Appendix B:
Long-term Trend
Groundwater & Surface Water
Monitoring Program

APPENDIX B: LONG-TERM TREND GROUNDWATER AND SURFACE WATER MONITORING PROGRAM
DUNTROON QUARRY EXPANSION
AGGREGATE RESOURCES ACT APPLICATION
LOT 25 AND PT. LOT 26, CONCESSION 11
TOWNSHIP OF CLEARVIEW

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B.1 Introduction and Background

This Appendix describes the Long-term Trend Groundwater and Surface Water Monitoring Program component of the Adaptive Management Plan (AMP). The interrelationships between this long-term monitoring program for the local water resources and the other components of the AMP are illustrated on **Figure B-1** (see Attachment B-1 for figures).

B.1.1 BACKGROUND

Long-term groundwater and surface water monitoring programs are on-going for the existing quarry operation and for the quarry expansion property, and similar programs will continue through the active life of both quarries through to their final rehabilitation as lakes. The monitoring program for the existing quarry is carried out in compliance with the current Permit To Take Water No. 1168-665NHB, as issued by the Ministry of the Environment (MOE). That Permit, which expires on October 31 2014, requires the submission of a report to MOE every three years to document the results of the monitoring program. The most recent report covered the monitoring period 2005 to 2007 inclusive and was submitted in March 2008 (see references).

Technical studies have been undertaken in support of the ARA application for the quarry expansion, including a Level 2 detailed geologic and hydrogeologic assessment of the expansion lands and the surrounding area. The Level 2 report was submitted in September 2005, and an addendum report that included a cumulative impact groundwater modeling assessment and a detailed wetlands water budget assessment was submitted in October 2007 (see references). Groundwater and surface water monitoring programs are an integral component of the assessment of the quarry expansion application to identify existing baseline conditions on and around the property, and to provide an evaluation of potential future impacts associated with the operation of that quarry.

The baseline groundwater and surface water conditions are described in detail in the 2005 Level 2 report, and the results of the monitoring programs were updated in an addendum monitoring report that was issued in October 2007 (see references). That addendum report includes groundwater and surface water data collected in support of the ARA application by MAQ Aggregates Inc. to operate the MAQ Highland Quarry on lands located immediately to the west of the Duntroon quarry expansion property, west of Grey Road 31 in Grey County. The Duntroon existing quarry and the quarry expansion are located in Simcoe County.

Groundwater and surface water monitoring is ongoing at the existing Duntroon Quarry and the quarry expansion property, and will continue through the active life through to final rehabilitation and ultimate closure of the quarry expansion, as described below.

B.1.2 PURPOSE AND SCOPE OF LONG TERM TREND MONITORING

Long-term trend monitoring will be used to track the seasonal and year-over-year natural variations in the groundwater and surface water systems, as well as the progressive response of those systems as the quarry expansion extraction operation starts, and then continues over the next 20 to 30 years, followed by several decades of rehabilitation to lakes. Given this extended timeframe, the long-term trend monitoring information will expand the baseline conditions database and will provide future scientific assessment to:

- adapt the environmental baseline;
- identify climate trends;
- fine-tune the groundwater model;
- apply mitigation measures;
- adapt quarry operations;
- assess the validity of the performance indicator monitoring;
- adapt the performance indicator trigger monitoring program; and
- adapt the long-term trend monitoring program.

The scope of the long-term trend monitoring for the quarry expansion will incorporate the results of the programs that are being undertaken at:

- the existing quarry under the existing PTTW;
- the quarry expansion property and surrounding lands;
- the unopened Walker Aggregates Inc. Osprey Quarry Licence property, and
- the MAQ Aggregates Inc. Highlands Quarry property (to be provided by others).

The current groundwater and surface water monitoring programs noted above and which are documented in the referenced reports, are very comprehensive in nature. It is proposed that the long-term trend monitoring program for the quarry expansion incorporate a scaled-down version of those programs that will continue to provide the key information that is necessary for evaluation of groundwater and surface water conditions on and around the quarry expansion property.

As well, it is proposed that several additional groundwater monitor locations be established within the future extraction area and buffer lands of the quarry expansion, so that the progressive impact of the rock extraction and dewatering operations starting in Phase 1 can be

observed in detail and tested against the predictions from the groundwater model. The model will be updated and re-calibrated on a five-year cycle to incorporate new information as it becomes available, so that future impact predictions can be refined and the need for mitigation measures considered.

B.1.3 LIVING DOCUMENT

Adaptive management is a systematic process for continually improving management practices by learning from the outcomes of operational programs. The AMP and its component monitoring programs will be reviewed and updated on a five year cycle. Particular attention is paid to the water budget relative to the Rob Roy Wetland (individual wetland units and overall wetland feature) and ANSI A and ANSI B, and the important components of the flow regimes in the surrounding watercourses present in the Pretty River, Batteaux Creek and Beaver River systems. As such, the Long-term Trend Monitoring is designed to be a 'living document', whereby new information based on observation and monitoring of the system's response to quarry operations and long-term climatic trends are constantly assessed and incorporated into the AMP. Long-term trend analysis may lead to refinements to the monitoring locations and to the method and frequency of monitoring.

B.2 Method

Figure B-2 is a topographical map of the area that illustrates the surface water drainage divides and local catchment areas for the Pretty River, Batteaux Creek, Beaver River and the Mad River systems. The map also shows the locations of the groundwater and surface water monitoring stations that have historical baseline monitoring data available. It is recognized that the surface water and groundwater monitoring stations that now are to form the basis of the Performance Indicator Trigger (PIT) compliance monitoring component of the Adaptive Management Plan (see **Appendix A**), historically have been part of the overall monitoring program to identify baseline conditions for the quarry expansion. For completeness and continuity, those PIT monitoring stations are identified as being integral to this long-term trend monitoring program as well, such that monitoring results from those stations will be incorporated into the assessment of long-term trends.

B.2.1 CLIMATE DATA

B.2.1.1 Long Term Normals

Climate data that are used as part of hydrogeologic studies are generally obtained from an operational climate station with at least 30 years of data located in close proximity to the subject area. Environment Canada routinely publishes 30 Year Normals (or averages) for active climate stations with at least 30 Years of climate data. The 30 Year Normal data are used as a historical baseline against which recent climate data are compared to determine if a particular year or month is wetter or drier than normal. The information is also used in the assessment of future conditions and impacts that may occur as a result of changes in land use.

Previous monitoring reports have utilized the Environment Canada Thornbury Slama climate station to obtain local climate data for the Duntroon Quarry hydrogeologic studies (see **Table B-1**) (see Attachment B-2 for tables). The Thornbury Slama station was cancelled in early 2005. The September 2005 Duntroon Quarry Expansion Level 2 Hydrogeological Assessment report utilized the Environment Canada Ruskview climate station as a replacement for the Thornbury Slama climate station since there was a favourable correlation between the recent available climate data for these two stations. Unfortunately, the Ruskview station was cancelled in early 2006.

In order to provide a suitable replacement set of climate data, a detailed assessment of the available climate stations within a 60 km radius round the Duntroon Quarry and expansion lands was undertaken. That assessment showed that the Shanty Bay Climate Station located on Lake Simcoe, approximately 60 km east of the Duntroon Quarry provides a reasonable correlation with the climate data from the Thornbury Slama climate station. On this basis, the 30 Year Normal climate data for the Shanty Bay Station are considered representative of the general climatic conditions at Thornbury Slama, such that these data can be used to reflect general

regional climatic conditions on and around the quarry expansion property. **Table B-2** provides the Shanty Bay 2007 climate data and **Table B-3** provides the 2008 data.

B.2.1.2 Local Climatic Conditions

In 2008, Walker Aggregates Inc. established an automatic recording weather station at the office building for the existing quarry operation. That system records hourly measurements of precipitation total, temperature, wind speed and direction, relative humidity and barometric pressure. In the winter, a heated snow water equivalent gauge melts the snow and by means of a tipping bucket records the rainfall-equivalent of the snowfall. That information is used to compile local daily, monthly and yearly climate information for comparison against the Environment Canada regional data.

The local and regional climate data are used to prepare seasonal and annual water budget assessments based on the Thornthwaite-Mather method as used by Environment Canada. That information is then used to estimate seasonal and annual water surplus / deficit amounts for consideration in surface water runoff and groundwater recharge evaluations and for comparison against quarry discharge volumes.

B.2.2 GROUNDWATER MONITORING PROGRAM

Table B-4 provides details of the groundwater monitors that are included in the Long-term Groundwater Trend Monitoring Program. **Table B-5** provides details of other groundwater monitors that historically have been monitored at the Walker Aggregates Inc. properties, but which are not included in the Long-term Trend Groundwater Monitoring Program. **Table B-6** provides a summary of proposed Long-term Trend Groundwater Monitoring Program.

B.2.2.1 Existing Duntroon Quarry

The groundwater monitoring program that is undertaken on and around the existing quarry will continue in compliance with the requirements of the current Permit To Take Water No. 1168-665NHB, which expires on October 31 2014. Any additional components that may be included on an amended permit, should one be issued by the Ministry of the Environment in the future, will be incorporated into the program. The current Permit requires the following program:

- The Permit Holder shall measure and record static water levels in each monitoring well, in the water supply wells CLF1 and CLF2 on the Carmarthen Lake Farms property, on a monthly basis and stream flows at SW1 and SW2 on a weekly basis during the period or season of operation (supply wells and stream flow locations are as described in Schedule “A” of the Permit.
- The Permit Holder shall maintain a record of all water takings. This record shall include the dates and times of water takings, and the total measured amounts of water pumped per day

for each day that water is taken under the authorization of this Permit. A separate record shall be maintained for each source. The total amounts of water pumped shall be measured using a datalogger to monitor the duration that each pump is operated on a daily basis.

The actual monitoring program that is undertaken at the existing Duntroon Quarry includes the following groundwater monitor locations:

- On-site monitoring wells designated: PW99-1, BH98-8, BH98-9, BH98-10, BH98-11 and BH98-12, and the on-site water supply well for the maintenance shop designated E2.
- Four shallow water table drivepoint monitors designated DP1 to DP4 were installed in wetland features at the Duntroon Quarry and on adjacent lands as part of on-going hydrogeological investigations in 1999. Those drivepoint monitors are included in the current monitoring program.
- In November 2007, a new potable water supply well was established for the quarry office. The original office well is located beneath the floor of the office building and is not easily accessible for monitoring. The new water supply well is designated as the New Office Well and is included in the monitoring program.
- Carmarthen Lake Farms:
  - Groundwater levels are measured at five off-site water supply wells on the Camarthen Lakes Farms (CLF) properties, designated as CLF1, CLF2, CLF3, CLF4 and CLF5.
- Osprey Quarry Licence Property:
  - The northern half of the Osprey Quarry Property is owned by Walker Aggregates Inc. and the property is licensed to extract aggregate from above the water table. There has not been any extraction activity at this property to-date. Monitoring at the Osprey Quarry Property consists of monthly groundwater level measurements in nine (9) monitoring wells designated; 101-B, 102-C, 103-D, 104-A, OW1-4, OW3-1, OW5-2 and OW6-3.
- Residential Properties:
  - During 2003, several residential water wells were made accessible to Jagger Hims Limited for monitoring purposes. The following residential water wells currently are included in the water level monitoring program; Armstrong, former Bridson (now owned by Walker Aggregates), Dempsey, Fabrizio, Kekanovich, former Millar Farm (now owned by Walker Aggregates), Sampson, Skippen, Swinton, Urbaniak and Young (see **Figure B-2** for well location details). The Binczyk house (quarry house also owned by Walker Aggregates Inc.) well was made accessible for monitoring in 2006 and is

included in the monitoring program. The inclusion of private residential wells in the long term trend monitoring program is contingent upon permission of the landowner.

B.2.2.2 Duntroon Quarry Expansion Property

The water level monitoring program that is conducted at the quarry expansion property consists of groundwater level measurements recorded monthly at the following locations:

- 10 monitoring wells designated BH02-1, BH02-2, BH02-3, BH02-4, BH02-5, BH02-6, BH02-7-I, BH02-7-II, BH03-8 and BH03-9.
- In addition to the monthly groundwater level monitoring events, data loggers were installed in mid-September 2006 at BH02-1, BH02-4, BH02-7-II and BH03-8 to record groundwater level data twice per day at each location.
- Shallow water table drivepoint monitor designated Bridson DP that is installed in the wetland feature located on the former Bridson property (now owned by Walker Aggregates Inc.).
- Three test wells designated TW04-1, TW04-2 and TW04-3 that were installed in 2004 near the southwestern corner of the expansion lands.
- Two shallow water table drivepoint monitors designated DP5 and DP6 established to monitor groundwater levels in the Rob Roy Swamp Unit #2 and the area designated ANSI A, respectively.
- Data loggers were installed in the drivepoints designated DP5 and DP6 in July 2007 to monitor the groundwater level twice per day.

In addition to the historical monitoring locations noted above, upon issuance of the ARA licence for the quarry expansion, Walker Aggregates has committed to installing several new groundwater monitors within the extraction footprint and in the perimeter buffer lands around the quarry.

Figure B-3 illustrates the general location of the proposed new monitors. The initial focus of this additional monitoring component is centered on quantification of the progressive magnitude and lateral extent of the groundwater drawdown zone that develops in the bedrock as quarrying starts and then progresses through Phase 1. The observed drawdown will be tested against the predicted drawdown from the groundwater model. That new information will be used periodically to update and re-calibrate the groundwater model so that predictions of future impacts associated with Phase 2 / Phase 3 extraction, and final rehabilitation as a lake can be refined.

The resulting network of monitors will provide good spatial coverage of groundwater conditions beneath the entire expansion property, and will allow the progressive effects of extraction in

Phase 1 to be quantified in a radial pattern centered on the initial sinking-cut at the tunnel entrance. As extraction approaches the outer limits of Phase 1 and internal monitors are removed, it may be beneficial to install additional monitors at key locations in Phase 2 to provide additional coverage in certain areas. A similar situation may arise in preparation for extraction in Phase 3 down to the 500 m asl (metres above sea level) floor elevation, followed by final extraction beneath Phase 1 down to elevation 490 m asl.

The new monitors will, for the most part, be extended down to the bottom of the Amabel Formation as open-hole monitors, unless conditions warrant establishing a shallow monitor and a deep monitor in the Amabel at some locations. Continuous water level data will be recorded in the seven monitors located within the Phase 1 area by means of pressure transducers and dataloggers (signified by "D" on **Figure B-3**). Manual water level measurements will be obtained for QA/QC purposes on a monthly basis, and the dataloggers will be downloaded at that time for review and evaluation. Groundwater levels will be measured manually on a monthly frequency at the monitors located around the periphery of the property and at off-property locations.

Once baseline conditions have been established at the new peripheral monitor locations, (one to two years), the frequency of monitoring will be reviewed and may be reduced to quarterly, if appropriate. As extraction in Phase 1 extends outward from the initial sinking cut, and drawdown effects are observed at the internal monitors, dataloggers will be installed in additional monitors located in Phase 2 and Phase 3 in preparation for future extraction in those areas. The dataloggers in the Phase 1 monitors will be removed from their locations as the extraction face approaches since they will no longer provide useful information with respect to drawdown effects in Phase 1, and they will be re-used at other locations.

Since extraction below the water table in Phase 1 will induce groundwater to enter the quarry (as opposed to leaving it), water quality on-site will be monitored through sampling at the dewatering sump(s) on a quarterly frequency. Samples will be analyzed for the following parameters:

- General chemistry including pH, temperature, dissolved oxygen, specific conductance, alkalinity, hardness, colour, total suspended solids;
- Major and minor ion constituents and nutrients;
- Total petroleum hydrocarbons; and
- Bacteriological content (*e. coli*, total coliform and heterotrophic plate count). These parameters will be tested since excess water from the sump may be discharged off-site during Phase 1 operations and may infiltrate / recharge the rock east of the quarry. The local groundwater is used for residential water supplies water.

Water quality will be compared to the Ontario Drinking Water Standards (for groundwater) and to the Provincial Water Quality Objectives (for surface water). The list of analytical parameters and the frequency of monitoring will be reviewed once baseline conditions have been established for the sump water. In addition, the sump water quality will be compared to the groundwater quality to be obtained annually from the four closest private residential water supplies (drilled wells at Dempsey / Brown and Fabrizio, and Escarpment spring sources SW10 and SW21C to the east, provided that permission is granted). This will provide water quality information for future use during operation of mitigation recharge wells.

B.2.3 SURFACE WATER MONITORING PROGRAM

The historical surface water monitoring program that has been undertaken starting in 2003 has provided a good understanding of the surface water resources and the seasonal variation around the expansion property. To date, monitoring has been undertaken on a generally monthly frequency at several locations within the drainage basins of the Beaver River, Batteaux Creek, Pretty River and the Mad River. That monitoring has included monthly estimates of surface water flows and measurement of the field chemistry parameters pH, temperature, conductivity and dissolved oxygen, as well as occasional laboratory analysis for general chemistry and major ions for water samples collected from specific locations. That information has provided baseline conditions for the surface water courses in the four drainage basins.

A scaled-down version of the current monitoring program is proposed to be carried out through extraction in Phase 1, since potential off-site drawdown effects on surface water resources are not anticipated until extraction in Phases 2 and 3. It is noted that due to climatic conditions during the winter months, several surface water monitoring stations have limited monitoring access due to snow and/or ice accumulation. A description of the surface water monitoring stations that are to be included in the Long-term Trend Surface Water Monitoring Program for the existing Duntroon Quarry and for the quarry expansion properties is provided in **Table B-7**. **Table B-8** provides details of stations that historically were monitored as part of the original baseline program. **Table B-9** provides a summary of the Long-term Trend Surface Water Monitoring Program, details of which are provided below. **Table B-10** provides a summary of the baseline surface water that flows at the monitoring stations.

B.2.3.1 Beaver River Basin

The western part of both the expansion lands and the existing quarry are situated within the drainage basin of the Beaver River, which discharges into Georgian Bay at Thornbury. The surface drainage within the subcatchment area as identified on **Figure B-2** (Existing Monitoring Network) flows from east to west, and forms the headwaters of one of the eastern tributaries of the Beaver River. Excess water from dewatering operations at the existing quarry is discharged into this tributary.

Surface water monitoring stations SW1, SW2, SW3, SW6A and SWO-2 within the Beaver River subcatchment area are proposed for monitoring. In May 2007 two staff gauges were installed to monitor surface water levels in the Rob Roy Swamp Unit #2, also part of the Beaver River Basin, and are designated as BH03-7 SG1 and BH03-7 SG2. Routine monitoring is to be continued at those stations to characterize the hydroperiod in the wetlands.

As part of the Permit To Take Water for the existing Duntroon Quarry monitoring program, weekly surface water flow monitoring is conducted at surface water stations SW1 and SW2 and, in addition, surface flows across the quarry floor are obtained at station QFSW2 near the sump within the existing quarry.

B.2.3.2 Batteaux Creek Basin

Batteaux Creek (also called Batteaux River) and its un-named tributary headwaters originate on the Niagara Escarpment and flow eastward and then north to Nottawasaga Bay just east of Collingwood. The subcatchment includes approximately the eastern half of the expansion lands and, prior to the start of quarry operations, would also have included the eastern section of the existing quarry extraction area that now is within the Beaver River subcatchment as a result of the quarry discharge to the west.

The individual watercourse channels progressively merge on their way down the Escarpment to form the main channel of Batteaux Creek (fourth order channel) just west of County Road 124. The flow in the main channel is monitored at the culvert crossing at County Road 124, about 900 m south of Duntroon. This station, designated as SW19, is to be maintained.

In addition to surface water station SW19, the following surface water monitoring stations located in the Batteaux Creek basin are to be maintained; SW7, SW8, SW9, SW10, SW11 series of springs, SW13, SW14, SW15, SW21, SW21A, SW21B, SW22, SW22A and SW22B.

B.2.3.3 Pretty River Basin

The monitored surface water stations located within the Pretty River subcatchment are located to the northeast of the expansion lands, and are accessible from the 26/27 Sideroad. Stream flow monitoring locations that are to be continued include groundwater spring areas that originate near the brow of the Escarpment at the base of the Amabel Formation (SW20 below the Cowan water supply collection system), groundwater springs that originate lower down the Escarpment at the Manitoulin Formation scarp (SW24A) above the discharge into the collection pond on the former Sestito (now H/E Franks) property.

Locations that are to be monitored in stream channels adjacent to the 26/27 Sideroad are designated as monitoring stations SW17, SW17A and SW16. The cumulative flow in the main channel monitored at Concession 10 is designated station SW18. Escarpment springs SW21C (water supply spring H/E Franks property) and SW77, both of which originate from the Amabel dolostone are to be monitored visually for flow, and measured for temperature.

B.2.3.4 Quarry Pumping and Off Site Discharge

The Permit To Take Water and the Certificate of Approval for Discharge off-site of excess water from the quarry expansion operations will include conditions that will require monitoring of the amount of water that is pumped on-site for dewatering and other purposes, and monitoring of the amount and quality of the water that is discharged off-site from the quarry property. Typically, such operational monitoring programs include daily records of the number and types of pumps that are in use, the hours of operation and volumes pumped, as well as details of the volume and quality of water that is discharged off-site. Final details of the required monitoring program will be developed in conjunction with the Ministry of the Environment as part of the approvals process for the Permit To Take Water and the Certificate of Approval for Discharge. This monitoring information will be incorporated into overall monitoring program for the quarry.

B.2.4 MONITORING METHODOLGY

Since the Long-Term Trend Monitoring Program and the Performance Indicator Trigger Monitoring Program include the same types of groundwater and surface water monitoring activities at many of the same stations, this section on monitoring methodology is the same for both components.

The methodology that will be used for the Long Term Trend Monitoring and the Performance Indicator Trigger Monitoring programs reflects the parameters that are being monitored and the site-specific characteristics of the locations under observation.

Details of the groundwater monitoring program locations, methodology (datalogger or manual), and frequency of measurement are provided in **Section B.2.2** of this document.

B.2.4.1 Surface Water Channel Flow and Temperature by Datalogger

Pretty River Tributary System:	SW16, SW17, SW17A at 26/27 Sideroad SW18 at Concession 10 Road Background Control Station (To Be Established)
Batteaux Creek Tributary System:	SW14 and SW15 at Concession 10 Road SW9 seasonally (directly east of expansion property) Background Control Station (To Be Established)
Beaver River Tributary System:	SW1 at Grey Road 31 SW2 at County Road 91 SWO-2 Osprey Quarry property west of Grey 31 SW6A at Grey Highlands Sideroad 30 SW3 seasonally, Rob Roy Unit 2 at Grey Highlands Sideroad Road 30

- Water level (stage) and water temperature datalogger recorders will be established in these tributary stream channel road culvert crossings. Initially, the dataloggers will be set to record values three times per day (7:00 AM, 3:00 PM and 11:00 PM) to provide a measure of the daily variation in flow conditions and will be downloaded on a monthly basis at the outset. The dataloggers will be installed in the same locations (if practical with respect to flow conditions and winter freezing concerns) as the existing monitoring stations at these locations so that existing stage-discharge relationships can be utilized. In the event that existing stage-discharge relationships cannot be used at specific stations, new stage-discharge curves will be established.
- Quarterly estimate of streamflow (as a check on stage-discharge relationship) and measurement of the field chemistry parameters: pH, temperature, conductivity and dissolved oxygen.
- Annual sampling for water quality parameters as follows:
  - General chemistry including pH, temperature, dissolved oxygen, specific conductance, alkalinity, hardness, colour, total suspended solids.
  - Major and minor ion constituents and nutrients.
  - Total petroleum hydrocarbons.

B.2.4.2 Surface Water Escarpment Springs

Pretty River Tributary:	SW21C Private property east of expansion lands spring from Amabel Formation surface water source supply H/E Franks SW24A Private property spring from Manitoulin Formation surface water source on former Sestito (now H/E Franks) property SW77 Free-flowing natural spring from Amabel Formation south of 26/27 Sideroad
Batteaux Creek Tributary:	SW10 Private property east of expansion lands, surface water supply spring from Amabel Formation SW11 Private property east of expansion lands, series of springs below Manitoulin Amabel Formation above collection pond

- Monthly temperature measurement and visual assessment (presence / absence) of flow conditions at springs, with manual estimate of flow when practical.
- Annual sampling for water quality parameters as follows:

- General chemistry including pH, temperature, dissolved oxygen, specific conductance, alkalinity, hardness, colour, total suspended solids.
- Major and minor ion constituents and nutrients.
- Total petroleum hydrocarbons.
- Bacteriological content (*e. coli*, total coliform and heterotrophic plate count) for SW10 and SW21C as these sources are used as residential / farm water supplies.

B.2.4.3 Wetland Water Levels

Beaver River Tributary:

Rob Roy Wetland Unit #2: Drivepoint DP5 and DP7
Rob Roy Wetland Unit #6: Drivepoint DP2, DP4 and DP8

Batteaux Creek Tributary:

ANSI A Wetland Unit: Drivepoint DP6
ANSI B Wetland Unit: Drivepoint DP9 and Bridson DP

- Monthly manual groundwater level measurement (inside monitor) and ponded surface water level measurement (outside monitor), and water temperature measurement. Frequency of ponded surface water level and temperature measurements increased from monthly to every two weeks from May to the end of July to reflect the amphibian breeding hydroperiod.

B.2.4.4 Quarry Discharge Water Quality

Quarterly analysis of the chemical quality of the quarry discharge water for the following parameters:

- General chemistry including pH, temperature, dissolved oxygen, specific conductance, alkalinity, hardness, colour, total suspended solids.
- Major and minor ion constituents and nutrients.
- Total petroleum hydrocarbons.
- Bacteriological content of *e. coli*, total coliform and heterotrophic plate count, and only in the event that quarry discharge water is used for recharge injection wells.

B.2.4.5 Instrumentation

The instrumentation that currently is in use for this monitoring program reflects contemporary industry standards for this type of work, and generally consists of the following:

- Water Level and Temperature Dataloggers:
  Solinst Levelogger Gold and / or Silver
- Barologger:
  Solinst Barologger
- Manual Electronic Water Level Meter:
  Solinst Graduated Tape Meter
- Manual Water Temperature Thermometer:
  YSI 556 Multiparameter System
- Streamflow Velocity Meter:
  Valeport Model 801
- Dissolved Oxygen Meter:
  YSI 556 Multiparameter System
- Field pH:
  YSI Multiparameter System
- Field Conductivity:
  YSI 556 Multiparameter System
- Climate Station:
  Davis Vantage Pro2

The instruments will be maintained in good working order and will be calibrated on a regular basis, as per the manufacturer's recommendations, and results will be recorded in a field book for future reference if needed.

B.2.4.6 Record Keeping

A detailed record of all monitoring events and field measurements will be maintained in a dedicated field book, and results will be QA/QC'ed against previous data and then entered into the monitoring database for the quarry in a timely manner. Any seemingly anomalous results will be investigated immediately, and will be re-measured in the field for verification if necessary.

Once the monitoring results have undergone the internal QA/QC process, they will be posted to the Walker Aggregates Inc. web-site that has been established for the Duntroon quarry expansion. The results for the current monitoring event should be available on the web site no

later than seven days following the event, excluding any laboratory chemistry data which will be posted within 48 hours of receipt from the laboratory. Any seemingly anomalous results will be identified as such, and the verification process that will be underway will be documented.

Results pertaining to compliance aspects with respect to the Performance Indicator Trigger Monitoring program will be compiled into a tabular format summary report that will identify any non-compliance concerns which will be posted to the web-site on a monthly basis.

Since extraction in most of Phase 1 is not expected to result in any off-site impacts to ground water or surface water resources or the associated natural heritage features, the reporting time-lines noted above should be satisfactory. As the extraction nears the end of Phase 1, it may be necessary to re-visit the reporting time-lines and develop a system of real-time reporting for specific key parameters, if that is deemed appropriate. Such decisions will be made in consultation with the MNR, MOE and the Conservation Authorities.

B.3 Reporting and Adaptation

An annual report will be prepared for the Long Term Trend Monitoring program that will be integrated into the overall report of the Adaptive Management Plan, as outlined in the main text of the AMP. The report will describe the scope of the monitoring program that was completed for the reporting period, and it will provide the results of the monitoring.

Results will be compared against historical data to confirm the continuation of previous trends, and / or identify and interpret the significance of any new trends as and when they develop. Recommendations will be provided with respect to any modifications to the program that are considered appropriate, based on the results that are obtained. This trend information will be incorporated into the evaluation of the Performance Indicator Trigger compliance monitoring component of the AMP.

Adaptive Management Planning

The integrated AMP report will make recommendations on:

- Whether and how to better integrate with the long term trend ground and surface water monitoring program;
- Whether long term changes in the site environment that may be related to quarry operations;
- Whether long term changes in the Regional environment and assess whether they are quarry related or as a result of other factors;
- Updating the environmental baseline for both site environment and regional environment;
- The implication of any climate trends and adaptations that may be required as a result to any of the AMP components;
- Applying necessary mitigation measures;
- Adapting the quarry operations;
- The validity of the performance indicator specified in the Performance Indicator Trigger (PIT) Monitoring Program;
- The need to adapt or modify the performance indicator trigger monitoring program; and
- The need to adapt or modify the long-term trend monitoring program.

B.4 References

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APPENDIX B: LONG-TERM TREND GROUNDWATER AND SURFACE WATER MONITORING PROGRAM
DUNTROON QUARRY EXPANSION
AGGREGATE RESOURCES ACT APPLICATION
LOT 25 AND PT. LOT 26, CONCESSION 11
TOWNSHIP OF CLEARVIEW

ATTACHMENT B-1: FIGURES

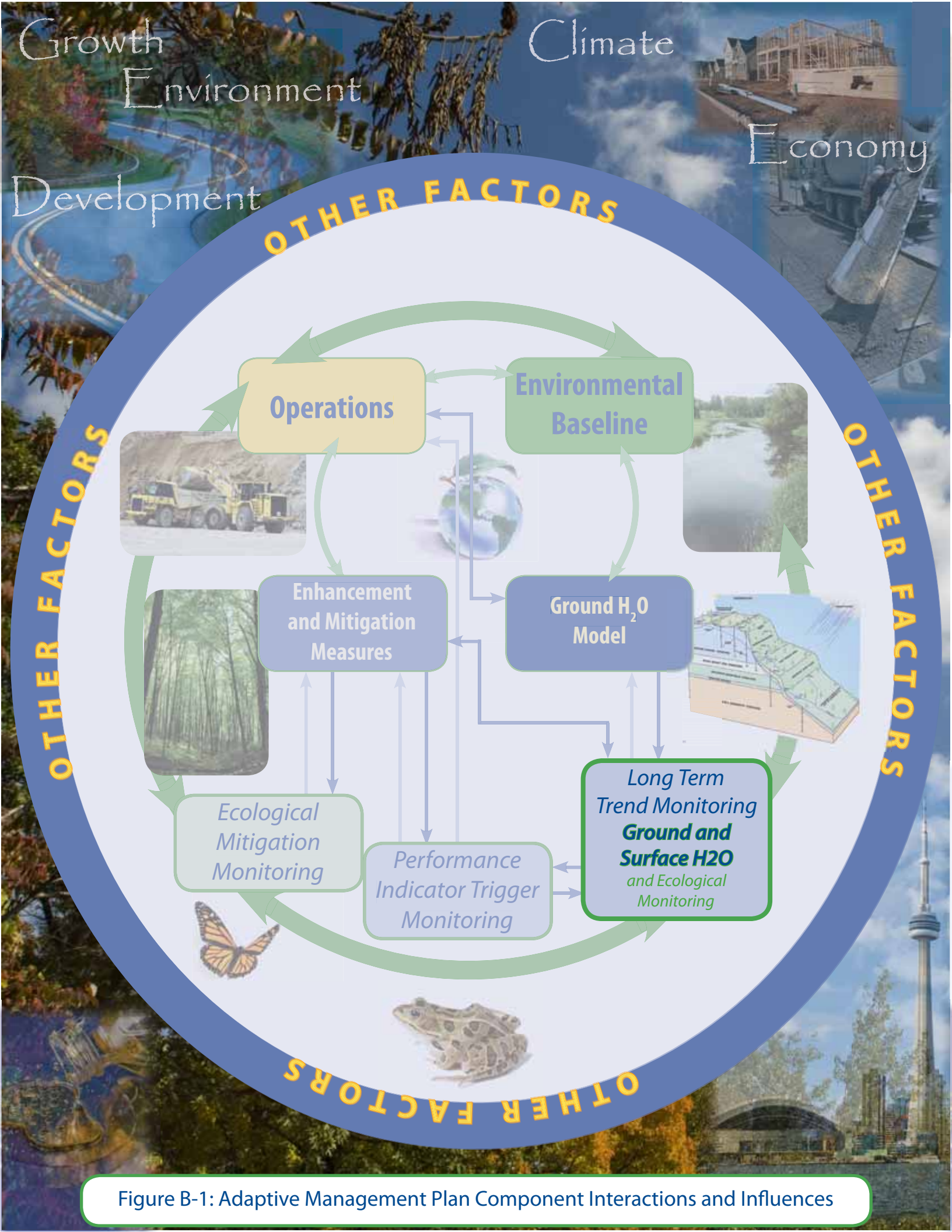
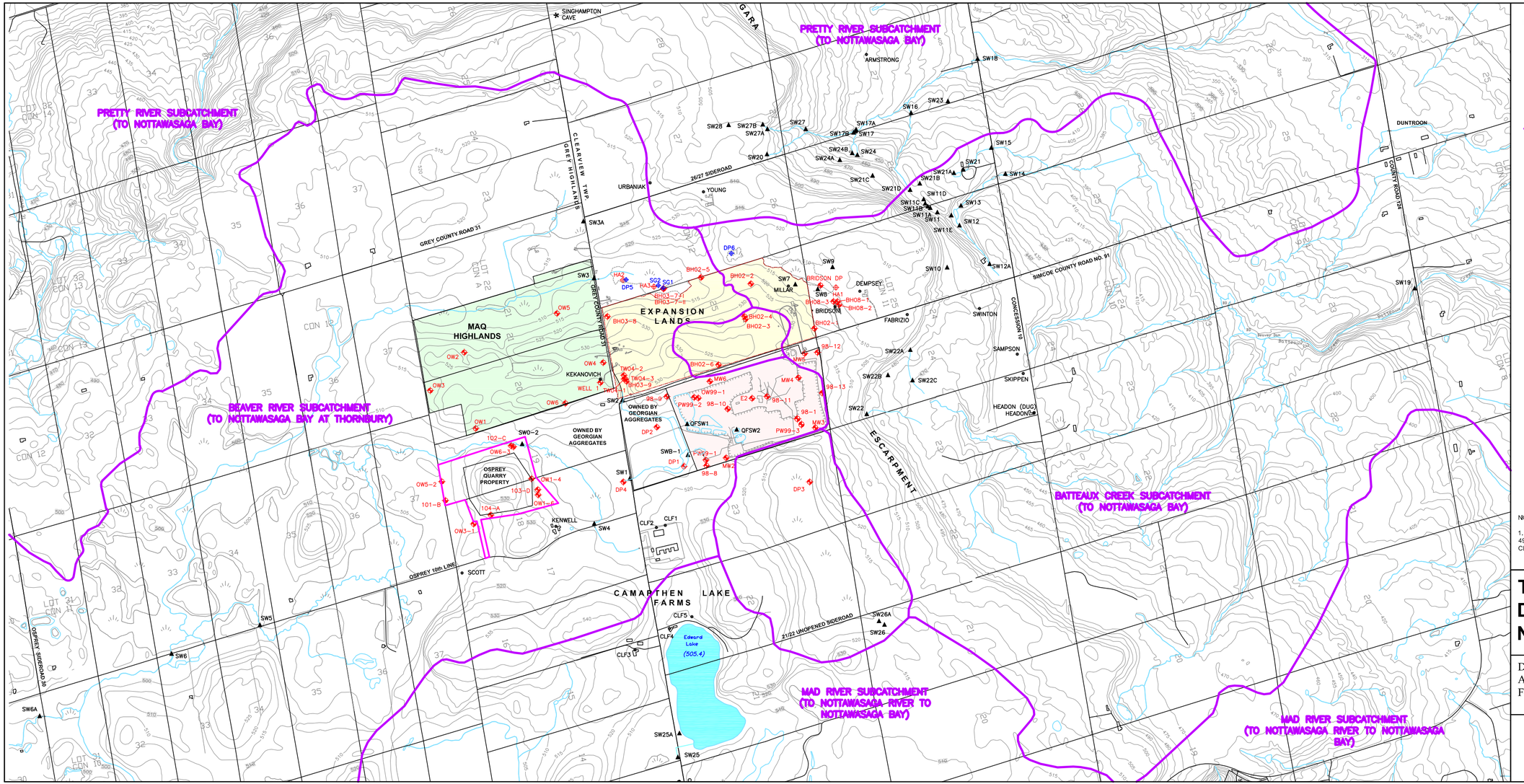


Figure B-1: Adaptive Management Plan Component Interactions and Influences



LEGEND

- EXISTING DUNTROON QUARRY PROPERTY
- PROPOSED DUNTROON QUARRY EXPANSION LANDS
- MAQ HIGHLANDS PROPERTY
- WATERSHED DIVIDE
- ▲ SW26 — SURFACE WATER MONITORING LOCATION AND DESIGNATION
- OW1–6 — BOREHOLE LOCATION AND DESIGNATION
- KENWELL — RESIDENTIAL WELL LOCATION AND DESIGNATION
- DP5 — DRIVEPOINT LOCATION AND DESIGNATION
- SG1 — STAFF GAUGE LOCATION AND DESIGNATION

NOTES:

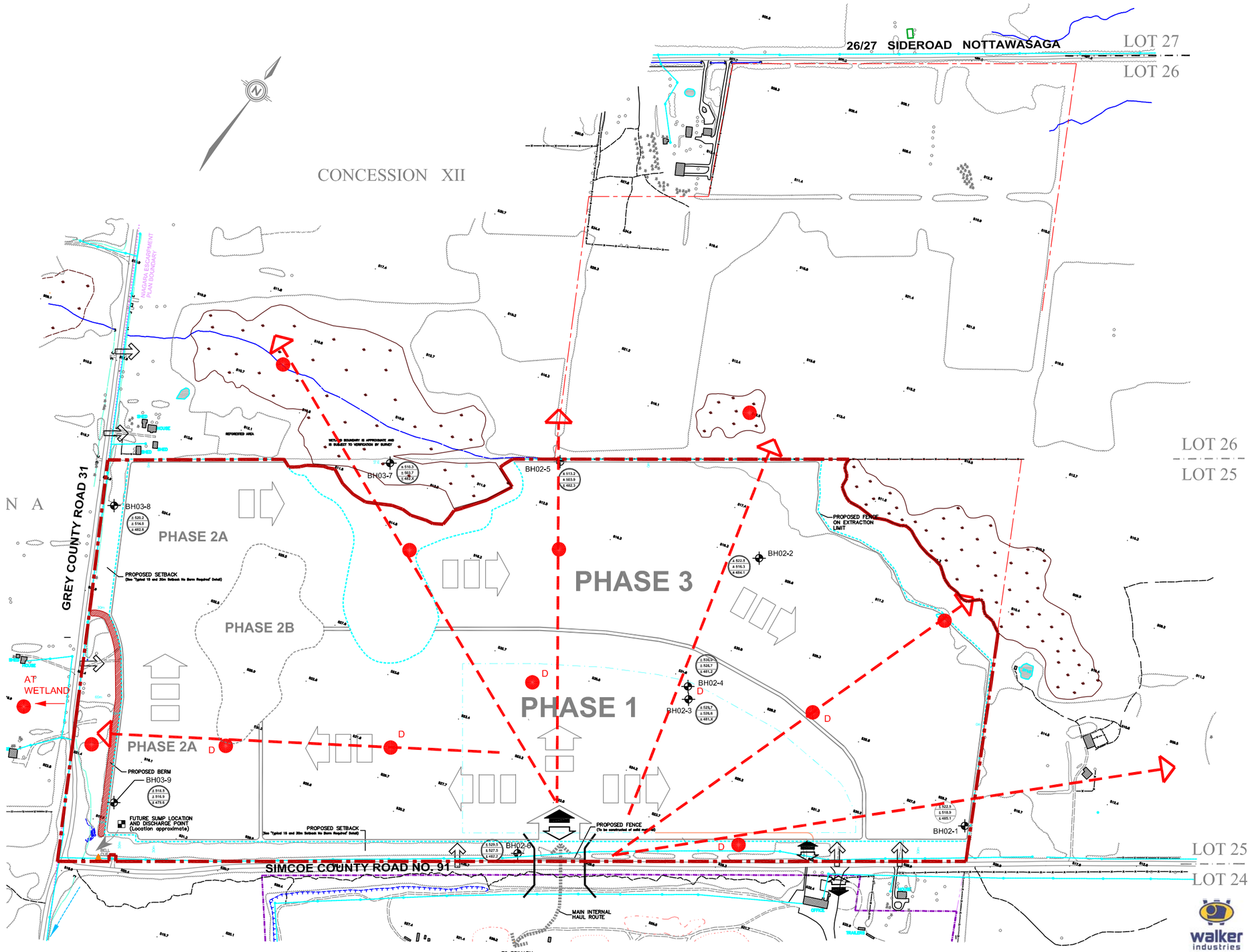
1. MAP SOURCES OBM SHEETS 10 17 5600 49150, 10 17 5550 49100, 10 17 5550 49150 AND 10 17 5600 49100, NAD 27 DATUM AND McNAUGHTON HERMSEN CLARKSON PLANNING LIMITED, EXISTING FEATURES 2003.

TOPOGRAPHY, SURFACE DRAINAGE & MONITORING NETWORK

DUNTROON QUARRY EXPANSION APPLICATION
ADAPTIVE MANAGEMENT PLAN
For Walker Aggregates Inc.

walker industries
Walker Aggregates Inc.

SCALE: 1:20000	FIGURE
FILE NO.: 4-93052152FB2-SW	B-2
DATE: NOVEMBER 2009	
PROJECT: 4-930521.52	



Legend

- Boundary of Area to be Licensed
- Licensed Boundary
- Building/Structure
- Field/Service Entrance
- Entrance/Exit
- Direction of Excavation
- Main Internal Haul Road
- Direction of Surface Drainage
- Excavation Face
- Proposed Additional Monitor Location (D = SIGNIFIES DATALOGGER TO BE INSTALLED)
- Limit of Extraction
- Existing Spot Elevation (520.6)
- Existing Vegetation
- Existing Fence
- Proposed Elevations (EXISTING ELEVATION (metres) / TOP OF ROCK (metres) / MAXIMUM DEPTH OF EXTRACTION (metres))
- Proposed Berms
- Proposed Fence
- Plant Site
- Existing Monitor Location and Designation (BH02-6 D; D = SIGNIFIES DATALOGGER TO BE INSTALLED)
- Radial Expansion of Drawdown Zone

0 50 100 250 metres

NOTE:

MAP SOURCES OBM SHEETS 10 17 5600 49150, 10 17 5550 49100, 10 17 5550 49150 AND 10 17 5600 49100, NAD 27 DATUM AND McNAUGHTON HERMSEN CLARKSON PLANNING LIMITED, EXISTING FEATURES 2003.

PROPOSED ADDITIONAL GROUNDWATER MONITORS

DUNTROON QUARRY EXPANSION APPLICATION
ADAPTIVE MANAGEMENT PLAN
For Walkers Aggregates Inc.

walker industries
Walker Aggregates Inc.

DATE: NOVEMBER 2009	SCALE: 1:6000	FIGURE B-3
PROJECT: 4-930521.52	FILE NO.: 4-93052152FB3-SP	

APPENDIX B: LONG-TERM TREND GROUNDWATER AND SURFACE WATER MONITORING PROGRAM
DUNTROON QUARRY EXPANSION
AGGREGATE RESOURCES ACT APPLICATION
LOT 25 AND PT. LOT 26, CONCESSION 11
TOWNSHIP OF CLEARVIEW

ATTACHMENT B-2: TABLES