KEPPEL QUARRY

2015 Adaptive Management Plan Compliance Monitoring Report

Project Location:
Proposed New Keppel Quarry
Harold Sutherland Construction
Part Lots 26, 27 and 28
Concession 10, Township of Georgian Bluffs
Grey County, Ontario

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May 30, 2016

MTE File No.: 33862-100

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1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained by Harold Sutherland Construction Ltd. (HSCL) to complete an annual monitoring report to comply with the Adaptive Management Plan (AMP) dated April 10, 2015 and the approved Aggregate Resources Act (ARA) Site Plans dated December 11, 2014 for the Keppel Quarry (ARA License Number 609501). The approved ARA Site Plans are found in **Appendix A**. The AMP, including monitor locations, triggers, and actions are summarized on page 5 of the Site Plans.

The Keppel Quarry also operates under: Permit to Take Water (PTTW, Number 4028-8RCKTY); Environmental Compliance Approval (ECA, Number 3515-8M4PWM); and Niagara Escarpment Development Permit (NEC, Number 6468/G/E/2011-2012/9072). These permits are found in **Appendix B**.

As per the AMP, the monitoring program is intended to minimize potential impacts on water resources, ecological features and monitor the effects of blasting to ensure that proposed mitigation measures are sufficient. There are three components to the monitoring program:

1. Water Resources Monitoring (including Private Well Monitoring);
2. Ecological Monitoring; and
3. Blast Monitoring.

Monitoring data associated with the Water Resources Monitoring Program was collected by HSCL staff and then forwarded to MTE for review, interpretation, and reporting. E cological monitoring data was collected and interpreted by AWS Environmental Consulting Inc. Blast monitoring was completed by Consbec Inc. and HSCL staff. C onsbec Inc. trained HSCL staff to properly install, monitor, record, and report the blast induced vibrations and overpressure.

The objectives of this report are to:

1. Present the monitoring data collected to track the performance of the Keppel Quarry and ensure the AMP is effectively monitoring the existing conditions;
2. Evaluate the performance monitoring data for indicators of change to groundwater resources, the Shouldice Wetland; and the Glen Management Area; and
3. Provide recommendations for future monitoring and mitigation (if required).

1.1 Site Description

The Keppel Quarry is located on Part Lots 26, 27, and 28, Concession 10, in the Township of Georgian Bluffs, County of Grey, hereby referred to as the ‘Site’. **Figure 1** shows the Site approximately eight kilometres northwest of Owen Sound, ON. **Figure 2** shows the licensed area, which is bisected by County Road 17.

Figure 2 also shows the Water Resources Monitoring Network including monitoring well locations, private residential water supply wells, the Shouldice Wetland, and the Glen Management Area. **Figure 3** shows the Ecological Monitoring Locations and **Figure 4** shows the Blasting Monitoring Locations.

1.2 Extraction Activities

MTE understands that ARA License Number 609501 was issued to HSCL on February 18, 2015 and that extraction activities commenced in the spring of 2015. With the exception of clearing and stripping in Area 1b, Area 2, and Area 3, extraction activities (i.e. blasting and extraction of aggregate) have been exclusive to Area 1a. The current elevation of the quarry floor in Area 1a is approximately 234 masl, which is consistent with the floor elevation of the existing Keppel Quarry.

Area 1a is an extension of the existing Keppel Quarry and is located east of County Road 17 (**Figure 5**). Dewatering from Area 1a was directed to the Sump Pond found in the southwest corner of the Keppel Quarry and then discharged onto Lot 27 Concession 10 (**Figure 5**). Due to its small area, connection to the existing Keppel Quarry, and distance from any environmental receptors, data collected while this area was being extracted is considered to represent baseline conditions.

The aggregate reserve in the Keppel Quarry (including Area 1a, 1b, 2 and 3) is approximately 14,110,000 tonnes that will require approximately 29 years to extract, depending on market conditions. The ARA license permits a maximum annual extraction of 600,000 tonnes.

2.0 WATER RESOURCES MONITORING PROGRAM

The Water Resources Monitoring Program is designed to track the performance of the Keppel Quarry and the potential impacts on water resources. The Water Resources Monitoring Program including monitor locations and measurement frequencies are summarized in **Table 1**. The Water Resources Monitoring Program tracks changes at each of the following environmental receptors:

- The bedrock groundwater flow system;
- The Shouldice Wetland; and
- The Glen Management Area.

Tables and hydrographs showing seasonal trends in groundwater chemistry (electrical conductivity and temperature), water levels, and flows are found in **Appendix C**. This database will be used as a baseline for comparison to data collected following extraction in subsequent phases (Areas 1b, 2, and 3 – see **Figure 5**). The following is a list of the tables and hydrographs found in **Appendix C**:

- **Appendix C-1 –** Groundwater Monitor Details;
- **Appendix C-2 –** Groundwater Levels and Elevations and Hydrographs;

- **Appendix C-3 –** Groundwater Vertical Hydraulic Gradients and Hydrographs;
- A**ppendix C-4 –** Flow observations – Springs, Sinkhole, and Surface Water Culverts;
- **Appendix C-5 –** Electrical Conductivity Measurements;
- **Appendix C-6 –** Temperature Measurements;
- **Appendix C-7 –** Private Well Monitoring Data;
- **Appendix C-8** – Distance Elevation Plots;
- **Appendix C-9** – Sentry Well and Trigger Values – Hydrographs;
- **Appendix C-10** – Mitigation Measures; and
- **Appendix C-11** – Photo Log.

While private water supply wells are related to water resources, the results of the Private Well Monitoring Program are described separately in Section 3.0.

2.1 The Bedrock Groundwater Flow System

The purpose of monitoring the bedrock groundwater flow system is to observe trends in groundwater levels over time, confirm the lateral extent of the zone of influence and avoid potential impacts related to interfering with larger water-bearing fractures (if present), which may cause issues with local natural functions and/or water management issues in the quarry. Key indicators used to monitor the bedrock groundwater flow system include:

- Quarry face fractures;
- Groundwater levels;
- Groundwater vertical hydraulic gradients;
- Cone of influence;
- Pumping records; and
- Precipitation records.

The following describes the results of the Water Resources Monitoring Program using these key indicators.

Quarry Face Fractures

The AMP requires visual inspections along the active quarry face after each blast for water bearing fractures. The intent was to ensure that the quarry does not interfere with potential epikarst pathways that might otherwise deliver water to surface water features such as springs found in the Shouldice Wetland (i.e. springs s8 and s13 – see **Figure 2**).

Visual inspections were made by HSCL staff after each blast in 2015. MTE understands that no concerns related to water (i.e. high flows) were observed or noted. To keep a record of the inspections on a go forward basis, HSCL has agreed to keep a photolog of the working face after each blast so that they can be included in future reports.

Groundwater Levels – Observation Wells

The AMP requires the measurement of groundwater levels from on-Site observation wells on a monthly basis from January to December, inclusive. Their locations are shown on **Figure 2.** The current monitoring program includes eighty observation wells (OW) including:

- OW3, OW4, OW7s, OW7d, OW8s, OW8d, OW9s, OW9d, OW10s, OW10d, ~~OW11s, OW11d~~[1], OW12s, OW12d, OW13s, OW13d, OW14s, OW14d, OW15s, OW15d, ~~OW16s, OW16d~~[2], OW24, OW25s, OW25d, OW26, OW27s, OW27d, OW28s, OW28d, OW29s, OW29d, OW30s, OW30d, OW31s, OW31d, OW32s, OW32d, OW33s, OW33d, OW34, OW35, OW36, OW37, OW38, OW39, ~~OW40~~[3], OW41s, OW41d, OW42s, OW42d, OW43s, OW43d, OW44s, OW44d, OW45, OW46k, OW46s, OW46d, OW47s, OW47d, OW48, OW49, OW50, OW51, OW52, OW53, OW58s, OW58d, OW59s, OW59d, OW60s, OW60d, OW62k, OW62s, OW62d, OW63s, OW63d, OW64s, OW64d, OW65s, OW65d, OW71k, OW71s, OW71d.

Shallow wells (designated by the letter 's') extend five to 10 metres below ground surface (mBGS), while deep wells (designated by the letter 'd') are between 10 and 22 mBGS. Deep wells are screened at an elevation close to the current quarry floor elevation (234 mAMSL), while shallow screens are placed about half way between the natural grade and the finished quarry floor elevation.

Three monitors were destroyed in 2015 due to clearing and stripping of Area 1b, Area 2, and Area 3 (OW11s, OW11d, and OW40). Other monitoring wells proposed for construction in 2015 by the AMP (OW67s and OW67d) were not installed due to the ecological sensitivity of the well location (Hearts-tongue Fern habitat[4]) (MTE, 2015b). MTE understands that HSCL plans to replace observations wells OW11s, OW11d in 2016. Observation well OW40 cannot be re-installed because its location has been replaced by the berm buffering County Road 17 from Area 1b. Observation well OW39 is located in close proximity to the former OW40 and will suffice for measuring groundwater levels in this area.

Groundwater levels have been monitored in the shallow and deep bedrock using observation wells since 2004. Groundwater elevations collected in 2015 found in **Table 2** and **Table 3** provide a summary of the 2015 data compared to the historical data. Historical water levels dating back to 2004 are presented in **Appendix C-2** (**Hydrographs C-2.1** though **C-2.48** and tabulated in **Table C-2.1**).

[1] Destroyed by clearing and stripping activities in 2015
[2] Destroyed in 2007 by extraction
[3] Destroyed by clearing and stripping activities in 2015
[4] Heart-Tongue Fern has a "Special Concern" status, which means the species lives in the wild in Ontario, is not endangered or threatened, but may become threatened or endangered due to a combination of biological characteristics and identified threats.

The general year-over-year seasonal groundwater pattern (hereby referred to as 'baseline seasonal fluctuations') is comprised of higher water levels in winter and/or during the spring freshet (snowmelt), decreasing through the summer and early-autumn, followed by a smaller increase during the mid to late-autumn. As expected, monitors located close to the quarry showed lower water levels than those further away from the quarry.

To augment the manual monthly measurements, the AMP required the installation and maintenance of data loggers in the Sentry Wells including:

- OW8s, OW8d, OW9s, OW9d, OW12s, OW12d, OW13s, OW13d, OW33s, OW33d, OW45, OW47s, OW47d, OW51, OW67s, OW67d, OW71K, OW71s, and OW71d.

These wells were identified as 'Sentry Wells' because they are located along the boundary where water level impacts due to the zone of influence of the quarry are not interpreted to occur (MTE, 2015a). Data loggers were installed in the Sentry Wells on March 10, 2015. Hydrographs showing measurements from the Sentry wells are found in **Appendix C-2**. Water levels measured at the Sentry wells showed seasonal trends for bedrock. No fluctuations in water levels in the bedrock were related to extraction in the quarry. The AMP identified trigger values for the Sentry Wells that, if exceeded, will trigger action by HSCL so that mitigation can occur before any negative effects to the natural environment can occur. Groundwater levels with respect to the trigger values are discussed in **Section 2.4**.

Groundwater levels measured from observation wells OW58s, OW58d, OW59s, OW59d, OW60s, OW60d, OW71k, OW71s, and OW71d are used to monitor the Shouldice Wetland while extraction proceeds. Observation well nests OW58 through OW60 are installed near s8, while observation well nest OW71 is installed into the lobe of the Shouldice Wetland encompassing spring s13 and the dugout pond. Groundwater levels from these monitors are presented in **Appendix C-2.**

Groundwater levels at OW58s, OW58d, OW59s, OW59d, OW60s, OW60d, OW71k, OW71s, and OW71d exhibited baseline seasonal fluctuations indicating that the movement of groundwater into the wetland was unaffected by extraction in Area 1a in 2015. In addition to using observation wells, the Shouldice Wetland is monitored using springs, culvert flows, mini-piezometers and a staff gauge. The results of this monitoring are presented in **Section 2.2**.

Groundwater levels measured from observation wells OW49 through OW52 are used to monitor water levels between the Site and the portion of the Glen Management Area north of Area 1a while extraction proceeds. Groundwater levels from OW49 through OW52 are presented in **Appendix C-2.** Groundwater levels from these observations wells exhibited baseline seasonal fluctuations and were comparable to historical data indicating that the movement of groundwater between the Site and this portion of the Glen Management Area was unaffected by extraction in Area 1a in 2015. In addition to using observation wells, this portion of the Glen Management Area is monitored using springs, two water channels (Channel A and B) that feed into Mud Creek, and the weir at the dam regulated by Ducks Unlimited. The results of this monitoring are presented in **Section 2.3**.

Groundwater Vertical Hydraulic Gradients

Condition 4.1 of the AMP requires vertical hydraulic gradients to be calculated using water level measurements from observation wells installed in the shallow and deep bedrock flow systems. This calculation was used to evaluate the potential for vertical movement of groundwater from the shallow to the deep bedrock or vice versa. The calculated vertical gradients are presented in **Table C-3.**

The calculations showed that vertical gradients changed near the active face of Area 1a (less than 400 m) as seen at OW7 (**Hydrograph C-2.2, Appendix C-2**) and OW30 (**Hydrograph C-2.16**), but beyond this distance, they remain unaffected as seen at OW9 and OW10 (**Hydrograph C-2.4**, **Appendix C-2**). The vertical gradients indicate that groundwater resources are not being affected beyond 400 m from Area 1a, which is consistent with historical data.

Zone of Influence

Condition 4.1 of the AMP requires that the zone of influence for the Keppel Quarry to be tracked using groundwater flow maps (**Figure 6 and Figure 7**) and distance-elevation plots (**Appendix C-8**).

Groundwater elevations at the observation wells were contoured using water level data obtained on November 17, 2015. **Figure 6** (shallow bedrock groundwater regime) shows fairly evenly spaced groundwater contours with groundwater moving towards the west and southwest. There was no cone of influence apparent in the shallow bedrock groundwater flow system. Even the closest observation well (OW30s) maintained a water level that was 13 m above the elevation of the existing quarry floor (on average), which was approximately ~234 mAMSL in Area 1a. This observation well is situated less than 50 m from the edge of the working face in Area 1a.

Figure 7 shows that the effects of drawdown in the deep bedrock groundwater regime diminish with distance from the quarry face. The magnitude of drawdown influence is greatest within the extraction area, and decreases relatively quickly with distance away from the quarry extraction faces. The zone of influence in the deep bedrock groundwater flow regime was previously mapped to be approximately 400 m (MTE, 2011a). Even though the size of the extraction area has increased (into Area 1a), the zone of influence of the quarry on the local groundwater system has not changed.

Figure 8 provides an illustration of the interpreted zone of influence around the quarry footprint based on the November 2015 data. Bedrock extraction below the water table resulted in a zone of influence on the local groundwater system that is variable and due in part to the hydraulic interconnectivity of the fractures within the bedrock mass.

Figure 8 breaks the zone of influence up into two zones. Zone one has the greatest amount of drawdown (4-10 m); followed by Zone 2 (0-4 m of drawdown); and then Zone 3 (no impact).

Zone 1 varies in distance as observed at a number of on-site observation wells. Zone 1 presently does not extend beyond 200 m from the working face in Area 1a. The zone of influence is indistinguishable from normal seasonal climatic trends beyond a distance of about 100 m at OW49 (north), 200 m at OW14 (west), 120 m at OW7 (south) and 200 m at OW53 (east). Beyond 400 m there is no impact related to the Keppel Quarry.

Figure 4 of the AMP shows the predicted the zone of influence for the Keppel Quarry when at its maximum extent (MTE, 2015a). For the sake of convenience, this figure has been relabeled as **Figure 9** and included in this report.

Pumping Records

Pumping records are used to track dewatering volumes at the Keppel Quarry. HSCL has incorporated a flow meter into the dewatering system to allow for the retrieval of accurate data.

Condition 4.1 of the AMP requires pumping records to be downloaded on a monthly basis. HSCL downloaded and compiled the pumping records, which are presented in **Table 6** and summarized in **Table 7**. The maximum amount pumped in a day for 2015 was 2,156,783 L/day and the total volume pumped in 2015 was 136,183,910 L. The total volume pumped in 2015 represents less than 20% of the total volume allowed by the PTTW. The PTTW also specifies an allowable pumping rate of 3,000 L/min, which was the pumping rate used by HSCL in 2015.

No water issues were encountered while extraction occurred in Area 1a. All dewatering was done within the specification of the Permit, which supports the finding that the quarry did not intercept any large water-bearing fractures that may affect groundwater resources.

Precipitation Data

Condition 4.1 of the AMP requires a weather station to be installed on-Site so that precipitation data can be collected. HSCL installed a rain gauge (rain logger + tipping bucket system) on June 16, 2015. To complete the data set for 2015, precipitation data was obtained from Wiarton Airport (Environment Canada Weather Station) located approximately 15.5 km northwest of the Site. **Table 8** shows the combined 2015 precipitation dataset (Wiarton Airport [Jan-June] + Keppel Quarry [July-Dec]).

Figure 10 shows the combined 2015 precipitation values for the Site vs. the Climate Normals (1981 – 2010) as recorded at the Wiarton Airport. Overall, the annual total for the Site (832 mm) was below the Climate Normal (1,048 mm), with only three months (January, June and August) having above average precipitation, indicating that 2015 was a 'dryer' than average year for precipitation.

2.2 The Shouldice Wetland

The Shouldice Wetland is a Provincially Significant Wetland (PSW). The wetland has been identified as an environmental receptor due to its ecological importance and its unique hydraulic and hydrogeologic characteristics (MTE, 2009). Key indicators used to monitor the Shouldice Wetland include:

- Groundwater recharge;
- Groundwater vertical hydraulic gradients using mini-piezometers;
- Springs (s8 and s13) and the dugout pond;
- Shouldice Wetland culverts; and
- Beaver dam and sinkhole.

Groundwater Recharge

Condition 4.2 of AMP requires the measurement of groundwater levels from four test pits with stand pipes (TP) installed in the overburden within 100 m of the wetland boundary. These test pits include:

- TP16, TP17, TP18, TP19.

Their locations are shown on **Figure 2.** These test pits are used to measure groundwater levels in the glaciofluvial overburden materials found on Lot 25, Concession 10. Monitoring groundwater levels in this overburden is important because it has been identified as a potential source of groundwater recharge for the Shouldice Wetland springs, particularity spring s8 (Cowell, 2009).

Groundwater levels measured from the testpits are shown in **Table 9** and historical data is presented in **Appendix C-2**. The results showed baseline seasonal trends in water levels fluctuations indicting that extraction in Area 1a did not affect this recharge zone.

Groundwater Vertical Hydraulic Gradients

Condition 4.2 of the AMP requires the measurement of groundwater levels from four mini-piezometers (MP) installed in the wetland deposits on a monthly basis from January to December, inclusive. These mini-piezometers include:

- MP54, MP55, MP56, MP57.

Their locations are shown on **Figure 2.** These mini-piezometers are used to measure groundwater levels in the wetland deposits so that the vertical hydraulic gradients can be calculated to determine the vertical movement of groundwater into the Shouldice Wetland. Vertical gradients calculated using water levels measured from the mini-piezometers are shown in **Table 11** and historical data is presented in **Appendix C-3**.

Neutral gradients were observed at the minipiezometers, indicating that movement of shallow groundwater in the wetland was primarily horizontal in 2015. This vertical gradient is consistent with the historical data.

Groundwater vertical hydraulic gradients were also calculated using observation wells installed in the bedrock underlying the Shouldice Wetland. Groundwater levels measured from observation wells OW58s/d, OW59s/d, OW60s/d, and OW71k/s/d are shown in **Table 4** and historical data is presented in **Appendix C-3**. The calculated values for OW58, OW59, and OW60 showed small positive gradients (0.03 m/m) in 2015, while the calculated values for OW71 showed neutral to slightly downward gradients (0.00 to 0.05 m/m). These gradients were consistent with historical data at these locations. This information coupled with the gradients calculated from the mini-piezometers indicates that the groundwater vertical hydraulic gradients in the Shouldice Wetland or the bedrock underneath the wetland were not affected by extraction in Area 1a.

Spring (s8 and s13) and the Dugout Pond

Condition 4.2 of the AMP requires the following parameters to be measured at springs s8, s13, and the dugout pond using dataloggers on a monthly basis from January to December, inclusive:

- Water levels;
- Flows - observed as 'flowing'; 'no apparent flow'; or 'dry';
- Electrical conductivity (EC); and
- Water temperature.

Spring s8 is located along the edge of the Shouldice Wetland approximately 850m west of Area 1a (**Figure 2**). Spring s13 is located approximately one kilometer southwest of Area 1a on Lot 26, Concession 9. The Dugout pond is located adjacent to s13 (**Figure 2**).

Water levels collected in 2015 at spring s8, s13 and the dugout pond are found in **Table 12.** Historical water levels dating back to 2009 are presented in **Appendix C-2** (**Hydrographs C-2.46, C-2.47, and C-2.48**). Water levels measured in 2015 were comparable to historical values fluctuating around 240 mAMSL. Water levels at spring s13 and the dugout pond fluctuated around 243 mASML, which was also consistent with historical values. Water levels at these locations were not affected by extraction in Area 1a.

Flows collected in 2015 at spring s8, s13 and the dugout pond are found in **Table 13.** Historical flows dating back to 2007 are presented in **Appendix C-4**. Based on the 2015 flow data collected, the hydroperiod for these springs extended from March through to June. Observations made after June showed there was ponded water present but there was no flow observed. Flow at spring s8 was again observed in

November but no flow was observed at s13 or the dugout pond. This information is consistent with the historical data, which indicated that the hydroperiod for these locations ended in the summer of each year.

EC values collected in 2015 at the springs and dug out pond are found in **Table 14.** Historical EC values dating back to 2009 are presented in **Appendix C-5**. EC values ranged from 452 to 650 at spring s8, 500 to 1054 at spring s13 and 520 to 1172 at the dugout pond. These values are comparable to historical data collected at these locations (**Appendix C-5**).

Water temperature values collected in 2015 at the springs and dugout pond are found in **Table 15.** Historical water temperatures dating back to 2009 are presented in **Appendix C-6**. Water temperature at spring s8 ranged from 7 to 16 in 2015. Similarly, water temperatures at spring s13 ranged from 5 to 17 degrees Celsius, while temperatures in the dugout pond ranged from 5 to 23 degrees Celsius. As expected, the highest water temperatures were observed in the summer while the coolest water temperatures were observed in the spring. The range in water temperatures recorded at springs s8 and s13 is smaller because the water is regulated by groundwater contributions. The dugout pond will be more susceptible to atmospheric temperatures, causing the pond temperatures to rise higher in the middle of summer. Water temperatures measured in 2015 were comparable to historical data collected at these locations (**Appendix C-6**).

Shouldice Wetland Culverts

There are several culverts (culverts 4 through 7) that allow water to cross under a snowmobile trail constructed at the end of Gun Club Road, which runs in a northwesterly direction through the Shouldice Wetland **(Figure 2)**. Condition 4.2 of the AMP requires that the following parameters to be measured at these culverts on a monthly basis from January to December, inclusive:

- Flows - observed as ‘flowing’, ‘no apparent flow’, ‘dry’;
- Electrical conductivity (EC); and
- Water temperature.

Monitoring flows through these culverts aides in understanding the hydroperiod of the Shouldice Wetland. Due to significant beaver activity at the culvert locations, only ‘flowing’, ‘no apparent flow’, ‘dry’ observations coupled with observations on the extent of beaver activity can be made at each culvert.

Flows collected in 2015 at the culverts are found in **Table 13.** Historical flows dating back to 2007 are presented in **Appendix C-4**. Based on the 2015 flow data collected, the hydroperiod for these culverts extended from the spring through to summer (April to July). Observations made in the summer showed there was ponded water at some of the culverts but there was no flow observed. Flow was again observed in November and December. This information showed agreement with the flow data collected at the springs (s8 and s 13) and t he dugout pond indicating that the Shouldice Wetland hydroperiod for these locations ended in the summer of 2015 and resumed in late fall.

EC values collected in 2015 at the culverts are found in **Table 14.** Historical EC values dating back to 2009 are presented in **Appendix C-5**. EC values ranged from 452 to 650 at the culverts. These values are comparable to historical data collected at these locations (**Appendix C-5**).

Water temperature values collected in 2015 at the culverts are found in **Table 15.** Historical water temperatures dating back to 2009 are presented in **Appendix C-6**. Water temperatures at the culverts ranged from 3 to 32 degrees in 2015. As expected, the highest water temperatures were observed in the summer while to coolest water temperatures were observed in the winter. Water at the culverts is susceptible to atmospheric temperatures, causing temperatures to rise in the middle of summer. The water temperatures measured at the culverts in 2015 were comparable to historical data collected at these locations.

Beaver Dam and Sinkhole

The Beaver Dam and sinkhole are located approximately 850 m north of the Keppel Quarry (**Figure 2**) in the Shouldice Wetland. The beaver dam is an attempt by beavers to maintain water levels in the north portion of the Shouldice Wetland which would otherwise be dr ained by the sinkhole at the edge of the wetland. Water from the Shouldice Wetland drains over the dam where it flows into a s mall 'cove'. The south edge of the cove is formed by a pr ominent joint in the limestone bedrock and water sinks into the bedrock all along the south shore. This sinkhole is a discrete karst feature that is connected to springs s1-s3 in the Glen Management Area. This feature serves to drain the northeast lobe of the Shouldice Wetland during peak recharge periods.

Condition 4.2 of the AMP requires that the following parameters to be measured at the beaver dam and sinkhole on a monthly basis from January to December, inclusive:

- Flows - observed as 'flowing', 'no apparent flow', 'dry';
- Electrical conductivity (EC); and
- Water temperature.

Monitoring flow conditions at the beaver dam and sinkhole aides in understanding the hydroperiod of the Shouldice Wetland at this location. Only 'flowing'; 'no apparent flow'; or 'dry' observations can be made at these locations.

Flows collected in 2015 at the beaver dam and sinkhole are found in **Table 13.** Historical flows dating back to 2007 are presented in **Appendix C-4**. Based on the flow data collected at the beaver dam, water was observed flowing through and into the cove all year in 2015 (May to December). Flow observations at the sinkhole are made at the eastern extent of the cove and f lows ending after June (**Table 13**). H owever, the bedrock joint extends through the entire cove and water sinks along its entire length

(Cowell, 2008). As such, the hydroperiod for the sinkhole is tied to flows through the beaver dam (May to December, 2015), with lesser amounts of water being contributed after June, 2015.

EC values collected in 2015 at the culverts are found in **Table 14.** Historical EC values dating back to 2009 are presented in **Appendix C-5**. EC values ranged from 344 to 639 at the beaver dam and sinkhole. These values are comparable to historical data collected at these locations.

Water temperature values collected in 2015 at the beaver dam and sinkhole are found in **Table 15.** Historical water temperatures dating back to 2009 are presented in **Appendix C-6**. Water temperatures at the beaver dam ranged from 0.7 to 23 degrees Celsius in 2015. As expected, the highest water temperatures were observed in the summer while to coolest water temperatures were observed in the spring. Water at the beaver dam is susceptible to atmospheric temperatures, causing the temperatures to rise in the middle of summer. The water temperatures measured at the beaver dam and sinkhole in 2015 were comparable to historical data collected at these locations.

2.2.1 Area 3 Monitoring

With the exception of clearing and stripping for the purpose of constructing the berm, no extraction activities occurred in Area 3 in 2015. Condition 4.7 of the AMP indicates that there is a holding provision on Area 3, which can only be lifted if the monitoring and triggers of the AMP clearly indicate that there will be no significant negative impact to the Shouldice Wetland as determined by the Ministry of Natural Resources and Forestry (MNRF) and the Ministry of the Environment and Climate Change (MOECC).

2.2.2 Infiltration Pond Monitoring

The purpose of the infiltration pond is to augment flow to the lobe of the Shouldice Wetland encompassing spring s13 and the Dugout Pond if the results of the AMP deem this mitigation measure is required (MTE, 2015a). If required, then the infiltration pond shall be constructed in the headwater recharge area for spring s13.

Monitoring data collected in 2015 did not trigger the construction of the infiltration pond. As such, the infiltration pond has yet to be constructed and no monitoring was required in 2015.

2.3 The Glen Management Area

The north portion of the Glen Management Area located approximately 500 m north of the Area 1a is monitored as part of the AMP. The key indicators that are used to monitor this feature include:

- *Glen Management Area Springs s1-s3;*
- *Mud Creek;*
- *Flow over the weir at the dam regulated by Ducks Unlimited; and*
- *Beaver Dam Sinkhole.*

Glen Management Area Springs s1, s2, s3

The Glen Management Area contains springs (s1-s3) located on the top of the Amabel Plateau that are derived from infiltrating water at the Beaver Dam Sinkhole. They are located 550 m north of the existing Keppel Quarry along the Niagara Escarpment (**Figure 2**). The current interpretation is that these springs will not be impacted by the New Keppel Quarry (Cowell, 2009). However, water emanating from these springs is dependent on water sinking at the Beaver Dam Sinkhole and so natural changes may occur while the New Keppel Quarry is operating. As a result, springs s1-s3 are included in the Water Resources Monitoring Program so that natural changes can be noted (if any) while extraction occurs.

Condition 4.3 of the AMP requires the following parameters to be measured at these springs a monthly basis from January to December, inclusive:

- Flows - observed as 'flowing'; 'no apparent flow'; or 'dry';
- Electrical conductivity (EC); and
- Water temperature.

Flows collected in 2015 at theses springs are found in **Table 16.** Historical flows are presented in **Appendix C-4**. Based on the flow data collected, the hydroperiod for these springs extended from December through to January in 2015. This information is consistent with the historical data, which indicated that these springs flow all year with the exception of 2013 when spring s1 and s2 stopped flowing in July and August.

EC values collected in 2015 at the springs are found in **Table 17.** Historical values are presented in **Appendix C-5**. EC values ranged from 419 to 623 at these springs in 2015, which is comparable to historical data collected at these locations. Conductivity values in this range means there is a mix of groundwater and surface water flowing from these features (Cowell, 2009).

Water temperature values collected in 2015 at the springs are found in **Table 18.** Historical water temperatures dating back to 2009 are presented in **Appendix C-6**. Water temperature at spring s1, s2, and s3 ranged from 3 to 14 degrees Celsius in 2015. Due to inputs from groundwater water at these springs do not raise much beyond 15 degrees Celsius. The water temperatures recorded at these springs in 2015 were comparable to historical data collected at these locations.

Mud Creek

The headwaters for Mud Creek include springs s1-s3. There are two channels that flow from these springs into Mud Creek:

- Channel A, the main channel, and
- Channel B, a secondary channel that tends to have intermittent flows.

Condition 4.3 of AMP requires the following parameters to be measured at these springs a monthly basis from January to December, inclusive:

- Flows – estimated at Channel A using velocity-area measurements;
- Electrical conductivity (EC); and
- Water temperature.

Flows collected in 2015 at Mud Creek (Channel A and B) are found in **Table 16.** Historical flows are presented in **Appendix C-4**. Based on the 2015 flow data collected, the hydroperiod for Channel A extended from December through to January, while Channel B was dry all year, except in April. This information is consistent with historical data, which saw Channel B dried up regularly after the spring melt, whereas Channel A flowed almost all year (**Appendix C-4**).

EC values collected in 2015 at Mud Creek (Channel A and B) are found in **Table 17.** Historical values are presented in **Appendix C-5**. EC values ranged from 414 to 635 at these channels in 2015, which is comparable to historical data collected at these locations.

Water temperature values collected in 2015 at Mud Creek (Channel A and B) are found in **Table 18.** Historical water temperatures are presented in **Appendix C-6**. Water temperature in Channel A ranged from 3 to about 25 degrees Celsius in 2015. Water temperatures at these locations are regulated by groundwater. The water temperatures recorded in Mud Creek (Channel A and B) in 2015 were comparable to historical data collected at these locations.

Beaver Dam Sinkhole

Flow observations made at the beaver dam showed that there was water moving through the beaver dam into the cove almost all year in 2015 (May to December). This hydroperiod showed good agreement with the flow observations made at the springs (s1-s3), which also flowed all year.

EC values at the beaver dam and sinkhole were 508 us/cm and 504 us/cm, on average. EC values at springs s1-s3 were 541 us/cm. This similarity supports the conclusion that the sinkhole may extend through the entire cove so that any water flowing through the beaver dam is contributing to flow at springs s1-s3.

2.4 Trigger Values

As outlined in the AMP there are three categories of trigger values; green, yellow and red. Each trigger value is accompanied by a set of actions to occur if these values are exceeded.

Green Trigger Values

Green trigger values are set at 15 cm above observed seasonal lows (spring, summer, autumn, and winter) for each of the Sentry Wells and for springs s13 and s8. An exceedance of a green trigger value indicates no significant negative impacts have been observed and water levels are still within the normal historical range. This will trigger a 'Green Action' as an early response action (i.e. increase monitoring frequency and investigate).

Yellow Trigger Values

Yellow trigger values are equal to observed seasonal lows for each location. An exceedance of a yellow trigger value indicates water levels are slightly below seasonal lows, but no significant negative impacts have been observed. This is used to trigger a 'Yellow Action' or a precautionary mitigation measure.

Red Trigger Values

Red trigger values are set at 15 cm below observed seasonal lows. Fifteen centimeters was selected since this amount of change may result in the extension of the cone of influence into Zone 3, which could result in a negative impact to the Shouldice Wetland.

An exceedance of a red trigger value is used to trigger 'Red Actions' or immediate responses in the event that the yellow actions fail to correct or reverse the impact.

2.4.1 Trigger Values - Results

Seasonal trigger values for each Sentry Well, s8, s13 and SG1 can be seen in **Table 19**. These values were established based on data collected from 2004 to 2009. Since then, new groundwater levels have been measured that show more recent seasonal trends. As such, the trigger values shown in **Table 19** must be revised to reflect the updated baseline data. As previously mentioned, the groundwater trends observed at the sentry wells exhibited baseline seasonal fluctuations indicating that groundwater resources were unaffected by extraction in Area 1a in 2015. Amended trigger values are proposed in **Table 20**.

The following is a summary of where groundwater levels have exceeded green, yellow and red trigger values during the monitoring period from 2009 to 2015, as a result of seasonal climatic conditions:

- From 2009 to 2015, groundwater levels in OW8s fluctuated between 243 mAMSL and 245 mAMSL with an average groundwater level of 243.88 mAMSL (**Hydrograph C-9.1**). Green trigger values were exceeded during the winter, spring and occasionally during the summer months between 2009 and 2015. Of note is the groundwater level measured on July 26, 2011 which was 0.35 m below the summer red trigger value (243.06 mAMSL).

- From 2009 to 2015, groundwater levels in OW8d fluctuated between 242 mAMSL and 244 mAMSL with an average groundwater level of 243.24 mAMSL (**Hydrograph C-9.2**). Green trigger values were occasionally exceeded during the winter, spring and summer months during this period. The spring yellow trigger value was exceeded once on March 13, 2015 with a measured groundwater level of 243.31 mAMSL. No observed groundwater levels have exceeded the red trigger value.
- From 2009 to 2015, groundwater levels in OW9s fluctuated between 242 mAMSL and 244 mAMSL with an average groundwater level of 242.99 mAMSL (**Hydrograph C-9.3**). Green trigger values was exceeded several times from 2009 to 2015, but neither the yellow or red trigger values were observed to be exceeded since monitoring began.
- From 2009 to 2015, groundwater levels in OW9d fluctuated between 242 mAMSL and 244 mAMSL with an average groundwater level of 243.05 mAMSL (**Hydrograph C-9.4**). Exceedances of green, yellow and red trigger values were observed to occur during the winter and spring months between 2009 and 2015. The majority of groundwater levels in summer and fall tended to be above the green trigger values.
- From 2009 to 2015, groundwater levels in OW12s and OW12d fluctuated between 243 mAMSL and 245 mAMSL with average groundwater levels of 243.80 and 243.53 mAMSL respectively (**Hydrograph C-9.5 & C-9.6**). The green trigger values were exceeded several times throughout from 2009 to 2015 in both OW12s and OW12d. Winter yellow trigger values for OW12s and OW12d were exceeded in 2011. The red trigger values for both OW12s and OW12d have not been exceeded since monitoring began.
- From 2009 to 2015, groundwater levels in OW13s fluctuate between 243.5 mAMSL and 245.5 mAMSL with an average groundwater level of 244.56 mAMSL (**Hydrograph C-9.7**). The green trigger value was exceeded several times throughout from 2009 to 2015. Neither the yellow or red trigger values were observed to be exceeded since the initiation of the monitoring program.
- From 2009 to 2015, groundwater levels in OW13d fluctuate between 241.5 mAMSL and 243.5 mAMSL with an average groundwater level of 242.31 mAMSL (**Hydrograph C-9.8**). Green trigger value were occasionally exceeded during the winter and summer months throughout this period. The winter yellow trigger value was exceeded twice on February 9, 2011 and March 13, 2015 with groundwater levels of 242.44 mAMSL and 242.38 mAMSL respectively. Exceedances of the red trigger value have not been observed since monitoring of OW13d began.
- From 2009 to 2015, groundwater levels in OW33s fluctuate between 243 mAMSL and 246 mAMSL with an average groundwater level of 243.86 mAMSL (**Hydrograph C-9.9**). Green trigger values were exceeded several times throughout from 2009 to 2015. The spring yellow trigger value was exceeded twice in 2012 and once in the spring of 2015. Red trigger values were exceeded on September 19, 2013 and March 13, 2015 with groundwater levels of 242.09 and 243.38 mAMSL.

- From 2009 to 2015, groundwater levels in OW33d fluctuate between 238.5 mAMSL and 241.5 mAMSL with an average groundwater level of 239.87 mAMSL (**Hydrograph C-9.10**). Green trigger values were occasionally exceeded during the winter and spring months from 2009 to 2015. Yellow trigger values were exceeded twice on February 9, 2011 and June 15, 2012 with groundwater levels of 239.78 mAMSL and 239.23 mAMSL. Exceedance of the winter red trigger value occurred on March 13, 2015 with a groundwater level of 239.52 mAMSL.
- From 2009 to 2015, groundwater levels in OW45 typically fluctuate between 243.5 mAMSL and 246 mAMSL with an average groundwater level of 244.26 mAMSL (**Hydrograph C-9.11**). Green trigger values were often exceeded during the winter and spring throughout this period. Groundwater levels in OW45 have occasionally exceeded the yellow trigger value. The spring red trigger value was exceeded twice in 2012. The red trigger value was exceeded once in the fall of 2012 and 2015.
- From 2009 to 2015, groundwater levels in OW47s fluctuate between 243 mAMSL and 244.5 mAMSL with an av erage groundwater level of 243.53 mAMSL (**Hydrograph C-9.12**). Green trigger values were often exceeded during the winter and s pring from 2009 to 2015. Groundwater levels in OW45 exceeded yellow trigger values on May 28, 2015 and September 25, 2012 with groundwater levels of 243.42 and 243.10 mAMSL respectively. Groundwater levels in OW47s have not been observed to exceed the red trigger value.
- From 2009 to 2015, groundwater levels in OW47d fluctuate between 243 mAMSL and 244.5 mAMSL with an average groundwater level of 243.32 mAMSL (**Hydrograph C-9.13**). Green trigger values were exceeded during the winter and spring from 2009 to 2015. Water levels in OW47d exceeded yellow trigger values in the winter of 2011, spring of 2012 and the winter and fall of 2015. Groundwater levels in OW47d exceeded the red trigger value on October 22, 2015 having a groundwater level of 243.08 mAMSL. Exceedances of the red trigger value in the summer of 2011 likely represent groundwater recovery as a r esult of sampling occurring in the spring of 2011. As such groundwater levels in the summer of 2011 are not considered to be natural baseline levels but rather reflect response to well testing.
- From 2009 to 2015, groundwater levels in OW51 typically fluctuate between 239 mAMSL and 243 mAMSL with an average groundwater level of 240.35 mAMSL (**Hydrograph C-9.14**). Green trigger values were occasionally exceeded during the winter and spring from 2009 to 2015. Water levels in OW51 exceeded yellow trigger values once in the winter of 2011 and once during the spring and fall of 2015. Red trigger values were exceeded three times, twice in the spring of 2012 and once in the winter of 2015.
- From 2009 to 2015, groundwater levels in OW53 typically fluctuate between 242 mAMSL and 246 mAMSL with an average groundwater level of 240.33 mAMSL (**Hydrograph C-9.15**). Green trigger values were occasionally exceeded during the fall and winter from 2009 to 2015. Water levels in OW53 have been observed to exceed yellow trigger values four times during the monitoring program. Yellow trigger values were exceeded once in spring 2011, fall 2012, summer 2013 and

summer 2015. The red trigger value was exceeded on two occasions, March 13, 2015 and October 22 2015 with groundwater levels of 243.8 and 242 mAMSL respectively.

- Observation wells OW71s, OW71k and OW71d were installed in 2011. Since five years of monitoring data has been collected at this location, triggers values for these observation wells are proposed in **Table 20**. OW71s, OW71k and OW71d have water levels that fluctuate annually between 242 and 244 mAMSL and average groundwater elevations of 243.01, 242.82 and 243.04 mAMSL as presented in **Hydrographs C-9.16- C-9.18.**

To date extraction has been limited to Area 1a, which started in 2015. As such, any groundwater levels exceeding green, yellow and red trigger values are a result of seasonal climatic conditions. In light of many of the Sentry Wells exceeding trigger values, MTE has proposed new trigger values as outlined in **Table 20,** which includes trigger values for OW71k, OW71s and OW71d. As per the AMP, all sentry wells have been outfitted with data loggers, which will allow for the collection of continuous groundwater data so that a more detailed trend analysis can be completed in the future.

2.5 Mitigation Measures

Mitigation measures are shown as a sequence of green, yellow and red actions in **Appendix C-11**. Since groundwater levels at all the Sentry Wells exhibited seasonal fluctuations, groundwater resources were unaffected by extraction in Area 1a in 2015. As such, no mitigation measures were required in 2015.

2.6 Ephemeral Pond

There is an ephemeral pond on Lot 26 Concession 10. The AMP requires that three years of baseline water levels be measured using a staff gauge in this feature prior to extraction occurring within Area 1B. Water levels shall be measured during the amphibian breeding season which extends from April 1 to June 30.

Water levels in this pond were not measured in 2015 because extraction in Area 1a started after the amphibian breeding season. MTE understands that HSCL installed a staff gauge in this feature on April 26, 2016 so that water levels could be measured in 2016.

3.0 PRIVATE WELL MONITORING PROGRAM

A Private Well Monitoring Program has been developed to monitor water supplies of residents within one kilometer of the Keppel Quarry. Private wells are be separated into two categories:

- **Category A wells** – includes those wells within or just outside the predicted cone of influence for the deep bedrock aquifer when the Keppel Quarry is at its full extent. The predicted zone of influence is shown in **Figure 9**.

- **Category B wells** - includes those wells within 1 km of the Keppel Quarry license boundaries but outside the predicated cone of influence.

3.1 Category A Private Wells

Category A Private Wells include:

- Private well no. 7253 (the Cramp well);
- Private well no. 3447 (owned by HSCL – rented by McGregor);
- Private well no. 3345 (the Ritchie well); and
- Private well no. 5197 (the Ruthven well).

The locations of the private wells are shown on **Figure 2** and **Figure 9**. With the exception of Private Well no. 3447, baseline data dating back as far as 2006 has been collected as part of previous studies (WGC, 2003, 2007). Monitoring results for the Category A Private Wells are shown on **Hydrographs C-7.1** to **C-7.4** found in **Appendix C-7**. The following is a summary of the water level data collected from Category A Private Wells in 2015 compared to the historical baseline data.

- Water levels in Private Well no. 7253 were measured using a data logger. Occasional manual measurements were also obtained by HSCL staff using an electric water level tape for calibration purposes. Water levels measured in 2015 were similar to historical values fluctuating around 248 mAMSL on average (**Hydrograph C-7.1**). Water levels as low as 245.5 mAMSL were measured in October due to the household use of the well. Water levels as high as 249.2mAMSL were measure in the spring. At least 14 m of water column remained in this well while extraction occurred in Area 1a in 2015. This information indicates that the water supply in Private well no. 7253 was not affected by extraction in Area 1a.
- Water levels in Private Well no. 3447 were measured manually using an electric water level tape on a seasonal basis by HSCL staff. Water levels in 2015 fluctuated around 247.5 mAMSL on average (**Hydrograph C-7.2**). Water levels as low as 247 mAMSL were measured in October and water levels as high as 248 mAMSL were measured in the spring. At least 8 m of water column remained in this well while extraction occurred in Area 1a in 2015. This information indicates that the water supply in Private well no. 3447 was not affected by extraction in Area 1a. MTE understands that the dwelling at Private Well no. 3447 is owned by HSCL and is occupied by a renter.
- Water levels in Private Well no. 3345 were measured manually using an electric water level tape on a seasonal basis by HSCL staff. Water levels in this well appeared more stable in 2015 than in previous years and fluctuated around 241 mAMSL, on average (**Hydrograph C-7.3**). The highest water level observed in 2015 was about 243 mAMSL compared to almost 249 mAMSL measured in the spring of 2011. The lowest water level was about 239 mAMSL measured in November, 2015 which was compared to historical lows. At least 23 m of water column remained in this well while extraction occurred in Area 1a in 2015. This information indicates that the water supply in Private well no. 3345 was not

affected by extraction in Area 1a. The resident has declined to be a part of the monitoring program in 2016. A letter received from the resident by HSCL dated October 6, 2015 is found in **Appendix C-7**.

- Water levels in Private Well no. 5197 in 2015 were measured using a data logger. Water levels were similar to historical values fluctuating around 248 mAMSL on average (**Hydrograph C-7.4**). Water levels fluctuated seasonally in this well with high water levels in the spring (peaking at 251.5 mAMSL) and progressively lower water levels throughout the summer. The lowest water level measured was 243 mAMSL in October, 2015. At least 4.75 m of water column remained in this well while extraction occurred in Area 1a in 2015, which is similar to previous years. This information indicates that the water supply in Private well no. 5197 was not affected by extraction in Area 1a.

3.2 Category B Private Wells

HSCL delivered letters to residents living with one kilometer of the Keppel Quarry on November 7, 2014 inviting them to be part of the Private Well Monitoring Program. HSCL delivered five letters and four were returned accepting the offer.

HSCL completed an inspection of each of the wells and three were considered suitable for monitoring, based on access to the well head. Based on the inspection results the following well were included as Category B Private Wells:

- Private well no. PW1 (the Jenks well);
- Private well no. PW2 (the Thompson well); and
- Private well no. PW3 (the Porter well).

As per the AMP, a baseline water quality sample was obtained from each of the Category B Private Wells. The analysis included the following parameters:

- hardness, alkalinity, pH, conductivity,
- chloride, nitrite, nitrate; and
- calcium, magnesium, iron, ammonia and sodium.

Water quality samples were submitted to Caduceon Environmental Laboratories and the certificate of Analysis for each sample is found in **Appendix C-7**.

The AMP requires that water levels be measured manually from each of the participating Category B private wells on a seasonal basis (4 times per year). The results of the monitoring are presented on **Hydrograph C-7.5** found in **Appendix C-7**. The following is a summary of the results of the monitoring:

3.3 Private Well Trigger values and Mitigation Measures

Condition 7.3 of the AMP requires that yellow trigger values be established for all Category A and B Private Wells. Yellow trigger values have been calculated for well 7253, and 3345. Condition 7.3 of the AMP indicated that private well no. 3447 was expected to be decommissioned and that a yellow trigger value was not required. MTE understands that this well will not be decommissioned because there is a resident renting the property. As such a yellow trigger value will be required if it is to be included in the AMP.

To calculate yellow trigger values for the remaining private wells that are part of the Private Well Monitoring Program, the well head must be surveyed for elevation with respect to meters above sea-level using total station or GPS survey equipment. In addition, MTE recommends the collection of three years of water level data before a trigger value is calculated. Since 2015 represents the first year for data collection from Category B wells, an additional two years is required. MTE understands that the elevation survey may be completed in 2016.

No yellow trigger values were exceeded at the any of the Category A Private Wells. Once trigger values have been established for Category B wells, they should be incorporated into the AMP.

Condition 7.3 of the AMP indicates that a well interference complaint from a private well owner constitutes a red trigger action. A private well interference complaint response procedure has been established for all Category A and Category B private wells (MTE, 2015). No complaints were received by HSCL related to extraction in Area 1a in 2015. As such, no mitigation measures were required in 2015.

Condition 7.1 of the AMP requires the replacement of private well no. 7253 owned by Mr. Cramp and that a new yellow trigger value is to be established for this new well. MTE understands that this well must be replaced prior to extraction in Area 2.

4.0 ECOLOGICAL MONITORING PROGRAM

An Ecological Monitoring Program has been developed to evaluate the ecological health of selected natural features throughout the life cycle of the quarry and ensure that their ecological function is maintained. As per Condition 5.0 of the AMP, year one reporting shall be considered "normal" for flora community diversity and be used to establish trigger threshold levels for comparison to future monitoring results. The results of the program after year one are presented in a report completed by AWS Environmental Consulting Services Inc. dated March 2016 found in **Appendix D.**

The Ecological Monitoring Program is focused on features in the woodlands of the Area of Natural and Scientific Interest (ANSI), the Shouldice Wetland and the upper Glen Management Area. Ecological monitoring areas (EMA) are shown on **Figure 3**. Monitoring activities were conducted in both terrestrial ecological features (EMA-1 and EMA-2) and wetland ecological features (EMA-2 through EMA-6) as outlined below:

- EMA-1: Woodland Tree Health, Woodland Regeneration and Woodland Flora Species Diversity;
- EMA-2: Woodland Breeding Birds;

- EMA-3: The Glen Area s1 to s3 groundwater discharge feature;
- EMA-4: The Shouldice Wetland at the s8 groundwater discharge feature;
- EMA-5: The Woodland Ephemeral Pond amphibian breeding surface water feature; and
- EMA-6: The lobe of the Shouldice Wetland encompassing spring s13 and the Dugout Pond and the upper headwater channel for the East Branch of Park Head Creek.

The following is a summary of the results of the ecological monitoring.

EMA-1: Woodland Tree Health, Woodland Regeneration and Woodland Flora Species Diversity:

- Three fixed forest plots have been established in Lot 26 and 27, north of Area 1b of the Keppel Quarry. (**Figure 3**). All trees which are >10cm diameter at breast height (dbh) have been tagged for long-term monitoring. All monitoring aspects of points **I** (a - i), **II** (a - d) and **III** (a - c) noted within the AMP-Ecological Monitoring Plan have been completed. Ecological data and site photographs are provided under Appendix 1 of the AWS report (**Appendix D**).

EMA-2: Woodland Breeding Birds:

- Eight fixed woodland point counts have been established north of the Area 1b. The location of each plot was based on the two transect lines as shown on **Figure 3** with four point counts established along each transect line. Point Count data and site photographs are provided under Appendix 2 of the AWS report (**Appendix D**).

EMA-3: The Glen Area s1 to s3 Groundwater Discharge Feature:

- Two fixed 1m x 1m vegetation monitoring plots have been established immediately down gradient of springs s1 and s2 for observations on flora species diversity. Plot data and site photographs are provided under Appendix 3 of the AWS report (**Appendix D**).

EMA-4: The Shouldice Wetland at the s8 groundwater discharge feature:

- Two fixed 1m x 1m vegetation monitoring plots have been established immediately down gradient of springs s8 and s9 for observations on flora species diversity. Plot data and site photographs are provided under Appendix 3 of the AWS report (**Appendix D**).
- Logging activity in Area 1b and Area 2 prevented the completion of an Anuran survey in 2015. Anuran survey works for baseline monitoring will be undertaken in 2016 with the findings provided in a Supplement Ecological Monitoring Report.

EMA-5: The Woodland Ephemeral Pond amphibian breeding surface water feature:

- Logging activity in Area 1b and Area 2 prevented the completion of an Anuran survey and day time egg mass searches in 2015. A nuran survey works for baseline monitoring will be under taken in 2016 with the findings provided in a Supplement Ecological Monitoring Report.

EMA-6: The lobe of the Shouldice Wetland encompassing spring s13 and the Dugout Pond and the upper headwater channel for the East Branch of Park Head Creek:

- Two 1m x 1m vegetation monitoring plots have been established in proximity to spring s13 and in the outlet channel of the dugout pond for the purpose of flora species diversity observations (**Figure 3)**. Plot data and site photographs are provided under Appendix 3 of the AWS report (**Appendix D**).
- No water was observed flowing within this outflow channel in August, 2015. Extensive graminoid growth was observed in the channel with muck soils. No fish or aquatic invertebrates were evident. Plot data and s ite photographs are provided under Appendix 3 of the AWS report (**Appendix D**).
- Limited macro-invertebrate diversity sampling was accomplished in the dugout pond during August 2015 due to excessive organic/muck and extensive emergent vegetation growth.
- Sampling within the outflow channel was limited by little surface water. Sampling occurred at S13-D but no invertebrates were captured.
- Since Anuran surveys could not be completed at the other EMAs due to logging activity, the Anuaran survey at EMA-6 was postponed until 2016 so that this survey could be done in tandem with the Anuaran survey for EMA-4 and EMA-5. Findings shall be provided in the supplemental report.

5.0 TREE PRESERVATION PLAN

Condition 6.0 of the AMP requires the implementation of the Tree Preservation Plan (TPP) for the Keppel Quarry. This plan requires the preservation of trees within the three zones of the TPP Corridor along County Road 17 and Concession Road 10 (**Figure 11**). The results of the TPP after year one are presented in Section 4.0 of the AWS Report (**Appendix D).** The following is a summary of the results of the TPP.

Zone 1

Zone 1 of the TPP Corridor is the front line of existing trees in Area 1A (**Figure 11**). This front line of trees is approximately 5 m wide and serves to protect successive trees, which visually screen Area 1a along County Road 17.

Trees in this zone were assessed in September 2014. Appendix 4 of the AWS report (**Appendix D**) provides the 2014 data summary and identifies which trees require replacement and trees that will require replacement in the future due to poor growing or health standards. Protocols for replacement will be provided in the Year 1- Supplemental Monitoring Report.

Zone 2

Zone 2 of the TPP Corridor is a stand of existing trees that shall remain at least 20 m wide to visually screen Areas 1B, Area 2 and Area 3 along County Road 17. No monitoring data on the trees in this zone was collected in 2015. MTE understands that Zone 2 data shall be collected and provided in the Year 2 - Ecological Monitoring Report (AWS Report – **Appendix D**).

Zone 3

Zone 3 of the TPP Corridor is a stand of existing trees that shall remain at least 30 m wide to visually screen Areas 2 and Area 3 along Concession Road 10. No monitoring data on the trees in this zone was collected in 2015. MTE understands that Zone 3 data shall be collected and provided in the Year 2 - Ecological Monitoring Report (AWS Report – **Appendix D**).

6.0 BLASTING MONITORING PROGRAM

Condition 8.2 of the AMP requires the implementation of the Blasting Monitoring Program to ensure that blasting operations are carried out in a safe and productive manner and to ensure no damage to any buildings, structures or residences surrounding the Keppel Quarry.

Blasts were designed by Consbec Inc. so that the seismic activity (vibrations) and noise induced by blasting operations remain within the guidelines set by the MOECC. The Blast design completed by Consbec Inc. and during extraction of Area 1a is found in **Appendix E1**. HSCL staff were trained by a Consbec Inc. to properly install, monitor, record and report the blast induced vibrations and overpressure. As per Condition 8.1 of the AMP, all blasts were monitored for vibration and overpressure using digital seismographs at the following Blasting Receptors (BR):

- BR1 - Ritchie Property; and
- BR2 - Cramp Property.

Although not required by the AMP, the following blasting receptors were also monitored:

- BR3 - McGregor residence; and
- BR4 - Ruthven residence.

The location of each blasting receptor is shown on **Figure 4**. The following is a summary of the results of the Blasting Monitoring Program.

6.1 Blast Monitoring Results

MTE understands there were six blasts in 2015 while extraction occurred in Area 1a on the following dates:

- May 26, 2015;
- June 30, 2015;
- August 5, 2015;
- September 4, 2015;
- September 30, 2015;
- November 10 2015; and
- December 1, 2015.

Event Reports showing noise and v ibration readings measured in 2015 during each blast are found in **Appendix E2** and the results are summarized in **Table 22**. Seismograph readings showed that vibrations levels ranged from 1.4 mm/sec (BR4) to 27.2 mm/sec (BR1 or BR2). O n average the vibration levels were 5.10 mm/sec. Overpressure readings ranged from to 95.92 dB (Doug Wilde Residence) to 127.1 dB (BR2), 120.8 dB on average.

The recommended limit set by the MOECC for vibration and overpressure (noise) are as follows:

- Vibration - 12.5 mm/sec
- Overpressure (Noise) - 128 dB

There were two vibration exceedances for vibration in 2015. The first exceedance occurred during the blast on September 30, 2015 at BR1 or BR2 (27.2 mm/sec). The second exceedance occurred on N ovember 10, 2015 at BR2 (20.1 mm/sec). MTE understands that instrument error is the cause for these exceedances. All measured values for overpressure were below the recommended MOECC limit.

There was one complaint received from the public in 2015 related to vibration and overpressure. This complaint was received from the resident at 302377 Grey Road 170, approximately 1.5 km from the Keppel Quarry. H SCL investigated the complaint and a seismograph monitoring station was established at this location on August 5, 2015. The results of the monitoring showed that the vibration and overpressure levels were within MOECC limits (3.44 mm/sec for vibration and 95.92 for overpressure – see **Table 22)**. MTE understands that the results were reported to the resident and further understands that no further monitoring was required.

In addition to the vibration and overpressure, there was no flyrock generated beyond the blast area in any of the blasts in 2015.

To ensure no negative impact related to blasting, Condition 8.3 of the AMP requires private well no. 3345 (the Ritchie well) and the replacement water supply well on Mr. Cramp's property to be sampled annually for the following parameters:

- hardness, alkalinity, pH, conductivity, chloride, nitrite, nitrate, calcium, magnesium, iron, ammonia and sodium.

Since the resident at Private Well 3345 declined to be part of the program in 2015, a sample was not obtained. No sample has been collected from the replacement well on Cramp's property because the installation of this well is not required until extraction commences in Area 1b. Water quality samples were collected from the existing Cramp well (well no. 7253) as part of the monitoring conditions of Niagara Escarpment Development Permit (Permit Number 6468/G/E/2011-2012/9072). These water quality results are found in **Appendix C-7**.

7.0 SITE PLAN AMENDMENTS

Trigger values for the Sentry Wells require revisions. MTE has proposed new trigger values as outlined in **Table 20**. As such, a Site Plan amendment may be required.

8.0 CONCLUSIONS

MTE offers the following conclusions:

- The general year-over-year baseline seasonal pattern of the groundwater regime is comprised of higher water levels in winter and/or during the spring freshet (snowmelt), decreasing through the summer and early-autumn, followed by a smaller increase during the mid to late-autumn. As expected, monitors located close to the quarry showed lower water levels than those further away from the quarry.
- Water levels measured at the Sentry wells showed baseline seasonal trends for bedrock. No fluctuations in water levels at the Sentry wells were related to extraction in Area 1a.
- The movement of groundwater into the Shouldice Wetland was unaffected by extraction in Area 1a in 2015.
- Groundwater levels measured from observation wells between the Site and the portion of the Glen Management Area north of Area 1a were consistent with baseline seasonal fluctuations indicating that the movement of groundwater between the Site and this portion of the Glen Management Area was unaffected by extraction in Area 1a in 2015.
- The effects of drawdown in the deep bedrock groundwater regime diminish with distance from the quarry face.

- The magnitude of drawdown influence is greatest within the extraction area, and decreases relatively quickly with distance away from the quarry extraction faces. Beyond 400 m there is no impact to groundwater resources related to the Keppel Quarry.
- No water issues were encountered while extraction occurred in Area 1a. All dewatering was done within the specification of the Permit, which suggests the quarry did not intercept any large water-bearing fractures that may affect groundwater resources.
- Precipitation data collected on-Site showed that 2015 was ‘dryer’ than average.
- The groundwater recharge zone within 100 m of the Shouldice Wetland was not affected by extraction in Area 1a. .
- The groundwater vertical hydraulic gradients in the Shouldice Wetland and/or the bedrock underneath the wetland were not affected by extraction in Area 1a.
- Water levels, flows and chemistry (EC and temperature) at the springs monitored in the Shouldice Wetland (s8 and s13) and the dugout pond were not affected by extraction in Area 1a.
- Based on the flow observations made at the springs and culverts in 2015, the hydroperiod for the Shouldice Wetland ended in the summer and resumed in late fall, which is consistent with historical data.
- The hydroperiod for the springs found in the portion of the Glen Management Area north of Area 1a extended from January through December in 2015, which matched the hydroperiod for the flow through the beaver dam and into the sinkhole (May through December).
- No mitigation actions were required in 2015, despite exceeded trigger values at the Sentry Wells, because all groundwater trends exhibited baseline seasonal fluctuations.
- There were no well interference complaints received by HSCL in 2015.
- Water levels measured in private wells owned by residents participating in the Private Well Monitoring Program (Category A and B) showed normal baseline seasonal fluctuations or drawdown related to the normal household use of the well. No water fluctuations were observed related to extraction in Area 1a.
- No flyrock was generated beyond the blast area in any of the blasts in 2015. The Blasting Monitoring Program showed that there were there were two vibration exceedances for vibration in 2015 that were related to instrument error. All measured values for overpressure were below the recommended MOECC limit.
- HSCL received one complaint related to vibration and overpressure in 2015 from a resident 1.5 km from the Keppel Quarry. HSCL investigated the complaint and completed additional monitoring. The results showed that vibration and overpressure levels were within MOECC limits. No further monitoring was required.

Based on the monitoring data provided, MTE concludes that there was no overall negative impact of the quarry operation on the groundwater flow system in 2015.

9.0 RECOMMENDATIONS

MTE offers the following recommendations:

1. Keep a record of the inspections. HSCL has agreed to keep a photolog of the working face after each blast so that they can be included in future reports.
2. Replace observations wells OW11s and OW11d in 2016.
3. Revise seasonal trigger values for each Sentry Well, s8, s13 and SG1 (the dugout pond) to reflect the updated baseline data.
4. Measure water levels using the staff gauge installed in the ephemeral pond during the amphibian breeding season, which extends from April 1 to June 30.
5. Survey the well head of all Private Wells (Category A and B) for elevation and location with respect to meters above sea-level using total station or GPS survey equipment so that trigger values can be established.
6. Collect at least three years of water level data from all Category B Private Wells before a yellow trigger value is calculated.
7. Retain a qualified person to complete the Anuran survey in EMA-4, EMA-5, EMA-6 in 2016 so that the baseline monitoring requirements as per Condition 5.0 of the AMP can be satisfied.
8. Collect monitoring data on the trees in this Zone 2 and 3 as per the TPP and provide the results of this monitoring in the Ecological Monitoring Report for Year 2.
9. Review the environmental conditions and blast design parameters. Make reasonable adjustments for subsequent blasts. Report the findings and remedial measures to be taken for subsequent blasts to complainants and affected residents.
10. A Site Plan amendment may be required to revise the trigger values for the Sentry Wells as the quarry operation progresses.

10.0 LIMITATIONS

Services provided by **MTE Consultants Inc**. (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Environmental Engineering & Consulting profession. No other warranty or representation, expressed or implied, as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of MTE and their client. It was completed in accordance with the scope of work identified in the introduction of the text. As such, this report may not deal with all issues potentially applicable to the Site and may omit issues, which are, or may be, of interest to the reader. MTE makes no representation that the present report has dealt with any and all of the important features, including any or all important environmental features, except as provided in the Introduction. All findings and conclusions presented in this report are based on Site conditions, as they existed during the time period of the investigation. This report is not intended to be exhaustive in scope or to imply a risk-free facility.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such third parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by any third party as a result of decisions made or actions taken, based upon this report. Others with interest in the site should undertake their own investigations and studies to determine how or if the condition affects them or their plans.

It should be recognized that the passage of time may affect the views, conclusions and recommendations (if any) provided in this report because environmental conditions of a property can change. Should additional information become available, MTE recommends that it be brought to our attention in order that we may re-assess the contents of this report.

We trust this meets your current requirements. If you have any questions or comments, please do not hesitate to contact the undersigned directly at (519) 743-6500.

Respectfully submitted,

MTE CONSULTANTS INC.

PROFESSIONAL GEOSCIENTIST
May 30/16
PETER A. GRAY
PRACTISING MEMBER
0335
ONTARIO

Jay Flanagan, B.E.S.
Project Manager

Peter A. Gray, P.Geo., QPESA
VP., Senior Hydrogeologist

JBF:scp

11.0 GLOSSARY OF TERMS

Bedrock (epikarst) - The epikarst is a zone of bedrock openings enhanced by solution weathering that directs flow to local surface features located on the top of the Amabel Plateau. Epikarst found in the Study Area is typically three to five metres deep and is highly efficient at redirecting recharge water (i.e. snow melt water and/or precipitation) infiltration laterally to natural features, such as the Shouldice Wetland. The epikarst component has been described in detail by Daryl W. Cowell & Associates Inc. (Cowell, 2009).

Bedrock (shallow) - Groundwater in the shallow bedrock has shown a delayed response to the presence of the existing Keppel Quarry. Current evaluations showed that shallow groundwater remained unaffected until the existing Keppel Quarry face was within approximately 40 m of an observation well (MTE, 2010). The reduced effect in the shallow bedrock may be, in part, due to recharge received through the epikarst system.

Bedrock (deep) - Current interpretations (MTE, 2009) have shown that the extreme outer edge of the cone of influence for the deep bedrock groundwater was observed up to approximately 400 m away from the face of the existing Keppel Quarry (MTE, 2009 and WGC, 2009). The hydraulic properties (Hydraulic Conductivity and Transmissivity) of the bedrock at the Keppel Quarry are similar to those surrounding the existing Keppel Quarry, and so it is predicted that the Keppel Quarry will exert a similar drawdown on the surrounding deep bedrock groundwater flow system.

Biologist/Ecologist – A scientist who studies living organisms and their relationship to their environment.

Blast Induced Peak Particle Velocity – The rate of change of the velocity amplitude usually measured in mm/sec or in/sec. This is the excitation of the particles in the ground resulting from vibratory motion induced by the blasting operations.

Blast Induced Overpressure – A compression wave in air caused by:
a) The direct action of the unconfined explosive; or
b) The direct action of the confining material subjected to explosive loading.

Co-dominant Tree – a tree that extends its crown into the canopy and receives direct sunlight from above but limited sunlight from the sides. One or more sides of a co-dominant tree are crowded by the crowns of dominant trees.

Cone of Influence – a pumping cone or cone of depression formed in an aquifer around a pumping well as the water level declines. In the case of a quarry, the excavation acts similar to a large well in that surrounding water levels decline in proximity to the quarry resulting in a depressed groundwater surface.

Coniferous Tree – any tree that produces seeds in cones.

Crown – the uppermost branches and foliage of a tree.

Cumulative Caliper – calculated by adding the DBH of several smaller trees planted to replace a Preservation Tree.

Deciduous Tree – shedding or losing leaves annually; the opposite of evergreen. Trees such as maple, ash, cherry, and larch are deciduous.

Diameter at Breast Height (DBH) – is a standard method of expressing the diameter of the trunk of a standing tree, usually taken at 4 1/2 feet above the ground.

Crown Class – see: Co-dominant Tree, Dominant Tree, Intermediate Tree, and Suppressed Tree.

Dominant Trees – trees that extend above surrounding individuals and capture sunlight from above and around the crown.

Emerald Ash Borer – is a green beetle native to Asia and Eastern Russia. Outside its native region, the emerald ash borer (also referred to as EAB) is an invasive species, and emerald ash borer infestation is highly destructive to ash trees in its introduced range. The emerald ash borer was first discovered in America in June 2002 in Michigan. It is believed to have been brought to America unintentionally in ash wood which was used to stabilize crates during shipping.

Environmental Receptor – a groundwater or surface water feature where the quarry influence may have an effect.

Groundwater Sink – a depression in the water table that causes water to be drawn from surrounding groundwater resources.

Hydraulic Conductivity – the rate of flow of water through a porous medium such as bedrock fractures or bedding planes.

Hydraulic Gradient – is the change in static head per unit of distance in a given direction.

Hydrogeologist - a professional geoscientist or a licensed professional engineer specializing in hydrogeology.

Hydroperiod – the flow period over which surface water features such as a springs or water courses receives inputs from groundwater and/or overland runoff from surrounding lands.

Infiltration Gallery – a pond or nest of wells drilled into the bedrock that allows water back into the bedrock groundwater flow system.

Intermediate Crown Class – trees with crowns that extend into the canopy with dominant and codominate trees. These trees receive little direct sunlight from above and none from the sides. Crowns generally are small and crowded on all sides.

Karst Flow – the movement of groundwater through preferentially-enhanced fracture zones within the overall bedrock mass. Typically flow rates (as expressed by the hydraulic conductivity) are significantly greater than within non-karst areas of the bedrock aquifer.

Key Indicator – a feature or thing that is used to help evaluate the performance of the quarry with respect to the natural environment.

Live Crown – is the top part of a tree, the part that has green leaves (as opposed to the bare trunk, bare branches, and dead leaves). The ratio of the size of a tree's live crown to its total height is used in estimating its health and its level of competition with neighboring trees.

Long-Term Monitoring Program – a sequence of regular field activities carried out on a monthly basis to collect data on groundwater and surface water to ensure that there are no significant negative impacts to natural features while the quarries proceeds.

'Natural' Spring Flow – water coming from a spring without being artificially augmented. The spring must be flowing in its natural state or in a manner that is comparable to pre-quarry conditions.

Performance Monitoring – an evaluation of the extent of the quarry influence on the surrounding environment. data collected through the groundwater/surface water monitoring program will be compared to baseline conditions (data collected before extraction started).

Pathway – a karst conduit, fracture or bedding plane of bedrock that potentially connects a receptor to the quarry.

Preservation Tree – a tree found in the TPP Corridor that has a minimum DBH of 15 cm or a minimum crown height of 5 m.

Qualified Person (for the Water Resources Monitoring Program) – an independent Hydrogeologist.

Qualified Person (for the Ecological Monitoring Program) – an independent biologist or person specializing in ecology.

Qualified Person (for the Blasting Monitoring Program) – a blasting specialist.

Qualified Person (for the Tree Preservation Plan) – an Ecologist, Landscape Architect, arborist, or forester.

Replacement Tree – A tree(s) found in the TPP Corridor (planted or natural) counted as a replacement for a lost Preservation Tree. The Replacement Tree(s) shall have a minimum DBH of 15 cm or a cumulative caliper DBH of at least 15 cm.

Recovery – water level(s) in an observation well(s) that are equal to or higher than green trigger values for at least three monitoring events space one week apart.

Suppressed Tree – a tree condition characterized by low growth rate and low vigor as a result of competition with overtopping trees.

Transmissivity – the rate at which water is transmitted through a unit width of the aquifer under a unit hydraulic gradient.

Water Table – is the water surface in an unconfined aquifer at which the pressure is atmospheric. It is defined by the levels at which water stands in wells that penetrate the aquifer. In wells penetrating the aquifer to greater depths, the water level will stand above or below the water table if an upward or downward component of groundwater flow exists. It should be noted that the technical standards defined in the *Aggregate Resource Act* for reporting Hydrogeological Information define the water table as the static level or surface that the water rises to within any aquifer (confined or unconfined aquifer), which is also referred to as the potentiometric level, and the upper surface as the potentiometric surface.

Water-bearing Fracture – high or turbulent flows from a fracture or bedding plane. Turbulent flow from a water-bearing fracture may be an indication that water is being intercepted from surface water features such as springs. Signs of groundwater inputs in the form of minor leakage and wetted surfaces are not considered turbulent flow.

Well Interference – an unacceptable reduction in groundwater quantity and/or degradation in water quality to a private well caused by dewatering the quarry.

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FIGURES

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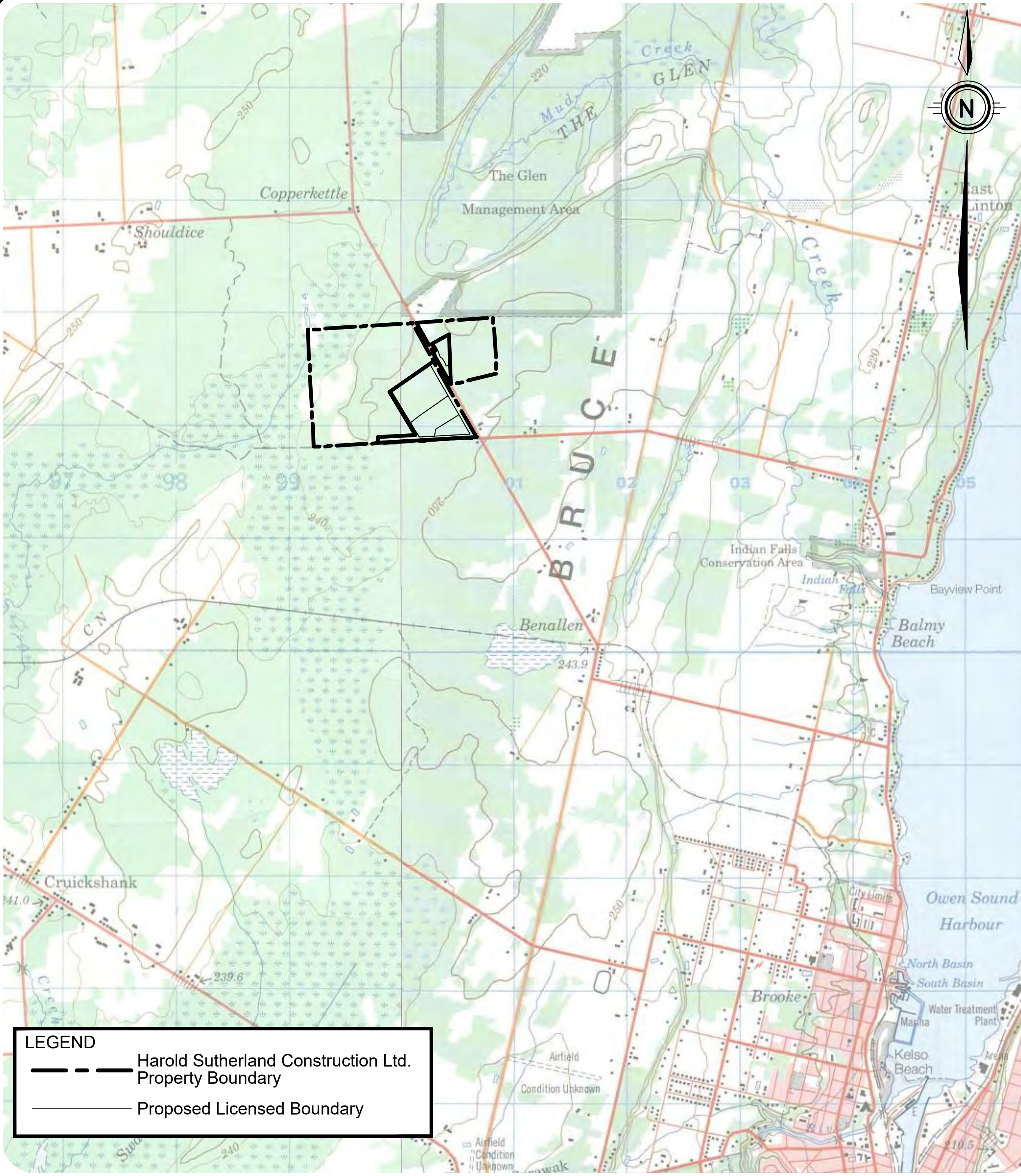

Figure 1 KEY MAP

25 YEARS 1985-2010

MTE

ENVIRONMENTAL DIVISION

Project Name			
Keppel Quarry			
Site		Client	
Georgian Bluffs, Ontario		Harold Sutherland Construction Limited	
Scale	MTE Project No.	Date	Layout No.
1:50,000	33862-100	July 2012	EV4.4

July 11, 2012 – 1:49 p.m. – Plotted By: emacintyre

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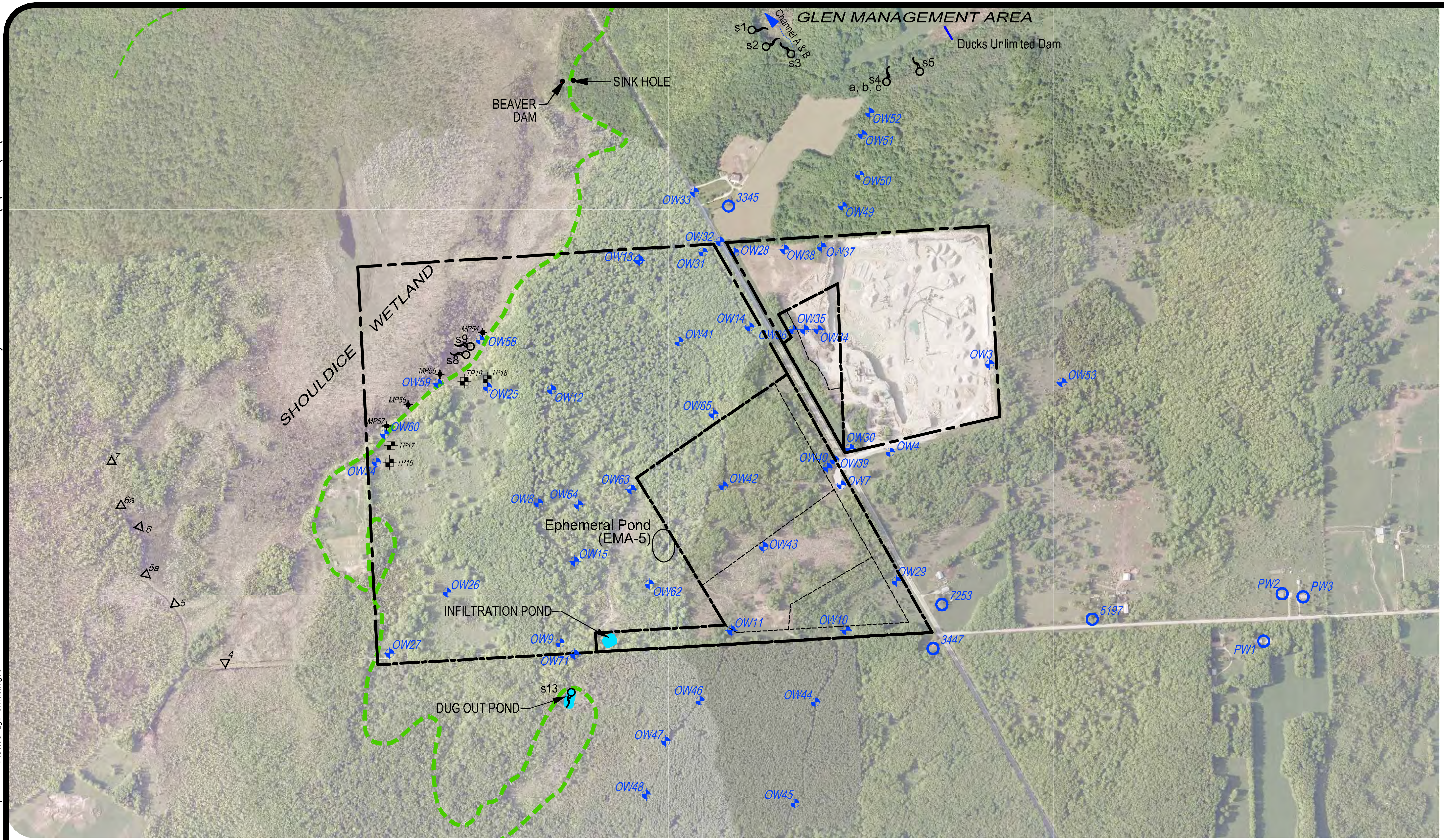

LEGEND

- Extraction Area
- Licensed Boundary
- HSCL owned lands
- Surface Water Monitoring Locations
- Wetland Boundary
- OW15 Monitoring Well
- 3447 Private Well (Category A)
- PW1 Private Well (Category B)
- TP18 Test Pit
- MP55 Mini Piezometer

May 19, 2016 – 2:46 p.m. – Plotted By: emacintyre

MTE
Engineers | Scientists | Surveyors

Figure 2 WATER RESOURCES MONITORING NETWORK

Project Name			
Keppel Quarry			
Site: Georgian Bluffs, Ontario		Client: Harold Sutherland Construction Limited	
Scale: 1:10,000	MTE Project No.: 33862-100	Date: April 2016	Layout No.: EV30.3

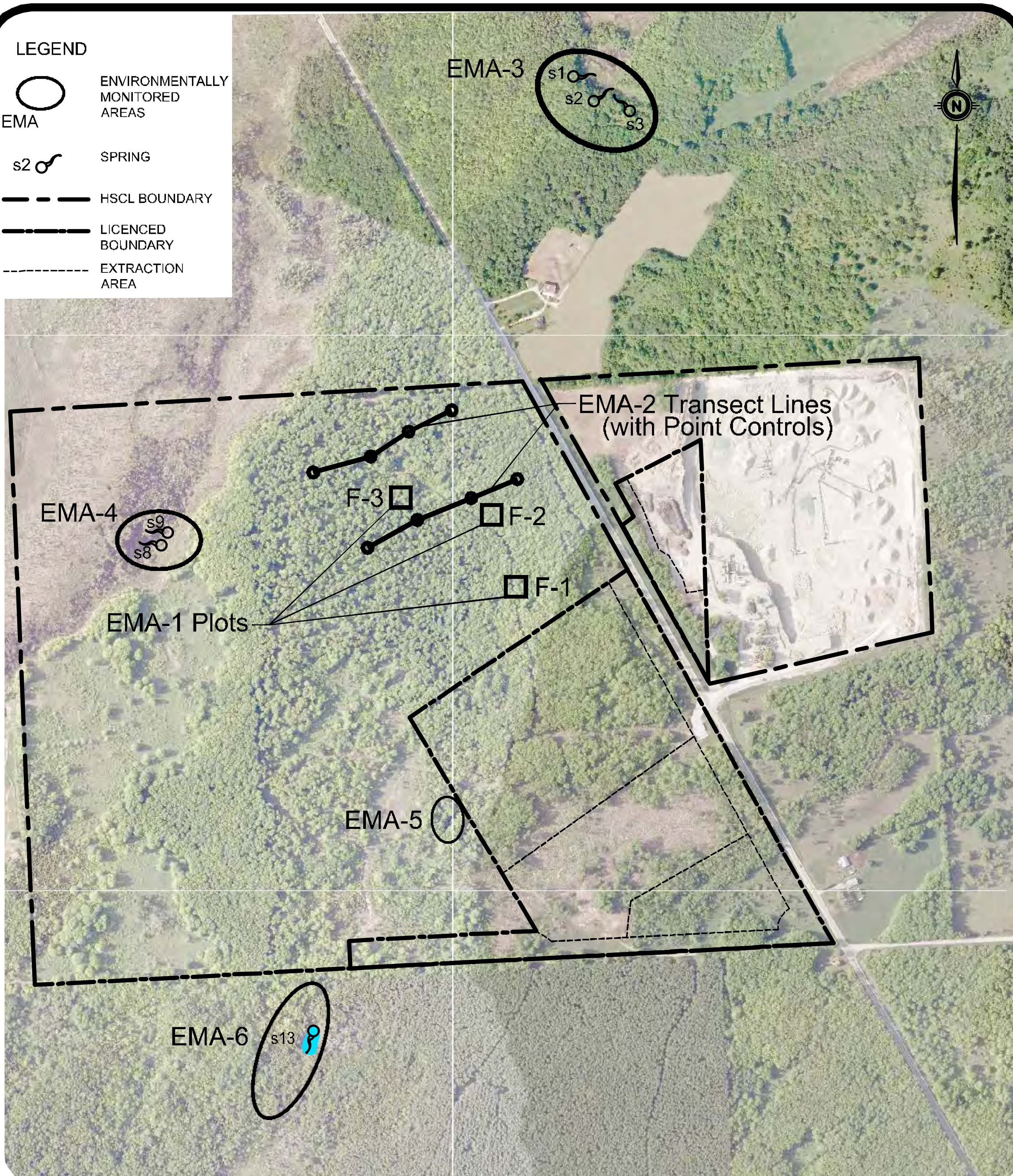

Figure 3 ECOLOGICAL MONITORING NETWORK

MTE Engineers | Scientists | Surveyors

Project Name			
Keppel Quarry			
Site		Client	
Georgian Bluffs, Ontario		Harold Sutherland Construction Limited	
Scale. (8.5x11)	MTE Project No.	Date	Layout No.
1:5000	33862-100	May 2016	EV14.1

Project: 33862–100 CAD: P:\P\33862\EV\33862–100–EV15.DWG EV4.9 May 13, 2016 – 2:46 p.m. – Plotted By: emacintyre

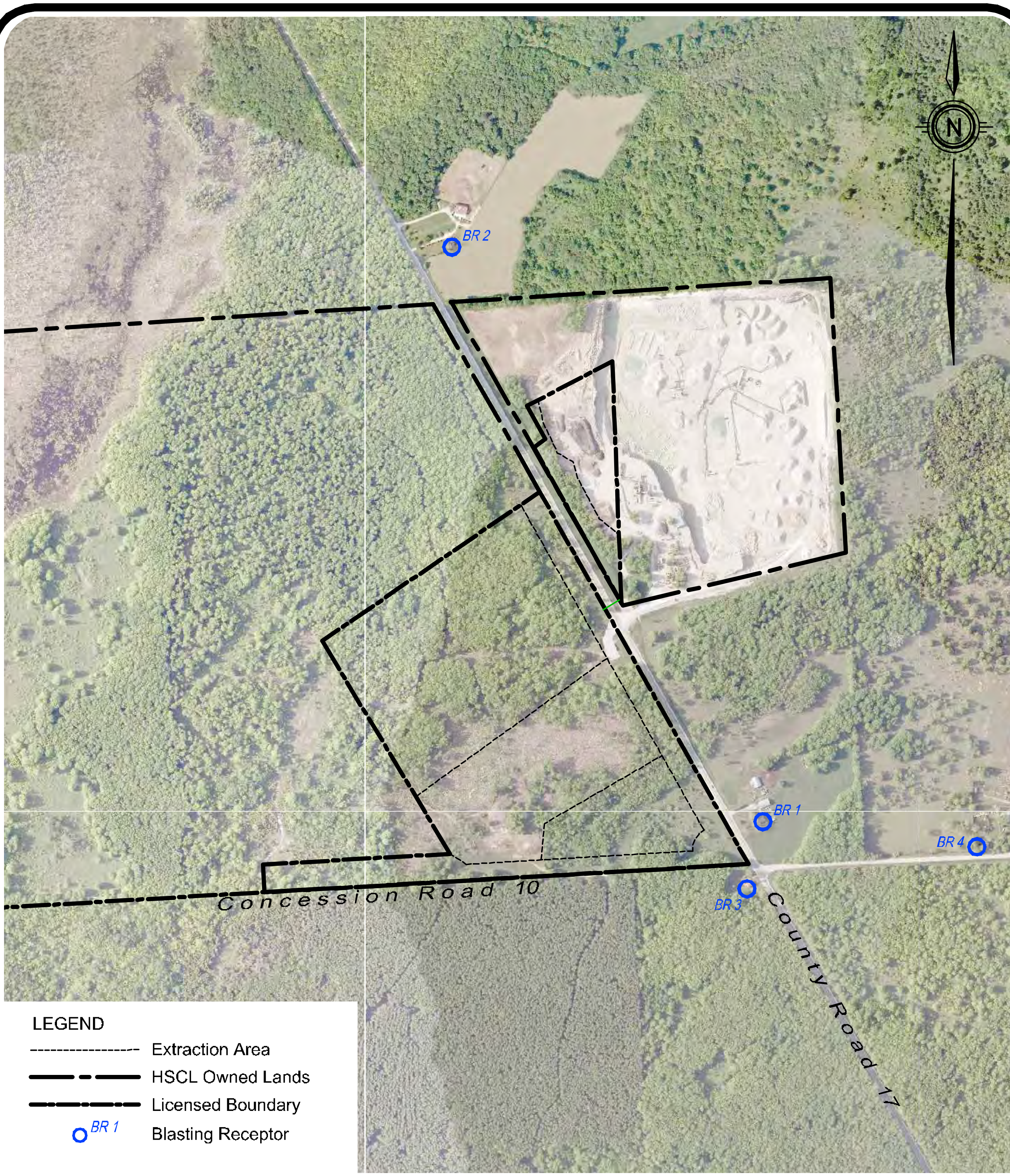

Figure 4 BLASTING MONITORING LOCATIONS

MTE
Engineers | Scientists | Surveyors

Project Name	
Keppel Quarry	
Site	Client
Georgian Bluffs, Ontario	Harold Sutherland Construction Limited

Scale. (8.5x11)	MTE Project No.	Date	Layout No.
1:10,000	33862-100	May 2016	EV4.9

Project: 33862-100 CAD: P:\P\33862\EV\33862-100-EV13.DWG

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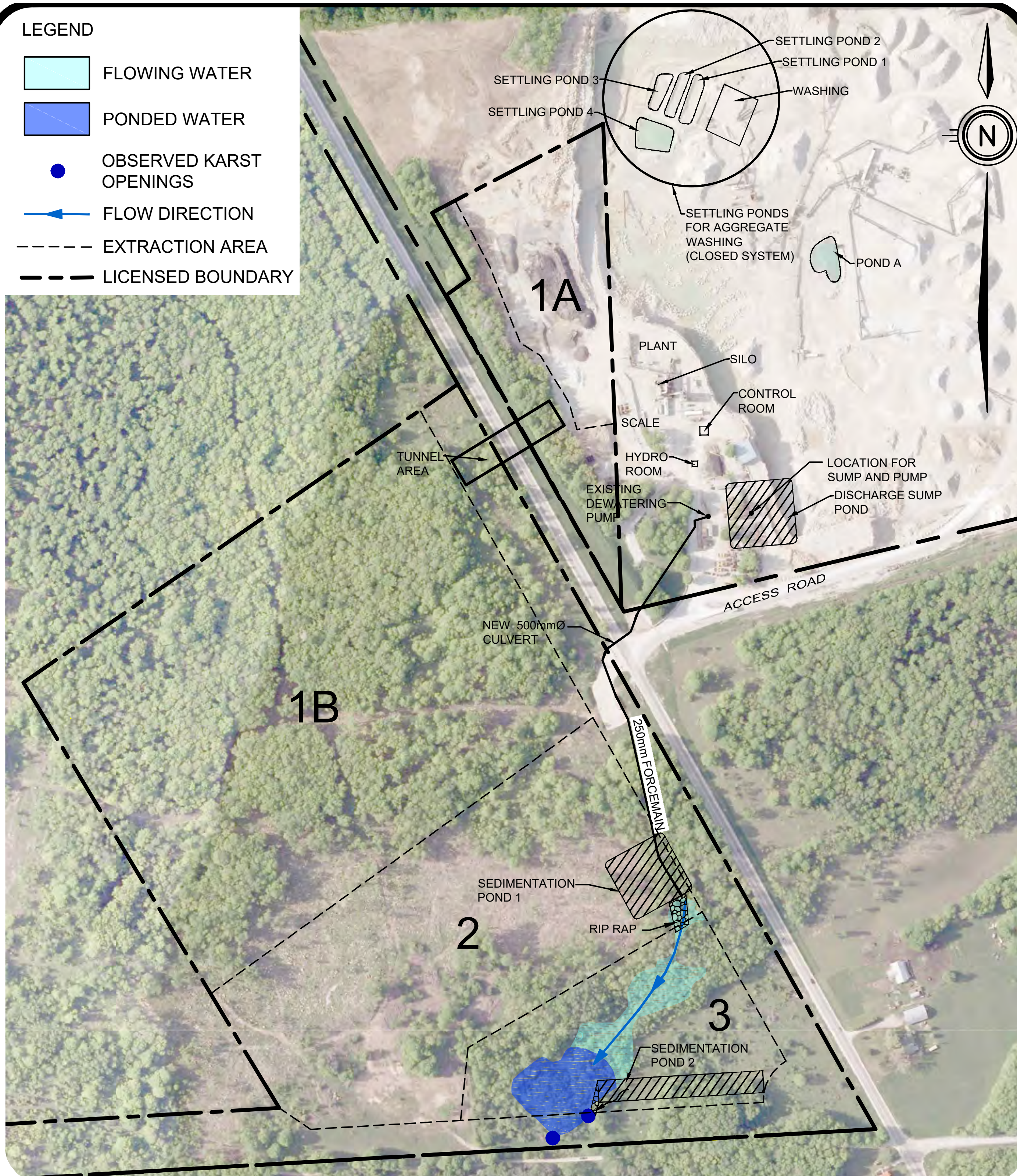

Figure 5 SEQUENCE OF OPERATIONS MAP

MTE 25 YEARS 1985-2010

Project Name			
Keppel Quarry			
Site		Client	
Georgian Bluffs, Ontario		Harold Sutherland Construction Limited	
Scale.	MTE Project No.	Date	Layout No.
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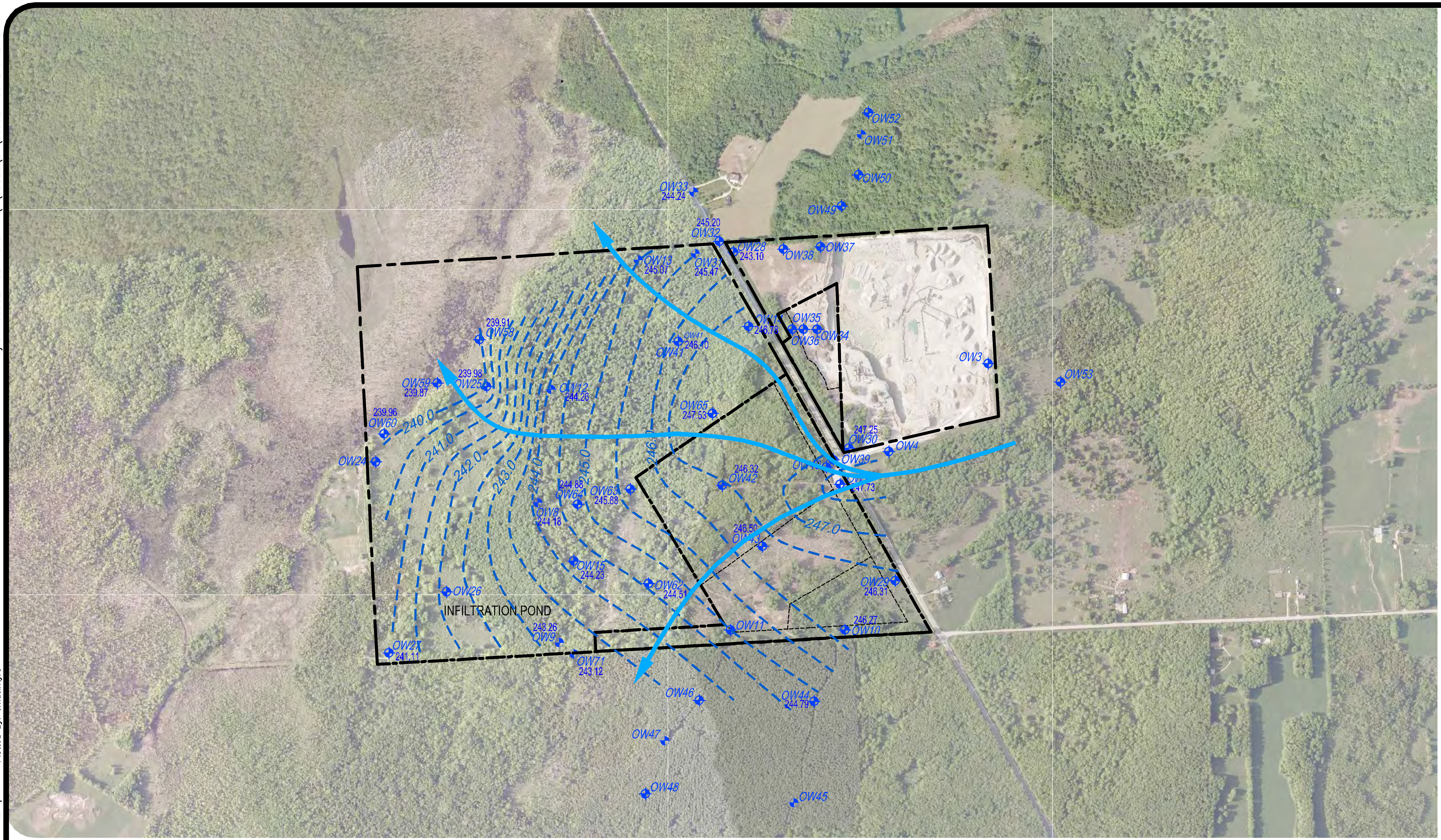

LEGEND

Extraction Area

Licensed Boundary

HSCL owned lands

OW15 243.47 Monitoring Well
Groundwater Elevation (masl) on Nov. 17/15

Direction of Groundwater Flow

May 5, 2016 – 1:21 p.m. – Plotted By: emcintyre

Figure 6 SHALLOW BEDROCK GROUNDWATER REGIME Nov. 2015

MTE
Engineers | Scientists | Surveyors

Project Name	
Keppel Quarry	
Site	Client
Georgian Bluffs, Ontario	Harold Sutherland Construction Limited

Scale	MTE Project No.	Date	Layout No.
1:10,000	33862-100	April 2016	EV34.1

Project: 33862-100 CAD: P:\P\33862\EV\33862-100-EV33.DWG

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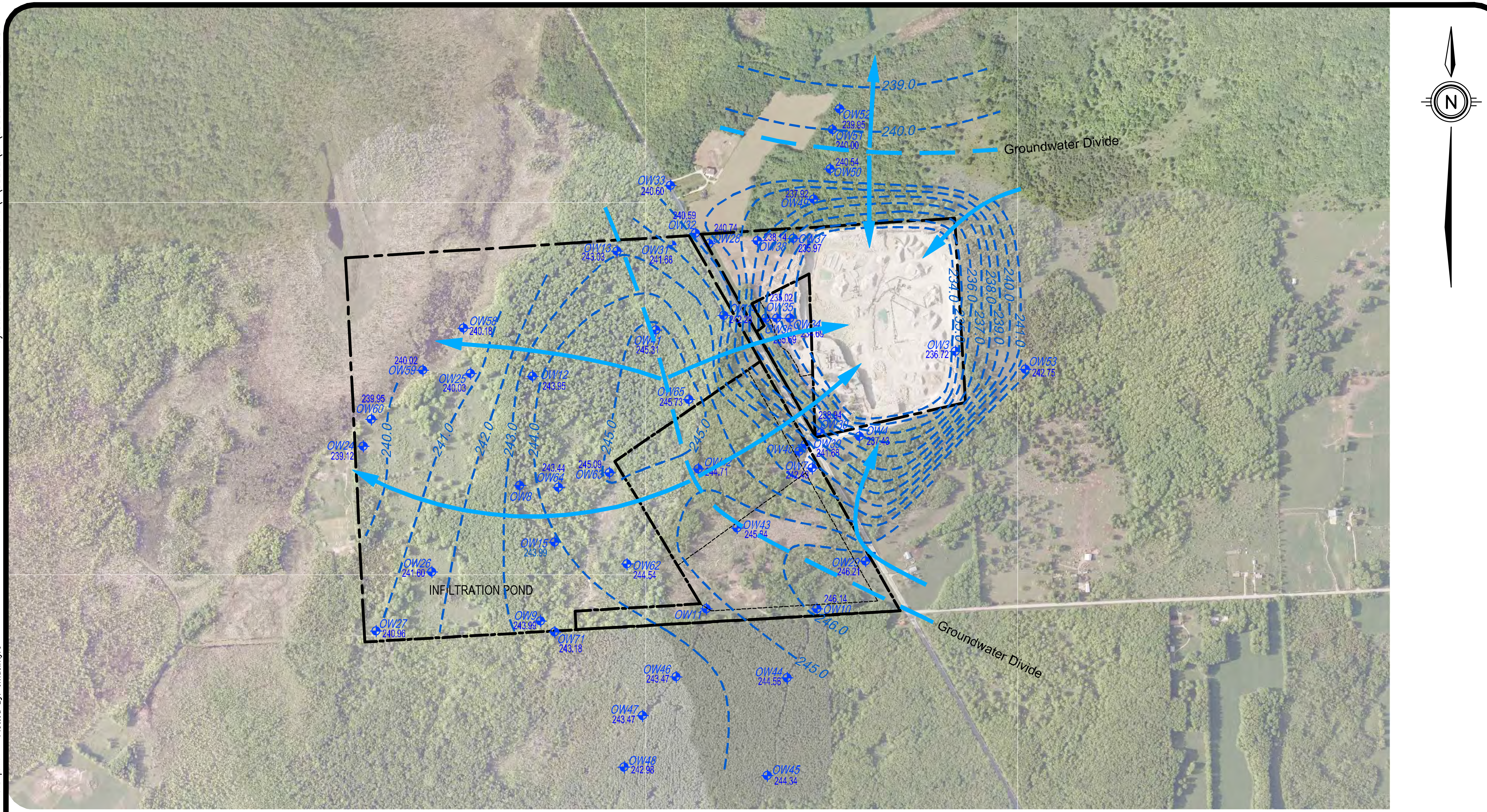


LEGEND

Extraction Area

Licensed Boundary

HSCL owned lands

OW15 243.47 Monitoring Well
Groundwater Elevation (masl) on Nov. 17/15

Direction of Groundwater Flow

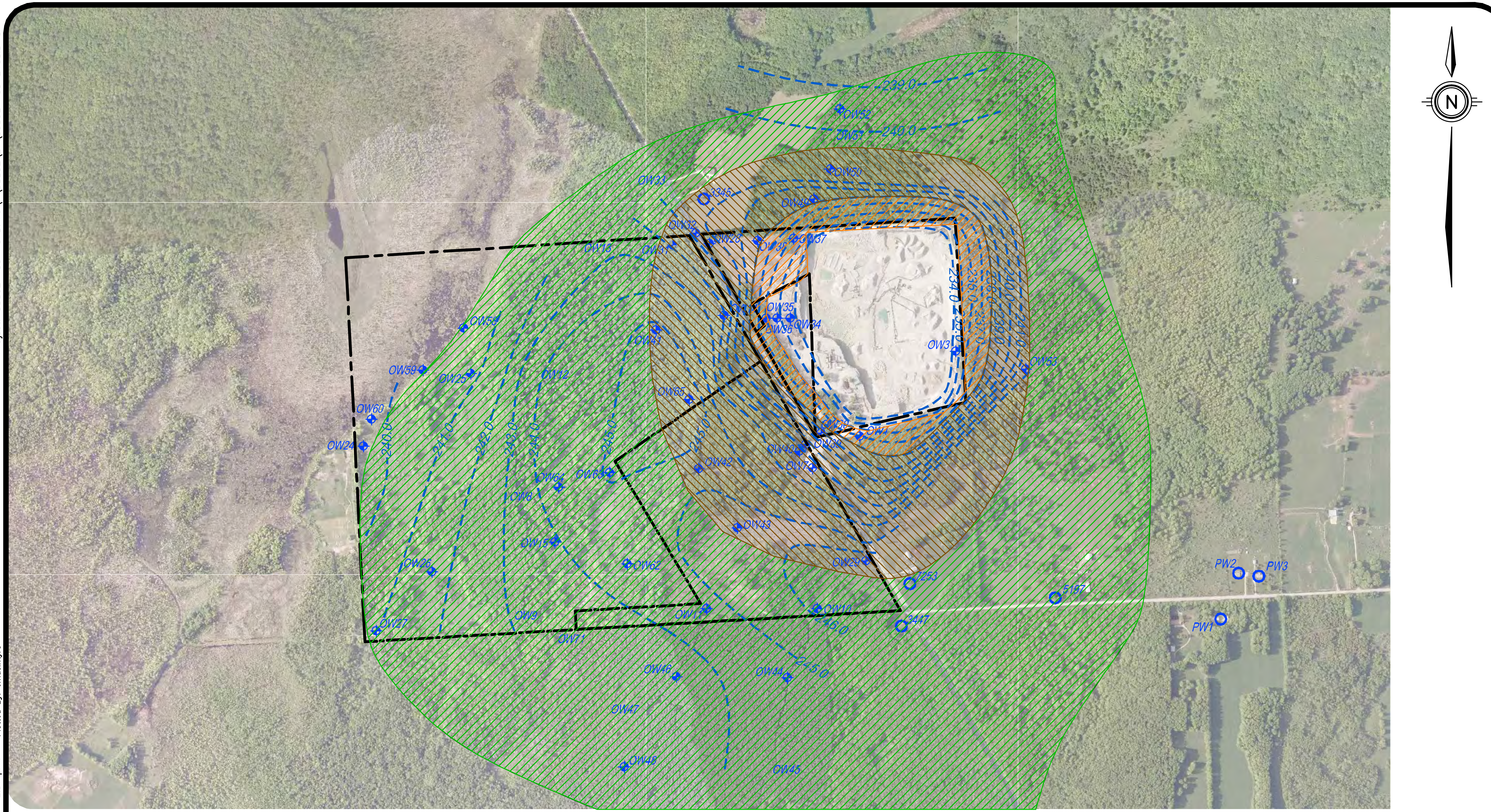
Figure 7 DEEP BEDROCK GROUNDWATER REGIME NOV. 2015

MTE
Engineers | Scientists | Surveyors

Project Name: Keppel Quarry			
Site: Georgian Bluffs, Ontario		Client: Harold Sutherland Construction Limited	
Scale: 1:10,000	MTE Project No.: 33862-100	Date: April 2016	Layout No.: EV33.1

Project: 33862-100 CAD: P:\P\33862\EV\33862-100-EV33.DWG

May 9, 2016 — 2:51 p.m. — Plotted By: emcintyre



LEGEND

-----------------	Extraction Area
—·—·—	Licensed Boundary
— - —	HSCL owned lands
OW15	Monitoring Well
3447	Private Well (Category A)
PW1	Private Well (Category B)
ZONE 1	4 - 10m predicted drawdown
ZONE 2	0 - 4m predicted drawdown
ZONE 3	No Impact predicted

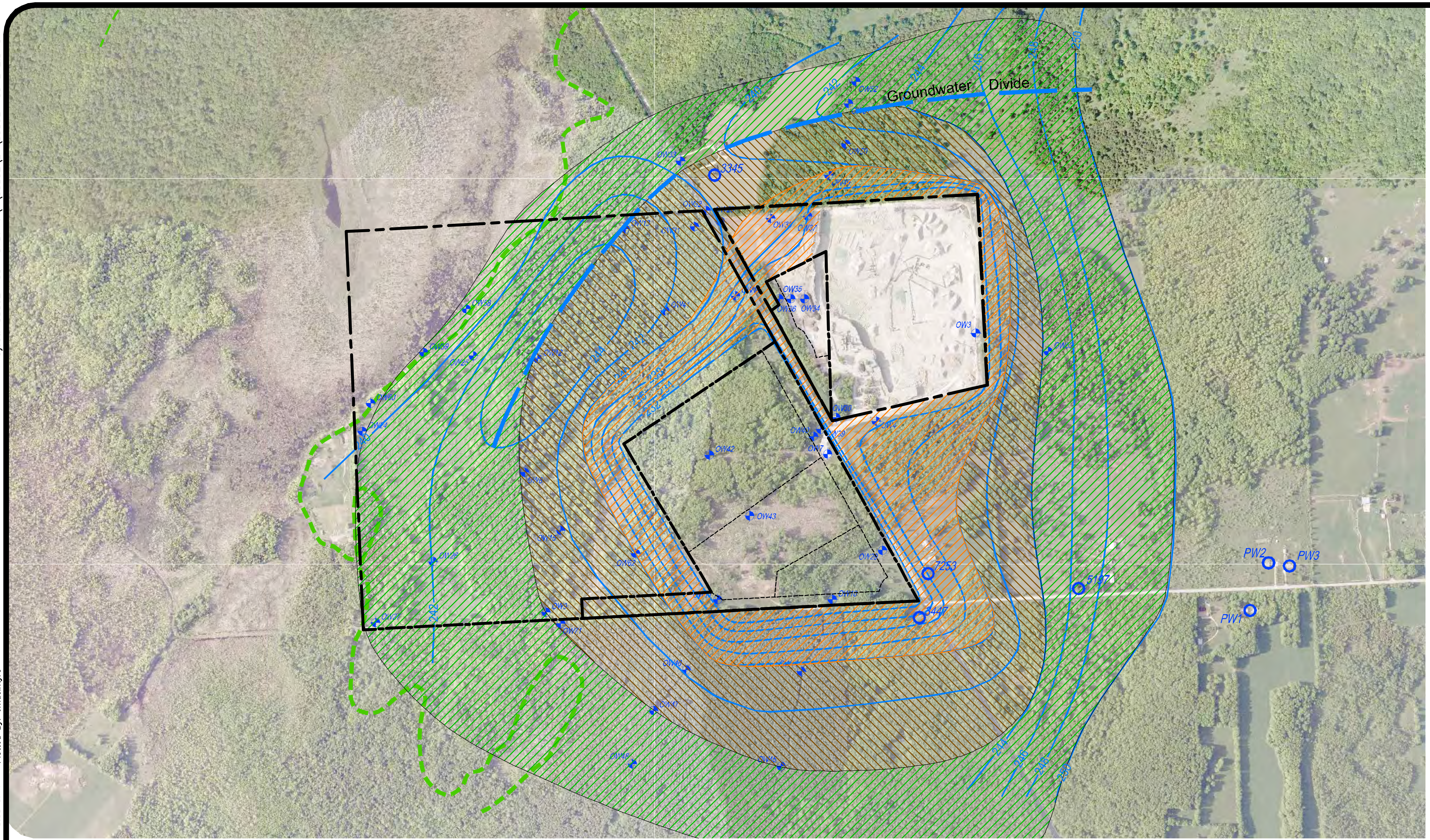
MTE
Engineers | Scientists | Surveyors

Figure 8 INTERPRETED ZONE OF INFLUENCE - 2015

Project Name			
Keppel Quarry			
Site: Georgian Bluffs, Ontario		Client: Harold Sutherland Construction Limited	
Scale: 1:10,000	MTE Project No.: 33862-100	Date: April 2016	Layout No.: EV33.2

Project: 33862-100 CAD: P:\P\33862\EV\33862-100-EV2.DWG

May 6, 2016 — 9:08 a.m. — Plotted By: emacintyre



LEGEND

ZONE 1	4 - 10m predicted drawdown
ZONE 2	0 - 4m predicted drawdown
ZONE 3	No Impact predicted

HSCL Owned Lands

Licensed Boundary

Extraction Boundary

Wetland Boundary

242 Observed groundwater contours (mAMSL) for the deep Amabel Formation -

OW15 Monitoring Well

3447 Private Well (Category A)

PW1 Private Well (Category B)

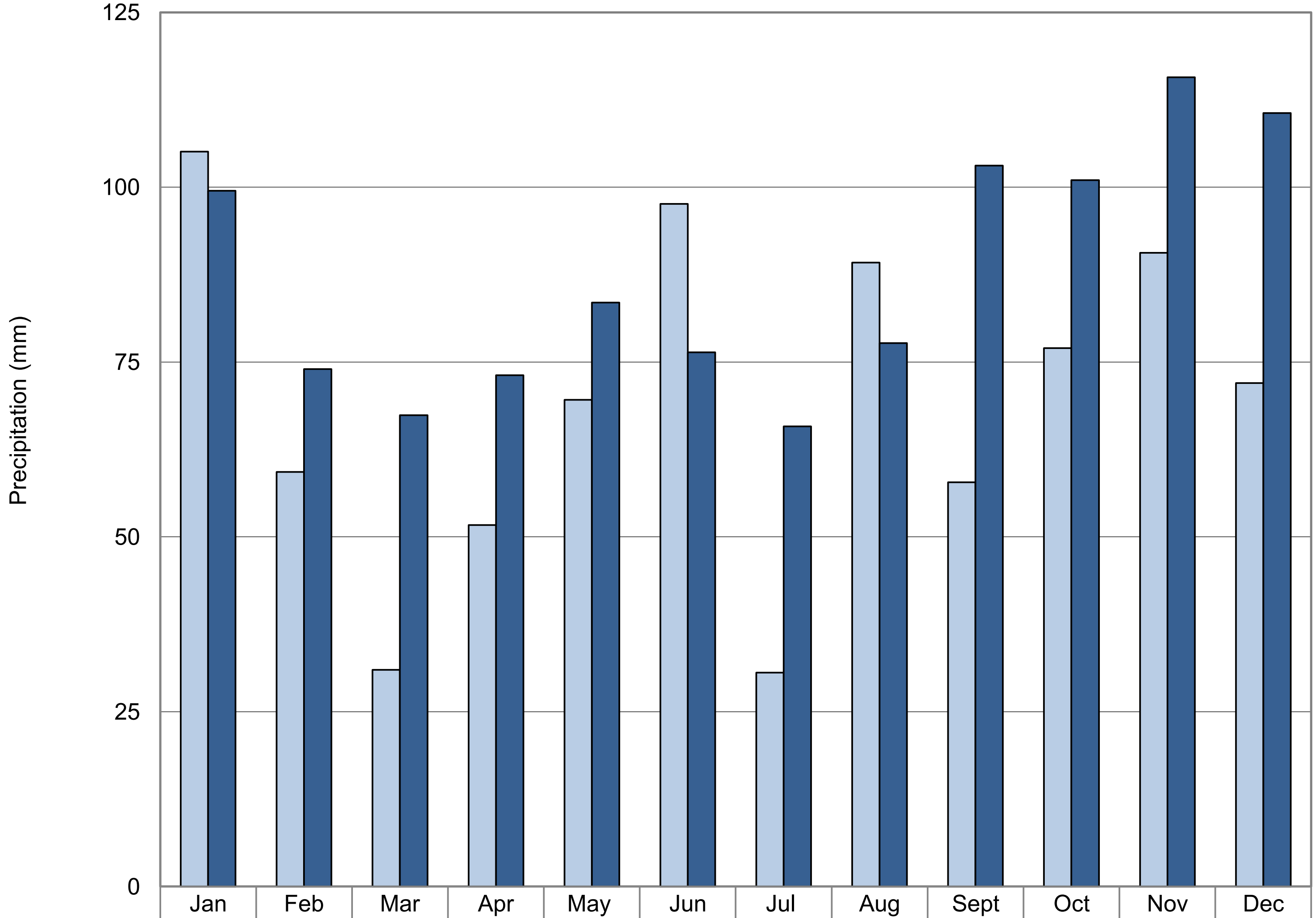
MTE ENVIRONMENTAL DIVISION

Figure 9 PREDICTED ZONE OF INFLUENCE - POST EXTRACTION

Project Name	
Keppel Quarry	
Site	Client
Georgian Bluffs, Ontario	Harold Sutherland Construction Limited

Scale	MTE Project No.	Date	Layout No.
1:7500	33862-100	April 2016	EV2.3

Figure 10: Precipitation (mm) - Keppel Quarry (2015) vs. Climate Normals (1981 - 2010)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Wiarton Airpot + Keppel Quarry	105.1	59.3	31	51.7	69.6	97.6	30.6	89.2	57.8	77	90.6	72
Climate Normals 1981-2010	99.5	74	67.4	73.1	83.5	76.4	65.8	77.7	103.1	101	115.7	110.6

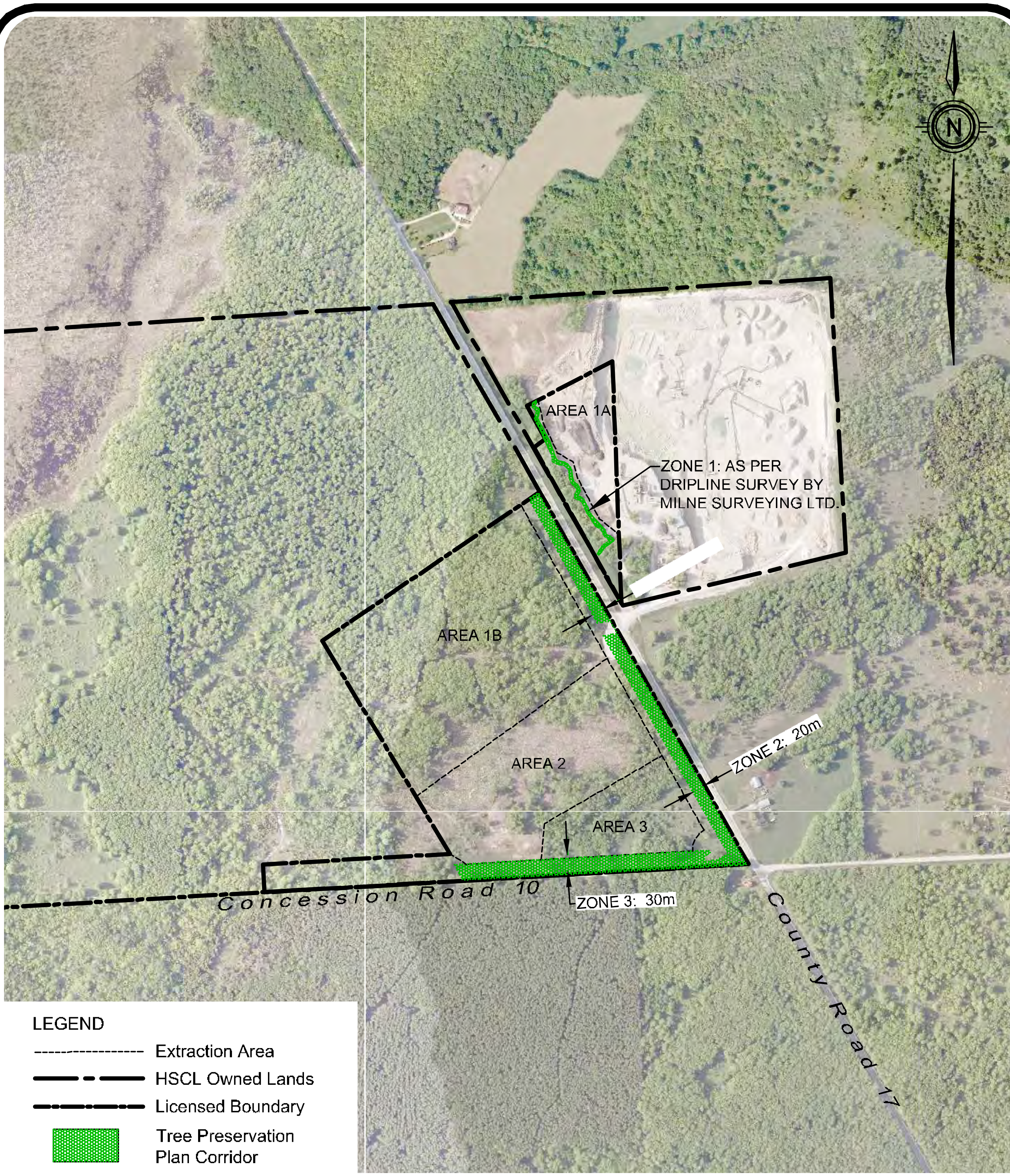


Figure 11 TREE PRESERVATION PLAN

MTE
Engineers | Scientists | Surveyors

Project Name	
Keppel Quarry	
Site	Client
Georgian Bluffs, Ontario	Harold Sutherland Construction Limited

Scale (8.5x11)	MTE Project No.	Date	Layout No.
1:10,000	33862-100	May 2016	EV4.8

TABLES

Table 1: Water Monitoring Program

Item	Station	Type of Monitoring	Number of Events											
			Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Groundwater Monitors	OW3, OW4, OW7s, OW7d, OW8s, OW8d, OW9s, OW9d, OW10s, OW10d, ~~OW11s, OW11d~~, OW12s, OW12d, OW13s, OW13d, OW14s, OW14d, OW15s, OW15d, ~~OW16s, OW16d~~, OW24, OW25s, OW25d, OW26, OW27s, OW27d, OW28s, OW28d, OW29s, OW29d, OW30s, OW30d, OW31s, OW31d, OW32s, OW32d, OW33s, OW33d, OW34, OW35, OW36, OW37, OW38, OW39, ~~OW40~~, OW41s, OW41d, OW42s, OW42d, OW43s, OW43d, OW44s, OW44d, OW45, OW46k, OW46s, OW46d, OW47s, OW47d, OW48, OW49, OW50, OW51, OW52, OW53, OW58s, OW58d, OW59s, OW59d, OW60s, OW60d, OW62k, OW62s, OW62d, OW63s, OW63d, OW64s, OW64d, OW65s, OW65d, OW71k, OW71s, OW71d	Water Level	1	1	1	1	1	1	1	1	1	1	1	1
	OW8s, OW8d, OW9s, OW9d, OW12s, OW12d, OW13s, OW13d, OW33s, OW33d, OW45, OW47s, OW47d, OW51, ~~OW67s, OW67d~~, OW71k, OW71s, OW71d	Logger Download												
	TP16, TP17, TP18, TP19, MP54, MP55, MP56, MP57	Water Level												
Category A Private Wells	~~3345 (Ritchie)~~, 7253 (Cramp), 5197 (S.Ruthven), 3447 (HSC – rental house)	Water Level	1	1	1	1	1	1	1	1	1	1	1	1
	7253 (Cramp), 5197 (S. Ruthven)	Logger Download												
Category B Private Wells	Thompson (283249 Indian Acres Rd), ~~McCutcheon (283230 Indian Acres Rd),~~ Porter 283253 Indian Acres Rd), Jenks (283242 Indian Acres Rd)	Water Level			1			1			1			1
Shouldice Wetland Surface Water Stations	Culvert 4, Culvert 5, Culvert 5a, Culvert 6, Culvert 6a, Culvert 7	Flow, EC, temp	1	1	1	1	1	1	1	1	1	1	1	1
Shouldice Wetland Dugout Pond	SG1 (plate), SG1 (pvc)	Water Level, Flow, EC, temp Logger Download	1	1	1	1	1	1	1	1	1	1	1	1
	Outflow	Flow, EC, temp	1	1	1	1	1	1	1	1	1	1	1	1
Shouldice Wetland Springs	s8, s9, s13	Water Level, Flow, EC, temp	1	1	1	1	1	1	1	1	1	1	1	1
	s8, s13	Logger Download	1	1	1	1	1	1	1	1	1	1	1	1
Shouldice Wetland – Beaver Dam Sinkhole	At dam, At sinkhole	Flow, EC, temp	1	1	1	1	1	1	1	1	1	1	1	1

Table 1: Water Monitoring Program (Continued)

Item	Station	Type of Monitoring	Number of Events											
			Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Niagara Escarpment Springs	Spring s1, s2, s3, s4(a, b, c), s5	Flow, EC, temp	1	1	1	1	1	1	1	1	1	1	1	1
Niagara Escarpment Ducks Unlimited Dam	Outflow weir	Flow, EC, temp	1	1	1	1	1	1	1	1	1	1	1	1
Niagara Escarpment Mud Creek	Channel A, Channel B	Flow, EC, temp	1	1	1	1	1	1	1	1	1	1	1	1
Ephemeral Pond	SG2	Water Level				4	4	4						
Precipitation	Precipitation gauge	Logger Download	1	1	1	1	1	1	1	1	1	1	1	1
Pumping Records	Flow meter	Totalizer Readings (if pumping)	31	28	31	30	31	30	31	31	30	31	30	31
Water Bearing Fractures	Active Quarry face	Inspect after each blast (photograph)			1	1	1	1	1	1	1	1	1	

Table 3: Groundwater Elevation Summary – Observation Wells - Historical vs. 2015

Location	Historical Elevations (mAMSL)				2015 Groundwater Elevations (mAMSL)			
	Minimum	Maximum	Range	Average	Minimum	Maximum	Range	Average
OW3	236.28	237.19	0.91	236.49	236.43	237.01	0.58	236.53
OW4	237.30	247.93	10.63	239.91	237.17	237.99	0.82	237.46
OW7s	246.18	248.32	2.13	247.47	246.85	247.88	1.03	247.51
OW7d	241.73	244.41	2.68	243.05	241.94	243.02	1.08	242.54
OW8s	242.75	245.29	2.54	243.89	243.69	244.31	0.62	243.92
OW8d	242.31	244.38	2.07	243.24	242.97	243.63	0.66	243.30
OW9s	242.20	244.07	1.87	242.99	242.71	243.38	0.67	242.97
OW9d	241.99	243.99	2.00	243.05	242.79	243.37	0.58	243.05
OW10s	245.18	247.29	2.11	246.13	245.90	246.40	0.50	246.17
OW10d	245.07	247.03	1.96	245.99	245.56	246.43	0.87	245.92
OW11s	243.43	245.94	2.51	243.69	243.30	243.84	0.54	243.54
OW11d	243.32	245.37	2.05	244.02	244.10	244.60	0.50	244.42
OW12s	243.30	245.23	1.93	243.80	243.63	244.26	0.63	243.84
OW12d	242.76	244.78	2.02	243.53	243.32	243.95	0.63	243.58
OW13s	243.40	245.39	1.99	244.55	244.35	245.17	0.82	244.76
OW13d	241.32	243.46	2.14	242.31	242.14	243.13	0.99	242.55
OW14s	244.26	247.29	3.03	246.06	245.37	246.90	1.53	246.19
OW14d	240.87	242.96	2.09	241.88	241.57	242.34	0.77	241.89
OW15s	243.18	245.86	2.68	243.93	243.67	244.37	0.70	243.97
OW15d	242.76	245.99	3.23	243.78	243.50	244.17	0.67	243.75
OW16s	242.46	247.79	5.33	246.15	Destroyed			
OW16d	235.10	247.05	11.95	243.01	Destroyed			
OW24	239.06	240.54	1.48	240.11	239.99	240.42	0.43	240.17
OW25s	239.10	240.41	1.31	239.85	239.73	240.08	0.35	239.88
OW25d	239.42	240.25	0.83	239.94	239.83	240.13	0.30	239.97
OW26	239.70	242.34	2.64	241.31	240.54	241.99	1.45	241.28
OW27s	239.09	241.78	2.69	240.95	240.41	241.51	1.10	240.94
OW27d	239.24	241.49	2.24	240.85	239.99	241.25	1.26	240.72
OW28s	242.68	245.55	2.87	243.23	242.71	243.99	1.28	243.19
OW28d	238.21	244.46	6.25	239.95	238.28	241.24	2.96	239.20
OW29s	245.09	246.93	1.84	246.27	245.45	246.54	1.09	246.01
OW29d	244.97	247.17	2.20	246.21	245.37	246.58	1.21	245.95
OW30s	245.55	247.64	2.09	247.08	246.06	247.47	1.41	247.03
OW30d	238.66	240.38	1.72	239.42	238.49	239.62	1.13	239.04
OW31s	244.21	247.13	2.92	245.17	244.41	246.03	1.62	244.93
OW31d	239.95	242.65	2.70	241.22	240.08	242.00	1.92	240.89
OW32s	244.06	246.41	2.35	244.89	244.24	245.46	1.22	244.69
OW32d	239.12	244.61	5.49	240.45	239.39	241.35	1.96	240.09
OW33s	242.09	246.24	4.15	243.91	243.16	244.80	1.64	243.66
OW33d	238.59	241.52	2.93	239.91	239.01	240.99	1.98	239.76
OW34	233.99	236.28	2.29	234.97	233.97	234.91	0.94	234.56
OW35	234.84	236.22	1.38	235.12	234.79	235.09	0.30	234.91
OW36	235.38	236.56	1.18	235.64	235.39	235.69	0.30	235.46
OW37	235.73	237.95	2.22	236.37	235.74	236.62	0.88	236.06
OW38	237.35	239.51	2.16	238.25	237.31	238.49	1.18	237.85
OW39	241.25	243.20	1.95	242.36	241.06	242.45	1.39	241.87
OW40	241.58	243.56	1.98	242.98	243.63	243.63	0.00	243.63
OW41s	244.44	246.31	1.87	245.89	245.80	246.15	0.35	245.96
OW41d	243.66	245.58	1.92	244.94	244.76	245.35	0.59	244.98
OW42s	244.78	248.27	3.49	246.03	245.45	246.32	0.87	245.89
OW42d	243.73	245.28	1.55	244.65	244.04	244.88	0.84	244.49

Location	Historical Elevations (mAMSL)				2015 Groundwater Elevations (mAMSL)			
	Minimum	Maximum	Range	Average	Minimum	Maximum	Range	Average
OW43s	245.67	247.09	1.42	246.48	245.90	246.72	0.82	246.29
OW43d	244.81	246.52	1.71	245.84	245.24	246.02	0.78	245.63
OW44s	244.25	246.23	1.98	244.71	244.37	244.91	0.54	244.59
OW44d	244.01	246.39	2.38	244.75	244.20	244.78	0.58	244.48
OW45	243.22	246.40	3.19	244.30	243.29	244.57	1.28	244.07
OW46k	242.99	244.52	1.53	243.53	243.06	243.80	0.74	243.39
OW46s	242.63	244.58	1.95	243.59	243.09	243.89	0.80	243.44
OW46d	242.53	244.38	1.85	243.46	243.03	243.60	0.57	243.29
OW47s	243.00	244.52	1.52	243.55	243.21	243.61	0.40	243.43
OW47d	240.56	244.45	3.89	243.33	243.08	243.62	0.54	243.30
OW48	242.67	244.39	1.72	243.02	242.72	243.04	0.32	242.84
OW49	236.86	240.86	4.00	238.32	236.87	239.21	2.34	237.72
OW50	237.06	246.69	9.63	240.75	236.82	244.27	7.45	239.27
OW51	238.97	243.13	4.16	240.46	238.94	241.61	2.67	239.84
OW52	239.11	242.70	3.59	240.42	239.12	242.09	2.97	239.98
OW53	241.65	246.39	4.74	244.13	242.01	244.72	2.71	243.10
OW58s	239.51	240.08	0.57	239.85	239.73	240.00	0.27	239.84
OW58d	239.81	240.35	0.54	240.12	239.98	240.34	0.36	240.15
OW59s	239.40	240.18	0.78	239.79	239.63	240.00	0.37	239.77
OW59d	239.63	240.35	0.72	239.97	239.84	240.11	0.27	239.96
OW60s	239.54	240.17	0.63	239.90	239.73	240.07	0.34	239.87
OW60d	239.54	240.13	0.58	239.87	239.75	240.01	0.26	239.86
OW62k	243.55	245.29	1.74	244.50	243.93	244.73	0.80	244.34
OW62s	243.82	245.36	1.54	244.41	243.90	244.63	0.73	244.26
OW62d	243.80	245.26	1.46	244.40	243.96	244.66	0.70	244.29
OW63s	Installed in November 2014				244.85	246.07	1.22	245.46
OW63d	Installed in November 2014				244.29	245.19	0.90	244.75
OW64s	Installed in November 2014				244.21	244.95	0.74	244.60
OW64d	Installed in November 2014				244.18	244.90	0.72	244.57
OW65s	Installed in November 2014				246.64	247.58	0.94	247.13
OW65d	Installed in November 2014				244.95	245.73	0.78	245.40
OW71k	242.45	243.56	1.11	242.88	242.50	243.16	0.66	242.75
OW71s	242.62	243.85	1.23	243.04	242.68	243.26	0.58	242.92
OW71d	242.65	243.77	1.12	243.08	242.69	243.33	0.64	242.94

Notes:

mAMSL = Metres Above Mean Sea Level

Table 4: Groundwater Vertical Hydraulic Gradients – Observation Wells - 2015

Location	29-Jan-15	13-Mar-15	27-Apr-15	29-May-15	30-Jun-15	28-Jul-15	27-Aug-15	29-Sep-15	22-Oct-15	17-Nov-15	23-Dec-15	Max	Min	Avg
OW7	-0.32	-0.33	-0.32	-0.32	-0.33	-0.34	-0.34	-0.34	-0.33	-0.36	-0.34	-0.32	-0.36	-0.33
OW8	-0.03	-0.04	-0.04	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.03	-0.05	-0.04
OW9	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01
OW10	-0.01	++	-0.01	-0.02	-0.03	-0.02	-0.05	-0.02	-0.03	-0.01	0.00	0.00	-0.05	-0.02
OW11	0.05	Damaged	0.06	0.09	Destroyed							0.09	0.05	0.06
OW12	-0.02	-0.01	-0.02	-0.03	-0.01	-0.03	-0.03	-0.03	-0.03	-0.03	-0.02	-0.01	-0.03	-0.02
OW13	-0.18	-0.20	-0.17	-0.18	-0.20	-0.20	-0.19	-0.19	-0.18	-0.17	-0.17	-0.17	-0.20	-0.18
OW14	-0.38	-0.35	-0.39	-0.35	-0.37	-0.33	-0.31	-0.32	-0.31	-0.37	-0.37	-0.31	-0.39	-0.35
OW15	-0.03	-0.02	-0.01	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.01	-0.03	-0.02
OW16	Destroyed													
OW25	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01
OW27	0.00	0.00	-0.01	0.00	0.00	-0.03	-0.04	-0.04	-0.04	-0.01	-0.02	0.00	-0.04	-0.02
OW28	-0.66	-0.65	-0.56	-0.67	-0.64	-0.67	-0.65	-0.66	-0.66	-0.35	-0.33	-0.33	-0.67	-0.59
OW29	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.01	-0.01	-0.01	-0.01	0.00	0.01	-0.01	-0.01
OW30	-0.63	-0.62	-0.62	-0.63	-0.66	-0.66	-0.64	-0.65	-0.61	-0.66	-0.66	-0.61	-0.66	-0.64
OW31	-0.30	-0.32	-0.28	-0.32	-0.33	-0.33	-0.34	-0.34	-0.34	-0.30	-0.32	-0.28	-0.34	-0.32
OW32	-	-0.41	-0.36	-	-0.40	-0.41	-0.42	-0.41	-0.42	-0.40	-0.35	-0.35	-0.42	-0.40
OW33	-	-0.44	-0.40	-0.45	-0.45	-0.45	-0.46	-0.45	-0.47	-0.41	-0.43	-0.40	-0.47	-0.44
OW41	-0.11	-0.10	-0.11	-0.10	-0.11	-0.12	-0.11	-0.11	-0.11	-0.08	-0.08	-0.08	-0.12	-0.10
OW42	-0.15	-0.16	-0.16	-0.14	-0.16	-0.14	-0.17	-0.15	-0.16	-0.18	-0.16	-0.14	-0.18	-0.16
OW43	n/a	-0.06	-0.07	-0.06	-0.06	-0.07	-0.06	-0.06	-0.06	-0.06	-0.07	-0.06	-0.07	-0.06
OW44	-0.03	0.00	0.01	-0.01	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	0.01	-0.03	-0.01
OW46	-0.01	-0.02	-0.03	-0.01	-0.02	-0.02	-0.01	-0.01	0.00	-0.02	-0.03	0.00	-0.03	-0.01
OW47	-0.01	-0.01	0.00	-0.01	-0.02	-0.02	-0.02	-0.02	-0.01	-0.01	0.00	0.00	-0.02	-0.01
OW58	++	++	0.03	0.03	0.03	0.07	0.03	0.03	0.03	0.03	0.03	0.07	0.03	0.03
OW59	++	++	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.02	0.04	0.02	0.03
OW60	++	++	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
OW62 S&K	++	0.02	0.03	0.02	0.03	0.01	0.01	0.01	0.00	0.02	0.02	0.03	0.00	0.02
OW62 S&D	++	-0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	-0.01	0.00
OW63	-0.09	-0.10	-0.10	-0.09	-0.09	-0.08	-0.07	-0.07	-0.07	-0.10	-0.11	-0.07	-0.11	-0.09
OW64	-0.01	-0.01	-0.01	-0.02	-0.02	0.05	-0.01	-0.01	0.00	-0.02	-0.01	0.05	-0.02	-0.01
OW65	-0.17	-0.17	-0.18	-0.17	-0.19	-0.18	-0.19	-0.19	-0.18	-0.19	-0.20	-0.17	-0.20	-0.18
OW71 S&K	-0.05	-0.05	-0.04	-0.07	-0.05	-0.06	-0.07	-0.06	-0.06	-0.03	-0.03	-0.03	-0.07	-0.05
OW71 S&D	0.01	0.00	0.01	0.00	0.00	0.00	-0.01	0.00	0.00	0.01	0.01	0.01	-0.01	0.00

Notes:

++ = frozen

- = not measured

Table 5: Groundwater Vertical Hydraulic Gradients Summary – Historical vs. 2015 - Observation Wells

Location	Historical Gradients (mAMSL)				2015 Groundwater Gradients (mAMSL)			
	Minimum	Maximum	Range	Average	Minimum	Maximum	Range	Average
OW7	-0.35	-0.24	0.11	-0.30	-0.36	-0.32	0.04	-0.33
OW8	-0.10	-0.01	0.10	-0.05	-0.05	-0.03	0.02	-0.04
OW9	-0.05	0.03	0.08	0.00	0.00	0.01	0.02	0.01
OW10	-0.04	0.02	0.06	-0.01	-0.05	0.00	0.05	-0.02
OW11	-0.04	0.07	0.11	0.02	0.05	0.09	0.05	0.06
OW12	-0.08	0.01	0.09	-0.02	-0.03	-0.01	0.02	-0.02
OW13	-0.22	-0.07	0.15	-0.19	-0.20	-0.17	0.03	-0.18
OW14	-0.45	-0.26	0.19	-0.34	-0.39	-0.31	0.08	-0.35
OW15	-0.26	0.01	0.28	-0.01	-0.03	-0.01	0.02	-0.02
OW16	-0.67	-0.01	0.67	-0.23	Destroyed			
OW25	-0.05	0.09	0.14	0.01	0.00	0.01	0.00	0.01
OW27	-0.05	0.05	0.10	-0.01	-0.04	0.00	0.04	-0.02
OW28	-0.71	-0.01	0.69	-0.48	-0.67	-0.33	0.34	-0.59
OW29	-0.02	0.03	0.05	-0.01	-0.01	0.01	0.02	-0.01
OW30	-0.66	-0.52	0.14	-0.61	-0.66	-0.61	0.06	-0.64
OW31	-0.41	-0.25	0.15	-0.31	-0.34	-0.28	0.06	-0.32
OW32	-0.46	-0.06	0.40	-0.38	-0.42	-0.35	0.07	-0.40
OW33	-0.59	-0.36	0.23	-0.45	-0.47	-0.40	0.07	-0.44
OW41	-0.12	-0.06	0.06	-0.10	-0.12	-0.08	0.04	-0.10
OW42	-0.36	-0.03	0.33	-0.15	-0.18	-0.14	0.04	-0.16
OW43	-0.13	-0.05	0.09	-0.06	-0.07	-0.06	0.01	-0.06
OW44	-0.03	0.04	0.08	0.00	-0.03	0.01	0.04	-0.01
OW46	-0.05	0.01	0.06	-0.01	-0.03	0.00	0.02	-0.01
OW47	-0.25	0.04	0.29	-0.02	-0.02	0.00	0.02	-0.01
OW58	0.02	0.04	0.01	0.03	0.03	0.07	0.04	0.03
OW59	0.00	0.05	0.05	0.03	0.02	0.04	0.02	0.03
OW60	-0.03	0.00	0.04	0.00	-0.01	0.00	0.01	0.00
OW62 S&K	-0.02	0.04	0.06	0.02	0.00	0.03	0.02	0.02
OW62 S&D	-0.02	0.02	0.05	0.00	-0.01	0.01	0.02	0.00
OW63	Installed in November 2014				-0.11	-0.07	0.04	-0.09
OW64	Installed in November 2014				-0.02	0.05	0.07	-0.01
OW65	Installed in November 2014				-0.20	-0.17	0.03	-0.18
OW71 S&K	-0.09	0.04	0.14	-0.05	-0.07	-0.03	0.03	-0.05
OW71 S&D	-0.01	0.05	0.06	0.00	-0.01	0.01	0.01	0.00

Notes:

mAMSL = Metres Above Mean Sea Level

Table 6: Pumping Records (L) – 2015

Date	January	February	March	April	May	June	July	August	September	October	November	December	Total
1	0	0	0	887,996	0	0	0	0	0	0	0	0	
2	0	0	0	1,064,878	0	0	0	0	0	0	1,129,215	1,837,640	
3	798,963	0	0	0	0	0	0	0	0	0	1,137,068	0	
4	0	0	976,741	0	0	0	0	1,836,100	0	0	1,149,689	1,818,509	
5	0	0	708,962	0	110,009	0	0	363,258	0	0	1,128,163	0	
6	0	0	0	1,331,607	0	0	0	0	0	0	0	0	
7	0	0	0	1,776,101	1,064,833	0	0	0	0	0	0	2,123,928	
8	0	0	0	1,775,627	0	1,342,216	1,656,231	0	1,408,959	0	0	0	
9	0	0	0	1,775,011	0	0	0	0	2,156,783	0	1,063,332	347,365	
10	0	0	0	1,776,099	0	0	0	0	1,720,734	0	0	0	
11	0	0	0	0	1,064,899	591,556	0	0	1,433,209	0	334,896	0	
12	0	0	0	0	0	0	0	0	0	0	2,154,972	0	
13	0	0	0	2,155,706	0	1,734,650	0	0	0	2,098,420	2,152,215	2,151,157	
14	0	0	0	2,156,076	0	0	0	0	1,073,812	0	0	2,152,943	
15	0	0	709,879	2,156,506	709,716	1,192,026	0	0	0	0	0	0	
16	0	0	0	2,155,962	0	1,485,524	0	0	0	0	846,833	0	
17	1,065,569	0	708,033	1,242,919	0	1,594,237	1,411,114	0	0	0		0	
18	0	0	709,679	0	0	1,578,058	0	0	0	0	936,245	0	
19	1,065,569	0	0	0	1,064,990	0	0	0	0	0	1,075,966	0	
20	1,064,989	0	0	1,064,909	0	0	1,343,815	0	0	0	0	0	
21	0	0	0	1,065,073	1,064,781	0	0	1,922,686	0	999,009	0	0	
22	709,916	0	709,966	1,064,662	0	1,602,877	0	1,812,093	1,757,146	0	0	0	
23	0	0	0	1,064,961	0	0	0	1,794,658	0	0	1,456,518	0	
24	0	0	0	0	0	1,555,603	0	1,859,364	0	0	1,468,081	0	
25	0	0	0	0	0	1,509,061	0	0	1,625,612	0	1,413,481	0	
26	0	0	1,065,595	0	532,763	0	0	1,025,387	0	512,303	1,272,480	0	
27	0	0	0	1,064,902	0	0	0	0	0	806,896	1,896,682	0	
28	709,833	0	0	0	0	0	0	1,495,540	0	0	1,861,139	0	
29	533,063	0	0	1,065,036	0	1,656,634	0	0	1,256,656	2,001,196	1,851,254	0	
30	0	0	1,065,518	0	0	0	1,700,609	0	0	2,151,323	1,500,487	0	
31	0		0		0		0	0		0		0	
Total	5,947,902	0	6,654,373	26,644,031	5,611,991	15,842,442	6,111,769	12,109,086	12,432,911	8,569,147	25,828,716	10,431,542	136,183,910

Table 7: Summary of 2015 Pumping Records – Takings vs. Limits

Parameter	Value
Maximum Amount Taken (L/day) Maximum Allowed Daily Taking (L/day)	2,156,783 2,160,000
Maximum Number of Hours Pumped per day Maximum Allowed Hours Pumped per day	12 12
Maximum Rate of Taking (L/min) Maximum Allowable Rate of Taking (L/min)	3,000 3,000
Actual Number of Days of Taking per Year Maximum Number of Days Allowed per Year	102 365
Total Pumped (Litres) Total Allowable (Litres)	136,183,910 788,400,000
Difference between Allowable and Actual Pumped	619,800,758

Table 8: Precipitation Data (mm) - Keppel Quarry - 2015

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
1	7.9	1.8	0	0	0	0	0	0	0	0	0	1.4	
2	0	6.6	0.2	5.2	0	0	0	33.8	0.2	0	0	1	
3	8.4	1.4	7.2	0	0	0	0	2	0.2	8.8	0	0	
4	12	9.2	0.4	0	2.4	0	0	0.4	0	2.8	0	0	
5	15.3	0.9	0	0	0	0	0	0	1.8	0	7.2	0	
6	4	2.4	0	0.6	0	0	2.2	0	0	0	2	0	
7	2.2	9.1	0.4	0	0	10.4	1	0	21.2	0	3.8	0	
8	10	3.2	1.2	2.2	1	2	0	0	15.8	4.6	0	0.2	
9	8.2	0.4	0	17.3	1	4	0	0	0	0.2	0.2	1.8	
10	5.8	0	0	7.6	14	11.4	0	6.2	0.2	0	2.2	0.2	
11	0.6	2.6	0	0	10.2	0.2	0	4	0.2	0	2.8	0	
12	2.7	1.6	0	0	1.8	26.4	0	0	0	4.4	24.4	7.4	
13	0.6	3.2	0	2.8	0	0	0.2	0.6	0.2	3.4	6.2	8	
14	0	6.6	2.4	0	0	15	0	0	0	0.8	0	11	
15	2.2	1.2	0	0	19.6	0.2	0	0	0	3.8	0.2	0	
16	0	0	5.2	0.4	0	0.6	9.2	0	0	0.8	0	0.6	
17	0	1.2	0	0	0	0	7	2.8	6.8	0.8	0.4	0.6	
18	11.9	1.2	0	0	0	0	0	0	7.6	0.2	1.4	0	
19	0.4	0.6		2.4	0	0	0	22.4	0	2	2	0	
20	0	0.2	1.8	11	0	0.4	10.6	1.2	0.2	0.2	0.8	8.6	
21	0	1.8	3.2	1.4	0	5.4	0	0	0.2	2.6	0.4	9	
22	1	1.1	0	0.6	0	10.8	0	0	0	0	0.2	0.2	
23	1.3	0	0	0	0	0	0	1	0.2	2.2	4	1.4	
24	1.9	2.4	0	0	0.4	0	0	7	0	3	7.2	0	
25	0.4	0.2		0	14.6	5	0	5.6	0	0	15	0	
26	0	0	1.4	0	0.2	0	0	1.8	0	0	10	13.2	
27	0	0.4	0.4	0.2	0	0.8	0	0.2	0	11	0.2	0.2	
28	0	0	0	0	0	1.4	0	0	3	7.4	0	2.4	
29	5.2		6	0	0	0	0	0	0	4.6	0	4.8	
30	2.5		1.2	0	4.4	3.6	0	0	0	0	0	0	
31	0.6		0		0		0.4	0.2		13.4		0	
Total	**105.1**	**59.3**	**31**	**51.7**	**69.6**	**97.6**	**30.6**	**89.2**	**57.8**	**77**	**90.6**	**72**	**831.5**

Notes:

Precipitation data from January to June, 2015 (inclusive) is taken from the Wiarton Airport weather station. Precipitation data from July to December was recorded on-Site by rain guage installed in June 2015.

Table 9: Groundwater Elevations – Testpits and Mini-Piezometers - 2015

Monitoring Location	MP54(in)	MP54(out)	MP55(in)	MP55(out)	MP56(in)	MP56(out)	MP57(in)	MP57(out)	TP16	TP17	TP18	TP19
29-Jan-15	++	++	++	++	++	++	++	++	++	++	239.90	++
13-Mar-15	++	++	++	++	++	++	++	++	240.04	++	239.84	++
27-Apr-15	239.96	239.96	240.05	240.05	240.03	240.03	239.95	239.95	240.57	240.08	239.97	239.99
29-May-15	239.86	239.86	239.81	239.81	239.94	239.94	239.87	239.87	239.97	239.80	239.84	239.87
30-Jun-15	239.82	239.82	239.81	239.81	239.95	239.95	239.87	239.87	239.95	239.79	239.84	239.86
28-Jul-15	239.78	**	239.74	**	239.87	239.87	239.76	239.76	239.73	239.63	239.68	239.74
27-Aug-15	239.74	239.74	239.75	239.75	239.82	239.82	239.74	239.74	239.72	239.62	239.68	239.73
29-Sep-15	239.78	239.78	239.77	239.77	239.82	239.82	239.77	239.77	239.75	239.64	239.70	239.75
22-Oct-15	239.78	239.78	239.78	239.78	239.82	239.82	239.78	239.78	239.77	239.65	239.70	239.75
17-Nov-15	239.93	239.90	239.97	239.97	239.91	239.91	239.89	239.88	240.19	239.97	239.93	239.94
23-Dec-15	239.99	239.95	240.08	239.95	240.03	239.99	239.95	239.95	240.57	240.07	240.03	240.03
Max	239.99	239.96	240.08	240.05	240.03	240.03	239.95	239.95	240.57	240.08	240.03	240.03
Min	239.74	239.74	239.74	239.75	239.82	239.82	239.74	239.74	239.72	239.62	239.68	239.73
Avg	239.85	239.85	239.86	239.86	239.91	239.91	239.84	239.84	240.03	239.81	239.83	239.85

Notes:

*** = dry*

++ = frozen

Table 10: Groundwater Elevation Summary – Testpits and Mini-Piezometers - Historical vs. 2015

Location	Historical Elevations (mAMSL)				2015 Groundwater Elevations (mAMSL)			
	Minimum	Maximum	Range	Average	Minimum	Maximum	Range	Average
MP54(in)	239.52	240.29	0.77	239.83	239.74	239.99	0.25	239.85
MP54(out)	239.49	240.29	0.81	239.84	239.74	239.96	0.22	239.85
MP55(in)	239.52	240.19	0.67	239.85	239.74	240.08	0.34	239.86
MP55(out)	239.54	240.17	0.63	239.84	239.75	240.05	0.30	239.86
MP56(in)	239.60	240.13	0.53	239.88	239.82	240.03	0.21	239.91
MP56(out)	239.62	240.13	0.51	239.88	239.82	240.03	0.21	239.91
MP57(in)	239.62	240.08	0.46	239.85	239.74	239.95	0.21	239.84
MP57(out)	239.64	240.08	0.44	239.85	239.74	239.95	0.21	239.84
TP16	239.21	240.72	1.51	240.09	239.72	240.57	0.85	240.03
TP17	239.24	240.66	1.42	239.89	239.62	240.08	0.46	239.81
TP18	239.18	240.30	1.12	239.81	239.68	240.03	0.35	239.83
TP19	239.24	240.15	0.91	239.83	239.73	240.03	0.30	239.85

Notes:

mAMSL = Metres Above Mean Sea Level

Table 11: Groundwater Vertical Hydraulic Gradients – Mini-Piezometers - 2015

Location	MP54	MP55	MP56	MP57
29-Jan-15	++	++	++	++
13-Mar-15	++	++	++	++
27-Apr-15	0.00	0.00	0.00	0.00
29-May-15	0.00	0.00	0.00	0.00
30-Jun-15	0.00	0.00	0.00	0.00
28-Jul-15	**	**	0.00	0.00
27-Aug-15	0.00	0.00	0.00	0.00
29-Sep-15	0.00	0.00	0.00	0.00
22-Oct-15	0.00	0.00	0.00	0.00
17-Nov-15	0.01	0.00	0.00	0.00
23-Dec-15	0.02	0.06	0.02	0.00
Max	0.02	0.06	0.02	0.00
Min	0.00	0.00	0.00	0.00
Avg	0.00	0.01	0.00	0.00

Notes:

** = *dry*

++ = *frozen*

Table 12: Water Elevations – Shouldice Wetland - 2015

Monitoring Location	SG1	S8	S13
29-Jan-15	++	239.91	243.23
13-Mar-15	243.17	239.88	243.24
27-Apr-15	243.21	239.93	243.27
29-May-15	243.12	239.87	243.17
30-Jun-15	243.16	239.87	243.22
28-Jul-15	242.97	239.74	242.98
27-Aug-15	243.08	239.73	243.14
29-Sep-15	243.01	239.76	243.06
22-Oct-15	242.99	239.76	243.02
17-Nov-15	243.18	239.91	243.27
23-Dec-15	243.40	239.96	243.31
Max	243.40	239.96	243.31
Min	242.97	239.73	242.98
Avg	243.13	239.85	243.17

Notes:

mAMSL = Metres Above Mean Sea Level

++ = *frozen*

Table 13: Flow Data – Shouldice Wetland - 2015

Date	s8	s9	s13	Dugout Pond outflow	Culvert 4	Culvert 5	Culvert 5a	Culvert 6	Culvert 6a	Culvert 7	Beaver Dam	Sinkhole
29-Jan-15	*	*	*	++	++	++	++	++	++	++	++	++
13-Mar-15	flowing	flowing	flowing	++	++	++	++	++	++	++	flowing	flowing
27-Apr-15	flowing	flowing	flowing	flowing	flowing	flowing	flowing	flowing	flowing	flowing	flowing	flowing
29-May-15	flowing	flowing	*	*	flowing	*	flowing	flowing	flowing	flowing	flowing	flowing
29-Jun-15	flowing	flowing	flowing	flowing	*	*	flowing	flowing	flowing	*	flowing	flowing
28-Jul-15	*	**	*	**	**	*	*	*	**	*	flowing	*
26-Aug-15	*	**	*	*	*	*	*	*	*	*	flowing	**
28-Sep-15	*	**	*	*	flowing	*	*	*	*	*	flowing	**
22-Oct-15	*	*	-	*	**	*	*	*	flowing	*	flowing	**
17-Nov-15	flowing	flowing	-	*	**	flowing	flowing	flowing	flowing	flowing	flowing	**
23-Dec-15	*	-	-	*	*	flowing	flowing	flowing	flowing	flowing	flowing	**

Notes:

** = no flow observed*

*** = dry*

++ = frozen

- = not measured

Table 14: Electrical Conductivity Data – Shouldice Wetland - 2015

Date	s8	s9	s13	Dugout pond (SG1)	Culvert 4	Culvert 5	Culvert 5a	Culvert 6	Culvert 6a	Culvert 7	Beaver Dam	Sinkhole
29-Jan-15	503	499	609	++	++	++	++	++	++	++	++	++
13-Mar-15	585	565	636	646	++	++	++	++	++	++	573	568
27-Apr-15	518	518	500	520	523	473	402	391	392	344	440	443
29-May-15	543	542	608	596	563	589	443	438	429	432	499	506
29-Jun-15	576	582	753	774	574	574	413	408	403	382	503	499
28-Jul-15	595	**	687	951	**	571	452	406	**	409	495	**
26-Aug-15	452	**	1016	1172	634	495	437	450	438	427	510	**
28-Sep-15	639	**	1054	1064	589	546	458	454	444	408	550	**
22-Oct-15	650	508	1028	1048	**	618	470	462	460	409	555	**
17-Nov-15	615	604	636	665	**	410	380	362	356	352	508	**
23-Dec-15	582	567	548	566	639	452	404	376	368	364	447	**
Max	650	604	1054	1172	639						573	568
Min	452	499	500	520	344						440	443
Avg	569	548	734	800	453						508	504

Notes:

units = ųS/cm

values are compensated to 20 degrees Celsius

*** = dry*

++ = frozen

Table 15: Temperature Data – Shouldice Wetland – 2015

Date	s8	s9	s13	Dugout Pong (SG1)	Culvert 4	Culvert 5	Culvert 5a	Culvert 6	Culvert 6a	Culvert 7	Beaver Dam	Sinkhole
29-Jan-15	8.10	7.60	5.30	++	++	++	++	++	++	++	++	++
13-Mar-15	6.90	7.30	5.10	4.80	++	++	++	++	++	++	0.70	0.80
27-Apr-15	6.70	10.10	6.00	6.40	10.40	8.20	8.50	8.70	8.40	8.10	9.90	9.90
29-May-15	7.90	9.30	11.40	12.70	32.40	27.90	23.50	24.70	23.90	24.20	22.70	20.60
29-Jun-15	8.60	9.60	10.30	9.70	15.90	20.10	17.20	17.40	17.60	15.60	17.20	17.00
28-Jul-15	16.30	**	15.70	19.30	**	18.80	19.70	23.10	***	21.20	21.50	**
26-Aug-15	14.70	**	12.90	11.40	19.60	19.20	19.50	20.30	19.10	19.60	20.90	**
28-Sep-15	15.70	**	16.50	22.50	18.10	17.00	17.90	17.60	17.80	17.90	18.90	**
22-Oct-15	11.20	12.10	11.20	11.20	**	10.70	11.40	11.30	11.20	10.70	11.80	**
17-Nov-15	10.50	10.40	10.10	10.40	**	5.70	5.30	5.00	5.00	4.90	8.80	**
23-Dec-15	9.30	9.20	8.40	8.50	3.40	3.50	3.80	2.60	2.60	2.70	3.70	**
Max	16.30	12.10	16.50	22.50	32.40						22.70	20.60
Min	6.70	7.30	5.10	4.80	2.60						0.70	0.80
Avg	10.54	9.45	10.26	11.69	14.38						13.61	12.08

Notes:

values are compensated to 20 degrees Celsius

*** = dry*

++ = frozen

Table 16: Flow Data – Glenn Management Area - 2015

Date	s1	s2	s3	Channel A	Channel B	D.U. Dam
29-Jan-15	flowing	flowing	flowing	flowing	++	flowing
13-Mar-15	flowing	flowing	flowing	flowing	++	flowing
27-Apr-15	flowing	flowing	flowing	flowing	flowing	flowing
29-May-15	flowing	flowing	flowing	flowing	**	flowing
29-Jun-15	flowing	flowing	flowing	flowing	**	flowing
28-Jul-15	flowing	flowing	flowing	flowing	**	flowing
26-Aug-15	flowing	flowing	flowing	flowing	**	flowing
28-Sep-15	flowing	flowing	flowing	flowing	**	flowing
22-Oct-15	flowing	flowing	flowing	flowing	**	flowing
17-Nov-15	flowing	flowing	flowing	flowing	**	flowing
23-Dec-15	flowing	flowing	flowing	flowing	**	flowing

Notes:

*** = dry*

++ = frozen

Table 17: Electrical Conductivity Data – Glenn Management Area - 2015

Date	s1	s2	s3	Channel A	Channel B	D.U. Dam
29-Jan-15	579	571	511	589	++	595
13-Mar-15	571	578	578	600	++	537
27-Apr-15	458	460	465	476	529	481
29-May-15	513	528	525	536	**	432
29-Jun-15	419	498	491	414	**	430
28-Jul-15	570	566	576	577	**	356
26-Aug-15	610	606	605	622	**	368
28-Sep-15	605	602	604	608	**	567
22-Oct-15	615	622	623	635	**	415
17-Nov-15	520	516	510	519	**	537
23-Dec-15	443	445	461	462	**	454
Max		623		635	529	595
Min		419		414	529	356
Avg		541		549	529	470

Notes:

units = ųS/cm

values are compensated to 20 degrees Celsius

D.U. Dam = Ducks Unlimited Dam

*** = dry*

++ = frozen

Table 18: Temperature Data – Glenn Management Area – 2015

Date	s1	s2	s3	Channel A	Channel B	D.U. Dam
29-Jan-15	4	2.9	2.8	3.3	++	2.7
13-Mar-15	3.8	3	2.8	3.6	++	3.3
27-Apr-15	7.4	7.6	7.5	7.6	6.3	8.5
29-May-15	11.3	10.7	11.5	24.6	**	13.5
29-Jun-15	11.7	13.8	13.9	12.8	**	16.4
28-Jul-15	10.7	13.3	13	19.3	**	28.9
26-Aug-15	11	13	12.5	12.3	**	22
28-Sep-15	11.9	13.1	13.2	15.7	**	16.2
22-Oct-15	11.3	12.3	12.3	11	**	113
17-Nov-15	10.2	10.2	10.1	10.3	**	8.1
23-Dec-15	5.2	5.1	5.5	5.8	**	5
Max	13.9			24.6	6.3	113.0
Min	2.8			3.3	6.3	2.7
Avg	9.4			11.5	6.3	21.6

Notes:

values are compensated to 20 degrees Celsius

D.U. Dam = Ducks Unlimited Dam

*** = dry*

++ = frozen

Table 19 : Current Trigger Values (mAMSL)

Sentry Observation Wells	Green				Yellow				Red			
Season	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
OW8s	243.92	243.38	243.22	244.04	243.77	243.23	243.07	243.89	243.62	243.08	242.92	243.74
OW8d	243.34	242.60	242.46	243.61	243.19	242.45	242.31	243.46	243.04	242.30	242.16	243.31
OW9s	242.98	242.35	242.40	243.08	242.83	242.20	242.25	242.93	242.68	242.05	242.10	242.78
OW9d	243.16	242.14	242.38	243.38	243.01	241.99	242.23	243.23	242.86	241.84	242.08	243.08
OW12s	243.80	243.51	243.45	243.87	243.65	243.36	243.30	243.72	243.50	243.21	243.15	243.57
OW12d	243.62	243.04	242.91	243.83	243.47	242.89	242.76	243.68	243.32	242.74	242.61	243.53
OW13s	244.73	243.82	243.55	244.95	244.58	243.67	243.40	244.80	244.43	243.52	243.25	244.65
OW13d	242.14	241.57	241.47	242.63	241.99	241.42	241.32	242.48	241.84	241.27	241.17	242.33
OW33s	243.62	243.25	243.24	243.77	243.47	243.10	243.09	243.62	243.32	242.95	242.94	243.47
OW33d	239.40	238.74	238.88	240.07	239.25	238.59	238.73	239.92	239.10	238.44	238.58	239.77
OW45	244.08	243.37	243.98	244.28	243.93	243.22	243.83	244.13	243.78	243.07	243.68	243.98
OW47s	243.60	243.15	243.29	243.62	243.45	243.00	243.14	243.47	243.30	242.85	242.99	243.32
OW47d	243.51	242.86	243.42	243.57	243.36	242.71	243.27	243.42	243.21	242.56	243.12	243.27
OW51	239.90	239.15	239.12	240.23	239.75	239.00	238.97	240.08	239.60	238.85	238.82	239.93
OW53	241.80	242.54	243.60	244.53	241.65	242.39	243.45	244.38	241.50	242.24	243.30	244.23
s8	239.97	NA	239.78	240.04	239.82	NA	239.63	239.89	239.67	NA	239.48	244.23
s13	243.01	NA	242.50	243.08	242.86	NA	242.35	242.93	242.71	NA	242.20	244.23
(Dugout Pond) SG1	243.24	243.16	243.22	243.21	243.09	243.01	243.07	243.06	242.94	242.86	242.92	244.23

Notes:

NA= Not Applicable

Table 20: Ammended Trigger Values (mAMSL)

Sentry Observation Wells	Green				Yellow				Red			
Season	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
OW8s	243.92	242.90	243.22	243.94	243.77	242.75	243.07	243.79	243.62	242.60	242.92	243.64
OW8d	243.32	242.60	242.46	243.46	243.17	242.45	242.31	243.31	243.02	242.30	242.16	243.16
OW9s	242.98	242.35	242.40	243.08	242.83	242.20	242.25	242.93	242.68	242.05	242.10	242.78
OW9d	243.12	242.14	242.38	242.99	242.97	241.99	242.23	242.84	242.82	241.84	242.08	242.69
OW12s	243.80	243.51	243.45	243.74	243.65	243.36	243.30	243.59	243.50	243.21	243.15	243.44
OW12d	243.60	243.04	242.91	243.68	243.45	242.89	242.76	243.53	243.30	242.74	242.61	243.38
OW13s	244.28	243.82	243.55	243.97	244.13	243.67	243.40	243.82	243.98	243.52	243.25	243.67
OW13d	242.14	241.57	241.47	242.53	241.99	241.42	241.32	242.38	241.84	241.27	241.17	242.23
OW33s	243.49	242.24	243.24	243.53	243.34	242.09	243.09	243.38	243.19	241.94	242.94	243.23
OW33d	239.38	238.74	238.88	239.67	239.23	238.59	238.73	239.52	239.08	238.44	238.58	239.37
OW45	243.85	243.37	243.44	244.16	243.70	243.22	243.29	244.01	243.55	243.07	243.14	243.86
OW47s	243.56	243.15	243.25	243.60	243.41	243.00	243.10	243.45	243.26	242.85	242.95	243.30
OW47d	243.41	242.86	243.23	243.48	243.26	242.71	243.08	243.33	243.11	242.56	242.93	243.18
OW51	239.48	239.15	239.09	239.88	239.33	239.00	238.94	239.73	239.18	238.85	238.79	239.58
OW53	241.80	242.44	242.16	243.95	241.65	242.29	242.01	243.80	241.50	242.14	241.86	243.65
OW71k	242.75	242.60	242.69	242.90	242.60	242.45	242.54	242.75	242.45	242.30	242.39	242.60
OW71s	242.91	242.77	242.87	243.07	242.76	242.62	242.72	242.92	242.61	242.47	242.57	242.77
OW71d	242.96	242.80	242.86	243.09	242.81	242.65	242.71	242.94	242.66	242.50	242.56	242.79
s8	239.87	NA	239.59	239.98	239.72	NA	239.44	239.83	239.57	NA	239.29	239.68
s13	243.01	NA	242.48	243.08	242.86	NA	242.33	242.93	242.71	NA	242.18	244.23
(Dugout Pond) SG1	243.18	243.00	243.07	243.12	243.03	242.85	242.92	242.97	242.88	242.70	242.77	242.82

Notes:

NA= Not Applicable

Table 21: Water Elevations – Private Wells - 2015

Category	Location	ID	29-Jan-15	13-Mar-15	27-Apr-15	29-May-15	30-Jun-15	28-Jul-15	27-Aug-15	29-Sep-15	22-Oct-15	17-Nov-15	23-Dec-15	Max	Min	Avg
A	Ritchie	3345	-	-	7.86	-	6.79	-	-	9.84	Asked to be Removed from Program			9.84	6.79	8.16
	Cramp	7253	-	-	3.02	-	3.06	-	-	3.95	4.07	3.21	3.17	4.07	3.02	3.41
	S.Ruthven	5197	-	-	n/a	-	-	-	-	-	-	-	-	-	-	-
	Sutherland	3447	-	-	3.03	-	3.02	-	-	3.92	3.93	3.14	3.15	3.93	3.02	3.37
B	Jenks	PW1	-	-	-	-	9.95	-	-	12.28	12.58	-	8.12	12.58	8.12	10.73
	Thompson	PW2	-	-	-	-	9.9	-	-	11.83	12.13	-	7.51	12.13	7.51	10.34
	Porter	PW3	-	-	-	-	9.66	-	-	11.47	11.78	-	7.74	11.78	7.74	10.16

Notes:

- = not measured

Table 22: Noise and Vibration Data Summary

Date	Serial Number	Receptor	Vibration (mm/s)	Noise - Overpressure (dB)
26-May-15	BE12756	Ruthven	4.10	123.70
26-May-15	BE17339	Ritchie or Cramp	11.44	116.40
26-May-15	BE13291	Ritchie or Cramp	3.47	126.10
30-Jun-15	BE12756	McGregor	3.57	122.80
30-Jun-15	3219	Ruthven	1.57	< 100
30-Jun-15	BA10985	Ritchie or Cramp	7.42	118.30
30-Jun-15	BE17339	Ritchie or Cramp	3.32	123.00
5-Aug-15	BE13291	Ritchie or Cramp	5.81	115.70
5-Aug-15	BE16234	Ritchie or Cramp	3.18	125.30
5-Aug-15	BE12756	Doug Wilde Residence, 302377 Gr. Rd. 170	3.44	95.92
5-Aug-15	3219	Ruthven	2.05	< 100
4-Sep-15	BE17338	Ritchie or Cramp	2.16	124.30
4-Sep-15	3219	Ruthven	1.67	< 100
4-Sep-15	BE12756	McGregor	2.16	122.10
30-Sep-15	BE17339	Ritchie or Cramp	2.98	124.00
30-Sep-15	BE17338	Ritchie or Cramp	**27.23**	119.00
30-Sep-15	BE12756	Ruthven	1.84	121.60
30-Sep-15	3219	McGregor	1.94	< 100
10-Nov-15	BE17339	Ritchie	**20.06**	127.10
10-Nov-15	BE17338	Cramp	3.03	126.00
10-Nov-15	3219	Ruthven	1.57	< 100
10-Nov-15	BE12756	McGregor	4.40	123.20
1-Dec-15	BE12756	McGregor	2.77	119.30
1-Dec-15	3219	Ruthven	1.43	< 100
1-Dec-15	BE16234	Ritchie or Cramp	4.63	120.60
1-Dec-15	BE13292	Ritchie or Cramp	5.26	122.00
Max			27.23	127.10
Min			1.43	95.92
Average			5.10	120.80

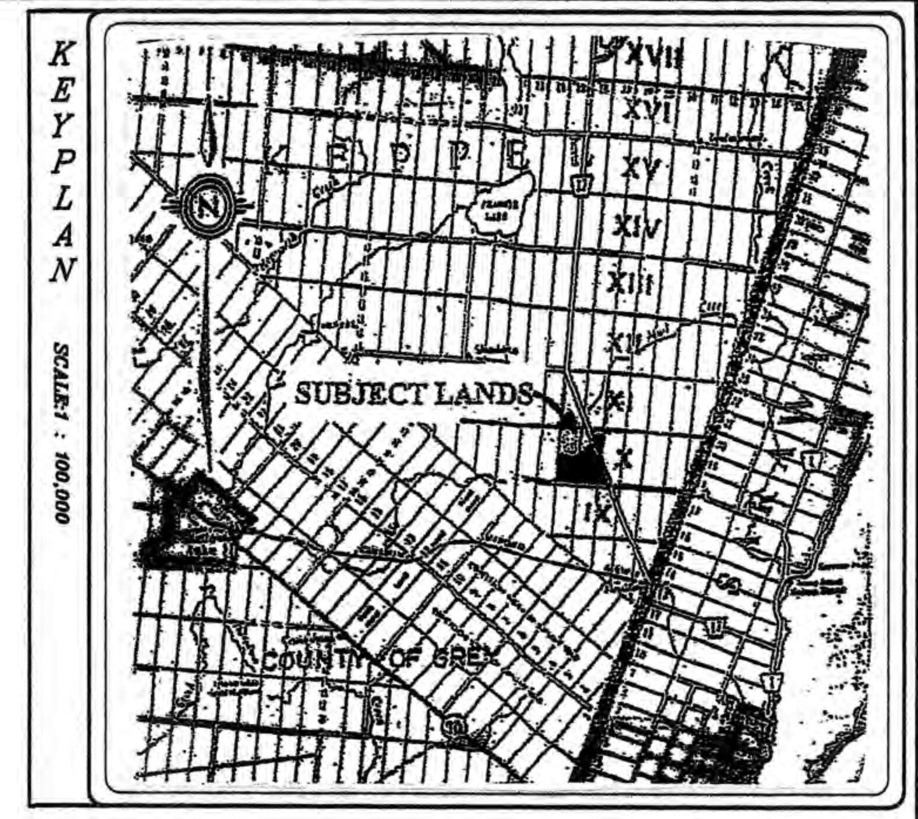
Notes:

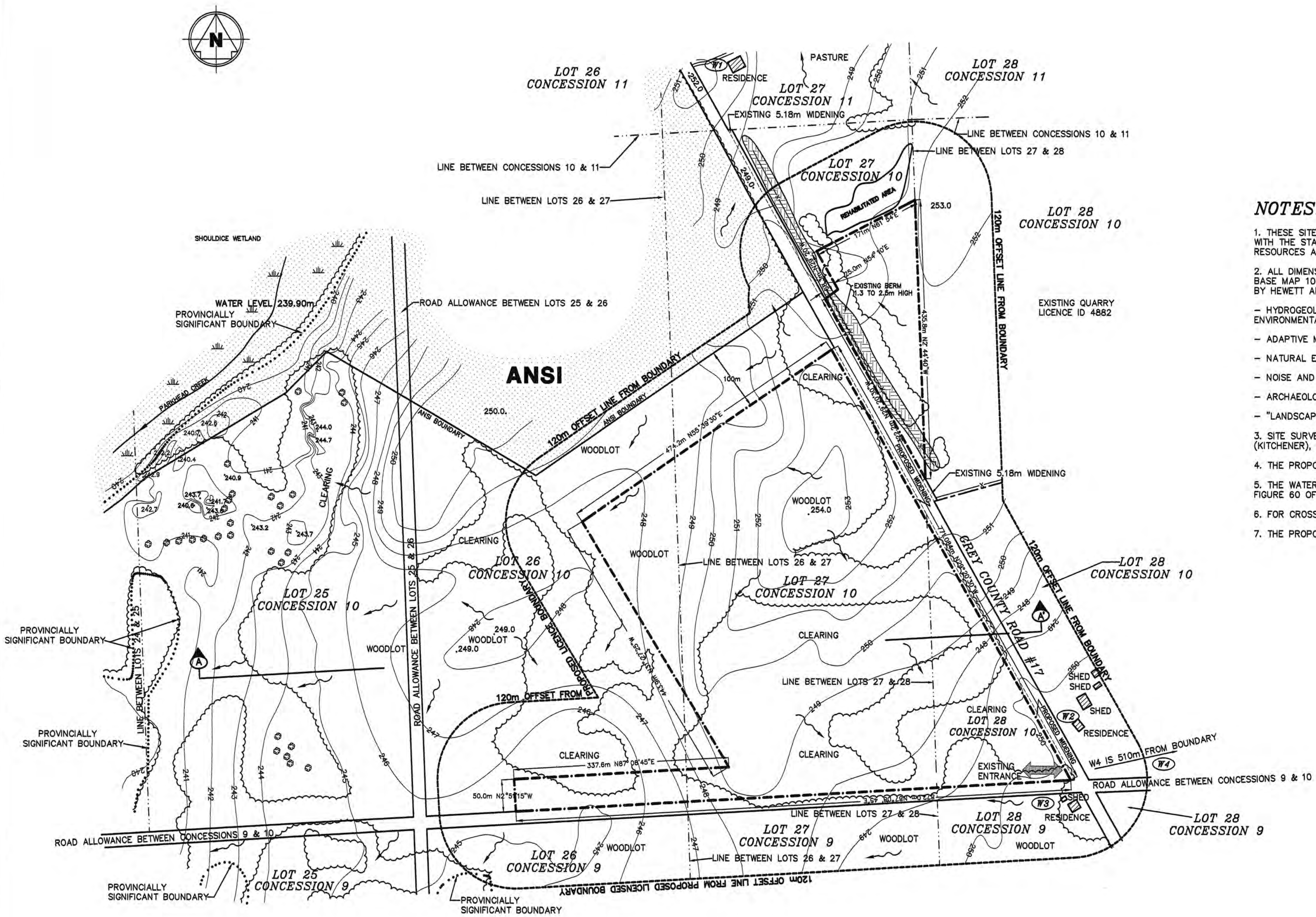
The MOECC recommended limit for Vibration is 12.5 mm/sec

The MOECC recommended limit for Overpressure is 128 dB

APPENDIX A

AGGREGATE RESOURCES ACT (ARA)
SITE PLANS





NOTES:

1. THESE SITE PLANS ARE PREPARED FOR SUBMISSION TO THE MINISTRY OF NATURAL RESOURCES TO COMPLY WITH THE STANDARDS FOR A CATEGORY 2, CLASS A (QUARRY BELOW WATER) LICENCE UNDER THE AGGREGATE RESOURCES ACT AND REGULATIONS.

2. ALL DIMENSIONS ARE IN METRIC UNITS. ELEVATIONS ARE GEODETIC, ASL. REFERENCE WAS MADE TO ONTARIO BASE MAP 10 17 4950 49400 & 10 17 5000 49400, REGISTERED PLAN 16R-3903, A DRAFT PLAN OF SURVEY BY HEWETT AND MILNE LIMITED, ONTARIO LAND SURVEYORS AND THE FOLLOWING REPORTS:

- HYDROGEOLOGICAL REPORTS, ADDENDUMS, RESPONSES BY WATERLOO GEOSCIENCE LIMITED, NOVATERRA ENVIRONMENTAL LIMITED, MTE CONSULTANTS INC.
- ADAPTIVE MANAGEMENT PLAN BY MTE CONSULTANTS INC.
- NATURAL ENVIRONMENT STUDIES, ADDENDUMS AND RESPONSES BY AQUATIC WILDLIFE SERVICES
- NOISE AND BLASTING STUDIES BY AERCOUSTICS ENGINEERING LTD. AND DST CONSULTING ENGINEERS INC.
- ARCHAEOLOGICAL STUDIES BY SCARLETT JANUSAS
- "LANDSCAPING DETAILS" & "VEGETATION INVENTORY & PRESERVATION PLAN" BY L. PORTER.

3. SITE SURVEYS AND INSPECTION BY WM. BRADSHAW, P.ENG. (OCTOBER, 2003) & ACI SURVEYS LTD. (KITCHENER), OCTOBER, 2006.

4. THE PROPOSED LICENSED AREA IS LOCATED IN THE NIAGARA ESCARPMENT AREA.

5. THE WATER TABLE ELEVATION VARIES FROM APPROXIMATELY 240m TO 247m AND WAS DERIVED FROM FIGURE 60 OF THE HYDROGEOLOGICAL INVESTIGATION BY MTE CONSULTANTS (OCT. 14, 2009).

6. FOR CROSS-SECTION INFORMATION, SEE DRAWING 7, CROSS-SECTIONS & DETAILS.

7. THE PROPOSED LICENSED AREA IS 35.0 HECTARES.

LEGEND:

- ANSI-Area of Natural & Scientific Interest
- BUILDING
- W4 DOMESTIC WATER WELL
- DRAINAGE DIRECTION
- PROPOSED LICENSED BOUNDARY
- PROVINCIALLY SIGNIFICANT BOUNDARY
- ENTRANCE/EXIT
- 1.2m HIGH POST & WIRE FENCE
- 120m OFFSET LINE FROM
- LOT LINE
- EXISTING BERM
- .462.5 SPOT ELEVATION
- 464 1m CONTOUR
- 455 5m CONTOUR
- DECIDUOUS TREE
- CONIFEROUS TREE
- WET AREA

HAROLD SUTHERLAND CONSTRUCTION LTD.
R.R. #2, KEMBLE, ONTARIO, N0H1S0

NEW KEPPEL QUARRY
PARTS LOTS 26, 27 & 28, CONCESSION 10
TOWNSHIP OF GEORGIAN BLUFFS (formerly Keppel Twp)
COUNTY OF GREY

EXISTING FEATURES
DRAWING 1 of 9

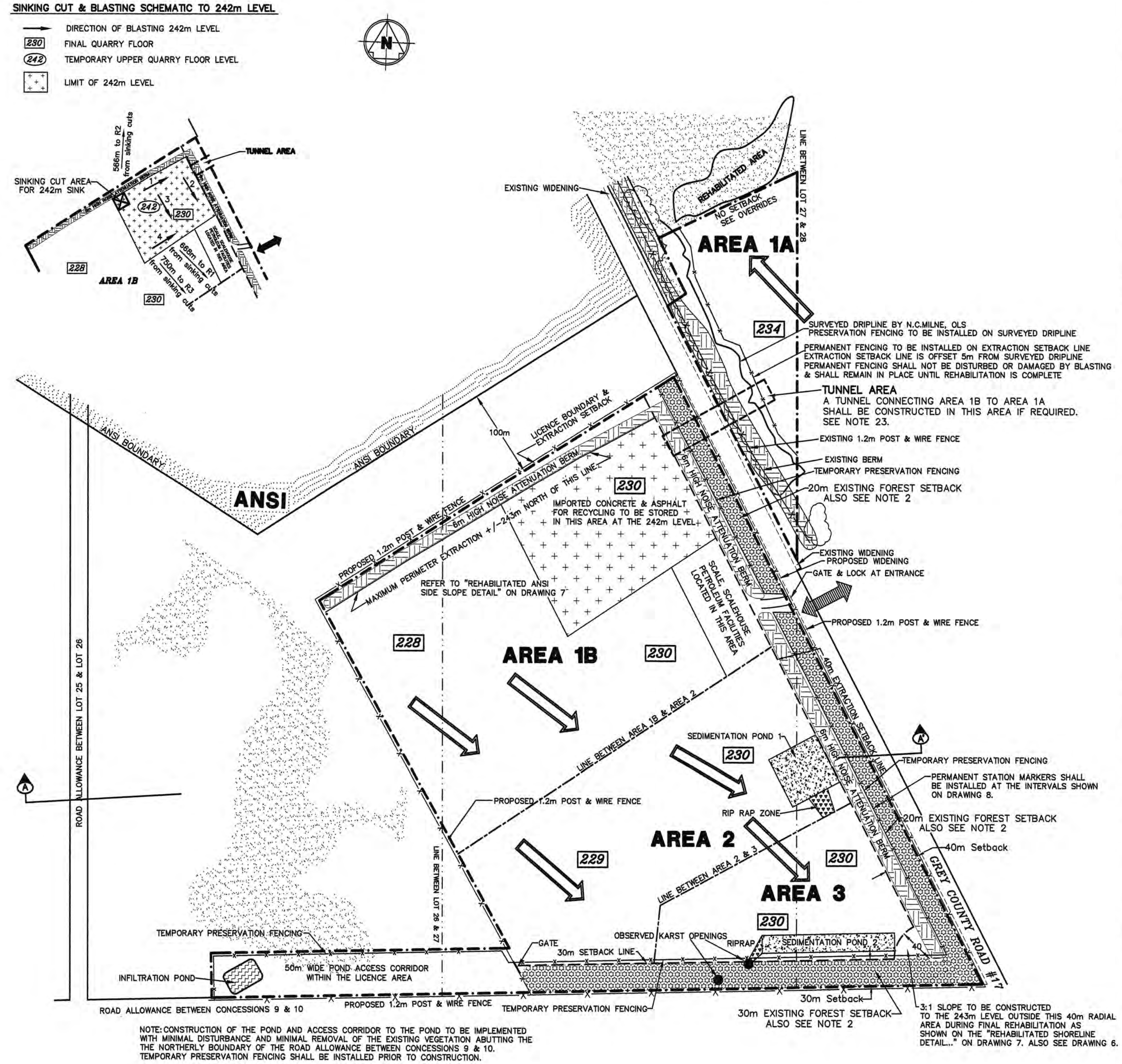
SCALE: 1:4000
100 50 0 100 200 300

LICENSED PROFESSIONAL ENGINEER
W.L. BRADSHAW
PROVINCE OF ONTARIO

Wm. Bradshaw, P.Eng.
Kitchener, Ontario

No.	AMENDMENT	DATE

December 11, 2014



OPERATIONAL NOTES

1. SETBACKS: Extraction setbacks shall be 40m along the County Road 17 road allowance boundary, 30m adjacent to the south boundary of Area 2 & Area 3 and as shown along the northwesterly side of Area 1B and in the southeasterly corner adjacent to Area 3. There shall be no disturbance, i.e. no tree removal, no stripping, no stockpiling within the buffer zone shown between the licence boundary and the ANSI. The extraction setback in Area 1A is 5m from the surveyed dripline and shall be fenced.

2. VEGETATED BUFFER: A "20m Existing Forest Setback" shall be maintained and enhanced adjacent to the County Road 17 boundary. Similarily, a "30m Existing Forest Setback" shall be maintained and enhanced within the southern 30m setback area adjacent to the road allowance between Concessions 9 & 10. Refer to drawing 8, "Landscaping Details" and drawing 9, "Vegetation Inventory & Preservation Plan by L. Porter for details.

3. MAXIMUM DEPTH OF EXTRACTION: The maximum depth of extraction shall be to the bottom of the Amabel Formation at the approximate elevations shown (228m to 230m in Area 1B, 2 & 3, 234 in Area 1A). The perimeter area adjacent to the extraction limit along the northerly boundary of Area 1B shall only be extracted to 242m where shown in order to allow backfilling and the creation of 3:1 slopes adjacent to the 100m ANSI setback line. The slope will be constructed from the limit of extraction to +/-1 metre below the final water level of the future pond of +/-244m.

4. SIDE SLOPES: Perimeter side slopes to elevation 244m adjacent to the 100m ANSI setback and the SE corner of Area 3 shall be created by backfilling with onsite overburden and topsoil and clean inert fill. Final perimeter slopes adjacent to the 100m ANSI setback and the SE corner of Area 3 shall be constructed no steeper than 3(horizontal) to 1(vertical). All other boundaries shall have vertical faces at the limit of extraction. Final slopes adjacent to the 100m ANSI setback and the SE corner of Area 3 shall be spread with a minimum of 0.15 metres (6 inches) of topsoil and shall be seeded and planted as outlined on Drawing 6, Progressive Rehabilitation & Final Rehabilitation Plans and Drawing 7, Cross-Sections and Details. Where the slopes adjacent to the 100m Ansi setback boundary and the SE corner of Area 3 reach the 243 metre level the "slopes" will be vertical to the bottom of the quarry.

5. ENTRANCE/EXIT/GATE: The entrance to the quarry shall be on the eastern boundary of Area 1B as shown to Grey County Road #17. Any required turning lanes, deceleration lanes or tapers shall be constructed to Grey County Standards and according to Grey County procedures. The entrance area treatment including grading, planting, gates, signage and lighting shall be constructed as outlined drawing 9, "Vegetation Inventory & Preservation Plan by L. Porter for details. Area 1A shall be accessed through the existing Keppel quarry entrance. A gate (minimum height 1.2m) with a lock shall be installed and maintained at the entrances. The entrance shall be closed & locked when the quarry is not operating.

6. FENCING: Post & wire fencing (minimum height 1.2 metres) shall be repaired or installed on the proposed licence boundary, where shown. Marker posts at intervisible intervals not to exceed 60m shall replace fences on the west and north side of the 50m infiltration pond access corridor. Warning signs shall be posted on the marker posts and along the fence at 20 metre intervals. Fences, marker posts and signs shall be maintained for the life of the quarry.

7. TOPSOIL/OVERBURDEN STORAGE: Stripped topsoil and overburden, and imported inert fill shall be used to construct the proposed berms where shown. These berms shall be constructed to the recommended heights as indicated in the Sequence of Operations notes. Also see note #27. After the required berms have been constructed, any further stripped materials not used immediately for rehabilitation, may be stored separately in berms in the perimeter areas and eventually used for perimeter backfilling. Stripped topsoil & overburden shall be graded to stable side slopes. Berms shall be seeded with perennial grasses. Vegetation on the berms and stockpiles shall prevent erosion.

8. VEGETATION: Vegetation on all berms, stockpiles, vegetated buffers and rehabilitated areas that dies or is otherwise damaged shall be reseeded or replanted in accordance with drawing 9, "Vegetation Inventory & Preservation Plan by L. Porter.

9. STOCKPILES: No stockpiles of aggregate or stripped materials shall be located within 30 metres of the licence boundary, north and west boundaries excepted. See overrides. Stockpiles shall not exceed a height that is greater than 2m below the top height of the accoustical berms.

10. PROCESSING EQUIPMENT: Processing equipment to be utilised on this site shall include scrapers, bulldozers, loaders, excavators, rock drills, drill rigs, crushers, screeners, conveyors, a wash plant and dump trucks. A wash plant may be operated once a valid Permit To Take Water has been obtained. Washing would entail the construction of three ponds on the quarry floor. The ponds will be approximately 50m by 20m and 2m deep. The ponds shall be constructed from low permeable clay. The first pond is a sedimentation pond, the second a clearing pond and the third a clear water pond. Water from the clear water pond is recirculated through the wash plant. The sedimentation pond shall be cleaned out as required to maintain the depth. The material removed from the pond shall be dried and sold for uses such as agri-lime on farm fields or other clay products. Ponds may be laid out in various configurations and may be relocated from time to time as dictated by operations.

11. DUST CONTROL: Dust control shall be maintained through the application of water when necessary.

12. NOISE, DUST OR GROUNDWATER INTERFERENCE PROBLEMS: Should noise, dust or groundwater interference complaints be received, the licensee shall take appropriate measures as deemed necessary by the Ministry of the Environment to rectify the problem(s).

13. DEWATERING: Sumps and dewatering facilities shall be located on the quarry floor and may be relocated from time to time as extraction progresses. Ground water and precipitation shall be pumped as outlined in the sequence of operations. See the Adaptive Management Plan summary on Drawing 5, "Adaptive Management Plan". The final water elevation in the pond is anticipated to be +/-244m.

14. SCRAP STORAGE: There shall be no scrap permanently stored on this site.

15. PETROLEUM STORAGE: Petroleum storage facilities shall be relocated to the vicinity of the shop in the new quarry from the old quarry when pumping to the old quarry commences. All petroleum storage shall be in above ground containers that meet the requirements of the Technical Standards and Safety Act 2000 and the Liquid Fuel Handling Code 2001 as may be amended. Any spills shall be removed and disposed of at a facility approved by the Ministry of the Environment. See the Spills Contingency Plan on this page. Mobile fuel tanks shall be the new generation engineered double-tanked variety with vacuum sealed valves.

16. BUILDINGS: Operational buildings shall be located within the areas shown in Phase 1B.

17. DRAINAGE: Surface drainage and ground water shall be captured in temporary sumps and removed as indicated in Note 13 above.

18. HOURS OF OPERATION: The hours of operation for this site shall be: Shipping: from 7am to 6pm Monday to Friday. No shipping on Saturday or Sunday, except in emergency situations. Processing: from 7am to 6pm Monday to Friday.

19. EXTRACTION AREA: The area to be extracted is 26.85 hectares.

20. TONNAGE CONDITION: The maximum number of tonnes to be removed from this site in any calendar year is 600,000. Note that while old Keppel quarry is still operating, the combined tonnage of this site and old Keppel quarry shall not exceed 600,000 tonnes.

21. TREE REMOVAL: Trees cut during stripping operations shall be marketed for lumber where possible or shall be cut up for fire wood. Stumps shall be stored for future use on the edges of the future quarry pond. All ash (fraxinus) tree removal and disposal shall be in accordance with CFIA regulations.

22. RECYCLING: Asphalt and concrete may be imported into this site for recycling and stored in the area shown.

23. TUNNEL: A tunnel, if required, shall be constructed between Area 1A and Area 1B for the transport of material between Areas. The tunnel, if required, shall consist of a precast and pre-engineered concrete culvert and shall be constructed and installed to meet the requirements of the Grey County Engineering Department.

24. ARCHAEOLOGICAL RECOMMENDATIONS (by Scarlett Janasus, Archaeological & Heritage Consulting, Tobermory, Ontario): Should deeply buried archaeological material be found on the property during excavation activities, the Ministry of Citizenship, Culture and Recreation (MCCR) shall be notified immediately (519-675-7742). In the event that human remains are encountered during excavation, the proponent shall immediately contact both the MCCR and the Registrar or Deputy Registrar of the Cemeteries Regulation Unit of the Ministry of Consumer & Commercial Relations (416-326-8392)

25. NATURAL ENVIRONMENT RECOMMENDATIONS (by Aquatic and Wildlife Services, Shallow Lake, Ontario): See Drawing 4 of 8: "Consultant Recommendations" Drawing 5 "Adaptive Management Plan" and Drawing 7, "Cross-sections and Details".

26. HYDROGEOLOGICAL RECOMMENDATIONS: (by MTE Consultants Inc., Kitchener, Ontario): See Drawing 4: "Consultant Recommendations", Drawing 5, "Adaptive Mangement Plan".

27. NOISE CONTROL RECOMMENDATIONS: (by Aercoustics Engineering Limited, Toronto, Ontario) See Drawing 4: "Consultant Recommendations".

28. BLASTING CONTROL RECOMMENDATIONS: (by Aercoustics Engineering Limited, Toronto, Ontario and DST Consulting Engineers Inc., Sudbury, Ontario) See Drawing 4: "Consultant Recommendations".

29. SECTIONS AND DETAILS: See Drawing 7: "Cross-sections and Details".

30. IMPORTATION OF FILL: Only topsoil, subsoil and overburden meeting the definition of inert fill under Regulation 347 of the Environmental Protection Act shall be imported into this site for the purposes of constructing berms or conducting rehabilitation. Incoming loads of fill shall be monitored by staff and as per NEC 2.2.1.1.1.5.

31. PRESERVATION FENCING: Prior to the commencement of tree removal and topsoil stripping temporary preservation fencing shall be installed along the dripline of the vegetation within: 1) the 20m setback forested zone abutting County Road 17, 2) the 30m setback forested zone along the Road Allowance between Concessions 9 & 10, and 3) the area 1A vegetated area that is to be retained. The installed fencing shall be inspected by the consulting Landscape Architect and a confirmation letter shall be submitted to NEC.

32. WILDLIFE SIGNAGE: In consultation with the County of Grey Roads Department and under the Highway Traffic Act, the licensee shall erect "ANIMAL CROSSING" signs at the locations shown. In addition, the licensee shall erect a "CAUTION, WILDLIFE CROSSING" sign at the quarry entrance. The licensee shall also request of the OPP and the County to forward any incident reports from their monitoring of any increased collisions along County Road 17 for 1 kilometre in both directions from the Keppel Quarry, for the inclusion in the reports to the Stakeholders Liason Committee and subject to other actions of posting signage or additional preventative measures.

SITE PLAN OVERRIDES OF THE OPERATIONAL STANDARDS

1. STANDARD 5.1 –

a.) The licensed boundaries shall not be fenced on the west or north side of the pond access corridor in the SW corner. Marker posts, minimum height 1.2m, shall be placed at the corners and at intervisible distances not to exceed 60m on any unfenced boundaries.

b.) The part of Area 1A that abuts the adjacent, existing Keppel quarry shall not be fenced. Marker posts shall be placed at the most northerly and most southerly corners of the unfenced boundary.

2. STANDARD 5.10.1 – Regulatory setbacks have been reduced to zero metres adjacent to lands owned by the licensee.

3. STANDARD 5.13.1 – Stockpiling within 30m of the north and west boundaries adjacent to lands owned by the licensee.

SPILLS CONTINGENCY PLAN

In case of accidental spill of petroleum based products the following contingency plan will be activated:

1. All spills of petroleum based products regardless of the quantity will be cleaned up immediately following the spill.

2. A supply of absorbent material suitable for use on spilled petroleum products (e.g., sand, "Stay-Dry") will be maintained on site. The absorbent material will be stored in a easily accessible location in bags or containers that can be moved by hand. The absorbent material will be kept dry by protective coverings or containers.

3. The quantity of absorbent material stored on site will be sufficient to meet the supplier's recommendations for absorbing petroleum products. If using sand, the owner will maintain a reasonable volume (3cu. m to 5 cu. m.) on site.

4. The owner will first contain the spill using the absorbent material and block any crack or route by which a spilled product could enter the rock or soil on and around the site. After containment, the owner will proceed to clean up the spill using additional absorbent materials as necessary.

5. All contaminated material will be removed from the site and placed in an approved landfill site.

6. The adjacent property owners will be notified of any spill that occurs on site as per the Environmental Protection Act.

7. For spills in excess of 20 L that are cleaned up immediately, the owner will also notify the local offices of the Ministry of the Environment and of the Ministry of Natural Resources of the occurrence and of the procedures followed including the disposal location.

8. For any spill regardless of quantity which can not be immediately cleaned up, the owner will notify the local offices of the Ministry of the Environment and of the Ministry of Natural Resources and the adjacent land owners of the problem. Action to clean up the spill will be undertaken as soon as possible and all parties will be notified when cleanup is complete.

LEGEND:

- NOISE ATTENUATION BERM
- 230 APPROXIMATE BENCH ELEVATIONS
- EXCAVATION DIRECTION
- PROPOSED LICENCE BOUNDARY
- EXTRACTION SETBACK LINE (EXCAVATION LIMIT)
- LINE BETWEEN AREAS
- ENTRANCE/EXIT
- 1.2m HIGH FENCE
- LOT LINE
- 20m EXISTING FOREST SETBACK
- ANSI AREA
- REFORESTATION AREAS

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R.R. #2, KEMBLE, ONTARIO, N0H1S0

NEW KEPPEL QUARRY

PARTS LOTS 26, 27 & 28, CONCESSION 10

TOWNSHIP OF GEORGIAN BLUFFS (formerly Keppel Twp)

COUNTY OF GREY

OPERATIONAL PLAN

DRAWING 2 of 9

SCALE: 1:3000

100 50 0 100 200

No.	AMENDMENT	DATE

December 11, 2014

IN GENERAL:

1. Prior to the commencement of operations in Area 1A, all required fencing and signs shall be constructed and the limits of extraction surveyed and clearly marked where shown. Unfenced boundaries shall be marked at intervisible distances not to exceed 60m with marker posts and signs. All fencing and markers shall be maintained for the life of the licence.

2. Prior to the commencement of operations in Area 1B, 2 and 3, all required fencing and signs shall be constructed and the limits of extraction surveyed and clearly marked where shown. Unfenced boundaries in these areas shall be marked and maintained as per Note 1.

3. Prior to the commencement of extraction and processing in any areas or any parts of areas, acoustical attenuation berms shall be constructed as shown on drawing 4, "Consultant Recommendations". The accoustical berm elevations shall be confirmed by survey to ensure that stockpile elevations remain a minimum of 2m below the accoustical berm elevations.

4. Once the acoustical attenuation berms are completed and the elevations confirmed by survey the planting of the tree/shrub screening plantings will be installed within the first year of operations.

5. The calculation to determine the phasing timeline is based on using 500,000 tonnes per year for extraction and a conversion of 1 cubic meter of rock to 2.5 tonnes. The timelines associated with the phases could be longer or shorter depending on yearly sales volumes. The MNR tonnage limit is 600,000 tonnes per calendar year.

6. Drainage sumps will be created within the licensed area to support the dewatering operation in various areas. Pumps and associated piping will routinely be relocated within the licensed area as the sumps are created. The creation of any new sumps or the movement of the associated pumps and piping will not require any additional permitting.

7. Area 3 shall not be excavated for a period of 12 years from the issuance of a license under the Aggregate Resources Act. The excavation of Area 3 may only proceed if it is determined acceptable by the MNR and MOE through the results of the Adaptive Management Plan (AMP) developed for this site.

8. The maximum depth of extraction shall be to the elevation of the bottom of the Amabel Formation and in the general direction of the arrows shown.

9. If it is determined from the Natural Environment monitoring and the Adaptive Management Plan shown on drawing 5 that the existing ephemeral pond has had unacceptable impacts, then an ephemeral pond shall be constructed and maintained as directed by the Natural Environment consultant or by MNR.

10. Prior to the commencement of tree removal and topsoil stripping temporary preservation fencing shall be installed along the dripline of the vegetation within: 1) the 20m setback forested zone abutting County Road 17, 2) the 30m setback forested zone along the Road Allowance between Concessions 9 & 10, and 3) the area 1A vegetated area that is to be retained. The installed fencing shall be inspected by the consulting Landscape Architect and a confirmation letter shall be submitted to NEC.

Phase 1 (The period when excavation focus is in Area 1A–Year 1 to 3)

AREA 1A

1. Area 1A shall be operated as an extension of the existing Keppel quarry with processing of aggregates taking place in the adjacent Keppel quarry. The depth of extraction shall be to +/-234m. The limit of extraction on the west side of the quarry will be set at 5m from the existing tree line. A fence is to be installed 5m from the trees to denote the limit of extraction.
2. Tunnel construction under County Road 17 can commence when Area 1A reaches the 242m level.
3. Extraction to the 234m level shall then be completed in Area 1A.
4. The asphalt plant is to be removed from the existing Keppel quarry by December 31, 2014.

AREA 1B

1. Construct access to Area 1B in accordance with landscape drawings.
2. Commence clearing and stripping operations in the north and north easterly portions of Area 1B and construct the required berms in the berm area along County Road 17 and in the berm area adjacent to the north boundary.
3. Execute the planting program for the 20m wide buffer strip between Area 1B and County Road 17.
4. Commence removal of aggregate in the proposed tunnel area to the 242m level and truck to the existing Keppel quarry for processing.
5. Complete tunnel construction from Area 1A.
6. Temporary sumps shall be created where necessary to catch precipitation and groundwater which will then be pumped to the "Sump Pond" located in the southeast corner of the Existing Keppel Quarry (as per ECA no. 3515–8M4PWM) when necessary. Associated pumps and piping shall also be moved within the licence area accordingly.

AREA 2

1. Commence stripping in the proposed berm area between Area 2 and County Road 17 and construct the proposed berm.
2. Execute the planting program for the 20m wide buffer strip between Area 2 and County Road 17.

Area 3

1. Commence stripping in the proposed berm area between Area 3 and County Road 17 and construct the proposed berm.
2. Execute the planting program for the 20m wide buffer strip between Area 2 and County Road 17.
3. Execute the planting program for the 30m wide buffer strip between Area 3 and Concession 10.
4. Area 3 shall be surveyed and the line between Area 2 and Area 3 shall be marked with highly visible marker posts at a minimum height of 2m.

Phase 2 (The period when excavation focus is in Area 1B–Year 3 to 7)

AREA 1A

1. Processing equipment shall be located in Area 1A until sufficient working area is established in Area 1B.
2. Commence moving aggregate from Area 1B to Area 1A through the tunnel for processing in Area 1A.
3. All processing equipment must be removed from Area 1A and rehabilitation commenced a maximum of seven (7) years after the issuance of the ARA licence.
4. Remove pumping equipment from Area 1A to Area 2.
5. Move existing stockpiles in Area 1A and from the old quarry floor to Area 1B as required.

AREA 1B

1. Establish the quarry floor working area at the 242m level in the north eastern part of Area 1B and relocate the primary crusher to Area 1B. Continue at elevation 242m until work area is made large enough to accommodate operational equipment. Once the 242m working area has been created, commence extraction to the lower bench levels.
2. Once the primary crusher has been established in Area 1B, crushed rock shall be transported through the tunnel for further processing in Area 1A.
3. Continue to clear and grub in the directions of the arrows shown.
4. Temporary sumps shall be created where necessary to catch precipitation and groundwater which will then be pumped to the "Sump Pond" located in the southeast corner of the Existing Keppel Quarry (as per ECA no. 3515–8M4PWM). Associated pumps and piping within the licensed area shall be moved/relocated within the licensed area when necessary.
5. Re-locate all processing equipment in the eastern part of Area 1B to the 230m level and commence all processing operations in Area 1B.

AREA 2

1. Clear the minimum required area and construct Sedimentation pond #1 (0.4 ha in size) on the north east side of Area 2. Construct the rip rap outlet south of sedimantation pond #1.

AREA 3

1. No action required.

Infiltration Pond

1. Subject to the results of the AMP the infiltration pond may be constructed and clear water pumped to it during this phase.

Phase 3 (The period when excavation focus is in area 1B–Year 8 to 14)

AREA 1A

1. Commence perimeter and entrance rehabilitation in Area 1A.
2. Rehabilitation starts in year 8 as the old quarry starts to fill with water.
3. Decommission the tunnel under County Road 17.

AREA 1B

1. Continue excavation to a depth of approximately 228m to 230m (to the bottom of the Amabel Formation).
2. Complete clearing and stripping operations in the southerly portion of Area 1B to Area 2.
3. Temporary sumps shall be created where necessary to catch precipitation and ground water which will then be pumped or trenched to the Sedimentation Pond #1 in Area 2. Associated pumps and piping shall be relocated where necessary.
4. Extraction in Area 1B continues south easterly.

AREA 2

1. Commence clearing and stripping in the rest of Area 2.
2. Pump clear water from sedimentation pond 1 to the riprap area so it can drain naturally to the karst openings.

AREA 3

1. No action required.

Infiltration Pond

1. Subject to the results of the AMP the infiltration pond may be constructed and clear water pumped to it during this phase.

Phase 4 (The period when excavation focus is in Area 1B–Year (15 to 18)

AREA 1A

1. Perimeter slope and entrance rehabilitation has been completed. The old quarry is filling with water.

AREA 1B

1. Continue all processing operations in Area 1B.
2. Extraction in the southern part of Area 1B shall continue south easterly to a depth of approximately 228m to 230m (the bottom of the Amabel Formation).
3. Temporary sumps shall be created where necessary to catch precipitation and groundwater which will then be pumped to Sedimentation Pond #1 located in Area 2. The water shall then be pumped to the rip rap in Area 2 and allowed to flow naturally to the observed karst openings. Associated pumps and piping within the licensed area shall be moved/relocated when necessary.

AREA 2

1. Complete clearing and stripping operations in Area 2.
2. Extraction shall commence in Area 2 in the direction of the arrows shown (south easterly) to a depth of approximately 229m to 230m (the bottom of the Amabel Formation).
3. Temporary sumps shall be created where necessary to catch precipitation and groundwater which will then be pumped or trenched to Sedimentation Pond #1 located in Area 2. Clear water shall then be pumped to the riprap in Area 2 and allowed to flow naturally to the observed karst openings.

AREA 3

1. No action required.

Infiltration Pond

1. Subject to the results of the AMP the infiltration pond may be constructed and clear water pumped to it during this phase.

Phase 5 (The period when excavation focus is in Area 2–Year 19 to 26)

AREA 1A

1. Perimeter rehabilitation has been completed. The old quarry is filling with water.

AREA 1B

1. Area 1B will accommodate stockpiles.
2. Temporary sumps shall be created where necessary to catch precipitation and groundwater which will then be pumped or trenched to Sedimentation Pond #1 located in Area 2. Clear water shall then be pumped to the rip rap in Area 2 and allowed to flow naturally to the observed karst openings. Associated pumps and piping within the licensed area shall be moved/relocated when necessary.

AREA 2

1. Extraction and production shall continue in Area 2 in the direction of the arrows shown to a depth of approximately 229m to 230m (the bottom of the Amabel Formation).
2. Temporary sumps shall be created where necessary to catch precipitation and groundwater which will then be pumped to Sedimentation Pond #1 in Area 2 and clear water shall be pumped to the rip rap in Area 2 and allowed to flow naturally to the observed karst openings.

AREA 3

1. The excavation of Area 3 may only proceed if it is determined acceptable by the MNR and MOE through the results of the Adaptive Management Plan (AMP).
2. Upon authorization to excavate Area 3 being granted by MNR and MOE,– commence clearing and grubbing the area in preparation for extraction. Extraction from Area 2 can proceed through into Area 3.
3. Construct Sedimentation Pond #2 in the location shown on the plans in the south east corner of Area 3 along Concession 10 and construct the riprap area.
4. Temporary sumps shall be created where necessary to catch precipitation and groundwater which shall then be pumped to Sedimentation Pond #2 in Area 3. The water will make its way into the riprap and be released into the adjacent observed karst openings. Associated pumps and piping shall be moved/relocated when necessary.

Infiltration Pond

1. Depending on the results of the AMP the infiltration pond may be constructed and clear water pumped to it during this phase.

Phase 6 (The period when excavation focus is in Area 3–Year (27 to 29)

AREA 1A

1. Perimeter rehabilitation has been completed. The old quarry is filling with water.

AREA 1B

1. Area 1B may accomodate stockpiles.
2. Temporary sumps shall be created where necessary to catch precipitation and groundwater which shall then be pumped to Sedimentation Pond #2 in Area 3. The water will make its way into the riprap and be released into the adjacent observed karst openings. Associated pumps and piping shall be moved/relocated when necessary.
3. Upon completion of extraction in Area 2 and Area 3, all operational buildings and structures shall be removed from the 242 level in Area 1B and that area shall be excavated to 230m (the bottom of the Amabel Formation).
4. As part of the rehabilitation works the berm along the ANSI boundary shall be removed in sections of 50 metres. The bedrock will be stripped to the extraction limit, drilled and blasted to the 243m level as shown in "Rehabilitation Shoreline Detail to 100m ANSI Setback" on Page 7. The blasted rock is to be cast to the quarry floor and the berm material placed into the excavated notch. The backfill material shall be graded to a 3:1 slope. The process shall be repeated in 50m increments moving northeasterly to the eastern extraction limit.
5. Step number 4 shall be repeated until all of the quarry rock is mined out from the northern perimeter area to elevation 243m.
6. The remaining perimeter berm on the roadside boundary shall also be excavated and used to finish the rehabilitation along the northern perimeter. The final perimeter rehabilitation shall be completed as shown on Drawing 7, "Cross-Sections and Details."
7. Once all final rehabilitation has been completed the quarry shall be allowed to fill with water from groundwater and precipitation.

AREA 2

1. Complete extraction in Area 2.
2. Area 2 may accomodate stockpiles.
3. Temporary sumps shall be created where necessary to catch precipitation and groundwater which shall then be pumped to Sedimentation Pond #2 in Area 3. The water will make its way into the riprap and be released into the adjacent observed karst openings. Associated pumps and piping shall be moved/relocated when necessary.

AREA 3

1. Move all processing operations into Area 3 when sufficient space becomes available. Processing equipment shall be located on the quarry floor at elevation 230m.
2. Continue excavtion south easterly to 230m (the bottom of the Amabel Formation).
3. Temporary sumps shall be created where necessary to catch precipitation and groundwater which shall then be pumped to Sedimentation Pond #2 in Area 3. The water will make its way into the riprap and be released into the adjacent observed karst openings. Associated pumps and piping shall be moved/relocated when necessary.
4. Relocate the sedimentation pond to the quarry floor and contine extraction to the 230m level. Temporary sumps, previously created to catch precipitation and groundwater, shall pump to the relocated sedimentation pond and then to the old quarry or to the infiltration pond if it has been created. Associated pumps and piping shall be moved/relocated when necessary.
5. Create a 3:1 slope in the southeast corner as shown on Drawing 6.

Infiltration Pond

1. If, based on the results of the AMP, the infiltration pond has been previously constructed and clear water pumped to it during operations, then once operations are completed and the infiltration pond is no longer needed as per the results of the post-closure monitoring program described in the AMP, the pond shall be regraded to form a shallow depressed area that shall naturally form a small marsh area.

Final

1. Once all operations are completed the quarry shall be allowed to fill with water.

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NEW KEPPEL QUARRY
PARTS LOTS 26, 27 & 28, CONCESSION 10
TOWNSHIP OF GEORGIAN BLUFFS (formerly Keppel Twp)
COUNTY OF GREY

SEQUENCE of OPERATIONS
DRAWING 3 of 9

No.	AMENDMENT	DATE

December 11, 2014

NATURAL ENVIRONMENT RECOMMENDATIONS (BY Aquatic Wildlife Services, Shallow lake, Ontario)

1 Mitigation Measures

These measures are recommended to maintain the ecological functioning role and natural heritage features that have been identified within this study area and are in keeping with provincial and municipal policies and guidelines.

1.1 The proposed licensed boundary is to maintain a minimum setback distance of 120 m from the Provincially Significant Shouldice Wetland boundary and a minimum setback of 100m from The Glen ANSI boundary.

1.2 The setback lands from the identified significant features are to be considered 'buffer lands' to these features; as such no site development is to occur including noise attenuation berms, aggregate stockpiling or buildings. Buffer lands are to remain in a natural vegetation condition though minor site alterations through reforestation; boundary fencing, and property internal road/trail upkeep is acceptable. The setback/buffer lands compliance monitoring shall be incorporated into the Aggregate Resources Act–Annual Compliance Assessment Reports.

1.3 In conjunction with the approved 'Adaptive Management Plan' if a yellow threshold level mitigative action requires construction of a new seasonal ephemeral pond, said pond shall be constructed with a low permeable bottom/lining, in suitable terrain conditions prior and location approved by reviewing agencies. Said ephemeral pond design & construction shall reflect the following design guidelines:

– Continuous forest cover around the pond perimeter to be maintained with direct linkage to the forested ANSI lands. No fencing or berm placement around the pond perimeter.

– Pond to maintain a minimum of 10:1 slope, with 20cm of native topsoil deposited over the pond bottom for the establishment of natural hydrophilic plants. Pond to be constructed with varying widths and depths but should not exceed 10m in width or exceed 0.7m in depth and a minimum length of 50m

– The ephemeral pond construction site should maximize natural terrain snowmelt runoff to the site. Pond design parameters should try to maintain surface waters within the pond between the spring snowmelt periods to late June, during the remaining life of the quarry operations and rehabilitative period.

1.4 The identified 'Significant–Rare' plant mitigation relocation measures within the 2012 extraction lands, shall be undertaken prior to extraction phase 1B start up and carried out by or under the direct supervision of a qualified person. Annual monitoring shall be undertaken by a qualified person during the flora growing season of relocated flora for survival rates, for 3 years post planting year relocation efforts.

1.5 Any and all equipment storage, stock piled material, out buildings etc. in relation to this aggregate extraction proposal shall be contained within the 'limit of extraction' area.

1.6 No vegetation clearing or overburden stripping should occur during the months of April, May or June in any given year, for the maintenance and protection of forest nesting birds, in accordance to the Migratory Birds Convention Act. The site clearing compliance monitoring aspects shall be incorporated into the Aggregate Resources Act–Annual Compliance Assessment Reports.

1.7 Required advanced tree and vegetation removal should be undertaken only 1–2 years prior to required extraction for that 'phase area' during the previous year's summer, fall or winter seasons. Land clearing should not occur beyond what can be utilized within the quarry for a 2–year period, other than those lands identified as being used for the settling/infiltration ponds.

1.8 The final rehabilitation plan is to include a 'Naturalized Shoreline' fronting the ANSI boundary incorporating the following design recommendations, but not limited to:

– Shoreline to be stabilized to a 3:1 slope out to a minimum water depth point of 1.0 m

– Removal of berm and any fence fronting the ANSI boundary with material utilized to slope shoreline and provide suitable growing substrate (above and below water).

– Reforestation phase shown on operational plan, with native tree/shrub species, sizes and density planting guideline.

– Final 'water's edge' of quarry environment fronting the ANSI boundary to be restored to a natural environment, with an irregular shoreline providing habitat cover creation (rock piles, logs, stumps, boulders), varying water depths through deposition of topsoil (berm material from overburden clearing) out to the quarry vertical face (approx. 1.5 m water depth zone).

1.9 A 'Stewardship Management Plan' focused on wildlife habitat and woodland ecology shall be completed for Lot 25, 26 and 27, Concession 10, geographic Township of Keppel, for the lands HSC Aggregates Ltd. owned lands which occur beyond the quarry extraction boundary. This Stewardship Plan shall follow the format of the Ontario 'Guide to Stewardship Planning for Natural Areas' and shall be submitted for review to the Ontario Ministry of Natural Resources, Niagara Escarpment Commission, SON, the Grey Sauble Conservation Authority and the Stakeholders Liaison Committee, prior to Extraction Phase 1B start up.

1.10 10. Reforestation mitigation zones that occur outside the licensed boundary area have been shown on the "REFORESTATION AREAS" figure on the Operational Plan, drawing 4. Said reforestation measures shall follow provincial standards outlined on the public document ' OMNRF Extension Notes AGCEX 322–Tree Planting' for planting plan, tree densities and native species to Grey County, with draft planting plan submission to SON for review and commenting with reforestation to be completed prior to extraction phase 1B start up. Annual reforestation monitoring shall be undertaken by a qualified person for 3 years post planting, during the flora growing season, with survival target rates of 80% and restoration plans if deemed necessary. Said monitoring activities shall be reported to provincial agencies, SON, Grey Sauble Conservation Authority and the Stakeholders Liaison Committee by calendar years end for that reporting year.

1.11 The Natural Environment Ecological Monitoring Plan requirements have been incorporated into the Keppel Quarry Adaptive Management Plan which shall be considered a mitigative measure for both short–term and long–term environmental monitoring activity with adaptive management strategies, threshold levels, remedial action works and contingency plans if deemed necessary. Said monitoring activities shall be reported to all reviewing agencies in a timely manner as per the 'AMP' monitoring program outline.

1.12. Terrestrial Invasive Plant Species Monitoring will be undertaken once a year between June 15th to September 15th within the Licence area (non–operating lands in that year), and Natural Environment Buffer Zones, plus an additional 30 meters in adjacent lands owned by HSC Aggregates Ltd. Said monitoring shall be conducted by a qualified person as 'general visual observations' of terrestrial invasive species, numbers, location and mapping with annual recommendations and reporting by calendar years end for that reporting year to the Stakeholder Liaison Committee, during the Quarry active operational period.

NETR NOTES:

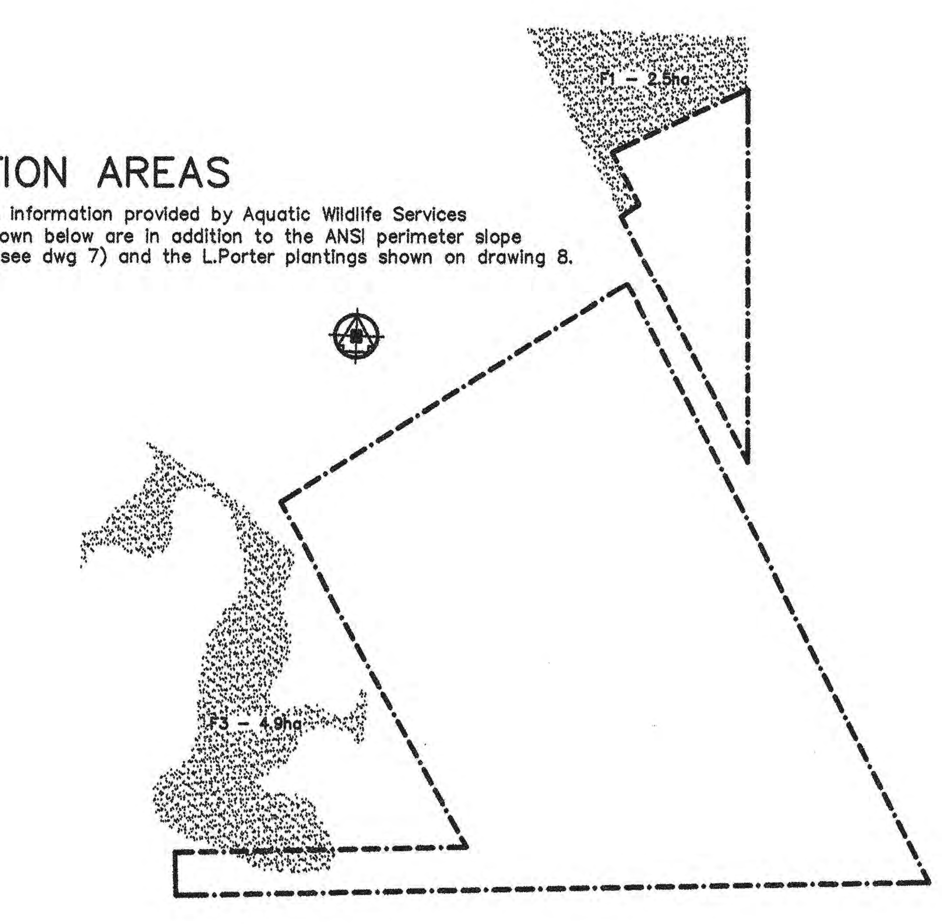
1) The 2007 Natural Environment Technical Reporting figures are based upon the draft extraction lands at that time, which have been significantly reduced to–date through the agency review/commenting process. The current licence lands and extraction area is still contained within the original 2007 Natural Environment Technical Reporting 'study lands' and as such environmental data analysis, impact assessment and conclusions are valid and consistent with the current licence/extraction lands and operational design.

2) The 2007 Natural Environment Technical Reporting for 'Mitigation Measures' and 'Ecological Monitoring Program' have been modified and revised above, to address the current 2012 licence boundary, extraction lands, Adaptive Management Plan and supplementary technical reporting on hydrology and hydrogeological assessment.

3) The 2007 Natural Environment Technical Reporting for the 'Recommendations' section associated with Mr. Sutherlands land holding of Lot 30, Concession 10 of the former Keppel Township are no longer deemed applicable to this current and significantly reduced extraction land area.

REFORESTATION AREAS

This figure is derived from information provided by Aquatic Wildlife Services
The reforestation areas shown below are in addition to the ANSI perimeter slope planting (+/– 0.55 ha.) (see dwg 7) and the L.Porter plantings shown on drawing 8.



NOISE CONTROL RECOMMENDATIONS (By Aercoustics Engineering Ltd.)

1) The Area 2 and Area 3 extraction shall have the working face moving towards the R1 receptor.

2) In Area 2 and Area 3, the secondary processing plant crushers and screens shall be positioned at a maximum distance of 60m from the quarry face in the direction towards the R1 receptor.

1.1 GENERAL CONTROLS

1.1.1 Equipment used in site preparation and other construction activities shall satisfy the noise emission levels of MOE NPC–115 "Noise due to Construction Equipment".

1.1.2 Quarry equipment shall satisfy the reference power levels listed in Table 1.

1.1.3 The drilling, extraction and processing (crushing, washing and/or screening) operations shall be limited to the daytime hours of 07:00 – 18:00.

Table 1: Reference Sound Power Levels of Quarry Equipment

Equipment	Reference Sound Power Level (dB(A))
Rock Drill	111
Primary Crusher	121
Secondary Processing Plant	129
Extraction Loader or Shovel	114
Pit Trucks (40 passes/hr, 100m section. 25km/hr)	104
Loader for shipment, loading trucks	109

1.2 AREA 1A (see Figure 1) – The following noise controls in addition to the general controls are recommended.

1.2.1 Extraction should proceed in a northwesterly direction. See Figure 1 below.

1.3 AREA 1B – (See Figure 2) The following noise controls in addition to the general controls are recommended.

1.3.1 Extraction shall proceed in a south or south–easterly direction.

1.3.2 Acoustic barriers (6m high) in the form of an earth berm, acoustic fence, or combination of these shall be constructed on the north and east perimeter of the quarry area as shown in Figure 2. This 6m perimeter acoustic barrier shall remain for the life of the quarry.

1.3.3 The primary plant shall travel with the working face positioned such that the working face provides shielding towards receptor R1.

1.3.4 When operating in Area 1B the secondary processing plant shall be located on the quarry floor at EL242m or less and shielded from the R1 and R2 receptors by an acoustic barrier. The barrier shall have minimum height of 8m and be positioned at a maximum distance of 50m from the processing plant crushers and screens. The acoustic barrier must be solid without gaps or openings and satisfy an area density of 20 kg/m2.

1.4 AREA 2 and AREA 3 (See Figure 3) – The following noise controls in addition to the general controls are recommended.

1.4.1 Extraction shall proceed in a southeasterly direction with the working face moving towards the R1 receptor.

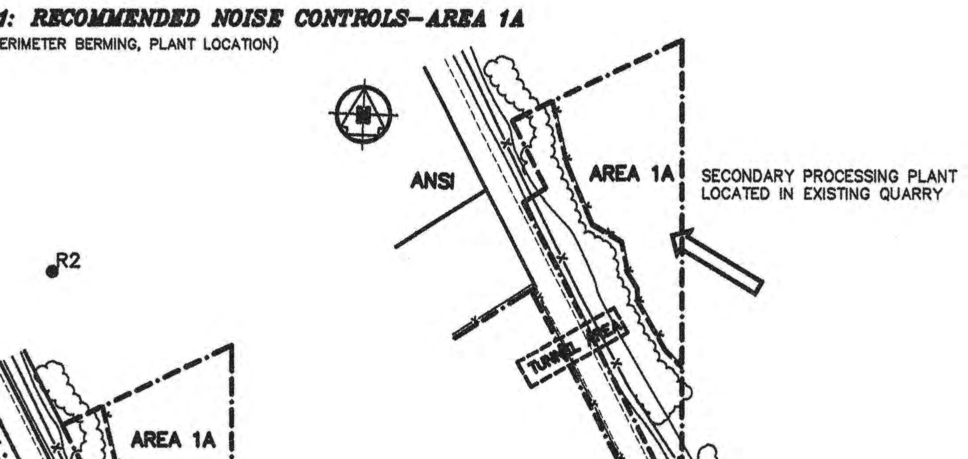
1.4.2 The primary plant shall travel with the working face positioned such that the working face provides shielding towards receptor R1.

1.4.3 The secondary processing plant shall be positioned on the quarry floor +/–EL230m and be shielded from the R2 receptor with an acoustic barrier. The barrier shall have a minimum height of 8m and be positioned at a maximum distance of 50m from the processing plant crushers and screens. The acoustic barrier must be solid without gaps or openings and satisfy an area density of 20 kg/m2. An acoustic barrier can take the form of a stockpile, an un–extracted rock face, stacked ISO containers, or anything else satisfying the requirements of an acoustic barrier.

1.4.4 In Area 2 and Area 3, the secondary processing plant crushers and screens shall be positioned at a maximum distance of 60m from the quarry face in the direction towards the R1 receptor.

1.4.5 When operating in Areas 2 or 3, the secondary processing plant shall be positioned on the quarry floor +/–EL230m and be shielded from the R2 receptor with an acoustic barrier. The barrier shall have a minimum height of 8m and be positioned at a maximum distance of 50m from the processing plant crushers and screens. The acoustic barrier must be solid without gaps or openings and satisfy an area density of 20 kg/m2. An acoustic barrier can take the form of a stockpile, an un–extracted rock face, stacked ISO containers, or anything else satisfying the requirements of an acoustic barrier.

FIGURE 1: RECOMMENDED NOISE CONTROLS–AREA 1A
(PERIMETER BERMING, PLANT LOCATION)



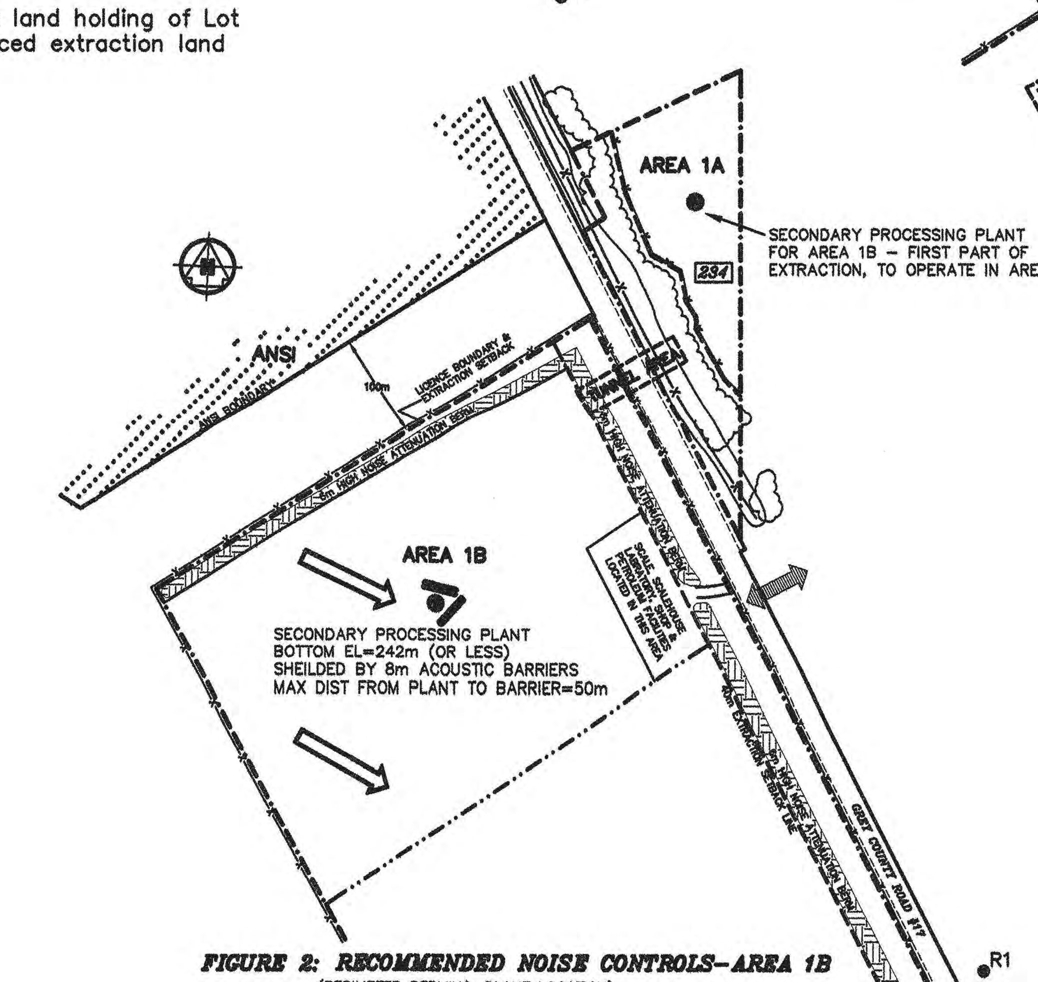


FIGURE 2: RECOMMENDED NOISE CONTROLS–AREA 1B
(PERIMETER BERMING, PLANT LOCATION)

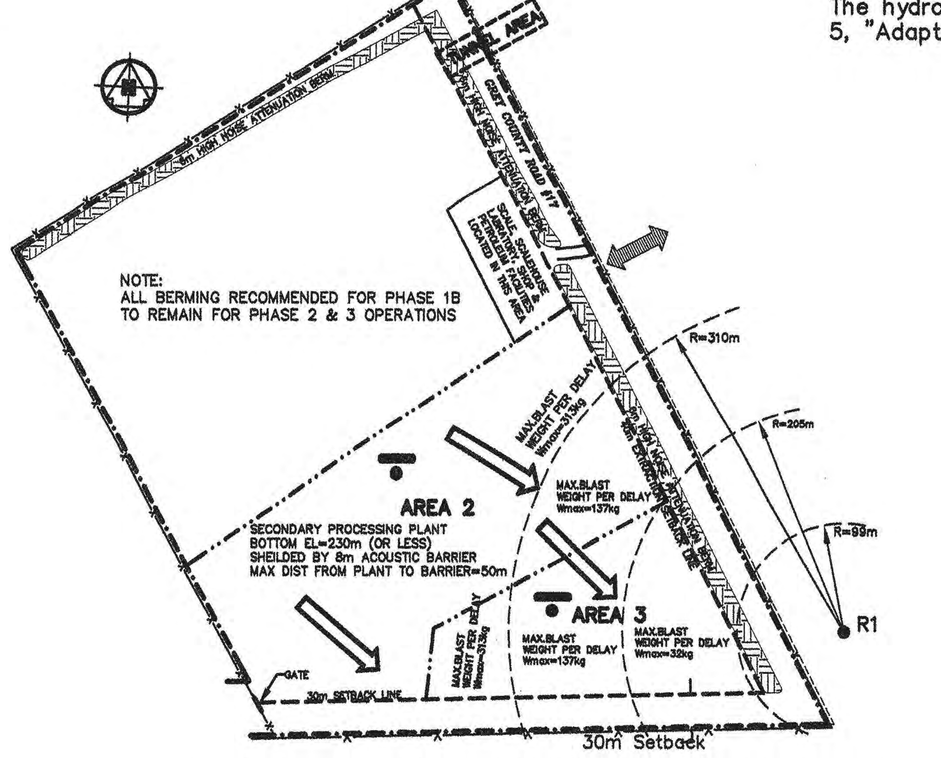


FIGURE 3: RECOMMENDED NOISE CONTROLS–AREAS 2 & 3
(PERIMETER BERMING, PLANT LOCATION)

DETAILS OF RECOMMENDED BLASTING PROCEDURES (by DST Consulting Engineers Inc., Sudbury, On)

– Sequential blasting techniques will be used to ensure minimum explosives per delay period initiated. These include:
  – Non–electric blasting systems such as the EZ–Det / Handi–Det / Snap–Det systems or,
  – Electronic initiation system with remote detonation.

– Drilling pattern for initial quarry blasting will be maximum 3.05 m (10') Burden by 3.66 m (12'). The pattern may be adjusted for subsequent blasts in order to achieve the required fragmentation.

– Maximum drill–hole diameter for initial quarry blasting will be 102 mm (4"). Vibration and overpressure data acquired during initial blasting may allow for an increase in drill–hole diameter. The pattern will be adjusted to accommodate for the increase in drill–hole diameter.

– Minimum collar will be 1.2 m (4 ft.) for 102 mm (4") diameter drill–holes.

– Bench height will not exceed 15.24 m (50') for initial quarry blasting.

– Clear crushed stone will be used for stemming.

– Primary and secondary dust collectors will be employed on the rock drills to keep the level of dust to a minimum.

– Blasting should be avoided during heavy overcast and temperature inversions when possible.

– Blast–hole detonation will be limited to a single hole per delay period.

– The amount of explosives per delay period for initial quarry blasting shall not exceed 141.9 kg.

BLAST IMPACT ANALYSIS RECOMMENDATIONS (by DST Consulting Engineers Inc., Sudbury, Ontario)

All blasts should be monitored for both vibration and overpressure (noise) at two of the closest third–party properties adjacent the site (Receptors 1 and 2) with digital seismographs. Compilation of the initial data should be used to establish a site specific vibration and noise attenuation graphs. The values of the Scaled Distance obtained from the graphs will assist in planning subsequent blasting operations. This will also allow blasts to be designed specifically for this location which should ideally induce vibration and noise levels within the MOE Guidelines. All subsequent blasts should also be monitored by the quarry operator at the closest third party building or facility to the blast site. The blasting operations should be audited periodically by an independent blasting consultant.

The seismographs must be self–triggering units and calibrated on an annual basis, or as recommended by the manufacturer. Seismogram copies as well as blast reports for each blast should be filed for future reference.

Detailed blast records should be maintained. The MOE (1985) recommended that the body of blast reports should include the following information:

a) Location, date and time of the blast.

b) Dimensional sketch including photographs, if necessary, of the location of the blasting operation, and the nearest point of reception (vibration receptor).

c) Physical and topographical description of the ground between the source and the receptor location.

d) Type of material being blasted.

e) Sub–soil conditions, if known.

f) Prevailing meteorological conditions including wind speed in m/s, wind direction, air temperature in degrees Celcius, relative humidity, degree of cloud cover and ground moisture content.

g) Number of drill holes.

h) Pattern and pitch of drill holes.

i) Size of holes.

j) Depth of drilling.

k) Depth of collar.

l) Depth of toe–load.

m) Weight of charge per delay period.

n) Number and time of delays.

o) The result and calculated value of Peak Sound Pressure Level in dB (L) and Peak Particle Velocity in mm/s.

p) Applicable limits.

q) The excess, if any, over the prescribed limits.

The blast parameters described within this report will provide a good basis for the initial blasting operations at this quarry. However, it may be necessary to refine these parameters once site–specific vibration and overpressure data from the blasting operations become available.

Blasting procedures such as drilling and loading should be monitored or audited on an occasional basis by an independent blasting consultant to ensure full compliance with governing guidelines and regulations.

HYDROGEOLOGICAL RECOMMENDATIONS (by MTE Consultants Inc., Kitchener, Ontario)

The hydrogeological recommendations have been included within the Adaptive Management Plan on Drawing 5, "Adaptive Management Plan".

HAROLD SUTHERLAND CONSTRUCTION LTD.
R.R. #2, KEMBLE, ONTARIO, N0H1S0

NEW KEPPEL QUARRY
PARTS LOTS 26, 27 & 28, CONCESSION 10
TOWNSHIP OF GEORGIAN BLUFFS (formerly Keppel Twp)
COUNTY OF GREY

CONSULTANT RECOMMENDATIONS

No.	AMENDMENT	DATE

December 11, 2014

ADAPTIVE MANAGEMENT PLAN - NEW KEPPEL QUARRY

WATER RESOURCES MONITORING PROGRAM

Purpose: To track the performance of the New Keppel Quarry and the potential impacts on water resources

1) Establish a weather station so that site-specific climate data can be obtained

2) Retain a person qualified to:

- Conduct monthly measurements of water levels at the observation wells, minipiezometers, and test pits listed below. and the private wells listed in the Private Wells Monitoring Program;
- Conduct monthly measurements of flows at springs, the Beaver Dam sinkhole, culverts, mud creek channel A. the Ephemeral Pond and the dugout pond listed below;
- Conduct monthly measurements of specific conductivity and temperature at springs listed below. the Beaver Dam sinkhole, culverts listed below, Mud Creek (Channel A) and the Dugout Pond;
- Install and maintain data loggers in 'Sentry Wells' listed below and download the data loggers monthly;
- Install and maintain data loggers in minipiezometers to be installed in spring s8, spring s13, and the dugout pond and download the data loggers monthly;
- Download precipitation data and pumping records monthly or as needed;
- Compile monitoring data and compare it to precipitation data and pumping records monthly;
- Inspect for water bearing fractures along active quarry faces immediately after a blast;
- Check infiltration pond (if installed) located near s13 for proper function on a weekly basis.

3) Retain an independent Hydrogeologist to:

- Assess and interpret water levels and flows measured against historical patterns. seasonal lows, trigger values, pumping records and precipitation records on a monthly basis;
- Compare monitoring data against trigger values on a monthly basis and make recommendations for monitoring program alterations if required;
- Map cone of influence on a monthly basis and assess its size and shape;
- Provide an annual monitoring report and make recommendations for future monitoring.

Water Resources Monitoring Locations

Observation Wells

Line 1:	OW36	OW37	OW49	OW50	OW51	OW52										
Line 2:	OW14s	OW14d	OW28s	OW28d	OW32s	OW32d	3345	OW33s	OW33d							
Line 3:	OW34	OW35	OW36	OW14s	OW14d	OW41s	OW41d	OW67s	OW67d	OW68s	OW68d	OW58k	OW58s	OW58d		
Line 4:	OW39	OW65s	OW65d	OW66s	OW66d	OW12s	OW12d	OW25s	OW25d	OW59s	OW59d					
Line 5:	OW39	OW40	OW42s	OW42d	OW63s	OW63d	OW64s	OW64d	OW8s	OW8d	OW69s	OW69d	OW24			
Line 6:	OW39	OW40	OW61s	OW61d	OW62k	OW62s	OW62d	OW9s	OW9d	OW70s	OW70d	OW27s	OW27d			
Line 7:	OW39	OW7s	OW7d	OW43s	OW43d	OW11s	OW11d	OW46s	OW46d	OW47s	OW47d	OW48s	OW48d			
Line 8:	OW30s	OW30d	OW39	OW10s	OW10d	OW44s	OW44d	OW45								
Line 9:	OW40	OW7s	OW7d	OW29s	OW29d											
Zone 1:	OW3	OW4	OW7s	OW7d	OW10s	OW10d	OW11s	OW11d	OW14s	OW14d	OW29s	OW29d	OW30s	OW30d	OW34	OW35
	OW36	OW37	OW38	OW39	OW40	OW42s	OW42d	OW43s	OW43d	OW61s	OW61d	OW63s	OW63d	OW65s	OW65d	
Zone 2:	OW15s	OW15d	OW28s	OW28d	OW31s	OW31d	OW32s	OW32d	OW41s	OW41d	OW44s	OW44d	OW46s	OW46d	OW49	OW50
	OW62k	OW62s	OW62d	OW64s	OW64d	OW66s	OW66d									
Zone 3:	OW8s	OW8d	OW9s	OW9d	OW12s	OW12d	OW13s	OW13d	OW24	OW25s	OW25d	OW26	OW27s	OW27d	OW33s	OW33d
	OW45	OW47s	OW47d	OW48	OW51	OW52	OW53	OW58k	OW58s	OW58d	OW59s	OW59d	OW60s	OW60d	OW67s	OW67d
	OW68s	OW68d	OW69s	OW69d	OW70s	OW70d	OW71k	OW71s	OW71d							
Sentry Wells	OW8s	OW8d	OW9s	OW9d	OW12s	OW12d	OW13s	OW13d	OW33s	OW33d	OW45	OW47s	OW47d	OW51	OW67s	OW67d
	OW71k	OW71s	OW71d													

Minipiezometers	MP54	MP55	MP56	MP57					
Test Pits	TP16	TP17	TP18	TP19					
Springs	s1	s2	s3	s8	s13				
Beaver Dam Sinkhole	flow into sinkhole								
Culverts	1	2	3	4	5	5a	6	6a	7
Mud Creek	Channel A								
Ephemeral Pond	water levels								
Dugout Pond	water levels	outflows							

Water Resources Triggers

Seasonal Values					Trigger Values											
Monitoring Station	spring low	summer low	autumn low	winter low	green (spring)	green (summer)	green (autumn)	green (winter)	yellow (spring)	yellow (summer)	yellow (autumn)	yellow (winter)	red (spring)	red (summer)	red (autumn)	red (winter)
	March 21 - June 21	June 21 - Sept 21	Sept 21 - Dec 21	Dec 21 - March 21	March 21 - June 21	June 21 - Sept 21	Sept 21 - Dec 21	Dec 21 - March 21	March 21 - June 21	June 21 - Sept 21	Sept 21 - Dec 21	Dec 21 - March 21	March 21 - June 21	June 21 - Sept 21	Sept 21 - Dec 21	Dec 21 - March 21
Sentry Observation Wells																
OW8s	243.77	243.23	243.07	243.89	243.92	243.38	243.22	244.04	243.77	243.23	243.07	243.89	243.62	243.08	242.92	243.74
OW8d	243.19	242.45	242.31	243.46	243.34	242.60	242.46	243.61	243.19	242.45	242.31	243.46	243.04	242.30	242.16	243.31
OW9s	242.83	242.20	242.25	242.93	242.98	242.35	242.40	243.08	242.83	242.20	242.25	242.93	242.68	242.05	242.10	242.78
OW9d	243.01	241.99	242.23	243.23	243.16	242.14	242.38	243.38	243.01	241.99	242.23	243.23	242.86	241.84	242.08	243.08
OW12s	243.65	243.36	243.30	243.72	243.80	243.51	243.45	243.87	243.65	243.36	243.30	243.72	243.50	243.21	243.15	243.57
OW12d	243.47	242.89	242.76	243.68	243.62	243.04	242.91	243.83	243.47	242.89	242.76	243.68	243.32	242.74	242.61	243.53
OW13s	244.58	243.67	243.40	244.80	244.73	243.82	243.55	244.95	244.58	243.67	243.40	244.80	244.43	243.52	243.25	244.65
OW13d	241.99	241.42	241.32	242.48	242.14	241.57	241.47	242.63	241.99	241.42	241.32	242.48	241.84	241.27	241.17	242.33
OW33s	243.47	243.10	243.09	243.62	243.62	243.25	243.24	243.77	243.47	243.10	243.09	243.62	243.32	242.95	242.94	243.47
OW33d	239.25	238.59	238.73	239.92	239.40	238.74	238.88	240.07	239.25	238.59	238.73	239.92	239.10	238.44	238.58	239.77
OW45	243.93	243.22	243.83	244.13	244.08	243.37	243.98	244.28	243.93	243.22	243.83	244.13	243.78	243.07	243.68	243.98
OW47s	243.45	243.00	243.14	243.47	243.60	243.15	243.29	243.62	243.45	243.00	243.14	243.47	243.30	242.85	242.99	243.32
OW47d	243.36	242.71	243.27	243.42	243.51	242.86	243.42	243.57	243.36	242.71	243.27	243.42	243.21	242.56	243.12	243.27
OW51	239.75	239.00	238.97	240.08	239.90	239.15	239.12	240.23	239.75	239.00	238.97	240.08	239.60	238.85	238.82	239.93
OW53	241.65	242.39	243.45	244.38	241.80	242.54	243.60	244.53	241.65	242.39	243.45	244.38	241.50	242.24	243.30	244.23
OW67s*	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
OW67d*	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
OW71s*	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
OW71d*	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
OW71k*	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Springs																
Spring s8 Water Levels	239.82	239.51	239.63	239.89	239.97	NA	239.78	240.04	239.82	NA	239.63	239.89	239.67	NA	239.48	239.74
Spring s13 Water Levels	242.86	242.33	242.35	242.93	243.01	NA	242.50	243.08	242.86	NA	242.35	242.93	242.71	NA	242.20	242.78
Dugout Pond																
SG1	243.09	243.01	243.07	243.06	243.24	243.16	243.22	243.21	243.09	243.01	243.07	243.06	242.94	242.86	242.92	242.91
Ephemeral Pond																
Staff Gauge	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

TBD = To Be Determined NA = Not Applicable

* = Seasonal values and subsequent trigger values shall be based on at least three years of monitoring data collected while extracting in Area 1B

ECOLOGICAL MONITORING PROGRAM

Purpose: To evaluate the ecological health of selected natural features throughout the life cycle of the quarry and ensure that their ecological function is maintained.

The Ecological Monitoring Program relies upon an understanding of changes observed through the Water Resources Monitoring Program because ecological receptors tend to respond more slowly to impacts compared to the hydrogeologic regime. Therefore, the Water Resources Monitoring Program will be a critical early warning system for detecting potential impacts to ecological health. The Ecological Monitoring Program shall be carried out by a Biologist/Ecologist. The Ecological Monitoring Program is described in detail in the AMP report. Trigger values for the Ecological Monitoring Program will be established during year one of the Ecological Monitoring Program and reported on in the first annual report. Year one reporting shall be considered "normal" for flora community diversity and be used to establish trigger threshold levels for comparison to future monitoring results. Baseline data collection shall be undertaken during late spring which is considered by SON as the "high" water level season.

Ecological Monitoring Areas (EMA)

The Ecological Monitoring Program will be focused on features in the woodlands of the Area of Natural and Scientific Interest (ANSI), the Shouldice Wetland and the upper Glen Management Area and include both terrestrial ecological features (EMA-1 and EMA-2) and wetland ecological features (EMA-2 through EMA-6).

EMA-1: Woodland Tree Health. Woodland Regeneration and Woodland Flora Species Diversity;
EMA-2: Woodland Breeding Birds;
EMA-3: The Glen area s1 to s3 groundwater discharge feature;
EMA-4: The Shouldice Wetland at the s8 and s9 groundwater discharge feature;
EMA-5: The Woodland Ephemeral Pond amphibian breeding surface water feature; and
EMA-6: The lobe of the Shouldice Wetland encompassing spring s13 and the Dugout Pond and the upper headwater channel for the East Branch of Park Head Creek.

APPENDIX B: TRIGGER LIMITS AND MITIGATION MEASURES

Water Resources/Ecological Green Actions

Purpose: Identify changes prior to impacting groundwater and surface water features and implement investigative actions

In the event there is a green trigger exceedence in the Water Resources and/or the Ecological Monitoring Program:

a) Report the exceedence to the quarry owner/operator within 24 hrs;
b) Report the exceedence to the Ecologist/Biologist within 24 hrs;
c) Report the exceedence to the Hydrogeologist within 24 hrs and increase monitoring frequency to weekly at:

- Observation wells along Lines 1 and 2, at Spring s1, s2. s3, and at the Beaver Dam Sinkhole IF a green trigger value is exceeded at OW33s, OW33d, or OW51
  - confirm that water is entering Beaver Dam sinkhole and that spring s3 is flowing
  - confirm that groundwater seepage along the north quarry face has not increased
- Observation wells along Lines 3, 4. 5, at Spring s8. at Test Pits TP15, TP16, TP17, TP18, and at Minipiezometers MP55. MP56, and MP57, IF a green trigger value is exceeded at OW67s, OW67d, OW12s, OW12d, OW8s, OW8d
- Observation wells along Lines 6, 7. 8, Spring s13, the Dugout Pond (water levels and flow) IF a green trigger value is exceeded at OW9s. OW9d, OW71k, OW71s, OW71d, OW47s, OW47d, OW45

d) Consult with a Hydrogeologist to review the extra data collected and make recommendations for changes to the monitoring program as required. Changes may include but not limited to:

- Increased frequency of monitoring
- Further investigation using pumping records and site-specific precipitation records
- Mapping the cone of influence using the most recent round of water levels;
- Installing new observation wells, if required, to more accurately define the cone of influence of the quarry with respect to a certain receptor:
- Retaining an Hydrogeologist to complete an analysis/evaluation of the data collected

Water Resources/Ecological Yellow Actions

Purpose: Implement mitigation measures that will prevent impacts to groundwater, the Shouldice Wetland, or the springs s1-s3 in the Glen Management Area thus preventing the need for Red Actions. If changes to natural features are related to climatological influences or non-quarry related activities then Yellow Actions may not be required.

A "Yellow Action" precautionary mitigation response is triggered if:
1. A yellow trigger value has been exceeded in the Water Resources Monitoring Program that can be attributed to the quarry operations; and/or
2. Early indicators of ecological impacts are observed that can be attributed to the quarry operations.

In the event of a yellow trigger exceedence in the Water Resources and/or the Ecological Monitoring Program:

a) Report the exceedence to the quarry owner/operator within 24 hrs;
b) Report the exceedence to the Ecologist/Biologist within 24 hrs;
c) Report the exceedence to the Hydrogeologist within 24 hrs; and
d) Report the exceedence to MNR, MOE, NEC, and SON within 72 hours and Yellow Actions that will be implemented.

Yellow Actions may include but may not be limited to:

1) Initiation of an internal interdisciplinary review of all monitoring programs and the data available (i.e. ecological monitoring data, water resources monitoring data. and blasting monitoring data);

2) Reviewing the Operational Plan for possible alterations, which may include but may not be limited to:
- Changing or ceasing quarry operations in a certain direction; and/or.
- Changing the quarry floor elevation.

3) Preparing to augment flows[1] to the springs in the Shouldice Wetland or Glen Management Area;
- flow augmentation shall be done in consultation with the Hydrogeologist to ensure adequate protection;

4) Grouting fractures exposed by the quarry along active quarry faces immediately after a blast (as
5) Continuing to monitor weekly until the system recovers as determined by a Hydrogeologist:

6) If Yellow Actions prove to be working whereby water levels in affected area have recovered[2] and there is no observed impact to the Shouldice Wetland springs and/or the springs in the Glen Management Area then:
- Quarry activities in the direction of the affected area can resume:
- Extraction in the direction of s8 and/or s13 can continue only when their flows are observed to occur naturally as determined by the Hydrogeologist and the Biologist/Ecologist.

7) Summarize the results of any Yellow Actions in a report to the MNR, MOE, NEC and SON and make recommendations for the operation of the quarry.

NOTES:

[1] *Augmentation of flows to springs may be in the form of a pipe that directs water or an infiltration pond that allows water to recharge the groundwater system.*

[2] *Recovered water levels means that water levels in the affected observation well(s) has returned above green trigger values for at least three monitoring events spaced one week apart.*

Water Resources/Ecological Red Actions

Purpose: To implement mitigation measures that will minimize the impact on groundwater due to the quarry. If changes to natural features are related to climatological influences or non-quarry related activities then Red Actions may not be required.

A "Red Action" immediate response is triggered if:
1) A red trigger value has been exceeded in the Water Resources Monitoring Program that can be attributed to the quarry operations;
2) Evidence of negative ecological impacts are observed that can be attributed to the quarry operations: and/or
3) The mitigative measures initiated during the Yellow Action failed to correct or reverse the impact.

In the event of a red trigger exceedence in the Water Resources and/or the Ecological Monitoring Program:

a) Report the exceedence to the quarry owner/operator within 24 hrs;
b) Report the exceedence to the Ecologist/Biologist within 24 hrs;
c) Report the exceedence to the Hydrogeologist within 24 hrs; and
d) Report the exceedence to MNR, MOE, NEC, and SON within 24 hours the exceeded trigger values and Red Actions that will be implemented.

Red Actions may include but may not be limited to:

1) Initiation of an internal interdisciplinary review of all monitoring programs and the data available;
2) Stopping quarry activities until signoff is obtained by the MNR indicating the quarry may restart;
3) Augmenting[1] flows to the bedrock system in the area of the observed impact;
4) Monitoring to determine the effectiveness of flow augmentation;
5) If it is deemed that flow augmentation is effective[2], then quarry activities may resume in a direction that will not exacerbate the impact, provided that a sign-off acceptance from the MNR has been obtained:
6) If it is deemed by the Hydrogeologist, the Biologist/Ecologist, the owner/operator and the MNR that the quarry cannot operate without negatively impacting water levels in the Shouldice Wetland and/or the springs in the Glen Management Area then the need to close the quarry should be assessed; and
7) Summarize the results of any Red Actions in a report to the MNR, MOE, NEC, and SON along with the recommendations for the operation of the quarry.

NOTES:

[1] *Augmentation of flows may involve direct discharges to the affected spring(s) or the construction of an infiltration pond that allows water to recharge the groundwater system.*

[2] *Groundwater levels in the impacted observation well(s) in Zone 3 have returned above green trigger values as determined by at least three monitoring events spaced one week apart.*

PRIVATE WELL MONITORING PROGRAM

Private Well Locations **Category A Wells:** 3345, 3447, 5197, New Cramp Well **Category B Wells:** TBD

Private Well Trigger Values

Monitoring Station	Green	Yellow	Red
Well No. 3345	None	227.5 mAMSL	Complaint Received
Well No. 3447	None	TBD	Complaint Received
Well No. 5197	None	TBD	Complaint Received
New Cramp Well	None	TBD	Complaint Received
Category B Wells	None	TBD	Complaint Received

TBD = To Be Determined

* = Seasonal values and subsequent trigger values shall be based on at least three years of monitoring data collected while extracting in Area 1B

Private Well Yellow Actions

Purpose: To implement mitigation measures that will prevent impacts to private water supply wells thus preventing the need for Red Actions. If impacts to private wells are not related to quarry activities then Yellow Actions may not be required.

If a yellow trigger value is exceeded for any of the Category A or Category B private wells, then the following mitigation measures will be initiated:

a) Report the exceedence to the quarry owner/operator within 24 hrs;
b) The quarry operator shall report to the local MOE District Office within 72 hours the exceeded trigger values and Mitigative Actions that will be implemented;
c) Inform the resident and enquire about well yield;
d) If well yield is affected, then the quarry operator shall retain an MOE licensed plumber to inspect the well and mechanical components thereof and confirm if mechanical issues (i.e. the pump and/or plumbing system) are the cause and to validate the decrease in well yield;

e) If the cause is not mechanically related, then:
- The quarry operator will provide a temporary supply of water within 24 hours (if required);
- The quarry operator will make arrangements to provide a suitable alternative water supply;
- Provisions for the affected resident could include all or part of the costs associated with water delivered to fill a temporary water system and associated costs. lowering the pump. drilling a new well, well-deepening, abandonment of the old well.

Private Well Red Actions

Purpose: To implement mitigation measures that will minimize the impact to private water supply wells due to the quarry. If changes to private wells are not related to quarry activities then Red Actions may not be required.

Well Interference Complaint Response Procedure

Upon receipt of a well interference complaint the receiver shall immediately notify the owner/operator by calling Harold Sutherland (Owner/Operator), at the following number(s):

Working Hours Contact
Phone: 519-376-5698
Fax: 519-371-6121
Mobile: 226-668-4495
Email: jennifer@hsc-ltd.com

After Hours Contact:
Mobile: 226-668-4495

A well interference complaint from a private well owner will constitute a red trigger breech, and the response procedure will be initiated:
1) Report to MOE within 24 hours the Mitigative Actions to be implemented:
2) The quarry operator will call a MOE licensed plumber immediately upon receipt of the complaint to inspect the well and mechanical systems to confirm that the problem is not mechanical (i.e. pump malfunction) and to validate the complaint;
3) If the complaint is determined not to be mechanically related (i.e. plumbing), the quarry operator will provide a temporary water supply within 24 hours for the affected resident and make arrangements to investigate (Hydrogeologist) the cause of the interference:
4) Where the results of the investigation indicate that the interference is legitimately from dewatering the New Keppel Quarry, the quarry operator will make arrangements to provide compensation. Compensation must be acceptable to the home owner and the quarry operator. and could include all or part of the costs associated with drilling of a new well, well deepening. abandonment of the old well;
5) Where the results of the investigation do not indicate interference from dewatering of the New Keppel Quarry, the quarry operator will provide a letter report summarizing the results of the investigation to the property owner. In this case, the quarry operator shall maintain the temporary water supply (provided under item 3) for at least an additional 24 hours to allow the resident to make alternate water supply arrangements;
6) The quarry operator shall document the interference complaint and its resolution and keep the results on file in the event that they be requested by a Ministry Inspector.

BLASTING MONITORING PROGRAM

Purpose: To ensure that the blasting operations are carried out in a safe and productive manner and to ensure that no possibility of damage exists to any buildings, structures or residences surrounding the New Keppel Quarry. The Blasting Monitoring Program is described in detailed in the AMP report

Blasts should be designed so that the seismic activity (vibrations) and noise induced by the blasting operations will remain well within the MOE guidelines. HSCL staff will be trained by a Blasting Consultant to properly install. monitor. record and report the blast induced vibrations and overpressure. All blasts will be monitored for vibration and overpressure at the Ritchie Property (R1) and Cramp Property (R2) with digital seismographs.

Green Blast Trigger

Seismograph readings are within the MOE guidelines for vibration and overpressure, there is no flyrock generated beyond the blast area. there are no complaints from the public, and there is no negative report in the water tested from the quarry.

Remedial Action - No remedial action is necessary.

Yellow Blast Trigger

Seismograph readings exceeded the MOE guidelines for vibration and/or overpressure, there is no flyrock generated beyond the blast area, there are no reported damage complaints, there may be complaints from noise or vibration, and slight elevated nitrates and/or other chemicals associated with explosives in the discharge water tested from the quarry as part of the ECA requirements.

Remedial Action – Review the environmental conditions and blast design parameters. Make reasonable adjustments for subsequent blasts. Report the findings and remedial measures to be taken for subsequent blasts to complainants and affected residents.

Red Blast Trigger

Seismograph readings exceeded the MOE guidelines for vibration and/or overpressure and/or there is flyrock generated beyond the blast area, there are reported damage complaints, there are complaints from noise or vibration, and there is an elevated level of nitrates and/or other chemicals associated with explosives used for blasting in the discharge water tested from the quarry as part of the ECA requirements.

Remedial Action – Stop any further blasting until a full investigation has taken place into the reasons for the unexpected results. Make appropriate changes and report these changes before commencement of the blasting operation.

REPORTING REQUIREMENTS

Report Type	Reporting Requirements
First Annual Report	Annual reports detailing the results of the monitoring program will be provided to the MNR, MOE, NEC, and SON by a Qualified Person (QP). Annual reporting will involve data compilation. presentation and evaluation of the performance monitoring data, including the trend analysis. The reports will determine if the AMP is effectively monitoring the site conditions. The first annual report will be completed at the initiation of operations to summarize the baseline data (Water Resources and Ecological) collected pre-quarry.
Subsequent Annual Reports	All subsequent annual reports, written by a QP, will include a discussion on: - The results of The Water Resources Monitoring Program - The results of The Ecological Monitoring Program - The results of The Private Well Monitoring Program - The results of The Blasting Monitoring Program
Interim Reports	Interim reports, written by a QP. will be submitted to MNR and NEC if trigger values are triggered as listed under the "Green". "Yellow" and "Red" actions in the AMP.

TREE PRESERVATION PLAN (TPP)

Purpose: To preserve trees in the TPP Corridor so that sufficient visual screening and buffering is achieved along CR 17 and Con Rd 10.

Tree Monitoring Protocol

The health of the TPP Corridor will be monitored on an annual basis by a qualified professional. The qualified professional shall identify and monitor the health of Preservation Trees in the TPP Corridor for the following:

a) Individual tree numbering for long-tern identification;
b) Tree species and Diameter at Breast Height (DBH);
c) Number of stems and total tree height;
d) Crown class:
e) Percentage live crown;
f) Evidence of twig dieback. branch dieback, defoliation, and discoloration:
g) Evidence of wounds, signs/symptoms of insect infestation. and any other health stressors; and
h) Overall growing conditions and general tree health.

Monitoring shall be completed during the growing season (June 1 to September 15) of every year.

Pre-quarry (baseline conditions) of the TPP Corridor shall be established:
- Baseline monitoring data in Zone 1 of the TPP Corridor data shall be collected prior to any site alterations commencing in Area 1A.
- Baseline monitoring data in Zone 2 and Zone 3 of the TPP Corridor shall be collected prior to site alterations in Area 1B, Area 2, and Area 3.

Tree Replacement Protocol

If monitoring in the TPP Corridor identifies a Preservation Trees in "Fair-Health", then implement an action plan within one year to:

a) Encourage the growth of a Replacement Tree(s) by promoting the growth of surrounding immature tree(s) and/or promoting the expansion of the crown of adjacent trees: or

b) If there is no suitable Replacement Tree(s) is within 6 m, then plant two native stock samplings (one Deciduous [not Ash] and one Coniferous tree) that are at least 1.5 m in height: one on each side and in close proximity to the identified Fair-Health tree(s).

If monitoring in the TPP Corridor identifies a Preservation Tree(s) in "Poor-Health", then
a) Determine the effectiveness of any previous efforts implemented to encourage the growth of Replacement Trees (natural or planted); and
b) If Replacement Tree efforts are deemed ineffective, then plant two additional native stock saplings (not Ash), that are at least 1.5 m in height. in close proximity to the identified "Poor-Health" tree(s).

If monitoring in the TPP Corridor identifies a Preservation Tree(s) as dying/dead, then
a) Remove the dying/dead tree(s) without harming adjacent Replacement Trees(s), otherwise leave the dying/dead tree standing and remove the upper branches and tree top for safety reasons;
b) Look for a Replacement Tree(s) (planted or natural) that is at least 15 cm DBH and number them as the new Replacement Tree;
c) If a Replacement Tree(s) cannot be found, then plant enough saplings in proximity to the dying/dead tree to achieve the cumulative caliper (at least 15 DBH) of a Replacement Tree so that the future trees(s) will provide similar buffering and visual screening; and
d) Include the Replacement Trees(s) in future monitoring.

NOTE: The tables above were taken from the Adaptive Management Plan by MTE Consultants Inc., August 14, 2014

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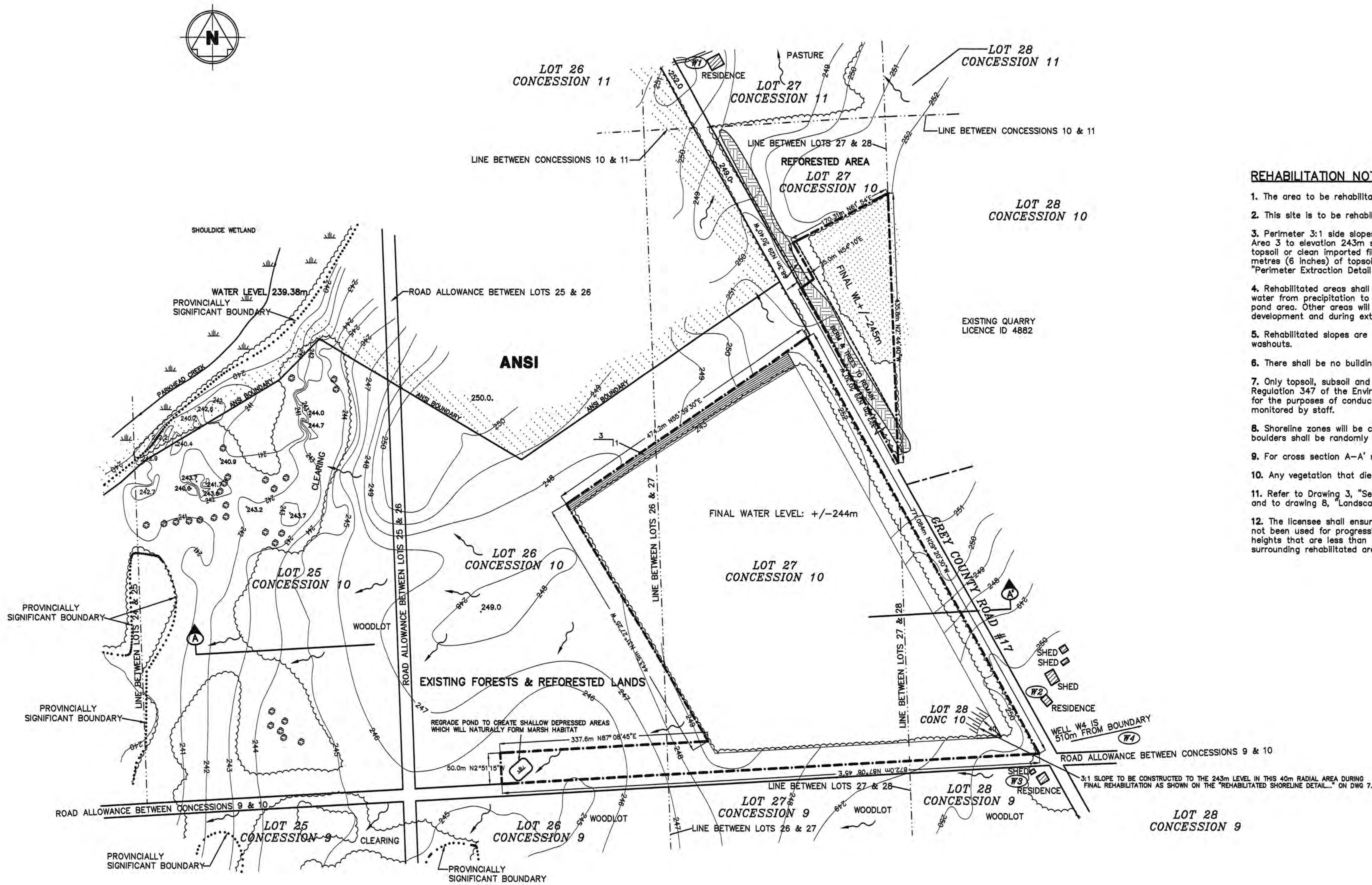
PARTS LOTS 26, 27 & 28, CONCESSION 10
TOWNSHIP OF GEORGIAN BLUFFS (formerly Keppel Twp)
COUNTY OF GREY

ADAPTIVE MANAGEMENT PLAN
DRAWING 5 of 9

No.	AMENDMENT	DATE

September 30, 2014



REHABILITATION NOTES

1. The area to be rehabilitated is 26.85 hectares.

2. This site is to be rehabilitated to a natural environment after use.

3. Perimeter 3:1 side slopes along the 100m ANSI setback line and the SE corner of Area 3 to elevation 243m shall be created by backfilling with onsite overburden & topsoil or clean imported fill. Final slopes shall be spread with a minimum of 0.15 metres (6 inches) of topsoil and shall be seeded and planted as outlined on the "Perimeter Extraction Detail (ANSI Side) on Drawing 7, "Cross-sections and Details".

4. Rehabilitated areas shall drain in the direction of the arrows as shown. Surface water from precipitation to the north of the site will continue to drain towards the pond area. Other areas will drain in the same direction as they had prior to development and during extraction operations.

5. Rehabilitated slopes are to be regraded and replanted in the event of die out or washouts.

6. There shall be no buildings or roads on site upon completion of rehabilitation.

7. Only topsoil, subsoil and overburden meeting the definition of inert fill under Regulation 347 of the Environmental Protection Act shall be imported into this site for the purposes of conducting rehabilitation. Incoming loads of fill shall be monitored by staff.

8. Shoreline zones will be created in a jagged fashion where possible. Stumps and boulders shall be randomly strewn along the waters edge .

9. For cross section A–A' refer to Drawing 7, "Cross Sections and Details".

10. Any vegetation that dies or is otherwise damaged shall be reseeded or replanted.

11. Refer to Drawing 3, "Sequence of Operations", for progressive rehabilitation timing and to drawing 8, "Landscaping Details", by L. Porter, Landscape Architect.

12. The licensee shall ensure that any material remaining in acoustic berms that has not been used for progressive and final rehabilitation purposes shall be graded to heights that are less than 3m and vegetated with native species to blend in to the surrounding rehabilitated areas.

LEGEND:

- WATER
- ANSI
- DRAINAGE DIRECTION
- PROPOSED LICENCE BOUNDARY
- PROVINCIALLY SIGNIFICANT BOUNDARY
- LOT LINE
- 462.5 SPOT ELEVATION
- 464 1m CONTOUR
- 465 5m CONTOUR
- DECIDUOUS TREE
- CONIFEROUS TREE
- WET AREA

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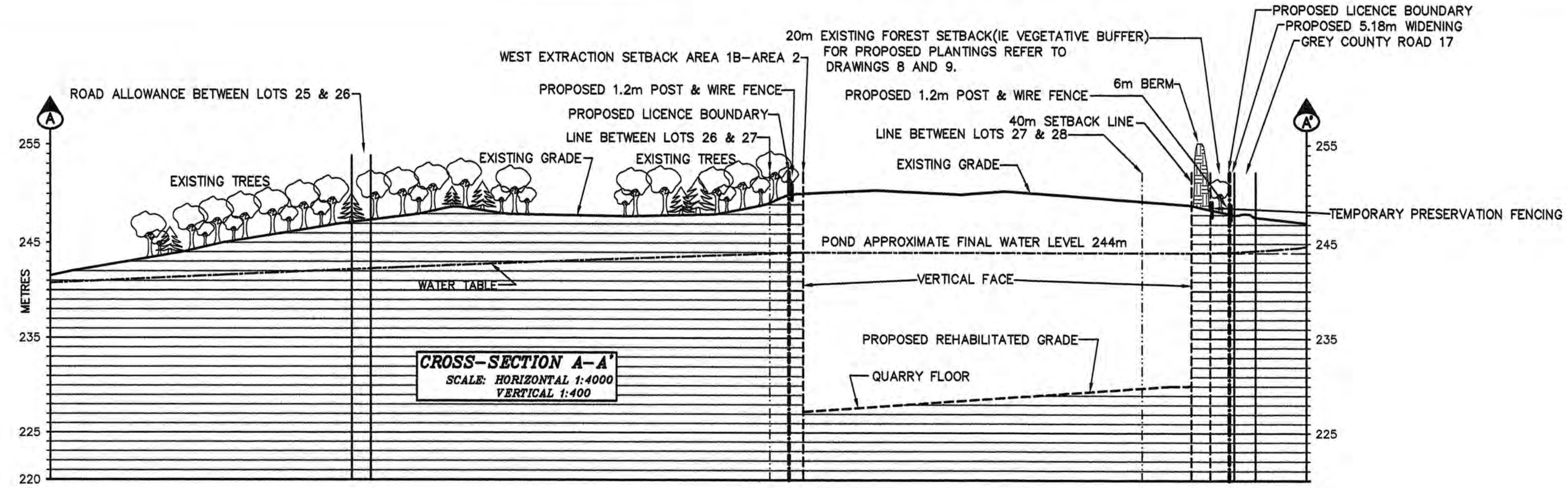
TOWNSHIP OF GEORGIAN BLUFFS (formerly Keppel Twp)
COUNTY OF GREY

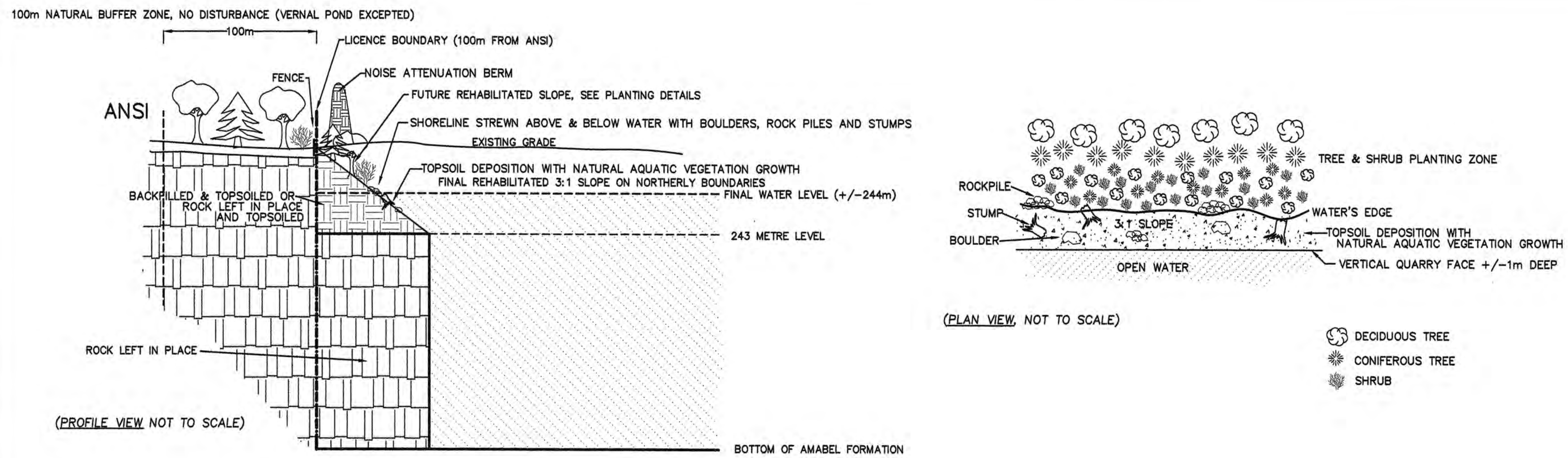
PROGRESSIVE REHABILITATION AND FINAL REHABILITATION PLANS
DRAWING 6 of 9

SCALE: 1:4000
100 50 0 100 200 300

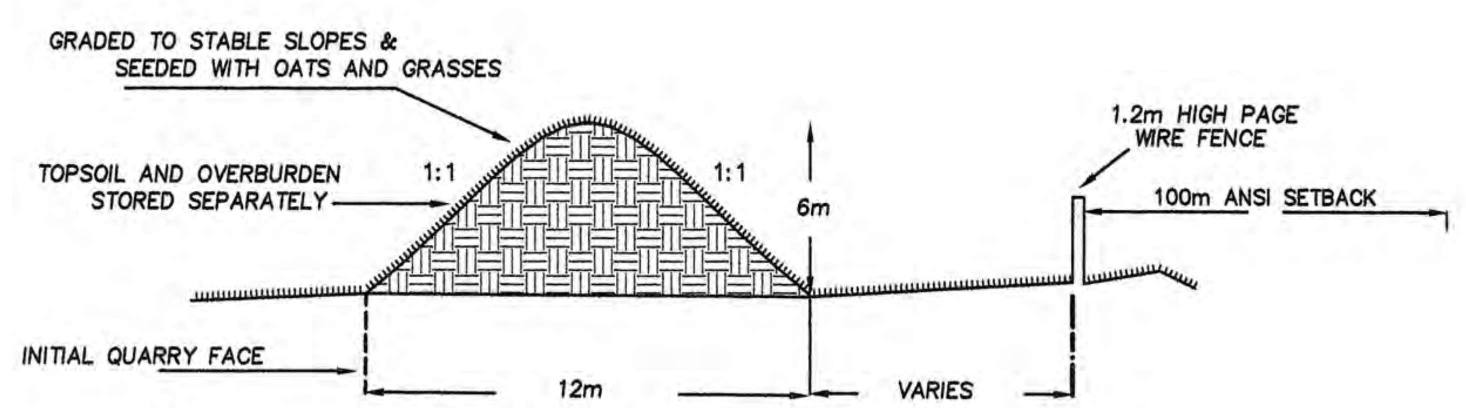
No.	AMENDMENT	DATE

December 11, 2014

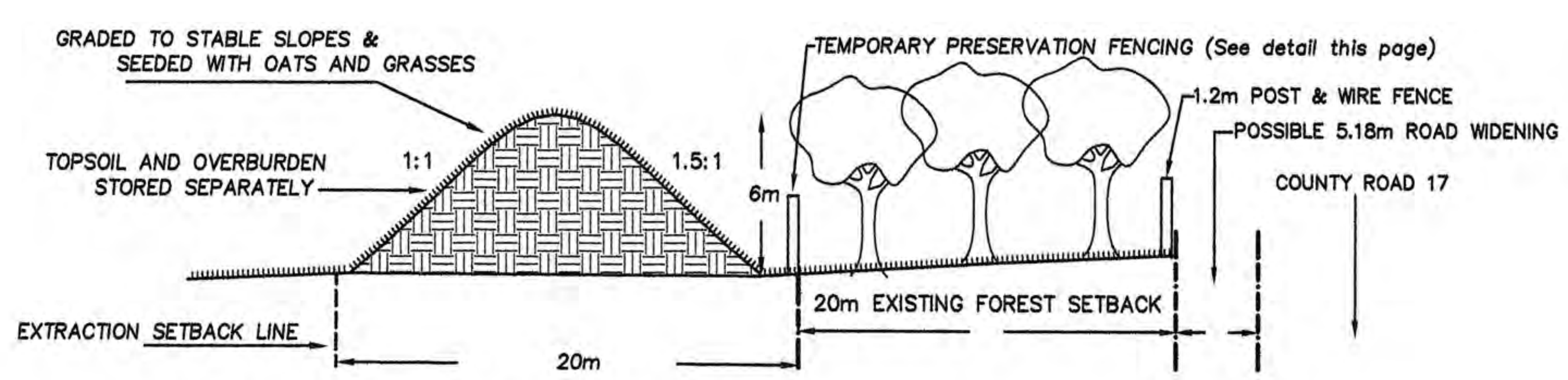




REHABILITATED SHORELINE DETAIL ADJACENT TO 100m ANSI SETBACK & THE SOUTHEAST CORNER OF AREA 3.

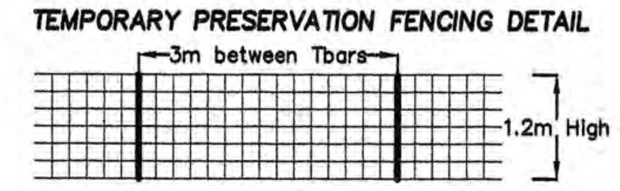


TYPICAL BERM DETAIL (ANSI SIDE)
(NOT TO SCALE)



TYPICAL BERM DETAIL (ROAD 17 SIDE)
(NOT TO SCALE)

TEMPORARY PRESERVATION FENCING DETAIL



– Temporary Preservation Fencing shall consist of orange barrier safety fencing such as "Tenax 1.2m High Orange Barrier Guardian Safety Fence".

Proposed Perimeter (ANSI side) and SE Corner Re-Vegetation Plan
(from Aquatic Wildlife Services)

The proposed re-vegetation plan is based on the goal of creating "Woodland Edge" and then "Woodland" over an extended period of time. The objectives for this re-vegetation plan include selecting the species and stocking density, which:

- Will thrive within the proposed buffer and slope areas (i.e. exposure to wind and sun).
- Will create an early successional tree community;
- Will develop into a woodland community comparable to the abutting woodland (ANSI);
- Will create valuable wildlife habitat.

The proposed re-vegetation plan will include the following species and quantities and sizes:
Each 100 meter square area (10 meters by 10 meters) would contain the following

Table 1
Number of Trees and Shrubs Per 100 Square Meters

Category	Size	Number
A Trees	40mm cal	1
B Trees	40mm cal	1
A Shrubs	30 cm	1
B Shrubs	30 cm	1
Total		4

This proposed re-vegetation shoreline plan would result in 380 (0.95 Ha. area) trees and shrubs to be planted within this transitional habitat zone, to have semi-open canopy and scattered structures. The aquatic plants are to naturally regenerate along the submerged slope.

Proposed Woody Species For Buffer and Slope Re-vegetation Areas

Category	Common Name	Scientific Name
	Trees	
A	White Pine	Pinus strobus
	Eastern White Cedar	Thuja occidentalis
	Trembling Aspen	Populus tremuloides
B	Large-toothed Poplar	Populus grandidentata
	White Birch	Betula papyrifera
	Sugar Maple	Acer saccharum
	Black Cherry	Prunus serotina
	Shrubs	
A	Pincherry	Prunus pennsylvanica
	Chokecherry	Prunus virginiana
B	Dogwood Family	Cornus racemosa
	Elderberry Family	Sambucus canadensis
	Staghorn Sumac	
	Nannyberry	Viburnum lentago

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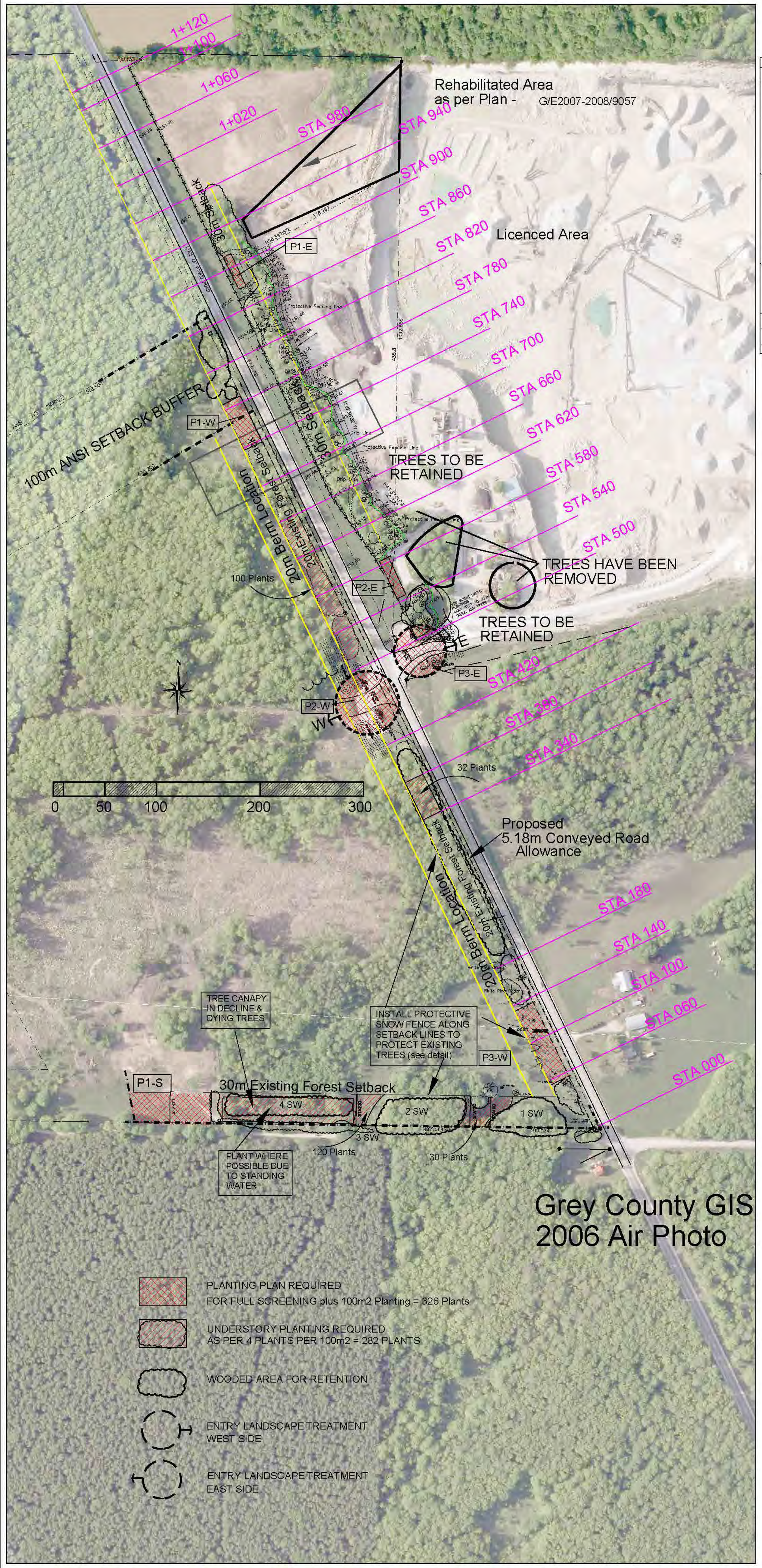
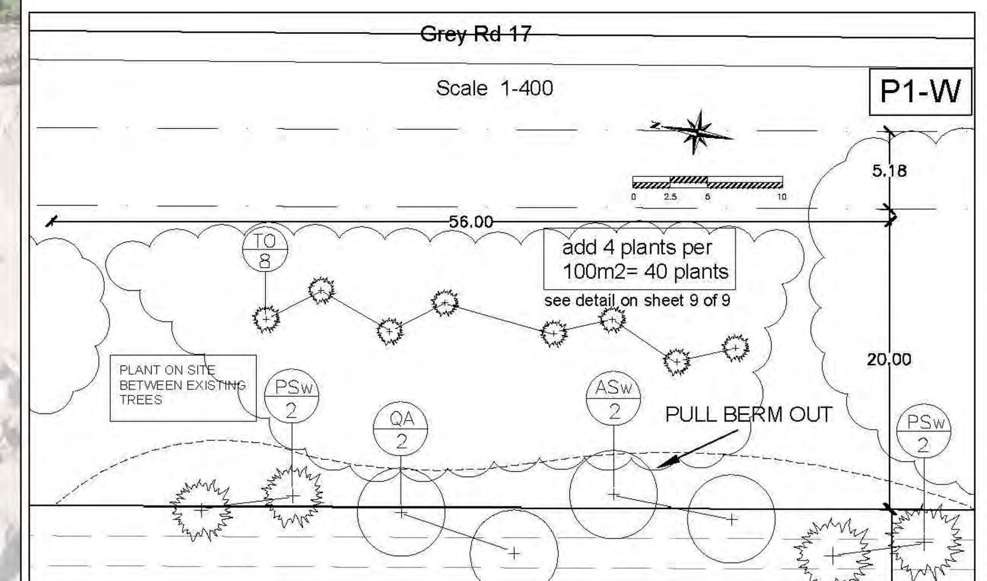
COUNTY OF GREY

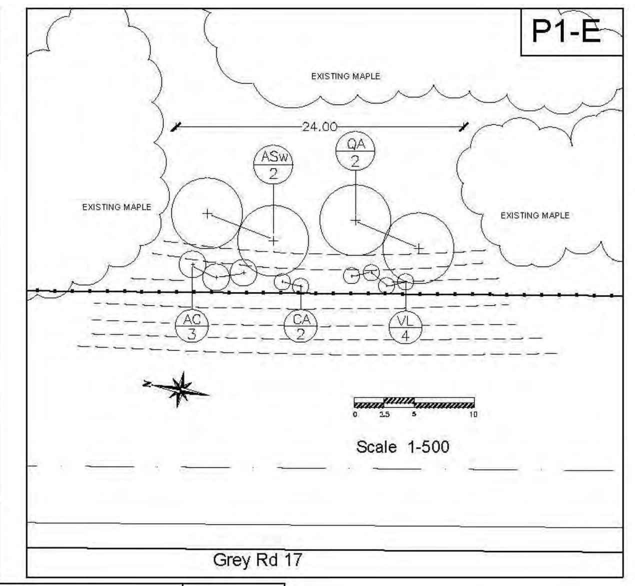
CROSS-SECTIONS & DETAILS
DRAWING 7 of 9

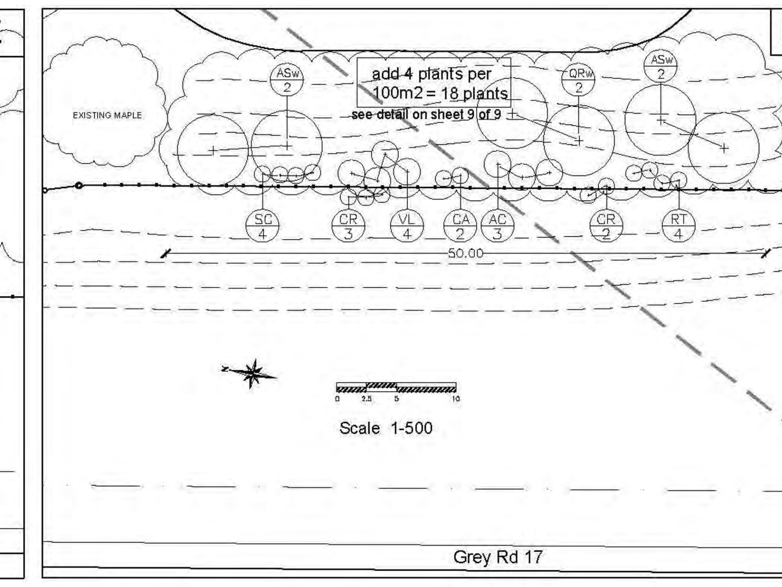
No.	AMENDMENT	DATE

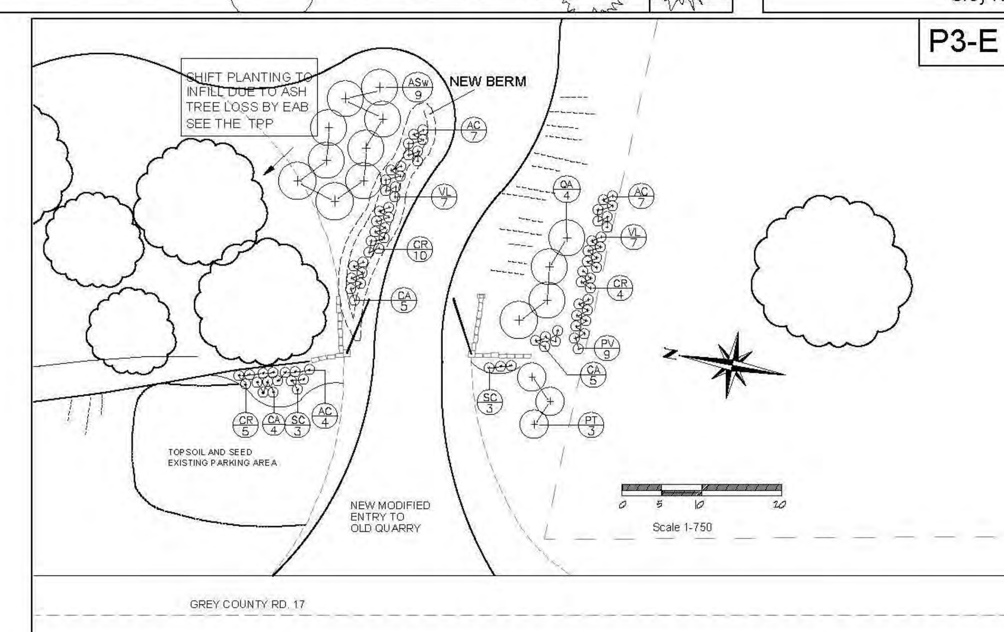
December 11, 2014

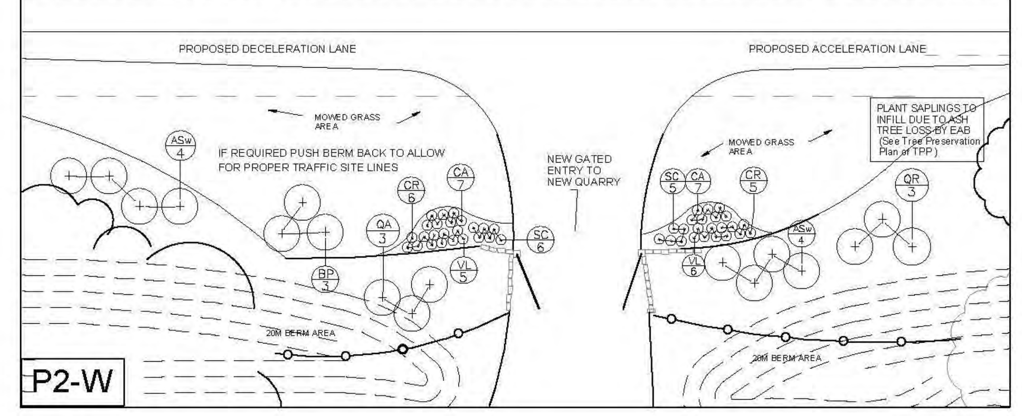


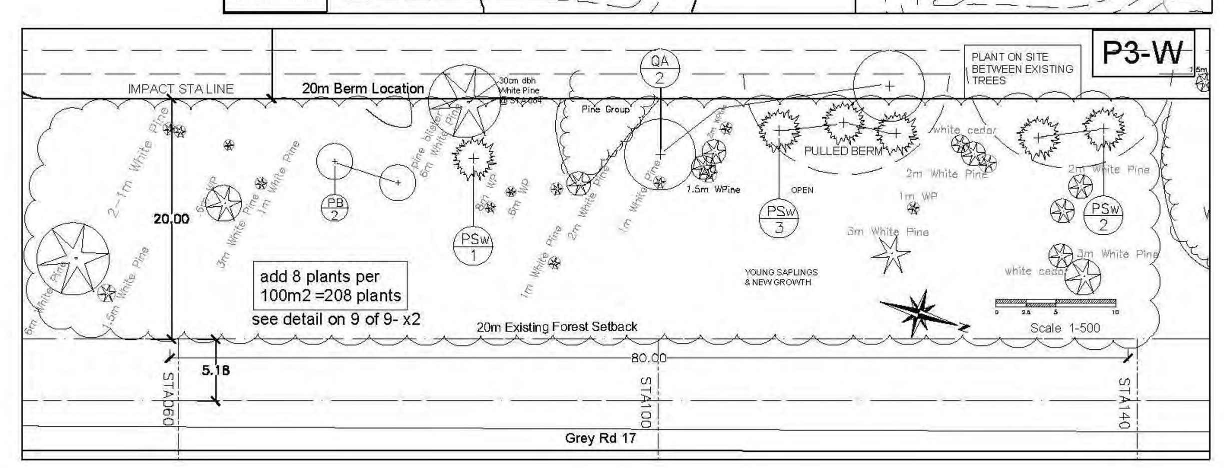


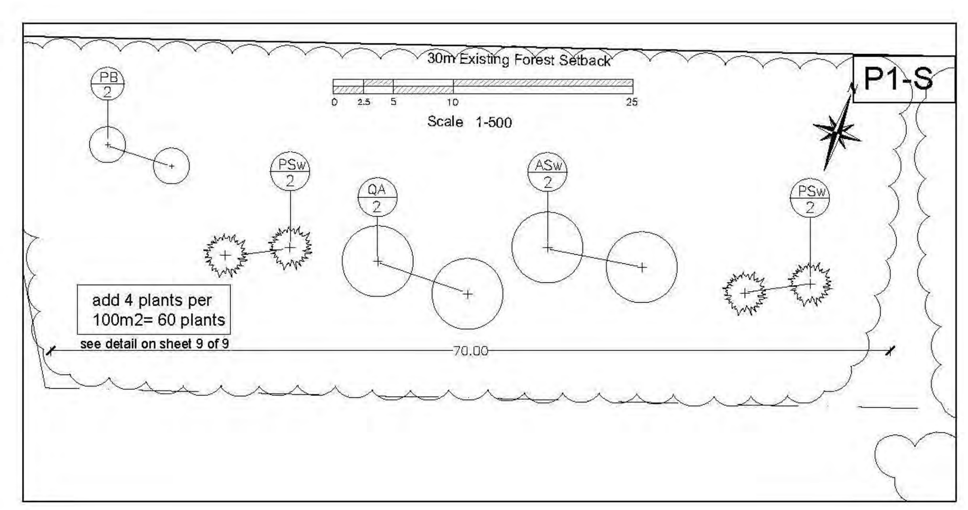


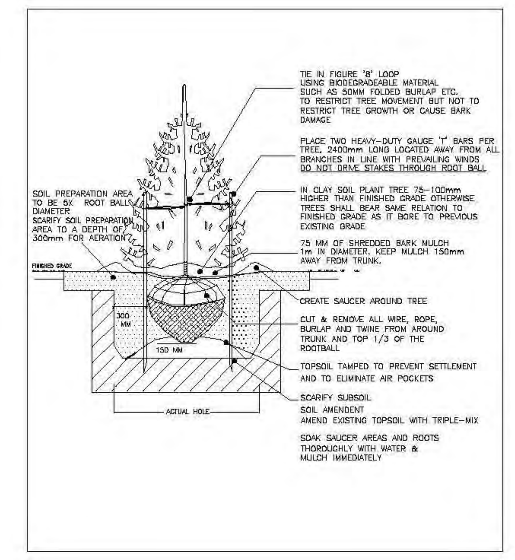




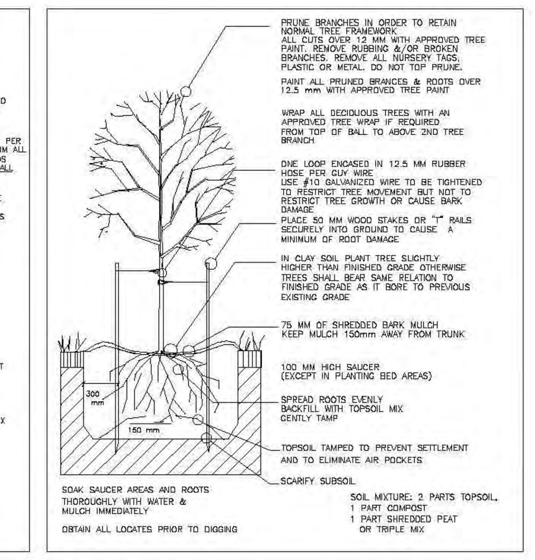




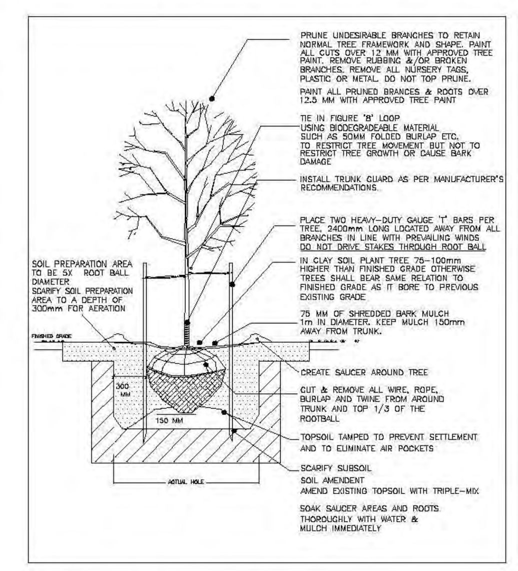




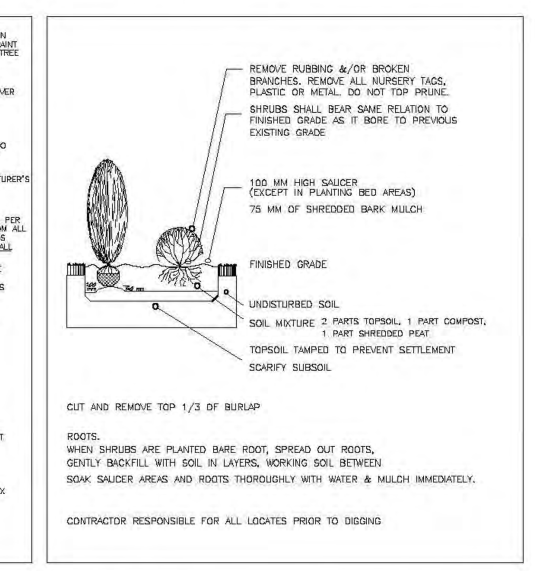
EVERGREEN TREE PLANTING DETAIL — OBTAIN ALL LOCATES PRIOR TO DIGGING



BARE ROOT DECIDUOUS DETAIL — OBTAIN ALL LOCATES PRIOR TO DIGGING



DECIDUOUS TREE PLANTING DETAIL — OBTAIN ALL LOCATES PRIOR TO DIGGING



SHRUB DETAIL — OBTAIN ALL LOCATES PRIOR TO DIGGING

NOTE:

ANY TREES NOTED FOR PRESERVATION THAT ARE DAMAGED DURING CONSTRUCTION, SHALL BE REPLACED ON AN ACCUMULATED PER CALIPER BASIS.

SUBSEQUENT TO THE COMPLETION OF THE WORKS, INCLUDING SUB-GRADE & TOPSOIL WORKS, SEEDING AND PLANTING, A LETTER CERTIFYING THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH THE APPROVED PLAN SHALL BE PROVIDED TO THE NEC BY THE CONSULTING LANDSCAPE ARCHITECT OR QUALIFIED CONSULTANT.

PROTECTIVE FENCING TO BE INSTALLED ALONG THE EASTERLY SIDE OF THE PROPOSED BERM & IS TO BE INSPECTED BY THE LANDSCAPE ARCHITECT OR QUALIFIED CONSULTANT & A LETTER CONFIRMING THE SAME PROVIDED TO NEC.

NOTE:
THE 2010 VIEWSHED REPORT CAN BE USED AS A BACKGROUND REPORT FOR THE PURPOSE OF MONITORING THE CHANGES OF THE VISUAL CONDITIONS

FOR ADDITIONAL INFORMATION REFER TO THE WOODY VEGETATION INVENTORY-IMPACT AND PRESERVATION METHOD REPORT, Larry T. Porter Landscape Architect October 2014

KEY	BOTANICAL NAME	QTY	COMMON NAME	QTY	HT OR CAL.	CONDITIONS
	TREES Qtys per 100m2 Areas		Qty per Planting Plans			
ASw	ACER SACCHARUM		SUGAR MAPLE	23	60mm/Cal	WIRE BASKET
AS	ACER SACCHARUM	76	SUGAR MAPLE		40mm/Cal	POTTED
BP	BETULA PAPRIFERA		WHITE BIRCH	3	40mm/Cal	POTTED
PSw	PINUS STROBUS		WHITE PINE	14	200cm/HT	BALLED/BURLAP
PS	PINUS STROBUS	76	WHITE PINE	0	100cm/HT	POTTED
PB	POPULUS BALSAMIFERA	38	BALSAM POPLAR	4	40mm/Cal	POTTED
PT	POPULUS TREMULOIDES	38	TREMBLING ASPEN	3	40mm/Cal	POTTED
QA	QUERCUS ALBA		WHITE OAK	15	60mm/Cal	WIRE BASKET
QRw	QUERCUS RUBRA		RED OAK	2	60mm/Cal	WIRE BASKET
QR	QUERCUS RUBRA		RED OAK	3	40mm/Cal	POTTED
	SHRUBS					
AC	AMELANCHIER CANADENSIS		CANADIAN SERVICEBERRY	24	30cm/HT	POTTED
CA	CORNUS ALTERNIFOLIA		ALTERNATE LEAF DOGWOOD	32	30cm/HT	POTTED
CR	CORNUS RACEMOSA	38	RED OSIER DOGWOOD	35	30cm/HT	POTTED
PP	PRUNUS PENSYLVANICA	76	PIN CHERRY	0	30cm/HT	POTTED
PV	PRUNUS SEROTINA	76	BLACK CHERRY	9	30cm/HT	POTTED
RT	RHUS TYPHINA	38	SUMAC	4	30cm/HT	POTTED
TO	THUJA OCCIDENTALIS	76	WHITE CEDAR	8	70cm/HT	POTTED
SC	SAMBUCUS CANADENSIS	38	ELDER BERRY	21	30cm/HT	POTTED
VL	VIBURNUM LENTAGO	38	NANNYBERRY	33	30cm/HT	POTTED

NOTE:
CONSULT WITH THE Canadian Food Inspection Agency FOR Removal & Disposal of Ash Trees affected by Emerald Green Ash Bore
See Tree Preservation Plan-(TPP) found in the Adaptive Management Plan (AMP) Section 6 of Appendix F.

IF INSIGNIFICANT OVER-BURDEN MATERIAL EXISTS PROVIDE 60-70cm OF CLEAN LOAM WITH AT LEAST 150-200mm OF CLEAN TOPSOIL SPREAD EVENLY OVER AREAS TO BE PLANTED

MAINTENANCE PROGRAM SHOULD PROVIDE SUFFICIENT WATERING DURING TIMES OF INADEQUATE RAIN FALL, TO ENSURE SURVIVAL AND GROWTH OF LARGE PLANT MATERIAL.

DATE	REVISION
December 5/14	Final Revisions as NEC notes
October 2/14	Notes relating to the new TPP
April 7/14	A1 Extent of Excavation Line
March 28/14	NEC Revisions
March 7/14	NEC Revisions
Nov 30/12	Revised as red line comments
April 30/12	Updated survey-ansi
April 28/12	5m Tree Setback Line/east side
April 26/12	Overlay Survey
April 23/12	Reset Stations 24.5m to north
April 17/12	Plant Qtys/dimensions

DESIGNED	LTP
APPROVED	
PROJECT	14.03.12
SCALE	AS NOTED

ONTARIO ASSOCIATION OF LANDSCAPE ARCHITECTS — LARRY T. PORTER — OALA — MEMBER

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KEPPLE QUARRY
VEGETATION BUFFER PLANTING PLAN

Larry T. Porter, OALA, CSLA

PORTER

Landscape Architect
Wiarton, Ont.
519-534-1711

TRUE NORTH	PROJECT NORTH	SHEET NO
		1

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NEW KEPPEL QUARRY

PARTS LOTS 26, 27 & 28, CONCESSION 10
TOWNSHIP OF GEORGIAN BLUFFS (formerly Keppel Twp)
COUNTY OF GREY

LANDSCAPING DETAILS

DRAWING 8 of 9

December 11, 2014

DATE	REVISION
December/14	Notes referring to the TPP
October/14	Notes referring to the TPP
April 7/14	A1 Excavation Extent Line
March 28/14	NEC comments update

DESIGNED	LTP
APPROVED	
PROJECT	07.01.13
SCALE	as noted

ONTARIO ASSOCIATION OF LANDSCAPE ARCHITECTS
OALA
LARRY T. PORTER
MEMBER

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TOWNSHIP OF GEORGIAN BLUFFS
(formerly Kepple Twp)

KEPPLE QUARRY
VEGETATIVE INVENTORY & IMPACT

Larry T. Porter, OALA, CSLA

PORTER

Landscape Architect
Wiarton, Ont.
519-534-1711

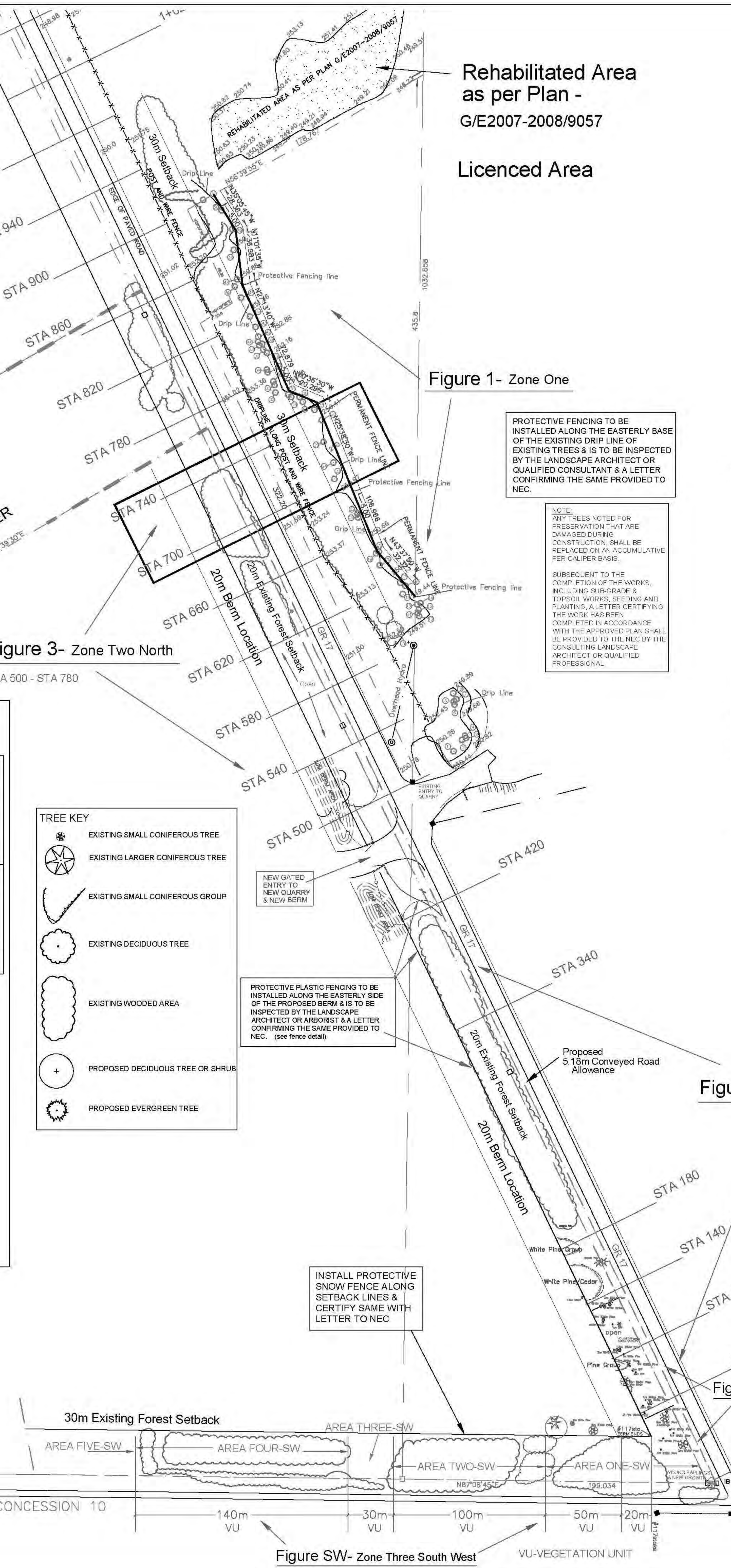


Figure 1- Zone One

Figure 3- Zone Two North
STA 500 - STA 780

Figure 2a- Zone Two South- STA 000 - STA 420

Figure 2b- Zone Two South - STA 000 - STA 180

Figure SW- Zone Three South West

PROTECTIVE FENCING TO BE INSTALLED ALONG THE EASTERLY BASE OF THE EXISTING DRIP LINE OF EXISTING TREES & IS TO BE INSPECTED BY THE LANDSCAPE ARCHITECT OR QUALIFIED CONSULTANT & A LETTER CONFIRMING THE SAME PROVIDED TO NEC.

NOTE:
ANY TREES NOTED FOR PRESERVATION THAT ARE DAMAGED DURING CONSTRUCTION, SHALL BE REPLACED ON AN ACCUMULATIVE PER CALIPER BASIS.

SUBSEQUENT TO THE COMPLETION OF THE WORKS, INCLUDING SUB-GRADE & TOPSOIL WORKS, SEEDING AND PLANTING, A LETTER CERTIFYING THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH THE APPROVED PLAN SHALL BE PROVIDED TO THE NEC BY THE CONSULTING LANDSCAPE ARCHITECT OR QUALIFIED PROFESSIONAL.

PROTECTIVE PLASTIC FENCING TO BE INSTALLED ALONG THE EASTERLY SIDE OF THE PROPOSED BERM & IS TO BE INSPECTED BY THE LANDSCAPE ARCHITECT OR ARBORIST & A LETTER CONFIRMING THE SAME PROVIDED TO NEC. (see fence detail)

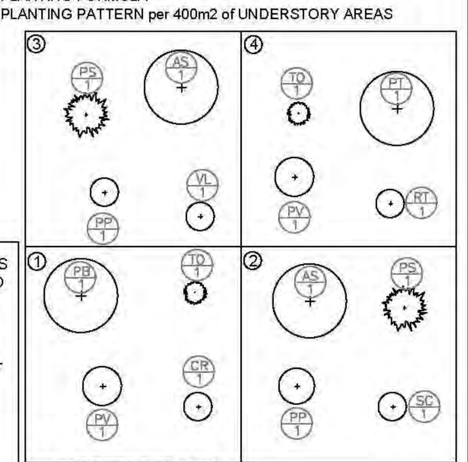
INSTALL PROTECTIVE SNOW FENCE ALONG SETBACK LINES & CERTIFY SAME WITH LETTER TO NEC

TREE KEY
- EXISTING SMALL CONIFEROUS TREE
- EXISTING LARGER CONIFEROUS TREE
- EXISTING SMALL CONIFEROUS GROUP
- EXISTING DECIDUOUS TREE
- EXISTING WOODED AREA
- PROPOSED DECIDUOUS TREE OR SHRUB
- PROPOSED EVERGREEN TREE

INFILL PLANTING FORMULA FOR AREAS REQUIRING ADDITIONAL SITE LINE SCREENING OR SITE REHABILITATION

IF NO INSIGNIFICANT OVER-BURDEN MATERIAL EXISTS PROVIDE 60-70cm OF CLEAN LOAM WITH AT LEAST 150-200mm OF CLEAN TOPSOIL SPREAD EVENLY OVER AREAS TO BE PLANTED

PLANTING FORMULA
PLANTING PATTERN per 400m2 of UNDERSTORY AREAS



see VEGETATION BUFFER PLANTING PLAN- Drawing 8

MONITORING CONDITIONS & HEALTH OF TREES & VEGETATION UNITS TO BE PRESERVED IS TO BE PERFORMED IN CONJUNCTION WITH THE TREE PRESERVATION PLAN (TPP)

IF TREES DESIGNATED TO BE PRESERVED ARE REMOVED OR DIE DUE TO CONST' IMPACT THEN THEY ARE TO BE REPLACE WITH AN ACCUMULATED PER CALIPER SIZE PLANT

IF PLANT MATERIAL IS SUFFERING OR DIES FROM EMERALD ASH BORE THEN MONITORING AND METHOD OF PRESERVATION OR REPLACEMENT WILL FALL UNDER THE TREE PRESERVATION PLAN (TPP) FOUND IN SECTION 6 AND APPENDIX F OF THE AMP

SUBSEQUENT TO THE COMPLETION OF THE WORKS, INCLUDING RESTORATION AND SCREENING AS WELL AS FUTURE REHABILITATION WORKS, LETTERS CERTIFYING THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH THE APPROVED PLANS SHALL BE PROVIDED TO THE NEC BY THE CONSULTING LANDSCAPE ARCHITECT OR APPROVED QUALIFIED CONSULTANT

SEE DRAWING 8 FOR PLANT LIST LATIN NAMES & QUANTITIES OF 100m2 AREAS

TREES
- AS SUGAR MAPLE
- PS WHITE PINE
- PT TREMBLING ASPEN
- PB BALSAM POLAR
- PV BLACK CHERRY

SHRUBS
- CR RED OSIER DOGWOOD
- PP PIN CHERRY
- RT SUMAC
- SC ELDER BERRY
- TO WHITE CEDAR
- VL NANNY BERRY VIBURNUM

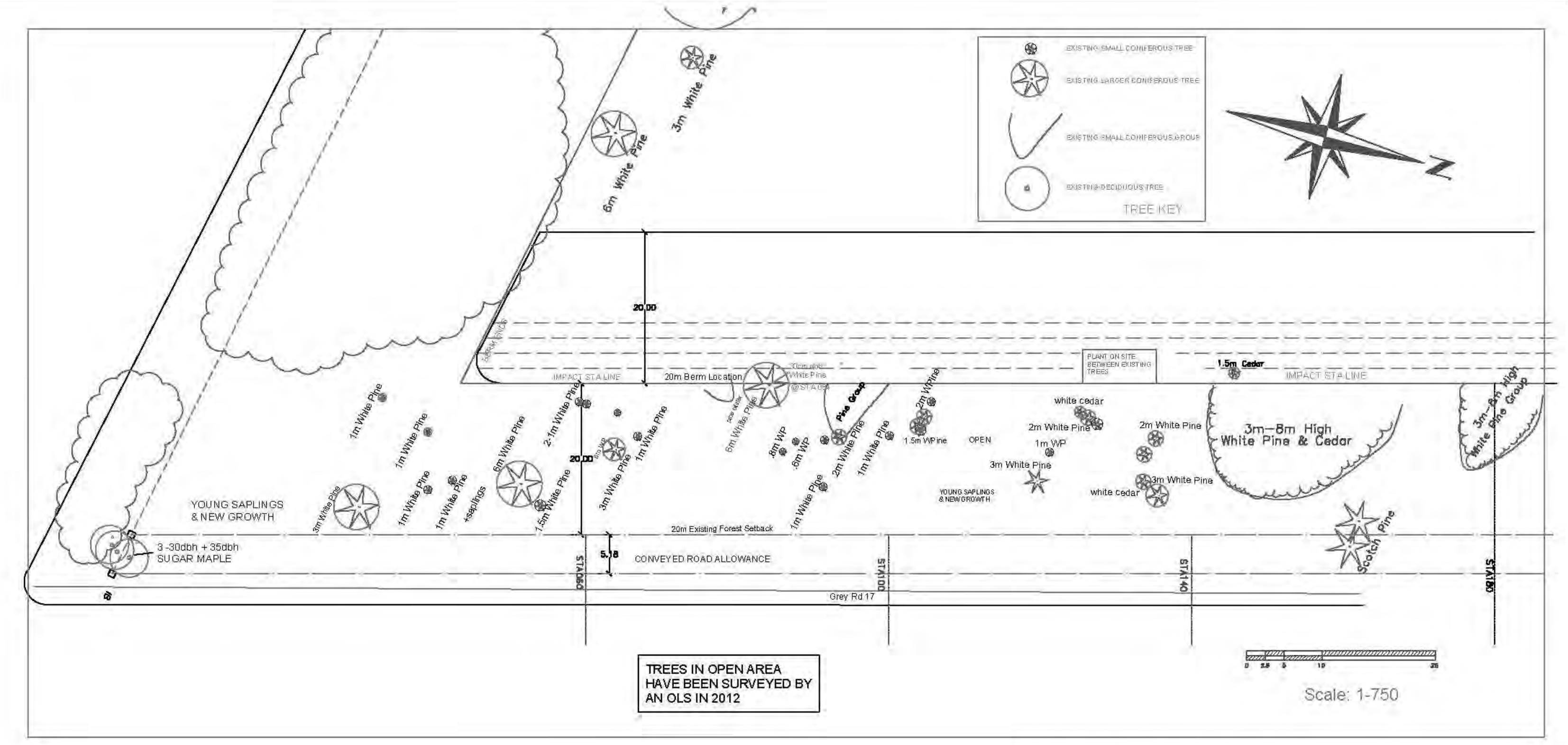


Figure 2b- Zone Two South

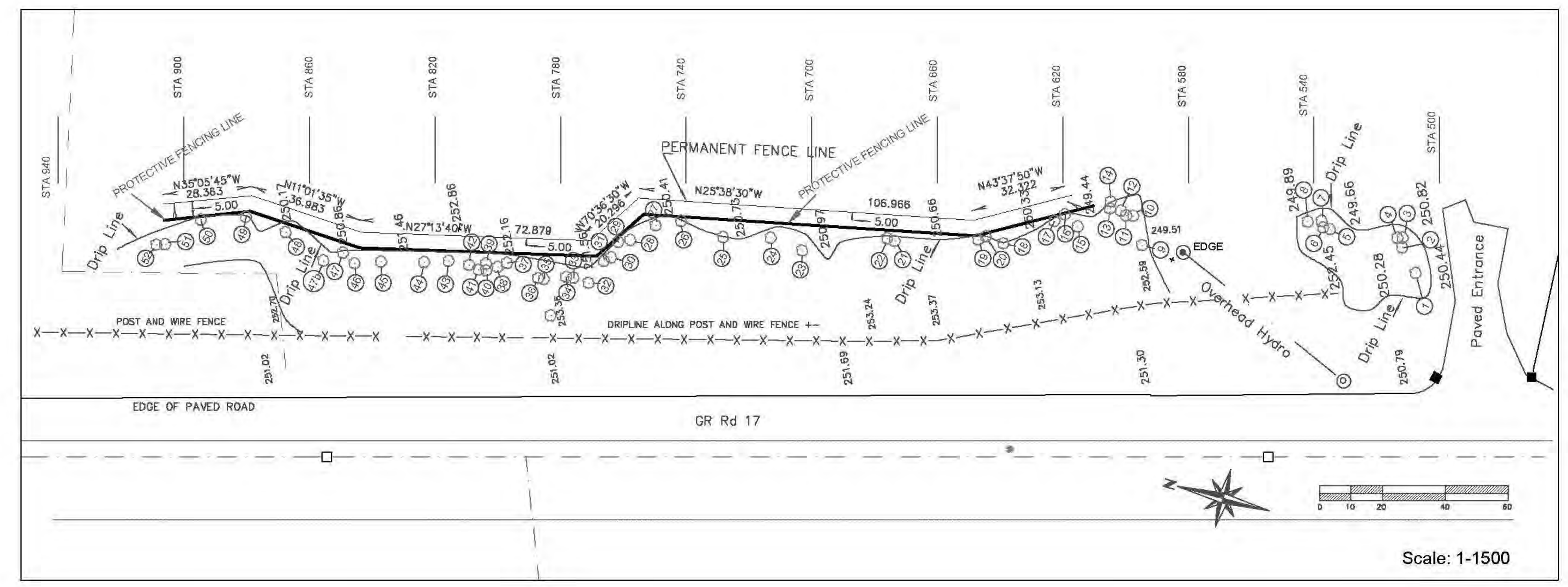


Figure 1- Zone One

- EXISTING TREE
- TREE NUMBER (see VEGETATION Report)

FOR ADDITIONAL INFORMATION REFER TO THE WOODY VEGETATION INVENTORY-IMPACT AND PRESERVATION METHOD REPORT, Larry T. Porter Landscape Architect October 2014

WOODY VEGETATION IMPACT ASSESSMENT AND PRESERVATION PLANS

We interpret the work under this guideline to provide an initial inventory assessment of the vegetation adjacent to the proposed works, the potential impact on the vegetation by the work plan and methods to protect the vegetation.

The long term tree monitoring, evaluation and replacement plan will be carried out under the Tree Preservation Plan (TPP) which is detailed in the Adaptive Management Plan (AMP) in Section 6 of Appendix F.

HAROLD SUTHERLAND CONSTRUCTION LTD.
R.R. #2, KEMBLE, ONTARIO, N0H1S0

NEW KEPPEL QUARRY

PARTS LOTS 26, 27 & 28, CONCESSION 10
TOWNSHIP OF GEORGIAN BLUFFS (formerly Keppel Twp)
COUNTY OF GREY

WOODY VEGETATION INVENTORY IMPACT ASSESSMENT & PRESERVATION METHOD PLAN

DRAWING 9 of 9

December 11, 2014