



TECHNICAL MEMORANDUM

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Project No. CA-GLD-1791470A-VCNA

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HYDROLOGICAL AND ECOLOGICAL MONITORING PLAN – PROPOSED CBM ABERFOYLE SOUTH LAKE PIT

In December 2023, CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada) submitted an *Aggregate Resources Act* application to licence the proposed Aberfoyle South Lake Pit, located at 6947 Concession Road 2, in the Township of Puslinch, County of Wellington, Ontario. WSP Canada Inc. (WSP) prepared a Level 1/2 Water Report (Water Report) and Natural Environment Report to support this application. Stakeholder comments have been received pertaining to various aspects of the application and reports.

The Water Report (WSP, 2023) presented site-specific groundwater and surface water monitoring recommendations to measure and evaluate the status on potential receptors associated with the development of the proposed pit, and to allow for comparison between the condition of the receptor measured during the monitoring program and those predicted as part of the impact assessment.

In response to stakeholder comments to the Water Report, WSP has prepared this Technical Memorandum which presents an enhanced site-specific monitoring plan, provides an approach to the establishment of trigger conditions (to be determined specifically based on all available baseline data prior to the Operational Phase), and identifies potential corrective actions. Monitoring locations are presented on Figure 1.

PROPOSED ENHANCED MONITORING PLAN

The Water Report recommends that a monitoring program be implemented to verify the pit's zone of influence on the surrounding Provincially Significant Wetlands (PSW), tributary features, and Mill Creek, as well as to monitor for potential interference with neighbouring private wells (WSP, 2023). The proposed enhanced monitoring program includes the following monitoring activities, which shall commence a minimum of one year prior to the start of extraction, continue through the Operational Period, and end one year after the completion of site Rehabilitation.

Groundwater Monitoring

- Monitoring shall include the current groundwater monitoring network, which consists of six overburden monitoring wells (MW18-01B to MW18-06), one previously existing bedrock well (TW11-16), and six standpipe piezometers (which measure shallow groundwater elevations) (SP18-01 to SP18-04, SP22-01, and SP22-02) . Groundwater level monitoring shall consist of recording groundwater level and temperature data at 15-minute intervals using data loggers, along with quarterly logger downloads and manual water level measurements.

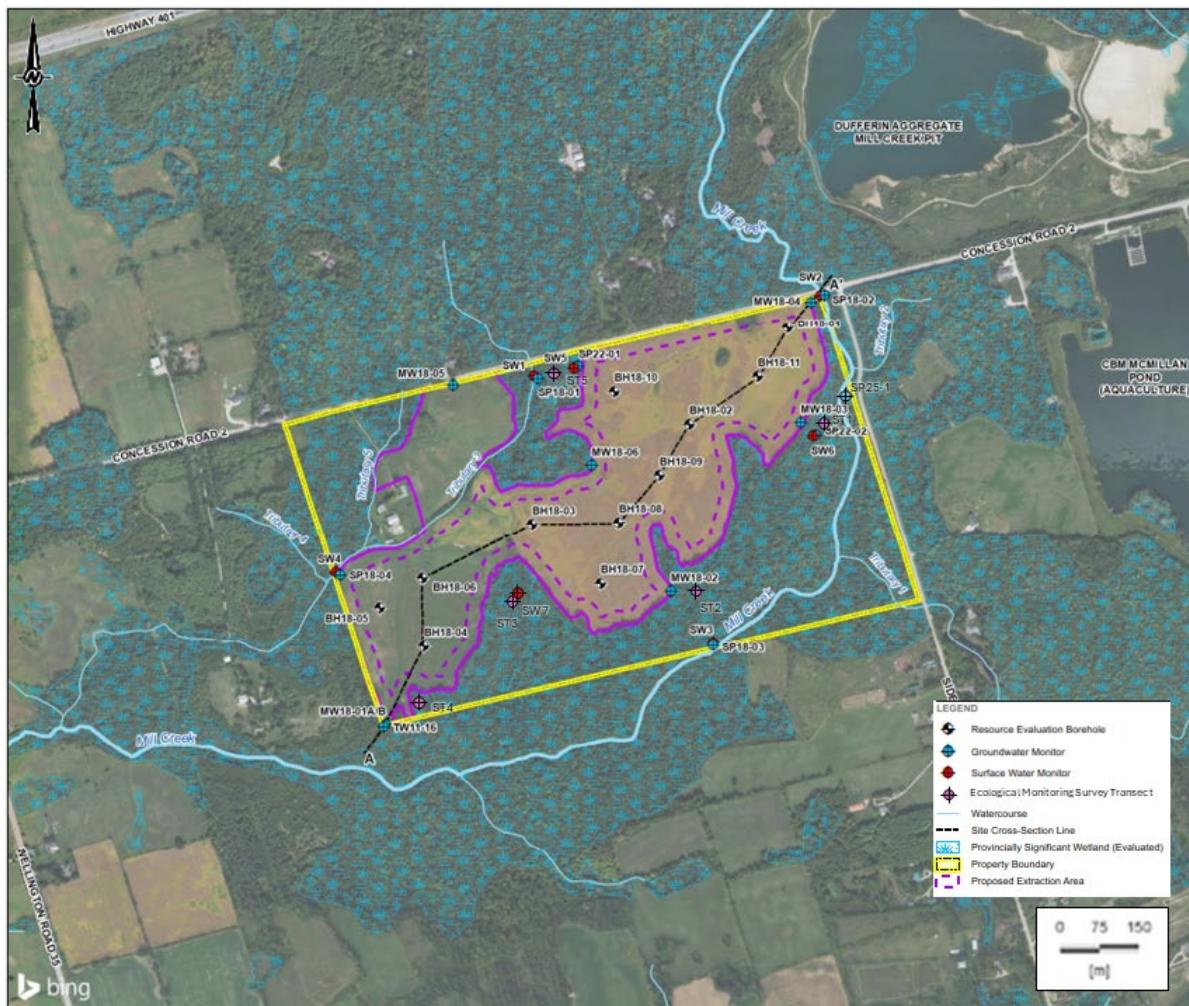


Figure 1: Monitoring Locations

- A new groundwater monitoring location shall be established to the east of Mill Creek, labeled SP25-1 on Figure 1, to observe groundwater conditions. Once installed, this location shall be included in the groundwater monitoring network described above.
- Groundwater quality monitoring is not proposed, as no water quality impacts are predicted.
- Based on the private well survey, the Applicant will give private residents, with >1 m of predicted drawdown caused by the proposed development or low available drawdown (<5 m), the opportunity to include their well in the water level monitoring program. Should private well users agree to their well being monitored, the monitoring plan will be revised to include their well.
- A well interference Complaint Response Protocol shall be implemented to respond to any potential interference with other water users, as described in the Water Report (WSP, 2023).

Surface Water Monitoring

- Surface water conditions shall continue to be monitored at the existing surface water stations SW1 to SW4 located in the channels of Mill Creek and Tributary 3, as well as SW5 and SW6 located within the PSW. Surface water monitoring shall include quarterly manual measurements of water level and flow, as well as continuous hourly monitoring of water levels and temperatures using dataloggers.
 - To identify temperature threshold exceedances and assess potential impacts of extraction, SW3 shall be monitored near (+/- 5 days) the start and middle of November.
- Elevation reference points for surface water stations shall be resurveyed once every two years.
- Surface water quality monitoring is not proposed, as no water quality impacts are predicted.
- An additional monitoring station SW7 shall be installed to monitor hydrological conditions in the PSW in the southwestern portion of the Site, which includes wetlands similar to those observed at SW5 and SW6, and a low-lying area. SW7 shall include two standpipe piezometers (SW7A and SW7B), one placed at the northern margin of the low-lying feature (interpreted to be the upgradient side of the surface water feature), another placed in wetland south of the low-lying area, and a surface water monitoring point within the low-lying area. Surface water monitoring shall include quarterly manual measurements of water level, as well as continuous hourly monitoring of water levels and temperatures using dataloggers.

Ecological Monitoring

- To observe ecological conditions in the PSW, monitoring of the form and function of the wetland shall be carried out annually (in early summer) along five survey transects as depicted on Figure 1 and detailed below in Recommended Ecological Monitoring Method. Ecological monitoring shall begin one year prior to the start of aggregate extraction, and continue during the Operational Period, and end one year after the completion of site Rehabilitation. During the one year of monitoring prior to the start of aggregate extraction, monitoring will be carried out biannually (early summer and early fall) to provide baseline data for comparison to enhanced monitoring in the event this is required (as discussed below).
- In order to ensure effective monitoring of the Mill Creek fishery, existing baseline data and monitoring programs will be consolidated prior to the commencement of extraction activities. Any identified gaps will be addressed to establish a comprehensive and robust baseline that serves as an essential reference point for evaluating the fishery during its operational phases. Ongoing monitoring will subsequently be conducted in response to hydrological conditions that may suggest potential ecological impacts.
- To effectively monitor the Mill Creek fishery, baseline monitoring shall be conducted prior to the start of extraction, with a particular focus on key ecological indicators such as Brown Trout spawning activity. This monitoring will serve as a critical reference point for evaluating the fishery during operational phases and will be presented to GRCA to ensure alignment with their current monitoring activities. Subsequent monitoring of the Mill Creek fishery will be conducted in response to hydrological conditions that indicate a potential ecological impact.

Monitoring of Setback Naturalization

The following monitoring of the naturalization of the setbacks along the alignment of tile drain is recommended:

- Monitor the site for signs of rill and other erosion until the area has stabilized and vegetation within the buffer has become established and self-sustaining;
- Monitor wetland edge for signs of erosion and sedimentation. Correct any potential issue and restabilize and plant areas; and
- Monitor the newly planting buffers for invasive species and if needed initiate an invasive species control program.

Data Review and Reporting

- Results of the monitoring program shall be reviewed by the licensee quarterly and reported to the Ministry of Natural Resources (MNR) annually as part of the licence requirements. Trends during Operations and Post-Rehabilitation shall be compared to Pre-Operational conditions. If the results of the monitoring program indicate the potential for adverse impacts to groundwater users (private wells), surface water features (Mill Creek and its tributaries) or to wetlands, then appropriate enhanced monitoring, and corrective actions shall be implemented, as described below.

RECOMMENDED ECOLOGICAL MONITORING METHOD

The proposed ecological monitoring involves the establishment of a combination of survey transects and associated fixed sample plots, as described below and the annual review of the outer limit of the wetlands abutting the Site through visual observation.

Survey Transects

One 100 m transect shall be established in each of the wetland zones, as illustrated on Figure 1, that are representative of the wetland vegetation communities within the wetland complex on the subject property. The Ontario Wetland Evaluation Southern Manual shall be consulted regarding plant species of interest within the wetlands. Reflective T-bar shall be used to mark start and end points, and flagging tape used to demarcate the center line at 10 m intervals along the transect. Vascular plants within 1 m of the center line of the transect shall be identified along the length of the transect, and the abundance for each species estimated using definitions provided in the Glossary of the ELC manual (Lee *et al.* 1998):

- **Rare:** Only one to a few individuals in the area of interest.
- **Occasional:** Scattered individuals throughout a community or represented by one or more large clumps of many individuals.
- **Abundant:** Referring to a plant that is represented throughout the polygon or community by large numbers of individuals or clumps. Likely to be encountered anywhere in area of interest. Usually forming > 10% ground cover.
- **Dominant:** A plant with the greatest cover or biomass within a plant community and by large numbers of individuals. Visually more abundant than other species in the same layer forming > 10% of the ground cover and >35% of the vegetation cover in any one layer.

In addition, the Floristic Quality Index (FQI) shall be calculated to provide a quantitative evaluation of botanical quality. The FQI is the product of Mean *Coefficient of Conservatism* (CC) and the square root of the area's plant richness (Swink and Wilhelm 1994).

Fixed Sample Plots

Fixed sample plots shall also be established at varying distances from the end of each transect plot. Each plot shall be 10 m x 10 m in size with corners demarcated by metal rebar, as illustrated on Figure 2. Within each plot, vascular plant species shall be identified, and the percent cover of each species within each vegetation layer shall be estimated visually. Photographs shall be taken at the center of each fixed sample plot and compared to overall plot conditions from year to year.

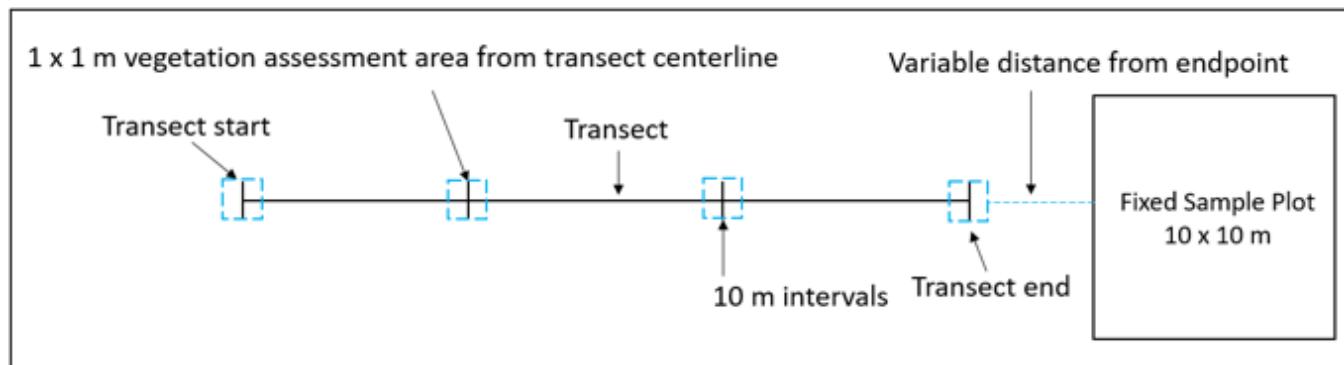


Figure 2: Schematic of Vegetation Monitoring Plot Layout

A weighted mean of *Coefficient of Conservatism* (CC) and *Coefficient of Wetness* (CW) shall be calculated for each vegetation layer based on species cover, and for the overall plot. The *Coefficient of Conservatism* and *Coefficient of Wetness* is based on information from the Floristic Quality Assessment System for Southern Ontario (Oldham et al. 1995). The *Coefficient of Conservatism* (CC) is a measure of habitat specificity / tolerance, and ranges in value from 0 (tolerant of a wide range of habitats) to 10 (very habitat specific) (see Table 1). The *Coefficient of Wetness* (CW) is an indicator of wetland or upland affinity, ranging in value from +5 (upland) to -5 (obligate wetland) (see Table 2).

Mean CW and CC values shall then be calculated based on sampling data and compared to subsequent monitoring years. These data provide indications of wetland condition changes in association with surface and groundwater levels, and climatic events. Total species richness and the weighted percentage of native species shall also be calculated for the overall plot. In addition to vascular plants, the percentage of standing water, organic detritus, and bare substrate shall also be estimated within each fixed sample plot. This information shall be used to compare to subsequent monitoring years.

Table 1. Coefficient of Conservatism (CC) Values Index

CC	RANK	DESCRIPTION
0 to 3	Tolerant	Found in a wide variety of plant communities, including disturbed sites.
4 to 6	Moderately Conservative	Typically associated with a specific plant community but tolerate moderate disturbance.

CC	RANK	DESCRIPTION
7 to 8	Conservative	Typically associated with a plant community in an advanced successional stage that has undergone minor disturbance.
9 to 10	Highly Conservative	Typically displaying a high degree of fidelity to a specific plant community or a narrow range of synecological parameters.

Adapted from Oldham *et al.* 1995.

Table 2. Coefficient of Wetness (CW) Values Index

CW	RANK	DESCRIPTION
- 5	OBL	OBLIGATE WETLAND: Occurs almost always in wetlands under natural conditions (99% probability)
- 4	FACW+	FACULTATIVE WETLAND: Usually occurs in wetlands, but occasionally found in non-wetlands (67-99%)
- 3	FACW	
- 2	FACW-	
- 1	FAC +	FACULTATIVE: Equally likely to occur in wetlands or non-wetlands (34-66%)
0	FAC	
1	FAC -	
2	FACU+	FACULTATIVE UPLAND: Occasionally occurs in wetlands, but usually occurs in non-wetlands (1-33%)
3	FACU	
4	FACU-	
5	UPL	UPLAND: Occurs almost never in wetlands under natural conditions (<1%)

Adapted from Oldham *et al.* 1995.

TRIGGER LEVELS AND CORRECTIVE ACTIONS

This section establishes an approach to the selection of triggers and identifies potential corrective actions. Specific trigger levels shall be established in consultation with the MNR and the Grand River Conservation Authority (GRCA) prior to the commencement of aggregate extraction using available information to establish baseline conditions.

Tiered triggers for each impact receptor shall be designed to identify conditions which precede an impact, enhance monitoring, and identify the potential for impact and engage mitigation measures, described as follows.

- 1) Preliminary Trigger Level: The levels established to identify conditions that precede those in which there is potential for impacts and proactively enhance monitoring to identify trigger levels and take corrective actions in a timely fashion.
- 2) Trigger Level: The levels at which a potential impact may occur to an impact receptor. In response to the identification of a trigger level, an impact assessment shall be performed with all relevant data and distributed to the regulating agency, and, if operation of the pit is identified as a contributing factor, corrective actions shall be taken to mitigate potential impacts.

Details of the approach to setting Preliminary Trigger Levels and Trigger Levels for each potential impact receptor are described as follows.

Mill Creek Fishery

The monitoring strategy for the Mill Creek Fishery will use hydrological triggers to identify conditions which have the potential to adversely affect the fishery. Brown Trout is the most sensitive impact receptor, so thermal thresholds are considered for this species. Seasonal thermal thresholds for Brown Trout life cycle activities are as follows (Réalis-Doyelle et al., 2016; Scott and Crossman, 1973; NDEP, 2017; Eakins, 2025):

- December to March 12°C (egg incubation)
- April to October 23.5°C (thermal stress)
- November 8.9°C (spawning)

In the event observed temperatures downstream of the pit (observed at SW3) exceed a threshold, a review of upstream temperature and flow data will first be conducted to determine whether the anomaly is localized or system-wide. Following this, enhanced hydrological monitoring will be initiated, the trigger level will be evaluated against observed natural variations as well as upstream data points to assess if extraction is a contributing factor in the changes observed, an assessment of potential for adverse impacts will be undertaken, notification of the regulating agency will occur, and, if necessary, corrective actions will be taken.

- 1) Preliminary Trigger: The preliminary trigger condition will be considered to have been met if the daily average surface water temperature exceeds the range of naturally occurring conditions, or the thermal threshold for the species (as detailed above). In the event the trigger condition is met, the trigger level will be evaluated against observed natural variations as well as upstream data points to assess if extraction is a contributing factor in the changes observed, or if another cause is identified, such as beaver activity or weather patterns.
- 2) Trigger Level: The trigger condition will be considered to have been met if it is determined that the Preliminary Trigger is not as a result of natural variation within the system. In the event the trigger condition is met, monitoring will be enhanced (from quarterly to monthly (or weekly within the spawning period (November)) to support the evaluation of the Trigger Level and determine if the duration has the potential for adverse impacts to the Mill Creek fishery.

The exceedance of the Trigger Level and associated findings shall be reported to the regulatory agency and if an impact of extraction is identified, corrective actions will be proposed. Corrective actions considered could include reduced extraction rates to allow groundwater levels to recover, temporary cessation of extraction, or providing a direct input of water from the pit pond to support the creek during such periods.

Provincially Significant Wetlands

A combined hydrological and ecological approach shall be established to identify and mitigate potential impacts on the wetland. In principle, the preliminary triggers will verify that hydrological conditions remain within the historically observe range of seasonal natural variations, and if hydrological conditions indicate that there is potential for impact, ecological features shall be assessed with consideration of weather conditions.

- 1) Preliminary Trigger Level: Hydrological monitoring will provide information to establish the Preliminary Trigger Level. If hydrological conditions are observed to remain within their observed range, then no adverse effect is predicted. Preliminary triggers shall be selected for each growing season (spring, summer, and fall) based on historic ranges of surface water and shallow groundwater levels in observed at the wetland hydrology monitoring stations (SW5, SW6, and SW7). If the condition of a preliminary trigger is met, there is potential for impact and the monitoring frequency at the affected surface water station shall be increased from quarterly to monthly and the frequency of ecological monitoring at the associated survey transect shall be increased from annually to biannually (early summer and early fall).
- 2) Trigger Level: The hydrological information collected serves to support ecological interpretations of an impact on the wetlands. In the event that a preliminary trigger condition is met, the enhanced ecological monitoring frequency shall be used to support an assessment of whether or not impacts are taking place to the wetland's form and function, for as long as hydrological trigger conditions exist.
- 3) Ecological Relationship: Following ecological monitoring, an impact assessment considering hydrological and ecological monitoring information shall be undertaken to identify whether or not pit operations are contributing to an adverse impact on the wetland, or if other factors such as weather patterns or invasive species have affected the wetland, and reported following each ecological monitoring event to the regulating agency. In the event an impact resulting from operational activities is identified, situation specific corrective actions shall be discussed with the regulating agency and implemented by the licensee. Corrective actions to consider shall include reduced extraction rate, cessation of extraction, infiltrating water in setback areas to increase groundwater levels, and / or irrigation of impacted wetland features.

Groundwater Levels to the East of Mill Creek

Trigger levels for groundwater to the east of Mill Creek shall be established to maintain the system within the range of natural variability.

- 1) Preliminary Trigger: Preliminary trigger conditions shall be established based on monitoring of the natural variability in groundwater conditions to the east of Mill Creek, as observed at SP25-1. If water levels fall within a specified margin of the historically observed naturally occurring minimum water level, the preliminary trigger condition shall be considered to have been met, and monitoring frequency shall be increased from quarterly to monthly, until the preliminary trigger condition is no longer met.
- 2) Trigger Level: In the event that groundwater levels are below the historically observed minimum groundwater elevation, an interpretation of available data shall be used to assess if operational activities are contributing to the observed groundwater level changes, or if another cause, such land use changes or weather patterns are the most likely explanation. This impact assessment shall be reported to the regulating agency with recommendations of corrective actions, if required. Corrective actions considered shall include reduced extraction rate, ceasing extraction, infiltrating water in setback areas to increase groundwater levels, and placement of a silt curtain to reduce groundwater inflows from the east.

Baseflow in Tributary 3

Tributary 3 is intermittent and subject to a range of seasonal baseflow conditions, with the upper reaches providing poor fish habitat. Notwithstanding, trigger levels in Tributary 3 shall be established to maintain the system within the range of natural variability.

- 1) Preliminary Trigger: Preliminary trigger conditions shall be established based on monitoring of the natural variability Tributary 3 to establish seasonal minimum surface water levels. Some seasonal levels will be 0 m of water, when Tributary 3 has been observed to be "dry" (water level observed to be near zero). When water levels fall within a specified margin of the lowest level observed in a season, levels will be considered to have met the preliminary trigger condition. In response to the preliminary trigger conditions, monitoring frequency shall be enhanced from quarterly to monthly until the trigger condition is no longer met. Daily average levels are recommended for the evaluation of this trigger to reduce the influence of "noise" in surface water level observations.
- 2) Trigger Levels: In conditions when Tributary 3 is "dry" (water level observed to be near zero), the number of days with a within the same season shall be considered to be the trigger condition for baseflow in Tributary 3. In the event the "dry" period exceeds that observed in the range observed within the natural variations, the trigger condition shall be considered to have been met. In conditions in which water levels are greater than zero but below their seasonal naturally occurring range, the trigger condition shall be considered to have been met. If the trigger condition is met, an interpretation of available data shall be used to assess if extraction is a contributing factor in the changes to observed to Tributary 3's conditions, or if another cause, such as beaver activity or weather patterns, are the most likely explanation for the observed changes. This impact assessment shall be reported to the regulatory agency and if an impact of extraction is identified, corrective actions will be proposed. Corrective actions considered shall include reduced extraction rates to allow groundwater levels to recover, temporary cessation of extraction, or providing a direct input of water from the pit pond to support the tributary during such periods.

CLOSURE

We trust that this enhanced site-specific monitoring plan for the proposed Aberfoyle South Pit meets your current needs. Should you have any questions or require clarification, please contact the undersigned at your earliest convenience.

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