Comments on the Application for PTTW at Findlay Creek Subdivison, Future Stages, July 2008

1.0 Introduction

I was asked by Ecojustice Canada to review and comment on the current application for a permit to take water (PTTW) prepared by Golder Associates for the Findlay Creek Village Subdivision site, Future Stages in the Leitrim area of Ottawa, dated July 2008. According to the reports provided, four permits to take water have previously been issued, with each one increasing in magnitude. The earliest permit (03-P-4001), for the period of January to May 2003 is not covered by the recent monitoring report. Presumably, monitoring data for this period was presented in an earlier report that was not available for review.

The PTTW application requests that a permit be granted that would allow the applicant to take up to 17,020,800 L/day continuously for a 10-year period (365 days per year) from Sept. 1, 2008 to Sept. 1 2018. The application is supported with two reports by Golder Associates; one a hydrogeological evaluation written specifically to support the current application, and a second monitoring report for the 2003-2008 period. These reports will be referred to simply as the application report and the monitoring report.

The application suggests that temporary control of groundwater influx from bedrock and permeable overburden zones will be required during construction of sewer trenches in support of a subdivision development. On page 3 of the application document, and in the two Golder reports, it is stated that in the past work typically took place over a 4 to 5 month period in the winter/spring and fall, and that the new work would be conducted during similar seasons. According to the monitoring report, work continued throughout the entire year in 2006 and the new application request, if granted, would permit construction and groundwater control activities to occur year round.

The application report acknowledges that the major feature of the site is the Provincially Significant Leitrim Wetland (PSW), a class 1 wetland that is sensitive to surface water level variations. The wetland includes a fen that is “sensitive to water level changes as these types of wetlands are groundwater-dependent and rely on relatively stable conditions” (Monitoring Report, p.7). As such, priority must be given to protecting the wetland from disturbances caused by construction activities and it is important to understand the timing and magnitude of those activities to be able to evaluate the impact they will have on the PSW. It is also important to understand the mechanisms that will be in place to identify potential adverse activities (trigger mechanisms) and the corrective actions that will be taken. It should also be noted that reference is often made to ‘the core wetland’. Wetlands are ecosystems that include both the core, and fringe or transition areas and require both to properly function. A decision appears to have been made previously to allow development to extend into the fringe parts of the wetland. This in itself will result in changes to the form and function of the wetland ecosystem.

Since the details for the application are contained within the Golder Associates reports, I will direct my comments to those two reports.

2.0 Site Geology and Groundwater Flow

The bedrock underlying the site is the dolomitic Oxford Formation and the elevation of the bedrock surface rises to the east, reaching to within 2 to 4 metres of ground surface near Bank Street. The bedrock surface is 10 to 15 m below ground level in the western part of the site. The upper portion is typically highly fractured and represents the major aquifer in the area. The bedrock is overlain by glacial till; the composition is described simply as generally not containing coarse-grained material suitable for use as an aquifer. Above the till is composed of sediment ranging in grain size from silt to silty sand. The uppermost layer is organic rich, especially in the wetland where there is an accumulation of peat.

Groundwater flow is generally eastward across the site in both the overburden and bedrock. On page 5 of the monitoring report (section 2.3), it is stated that there is good hydraulic connection between the overburden and bedrock. This suggests that the till, although not a good aquifer, is also not acting as an aquitard or barrier to groundwater flow. Section 2.2 of this monitoring report refers to a map (Figure 3) of groundwater level contours and flow direction for Aug. 24, 1998. I am not certain as to why this particular data set was chosen since it was collected toward the end of a 6-day rainy period that provided more than 50% of the rainfall that month. This map (Figure 3) is poorly drawn and contains numerous errors in the placement of groundwater contours. A revised map is attached. Although the direction of groundwater flow does not change significantly, the contour positions change and thus the gradients change, especially toward the east end of the wetland. The errors in the original map indicate either a basic lack of understanding of groundwater flow, or carelessness in data handling.

The authors of the monitoring report also have some problems with terminology, which could also indicate a lack of understanding of hydrogeology. In the last paragraph on p. 4, it is stated that "the water level in a monitoring well represents the hydraulic head at the centre of the screened interval". This is incorrect. It does not represent the hydraulic head at the centre of the screened interval, but the average hydraulic head of the screened interval; or more likely a value closer to the lowest head in the screened interval. On p. 5 of the monitoring report the authors refer to 'artesian conditions' as representing a situation where the "groundwater level [is] above ground surface". This actually represents flowing artesian conditions, which is more specific than artesian conditions in general.

Historically, the reports state that groundwater flow within the overburden was generally found to be small and no PTTW would be required, while higher flow rates occurred only while trenching the upper 1 to 2 m of highly fractured bedrock at the east end of the property (p. 4 in both reports). Construction of the Findlay Creek Extension, a 1 to 1.5 m deep excavation along the northwest boundary of the designated wetland in September and October 2007, proceeded without a PTTW, thereby implying that any control pumping was at a rate of less than 50,000 L/day. The monitoring report does not state how the surface water that was encountered was intercepted, how much water was pumped, where the sedimentation ponds were located or where along Findlay Creek the water was returned; but most probably downstream of the wetland. I would assume that other periods of pumping at rates of less than 50,000 L/day occurred outside of the permitted time periods. This historical summary would suggest that the requested rates in the application are far in excess of what should be required (17,000,000 versus 50,000 L/day) and that only the southeastern area, which may encounter bedrock, potentially requires permitting. The primary reason provided in the application for the high rates requested is in order to achieve rapid drawdown during the start of pumping activities. Subsequently, pumping rates would be reduced to maintain the lowered groundwater elevations during construction. Since the proposed length of the open trenches during construction is relatively small, the short-term high initial pumping rates would be repeated often (weekly?) throughout the construction period.

3.0 Previous Groundwater Control and Monitoring

The previous monitoring programs have been undertaken as part of ongoing construction activities that primarily include trenching for the installation of trunk and service sewer lines throughout the site. Permitting for water taken during construction is reported to have begun in January 2003. The monitoring report states that in addition to the trench work "a berm was built around the northern and eastern sides of the wetland area in the first part of 2004 to separate the wetland regime from the development drainage and to enable baseline surface water flow data to be collected for the design of the Findlay Creek Extension and habitat compensation measures" (p. 3). Baseline data should be collected before altering the site through construction activities. There is no further mention in this report of surface water monitoring or of habitat compensation measures.

Monitoring data are subdivided into 'baseline' (1998), 'pre-berm' (Oct.-Dec. 2003) and 'post-berm' sets. I am uncertain as to why monitoring was conducted in 1998, if construction did not begin until 2003, unless it was to provide baseline data. I would have expected that this monitoring would have continued through the period from 1999 to 2003, rather than stopping after almost one year. For the development of trigger elevations, the post-berm period refers to May to Dec. 2004, while for general monitoring it is the period from 2004 to 2008. These data sets are important because the application report is based on the monitoring report interpretations, and there are a number of concerns with the monitoring report. Therefore, the next part of my comments (section 4) will focus on the monitoring report, which will be examined section by section.

4.0 Groundwater Monitoring Report for the period October 2003 to March 2008

4.1 Historical Groundwater Data (Section 2.4):

This section references the historical groundwater data collected between 1990 and 1998. The period from July 1990 to November 1995 consists of four sets of measurements, each in a different season (July, Sept. 1990, March 1994, Nov. 1995). The 1998 data represent 10 sets measured between Feb. and Nov.

Many of these data sets were collected at times that were several days after any major precipitation event, and water levels would not be subject to rapid changes due to precipitation. However, the data set on July 24, 1990 was collected immediately following four days of rain (89 mm), the July 10, 1998 sampling followed a 15.2 mm rain event on July 9th, and the Aug. 24th, 1998 sampling followed an 18.8 mm rain event on the previous day. The data from Aug. 24th was chosen for the groundwater-contouring map (Figure 3), even though it would represent transient conditions following the rain event of the previous day. The heavy precipitation event prior to July 24th, 1990 may explain the flowing artesian conditions at 90-1, 90-4, and 90-6 being reported only on that one day within Golder's historical database.

It is interesting that in Figure 4 (and Table 1), the data for monitors BH90-2a and 2b show essentially no variation (< 10 cm), data for monitors BH90-3a and 3b show minor fluctuations (up to 35 cm), and data for BH97-2a and 2b show large changes (exceeding 1.0 m) through time, even though they are all in the wetland. The data loggers at BH97-2 do provide a more detailed record than the spot measurements at the other locations. On page 5, the report authors attribute the large variations at BH97-2 to the proximity of the monitoring site to a ditch, "which would be influenced by precipitation and beaver dam activity". As part of this review, an analysis of the relationship between changes in groundwater levels and precipitation amount (in mm) for BH97-2 found a poor correlation. This suggests that other factors play a significant role. The rapid water level drop shown for early to mid November of 2003 is not characteristic of a normal decline due to drying (lack of precipitation), especially when significant precipitation events (>10 mm) occurred throughout this period. It is more characteristic of a pumping response; however, no pumping (groundwater control) is indicated in the figures or text for the period of November – December 2003. In this context, it should be noted that the groundwater control work associated with the Findlay Creek extension in the fall of 2007 is not indicated on any of the figures in the report.

4.2 Groundwater Monitoring Rationale (3.0):

This section describes the rationale for the groundwater-monitoring program that was designed and implemented. It describes the three main potential effects from construction and operation of the sewer lines as:

1. lowering of groundwater levels in the northern fringe of the core wetland,
2. potential lowering of the surface water levels in the wetland; and
3. potential biological impacts to the core wetland in terms of its structure and ability to maintain current wetland habitat and function.

The report goes on to state that these three impacts can be examined in terms of the short-term effects (period of construction) and the long-term effects (operation of the sewer system). This is the only reference within the report to the operational impacts, which would extend beyond the period of the PTTW. Operational impacts would be due to the sewer lines acting as drains and permanently lowering the groundwater level in the vicinity of the lines. During construction, these lines are normally surrounded with permeable sand and gravel backfill to enhance their ability to drain water. Thus long-term operational impact is an important consideration that has not been addressed in the reports.

The focus of the monitoring program is or should be on the identification of potential adverse effects to the wetland, hydrogeologically and biologically. The rationale section contains several references to “expected” pumping rates and “predicted”: effects, all as being small, little, or none anticipated. There is no information (data) presented with which to justify these comments and this may belie an attitude of complacency. For the pumping required during September and October 2007, it was predicted that the drawdown cone would extend less than 20 m from the creek alignment. No data are reported for the actual size of the cone in radius or depth, and therefore, it is impossible to verify the validity of these statements.

On page 7, the report states that the fens are sensitive to water level changes and that they require stable water level conditions. It also suggests monitoring water levels and implementing mitigation measures if trigger levels were attained, but I could not find any evidence in the report that surface water levels were monitored. Trigger levels were developed based on “baseline”, “pre-berm”, and “post-berm” levels and three ‘contingency measures’ were suggested for mitigation. However, the activation of these triggers was not based on water level elevations alone, but on a subjective determination of the cause of the water level decline that set off the trigger – groundwater control activity or low precipitation conditions. Environmentally, trigger levels should be designed to sound an alarm bell due to potential negative impacts on the wetland, regardless of cause. This was not the case at the Findlay Creek development site.

Of the three ‘contingency measures’ the first was used once unsuccessfully, the second (a control structure) has not been constructed at the time of the report writing, and the third (a low-permeability liner for Findlay Creek) is not described, thereby preventing any analysis of its effectiveness or effect over the short or long term.

4.3 Methods (4.0)

This section describes the installation of monitoring wells and equipment. In the table on p. 10, the installations at BH97-2 and BH03-8 were to monitor the "residential subdivision area"; however, these monitors are located within the wetland, on the wetland side of the berm – a low-permeability structure designed to separate the water from the wetland from the development. The fact that they were to monitor water level changes caused by construction in the development area suggests that no effects were expected. The large changes that were observed at these monitors indicate failure of the berm to isolate the wetland from construction and long-term activities.

At the bottom of p. 10 reference is made to flooding in the eastern wetland fringe that submerged the barologger in Oct.-Nov. 2005. No indication is given as to what caused the flooding or for how long it persisted. The Ottawa precipitation records do not indicate any heavy rainfall during this period in 2005. Flooding of a wetland can be just as detrimental as lowering the water level. Reference is made later in the text (p. 22) to deliberately flooding the wetland for several months in early 2006 as a contingency measure (induced trigger), but it was ineffective at recharging the subsurface. Was this the same area in both instances and what were the effects on the biological system?

On page 11, there is a table detailing the monitoring period. All of the monitoring wells indicate a record from the fall of 2003 to the present. Earlier in the report it was stated that due to submergence of the barologger, compensated data were not available for a period of time in Oct. – Nov. 2005. This is not reported in the table, but it does show up in Figures 7- 14 as thinner lines joining data points from Oct 19th to Nov. 23rd, 2005. This interval should have been left blank in the figures and mentioned in the discussion of results.

4.4 Results (5.0)

The results section is divided into five parts.

4.4.1 Baseline and Pre-Berm Elevations (5.1)

This section contains two short paragraphs. The first simply states that the data are shown in Figure 4 and that "the 2003 groundwater levels are close to the 1998 groundwater levels and generally within 0.5 m of the 1998 groundwater levels". I am not sure what "within 0.5 m of the 1998 groundwater levels" means since the only period of overlap between the 1998 and 2003 data sets is a two-week period in late October. What makes 0.5 m significant, especially for a wetland? No rationale for this statement is provided. It should also be noted here that comparison of the BH97-2a monitor (bedrock) indicates that the 2003 groundwater levels are higher than the 1998 levels, while the opposite is true for the BH97-2bmonitor (overburden); the 1998 groundwater levels are higher than the 2003 levels. What is the significance of this dichotomy? No explanation is provided and the difference is not even acknowledged. It may suggest that although groundwater levels were higher in 2003 (bedrock monitor), in comparison to the 1998 baseline measurements, the water elevation in the overburden has been significantly reduced in 2003, perhaps due to groundwater control activities. Monitors 90-2 and 90-3 appear to have been abandoned since 1998, and therefore, do not provide a means of confirming the divergent water level data.

The use of 1998 data as the baseline is considered reasonable by the report authors after comparing the above mentioned two-week period in October 2003. This is then the basis for comparing all subsequent monitoring data. According to the precipitation records from the Ottawa airport, 1998 was the 4th driest year since 1990; 1997 was the 3rd driest and the period from 1996 to 2003 averaged 5.3% less precipitation than the 1971-2000 climate normal 30 year average. Only one year (2000) was in fact above the normal values for precipitation. The low precipitation year after year should have led to declines in the water table and so the baseline data start from a lower than average level. By contrast, since the berm was constructed, the site has experienced the wettest (2006) and 4th wettest (2005) years since 1990; averaging. 12.3 % above normal for 2005 and 2006, and 4.1% above normal for the years 2004 to 2007 inclusive. More precipitation than normal over the past 4 years should raise water levels, both within the ground and in surface water bodies. No data are presented to confirm whether or not this was the case.

Most of the current monitors did not exist in 1998 and, therefore, 'baseline data' are from instrumentation that no longer exists. It thus becomes difficult to compare baseline and post-berm at any locality except possibly BH97-2. Every site will be different and to compare two data sets they should be taken from the same site. Variation in responses throughout the area is why more than one monitoring station is required.

The second paragraph of this section states that "groundwater levels have been shown to recover quickly for groundwater pumping and that long-term effects of groundwater control on water levels have not been observed". No evidence is presented to substantiate this statement, yet it encapsulates the report conclusions.

4.4.2 Groundwater Trigger Elevations (5.2)

The trigger elevations were developed based on the 1998 baseline and 2003 pre-berm data, periods of below normal precipitation. Although these data would provide the low-end elevations for actual fluctuations (assuming no prior construction effects), the wetland plants probably would have been stressed by these low-water levels and, therefore, trigger elevations should not be set lower than the baseline data. However, the trigger elevations were set "0.1 m below the seasonal minimum levels", which I would interpret as 0.1 m lower in elevation than the minimum. This would permit additional stress on the wetland plants prior to trigger initiation. Table 3 of Golder's report presents the trigger elevations.

The report goes on to modify the triggers by subjectively determining whether the trigger alarm was caused by pumping activities or by low precipitation periods "such that unusually dry years did not trigger unnecessary actions" (p. 12). This subjective interpretation of cause undermines the purpose of a trigger; namely to protect the wetland. The evaluation that was conducted in terms of precipitation was not done by year as suggested in their statement of "unusually dry years", but rather by short-term intervals on the order of a month at the time of pumping. At three sites, trigger elevations were adjusted seasonally, but at the remainder of the sites the trigger elevation remained constant throughout the year.

4.4.3 Groundwater Elevation Monitoring (5.3)

This section starts with a discussion on the effects of barometric pressure changes on groundwater levels and presents a table on page 14 giving efficiencies for each monitor. The range is quite large. Another table on page 15 presents average water elevations for the baseline / pre-berm period (1998- 2003) and the post-berm period (2004 – 2008); with a third column showing the calculated difference in elevation between the two periods. The majority of the monitors show a decline in water level elevation in the post-berm period (up to 0.96 m), despite higher precipitation levels; precipitation in 1998 was 7.5% below the 30 year normal while in 2004 to 2007 it was 4.1% above normal. The report suggests that the difference may be due to temporary groundwater control efforts during the post-berm period, but then suggests that the actual water levels may have been similar to pre-berm levels and that no long-term pumping effects are likely.

Their interpretation is interesting since the groundwater pumping effects are always listed as temporary or short term, with recovery within hours to a few days. If this were true, the effects on the overall 3-year record should be minimal. The fact that lower water levels occur in the post-berm period when precipitation levels are more than 10% above the baseline period could suggest longer-term groundwater control effects or even permanent effects due to operation of the previously constructed sewer drains. The true magnitude of the elevation changes may be masked by the recent above normal precipitation and future low precipitation years may see even larger declines in water level.

The report then examines three sub-areas where construction has occurred. Along the Findlay Creek Extension, construction required "temporary groundwater control" during the period of September to October 2007. I must assume that this control activity was at a rate of less than 50,000 L/day since no permit is listed in the table on page 3; volume data are not presented to confirm my assumption. This period of groundwater control is also not reported in any of the figures (7-13). Changes in water levels occur subsequent to this period, especially at monitor BH03-1. The remainder of this section discusses periods when water levels were affected by groundwater control measures (early 2004, early 2005, July-August 2006) and then attributes the low groundwater levels of these same periods to low precipitation.

A table on page 17 summarizes the reasons (causes) of drawdown. Groundwater control was never the sole reason, low precipitation was also responsible. For August 2005, the sole reason listed is low precipitation. The Ottawa weather records show a total of 82.2

mm of precipitation that August, compared to the 30 year normal of 87.1 mm; June and July were above the norm in 2005.

Similar statements are made for the Residential Subdivision Area. The table for the RSA (p. 19) lists groundwater control as the sole cause only in October 2005, and then only for BH03-10a. I believe this is somewhat misleading. During this period the water level in monitor BH03-10b went below the transducer (i.e. dry), which indicates a significant decline in the overburden water level to an elevation not previously seen (p. 18). Why was this not considered to be due to groundwater control pumping? This is also the same period when the barologger was submerged due to flooding and all other monitoring data were unable to be 'compensated'. Therefore none of the other data could be properly evaluated and saying that only one monitor was affected by pumping is misleading.

It is also stated that groundwater levels in the overburden and bedrock "recovered within hours to several days". This is impossible to verify with the figures provided because the time interval graphed does not provide sufficient resolution.

Similar statements about groundwater control effects during certain time periods, which are then considered to be due to low amounts of precipitation, are also made for the Wetland Fen Area. This should raise concerns over the methodology for determining the trigger cause(s). There appears to be an emphasis placed on low precipitation as the primary cause and a down playing of the groundwater pumping effects.

4.4.4 Groundwater Triggers (5.4)

This section deals with the evaluation of the groundwater elevation data to determine whether trigger levels were reached and warranted control actions. Trigger elevations were achieved on several occasions, according to the data in Figures 7 to 13 and in Table 2. However, Golder determined that all of these events were due to low precipitation periods rather than groundwater control measures, with the exception of one event in early 2006 (February to April (table on p. 21), possibly January to May (BH03-8, Figure 10). As a result, in 2006 "water was pumped behind the wetland berm in an effort to encourage recharge"; however, "this method did not prove to be an effective method at recharging groundwater elevations" (p.22). In Table 2, the cause for many of the trigger events is listed as pumping; however, there is no indication that pumping was halted to permit water level recovery. Pumping was not stopped in the 2006 event, despite the ineffective attempt at recharge and the impact of flooding on the wetland was not discussed.

Two observations can be made with regard to the groundwater triggers. First, the data were examined only once a month – so trigger alarms could sound and be ignored for up to 30 days. Second, in every case groundwater control activities continued unabated. The purpose of the triggers should have been to protect the wetland. This clearly was not the case as water levels declined up to 1.8 m in the sensitive fen area (BH03-7 and BH03-9; p. 20) and 2.5 m in the wetland fringe (BH03-8 and BH97-2; p. 18).

There is also a statement that "water levels were observed to recover rapidly following precipitation events in July and October of 2007" (p. 22). From Figures 7 to 13, water levels in fact appear to fall rapidly in July 2007.

4.4.5 Vertical Hydraulic Gradients (5.5)

This short section lists the vertical component of the hydraulic gradients and notes that it varies from monitor to monitor. It is interesting that for monitor BH90-4 the vertical gradient was downward prior to 1998, but since April 1998 it has been upward. It was noted by Golder that upward gradients, indicating discharge, occur at monitor sites adjacent to ditches. This indicates that these ditches are causing water loss from the wetland and are acting as drains.

4.5 Conclusions (6.0)

This one page summary acknowledges that temporary groundwater drawdown occurred in both overburden and bedrock monitors as a result of pumping activities. It is also stated that no negative impacts to vegetation in the core wetland are expected. No evidence is provided to support the statement of impact and the report does not address the potential for long-term effects due to the sewer lines acting as deep drains. The authors reiterate that groundwater control activities for the overburden should be minimal.

4.6 Summary

Surface water monitoring of the wetland was not reported. Baseline levels were established during a period of below normal precipitation and, therefore, low water levels, while the post-berm period (since 2004) has experienced above normal precipitation, which would tend to reduce changes in water level and minimize the effects of groundwater control pumping. Trigger elevations were established based on the low baseline data. By justifying the low groundwater levels as being due to precipitation variability, trigger alarms essentially were ignored. This permitted pumping to continue, lowering groundwater levels in the wetland by up to 2.5 m and the sensitive fen by up to 1.8 m for extended periods of time, even though the report authors stated that the wetlands require stable water conditions. All of the current monitoring sites were established post-baseline. This does not permit proper comparison to the baseline data set, so it is impossible to determine at this time what if any changes have occurred at the wetland and surrounding area.

5.0 Application Report

The concerns listed above in section 4 will affect the evaluation of hydrogeological conditions. Therefore, I will now focus on the latter part of the report written as a hydrogeological evaluation in support of the application for the permit to take water, dated July 2008.

5.1 Effects of Previous Groundwater Control Events (section 4.1)

The application for pumping at a maximum rate of 17,020,800 L/day is based on a similar pumping rate in July 2006 when trenching through the upper fractured bedrock at the east end of the site required substantial dewatering. Golder presents a table (1) of the observed groundwater drawdown at various monitors during this period of pumping in 2006. In the table they show “average groundwater elevation data” for baseline and pre-berm conditions, the minimum groundwater elevations in the various monitors during July 2006, and then calculate the maximum drawdown as the difference between baseline and minimum measured groundwater elevation. It is not clear whether the baseline average was calculated using data from all of 1998 plus the October to December 2003 pre-berm data, or simply the average of July 1998 and July 2003. The former calculation, which I suspect was used, would not be representative of baseline seasonal conditions. As noted earlier the current monitors did not exist in 1998 so the data for the baseline data are from different localities.

Golder also notes that July 2006 “corresponds to a period of close to average monthly precipitation based on precipitation records from the Ottawa Airport Station”. The question is what do they consider as ‘close’? July 2006 precipitation data show that the monthly total was 10% above the 30-year (1971 – 2000) norm, while June 2006 was 30% above norm and May 2006 was 45% above norm. This would tend to increase groundwater levels above normal (baseline(?), based on below normal precipitation) and decrease the calculated drawdown. The below normal precipitation during the baseline period would also reduce measured drawdown on a relative basis. As a result, the magnitude of drawdown effects in a truly ‘normal’ year would most likely be greater than the “maximum” drawdowns calculated in Table 1. The higher than normal precipitation in 2006 could explain the rise (negative drawdown) of 0.40 m calculated for overburden monitor BH03-8B in Table 1. This variance from normal would also affect calculations for the area of influence (section 4.2 of application report) and the anticipated drawdowns 9section 4.3) during future construction activities.

The construction of the berm was to separate the wetland regime from the development area. During July 2006, pumping from the development area resulted in the lowering of water levels throughout the site, both outside and inside the wetland. A similar range of drawdown values was measured for the overburden and bedrock monitoring wells. It is interesting that Golder considered 0.7 m of drawdown in the overburden as “small” (p. 8). All of this suggests that the berm has not separated the wetland hydrogeologically from the development area.

5.2 Area of Influence (4.2)

Golder uses observed groundwater level data from July 2006 with baseline data to determine a distance-drawdown relationship (Figure 5) and note that the same relationship exists for the overburden and the bedrock, thus confirming their hydraulic connection. The drawdown should have been measured relative to static conditions just prior to the beginning of the construction period, rather than some 'average baseline value' of dubious meaning, especially since seasonal variations could affect the initial level prior to pumping. They also chose to use the geographical center of the 6 or 7 pumping wells in order to simplify the calculation, rather than considering the wells as a line source. No individual pumping rates are given. These simplifications would affect the distance (r) from pumping well to monitoring site and thus affect the distance-drawdown curve. In Figure 5 (9a and b), most of the data plot on the estimated drawdown line for pumping at a rate of 17,020,800 L/day, suggesting that this was the 'average rate' of pumping during July 2006, rather than the maximum rate.

Golder states that the monitors in the PSW fen areas "were found to experience significantly less temporary drawdown than predicted by the distance-drawdown curve". As a result they determine a smaller radius of influence 91,000 m) than would be indicated by the distance-drawdown graph (1,700 m). Because Golder has assumed average precipitation values for July 2006, rather than the above normal levels previously noted, and they used 'baseline water elevations' rather than static conditions just prior to pumping, they are probably underestimating the amount of actual drawdown that occurred in the wetland. Even with their estimate of 1,000 m, the area of influence encompasses the entire wetland, as shown in Figure 4. Thus we could expect to see some change in groundwater levels throughout the wetland at the proposed pumping rates.

5.3 Anticipated Drawdown (4.3)

The distance-drawdown graph constructed for area of influence calculations was also utilized to calculate "anticipated drawdowns" when pumping at 17 million litres per day. Since the 'observed drawdown' in the fen portion of the wetland was less than expected, Golder decided that "anticipated drawdowns for these monitors" (BH03-7 and BH03-9) "were calculated to be less than half of the value derived from the distance-drawdown curve" (p. 9). The table of calculations for the fen monitoring sites shown on page 9, therefore, minimizes the anticipated drawdowns. If the concerns expressed in the previous section are valid, then actual drawdowns during a 'normal' year of precipitation could be in excess of twice the values shown in the table; i.e., the drawdown at monitor BH03-9 could be in excess of 4 m during development of the southeastern stage. A year with 'below normal' precipitation could increase drawdown even more. Even at Golder's listed value of 1.9 m, the fen wetland, which Golder has acknowledged requires stable water level conditions to maintain plant function, would be adversely affected by groundwater control activities. Golder concludes by stating that "if variations in overburden groundwater levels are short term" then "impacts to vegetation communities within the fen are not expected to occur". The key word is "if".

5.4 Other

Golder again refers to quick groundwater recoveries and not anticipating any adverse effects due to groundwater control activities under the heading of potential impacts.

They do not list any remedial measures that would be taken in the event of the need for corrective measures. Their monitoring program is to be the same as for the 2003 to 2008 period, which was ineffective in preventing significant drawdowns in the groundwater levels of the fen and wetland in general.

6.0 Conclusions

I have reported a number of concerns that I have with the two Golder reports and the monitoring and control activities that occurred during the 2003 to 2008 period. There are errors in data manipulation, incorrect statements regarding the precipitation data, and calculations usually minimize the potential adverse impacts. It is also unclear when pumping activities occurred, since pumping at rates below the level requiring a permit occurred, but are not properly documented. There appears to be a bias by the consultant to ignore trigger alarms and no evidence has been presented to indicate that there is any concern with regard to preserving the wetland from adverse effects. The consultant has already decided that no long-term adverse effects will occur, no matter what the pumping rate, because the pumping would be 'temporary'. A permit that permits pumping at rates of up to 17 million L/day for 10 years would not produce temporary effects. With a permit to take water 365 days per year for 10 years, the government would be writing a blank cheque, with no effective controls in place to protect the wetland.

The two reports, provided as support documentation for the application, state in several places that the expected rate of pumping will be below the 50,000 L/day criteria for requiring a permit since construction will be focused on relatively shallow trenching within the overburden, which produces little water. Perhaps the consultants need to better define their work timetable and apply for reasonable permitted rates over reasonable time periods.

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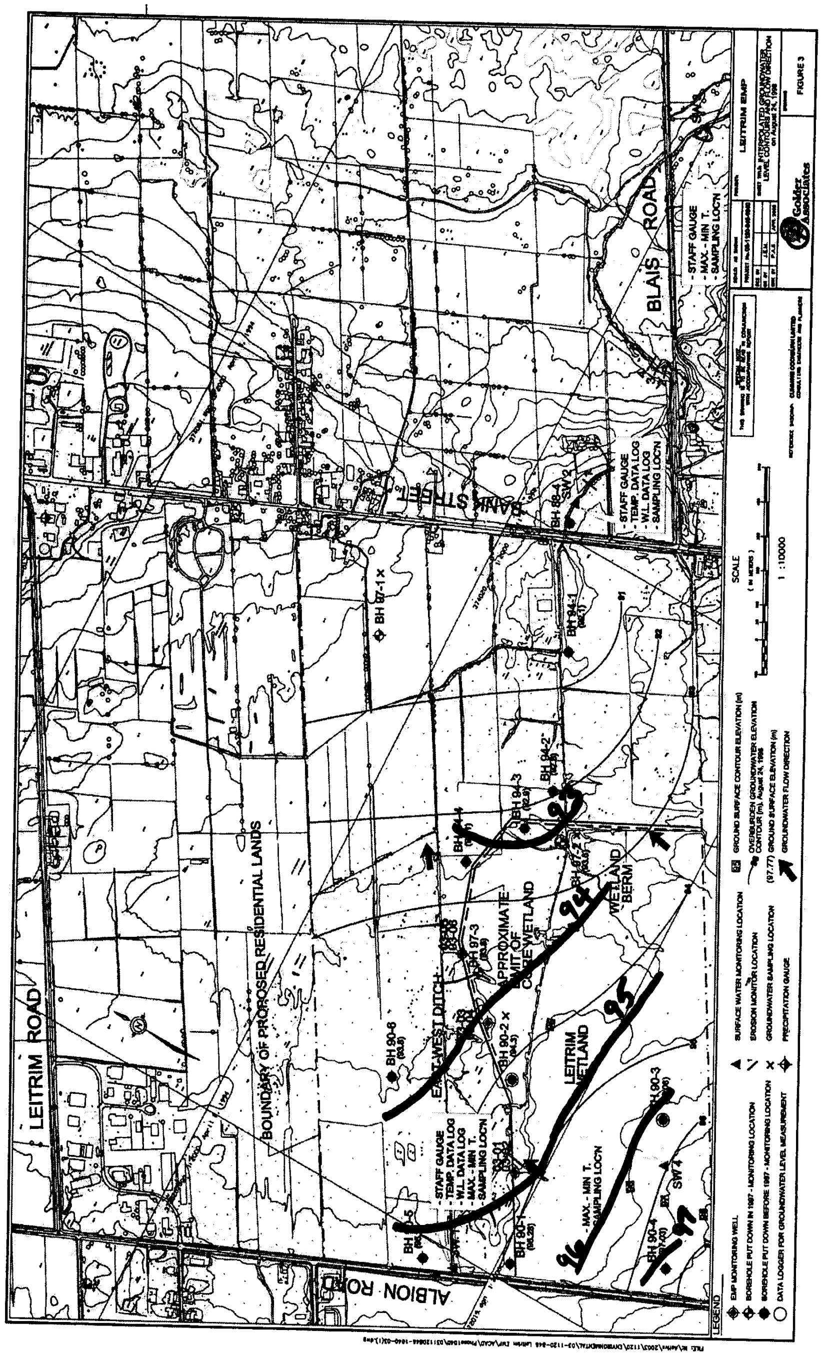

Figure3: Revised