April 7, 2009 Project No. 07-1122-0277/2000

Mr. Peter Taylor, Director, Section 34 OWRA, Eastern Region
Ontario Ministry of Environment
1259 Gardiners Road
Kingston, Ontario
K7P 3J6

PERMIT TO TAKE WATER MONITORING PROGRAM
FUTURE STAGES OF FINDLAY CREEK VILAGE SUBDIVISION
OTTAWA, ONTARIO
MOE REFERENCE # 4635-7GFNDT

Dear Mr. Taylor:

On behalf of Findlay Creek Co-Tenancy, Golder Associates Ltd. (Golder) have prepared this monitoring program to be implemented as part of the Future Stages Permit To Take Water (PTTW). The program was developed based on review comments received on the PTTW application and subsequent correspondence related to the Future Stages PTTW, and finalized in conjunction with the Ministry of Natural Resources (MNR), South Nation Conservation (SNC), Department of Fisheries and Oceans (DFO) and Ministry of Environment (MOE). The intent is that this Future Stages PTTW Monitoring Program (PTTWMP) will be included as a condition of the PTTW.

Construction of the Leitrim area external stormwater management system commenced in 2003 under various approvals including Authorization 5250-100 by DFO under the Fisheries Act. The Authorization was issued on October 25, 2003 with amendments in 2006, 2007 and 2008. Incorporated into this Authorization is an approved Environmental Management Plan (EMP); the original EMP was dated March 2003 and updated in December 2005 following relocation of the stormwater management pond. The EMP includes an ongoing groundwater monitoring program (commencing in fall 2003) and vegetation photomonitoring program (commencing in fall 2006), as well as a surface water monitoring program conducted in 2005 to measure flows and obtain information needed for final design of fish habitat compensation features. The Authorization includes conditions related to monitoring during construction of the external stormwater system, erosion and sediment control during construction, surface water monitoring in the reach of Findlay Creek adjacent to the stormwater pond, and post-construction monitoring for two years and six years, respectively, of vegetation and fish habitat compensation works in the Findlay Creek Extension. The Authorization also required the City of Ottawa to establish a Technical Advisory Committee (TAC) to monitor the construction of these works. Based on a construction schedule under which the remaining components of the external stormwater system (Findlay Creek Extension Phase 2, the North-South Swale and the Wetland Outlet Control Structure) will be built and commissioned in

2009, the EMP groundwater monitoring program is to continue until the end of 2010 and the EMP vegetation photomonitoring program until the end of 2009.

Construction of the water and sewer servicing for the Findlay Creek Village development area, as well as components of the external stormwater system, requires temporary groundwater and/or surface water control and has been carried out under a number of individual PTTW's issued by the MOE since 2003. Initially these PTTW relied on the ongoing monitoring components of the EMP, however the more recent PTTW's included specific groundwater monitoring requirements, as well as monitoring of surface water quality when the water taken was being discharged to Findlay Creek or its contributing water courses.

The Future Stages PTTW provides the regulatory approval, conditions and required actions on the part of the Permit Holder to take water temporarily for the periods of time needed to construct the remaining servicing of the Findlay Creek Village Development over the next 10 years, as described in the PTTW application dated July 2008. The PTTWMP has been designed to monitor potential impacts on the Leitrim Provincially Significant Wetland (PSW) and Findlay Creek from these periods of temporary groundwater and surface water control during the servicing construction. The activities included under the Future Stages PTTW include the internal servicing of the remaining development areas, ditch relocations and a watermain along Albion Road, as well as completion of the Findlay Creek Extension (FCE) and the North-South (N-S) swale. Temporary groundwater control requirements for construction of the Outlet Control Structure are covered under a separate PTTW issued by the MOE.

The Leitrim Wetland Advisory Committee (LWAC) was formed in 2001 "to provide direction to the Board members of the South Nation Conservation on how to manage the Leitrim Wetland", with objectives to "preserve the integrity of the Leitrim Wetland, manage it properly and use the wetland as an educational tool for the surrounding communities". (Leitrim Wetland Management Plan, SNC, 2004) The intent is that this PTTWMP will provide information and assist in fulfilling this mandate, and can be continued and/or incorporated into whatever long-term monitoring programs are implemented through LWAC for the PSW and Findlay Creek.

The PTTWMP is divided into Groundwater, Surface Water and PSW Vegetation components, each of which is described below.

Groundwater Component

A groundwater monitoring program is currently in place at the Leitrim PSW, which commenced in the fall of 2003; this component of the previously approved EMP currently entails hourly measurement and logging of groundwater levels using pressure transducers and data recorders at sixteen (16) wells in and around the PSW (see locations on Figure MP-1). The logged results have been typically downloaded and reviewed on a monthly basis when water taking for construction is not occurring. More recent PTTWs for specific water takings/servicing have specified groundwater monitoring requirements and more frequent downloading and review during periods of pumping.

For the Future Stages PTTW, the frequency of data download and groundwater level review will be monthly during periods when there are no temporary water takings for the purposes of site servicing. During servicing construction periods when there is temporary water taking, the frequency will be increased to two-week intervals. When downloading the groundwater data, if groundwater elevations within the last day of monitoring are within 0.1 metres of the trigger elevation, the downloading frequency in that/those monitors would be increased to weekly until such time as the groundwater elevations increase to greater than 0.1 metres above the triggers.

Immediately prior to a construction period involving pumping from service trenches, the contractor will advise the party responsible for groundwater monitoring. A pre-construction site visit will be made to download and review groundwater elevations in the monitors; the review will include any trend occurring in the groundwater levels. If groundwater elevations are less than 0.1 metres above the respective trigger elevations, or if the trend is that the water level is declining and may be expected to reach this point shortly, downloading during this construction period will commence at a weekly frequency in that/those monitors. If groundwater elevations are greater than 0.1 metres above the triggers, and if the trend does not suggest that reaching this threshold shortly is likely, downloading will occur every two weeks, as described above, until such time that ongoing monitoring indicates that a greater frequency may be warranted.

In addition, the vertical hydraulic gradient at multi-level monitors is to be maintained. The existing direction of vertical hydraulic gradient is summarized in the table below, along with the groundwater trigger elevations.

The groundwater trigger elevations were established in 2005 based on seasonally low groundwater levels recorded during 1998, September to December 2003 and May to December 2004. During 2007, and to a lesser degree in 2008, it was observed that the natural fluctuation of groundwater elevations during periods of low precipitation, when no temporary water takings occurred, fell below the previously established trigger elevations. On the other hand, in 2008, which was a wet year, pumping of groundwater from sewer trenches did not produce a measurable lowering response in groundwater levels in the PSW monitors. Although this factual information demonstrates that seasonal and annual fluctuations in precipitation can cause groundwater levels in areas of the PSW to naturally decline to as much as 0.8 m below the established triggers, it is proposed that the trigger elevations to be used for the Future Stages PTTW groundwater monitoring program remain at the previously established elevations.

Table 1: Groundwater Trigger Elevations and Vertical Hydraulic Gradients

Monitor	Ground Surface Elevation (m)	Trigger Water Level Elevation (m)	Vertical Gradient	Comments
97-2A	92.84	91.3	Upward	Bedrock
97-2B	92.85	91.2		Overburden
03-1	94.87	94.5	N/A	Overburden
03-2	94.88	94.5	N/A	Overburden
03-3	94.07	93.2	N/A	Overburden
03-4	94.08	93.5	N/A	Overburden
03-5	93.44	91.9 (Apr. - Sept.) 92.5 (Oct. - Mar.)	N/A	Overburden
03-6	93.43	91.9 (Apr. - Sept.) 92.5 (Oct. - Mar.)	N/A	Overburden
03-7A	93.47	93.4	Upward	Bedrock
03-7B	93.40	92.6		Overburden
03-8A	93.02	91.0	Downward	Bedrock
03-8B	93.01	91.1 (Apr. - Sept.) 91.8 (Oct. - Mar.)		Overburden

Monitor	Ground Surface Elevation (m)	Trigger Water Level Elevation (m)	Vertical Gradient	Comments
03-9A	93.75	92.4	Downward	Bedrock
03-9B	93.78	93.0		Overburden
03-10A and 03-10B	92.47	No trigger proposed	No trigger proposed	This bedrock/overburden monitor pair is located outside the PSW and wetland berm. Groundwater elevation data will continue to be downloaded, reviewed and included in the reporting, but there would be no trigger elevations or action required since groundwater elevations at this location are not representative of groundwater within the PSW.

The downloaded groundwater elevation data at each monitoring well will be compared to the trigger elevation and if the water level is approaching or has declined to the trigger, an assessment of the reason for the decline based on the activities ongoing at the time will be made. If the decline to the trigger level is due to temporary pumping for construction, then the contractor will be required to implement mitigation measures.

Because of the number of monitors and the access to their location, the downloading of data takes the better part of a day. The data would be reviewed and if there is a decline to below the trigger level and it is assessed to be due to temporary pumping, those responsible for the data monitoring would advise the contractor later that day or the following morning. The MOE District office would be notified verbally of the occurrence, followed by written confirmation and a description of the action taken.

Based on previous site-specific experience, the primary mitigation measure would be for the contractor to suspend pumping, at which point the groundwater level is expected to recover very quickly. If a decline occurs due to natural causes, and continued pumping is not inhibiting water level recovery, then no mitigative action by the Permit Holder would be required.

The Wetland Outlet Control Structure is located along the east portion of the wetland berm and has been designed to achieve two main purposes thorough adjustment of its water level elevation control mechanism. The first purpose is to discharge excess water (from storm events) that has been attenuated within the PSW directly to Findlay Creek; the second is to use the mechanism to control/limit the discharge of water from the PSW and thereby control/raise the water level within the wetland. In the context of the Future Stages PTTW, and as part of overall management of the PSW, if groundwater level monitoring indicates that groundwater levels

are naturally declining towards the trigger elevations due to seasonal lack of precipitation, the Control Structure could be used to restrict surface water discharge with the objective to maintain or induce a rise in the groundwater level within the PSW. If the observed groundwater level decline to the trigger elevation is due to temporary pumping for servicing construction, as mentioned above the most effective mitigation measure would be to suspend pumping. The operation of the Wetland Outlet Control Structure is subject to the overall requirements of the LRIA and the conditions of its specific LRIA approval.

Surface Water Component

As described in the PTTW application, most of the water takings during construction over the next ten years will be the pumping of groundwater from service trenches that penetrate into the upper bedrock zone; this groundwater will be discharged into the existing storm sewer system that will convey it to the stormwater management pond prior to its discharge to Findlay Creek.

The construction of the N-S swale will require the temporary diversion of surface water in existing ditches; this diverted water will also be sent to the storm sewer system.

The only portion of remaining servicing construction that will involve manipulation of surface water and discharge directly to Findlay Creek, which warrants monitoring under the PTTW, is the construction of the Findlay Creek Extension Phase 2 scheduled for the summer and fall of 2009. This construction will require the surface water flow that originates west of Albion Road to be intercepted and pumped around the FCE Phase 2 area and discharged to Findlay Creek. The proposed system is illustrated on Figure MP-1. Point A shows where the surface water flow will be intercepted, whether it is from the existing E-W ditch or the FCE Phase 1 section; this location will be immediately upstream of the interception point, which will include whatever contributing water from the North-South swale during the construction period. An appropriately screened intake will be set up at Point A so that it minimizes the potential for disturbance of the channel bottom and the associated introduction of total suspended solids (TSS). The pumped water would be conveyed via a pipe (labelled as B on Figure MP-1) along the south side of Findlay Creek Drive and then southerly along the rear lot line of the existing house lots. The FCE design baseflow is 40 L/s, although it is noted that during the 2005 surface water monitoring program that pre-development baseflows as low as 20 L/s were measured originating from west of Albion Road. The pump and pipe used to bypass water during the FCE Phase 2 construction will be sized to convey up to 60 L/s, which is 150% of the design baseflow, and thereby reduce the potential effects on downstream fish habitat of not conveying the full upstream flow during the brief construction period. Higher flows, which might result for example from larger storm events during construction, would be sent to the storm sewer as described above. The bypassed water will discharge to the start of Findlay Creek opposite the Wetland Outlet Control Structure location (labelled as C on Figure MP-1). Appropriate measures, which will be submitted for approval by SNC as part of the application for the work permit required to proceed with this work, will be put in place at the discharge location to control potential erosion and creation of suspended sediments.

During this construction activity, the quantity of surface water flow bypassed around the FCE Phase 2 work area would be recorded as per the PTTW requirements. TSS would be analysed and/or temperature measured during this surface water taking construction period at the four surface water sampling stations shown on Figure MP-1:

- Station SW-1 upstream at the Albion Road culvert;
- Station SW-2 just upstream of the interception location;
- Station SW-3 just downstream of the discharge location in Findlay Creek; and,

- Station SW-4 in the outlet channel from the stormwater management pond.

The temperature monitoring would be conducted on a continuous basis using an in-stream probe and automatic data recorder at each of the four locations.

At least one week prior to commencing the interception and pumping, the four temperature recorders would be set up and put into operation. SW-1 and SW-2 would be sampled one week prior to pumping and TSS determined; temperature data would also be downloaded at SW-1 and SW-2 at this time. TSS would be sampled for analysis and temperature data downloaded at SW-1, SW-2 and SW-3 three times (every two days) during the first week of pumping and, if found to meet the allowable limits, the monitoring at these three locations would occur on a weekly basis thereafter during the pumping period. If the allowable limits are not met, then mitigation measures would be implemented and samples/measurements taken every two days until compliance is achieved.

The temperature at SW-3 will be compared to the temperature at SW-2. Noting that the time during which the water being conveyed within the pipe will be very short (minutes), the expectation is that the temperature between stations SW-2 and SW-3 will be maintained within a couple of degrees; however the limiting allowable temperature at SW-3 is 18 degrees Celsius (below the upper lethal temperature for brown trout), or the temperature at SW-2, whichever is higher. The maximum allowable TSS concentration at SW-3 shall be 25 mg/L or the concentration at SW-2, whichever is higher.

Temperature data at SW-4, which will represent the discharge from the stormwater management pond that services the development area, and which may or may not contain contribution from temporary management of surface water associated with the FCE Phase 2 construction, will be downloaded every two weeks. At this time, a sample will be taken for TSS determination.

This surface water monitoring component will be discontinued once the FCE Phase 2 is brought on line.

PSW Vegetation Component

The vegetation monitoring component has three components:

1) Aerial imagery assessment of the wetland extent, patterns of community distribution and the drainage through the wetland, particularly in the vicinity of the discharge point on the east side;

2) Fixed-point photo-monitoring; and,

3) A quantitative sampling program based upon a belt transect and fixed plot sampling at four (4) locations along the length of the transect of about 450 metres inside the Wetland Berm (see Figure MP-2).

For Component 1, late-season (September-October) aerial imagery will be obtained for the Leitrim Wetland and vicinity at the initiation of the program and then at 5-year intervals. This imagery may be obtained from a dedicated photographic mission or from general surveys conducted in the vicinity of the Findlay Creek development. Current and/or historical imagery will also be obtained to permit the assessment of historical change in the wetland. This imagery will be used to map and document changes in the wetland area, the size and extent of plant communities and the principal drainage features through the wetland.

Component 2 will build upon the photo-monitoring protocols that have been employed by Golder during the preliminary assessment of conditions of vegetation in the Leitrim Wetland. However, the monitoring points will be located along the transect line and be established at the same locations that are used for the fixed plot sampling of vegetation (see below). The same photographic protocols as are used in the current monitoring will

be used, but instead of making early and late season observations, the monitoring will be conducted once annually at the height of the growing season, to capture the fullest development of the vegetation and eliminate the variability associated with the year to year differences in the start and end of the growing season. Photo-monitoring is a relatively rapid and efficient means of documenting conditions at the time of the observations.

Component 3 is intended to provide quantitative data on the distribution and cover provided by plants along a band within the wetland, as well as providing compositional data for four (4) particular locations within the wetland, including one location in the fen community that has been mapped by the OMNR (see Figure MP-2). The transect will permit the localization of plant community boundaries or transition zones. The fixed plots will provide quantitative data on the composition and structure of particular wetland communities. Although fixed plots require some initial time and effort to establish, they have the benefit of ensuring that subsequent sampling is conducted at the same location and that results from sequential sampling events are geographically localized. Quantitative sampling, whether plot-centered or plotless, requires a relatively high level of skill in plant identification, a good understanding of the vegetation that is being sampled, some knowledge of plant life cycles and population behaviours and knowledge of statistics and statistical analysis. For these reasons, this is the aspect of the proposed program that requires the greatest effort. The proposed methodology and applications will be adapted from the work by Meuller-Dombois, D. & H. Ellenberg (1974) Aims and Methods of Vegetation Ecology, published by J. Wiley & Sons.

The transect will extend approximately 450 m into the wetland, from the base of the berm at the northeast corner, in a southwest direction as shown on Figure MP-2. It is noted that the transect line coincides with MW 03-8A and 03-8B and 03-9A and 03-9B, thereby providing a continuous record of groundwater elevations in the area of the PSW by both elevation and depth below ground surface. Compositional data along the transect will be collected from the area within 1-m on either side of the center line, i.e., the transect will be 2 m wide. To stratify the transect data, the inventory data will be compiled for each 10 m segment of the transect. At approximately 100 m intervals, a fixed plot sampling location will be established, using a 10 m X 10 m plot. The corners of the plot will be geo-referenced to permit accurate mapping and relocation. It is important that the plot be located within a relatively homogeneous stand, representing a single plant community type or a homogeneous mosaic of community types and for this reason, the plot may be moved east or west along the transect line to an area of suitable vegetation. Within each main plot, a full inventory of vascular plants will be compiled. Having established the composition of each plot, five (5) 1 m X 1 m quadrats will be randomly placed within the 10 m X 10 m plots. To eliminate bias, the quadrat locations will be predetermined, using a random number table to select quadrat locations. Within the 1 m X 1 m quadrats, the cover representation by each plant species, including mosses, will be estimated, as will be the contribution from dead vegetation, bare substrate and surface water. Vegetation structure within each quadrat will also be identified, including discernable strata, the maximum height of those strata (ignoring any atypical outliers) and the general density of each stratum. Because the great majority of vascular plants in wetlands are perennials and annual variations are expected to be small, this sampling will be conducted at the initiation of the program and then every third year during the monitoring period.

The overburden groundwater monitoring wells 03-7B and 03-9B provide a continuous record of the depth of the water table relative to the ground surface level in the fen areas, and thereby information that can be related to the upper peat soil layer that supports vegetation growth. In addition, it is proposed to establish a specific plot between fixed plot location V-3 and monitor 03-9B (refer to Figure MP-2) where moisture measurements will be taken in the peat soils. The plot would be located and marked out so that it can remain in a natural state (doesn't get compressed by walking on it). Measurements of peat moisture would be taken with a TDR device at depths of 12 and 20 cm below ground surface. The measurements would be taken on a monthly basis (to

coincide with that site visits made to download groundwater monitoring data). This data, together with water level and precipitation information, will allow a correlation to be made among these factors, as well as assist in assessing potential effects on soil moisture for support of vegetation during times of temporary construction pumping activities. Once such a relationship has been established, an assessment would also be made regarding the need to continue this aspect of the program. In addition to the proposed annual reporting frequency described later in this document, a comprehensive, interpretative report would be prepared and submitted at 5-year intervals. This will permit some discrimination between annual variations in plant species dynamics and trends in compositional change within the wetland, as well as providing some perspective on the observational data from the various components of the vegetation monitoring studies. The assessment provided in this report will make full use of the observational data collected from the groundwater and surface water monitoring reports, as well as Environment Canada temperature and precipitation data for the period(s) of the monitoring studies.

Reporting

The Permit Holder will be responsible for ensuring this monitoring program is carried out, recording and assessing the data, and taking appropriate action. During the program, the Permit Holder will advise the MOE District Office when the trigger elevations (groundwater component) or temperature and/or TSS limits (surface water component) are exceeded, and describe the mitigation measures undertaken to bring the parameter within the limits. For each of the three monitoring components, an annual report will be prepared providing a summary of the water taking activities conducted during the year, the data obtained, an interpretation of the information including comparison to historical data, and any suggested modifications to the program(s). The reports will be submitted to the MOE District Office, MNR, SNC and DFO; the reports will also be submitted to the TAC for the remaining time it is in existence. When the requirement for the TAC is complete, there could be an annual meeting of the regulatory agencies and the Permit Holder convened, at the discretion of the MOE Section 34 Director, to review and discuss the monitoring reports.

Yours truly,

for Jeff Kaiser, M.Sc.
Senior Biologist

Paul Smolkin, P.Eng.
Principal

CC/JK/PAS/am

Attachments: Figure MP-1 – Groundwater and Surface Water Monitoring Components
Figure MP-2 – PSW Vegetation Monitoring Component

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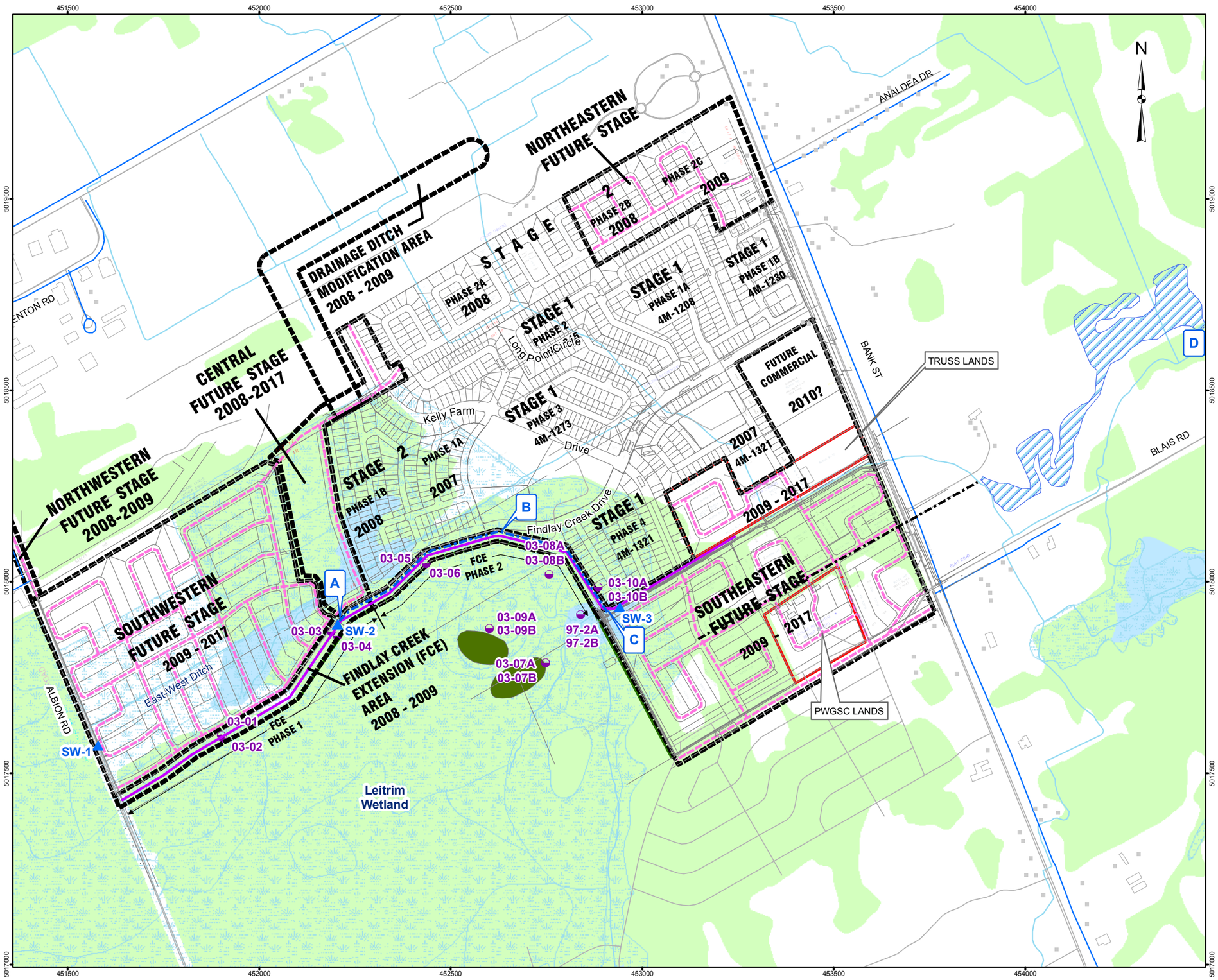

LEGEND

- Surface Water Sampling Location
- Monitoring Well
- Building
- Building Outline
- Railroad
- Roadway
- Proposed Lot Layout
- City of Ottawa Watermain Service
- Watercourse
- Wetland
- Waterbody
- Wooded Area
- Future Stage / Area
- Findlay Creek Extension
- Wetland Berm
- Stormwater Management Pond
- Fen
- Trunk Storm Sewer
- Service Trench
- Conveyance Piping

CONSTRUCTION OF FCE PHASE 2

- A — Location of Surface Water Taking
- B — Approximate Alignment of Conveyance Piping
- C — Location of Surface Water Discharge
- D — Stormwater Management Pond Outlet

REFERENCE

Digital OBM NRVIS data provided by Ontario Ministry of Natural Resources
Queen's Printer, used under licence, 2006
Base plan provided by Stantec Geomatics Ltd.
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18

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METRES

PROJECT
FINDLAY CREEK VILLAGE - FUTURE STAGES
PTTW APPLICATION

TITLE
GROUNDWATER AND SURFACE WATER MONITORING COMPONENTS

Golder Associates
Ottawa, Ontario

PROJECT No. 07-1122-0277-2000			SCALE AS SHOWN	REV. 0
DESIGN	CAMC	24 Feb. 2009		
GIS	BT	25 Feb. 2009		
CHECK				
REVIEW				

FIGURE: MP-1

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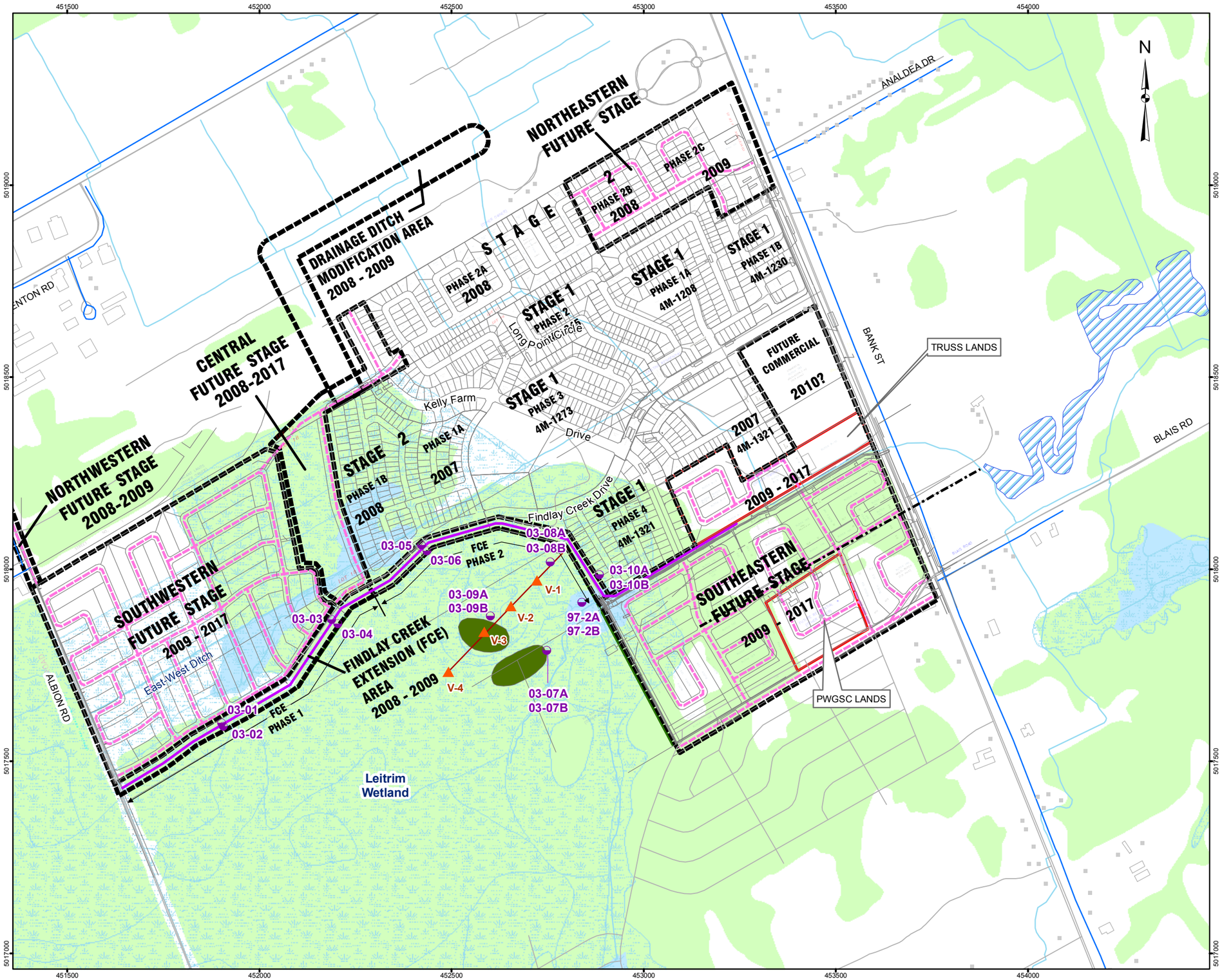

LEGEND

- V-1 Vegetation Monitoring and Photomonitoring Plot Location
- Vegetation Monitoring Transect
- 03-06 Monitoring Well
- Building
- Building Outline
- Railroad
- Roadway
- Proposed Lot Layout
- City of Ottawa Watermain Service
- Watercourse
- Wetland
- Waterbody
- Wooded Area
- Future Stage / Area
- Findlay Creek Extension
- Wetland Berm
- Stormwater Management Pond
- Fen
- Trunk Storm Sewer
- Service Trench

REFERENCE

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PROJECT
FINDLAY CREEK VILLAGE - FUTURE STAGES
PTTW APPLICATION

TITLE
PSW VEGETATION MONITORING COMPONENT

Golder Associates
Ottawa, Ontario

PROJECT No.07-1122-0277-2000			SCALE AS SHOWN	REV. 0
DESIGN	JK	24 Feb. 2009		
GIS	BT	24 Feb. 2009		
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REVIEW				

FIGURE: MP-2

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