding and Shale Partings	
305			BS-14	1.6	1/64 to 3/8	A to SR					

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
310	Rotary Drilling with Zones of Core Drilling							DRG - Lucas Formation	272.9	Tan LIMESTONE (308' to 310') (EL 274.9 to 272.9)	
315 320			15	1.3	1/64 to 3/8	A to SA			262.9	Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
325 330			16	1.5	1/64 to 1/2	A to SA			252.9	Amorphous to Fine Grained DOLOMITE with Trace Anhydrite, Limestone, and Frequent Stylolites	
335 340			17	1.8	1/64 to 1/5	A to SA			242.9	Massive Interbedded ANHYDRITE (330' to 331') (EL 252.9 to 251.9) Amorphous to Fine Grained DOLOMITIC LIMESTONE with Trace Limestone and Anhydrite, Occasional Shale Partings (331' to 337') (EL 251.9 to 245.9) Amorphous to Fine Grained DOLOMITE with Trace Limestone and Anhydrite, Occasional Shale Partings (337' to 340') (EL 245.9 to 242.9)	
										Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
	Rotary Drilling with Zones of Core Drilling							DRG - Lucas Formation		Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE	
345				1.3							
350									232.9	Buff Amorphous to Fine Grained DOLOMITE with Trace Limestone, Shale and Anhydrite	
355			BS-18	2	1/64 to 1/5	A to SR					
										Tan LIMESTONE (356' to 358') (EL 226.9 to 224.9)	
360			BS-19	1.4	1/64 to 1/5	A to SR				Buff Amorphous to Fine Grained DOLOMITE with Trace Limestone, Shale, and Anhydrite	
365											
370			BS-20	2	1/64 to 1/5	A to SR					
										Buff Amorphous to Fine Grained DOLOMITIC LIMESTONE with Trace Shale and Anhydrite	
375											

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/17/07

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
380	Rotary Drilling with Zones of Core Drilling							DRG - Lucas Formation	202.9		
385			BS-21	2.3	1/64 to 1/5	A to SR				Buff to Gray Amorphous to Fine Grained DOLOMITE with Little Limestone and Trace Anhydrite	
390									192.9	Buff to Gray Amorphous to Fine Grained DOLOMITE with Little Limestone and Trace Anhydrite	
395			BS-22	2.6	1/64 to 1/5	A to SR				Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (396' to 400') (EL 186.9 to 182.9)	
400			BS-23	1.4	1/64 to 1/5	A to SR				Buff to Gray Amorphous to Fine Grained DOLOMITE with Trace Limestone and Anhydrite	
405										Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding (404' to 412') (EL 178.9 to 170.9)	
410			BS-24	1.3	1/64 to 1/5	A to SR				Brown Amorphous to Fine Grained DOLOMITE	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling							DRG - Lucas Formation		with Trace Limestone and Anhydrite, Occasional Carbonaceous Banding (412' to 418') (EL 170.9 to 164.9)	
415											
420									162.9	Brown Amorphous to Fine Grained DOLOMITIC LIMESTONE with Trace Anhydrite, Occasional Carbonaceous Banding	
425			BS-25	2	1/64 to 1/5	A to SR				Brown Amorphous to Fine Grained DOLOMITE and LIMESTONE with Trace Anhydrite, Occasional Carbonaceous Banding	
430								DRG - Amherstburg Formation	152.9	Brown Amorphous to Fine Grained DOLOMITE and LIMESTONE with Trace Anhydrite, Occasional Carbonaceous Banding DRG - Amherstburg Formation Top EL 150.9 Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite, Occasional Carbonaceous Banding	
435			BS-26	1.8	1/64 to 1/5	A to SR					
440									142.9	Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite, Occasional Carbonaceous Banding	
445			BS-27	1	1/64 to 1/5	A to SR					

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
450	Rotary Drilling with Zones of Core Drilling							DRG - Amherstburg Formation	132.9	Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite, Occasional Carbonaceous Banding	
455 460			BS-28	1.6	1/64 to 1/5	A to SR			122.9	Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
465 470			BS-29	2.2	1/64 to 1/5	A to SR			112.9	Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
475 480			BS-30	1.9	1/64 to 1/10	A to SR			102.9	Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
										Gray Amorphous to Fine Grained DOLOMITE, Massive bedding, Slight Pitting, Occasional Styolites and Anhydrite Nodules	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
485	Rotary Drilling with Zones of Core Drilling			1.2				DRG - Amherstburg Formation		Gray Amorphous to Fine Grained DOLOMITE, Massive bedding, Slight Pitting, Occasional Stylolites and Anhydrite Nodules	
490				4.2					92.9		
495									87.9	Boring Advanced with Coring Methods Starting at 495' (EL 87.9) Rotary Drilling Methods Resumed at 550.1' (EL 32.8) Refer to Core Log TB-11A Boring Advanced with Coring Methods Starting at 495' (EL 87.9) Rotary Drilling Methods Resumed at 550.1' (EL 32.8) Refer to Core Log TB-11A Gray Amorphous to Fine Grained DOLOMITE, Massive bedding, Slight Pitting, Occasional Stylolites and Anhydrite Nodules	Refer to Log of Core Boring No. TB-11 (A)
500											
505								DRG - Sylvania Sandstone	79.6	DRG - Sylvania Sandstone Top EL 79.7 White to Light Tan Fine Grained SANDSTONE with Occasional Carbonaceous Banding and Stylolites	
510											
515											

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
520 525	Rotary Drilling with Zones of Core Drilling							DRG - Sylvania Sandstone	57.9	Boring Advanced with Coring Methods Starting at 495' (EL 87.9) Rotary Drilling Methods Resumed at 550.1' (EL 32.8) Refer to Core Log TB-11A White to Light Tan Fine Grained SANDSTONE with Occasional Carbonaceous Banding and Styolites	
530 535									45.9	White to Light Gray Fine Grained SANDSTONE, Massive Bedding with Frequent Carbonaceous Bands	Refer to Log of Core Boring No. TB-11 (A)
540									40.8	Medium Gray Fine Grained DOLOMITIC SANDSTONE, Massive Bedding with Frequent Carbonaceous Bands and Styolites	
545 550									32.8	White to Light Tan Fine Grained SANDSTONE, Massive Bedding with Occasional Carbonaceous bands and Styolites	
										Light Tan and Gray Fine Grained SANDSTONE with Little Gray and Tan Dolomite	Continued as Rotary Boring at 550.1' (EL 32.9)

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
555	Rotary Drilling with Zones of Core Drilling		BS-31	6	1/64 to 1/5	SA to SR		DRG - Sylvania Sandstone	22.9	Light Tan and Gray Fine Grained SANDSTONE with Little Gray and Tan Dolomite	
560 565			BS-32	4.6	1/64 to 1/5	SA to SR			12.9	Light Tan and Gray Fine Grained SANDSTONE with Little Gray and Tan Dolomite Bois Blanc Formation Top EL 14.9 Light Tan and Gray Fine Grained SANDY DOLOMITE with Trace Anhydrite	
570 575			BS-33	1.3	1/64 to 1/10	SA to SR		Bois Blanc Formation	2.899999999999998	Light Tan and Gray Fine Grained SANDY DOLOMITE with Trace Anhydrite	
580 585			NR	1.5						DOLOMITE (Lithology determined from wireline logs)	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
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LOG OF ROTARY BORING NO:
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NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling							Bois Blanc Formation		DOLOMITE (Lithology determined from wireline logs)	
590									-7.1000000000000002		
595			BS-34	1.7	1/64 to 1/10	SA to SR				Light Tan and Gray Fine Grained DOLOMITE	Little Sample Recovered
600									-17.1	Tan LIMESTONE (600' to 602') (EL -17.1 to -19.1) Gray Amorphous to Fine Grained DOLOMITE	
605			BS-35	1.8	1/64 to 1/5	SA to SR					Little Sample Recovered
610									-27.1	DOLOMITE (Lithology determined from wireline logs)	
615											
620			NR	2.4							

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Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
625 630	Rotary Drilling with Zones of Core Drilling							Bois Blanc Formation	-47.1	DOLOMITE (Lithology determined from wireline logs) Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (628' to 630') (EL -45.1 to -47.1)	
635 640			BS-36	2.5	1/64 to 1/5	SA to SR			-57.1	Gray and Tan Fine Grained LIMEY DOLOMITE with Occasional Black Shale	
645 650			BS-37	2.5	1/64 to 1/5	A to SR		Garden Island Formation	-67.1	Gray Fine Grained DOLOMITE with Anhydrite and Occasional Black Shale Garden Island Formation Top EL -64.1 Gray Fine Grained SANDSTONE with Little Dolomite and Trace Anhydrite	
655			BS-38	2.1	1/64 to 1/5	A to SR				Gray Fine Grained SANDSTONE with Little Dolomite and Trace Anhydrite	

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Elevations noted are above mean-sea level (AMSL)
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LOG OF ROTARY BORING NO:
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NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
660	Rotary Drilling with Zones of Core Drilling							Bass Islands Group	-77.1	Gray Fine Grained SANDSTONE with Little Dolomite and Trace Anhydrite Bass Islands Group Top EL -75.1 Gray Fine Grained DOLOMITE with Trace Chert	
665 670			BS-39	2.1	1/64 to 1/5	A to SR			-87.1	Gray Fine Grained DOLOMITE with Trace Chert	
675 680			BS-40	1.7	1/64 to 1/5	A to SR			-97.1	Gray Fine Grained DOLOMITE with Trace Chert	
685 690			BS-41	2.9	1/64 to 1/5	A to SR			-107.1	Gray Fine Grained DOLOMITE with Trace Anhydrite and Shale	
										Gray Fine Grained DOLOMITE with Trace Anhydrite	

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling							Bass Islands Group		Gray Fine Grained DOLOMITE with Trace Anhydrite	
695			BS-42	2.6	1/64 to 1/5	A to SR					
700									-117.1	Gray Fine Grained DOLOMITE with Trace Anhydrite	
705			BS-43	2.3	1/64 to 1/5	A to SR					
710									-127.1	Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite and and Limestone	
715			BS-44	1.9	1/64 to 1/5	A to SR					
720									-137.1	Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite and Shale	
725			BS-45	2.1	1/64 to 1/5	A to SA					

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling							Bass Islands Group		Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite and Shale	
730									-147.1	Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite and Occasional Carbonaceous Banding	
735			BS-46	2	1/64 to 1/5	A to SA					
740									-157.1	Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite, Limestone, and Occasional Carbonaceous Banding	
745			BS-47	1.7	1/64 to 1/5	A to SR					
750									-167.1	Brown and Tan Fine Grained DOLOMITE with Trace Anhydrite and Shale	
755			BS-48	1.9	1/64 to 1/5	A to SA					
760									-177.1		

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NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
765 770	Rotary Drilling with Zones of Core Drilling		BS-49	3.8	1/64 to 1/10	A to SR		Bass Islands Group	-187.1	Brown and Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	
775 780			BS-50	3.2	1/64 to 1/10	A to SA			-197.1	Brown and Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	
785 790			BS-51	3.1	1/64 to 1/5	A to SA			-207.1	Brown and Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (782' to 784') (EL -199.1 to -201.1) Brown and Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	
795			BS-52	3	1/64 to 1/5	A to				Brown and Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	

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Project Location: Detroit, Michigan
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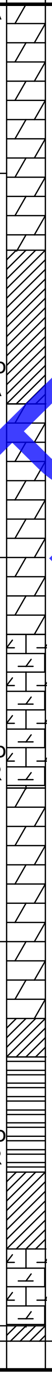

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
800	Rotary Drilling with Zones of Core Drilling					SA	Bass Islands Group	-217.1	Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite and Occasional carbonaceous Bands	
805 810			BS-53	4.5	1/64 to 1/2	A to SA		-227.1	Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite and Occasional Carbonaceous Banding Massive Interbedded ANHYDRITE (802' to 806') (EL -219.1 to -223.1) Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite and Occasional Carbonaceous Banding	
815 820			BS-54	2.2	1/64 to 1/5	A to SR		-237.1	Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite and Occasional Carbonaceous Bands Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (812' to 816') (EL -229.1 to -233.1) Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite and Occasional Carbonaceous Bands	
825 830			BS-55	3.5	1/64 to 1/5	A to SR		-247.1	Light Brown and Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite and Occasional Carbonaceous Bands Massive Interbedded ANHYDRITE (822' to 823') (EL -239.1 to -240.1) SHALE (823' to 826') (EL -240.1 to -243.1) Massive Interbedded ANHYDRITE (826' to 828') (EL -243.1 to -245.1) Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (828' to 830') (EL -245.1 to -247.1)	

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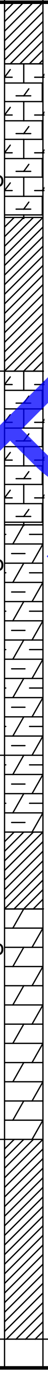
Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
835 840	Rotary Drilling with Zones of Core Drilling		BS-56	3.1	1/64 to 1/5	A to SA		Bass Islands Group	-257.1	Massive Interbedded ANHYDRITE Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (833' to 836') (EL -250.1 to -253.1) Massive Interbedded ANHYDRITE	
845 850			BS-57	2.6	1/64 to 1/5	A to SA			-267.1	Light Brown and Tan Amorphous to Fine Grained DOLOMITIC LIMESTONE with Anhydrite and Occasional Carbonaceous Bands and Shale Stringers Light Brown and Gray Amorphous to Fine Grained SHALEY DOLOMITE	
855 860			BS-58	2.4	1/64 to 1/3	A to SA			-277.1	Light Brown and Gray Amorphous to Fine Grained SHALEY DOLOMITE Massive Interbedded ANHYDRITE (852' to 854') (EL -269.1 to -271.9) Light Brown and Gray Amorphous to Fine Grained DOLOMITE with Shale and Anhydrite (854' to 860') (EL -271.1 to -277.1)	
865			BS-59	5						Massive Interbedded ANHYDRITE	

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LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
870	Rotary Drilling with Zones of Core Drilling				1/64 to 1/5	A to SA		Bass Islands Group	-287.1	Massive Interbedded ANHYDRITE	
875 880			BS-60	3.7	1/64 to 1/5	A to SR			-297.1	Massive Interbedded ANHYDRITE Light Brown and Gray Amorphous to Fine Grained DOLOMITE with Shale and Anhydrite (872' to 877') (EL -289.1 to -294.1) Light Brown and Tan Amorphous LIMESTONE with Occasional Shale Partings and Anhydrite	
885 890			BS-61	3.5	1/64 to 1/5	A to SA			-307.1	Light Brown and Tan Amorphous LIMESTONE with Occasional Shale Partings and Anhydrite Gray Amorphous SHALEY DOLOMITE with Occasional Anhydrite	
895 900			BS-62	3	1/64 to 1/10	A to SR			-317.1	Gray Amorphous SHALEY DOLOMITE with Occasional Anhydrite Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (894' to 898') (EL -311.1 to -315.1) Massive Interbedded ANHYDRITE	

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Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
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Subsurface Profile
Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
	Rotary Drilling with Zones of Core Drilling						▨	Bass Islands Group		Massive Interbedded ANHYDRITE	
905			BS-63	3.1	1/64 to 1/10	A to SA	▨				
								Salina Group - G Unit (G Shale)		Salina Group - G Unit (G-Shale) Top EL -325.1 Gray Amorphous SHALEY DOLOMITE with Trace Anhydrite	
910			BS-64	2.7	1/64 to 1/10	A to SA				Gray Amorphous SHALEY DOLOMITE with Trace Anhydrite	
915										Gray DOLOMITIC SHALE with Trace Anhydrite (915' to 918') (EL -332.1 to -335.1)	
							▨			Massive Interbedded ANHYDRITE (918' to 922') (EL -335.1 to -339.1)	
920							▨		-337.1		
										Gray Amorphous SHALE with trace Anhydrite (922' to 925') (EL -339.1 to -342.1)	
925									-342.1 -342.2	Boring Advanced with Coring Methods Starting at 925' (EL -342.1) Rotary Drilling Methods Resumed at 1035' (EL -452.1) Refer to Core Log TB-11B Dark Gray Amorphous to Fine Grained SHALE and DOLOMITIC SHALE, Frequent Anhydrite Nodules and Inclusions with Occasional Anhydrite Laminae	Refer to Log of Core Boring No. TB-11 (B)
930											

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LOG OF ROTARY BORING NO:
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Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling							Salina Group - G Unit (G Shale)	-353.1	Green and Gray Amorphous to Fine Grained DOLOMITIC SHALE with Laminated Bedding	
									-353.6	Dark Gray Amorphous to Fine Grained SHALE and DOLOMITIC SHALE, Laminated to massive Bedding, frequent Anhydrite Laminae, Inclusions, Replacement Zones, Infilling, and Nodules	Refer to Log of Core Boring No. TB-11 (B)
940											
945											
950											
955											
960											
965											

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Elevations noted are above mean-sea level (AMSL)
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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
970 975	Rotary Drilling with Zones of Core Drilling							Salina Group - G Unit (G Shale)		Dark Gray Amorphous to Fine Grained SHALE and DOLOMITIC SHALE, Laminated to massive Bedding, frequent Anhydrite Laminae, Inclusions, Replacement Zones, Infilling, and Nodules	Refer to Log of Core Boring No. TB-11 (B)
980									-395.1	White and Gray Amorphous to Fine Grained SHALEY DOLOMITE	
									-399	Gray Amorphous to Fine Grained DOLOMITIC SHALE with Frequent Anhydrite Nodules	
									-399.3	White and Gray Amorphous to Fine Grained SHALEY DOLOMITE	
985 990 995 1000									-402.1	Gray Amorphous to Fine Grained DOLOMITE with Frequent Anhydrite Laminae	

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1005	Rotary Drilling with Zones of Core Drilling							Salina Group - G Unit (G Shale)		Gray Amorphous to Fine Grained DOLOMITE with Frequent Anhydrite Laminae	
1010									-424.5	Brown Amorphous to Fine Grained DOLOMITE Slightly Pitted with Vugs with Selenite Infilling and Occasional Anhydrite Inclusions	Refer to Log of Core Boring No. TB-11 (B)
1015									-428.2	Gray Amorphous to Fine Grained SHALEY DOLOMITE, Massive bedding with Occasional Anhydrite Laminae, Inclusions, Replacement Zones, and Nodules	
1020									-434.4	Gray Amorphous DOLOMITE and Clear Orange HALITE	
1025 1030								Salina Group - F Unit (F-Salt)	-437.4	Salina Group - F unit (F-Salt) Top EL -437.4 Clear to Brown HALITE with Occasional Dolomite Laminae (F4 Bed)	
									-451.3	White to Gray SHALEY DOLOMITE Slightly Pitted with Few Halite Infilled Vugs	
1035									-452.1	Tan and Gray Amorphous DOLOMITE with Little Halite	Continued as Rotary Boring at 1035' (EL -452.1)

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Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1040	Rotary Drilling with Zones of Core Drilling		BS-65		1/64 to 1/4	A to SR		Salina Group - F Unit (F-Salt)		Tan and Gray Amorphous DOLOMITE with Little Halite	
1045										Clear HALITE with Little Tan and Gray Amorphous Dolomite (F3 Bed)	
1050			BS-66		1/64 to 1/4	A to SR			-467.1	Clear HALITE with Little Tan and Gray Amorphous Dolomite (F3 Bed)	
1055											
1060			BS-67		1/64 to 1/3	A to SA			-477.1	Clear HALITE with Little Tan and Gray Amorphous Dolomite (F3 Bed)	
1065											
1070									-487.1	Clear HALITE with Little Tan and Gray Amorphous Dolomite (F3 Bed)	

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Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1075	Rotary Drilling with Zones of Core Drilling		BS-68		1/64 to 1/3	A to SA		Salina Group - F Unit (F-Salt)		Gray and Tan Amorphous DOLOMITIC LIMESTONE with Trace Anhydrite	
1080									-497.1	Gray and Tan Amorphous DOLOMITIC LIMESTONE with Trace Anhydrite	
1085			BS-69		1/64 to 1/3	A to SR					
1090			BS-70		1/64 to 1/4	A to SR				Tan and Gray Amorphous DOLOMITIC LIMESTONE with Occasional Shale	
1095											
										Massive Interbedded ANHYDRITE (1098' to 1101') (EL -515.1 to -518.1)	
1100									-517.1	Brown Amorphous DOLOMITE with Trace Halite and Shale	
										Clear and White HALITE with Trace Brown Amorphous Dolomite (F2 Bed)	
1105			BS-71		1/64 to 1/5	A to SA					

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DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1110	Rotary Drilling with Zones of Core Drilling							Salina Group - F Unit (F-Salt)	-527.1	Clear and White HALITE with Trace Brown Amorphous Dolomite (F2 Bed)	
1115			BS-72		1/64 to 1/5	A to SA					
1120									-537.1	Clear and White HALITE with Trace Brown Amorphous Dolomite (F2 Bed)	
1125			BS-73		1/64 to 1/5	A to SR				Gray Fine Grained SHALEY DOLOMITE (1126' to 1130') (EL -543.1 to -547.1)	
1130									-547.1	Gray and Brown HALITE with Clear Gypsum (F1 Bed)	
1135			BS-74		1/64 to 1/3	A to SR					
1140									-557.1	HALITE with Clear Gypsum (F1 Bed)	

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1145 1150	Rotary Drilling with Zones of Core Drilling		NR				▦	Salina Group - F Unit (F-Salt)	-567.1	HALITE with Clear Gypsum (F1 Bed)	
1155 1160			BS-75		1/64 to 1/4	A to SA	▦		-577.1	White and Clear HALITE with Trace Gray Gypsum (F1 Bed)	
1165 1170			BS-76		1/64 to 1/3	A to SA	▦		-587.1	White and Clear HALITE with Trace Gray and Tan Amorphous Dolomite (F1 Bed)	
1175			BS-77		1/64 to 1/4	A to SA	▦			White and Clear HALITE with Trace Gray and Tan Amorphous Dolomite (F1 Bed)	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1180	Rotary Drilling with Zones of Core Drilling						▦		-597.11	White and Clear HALITE with Trace Gray and Tan Amorphous Dolomite (F1 Bed)	
1185 1190			BS-78		1/64 to 1/4	A to SA	▨	Salina Group - E Unit (E - Dolomite)	-607.1	Salina Group - E Unit (E-Dolomite) Top EL -597.1 Tan and Gray Amorphous SHALEY DOLOMITE	
1195 1200			BS-79		1/64 to 1/3	A to SA	▨		-617.1	Massive Interbedded ANHYDRITE (1190' to 1192') (EL -607.1 to -609.1) Tan and Gray Amorphous SHALEY DOLOMITE	
1205 1210			BS-80		1/64 to 1/5	A to SR	▨		-627.1	Gray and Brown Amorphous SHALEY DOLOMITE with Trace Anhydrite	
							▨			Gray and Brown Amorphous SHALEY DOLOMITE with Trace Limestone	

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1215 1220	Rotary Drilling with Zones of Core Drilling		BS-81		1/64 to 1/5	A to SR		Salina Group - E Unit (E - Dolomite)	-637.1	Gray and Brown Amorphous SHALEY DOLOMITE with Trace Limestone	
1225 1230			BS-82		1/64 to 1/5	A to SR			-647.1	Gray and Brown Amorphous DOLOMITE with Trace Limestone	
1235			BS-83		1/64 to 1/5	A to SR			-652.1	Gray and Brown Amorphous DOLOMITE with Trace Limestone	
1240									-652.11 -661.1	Boring Advanced with Coring Methods Starting at 1235' (EL -652.1) Rotary Drilling Methods Resumed at 1296' (EL -713.1) Refer to Core Log TB-11C	Boring continued as rock core. Low recovery (6%) from 1235' to 1264' (EL -652.1 to -681.1) due to broken core bit. This interval was redrilled using rotary techniques to remove cuttings (refer to bag sample information).
1245			BS-84		1/64 3/8	A to SR			-663.1	Dark Gray and Brown Amorphous DOLOMITE with Occasional Anhydrite	
			NR								

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NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling		BS-85		1/64 to 3/8	A to SA		Salina Group - E Unit (E - Dolomite)		Tan and Gray Amorphous DOLOMITE with Occasional Anhydrite	
1250			BS-86		1/64 to 3/8	A to SA					Refer to Log of Core Boring No. TB-11 (C)
			BS-87		1/64 to 3/8	A to SA					
			BS-88		1/64 to 1/2	A to SA					
1255											
			BS-89		1/64 to 3/8	A to SA					
			BS-90		1/64 to 1/2	A to SA					
1260			BS-91		1/64 to 1/2	A to SA					
			BS-92		1/64 to 3/8	A to SA					
									-681.1	Tan to Gray Amorphous SHALEY DOLOMITE Massive Bedding with Occasional Anhydrite Nodules and Inclusions Occasional Stylolites	
1265											
									-684.1	Gray Amorphous SHALEY DOLOMITE with Frequent Carbonaceous Bands	
1270											
1275									-692.1	Intermittent, Thin, Horizontal Layers of Dark Gray DOLOMITIC SHALE and Gray SHALEY DOLOMITE with Anhydrite Inclusions	
1280									-696.701	Salina Group - D unit (D-Salt) Top EL -696.7 White HALITE with Trace Anhydrite (D3 Bed)	

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1285 1290	Rotary Drilling with Zones of Core Drilling							Salina Group - D Unit (D-Salt)	-708.3	White HALITE with Trace Anhydrite (D3 Bed)	Refer to Log of Core Boring No. TB-11 (C)
									-711.1	Brown and Gray Amorphous to Fine Grained DOLOMITE	
1295										Brown and Gray Amorphous to Fine Grained SHALEY DOLOMITE	
									-714.1		
1300 1305			BS-93		1/64 to 1/5	A to SA				White HALITE with Trace Dark Gray Amorphous Dolomite (D2 Bed)	
									-727.1	Dark Gray Amorphous SHALE	
1310 1315			BS-94		1/64 to 1/5	A to SA				Dark Gray Amorphous SHALE	

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Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1320	Rotary Drilling with Zones of Core Drilling						▤	Salina Group - D Unit (D-Salt)	-737.1	Dark Gray Amorphous SHALE	
1325			BS-95		1/64 to 1/4	A to SR	▦			White HALITE with Little Gray Amorphous Dolomite (D1 Bed)	
1330							▤	Salina Group - C Unit (C-Shale)	-747.1	Dark Gray Amorphous SHALE	
1335			NR				▤			SHALE (Lithology derived from wireline logs)	
1340							▤		-757.1		
1345			NR				▤			SHALE (Lithology derived from wireline logs)	
1350							▨		-767.1	Massive Interbedded ANHYDRITE (1348' to 1350') (EL -765.1 to -767.1) (Lithology derived from wireline logs)	
							▤			SHALE (Lithology derived from wireline logs)	

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LOG OF ROTARY BORING NO:

DRICX11TB11 (TB-11)

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1355	Rotary Drilling with Zones of Core Drilling		NR					Salina Group - C Unit (C-Shale)		SHALE (Lithology derived from wireline logs)	
1360									-777.1	Medium Gray Amorphous SHALE with Little Orange and White Halite	
1365			BS-96		1/64 to 1/3	SA to SR					Sample Appears Clayey/Weathered
1370									-787.1	Medium Gray Amorphous SHALE with Little Orange Halite	Possible Shaley Halite Seam from 1371' to 1374' (EL -788.1 to -791.1)
1375			BS-97		1/64 to 3/8	SA to SR					
1380									-797.1	Light to Medium Gray Amorphous SHALE with Trace Orange Halite	
1385			BS-98		1/64 to 3/8	SA to SR				Massive Interbedded ANHYDRITE (1386' to 1388') (EL -803.1 to -805.1)	Sample Appears Clayey/Weathered

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1390	Rotary Drilling with Zones of Core Drilling							Salina Group - C Unit (C-Shale)	-807.1	Light to Medium Gray Amorphous SHALE with Trace Orange Halite Light to Medium Gray Amorphous SHALE with Some Dark Brwon Amorphous to Fine Grained Dolomite	
1395 1400			BS-99		1/64 to 3/8	A to SR			-817.1	Light to Medium Gray Amorphous SHALE with Some Dark Brwon Amorphous to Fine Grained Dolomite	
1405 1410			BS-100		1/64 to 1/3	SA to SR			-827.1	Massive Interbedded ANHYDRITE (1400' to 1402') (EL -817.1 to -819.1) Gray Amorphous SHALE	Sample Appears Clayey/Weathered Possibel Shaley Halite Seam from 1408' to 1412' (EL -825.1 to -829.1)
1415 1420			BS-101		1/64 to 1/3	SA to SR			-837.1	Gray Amorphous SHALE Massive Interbedded ANHYDRITE (1416' to 1418') (EL -833.1 to -835.1) Gray Amorphous SHALE	Sample Appears Clayey/Weathered
										Gray Amorphous SHALE	

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Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1425	Rotary Drilling with Zones of Core Drilling		BS-102		1/64 to 1/3	SA to SR		Salina Group - C Unit (C-Shale)	-847.1	Gray Amorphous SHALE	Sample Appears Clayey/Weathered
1430 1435			BS-103		1/64 to 1/3	SA to SR			-857.1	Gray Amorphous SHALE	Sample Appears Clayey/Weathered
1440 1445			BS-104		1/64 to 1/3	SA to SR				Gray Amorphous SHALE and Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite Massive Interbedded ANHYDRITE (1442' to 1444') (EL -859.1 to -861.1) Gray Amorphous SHALE and Brown Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
1450 1455			BS-105		1/64 to 1/5	A to SR				Brown Amorphous to Fine Grained DOLOMITE with Little Anhydrite and Occasional Black Shale	

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Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile	Notes
1457–1460	Rotary Drilling with Zones of Core Drilling						Salina Group - C Unit (C-Shale)			
1460–1470			BS-106		1/64 to 1/3	SA to SR		-877.1	Massive Interbedded ANHYDRITE (1459' to 1461') (EL -876.1 to -878.1) Gray Amorphous SHALE with Trace Anhydrite Massive Interbedded ANHYDRITE (1465' to 1470') (EL -882.1 to -887.1)	Sample Appears Clayey/Weathered
1470–1480			BS-107		1/64 to 1/4	A to SR		-887.1	Brown Amorphous SHALE with Trace Anhydrite	
1480–1490			BS-108		1/64 to 1/4	A to SR		-897.1	Brown Amorphous SHALE with Trace Anhydrite Massive Interbedded ANHYDRITE (1485' to 1486') (EL -902.1 to -903.1) Brown Amorphous SHALE with Trace Anhydrite	
1490–								-907.1	Brown Amorphous SHALE with Trace Anhydrite Salina Group - B Unit (B-Salt) Top EL -908.1	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1495 1500	Rotary Drilling with Zones of Core Drilling		BS-109		1/64 to 1/4	A to SR		Salina Group - B Unit (B-Salt)	-917.1	Brown and Clear HALITE (1491' to 1495') (EL -908.1 to -911.1) SHALE (1494' to 1495') (EL -911.1 to -912.1) Brown and Clear HALITE with Trace Anhydrite	
1505 1510			NR						-927.1	HALITE (Lithology derived from wireline logs)	
1515 1520			NR						-937.1	HALITE (Lithology derived from wireline logs) SHALE (1515' to 1518') (EL -932.1 to -935.1) (Lithology derived from wireline logs) HALITE (Lithology derived from wireline logs)	
1525			BS-110		1/64 to 1/5	A to SA				Clear HALITE with Shale and Anhydrite	

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Subsurface Profile

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
	Rotary Drilling with Zones of Core Drilling							Salina Group - B Unit (B-Salt)		Clear HALITE with Shale and Anhydrite	
1530 1535			BS-111		1/64 to 1/5	A to SA				Clear HALITE with Some Brown Shale SHALE (1538' to 1541') (EL -955.1 to -958.1)	
1540 1545			BS-112		1/64 to 1/3	A to SA			-957.1	Clear HALITE with Some Brown Shale and Anhydrite	
1550 1555			BS-113		1/64 to 1/3	A to SA			-967.1	Clear HALITE with Some Brown Shale and Anhydrite	Possible Carbonate Stringer
1560									-977.1	Clear HALITE with Some Brown Shale and Anhydrite	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
1565 1570	Rotary Drilling with Zones of Core Drilling		BS-114		1/64 to 1/3	A to SA		Salina Group - B Unit (B-Salt)	-987.1	Clear HALITE with Some Brown Shale and Anhydrite SHALE (1564' to 1567') (EL -981.1 to -984.1) Clear HALITE with Some Brown Shale and Anhydrite	
1575 1580			BS-115		1/64 to 1/3	A to SA			-997.1	Clear HALITE with Some Brown Shale and Anhydrite	Possible Carbonate Stringer
1585 1590			BS-116		1/64 to 1/3	A to SA			-1007.1	Clear HALITE with Some Brown Shale and Anhydrite SHALE	
1595			BS-117		1/64 to 1/5	A to SA				SHALE Clear HALITE with Trace Dark Gray Shale	

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Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 582.9

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile	Notes
	Rotary Drilling with Zones of Core Drilling						Salina Group - B Unit (B-Salt)		SHALE	
1600								-1017.1	Clear HALITE with Trace Dark Gray Shale	
1605			BS-118		1/64 to 1/3	A to SA				
1610								-1027.1	Clear HALITE with Trace Dark Gray Shale	
1615			BS-119		1/64 to 1/5	A to SA			DOLOMITIC LIMESTONE (1616' to 1618') (EL -1033.1 to -1035.1) Clear HALITE with Trace Dark Gray Shale	
1620								-1037.1	Clear HALITE with Trace Dark Gray Shale	
1625			BS-120		1/64 to 1/3	A to SA			LIMESTONE (1626' to 1630') (EL -1043.1 to -1047.1)	
1630								-1047.1	Clear HALITE with Trace Dark Gray Shale	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling							Salina Group - B Unit (B-Salt)		Clear HALITE with Trace Dark Gray Shale	
1635			BS-121		1/64 to 1/5	A to SA					
										Dark Gray Amorphous SHALE with Little Clear Halite and Trace Anhydrite	
1640									-1057.1		
										Dark Gray Amorphous SHALE with Little Clear Halite and Trace Anhydrite	
1645			BS-122		1/64 to 1/5	A to SR				Brown and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (1644' to 1650') (EL -1061.1 to -1067.1)	
1650			BS-123		1/64 to 1/5	A to SR				Dark Gray Amorphous SHALE with Trace Clear Halite and Anhydrite	
										Massive Interbedded ANHYDRITE (1652' to 1654') (EL -1069.1 to -1071.1)	
1655										Dark Gray Amorphous SHALE with Trace Clear Halite and Anhydrite	
										Massive Interbedded ANHYDRITE (1657' to 1662') (EL -1074.1 to -1079.1)	False "A2"
1660									-1077.1		
										Salina Group - A2 Carbonate Top EL -1079.1 Tan and Brown Amorphous DOLOMITE with Trace Anhydrite	
1665			BS-124		1/64 to 1/4	A to					

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB11 (TB-11)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 582.9	Notes
	Rotary Drilling with Zones of Core Drilling					SR		Salina Group - A2 Carbonate			
1670									-1087.1	Tan and Brown Amorphous DOLOMITE with Trace Anhydrite	
1675			BS-125		1/64 to 1/5	A to SA					
1680									-1097.1	Tan and Brown Amorphous DOLOMITE with Trace Anhydrite	
1685			BS-126		1/64 to 1/5	A to SA					
1690									-1107.1	Massive Interbedded ANHYDRITE (1690' to 1692') (EL -1107.1 to -1109.1) Tan and Brown Amorphous DOLOMITE with Trace Anhydrite	
1695			BS-127/128		1/64 to 3/8	A to SR					
1700											
										End of Boring at 1700 feet.	

NOTES: NTH Inspectors: D. Adler, H. Audet, M. Firestone, S. Gole, C. Haldi, C Johnson, E. Smith, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Inspector: NTH
Project Name: DRIC Brine Well Investigation
Contractor: Advanced Energy Services
Project Location: Detroit, Michigan
Driller: Rig 7, R. Thatcher, R. Yaklin
NTH Proj. No: 15-050014-12
Drilling Equipment: Walker-Neer Apache 150-25
Drilling Date: 1/17/2007 to 2/14/2007
Checked By: Z. Carr, P.E., C. Johnson
Borehole Size: 17, 12 1/4, 8 3/4, 7 7/8-inch
Lat/Long. Location: Lat. 42.3019 Long. -83.0938

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Overburden	587.1	FILL: SAND with Varying Amounts of Silt, Clay, Gravel, Concrete and Asphalt Debris, and Organic Material	
5									582.1	Medium Gray SILTY CLAY with Trace Sand and Gravel	
10											
15		339.7mm Cemented to Surface									
20											
25											
30											

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
35 40 45 50 55 60	Rotary Drilling	339.7mm Cemented to Surface					▨	Overburden		Medium Gray SILTY CLAY with Trace Sand and Gravel	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Overburden		Medium Gray SILTY CLAY with Trace Sand and Gravel	
70											
75											
80		339.7mm Cemented to Surface									
85											
90											
95											

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile — Ground Surface Elevation: 587.1

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
100	Rotary Drilling	339.7mm Cemented to Surface						Overburden	487.1	HARDPAN: hard Gray SILTY CLAY with Trace Sand and Gravel	
105								Dundee Limestone Formation	483.09	Dundee Limestone Formation Top EL 483.1 LIMESTONE (Weathered)	
		Elev 478.1 Depth 109	BS-1	1	1/64 to 2/3	A to SR			478.1	Light to Dark Gray and Tan Fine Grained LIMESTONE	
110 115			BS-2	10.6	1/64 to 3/8	A to SR			477.1	Light to Dark Gray, Tan, and Brown Amorphous to Fine Grained LIMESTONE with Occasional Fossils	Hydrocarbon Odor Noted Mild Hydrocarbon Odor Noted
120 125		244.5mm Cemented to Surface, Open-hole below 209' (EL 378.1)	BS-3	13.9	1/64 to 3/8	A to SR			467.1	Light to Dark Gray and Brown Fine Grained LIMESTONE with Occasional Carbonceous Banding, Fossils, and Gypsum Infilling	
130									457.1	Light to Dark Gray and Tan Amorphous to Fine Grained LIMESTONE with Occasional Fossils	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
135	Rotary Drilling		BS-4	12.9	1/64 to 3/8	A to SR		Dundee Limestone Formation		Light to Dark Gray and Tan Amorphous to Fine Grained LIMESTONE with Occasional Fossils	
140									447.1	Light Gray and Tan Amorphous to Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
145			BS-5	6.6	1/64 to 1/2	A to SR					
150		244.5mm Cemented to Surface, Open-hole below 209' (EL 378.1)							437.1	Light Gray and Tan Fine Grained LIMESTONE with Occasional Fossils and Carbonaceous Banding	
155			BS-6	6	1/64 to 3/8	A to SA					
160									427.1	Light Gray and Tan Fine Grained LIMESTONE with Occasional Fossils and Carbonaceous Banding	
165			BS-7	6.8	1/64 to 1/2	A to SR					

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
170	Rotary Drilling	244.5mm Cemented to Surface, Open-hole below 209' (EL 378.1)						Dundee Limestone Formation	417.1	Light Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
175			BS-8	4.4	1/64 to 3/8	A to SR					
180								DRG - Lucas Formation	407.09	DRG - Lucas Formation Top EL 407.1 Light Gray and Tan DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding	
185			BS-9	4.2	1/64 to 3/8	A to SA					
190									397.1	Light Gray and Tan Fine Grained LIMESTONE with Occasional Carbonaceous Banding	
195			BS-10	4.9	1/64 to 3/8	A to SR					
200									387.1	Light Gray and Tan Fine Grained DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding and Anhydrite	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
205	Rotary Drilling	244.5mm Cemented to Surface, Open-hole below 209' (EL 378.1)	BS-11	3.8	1/64 to 3/8	A to SR		DRG - Lucas Formation		Light Gray and Tan Fine Grained DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding and Anhydrite	
210									377.1	Tan Fine Grained DOLOMITE with Occasional Anhydrite	
215			BS-12	2.3	1/64 to 2/3	A to SA					Sample Contains Cement
220									367.1	Tan Fine Grained DOLOMITE with Occasional Anhydrite	
225			BS-13	2.9	1/64 to 3/8	A to SA				Massive Interbedded ANHYDRITE (223.5' to 224.5') (EL 363.6 to 362.6) Tan Fine Grained DOLOMITE with Occasional Anhydrite	Sample Contains Cement
230									357.1	Tan Fine Grained DOLOMITE with Occasional Anhydrite	
235			BS-14	2.2	1/64 to 1/5	A to SA				Massive Interbedded ANHYDRITE (235.5' to 236.5') (EL 351.6 to 350.6) Tan Fine Grained DOLOMITE with Occasional Anhydrite	Very Fine Cuttings

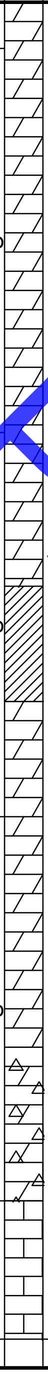
NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile
Ground Surface Elevation: 587.1



Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
240	Rotary Drilling							DRG - Lucas Formation	347.1	Tan Fine Grained LIMEY DOLOMITE with Occasional Anhydrite	
245			BS-15	2.3	1/64 to 1/5	A to SA					
250									337.1	Tan Amorphous to Fine Grained DOLOMITE with Occasional Calcite	
255			BS-16	1.9	1/64 to 1/3	A to SR				Massive Interbedded ANHYDRITE (254' to 257') (EL 333.1 to 330.1) Tan Amorphous to Fine Grained LIMEY DOLOMITE with Occasional Anhydrite	
260									327.1	Tan Amorphous to Fine Grained LIMEY DOLOMITE with Occasional Anhydrite	
265			BS-17	2	1/64 to 1/3	A to SA				CHERTY DOLOMITE (266' to 270') (EL 321.1 to 317.1)	
270									317.1	Tan Amorphous LIMESTONE with Occasional Anhydrite and Dolomite	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
275	Rotary Drilling		BS-18	2.2	1/64 to 1/5	A to SR		DRG - Lucas Formation		Tan Amorphous LIMESTONE with Occasional Anhydrite and Dolomite Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite	
280									307.1	Tan Amorphous to Fine Grained LIMEY DOLOMITE with Occasional Anhydrite	
285			BS-19	1.5	1/64 to 1/5	A to SA					
290									297.1	Tan Amorphous to Fine Grained LIMEY DOLOMITE with Some Anhydrite	
295			BS-20	1.8	1/64 to 1/5	SA to SR					
300									287.1	Tan Amorphous to Fine Grained DOLOMITE with Little Anhydrite	
305			BS-21	1.7	1/64 to 1/5	SA to SR					

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
310	Rotary Drilling							DRG - Lucas Formation	277.1	Tan Amorphous to Fine Grained DOLOMITE with Little Anhydrite	
315 320			BS-22	1	1/64 to 1/5	A to SR			267.1	Tan Amorphous DOLOMITE with Trace Anhydrite Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (316' to 318') (EL 271.1 to 269.1) Tan Amorphous to Fine Grained LIMEY DOLOMITE with Trace Anhydrite	
325 330			BS-23	1.7	1/64 to 1/5	A to SR			257.1	Tan Amorphous to Fine Grained LIMEY DOLOMITE with Trace Anhydrite Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (322' to 324') (EL 265.1 to 263.1) Tan and Dark Gray Amorphous to Fine Grained DOLOMITE with Little Anhydrite	
335 340			BS-24	2.4	1/64 to 1/5	A to SR			247.1	Tan and Dark Gray Amorphous to Fine Grained DOLOMITE with Little Anhydrite Massive Interbedded ANHYDRITE (333' to 336') (EL 254.1 to 251.1) Tan and Dark Gray Amorphous DOLOMITE with Little Anhydrite	
										Tan and Dark Gray Amorphous DOLOMITE with Little Anhydrite	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
345	Rotary Drilling		BS-25	1.3	1/64 to 1/32	A to SA		DRG - Lucas Formation	237.1	Tan and Dark Gray Amorphous DOLOMITE with Little Anhydrite	
350 355			BS-26	1.4	1/64 to 1/10	SA to SR			227.1	Tan Amorphous to Fine Grained DOLOMITE with Trace Anhydrite Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (354' to 356') (EL 233.1 to 231.1) Tan Amorphous to Fine Grained LIMEY DOLOMITE with Trace Anhydrite	
360 365			BS-27	1.9	1/64 to 1/10	SA to SR			217.1	Tan Amorphous to Fine Grained LIMEY DOLOMITE with Trace Anhydrite Tan and Gray Amorphous to Fine Grained DOLOMITE (366' to 368') (EL 221.1 to 219.1) Tan Amorphous to Fine Grained LIMEY DOLOMITE with Trace Anhydrite	
370 375			BS-28	2.4	1/64 to 3/8	A to SR				Tan Amorphous to Fine Grained LIMEY DOLOMITE with Trace Anhydrite	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							DRG - Lucas Formation		Tan Amorphous to Fine Grained LIMEY DOLOMITE with Trace Anhydrite	
380									207.1	Tan Amorphous DOLOMITE with Trace Anhydrite	
385			BS-29	1.9	1/64 to 2/3	A to SR					
390									197.1	Tan Amorphous DOLOMITE with Trace Anhydrite	
395			BS-30	2	1/64 to 3/8	A to SR					
400									187.1	Massive Interbedded ANHYDRITE (400' to 404') (EL 187.1 to 183.1)	
405			BS-31	1.4	1/64 to 1/3	A to SR				Tan Amorphous LIMEY DOLOMITE with Trace Anhydrite	
410			BS-32	1.9	1/64 to 1/3	A to SR				Tan Amorphous DOLOMITE with Trace Anhydrite and Occasional Carbonaceous Banding	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
415	Rotary Drilling							DRG - Lucas Formation		Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE with Trace Shale (414' to 424') (EL 173.1 to 163.1)	
420									167.1		
425			BS-33	2.3	1/64 to 1/3	A to SA		DRG - Amherstburg Formation		DRG - Amherstburg Formation Top EL 163.1 Brown Amorphous DOLOMITE with Trace Anhydrite	
430									157.1	Brown Amorphous DOLOMITE with Trace Anhydrite	
435			BS-34	1	1/64 to 1/3	A to SA					
440									147.1	Brown Amorphous DOLOMITE with Trace Anhydrite	
445			BS-35	1.3	1/64 to 1/3	A to SA					

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
450	Rotary Drilling							DRG - Amherstburg Formation	137.1	Brown Amorphous DOLOMITE with Trace Anhydrite	
455 460			BS-36	1.6	1/64 to 1/3	A to SR			127.1	Dark Tan Amorphous DOLOMITE with Trace Anhydrite and Occasional Carbonaceous Banding	
465 470			BS-37	1.3	1/64 to 1/3	A to SR			117.1	Dark Gray Amorphous DOLOMITE with Trace Anhydrite and Chert	
475 480			BS-38	1.1	1/64 to 1/3	A to SR			107.1	Dark Tan Amorphous DOLOMITE with Trace Anhydrite	
										Dark Tan Amorphous DOLOMITE with Trace Anhydrite	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							DRG - Amherstburg Formation		Dark Tan Amorphous DOLOMITE with Trace Anhydrite	
485			BS-39	1.4	1/64 to 1/5	A to SR					
490									97.1	Dark Tan Amorphous DOLOMITE with Trace White Fine Grained Sandstone and Anhydrite	
495			BS-40	0.9	1/64 to 1/4	A to SR		DRG - Sylvania Sandstone		DRG - Sylvania Sandstone Top EL 92.1 White Fine Grained SANDSTONE with Trace Tan Dolomite	
500									87.1	White Fine Grained SANDSTONE with Trace Tan Dolomite	
505			BS-41	1	1/64 to 1/5	SA to SR					
510									77.1	White Fine Grained SANDSTONE with Trace Tan Dolomite	
515			BS-42	0.9	1/64 to 1/5	SA to SR					

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
520	Rotary Drilling							DRG - Sylvania Sandstone	67.1	White Fine Grained SANDSTONE with Trace Tan Dolomite	
525 530			BS-43	0.8	1/64 to 1/5	SA to SR			57.1	White Fine Grained SANDSTONE with Trace Tan and Gray Dolomite	
535 540			BS-44	1.1	1/64 to 1/5	SA to SR			47.1	White Fine Grained SANDSTONE with Trace Tan and Gray Dolomite	
545 550			BS-45	1.6	1/64 to 1/3	A to SR			37.1	White Fine Grained SANDSTONE with Some Tan and Gray Dolomite	
										Tan Amorphous DOLOMITE with Some White Fine Grained Sandstone	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							DRG - Sylvania Sandstone		Tan Amorphous DOLOMITE with Some White Fine Grained Sandstone	
555			BS-46	1.1	1/64 to 1/3	A to SR					
560									27.1	Tan Amorphous DOLOMITE with Some White Fine Grained Sandstone and Trace Anhydrite	
565			BS-47	1.3	1/64 to 1/3	SA to SR					
570								Bois Blanc Formation	17.09	Bois Blanc Formation Top EL 17.1 Gray Amorphous to Fine Grained DOLOMITE with Trace Anhydrite	
575			BS-48	2.1	1/64 to 1/5	A to SR					
580									7.100000000000002	Gray Amorphous to Fine Grained DOLOMITE with Trace White Chert	
585			BS-49	2.6	1/64 to 1/5	A to SR					

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
590	Rotary Drilling							Bois Blanc Formation	-2.89999999999998	Gray Amorphous to Fine Grained DOLOMITE with Trace White Chert	
595 600			BS-50	3.3	1/64 to 1/5	A to SA			-12.9	Gray Amorphous to Fine Grained DOLOMITE with Trace White Chert	
605 610			BS-51	3.3	1/64 to 1/5	A to SR			-22.9	Gray Fine Grained DOLOMITE with White Chert and Anhydrite	
615 620			BS-52	3.3	1/64 to 1/3	A to SR			-32.9	Gray Fine Grained DOLOMITE with Trace Anhydrite	
										Gray Fine Grained DOLOMITE with Trace Anhydrite and Chert	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Bois Blanc Formation		Gray Fine Grained DOLOMITE with Trace Anhydrite and Chert	
625			BS-53	3.1	1/64 to 1/3	A to SR					
630									-42.9	Gray Fine Grained DOLOMITE with Trace Anhydrite and Chert	
635			BS-54	3.1	1/64 to 1/3	A to SR					
640								Garden Island Formation	-52.91	Garden Island Formation Top EL -52.9 Gray and Tan Fine Grained DOLOMITE with Trace Anhydrite	
645			BS-55	2	1/64 to 1/3	A to SR					
650								Bass Islands Group	-62.9	Bass Islands Group Top EL -61.9 Gray and Tan Fine Grained DOLOMITE with Trace Anhydrite and Chert	
655			BS-56	2.8	1/64 to 3/8	A to SA					

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Bass Islands Group		Gray and Tan Fine Grained DOLOMITE with Trace Anhydrite (656' to 660') (EL -68.9 to -72.9)	
660									-72.9	Gray and Tan Fine Grained DOLOMITE with Trace Anhydrite, Chert, and Shale	
665			BS-57	3.3	1/64 to 1/3	A to SA					
670			BS-58	4.5	1/64 to 1/5	A to SA				Gray and Tan Fine Grained DOLOMITE with Trace Anhydrite and Shale	
675											
										Gray Fine Grained SHALEY DOLOMITE (678' to 682') (EL -90.9 to -94.9)	
680									-92.9		
										Gray Fine Grained DOLOMITE with Shale	
685			BS-59	3.7	1/64 to 1/3	A to SR					
690									-102.9	Gray Fine Grained DOLOMITE with Trace Shale	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
695 700	Rotary Drilling		BS-60	3.3	1/64 to 1/3	SA to SR		Bass Islands Group	-112.9	Gray Fine Grained DOLOMITE with Trace Shale	
705 710			BS-61	2.3	1/64 to 1/5	A to SR			-122.9	Gray and Tan Fine Grained DOLOMITE with Shale Tan and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (703' to 705') (EL -115.9 to -117.9) Gray Fine Grained DOLOMITE and Anhydrite and Shale	
715 720			BS-62	2.9	1/64 to 1/3	A to SR			-132.9	Gray Fine Grained DOLOMITE with Anhydrite and Shale	
725			BS-63	2.6	1/64 to 1/32	A to SR				Gray Fine Grained DOLOMITE with Anhydrite and Shale	Fine Cuttings

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Bass Islands Group		Gray Fine Grained DOLOMITE with Anhydrite and Shale	
730									-142.9	Gray Fine Grained DOLOMITE with Shale and Trace Anhydrite	
735			BS-64	2.6	1/64 to 1/10	SA to SR					
740									-152.9	Gray Fine Grained DOLOMITE with Shale and Trace Anhydrite	
745			BS-65	2.4	1/64 to 1/10	SA to SR					
750									-162.9	Gray Fine Grained DOLOMITE with Shale and Trace Anhydrite	
755			BS-66	2.2	1/64 to 1/10	A to SR				SHALE (756' to 759') (EL -168.9 to -171.9)	
760									-172.9	Gray Fine Grained DOLOMITE with Occasional Black Shale	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
765	Rotary Drilling		BS-67	2.9	1/64 to 1/3	A to SR		Bass Islands Group	-182.9	Gray Fine Grained DOLOMITE with Occasional Black Shale	Fewer Fine Cuttings
770 775			BS-68	2.9	1/64 to 1/5	A to SR			-192.9	Gray Fine Grained LIMEY DOLOMITE with Occasional Black Shale	
780 785			BS-69	3.7	1/64 to 1/5	A to SR	▨			SHALEY ANHYDRITE (780' to 782') (EL -192.9 to -194.9) Gray Amorphous DOLOMITE with Occasional Black Shale	
790 795			BS-70	2.7	1/64 to 1/5	A to SR				Gray LIMEY DOLOMITE with Shale and Anhydrite	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Bass Islands Group		Massive Interbedded SHALEY ANHYDRITE (798' to 806') (EL -210.9 to -218.9)	
800									-212.9		
805			BS-71	2.5	1/64 to 1/5	A to SR					
										Gray DOLOMITE with Occasional Shale and Anhydrite	
810									-222.9	Gray DOLOMITE with Occasional Shale and Anhydrite	
815			BS-72	3.4	1/64 to 1/5	A to SR					
										Gray SHALEY LIMESTONE with Occasional Dolomite	
820									-232.9	Gray SHALEY LIMESTONE with Occasional Dolomite	
825			BS-73	3.4	1/64 to 1/3	A to SR					
830									-242.9		

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835 840	Rotary Drilling		BS-74	3.3	1/64 to 1/3	A to SR		Bass Islands Group	-252.9	Gray DOLOMITE with Anhydrite Massive Interbedded ANHYDRITE (834' to 836') (EL -246.9 to -248.9) Gray Amorphous SHALEY DOLOMITE with Trace Anhydrite	Possible Gypsum 830' to 832' (EL -242.9 to -244.9)
845 850			BS-75	3.6	1/64 to 1/5	SA to SR			-262.9	Gray Amorphous SHALEY DOLOMITE with Anhydrite	
855 860			BS-76	2.9	1/64 to 1/5	SA to SR			-272.9	Massive Interbedded ANHYDRITE (850' to 852') (EL -262.9 to -264.9) Gray SHALEY DOLOMITE with Some Anhydrite (852' to 860') (EL -264.9 to -272.9)	
865			BS-77	3.7						Massive Interbedded ANHYDRITE (860' to 867') (EL -272.9 to -279.9)	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling				1/64 to 1/3	A to SR		Bass Islands Group		Massive Interbedded ANHYDRITE (860' to 867') (EL -272.9 to -279.9) Gray SHALEY DOLOMITE with Some Anhydrite (867' to 870') (EL -279.9 to -282.9)	
870									-282.9	Tan Amorphous DOLOMITE with Occasional Anhydrite	
875			BS-78	4.9	1/64 to 1/3	A to SR					
										Brown and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (877' to 879') (EL -289.9 to -291.9) Tan and Gray Amorphous DOLOMITE with Anhydrite and Shale	
880									-292.9	Tan and Gray Amorphous DOLOMITE with Anhydrite and Shale	
885			BS-79	4.1	1/64 to 1/3	A to SA					
890									-302.9	Tan and Brown Argillaceous DOLOMITE with Trace Anhydrite	
895			BS-80	3	1/64 to 1/3	A to SR					
900									-312.9		

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	Rotary Drilling							Bass Islands Group		Gray and Tan Fine Grained DOLOMITE with Occasional Anhydrite	
										Massive Interbedded ANHYDRITE (903' to 906') (EL -315.9 to -318.9)	
905			BS-81	4	1/64 to 1/5	A to SR					
								Salina Group - G Unit (G Shale)		Salina Group - G Unit (G-Shale) Top EL -318.9 Gray Amorphous SHALEY DOLOMITE (906' to 910') (EL -318.9 to -322.9)	
910			BS-82	2.9	1/64 to 1/5	A to SR				Gray Amorphous SHALE with Trace Anhydrite	
915											
920									-332.9	Massive Interbedded ANHYDRITE (919' to 921') (EL -331.9 to -333.9) Gray DOLOMITE with Anhydrite Gray Amorphous SHALE with Trace Anhydrite	
925			BS-83	2.5	1/64 to 1/5	A to SR					
930									-342.9	Gray and Brown Amorphous SHALE with Trace Anhydrite Dolomite	

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ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/16/07

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling		BS-84	2.2	1/64 to 1/5	A to SR		Salina Group - G Unit (G Shale)		Gray and Brown Amorphous SHALE with Trace Anhydrite Dolomite	
940									-352.9	Gray and Brown Amorphous SHALE with Trace Dolomite and Anhydrite	
945			BS-85	2.3	1/64 to 1/5	A to SR					
950									-362.9	Gray and Brown Amorphous SHALE with Trace Dolomite and Anhydrite	
955			BS-86	2.7	1/64 to 1/5	A to SR					
960									-372.9	Gray and Brown Amorphous SHALE with Trace Dolomite and Anhydrite	
965			BS-87	3	1/64 to 1/5	A to SR					

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970	Rotary Drilling						▤	Salina Group - G Unit (G Shale)	-382.9	Gray and Brown Amorphous SHALE with Trace Dolomite and Anhydrite	
975			BS-88	3.1	1/64 to 1/5	A to SR	▤				
							▨			Massive Interbedded ANHYDRITE (976' to 980') (EL -388.9 to -392.9)	
980							▤		-392.9	Gray, Tan, and Brown Amorphous SHALE with Trace Dolomite and Anhydrite	
							▨			Massive Interbedded ANHYDRITE (983' to 986') (EL -395.9 to -398.9)	
985			BS-89	2.5	1/64 to 1/5	A to SR					
							▤			Gray, Tan, and Brown Amorphous SHALE with Trace Dolomite and Anhydrite	
990							▤		-402.9	Gray, Tan, and Brown Amorphous SHALE with Trace Dolomite and Anhydrite	
							▨			Massive Interbedded ANHYDRITE (992' to 996') (EL -404.9 to -408.9)	
995			BS-90	3.3	1/64 to 1/5	A to SR					
							▤			Gray, Tan, and Brown Amorphous SHALE with Trace Dolomite and Anhydrite	
1000							▨		-412.9	Massive Interbedded ANHYDRITE (1000' to 1006') (EL -412.9 to -418.9)	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
1005	Rotary Drilling		BS-91	3.9	1/64 to 1/5	A to SR		Salina Group - G Unit (G Shale)		Massive Interbedded ANHYDRITE (1000' to 1006') (EL -412.9 to -418.9) Gray, Brown, and Tan Fine Grained DOLOMITE with Occasional Anhydrite (1006' to 1010') (EL -418.9 to -422.9)	
1010									-422.9	Gray and Brown SHALE with Dolomite and Trace Anhydrite	
1015			BS-92	3.4	1/64 to 1/5	A to SR		Salina Group - F Unit (F-Salt)		Salina Group - F Unit (F-Salt) Top EL -427.9 White HALITE with Gray Fine Grained Dolomite and Occasional Anhydrite (F4 Bed)	
1020									-432.9	White HALITE with Gray Fine Grained Dolomite and Occasional Anhydrite (F4 Bed)	
1025			BS-93	0.8	1/64 to 1/4	A to SR					
1030									-442.9	Clear and White HALITE with Gray and Brown Dolomite and Occasional Anhydrite (F4 Bed) Clear and White HALITE with Trace Gray Amorphous to Fine Grained Dolomite (F1 Bed) Brown and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE (1033' to 1035') (EL -445.9 to -448.9) Tan and Brown Amorphous DOLOMITE with Trace Shale	
1035			BS-94	0.4	1/64 to 1/3	A to SR					

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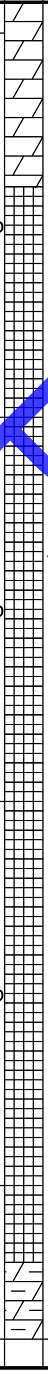

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
1040	Rotary Drilling							Salina Group - F Unit (F-Salt)	-452.9	Tan and Brown Amorphous DOLOMITE with Trace Shale Clear and White HALITE with Brown and Gray Dolomite and Occasional Anhydrite (F3 Bed)	
1045			BS-95	2.3	1/64 to 1/3	A to SR					
1050									-462.9	Clear and White HALITE with Brown and Gray Dolomite and Occasional Anhydrite (F3 Bed)	
1055			BS-96	1	1/64 to 1/4	A to SR					
1060									-472.9	Clear and White HALITE with Trace Gray Dolomite (F3 Bed)	
1065			BS-97	1.2	1/64 to 1/4	A to SA					
1070									-482.9	Clear and White HALITE with Trace Gray Dolomite (F3 Bed) SHALEY DOLOMITE (1072' to 1078') (EL -484.9 to -490.9)	

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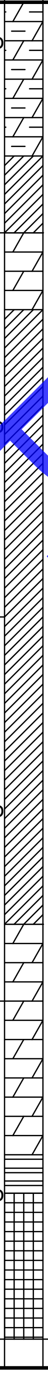
Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
1075	Rotary Drilling		BS-98	4.1	1/64 to 1/3	A to SR		Salina Group - F Unit (F-Salt)		Clear and White HALITE with Trace Gray Dolomite (F3 Bed)	
										Massive Interbedded ANHYDRITE (1078' to 1080') (EL -490.9 to -492.9)	
1080									-492.9	Brown Amorphous to Fine Grained DOLOMITE (1080' to 1082') (EL -492.9 to -494.9)	
										Massive Interbedded ANHYDRITE (1082' to 1084') (EL -494.9 to -496.9)	
1085			BS-99	3.6	1/64 to 1/3	A to SR				Massive Interbedded ANHYDRITE with Tan Amorphous to Fine Grained Dolomite	
1090									-502.9		
1095			BS-100	3.6	1/64 to 1/3	A to SR				Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite and Halite	
1100									-512.9	Tan Amorphous to Fine Grained DOLOMITE with Occasional Anhydrite and Halite	
										SHALE (1104' to 1105') (EL -516.9 to -517.9)	
1105			BS-101	0.8	1/64 to 1/5	A to SR				Clear and White HALITE with Gray Dolomite and Trace Anhydrite (F2 Bed)	

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Subsurface Profile

Ground Surface Elevation: 587.1

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1110	Rotary Drilling							Salina Group - F Unit (F-Salt)	-522.9	Clear and White HALITE with Gray Dolomite and Trace Anhydrite (F2 Bed)	
1115			BS-102	0.7	1/64 to 1/4	A to SA					
1120			BS-103	1.4	1/64 to 1/3	A to SA				Clear and White HALITE with Gray Dolomite and Trace Anhydrite (F2 Bed)	
1125											
										SHALE (1127' to 1131') (EL -539.9 to -543.9)	
1130									-542.9		
1135			BS-104	1	1/64 to 1/3	A to SR					
1140									-552.9	Clear and White HALITE with Trace Gray Amorphous to Fine Grained Dolomite (F1 Bed)	

ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/16/07

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Salina Group - F Unit (F-Salt)		Clear and White HALITE with Trace Gray Amorphous to Fine Grained Dolomite (F1 Bed)	
1145			BS-105	0.8	1/64 to 1/3	A to SR					
											Possible Gypsum
1150									-562.9	Clear and White HALITE with Trace Gray Amorphous to Fine Grained Dolomite (F1 Bed)	
1155			BS-106	0.9	1/64 to 1/3	A to SR					
											Possible Gypsum
1160									-572.9	Clear and White HALITE with Trace Gray Amorphous to Fine Grained Dolomite (F1 Bed)	
1165			BS-107	0.7	1/64 to 3/8	A to SR					
1170									-582.9	Clear and White HALITE with Trace Gray Amorphous to Fine Grained Dolomite (F1 Bed)	Possible Gypsum
1175			BS-108	0.8	1/64 to 1/3	A to SR					Possible Gypsum

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

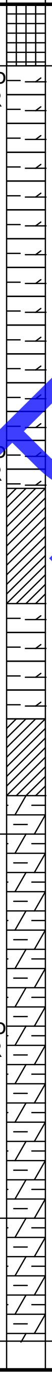
LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling									Clear and White HALITE with Trace Gray Amorphous to Fine Grained Dolomite (F1 Bed)	
1180			BS-109	3	1/64 to 3/8	A to SR		Salina Group - E Unit (E - Dolomite)		Salina Group - E unit (E-Dolomite) Top EL -592.9 Tan Amorphous to Fine Grained DOLOMITIC SHALE with Anhydrite and Trace Orange Halite	
1185											
1190			BS-110	3.5	1/64 to 1/3	A to SR				Massive interbedded ANHYDRITE (1191' to 1194') (EL -603.9 to -606.9)	
1195										Tan Amorphous to Fine Grained DOLOMITIC SHALE with Anhydrite and Trace Orange Halite (1194' to 1197') (EL -606.9 to -609.6) Massive Interbedded ANHYDRITE (1197' to tp 1199') (EL -609.9 to -611.9)	
1200									-612.9	Tan Amorphous to Fine Grained SHALEY DOLOMITE with Trace Anhydrite	
1205			BS-111	3.7	1/64 to 1/5	A to SR					
1210									-622.9	Tan Amorphous to Fine Grained SHALEY DOLOMITE	



NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 587.1

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1215	Rotary Drilling		BS-112	3.5	1/64 to 1/3	A to SR		Salina Group - E Unit (E - Dolomite)		Tan Amorphous to Fine Grained SHALEY DOLOMITE Massive Interbedded ANHYDRITE (1218' to 1220') (EL -630.9 to -632.9)	
1220									-632.9	Tan Amorphous to Fine Grained SHALEY DOLOMITE	
1225			BS-113	3.5	1/64 to 1/5	A to SR				Massive interbedded ANHYDRITE (1224' to 1226') (EL -636.9 to -638.9) Tan Amorphous to Fine Grained SHALEY DOLOMITE	
1230									-642.9	Tan Amorphous to Fine Grained SHALEY DOLOMITE	
1235			BS-114	3.9	1/64 to 1/5	A to SR					
1240									-652.9	Tan and Brown Amorphous to Fine Grained SHALEY DOLOMITE with Trace Anhydrite	
1245			BS-115	4.1	1/64 to 1/3	A to SR					

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
1250	Rotary Drilling							Salina Group - E Unit (E - Dolomite)	-662.9	Tan and Brown Amorphous to Fine Grained SHALEY DOLOMITE with Trace Anhydrite	
1255 1260			BS-116	4.2	1/64 to 3/8	A to SA			-672.9	Gray and Tan Amorphous to Fine Grained SHALEY DOLOMITE with Red and Clear Halite and Occasional Anhydrite	
1265 1270			BS-117	3	1/64 to 1/5	A to SA			-682.9	Gray Amorphous to Fine Grained SHALEY DOLOMITE with Red and White Halite and Occasional Anhydrite	
1275 1280			BS-118	2.7	1/64 to 1/3	A to SA			-692.9	Brown Amorphous to Fine Grained SHALEY DOLOMITE Massive Interbedded ANHYDRITE (1273' to 1276') (EL -685.9 to -688.9) Brown and Gray Amorphous to Fine Grained DOLOMITE with Trace Halite (1276' to 1282') (EL -688.9 to -694.9)	
										Salina Group - D unit (D-Salt) Top EL -694.9	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Salina Group - D Unit (D-Salt)		Clear HALITE with Fine Grained Dolomite (D3 Bed)	
1285			BS-119	1	1/64 to 1/3	A to SA					
1290			BS-120	3	1/64 to 1/5	A to SR				Clear HALITE with Fine Grained Dolomite (D3 Bed)	
1295										DOLOMITIC SHALE (1296' to 1302') (EL -708.9 to -714.9)	
1300									-712.9	Clear HALITE with Fine Grained Dolomite (D2 Bed)	
1305			BS-121	0.9	1/64 to 1/5	A to SA					
1310									-722.9	Clear HALITE with Fine Grained Dolomite and Occasional Anhydrite (D2 Bed)	
1315			BS-122	1.7	1/64 to 1/5	A to SA				Salina Group - C unit (C-Shale) Top EL -729.9	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
1320	Rotary Drilling							Salina Group - C Unit (C-Shale)	-732.9	Gray Amorphous SHALE with Trace Dolomite Clear HALITE with Fine Grained Dolomite and Occasional Anhydrite (D2 Bed)	
1325 1330			BS-123	1.7	1/64 to 1/5	A to SA			-742.9	Gray Amorphous SHALE with Trace Dolomite	
1335 1340			BS-124	2.2	1/64 to 1/3	A to SR			-752.9	Gray Amorphous SHALE with Trace Dolomite	
1345 1350			BS-125	2.3	1/64 to 1/5	SA to SR			-762.9	Gray Amorphous SHALE with Trace Dolomite	
										Gray Amorphous SHALE with Trace Dolomite and Halite	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
1355 1360	Rotary Drilling		BS-126	2.1	1/64 to 1/5	SA to SR		Salina Group - C Unit (C-Shale)	-772.9	Gray Amorphous SHALE with Trace Dolomite and Halite	Sample Appears Clayey/Weathered
1365 1370			BS-127	2.6	1/64 to 1/5	SA to R			-782.9	Gray Amorphous SHALE with Trace Dolomite	Sample Appears Clayey/Weathered
1375 1380			BS-128	2.3	1/64 to 1/3	SA to R			-792.9	Gray Amorphous SHALE with Trace Dolomite	Sample Appears Clayey/Weathered
1385			BS-129	2.6	1/64 to 1/3	SA to R				Gray Amorphous SHALE with Trace Dolomite	Sample Appears Clayey/Weathered

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Salina Group - C Unit (C-Shale)		Gray Amorphous SHALE with Trace Dolomite	
1390									-802.9	Gray Amorphous SHALE with Trace Dolomite Massive Interbedded ANHYDRITE (1392' to 1394') (EL -804.9 to -806.9) Gray Amorphous SHALE with Trace Dolomite	
1395			BS-130	2.5	1/64 to 1/3	SA to R					Sample Appears Clayey/Weathered
1400									-812.9	Gray and Brown Fine Grained SHALE with Occasional Dolomite and Orange Halite	
1405			BS-131	2.6	1/64 to 1/5	A to SR					Sample Appears Clayey/Weathered
1410									-822.9	Gray Fine Grained SHALE with Occasional Orange Halite	
1415			BS-132	2.8	1/64 to 1/5	SA to SR					Sample Appears Clayey/Weathered
1420									-832.9	Brown and Gray Fine Grained SHALE with Occasional Orange Halite	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:

DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Salina Group - C Unit (C-Shale)		Brown and Gray Fine Grained SHALE with Occasional Orange Halite	
1425			BS-133	2.1	1/64 to 1/5	SA to SR					Sample Appears Clayey/Weathered
1430									-842.9	Gray and Brown SHALE with Trace Halite	
1435			BS-134	2.1	1/64 to 1/5	SA to SR					Sample Appears Clayey/Weathered
1440									-852.9	Gray and Brown SHALE with Occasional Halite	
1445			BS-135	2.6	1/64 to 1/5	SA to SR					
1450									-862.9	Massive Interbedded ANHYDRITE (1450' to 1454') (EL -862.9 to -866.9)	
										Gray Amorphous SHALE	
1455			BS-136	2.1	1/64 to 1/5	SA to SR					

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
	Rotary Drilling							Salina Group - C Unit (C-Shale)			
1460			BS-137	2.3	1/64 to 1/3	SA to SR				Gray Amorphous SHALE	
1465											
										Massive interbedded ANHYDRITE (1468' to 1469') (EL -880.9 to -881.9)	
1470									-882.9	Gray SHALE	
1475			BS-138	2.5	1/64 to 1/3	SA to SR					Possible Halite (Argillaceous) 1473' to 1477' (EL -885.9 to -889.9)
1480									-892.9	Gray SHALE with Occasional Orange Halite	
1485			BS-139	2.4	1/64 to 1/5	SA to SR					
1490									-902.9	Gray Amorphous SHALE	

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/16/07

LOG OF ROTARY BORING NO:
DRICX11TB12 (TB-12)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 587.1	Notes
1495	Rotary Drilling		BS-140	2.5	1/64 to 1/5	SA to SR		Salina Group - C Unit (C-Shale)		Gray Amorphous SHALE	
1500										End of Boring at 1500 feet.	
1505											
1510											
1515											
1520											
1525											

NOTES: NTH Inspectors: M. Firestone, S. Gole, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)
DRG - Detroit River Group

PROJECT NO. C05002A

LOG OF TEST BORING TB-13

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)
			GLACIAL SEDIMENT (DRIFT)	90
	DUNDEE LIMESTONE	481.7	Fine grained to amorphous, gray to buff LIMESTONE; bedding laminar to indistinct; subangular to angular grains, occasional angular chert particles, calcite and carbonaceous particles, moderate reaction to HCl	100
				110
				120
				130
				140
				150
		421.7	Fine grained to amorphous, gray and buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional angular chert particles, and calcite and carbonaceous particles, low reaction to HCl	160
				170
				180
				190

ROCK SAMPLE DATA

SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest (10 20 30 40)	COLOR	DRILLING RATE (min/ft)
BS-1	1 ↔ 25	Gray/Buff	4.4
BS-2	1 ↔ 8	Gray/Buff	
BS-3	2 ↔ 15	Gray/Buff	
BS-4	2 ↔ 10	Gray/Buff	
BS-5	2 ↔ 10	Gray/Buff	
BS-6	2 ↔ 20	Gray/Buff	
BS-7	1 ↔ 10	Gray/Buff	
BS-8	1 ↔ 10	Buff	2.2

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

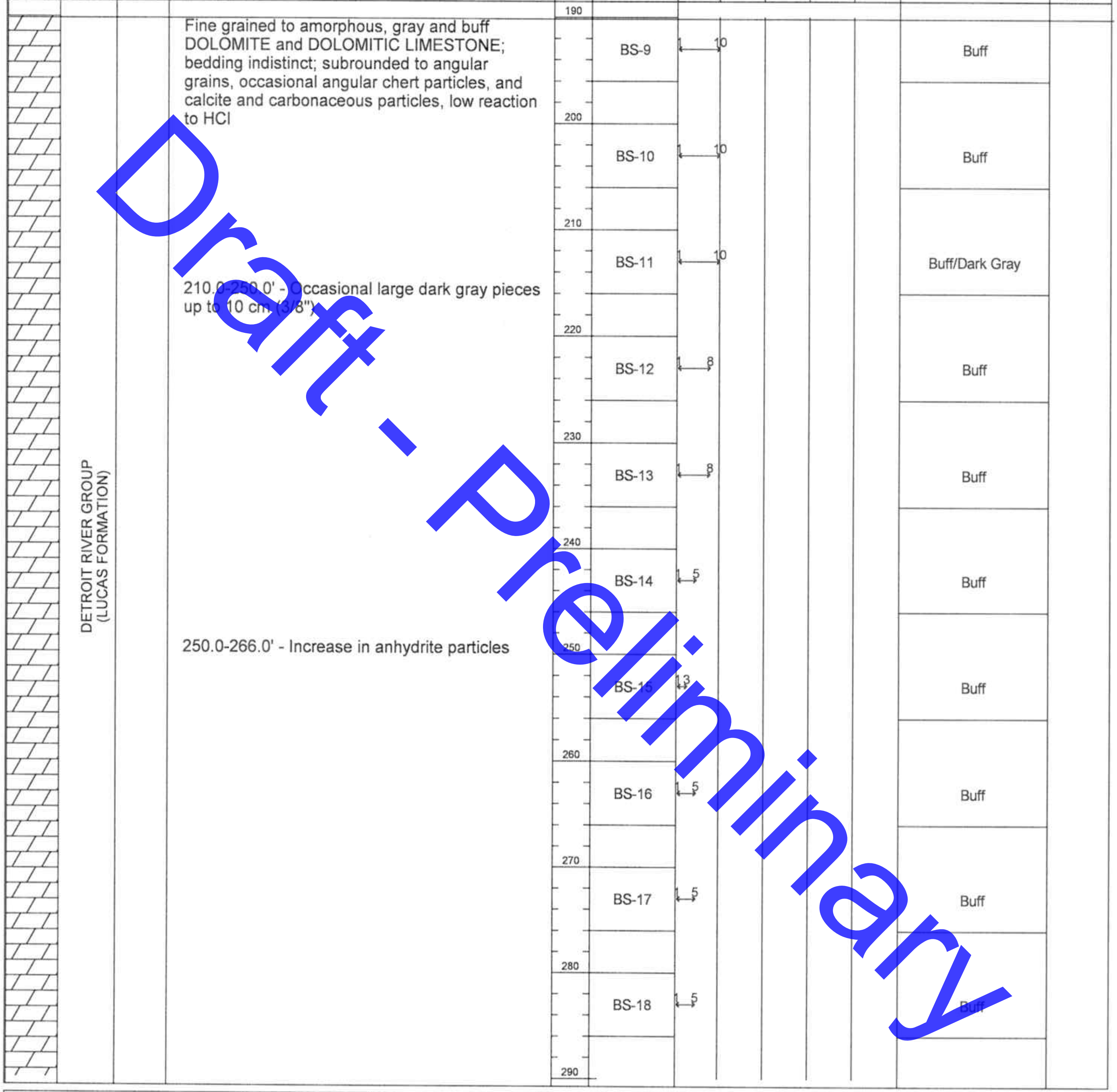
Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-13

SUBSURFACE PROFILE | **ROCK SAMPLE DATA**



LITHOLOGICAL DESCRIPTION

Fine grained to amorphous, gray and buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional angular chert particles, and calcite and carbonaceous particles, low reaction to HCl

210.0-250.0' - Occasional large dark gray pieces up to 10 cm (3/8")

250.0-266.0' - Increase in anhydrite particles

SAMPLE NO.	PARTICLE SIZE (mm)	COLOR
BS-9	1 10	Buff
BS-10	1 10	Buff
BS-11	1 10	Buff/Dark Gray
BS-12	1 8	Buff
BS-13	1 8	Buff
BS-14	1 5	Buff
BS-15	1 3	Buff
BS-16	1 5	Buff
BS-17	1 5	Buff
BS-18	1 5	Buff

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-13

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, gray and buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional angular chert particles, and calcite and carbonaceous particles, low reaction to HCl 340.0-386.0' - Increase in anhydrite particles

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ↔ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
290				
	BS-19	1 ↔ 5	Buff	
300				
	BS-20	1 ↔ 5	Buff	
310				
	BS-21	1 ↔ 3	Buff	
320				
	BS-22	1 ↔ 3	Buff	
330				
	BS-23	1 ↔ 3	Buff	
340				
	BS-24	1 ↔ 3	Buff	
350				
	BS-25	1 ↔ 5	Buff	
360				
	BS-26	1 ↔ 5	Buff	
370				
	BS-27	1 ↔ 5	Buff	
380				
	BS-28	1 ↔ 5	Buff	
390				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, gray and buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional angular chert particles, and calcite and carbonaceous particles, low reaction to HCl	390				
					BS-29	1↔3	Buff	
				400				
					BS-30	1↔3	Buff	
				410				
					BS-31	1↔3	Buff	
				420				
					BS-32	1↔3	Buff	
	DETROIT RIVER GROUP (AMHERSTBURG FORMATION)			430				
					BS-33	1↔3	Buff	
				440				
					BS-34	1↔3	Brown/Buff	
				450				
					BS-35	1↔3	Brown/Buff	
				460				
					BS-36	1↔3	Brown/Buff	
				470				
					BS-37	1↔3	Brown/Buff	
				480				
					BS-38	1↔3	White/Light Gray	
				490				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-13

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SYLVANIA SANDSTONE		Fine grained to amorphous, gray and buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional angular chert particles, and calcite and carbonaceous particles, low reaction to HCl	490	BS-39	1↔3	White/Light Gray	1.1
		79.7	Fine to medium grained, light gray to white SACCHAROIDAL SANDSTONE; subrounded to subangular grains, occasional dolomite and gypsum particles, low reaction to HCl	500	BS-40	1↔3	White/Light Gray	
				510	BS-41	1↔3	White/Light Gray	
				520	BS-42	1↔3	White/Light Gray	
				530	BS-43	1↔3	White/Light Gray	
				540	BS-44	1↔3	White/Light Gray	
				550	BS-45	1↔3	White/Light Gray	
	BOIS BLANC FORMATION	21.7	Fine grained to amorphous, gray DOLOMITE; bedding is indictinct; subrounded to subangular grains, occasional angular chert particles and anhydrite, low reaction to HCl	560	BS-46	1↔3	White/Light Gray	
				570	BS-47	1↔3	Gray	2.8
				580	BS-48	1↔3	Gray	
				590				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-13

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BOIS BLANC FORMATION			590				
			Fine grained to amorphous, gray DOLOMITE; bedding is indictinct; subrounded to subangular grains, occasional angular chert particles and anhydrite, low reaction to HCl		BS-49	1 3	Gray	
				600				
					BS-50	1 3	Gray	
				610				
					BS-51	1 3	Gray	
				620				
					BS-52	1 3	Gray	
				630				
					BS-53	1 3	Gray	
	BASS ISLAND FORMATION	-58.3		640				
			Fine grained to amorphous, buff DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains, occasional angular chert particles, occasional subrounded anhydrite particles, low to very low reaction to HCl		BS-54	1 3	Gray	
				650				
					BS-55	1 3	Gray	
				660				
					BS-56	1 3	Gray	
				670				
					BS-57	1 3	Gray	
				680				
					BS-58	1 3	Gray	
				690				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-13

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Fine grained to amorphous, buff DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains, occasional angular chert particles, occasional subrounded anhydrite particles, low to very low reaction to HCl	690	BS-59	1↔3	Gray	
				700	BS-60	1↔3	Gray	
				710	BS-61	1↔3	Buff	
				720	BS-62	1↔3	Buff	3.8
				730	BS-63	1↔3	Buff	
				740	BS-64	1↔3	Buff	
				750	BS-65	1↔3	Buff	
				760	BS-66	1↔3	Buff	
				770	BS-67	1↔5	Gray	
				780	BS-68	1↔5	Gray	
				790				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-13

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Fine grained to amorphous, buff DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains, occasional angular chert particles, occasional subrounded anhydrite particles, low to very low reaction to HCl	790	BS-69	5	Gray	
				800	BS-70	5	Gray	3.4
				810	BS-71	5	Gray	
				820	BS-72	5	Gray	
				830	BS-73	5	Gray	
				840	BS-74	5	Gray	
				850	BS-75	5	Gray	
				860	BS-76	5	Gray	
				870	BS-77	5	Buff	
				880	BS-78	5	Buff	
				890				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

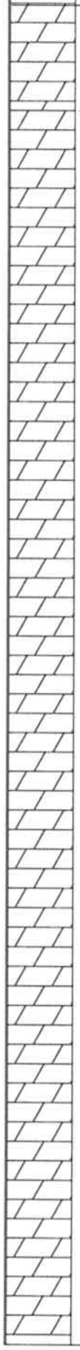
Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
	SALINA G UNIT	-316.3	Fine grained to amorphous, gray to buff DOLOMITE; bedding indistinct; subrounded to subangular grains, occasional anhydrite particles, low reaction to HCl



ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
890	BS-79	1↔5	Buff	
900	BS-80	1↔5	Buff	
910	BS-81	1↔5	Buff	
920	BS-82	1↔5	Buff	
930	BS-83	1↔5	Gray	
940	BS-84	1↔3	Gray	
950	BS-85	1↔3	Gray	
960	BS-86	1↔3	Gray	3.4
970	BS-87	1↔5	Gray	
980	BS-88	1↔5	Gray	
990				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
		-412.3	
	F5 SALT	-415.3	Crystalline HALTIE/ANHYDRITE and fine grained to amorphous DOLOMITE; subround to subangular grains, very low reaction to HCl
	SALINA F UNIT	-430.3	Mixed fine grained to amorphous, gray DOLOMITE, LIMESTONE and CRYSTALLINE HALITE and ANHYDRITE, subrounded to angular grains
	F4 SALT	-453.3	Crystalline HALITE/ANHYDRITE; occasional fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains
	SALINA F UNIT	-465.3	Mixed fine grained to amorphous, gray DOLOMITE and crystalline HALITE/ANHYDRITE; subrounded to subangular grains, low raction to HCl
	F3 SALT	-493.3	Mixed HALITE/ANHYDRITE and fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains
	SALINA F UNIT		Fine grained to amorphous, gray DOLOMITE; bedding indistinct; subrounded to subangular grains, trace halite/anhydrite particles, low reaction to HCl

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest	COLOR	DRILLING RATE (min/ft)
990	BS-89	1-5	Gray	2.2
1000	BS-90	1-3	Gray	
1010	BS-91	1-3	Buff	
1020	BS-92	1-5	Buff	
1030	BS-93	1-5	Gray	1.4
1040	BS-94	1-5	Gray	
1050	BS-95	1-5	Gray	
1060	BS-96	1-5	Buff	
1070	BS-97	1-5	Buff	
1080	BS-98	1-3	Buff	
1090				4.0

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE | **ROCK SAMPLE DATA**

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ↔ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA F UNIT		Fine grained to amorphous, gray DOLOMITE; bedding indistinct; subrounded to subangular grains, trace halite/anhydrite particles, low reaction to HCl	1090	BS-99	1↔3	Buff	
				1100	BS-100	1↔3	Buff	
	F2 SALT	-522.3	Mixed HALITE/ANHYDRITE and fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains					
				1110	BS-101	1↔5	Gray/White	
				1120	BS-102	1↔3	White/Gray	3.3
		-545.3	Fine grained to amorphous, gray DOLOMITE; bedding indistinct; subrounded to subangular grains, trace halite/anhydrite particles, low reaction to HCl					
	F1 SALT	-548.3	Mixed HALITE/ANHYDRITE and fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains	1130	BS-103	1↔3	White/Gray	
				1140	BS-104	1↔5	Gray/White	
				1150	BS-105	1↔5	Gray/White	
				1160	BS-106	1↔5	Gray/White	
				1170	BS-107	1↔5	Gray	
				1180	BS-108	1↔5	Gray	
		-600.3	Fine grained to amorphous, gray DOLOMITE; bedding indistinct; subrounded to subangular grains, trace halite/anhydrite particles, low reaction to HCl					
				1190				4.3

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-13

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ↔ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA E UNIT		Fine grained to amorphous, gray DOLOMITE; bedding indistinct; subrounded to subangular grains, trace halite/anhydrite particles, low reaction to HCl	1190	BS-109	1↔5	Gray	
				1200	BS-110	1↔5	Gray	
				1210	BS-111	1↔3	Gray	
				1220	BS-112	1↔5	Gray/Buff	
				1230	BS-113	1↔5	Gray/Buff	
				1240	BS-114	1↔3	Gray	
				1250	BS-115	1↔3	Gray	
				1260	BS-116	1↔5	Light Gray	
				1270	BS-117	1↔5	Light Gray	
		-700.3		1280				
	D3 SALT		Mixed HALITE/ANHYDRITE and fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains		BS-118	1↔5	Light Gray	
				1290				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-13

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
		-710.3		1290				
			Fine grained to amorphous, gray DOLOMITE; bedding indistinct; subrounded to subangular grains, trace halite/anhydrite particles, low reaction to HCl		BS-119	1–5	Gray	1.9
	D2 SALT	-718.3	Mixed HALITE/ANHYDRITE and fine grained to amorphous, gray DOLOMITE; subrounded to subangular grains	1300	BS-120	1–7	Gray/Buff	
	SALINA C UNIT	-727.3	Gray DOLOMITIC SHALE; occasional fine grained to amorphous gray dolomite particles, subrounded grains, low reaction to HCl	1310	BS-121	1–7	Gray/Buff	
				1320	BS-122	1–5	Gray/White	
				1330	BS-123	1–5	Gray/White	
				1340	BS-124	1–2	Gray	2.5
				1350	BS-125	1–2	Gray	
				1360	BS-126	1–2	Gray	
				1370	BS-127	1–2	Gray	
				1380	BS-128	1–2	Gray	
				1390				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA C UNIT		Gray DOLOMITIC SHALE; occasional fine grained to amorphous gray dolomite particles, subrounded grains, low reaction to HCl	1390	BS-129	1 2	Gray	
				1400	BS-130	1 3	Gray	
				1410	BS-131	1 3	Gray	
				1420	BS-132	1 3	Gray	
				1430	BS-133	1 2	Gray	2.6
				1440	BS-134	1 2	Gray	
				1450	BS-135	1 3	Gray	
				1460	BS-136	1 3	Gray	
				1470	BS-137	1 3	Gray	
				1480	BS-138	1 3	Gray	1.5
		-906.3		1490				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-13

SUBSURFACE PROFILE				ROCK SAMPLE DATA				
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA B UNIT		Mixed HALITE/ANHYDRITE with occasional shale stringers	1490	BS-139	1↔3	Gray	
				1500	BS-140	1↔3	Gray	
				1510	BS-141	1↔5	Gray/White	
				1520	BS-142	1↔5	Gray/White	
				1530	BS-143	1↔5	Gray/White	
				1540	BS-144	1↔5	Gray/White	
				1550	BS-145	1↔5	Gray/White	
				1560	BS-146	1↔5	Gray/White	
				1570	BS-147	1↔5	Gray/White	
				1580	BS-148	1↔5	Gray/White	
				1590				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

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PROJECT NO. C05002A

LOG OF TEST BORING TB-13

SUBSURFACE PROFILE				ROCK SAMPLE DATA				
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ↔ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA B UNIT		Mixed HALITE/ANHYDRITE with occasional shale stringers	1590	BS-149	1 ↔ 5	Gray/White	
				1600	BS-150	1 ↔ 5	Gray/White	
				1610	BS-151	1 ↔ 5	White/Gray	
				1620	BS-152	1 ↔ 5	White/Gray	
				1630	BS-153	1 ↔ 7	White/Gray	
		-1062.3		1640	BS-154	1 ↔ 7	White/Gray	
	SALINA A2		Fine grained to amorphous, gray DOLOMITE; trace to some shale pieces, trace to some halite and anhydrite pieces, subrounded to subangular grains, low reaction to HCl	1650	BS-155	1 ↔ 7	White/Gray	
				1660	BS-156	1 ↔ 9	Gray	
		-1098.3		1670	BS-157	1 ↔ 9	Gray	
			End of Boring at 1680 ft.	1680				
				1690				

BORING COORDINATES
N (y) Coordinate 4685866.6
E(x) Coordinate 327749

Remarks:
Ground Surface Elevation: 581.7 ft.

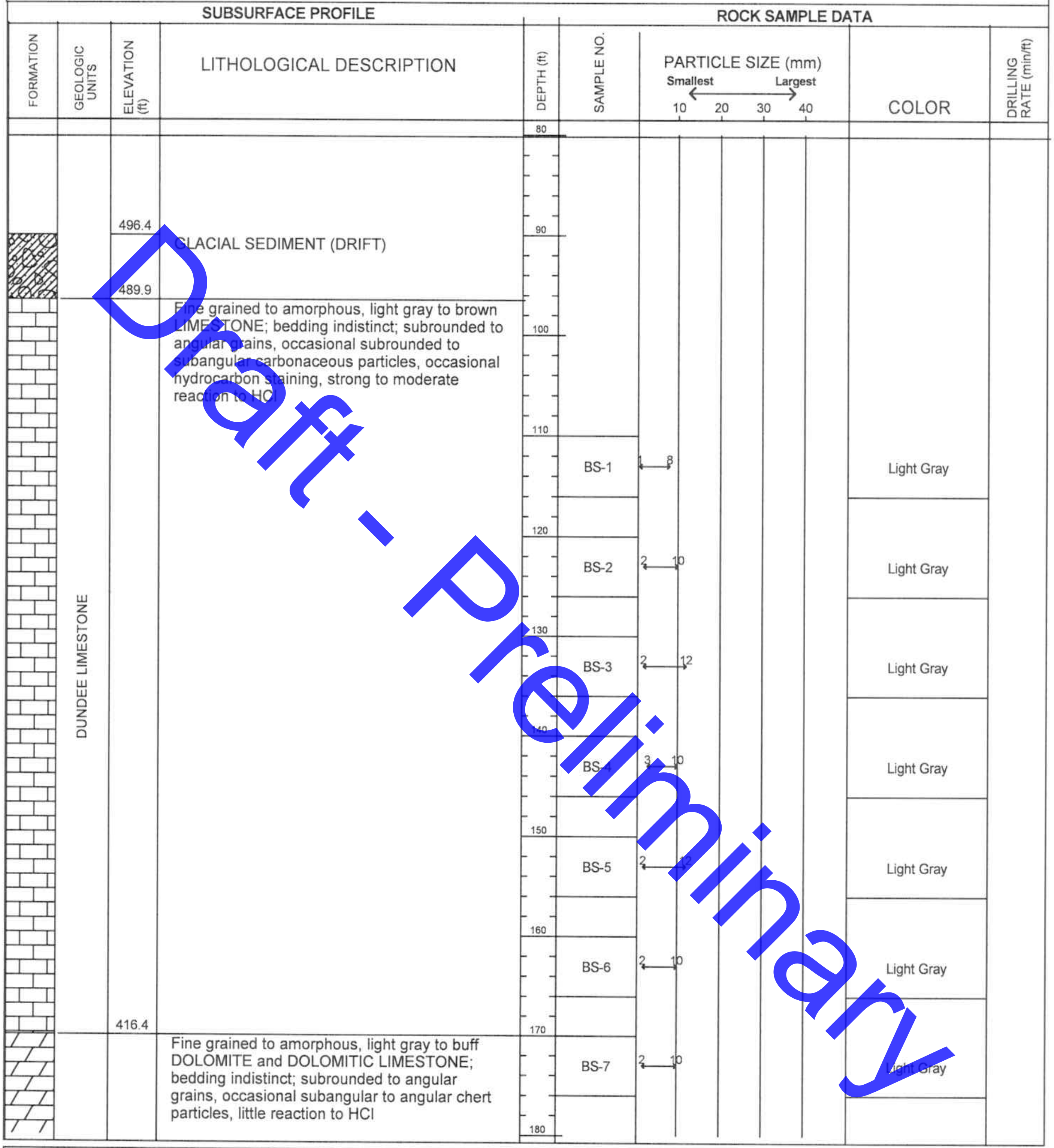
Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-23-07
Date Completed: 03-27-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-14



ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
496.4	GLACIAL SEDIMENT (DRIFT)
489.9	Fine grained to amorphous, light gray to brown LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subrounded to subangular carbonaceous particles, occasional hydrocarbon staining, strong to moderate reaction to HCl
416.4	Fine grained to amorphous, light gray to buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subangular to angular chert particles, little reaction to HCl

SAMPLE NO.	PARTICLE SIZE (mm) Smallest	PARTICLE SIZE (mm) Largest	COLOR
BS-1	1	8	Light Gray
BS-2	2	10	Light Gray
BS-3	2	12	Light Gray
BS-4	3	10	Light Gray
BS-5	2	12	Light Gray
BS-6	2	10	Light Gray
BS-7	2	10	Light Gray

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE				ROCK SAMPLE DATA				
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, light gray to buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subangular to angular chert particles, little reaction to HCl	180	BS-8	2 – 10	Light Gray	
				190	BS-9	2 – 10	Gray/Brownish Gray	
				200	BS-10	2 – 10	Light Gray	
			210.0-286.0' - Occasional large particles up to 20mm (13/16") in size	210	BS-11	1 – 6	Light Gray	
			220.0-286.0' - Particles become more subangular in appearance	220	BS-12	1 – 6	Light Gray	
				230	BS-13	1 – 6	Light Gray	
				240	BS-14	1 – 6	Light Gray	
				250	BS-15	1 – 6	Light Gray	
			260.0-286.0' - Particles become more buff in color	260	BS-16	1 – 6	Buff/Light Gray	
				270	BS-17	1 – 6	Buff/Light Gray	
				280				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-14

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ↔ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, light gray to buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subangular to angular chert particles, little reaction to HCl **No sample return after approx. 290 ft. Information obtained from geophysical logs.	280	BS-18	1 ↔ 6	Buff/Light Gray	
				290				
				300				
				310				
				320				
				330				
				340				
				350				
				360				
				370				
				380				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (AMHERSTBURG FORMATION)		Fine grained to amorphous, light gray to buff DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subangular to angular chert particles, little reaction to HCl	380 390 400 410 420 430 440 450 460 470				
		106.4		480				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-14

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SYLVANIA SANDSTONE		Fine to medium grained, light gray to white SACCHAROIDAL SANDSTONE	480 490 500 510 520 530 540 550				
	BOIS BLANC FORMATION	34.4	Gray to light gray, fine grained to amorphous DOLOMITE	560 570 580				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-14

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BOIS BLANC FORMATION		Gray to light gray, fine grained to amorphous DOLOMITE	580				
				590				
				600				
				610				
	BASS ISLAND FORMATION	-27.6	Gray to buff, fine grained to amorphous DOLOMITE					
				620				
				630				
				640				
				650				
				660				
				670				
				680				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

Gray to buff, fine grained to amorphous DOLOMITE

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Gray to buff, fine grained to amorphous DOLOMITE	780				
				790				
				800				
				810				
				820				
				830				
				840				
				850				
				860				
				870				
				880				

BORING COORDINATES

N (y) Coordinate 4685670.17

E(x) Coordinate 327252.06

Remarks:

Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services

Drill Rig: Walker-Neer Apache 150-25

Engineer on Rig: J. Lukasik/J. Cunningham

Drilling Method: Rotary Drilling

Hammer Type: N/A

Backfilled With: N/A

Date Started: 03-29-07

Date Completed: 04-05-07

Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-14

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
▨		-299.6	Gray to buff, fine grained to amorphous DOLOMITE	880				
▨	SALINA G UNIT	-371.6	Gray to buff, fine grained to amorphous DOLOMITE	890 900 910 920 930 940 950				
▨	F6 SALT		Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	960 970 980				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-14

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	F6 SALT	-399.6	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	980				
		-405.6	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	990				
	F5 SALT	-412.6	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE					
	SALINA F UNIT	-427.6	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1000 1010				
	F4 SALT	-449.6	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1020 1030				
	SALINA F UNIT	-460.6	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1040				
	F3 SALT	-491.6	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1050 1060 1070				
				1080				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA F UNIT	-518.6	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1080 1090 1100				
	F2 SALT	-543.6	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1110 1120				
		-547.6	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1130				
	F1 SALT		Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1140 1150 1160 1170 1180				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
		-597.6	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1180				
	SALINA E UNIT		Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1190 1200 1210 1220 1230 1240 1250 1260 1270 1280				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
		-702.6	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1280				
	D3 SALT	-716.6	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1290 1300				
	SALINA D UNIT	-725.6	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1310				
	D2 SALT	-728.6	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE					
	SALINA C UNIT		Dark gray DOLOMITIC SHALE	1320 1330 1340 1350 1360 1370 1380				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
▤	SALINA C UNIT		Dark gray DOLOMITIC SHALE	1380				
				1390				
				1400				
				1410				
				1420				
				1430				
				1440				
				1450				
				1460				
				1470				
				1480				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

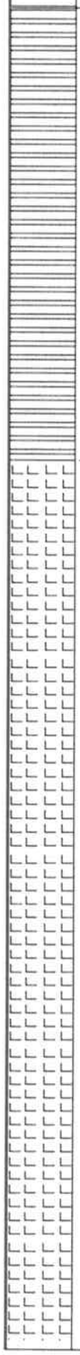
Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-14



SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA C UNIT		Dark gray DOLOMITIC SHALE	1480 1490 1500 1510				
	SALINA B UNIT	-927.6	Mixed HALITE/ANHYDRITE with occasional shale stringers	1520 1530 1540 1550 1560 1570 1580				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

PROJECT NO. C05002A

LOG OF TEST BORING TB-14

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA B UNIT		Mixed HALITE/ANHYDRITE with occasional shale stringers	1580				
				1590				
				1600				
				1610				
				1620				
				1630				
				1640				
				1650				
				1660				
	SALINA A2	-1079.6	Fine grained to amorphous, gray DOLOMITE					
				1670				
				1680				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

DRIC LOG DRIC.GPJ SOMAT.GDT 11/9/07

PROJECT NO. C05002A

LOG OF TEST BORING TB-14

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
		-1097.6	Fine grained to amorphous, gray DOLOMITE	1680				
			End of Boring at 1684 ft. (No sample return after approx. 290 ft. due to loss of circulation. Blind drilling of boring cont'd from 290 ft. to boring termination depth of 1684 ft.)	1690				
				1700				
				1710				
				1720				
				1730				
				1740				
				1750				
				1760				
				1770				
				1780				

BORING COORDINATES
N (y) Coordinate 4685670.17
E(x) Coordinate 327252.06

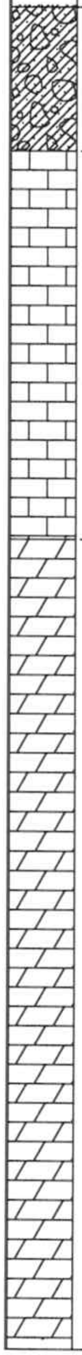
Remarks:
Ground Surface Elevation: 586.38 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-25
Engineer on Rig: J. Lukasik/J. Cunningham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 03-29-07
Date Completed: 04-05-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-15



SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest (10 20 30 40)	COLOR	DRILLING RATE (min/ft)
			GLACIAL SEDIMENT (DRIFT)	100				
	DUNDEE LIMESTONE	481.6	Fine grained to amorphous, light gray LIMESTONE; bedding indistinct; subrounded to angular grains, occasional subrounded to subangular carbonaceous particles, occasional hydrocarbon staining, strong to moderate reaction to HCl	110	BS-1	1 – 10	Buff/Gray	3.8
				120	BS-2	1 – 10	Light Gray	
				130	BS-3	1 – 10	Light Gray	
	DETROIT RIVER GROUP (LUCAS FORMATION)	452.6	Fine grained to amorphous, gray to brown DOLOMITE and DOLOMITIC LIMESTONE, bedding indistinct; subrounded to subangular graines, trace chert and carbonaceous particles, low reaction to HCL	140	BS-4	1 – 10	Light Gray	
				150	BS-5	3 – 13	Gray	
			160.0-166.0' - Increase in hydrocarbon staining	160	BS-6	2 – 10	Gray	
				170	BS-7	1 – 10	Gray	
				180	BS-8	2 – 10	Gray	
				190	BS-9	2 – 10	Gray	
				200				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, gray to brown DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to subangular graines, trace chert and carbonaceous particles, low reaction to HCL 250.0-540.0' - Anhydrite particles present 270.0-540.0' - Occasional large particles, up to 10mm (3/8") in size

ROCK SAMPLE DATA

DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest	PARTICLE SIZE (mm) Largest	COLOR	DRILLING RATE (min/ft)
200	BS-10	1	7	Gray	1.6
210	BS-11	1	10	Gray	
220	BS-12	1	8	Gray	
230	BS-13	3	15	Gray	
240	BS-14	1	10	Gray	
250	BS-15	1	15	Gray	
260	BS-16	1	3	Brown/Buff	
270	BS-17	1	3	Buff	
280	NR-18				
290	NR-19				
300					

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (LUCAS FORMATION)		Fine grained to amorphous, gray to brown DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to subangular graines, trace chert and carbonaceous particles, low reaction to HCL	300				
				310				
				320				
				330	BS-10	12	Buff	
				340				
				350				
				360				
				370				
				380	BS-21	12	Buff	
				390				
				400				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	DETROIT RIVER GROUP (AMHERSTBURG FORMATION)		Fine grained to amorphous, gray to brown DOLOMITE and DOLOMITIC LIMESTONE; bedding indistinct; subrounded to subangular graines, trace chert and carbonaceous particles, low reaction to HCL	400				
				410	BS-22		Buff	
				420				
				430				
				440				
				450	BS-23		Buff	
			460.0-540.0' - Color changes to brown	460	BS-24		Brown	
				470	BS-25		Brown	
				480	BS-26		Brown	
		100.6		490				
			Fine to medium grained, white to light gray SACCHAROIDAL SANDSTONE; subrounded to subangular grains, occasional dolomite particles, low reaction to HCl		BS-27		Brown	0.9
				500				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SYLVANIA SANDSTONE		Fine to medium grained, white to light gray SACCHAROIDAL SANDSTONE; subrounded to subangular grains, occasional dolomite particles, low reaction to HCl	500	BS-28		Brown	
				510	BS-29		Brown	
				520	BS-30		Brown	
				530	BS-31		Brown	
				540	BS-32		White/Light Gray	
				550	BS-33		White/Light Gray	
			560.0-590.0' - Particles become more subangular	560	BS-34		White/Light Gray	
	BOIS BLANC FORMATION	20.6	Fine grained to amorphous, gray to buff DOLOMITE; bedding indistinct; subrounded to subangular grains; occasional angular chert particles, occasional subrounded to subangular carbonaceous particles, occasional anhydrite particles, low reaction to HCl	570	BS-35		White/Light Gray	1.8
				580	BS-36		White/Light Gray	
				590	BS-37		Gray	
				600				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-15

SUBSURFACE PROFILE / **ROCK SAMPLE DATA**

FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BOIS BLANC FORMATION		Fine grained to amorphous, gray to buff DOLOMITE; bedding indistinct; subrounded to subangular grains; occasional angular chert particles, occasional subrounded to subangular carbonaceous particles, occasional anhydrite particles, low reaction to HCl	600	BS-38			
				610	BS-39	1 2	Gray	
		-31.4		620	BS-40	1 3	Gray	
	BASS ISLAND FORMATION		Fine grained to amorphous, buff DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains; occasional angular chert particles, subrounded anhydrite particles, low reaction to HCl	630	BS-41	1 3	Gray	
				640	BS-42	1 3	Gray	
				650	BS-43	1 3	Gray	
				660	BS-44	1 3	Gray	
				670	BS-45	1 3	Gray	
				680	BS-46	1 3	Buff/Gray	
				690	BS-47	1 3	Buff	
				700				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Fine grained to amorphous, buff DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains, occasional angular chert particles, subrounded anhydrite particles, low reaction to HCl	700	BS-48	1↔3	Buff	
				710	BS-49	1↔3	Buff	
				720	BS-50	1↔3	Buff	2.1
				730	BS-51	1↔3	Buff	
				740	BS-52	1↔4	Buff	
				750	BS-53	1↔4	Buff	
				760	BS-54	1↔4	Grayish Buff	
				770	BS-55	1↔4	Grayish Buff	
				780	BS-56	1↔4	Grayish Buff	
				790	BS-57	1↔4	Grayish Buff	
				800				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	BASS ISLAND FORMATION		Fine grained to amorphous, buff DOLOMITE; bedding laminar to indistinct; subrounded to subangular grains, occasional angular chert particles, subrounded anhydrite particles, low reaction to HCl	800	BS-58	1↔4	Gray	0.8
				810	BS-59	1↔4	Gray	
				820	BS-60	1↔4	Gray	
				830	BS-61	1↔4	Gray	
				840	BS-62	1↔4	Gray	
				850	BS-63	1↔4	Gray	
				860	BS-64	1↔4	Buff	
				870	BS-65	1↔4	Buff	
	SALINA G UNIT	-283.4	Fine grained to amorphous, buff to gray DOLOMITE; bedding indistinct; subrounded to subangular grains, occasional anhydrite particles, low to very low reaction to HCl 890.0-956.0' - Occasional large particles up to 10mm (3/8") in size	880	BS-66	1↔4	Buff	
				890	BS-67	1↔4	Buff	
				900				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA G UNIT		Fine grained to amorphous, buff to gray DOLOMITE; bedding indistinct; subrounded to subangular grains, occasional anhydrite particles, low to very low reaction to HCl	900	BS-68	1 ↔ 5	Dark Gray	
			900.0-956.0' - Dolomite particles are dark gray in color	910	BS-69	1 ↔ 5	Dark Gray	
				920	BS-70	1 ↔ 5	Dark Gray	
				930	BS-71	1 ↔ 5	Dark Gray	
				940	BS-72	1 ↔ 5	Dark Gray	
				950	BS-73	1 ↔ 5	Dark Gray	
		-369.4		960				
	F6 SALT		**No sample return after approx. 960 ft. Information obtained from geophysical logs Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	970				
				980				
		-399.4		990				
			Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1000				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
		-409.4		1000				
	F5 SALT	-415.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE					
	SALINA F UNIT	-431.4	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1010 1020				
	F4 SALT	-454.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1030 1040				
	SALINA F UNIT	-465.4	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1050				
	F3 SALT	-494.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1060 1070 1080				
	SALINA F UNIT		Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1090 1100				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA F UNIT	-523.4	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1100 1110				
	F2 SALT	-545.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1120 1130				
		-549.4	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1140				
	F1 SALT	-594.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1150 1160 1170 1180				
	SALINA E UNIT		Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1190 1200				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A **LOG OF TEST BORING** TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA E UNIT		Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1200 1210 1220 1230 1240 1250 1260 1270 1280 1290				
	D3 SALT	-699.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1300				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
		-711.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1300				
		-719.4	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1310				
	D2 SALT	-734.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1320				
	SALINA D UNIT	-747.4	Fine grained to amorphous, gray/white DOLOMITE and DOLOMITIC LIMESTONE and HALITE	1330				
	D1	-749.4	Crystalline, white HALITE/ANHYDRITE; with fine grained to amorphous, gray DOLOMITE	1340				
	SALINA C UNIT		Dark gray DOLOMITIC SHALE	1350 1360 1370 1380 1390 1400				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ⟷ Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA C UNIT		Dark gray DOLOMITIC SHALE	1400 1410 1420 1430 1440 1450 1460 1470				
		-888.4		1480				
	SALINA B UNIT		Mixed HALITE/ANHYDRITE with occasional shale stringers	1490 1500				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

PROJECT NO. C05002A

LOG OF TEST BORING TB-15

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
	SALINA B UNIT		Mixed HALITE/ANHYDRITE with occasional shale stringers	1500 1510 1520 1530 1540 1550 1560 1570 1580 1590 1600				

BORING COORDINATES
N (y) Coordinate 4685981.64
E(x) Coordinate 327501.43

Remarks:
Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services
Drill Rig: Walker-Neer Apache 150-5g
Engineer on Rig: J. Lukasik/J. Cunnigham
Drilling Method: Rotary Drilling
Hammer Type: N/A
Backfilled With: N/A
Date Started: 04-12-07
Date Completed: 04-15-07
Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

SUBSURFACE PROFILE					ROCK SAMPLE DATA			
FORMATION	GEOLOGIC UNITS	ELEVATION (ft)	LITHOLOGICAL DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PARTICLE SIZE (mm) Smallest ← → Largest 10 20 30 40	COLOR	DRILLING RATE (min/ft)
				1600				
	SALINA B UNIT	-1064.4	Mixed HALITE/ANHYDRITE with occasional shale stringers	1610 1620 1630 1640 1650				
	SALINA A2	-1085.4	Fine grained to amorphous, gray DOLOMITE	1660 1670				
			End of Boring at 1678 ft. (No sample return after approx. 960 ft. due to loss of circulation. Blind drilling of boring cont'd from 960 ft. to boring termination depth of 1678 ft.)	1680 1690 1700				

BORING COORDINATES

N (y) Coordinate 4685981.64

E(x) Coordinate 327501.43

Remarks:

Ground Surface Elevation: 592.59 ft.

Drilling Company: Advanced Energy Services

Drill Rig: Walker-Neer Apache 150-5g

Engineer on Rig: J. Lukasik/J. Cunnigham

Drilling Method: Rotary Drilling

Hammer Type: N/A

Backfilled With: N/A

Date Started: 04-12-07

Date Completed: 04-15-07

Checked By: SC

Somat Engineering Inc.

Detroit River International Crossing
Detroit, Michigan

LOG OF ROTARY BORING NO:
DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Drilling Date: 2/14/2007 to 2/22/2007
Borehole Size: 12 1/4, 8 3/4, 7 7/8-inch

Inspector: NTH
Contractor: Advanced Energy Services
Driller: Rig 7, R. Thatcher, R. Yaklin
Drilling Equipment: Walker-Neer Apache 150-25
Checked By: Z. Carr, P.E., C. Johnson
Lat/Long. Location: Lat. 42.3015 Long. -83.0908

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling							Overburden	579.4	FILL: SAND and GRAVEL	
5											
10											
									564.9	Soft Gray SILTY CLAY with Trace Sand and Gravel	
15		339.7mm Cemented to Surface									
20											
25											
30											

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/12/07

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling							Overburden		Soft Gray SILTY CLAY with Trace Sand and Gravel	
35											
40											
45		339.7mm Cemented to Surface									
50											
55											
60											

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling							Overburden		Soft Gray SILTY CLAY with Trace Sand and Gravel	
70											
75											
80											
		339.7mm Cemented to Surface									
85											
90											
									488.4	HARDPAN: Hard Gray SILTY CLAY with Trace Sand and Gravel	
95											
									480.4	LIMESTONE (Weathered)	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
100	Rotary Drilling	339.7mm Cemented to Surface Elev 477.9 Depth 101.5						Dundee Limestone	475.4	LIMESTONE (Weathered)	
105			BS-1	9.3	1/64 to 3/8	A			469.4	Light to Dark Gray Amorphous to Fine Grained LIMESTONE	Hydrocarbon Odor Noted
110 115		244.5mm Cemented to Surface Open Hole Below 227'	BS-2	11.5	1/64 to 3/8	A			459.4	Light to Dark Gray and Light Tan Fine Grained LIMESTONE	Hydrocarbon Odor Noted
120 125			BS-3	9.5	1/64 to 3/8	A			449.4	Light to Dark Gray and Light Tan Fine Grained LIMESTONE	Hydrocarbon Odor Noted
130										Light to Dark Gray and Light Tan Fine Grained LIMESTONE	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

NTH CONSULTANTS, LTD.

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
135	Rotary Drilling		BS-4	7.8	1/64 to 3/8	A		Dundee Limestone		Light to Dark Gray and Light Tan Fine Grained LIMESTONE	
140									439.4	Light Gray and Brown Fine Grained LIMESTONE	
145			BS-5	4.9	1/64 to 1/3	A					
150		244.5mm Cemented to Surface Open Hole Below 227'							429.4	Light Gray and Brown Fine Grained LIMESTONE	
155			BS-6	4.9	1/64 to 1/3	A					
160									419.4	Light Gray and Brown Fine Grained LIMESTONE	
165			BS-7	4.8	1/64 to 3/8	A					

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
170	Rotary Drilling							Dundee Limestone	409.4	Gray, Brown, and Tan Fine Grained LIMESTONE	DRG-Lucas Formation Top (EL 409.4)
175			BS-8	4.3	1/64 to 1/3	A					
180								DRG - Lucas Formation	399.4	Gray and Tan Fine Grained LIMESTONE	
185		244.5mm Cemented to Surface Open Hole Below 227'	BS-9	3.3	1/64 to 1/3	A					
190									389.4	Gray and Tan Fine Grained DOLOMITIC LIMESTONE with Occasional Carbonaceous Banding	
195			BS-10	2.6	1/64 to 3/8	A					
200									379.4		

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
205	Rotary Drilling							DRG - Lucas Formation			Circulation Loss
210			NR	3.5							
215		244.5mm Cemented to Surface Open Hole Below 227'									Continued Circulation Loss
220									359.4	Tan and Gray Fine Grained DOLOMITIC LIMESTONE	
225			BS-11	5	1/64 to 1/3	A					
230									349.4	Tan and Gray Fine Grained DOLOMITIC LIMESTONE with Occasional Anhydrite	
235			BS-12	1.7	1/64 to 3/8	A to R					

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 579.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
240	Rotary Drilling							DRG - Lucas Formation	339.4	Tan and Gray Fine Grained DOLOMITE with Occasional Anhydrite	
			BS-13	1.1	1/64 to 3/8	A					
245										Tan and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE (245' to 249') (EL 334.4 to 330.4)	
250									329.4	Tan and Gray Fine to Medium Grained DOLOMITIC LIMESTONE with Occasional Anhydrite	
255			BS-14	1	1/64 to 3/8	A					
260									319.4	Tan and Brown Fine to Medium Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding Tan LIMESTONE (261' to 262') (EL 318.4 to 317.4)	
265			BS-15	1.1	1/64 to 1/2	A to R					
270									309.4	Tan and Brown Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:
DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

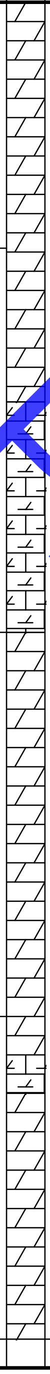
Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Subsurface Profile

Ground Surface Elevation: 579.4



Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
275	Rotary Drilling		BS-16	1.4	1/64 to 1/3	A		DRG - Lucas Formation		Tan and Brown Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	
280									299.4	Brown and Tan Fine Grained DOLOMITE with Occasional Anhydrite	
285			BS-17	1.4	1/64 to 3/8	A				Tan and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE (286' to 290') (EL 295.4 to 289.4)	
290									289.4	Tan and Brown Fine to Medium Grained DOLOMITE with Anhydrite and Carbonaceous Banding	
295			BS-18	1.1	1/64 to 1/5	A					
300									279.4	Dark Brown Fine Grained DOLOMITE and DOLOMITIC LIMESTONE with Occasional Anhydrite Tan and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE (301' to 302') (EL 278.4 to 277.4) Tan and Gray Interbedded DOLOMITE and LIMESTONE (302' to 305') (EL 277.4 to 274.4)	
305			BS-19	1.2	1/64 to 3/8	A				Tan and Gray Amorphous to Fine-Grained DOLOMITE (305' to 310') (EL 274.4 to 269.4)	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
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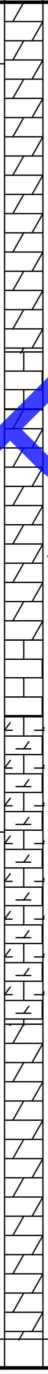

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
310	Rotary Drilling						DRG - Lucas Formation	269.4	Light Gray and Brown Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	
315			BS-20	1.1	1/64 to 1/3	A				Fine Cuttings
									Tan LIMESTONE (317.5' to 319') (EL 261.9 to 260.4)	
320								259.4	Brown and Gray Fine to Medium Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	
325			BS-21	1.8	1/64 to 1/5	A			Massive Interbedded ANHYDRITE (325' to 327') (EL 254.4 to 252.4)	
330								249.4	Brown Fine Grained DOLOMITIC LIMESTONE with Occasional Anhydrite and Carbonaceous Banding	
335			BS-22	1.4					Tan and Gray Amorphous to Fine-Grained DOLOMITE (335' to 348') (EL 244.4 to 231.4)	Fine Cuttings
340								239.4		

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
345	Rotary Drilling		NR	1				DRG - Lucas Formation			
350									229.4	Tan Fine Grained DOLOMITE with Trace Anhydrite	
355			BS-23	1.1	1/64 to 1/5	A					
360									219.4	Gray and Brown Fine Grained DOLOMITE with Anhydrite	
365			BS-24	1.2	1/64 to 1/3	A				Tan and Gray Interbedded DOLOMITE and LIMESTONE (368' to 371') (EL 211.4 to 208.4)	
370									209.4	Brown and Gray Fine Grained DOLOMITE with Occasional Anhydrite Tan LIMESTONE (371' to 372') (EL 208.4 to 207.4) Tan and Gray Amorphous to Fine-Grained DOLOMITE (372' to 373') (EL 207.4 to 206.4) Massive Interbedded ANHYDRITE (373' to 374') (EL 206.4 to 205.4)	
375			BS-25	1.4	1/64 to 1/5	A					

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
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Subsurface Profile

Ground Surface Elevation: 579.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
380	Rotary Drilling							DRG - Lucas Formation	199.4	Brown and Gray Fine Grained DOLOMITE with Occasional Anhydrite	
385 390			BS-26	1.3	1/64 to 1/5	A			189.4	Tan LIMESTONE (380.5' to 383') (EL 198.9 to 196.4) Tan and Gray Amorphous to Fone-Grained DOLOMITE (383' to 387') (EL 196.4 tp 192.4) Tan and Gray Interbedded DOLOMITE and LIMESTONE (387' to 390') (EL 192.4 to 189.4)	
395 400			BS-27	1	1/64 to 1/5	A			179.4	Gray and Tan Fine Grained Interbedded DOLOMITE and DOLOMITIC LIMESTONE with Occasional Anhydrite and Carbonaceous Banding	
405 410			BS-28	1	1/64 to 1/3	A			169.4	Gray and Tan Fine Grained Interbedded DOLOMITE and DOLOMITIC LIMESTONE with Occasional Anhydrite Tan and Gray Amorphous to Fine-Grained DOLOMITE (404' to 409') (EL 175.4 to 170.4)	
										Gray and Tan Fine Grained LIMESTONE and DOLOMITIC LIMESTONE with Occasional Anhydrite and Stylolites	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
415 420	Rotary Drilling		BS-29	1.6	1/64 to 3/8	A		DRG - Lucas Formation	159.4	Gray and Tan Fine Grained LIMESTONE and DOLOMITIC LIMESTONE with Occasional Anhydrite and Stylolites Tan and Gray Amorphous to Fine-Grained DOLOMITE (417' to 419') (EL 162.4 to 160.4)	
425 430			BS-30	1.2	1/64 to 1/5	A		DRG - Amherstburg Formation	149.4	Gray, Tan, and Dark Brown Fine Grained LIMESTONE and DOLOMITE with Occasional Anhydrite and Carbonaceous Banding DRG-Amherstburg Formation Top EL 155.4 Gray, Tan, and Brown Fine-Grained DOLOMITE	
435 440			BS-31	1	1/64 to 1/5	A			139.4	Gray, Tan, and Dark Brown Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	
445			BS-32	1	1/64 to 1/5	A				Tan and Dark Brown Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
450	Rotary Drilling							DRG - Amherstburg Formation	129.4	Tan and Dark Brown Fine Grained DOLOMITE with Occasional Anhydrite and Carbonaceous Banding	
455			BS-33	1.5	1/64 to 1/3	A				Tan and Dark Brown Fine Grained DOLOMITE with Little Limestone and Occasional Anhydrite and Carbonaceous Banding	
460									119.4		
465			BS-34	1.1	1/64 to 1/3	A				Tan and Dark Brown Fine Grained DOLOMITE with Anhydrite and Carbonaceous Banding	
470									109.4		
475			BS-35	1	1/64 to 1/5	A				Tan and Dark Brown DOLOMITE with Some Limestone and Occasional Anhydrite and Carbonaceous Banding	
480									99.4	Tan, Dark Brown, and Gray DOLOMITE with Anhydrite and Carbonaceous Banding	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
485	Rotary Drilling		BS-36	1.1	1/64 to 1/3	A		DRG - Amherstburg Formation		Tan, Dark Brown, and Gray DOLOMITE with Anhydrite and Carbonaceous Banding	
490									89.4	Gray and White Medium Grained SANDSTONE Sylvania Sandstone Top EL 86.9	
495			BS-37	1	1/64 to 1/8	A		Sylvania Sandstone			
500									79.4	White Medium Grained SANDSTONE	
505			BS-38	1.1	1/64 to 1/8	A					
510									69.4	White Medium Grained SANDSTONE	
515			BS-39	1.2	1/64 to 1/8	A					

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	Rotary Drilling							Sylvania Sandstone		White Medium Grained SANDSTONE	
520									59.4	White Medium Grained SANDSTONE	
525			BS-40	0.9	1/64 to 1/8	A					
530									49.4	White Medium Grained SANDSTONE with Trace Gray Fine Grained Dolomite	
535			BS-41	0.8	1/64 to 1/5	A					
540									39.4	White Medium Grained SANDSTONE with Trace Gray Fine Grained Dolomite and Anhydrite	
545			BS-42	1.2	1/64 to 1/8	A					
550									29.4	Tan and Gray Fine Grained SANDSTONE with Trace Chert	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
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ROTARY CORE LOG DRIC ROTARY LOGS.GPJ NTH CORE.GDT 9/12/07

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
555	Rotary Drilling		BS-43	1.3	1/64 to 1/8	A		Sylvania Sandstone		Tan and Gray Fine Grained SANDSTONE with Trace Chert	
560								Bois Blanc Formation	18.3	Bois Blanc Formation Top EL 18.4 Tan and Gray Fine Grained DOLOMITE with Some White Medium Grained Sandstone, Chert, and Anhydrite	
565			BS-44	1.8	1/64 to 1/3	A					
570									9.39999999999998	Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	
575			BS-45	2.2	1/64 to 1/3	A					
580									-0.600000000000023	Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	
585			BS-46	3.1	1/64 to 1/3	A					

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling							Bois Blanc Formation		Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	
590									-10.6	Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	
595			BS-47	3.4	1/64 to 1/5	A					
600									-20.6	Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	
605			BS-48	4.2	1/64 to 1/3	A					
610									-30.6	Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	
615			BS-49	3.4	1/64 to 1/3	A					
620									-40.6	Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
625 630	Rotary Drilling		BS-50	5.4	1/64 to 1/3	A		Bois Blanc Formation	-50.6	Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	
635 640			BS-51	4.1	1/64 to 1/5	A				Tan and Gray Fine Grained DOLOMITE with Chert and Anhydrite	
									-62.11		
645 650			BS-52	3	1/64 to 1/5	A		Garden Island Formation		Garden Island Formation Top EL -62.1 Tan and Gray Fine Grained DOLOMITE with Chert, Anhydrite, and Some Sandstone	
									-72.7		
655			BS-53	2.7	1/64 to 1/10	A				Bass Islands Group EL -72.6 Gray Fine Grained DOLOMITE with Some Anhydrite and Chert	

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	Rotary Drilling							Bass Island Formation		Gray Fine Grained DOLOMITE with Some Anhydrite and Chert	
660									-80.6	Gray and Tan Amorphous to Fine Grained DOLOMITE with Occasional Chert and Anhydrite	
665			BS-54	3.4	1/64 to 1/10	A					
670									-90.6	Gray and Tan Amorphous DOLOMITE with Occasional Chert and Anhydrite	
675			BS-55	6.3	1/64 to 1/10	A					
680									-100.6	Gray and Tan Amorphous DOLOMITE with Occsasional Chert, Anhydrite, and Shale	
685			BS-56	4.9	1/64 to 1/5	A					
690									-110.6	Tan and Gray Fine Grained DOLOMITE with Black Shale	

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	Rotary Drilling							Bass Island Formation		Tan and Gray Fine Grained DOLOMITE with Black Shale	
695			BS-57	5.2	1/64 to 1/5	A					
700									-120.6	Tan Fine Grained DOLOMITE with Anhydrite and Shale	
705			BS-58	4.8	1/64 to 1/10	A					
710									-130.6	Tan Fine Grained DOLOMITE with Shale and Anhydrite	
715			BS-59	4.6	1/64 to 1/10	A					
720									-140.6	Light Tan and Gray Fine Grained DOLOMITE with Shale	
725			BS-60	5.1	1/64 to 1/5	A					

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling							Bass Island Formation		Light Tan and Gray Fine Grained DOLOMITE with Shale	
730									-150.6	Light Tan Fine Grained DOLOMITE with Shale and Chert	
735			BS-61	5.1	1/64 to 1/3	A					
740									-160.6	Tan and Gray Fine Grained DOLOMITE with Occasional Shale	
745			BS-62	4.6	1/64 to 1/10	A					
750									-170.6	Tan and Gray Fine Grained DOLOMITE with Occasional Shale Tan and Gray Fine-Grained SHALEY DOLOMITE (753' to 757') (EL -173.6 to -177.6)	
755			BS-63	5	1/64 to 1/10	A					
760									-180.6		

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling							Bass Island Formation		Tan, Brown, and Gray Fine Grained DOLOMITE with Occasional Shale	
765			BS-64	5.3	1/64 to 1/10	A					
770											
									-191.6	Gray Fine Grained DOLOMITE with Occasional Anhydrite and Shale	
775			BS-65	5.4	1/64 to 1/10	A					
780									-200.6	Gray to Dark Gray Amorphous to Fine Grained DOLOMITE and SHALEY DOLOMITE with Occasional Anhydrite	
785			BS-66	5.3	1/64 to 1/5	A					
790									-210.6	Gray to Dark Gray Amorphous to Fine Grained DOLOMITE and SHALEY DOLOMITE with Occasional Anhydrite	
795			BS-67	4.6	1/64 to 1/5	A					

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
800	Rotary Drilling							Bass Island Formation	-220.6	Gray to Dark Gray Amorphous to Fine Grained DOLOMITE and SHALEY DOLOMITE with Occasional Anhydrite Massive Interbedded ANHYDRITE (797' to 800') (EL -217.6 to -220.6)	
805 810			BS-68	3.8	1/64 to 1/5	A			-230.6	Brown and Tan Amorphous to Fine Grained SHALEY DOLOMITE	Mild Hydrocarbon Odor Noted
815 820			BS-69	3.7	1/64 to 1/5	A			-240.6	Tan and Gray Interbedded DOLOMITE and LIMESTONE (812' to 820') (EL -232.6 to -240.6)	
825 830			BS-70	4.9	1/64 to 1/3	A			-250.6	Brown and Light Gray DOLOMITE with Trace Anhydrite and Shale Massive Interbedded ANHYDRITE (824' to 826') (EL -244.6 to -246.6)	

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Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
835	Rotary Drilling		BS-71	4.3	1/64 to 1/3	A		Bass Island Formation	-260.6	Gray Fine Grained DOLOMITE with Some Anhydrite Massive Interbedded ANHYDRITE (831' to 835') (EL -251.6 to -255.6) Gray and Brown Fine Grained SHALEY DOLOMITE with Some Anhydrite	
840 845			BS-72	5.1	1/64 to 1/3	A			-270.6	Gray and Brown Fine Grained SHALEY DOLOMITE with Some Anhydrite	
850 855			BS-73	5.1	1/64 to 3/8	A			-280.6	Gray Fine Grained SHALEY DOLOMITE with Some Anhydrite Massive Interbedded ANHYDRITE (859' to 866') (EL -279.6 to -286.6)	
860 865			BS-74	5.7							

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling				1/64 to 1/3	A		Bass Island Formation		Gray and Tan Fine-Grained DOLOMITIC LIMESTONE with Anhydrite	
870									-290.6	Gray and Tan Fine Grained DOLOMITE with Anhydrite	
875			BS-75	6.8	1/64 to 1/5	A					
880									-300.6	Gray and Tan Fine Grained DOLOMITE with Anhydrite	
885			BS-76	6.7	1/64 to 1/5	A				Tan LIMESTONE (884' to 885') (EL -304.6 to -305.6)	
890									-310.6	Gray to Dark Gray Fine Grained DOLOMITE with Anhydrite	
895			BS-77	2.7	1/64 to 1/5	A					
900									-320.6	Massive Interbedded ANHYDRITE (899' to 903')	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
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NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
905 910	Rotary Drilling		BS-78	3.3	1/64 to 1/5	A		Bass Island Formation	-330.6	(EL -319.6 to -320.6) Dark Gray SHALEY ANHYDRITE with Trace Dolomite (903' to 910') (EL -323.6 to -330.6)	
915 920			BS-79	2.7	1/64 to 1/5	A		Salina Group - G Unit (G Shale)	-340.6	Gray, Green, and Red Amorphous DOLOMITIC SHALE with Anhydrite Massive Interbedded ANHYDRITE (916' to 918') (EL -336.6 to -338.6) Salina Group - G Unit Top EL -338.6	G-Unit Exhibits both Dolomitic and Limey Shale Interbedding
925 930			BS-80	1.9	1/64 to 1/5	A			-350.6	Gray, Green, and Red Amorphous SHALE with Anhydrite Massive Interbedded ANHYDRITE (926.5' to 927.5') (EL -347.1 to -348.1)	
										Gray, Green, and Red Amorphous SHALE with Anhydrite	

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling		BS-81	2.5	1/64 to 1/5	A		Salina Group - G Unit (G Shale)		Gray, Green, and Red Amorphous SHALE with Anhydrite	
940									-360.6	Massive Interbedded ANHYDRITE (939.5' to 940.5') (EL -360.1 to -361.1) Gray, Green, and Red Amorphous SHALE with Anhydrite	
945			BS-82	2.1	1/64 to 1/5	A					
950									-370.6	Gray and Green Amorphous SHALE with Anhydrite Massive Interbedded ANHYDRITE (951' to 952') (EL -371.6 to -372.6)	G-Unit Exhibits both Dolomitic and Limey Shale Interbedding
955			BS-83	2.3	1/64 to 1/5	A					
960									-380.6	Gray Amorphous SHALE with Anhydrite	
965			BS-84	2.4	1/64 to 1/5	A					

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Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
970	Rotary Drilling							Salina Group - G Unit (G Shale)	-390.6	Gray Amorphous SHALE with Light Bronw Dolomite and Anhydrite Massive Interbedded ANHYDRITE (974' to 978') (EL -394.6 to -398.6)	
975			BS-85	2.5	1/64 to 1/4	A					
980									-400.6	Gray Amorphous SHALE with Light Brown Dolomite and Anhydritre Massive Interbedded ANHYDRITE (981' to 984') (EL -401.6 to -404.6) Gray and Brown SHALE with Some Anhydrite and Chert (984' to 990') (EL -404.6 to -410.6)	
985			BS-86	2.4	1/64 to 1/4	A					G-Unit Exhibits both Dolomitic and Limey Shale Interbedding
990									-410.6	Massive Interbedded ANHYDRITE (990' to 992.5') (EL -410.6 to -413.1) Gray and Brown SHALE with Some Anhydrite and Chert (992.5' to 1003') (EL -413.1 to -423.6)	
995			BS-87	3	1/64 to 1/5	A					
1000									-420.6	Tan and Gray Interbedded DOLOMITE and LIMESTONE (1003' to 1006') (EL -423.6 to	

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NTH CONSULTANTS, LTD.

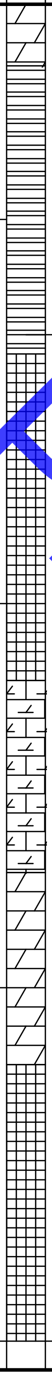
Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 579.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1005	Rotary Drilling		BS-88	3.9	1/64 to 1/5	A		Salina Group - G Unit (G Shale)	-430.6	-426.6) Gray and Brown DOLOMITIC SHALE and ANHYDRITE	G-Unit Exhibits both Dolomitic and Limey Shale Interbedding
1010 1015			BS-89	0.7	1/64 to 1/3	A		Salina Group - F Unit (F-Salt)	-440.6	Salina Group - F Unit (F-Salt) Top EL -434.1 Gray, White and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (F4 Bed) (1013.5' to 1022') (EL -434.1 to -442.6)	
1020 1025			BS-90	2	1/64 to 1/5	A			-450.6	Gray and Brown DOLOMITE with Black Shale and Some Clear Halite Brown and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE (1022' to 1027') (EL -442.6 to -447.6) Brown and Gray Amorphous to Fine-Grained DOLOMITE (1027' to 1032.5') (EL -447.6 to -453.1)	
1030 1035			BS-91	1.2	1/64 to 1/5	A				Tan and Gray DOLOMITE with Gray Shale and Clear Halite Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (F3 Bed)	

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LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

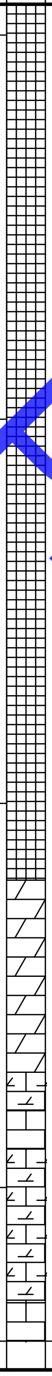
Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1040	Rotary Drilling							Salina Group - F Unit (F-Salt)	-460.6		
1045			BS-92	0.8	1/64 to 1/5	A				Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (F3 Bed)	
1050									-470.6	Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (F3 Bed)	
1055			BS-93	0.8	1/64 to 1/5	A					
1060									-480.6	Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (F3 Bed) Brown and Gray Amorphous to Fine-Grained DOLOMITE (1062' to 1067') (EL -482.6 to -487.6)	
1065			BS-94	3.5	1/64 to 1/5	A				Brown and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE (1067' to 1068') (EL -487.6 tp -488.6) Massive Interbedded ANHYDRITE (1068' to 1069') (EL -488.6 to -489.6)	
1070									-490.6	Brown and Gray Amorphous to Fine Grained DOLOMITIC LIMESTONE with Occasional Shale, Anhydrite, and Halite (1070' to 1073') (EL -490.6 to -493.6) Massive Interbedded ANHYDRITE (1073' to	



NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
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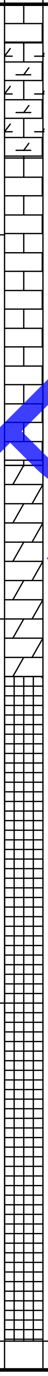
LOG OF ROTARY BORING NO:
DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 579.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1075	Rotary Drilling		BS-95	3	1/64 to 1/5	A		Salina Group - F Unit (F-Salt)	-500.6	1075') (EL -493.6 to -495.6) Brown and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE (1075' to 1078') (EL -495.6 to -498.6) Massive Interbedded ANHYDRITE (1078' to 1086') (EL -498.6 to -506.6)	
1080											
1085			BS-96	1.9	1/64 to 1/5	A			-510.6	Brown and Gray Amorphous to Fine-Grained DOLOMITE (1086' to 1091.5') (EL -506.6 to -512.1)	
1090											
1095			BS-97	0.6	1/64 to 1/5	A			-520.6	Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (F2 Bed)	
1100										Clear HALITE with Gray Shale and Chert	
1105			BS-98	0.4	1/64 to 1/3	A					



NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
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NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1110	Rotary Drilling							Salina Group - F Unit (F-Salt)	-530.6		
1115			BS-99	0.6	1/64 to 1/3	A				Brown and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE with Some Anhydrite (1114' to 1119') (EL - 534.6 to -539.6)	
1120									-540.6	Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (F1 Bed)	
1125			BS-100	0.7	1/64 to 1/4	A					
1130									-550.6	Clear HALITE with Shale	
1135			BS-101	0.4	1/64 to 1/5	A					
1140									-560.6	Clear HALITE with Occasional Shale and Anhydrite	

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NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation
Project Location: Detroit, Michigan
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Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1145	Rotary Drilling		BS-102	0.7	1/64 to 1/3	A	Salina Group - F Unit (F-Salt)		Clear HALITE with Occasional Shale and Anhydrite	
1150								-570.6	Clear HALITE with Shale	
1155			BS-103	0.8	1/64 to 1/5	A				
1160								-580.6	Interbedded HALITE and GYPSUM (1160' to 1163') (EL -580.6 to -583.1) Gray, White, and Opaque HALITE with Trace Shale (1162.5' to 1166') (EL -583.1 to -586.6)	
1165			BS-104	0.8	1/64 to 1/5	A			Brown and Gray Amorphous to Fine-Grained DOLOMITE (1166' to 1168') (EL -586.6 to -588.6) Gray, White, and Opaque HALITE with Trace Shale (1168' to 1169') (EL -588.6 to -589.6) Salina Group - E Unit (E-Dolomite) EL -589.6	
1170							Salina Group - E Unit (E - Dolomite)	-590.6	Gray Fine-Grained SHALEY DOLOMITE with Trace Clear and Red Halite	
1175			BS-105	2.1	1/64 to 1/5	A				

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1180	Rotary Drilling							Salina Group - E Unit (E - Dolomite)	-600.6	Gray Fine-Grained SHALEY DOLOMITE with Trace Clear and Red Halite	
1185			BS-106	2.5	1/64 to 1/5	A					
1190									-610.6	Gray Fine-Grained SHALEY DOLOMITE with Trace Red Halite and Anhydrite	
1195			BS-107	2.6	1/64 to 1/5	A					
										Massive Interbedded ANHYDRITE (1198' to 1201') (EL --618.6 to -621.6)	
1200									-620.6	Gray Fine Grained DOLOMITE with Trace Anhydrite, Shale, and Shaley Dolomite	
										Massive Interbedded ANHYDRITE (1203' to 1205') (EL -623.6 to -625.6)	
1205			BS-108	2.4	1/64 to 1/5						
1210									-630.6	Gray and Brown Fine Grained DOLOMITE with Trace Anhydrite and Shale	

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Project Location: Detroit, Michigan
NTH Proj. No: 15-050014-12
Checked By: Z. Carr, P.E., C. Johnson

Ground Surface Elevation: 579.4

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile	Notes
1215 1220	Rotary Drilling		BS-109	3.2	1/64 to 1/5	A		Salina Group - E Unit (E - Dolomite)	-640.6	Gray and Brown Fine Grained DOLOMITE with Trace Anhydrite and Shale	
1225 1230			BS-110	2.9	1/64 to 1/3	A			-650.6	Gray and Brown Fine to Medium Grained DOLOMITE with Trace Shale	
1235 1240			BS-111	3.4	1/64 to 1/3	A			-660.6	Brown and Gray Fine Grained SHALEY DOLOMITE with Trace Anhydrite Massive Interbedded ANHYDRITE (1232' to 1235') (EL -652.6 to -655.6)	
1245			BS-112	3.6	1/64 to 1/3	A				Brown and Gray Fine Grained SHALEY DOLOMITE with Trace Anhydrite	

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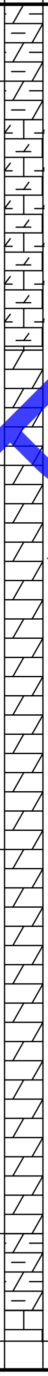

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1250	Rotary Drilling							Salina Group - E Unit (E - Dolomite)	-670.6	Brown and Gray Fine Grained SHALEY DOLOMITE with Trace Anhydrite	
1255 1260			BS-113	3.2	1/64 to 3/8	A			-680.6	Gray and Tan DOLOMITE with Trace Anhydrite Brown and Gray Amorphous to Fine-Grained DOLOMITIC LIMESTONE (1251' to 1257') (EL -671.6 to -677.6)	
1265 1270			BS-114	3.9	1/64 to 1/3	A			-690.6	Gray and Brown Amorphous to Fine Grained DOLOMITE Tan and Gray Interbedded DOLOMITE and LIMESTONE (1263' to 1269') (EL -683.6 to -689.6)	
1275 1280			BS-115	3.7	1/64 to 1/3	A			-700.6	Gray and Brown Amorphous to Fine Grained SHALEY DOLOMITE	
										Massive Interbedded ANHYDRITE (1282' to	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1285	Rotary Drilling		BS-116	3	1/64 to 1/3	A		Salina Group - E Unit (E - Dolomite)		1286') (EL -702.6 to -706.6)	
1290									-710.6		
1295			BS-117	1.7	1/64 to 1/3	A		Salina Group - D Unit (D-Salt)		Brown and Gray Amorphous to Fine Grained SHALEY DOLOMITE with Trace Anhydrite Salina Group - D Unit (D-Salt) EL -714.1	
1300									-720.6		
1305			BS-118	1	1/64 to 3/8	A				Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (D3 Bed)	
1310									-730.6		
1315			BS-119	1.5	1/64 to 3/8	A				Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (D3 Bed) Brown and Gray Amorphous to Fine-Grained DOLOMITE (1312' to 1320') (EL -732.6 to -740.6)	

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Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1320	Rotary Drilling							Salina Group - D Unit (D-Salt)	-740.6	Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (D3 Bed)	
1325			BS-120	1.5	1/64 to 1/3	A				Gray, White, and Opaque HALITE with Trace Shale, Dolomite, and Anhydrite (D2 Bed) Salina Group - C Unit (C-Shale) EL -748.6	
1330								Salina Group - C Unit (C-Shale)	-750.6		
1335			BS-121	2.8	1/64 to 1/3	A				Gray and Brown DOLOMITIC SHALE with Trace Anhydrite	
1340									-760.6		
1345			BS-122	2.6	1/64 to 1/5	A				Gray SHALE and DOLOMITIC SHALE with Trace Anhydrite	
1350									-770.6		
										Gray Fine Grained DOLOMITIC SHALE	

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NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1355	Rotary Drilling		BS-123	2.8	1/64 to 1/5	A		Salina Group - C Unit (C-Shale)		Gray Fine Grained DOLOMITIC SHALE	
1360									-780.6	Gray Fine Grained DOLOMITIC SHALE with Trace Orange Halite and Anhydrite	
1365			BS-124	2.8	1/64 to 1/5	A to R					
1370									-790.6	Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	
1375			BS-125	2.6	1/64 to 1/5	A to R					
1380									-800.6	Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	
1385			BS-126	2.9	1/64 to 1/3	A to R					

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
	Rotary Drilling							Salina Group - C Unit (C-Shale)		Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	
1390									-810.6		
										Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	
1395			BS-127	2.7	1/64 to 1/3	A to R					
1400									-820.6		
										Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	
										Massive Interbedded ANHYDRITE (1404' to 1406') (EL -824.6 to -826.6)	
1405			BS-128	2.7	1/64 to 1/3	A to R					
1410									-830.6		
										Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	
1415			BS-129	3	1/64 to 1/5	A to R					
1420									-840.6		
										Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1425 1430	Rotary Drilling		BS-130	3.3	1/64 to 1/3	A to R		Salina Group - C Unit (C-Shale)	-850.6	Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	
1435 1440			BS-131	3.1	1/64 to 1/3	A			-860.6	Massive Interbedded ANHYDRITE (1431' to 1433') (EL -851.6 to -853.6) Gray DOLOMITIC SHALE with Trace Anhydrite Massive Interbedded ANHYDRITE (1434' to 1436') (EL -854.6 to -856.6)	
1445 1450			BS-132	3.2	1/64 to 1/3	A to R			-870.6	Gray Amorphous SHALE with Anhydrite and Occasional Red Halite Massive Interbedded ANHYDRITE (1448' to 1450') (EL -868.6 to -870.6)	
1455			BS-133	3.4	1/64 to 3/8	A to R				Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1460	Rotary Drilling							Salina Group - C Unit (C-Shale)	-880.6	Gray Amorphous DOLOMITIC SHALE with Trace Anhydrite	
1465 1470			BS-134	3.3	1/64 to 1/3	A to R			-890.6	Massive Interbedded ANHYDRITE	
1475 1480			BS-135	4.4	1/64 to 1/3	A to R			-900.6	Gray Amorphous SHALE with Trace Anhydrite and Red Halite	
1485 1490			BS-136	4.1	1/64 to 1/3	A to R			-910.6	Gray Amorphous SHALE with Trace Red Halite Massive Interbedded ANHYDRITE (1482' to 1486') (-902.6 to -906.6)	
										Gray Amorphous SHALE with Trace Dolomite and Anhydrite	

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)

LOG OF ROTARY BORING NO:

DRICX11TB16 (TB-16)

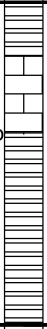
NTH CONSULTANTS, LTD.

Project Name: DRIC Brine Well Investigation

Project Location: Detroit, Michigan

NTH Proj. No: 15-050014-12

Checked By: Z. Carr, P.E., C. Johnson

Depth (ft)	Drilling Method	Casing Installation	Sample No.	Penetration Rate (min/ft)	Particle Size (Inches)	Angularity	Lithology Profile	Formation	Elevation	Subsurface Profile Ground Surface Elevation: 579.4	Notes
1495	Rotary Drilling		BS-137	3.9	1/64 to 1/3	A to R		Salina Group - C Unit (C-Shale)		Gray Amorphous SHALE with Trace Dolomite and Anhydrite Massive interbedded ANHYDRITE (1493' to 1495') (EL -913.6 to -915.6) Gray Amorphous SHALE with Trace Dolomite and Anhydrite (1495' to 1500') (EL -915.6 to -920.6)	
1500										End of Boring at 1500 feet.	
1505											
1510											
1515											
1520											
1525											

NOTES: NTH Inspectors: H. Audet, M. Firestone, S. Gole, Z. Kiefer, J. Wahlstrom, K. Warning
Elevations noted are above mean-sea level (AMSL)