



**Conceptual Drainage Report
Badour Farm Subdivision
Twp of South Frontenac**

Geographic Township of Bedford, now in the Township of South Frontenac
Part of Lots 34 and 35, Concession 5
Part of Part 1, and all of Parts 2 to 6, Plan 13R-16982

Part of Lots 32 and 33 and all of Lots 34 and 35, Concession 6
Parts 1 to 12, Plan 13R-16988

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1.0 Introduction

The subject lands were originally composed of several properties that were owned by members of the Badour family, local farmers. The total area of the proposed development is approximately 175 hectares.

The Badour Farm subdivision will create 35 lots and five blocks. Sixteen lots will front onto Bobs Lake, four onto Crow Lake, three onto Twin Pond, and two onto Hilltop Pond. The remaining large interior space will form another ten large lots and open space to be owned in common. With respect to access, there will be approximately 3.8 km of new rural subdivision roads with one internal intersection and two culs-de-sac. The development will be used primarily by seasonal cottagers, although site amenities and year-round public access will also attract some permanent residences.

Surface drainage patterns on the site will remain essentially unchanged following development. The one exception will be drainage associated with the construction of the new access road, as roadside ditching will necessitate minor changes to surface flow patterns.

2.0 Study Rational

The main purpose of this report is to provide a guide for the final stormwater management design plan for the proposed subdivision. This report recommends the implementation of "Best Management Practices" for the on site treatment of stormwater runoff.

By using "Best Management Practices" we will ensure that quantity and quality of the stormwater runoff has been addressed during construction and long after the development has been completed.

For the proposed development, the methodology outlined in the Ministry of Environment (MOE) Stormwater Management Planning and Design Manual (March 2003) has been implemented. This methodology promotes water management from an environmentally sustainable perspective.

3.0 Proposed Stormwater Management Concept

The entire site is contained within the upper reaches of Tay River watershed basin which is the second largest tributary of the Rideau River, located to the north east.

Runoff from the lands to be subdivided currently drains to either Bobs Lake or Crow Lake by way of natural streams, existing ditches or sheet drainage. Water from Crow Lake drains into Bobs Lake and then eventually drains over the Bolingbroke Dam 5 km to the north east and into Christie Lake by way of the Tay River. From Christie Lake, which is approximately twelve (12) km north east of the site, the Tay River eventually drains through the Town of Perth approximately 32 km to the north east of the subject site.

With the proposed development of the site, very little will change with respect to stormwater drainage, as natural drainage patterns will be preserved wherever possible. Stormwater runoff from the proposed site will continue to be channelled through existing grassed ditches and/or sheet drainage directed toward the existing outlets.

An Environmental Impact Assessment (EIA) dated December 2003 has been completed for the site by Niblett Environmental Associates Inc. Although the site contains several wetland areas, the EIA has indicated that none are provincially significant. The EIA does recognise Bobs Lake and Crow Lake as fish habitat with Crow Lake containing Lake Trout. Two streams in the northern half of the subdivision were also identified in the EIA as fish habitat containing minnows. The report includes recommendations for protecting fish habitat that will mitigate any adverse effects during construction. Many of the wetland areas and streams are contained within the development Blocks which are to be held in common and will be maintained in their natural state.

All recommendations from the EIA report will be included in the final stormwater management design. A copy of the EIA's recommendations has been appended to this report.

As noted in the introduction, the implementation of "Best Management Practices" for managing stormwater runoff will be used in the final design for the proposed subdivision.

Stormwater runoff control methods such as low gradient grassed ditches and overland sheet drainage will be used to ensure that pre and post development flow rates and quality remain comparable.

3.1 Existing Drainage Conditions

The majority of the proposed subdivision area is currently treed (60%), meadow (20%) or wetland/ponds (20%). The area is rolling in nature and some of the lands have recently been used for agricultural purposes. Drainage is varied due to the undulating nature of the area. The site contains numerous areas of wetland and bog which stores much of the surface runoff. There are many signs of beaver activity on the ponds that may affect the direction of surface runoff depending on dam sizes etc.

As noted earlier, the site is located entirely within the upper reaches of the Tay River. Most of the subdivision lands drains into Crow Lake (60%) while the remaining lands drain toward Bobs Lake (40%). (See Drainage Plan in Appendix B)

The water levels on Bobs Lake and Crow Lake are carefully controlled at the Bolingbroke Dam by Parks Canada. Water from Bobs Lake is used to maintain the depth of water in the Rideau Canal system further downstream during the summer and fall. From available data, a typical high water level on Bobs Lake is approximately 162.65 in May/June and has an average low level elevation of 161.45 in October/November. Using 2003 water level records, which was an above average year for water elevations, the peak elevation was 162.79, therefore it is estimated that a reasonable flood elevation for Bobs and Crow Lakes will be 163.00. Given the large setbacks as well as the steep shorelines, most of the building envelopes will be several meters above this elevation and will be safe from flooding. The lowest proposed building sites are located on Lots 18 & 19 and will be in excess of 2 meters above the projected flood elevation. Therefore the proposed Subdivision will be safe from flooding.

3.2 Future Drainage Conditions

The overall drainage scheme will remain consistent with the existing drainage patterns.

Some drainage areas will be changed slightly due to roadside ditching, but these changes will be minor in scope. Where required, drainage easements will be used to help maintain existing drainage patterns.

The developer plans to leave many of the natural low-lying areas within the common ownership lands in their natural state. These areas will continue to help attenuate peak flows during major events. No additional runoff will be directed into the wetlands as these areas are not to be used for quality control treatment.

The existing drainage areas will not be altered in any significant manner so that base flows and quantities are maintained.

The proposed design will attempt to maintain the hydrogeological conditions as close as possible to predevelopment conditions. Development and construction activities will be confined to the least critical areas and sedimentation controls will be implemented at all stages of construction to prevent sediment loading of downstream watercourses. There will be minimal changes to the existing topography and much of the natural drainage system will be preserved. Bacteriological inputs and nutrient loadings will be kept to a minimum to prevent any change in the environmental quality of the surrounding water bodies (e.g. minimum 30m to 50m natural set backs from edge of water for development/septic systems).

Natural drainage swales should be used where possible to convey runoff from the development to receiving waters. There will be a reduction in disturbed area by utilizing the natural grading available, in turn minimizing the amount of surface area susceptible to erosion.

All culverts crossing the subdivision road will be designed to accommodate the 1:10 year storm event, and driveway culverts will be designed to handle the 1:5 year storm.

Low gradient, grassed swales will provide an opportunity for settling, absorption, filtration and infiltration of the stormwater before outletting to the surrounding waterbodies. This will reduce the peak flows and volume of stormwater runoff from the developed site. The preservation of natural drainage patterns and maintaining stormwater runoff volume to near pre-development levels will result in minimal impact to the surrounding water bodies. It should also be noted that existing pasturelands used for livestock will be allowed to naturally re-vegetate thereby providing additional natural areas for filtration and absorption of runoff.

The increase in hard surfaces associated with development will increase the runoff coefficient from 0.15 to 0.18 since the lots are typically larger in size. We do not anticipate any increase in runoff volumes given the sandy nature of the overburden on site and the large percentage of natural wetlands which will continue to allow for absorption and natural retention.

The following Best Management Practices (BMP's) will be implemented on the site:

Lot Level Controls

It is now standard practice to direct roof leaders onto grassed areas, as opposed to a hard surfaced driveway. Discharge to rear yards will be implemented wherever possible, increasing the likelihood of particle filtration and runoff re-absorption.

The use of soak away pits should be investigated given the sandy nature of some of the lots.

At the lot level, the effects of runoff reduction measures are enhanced by minimizing lot grades to allow greater ponding of stormwater and promote natural infiltration. Due to the natural topography or relief of the site, very little grading of each lot will be required, thus allowing natural filtration and absorption to continue while maintaining base flows and reducing TSS levels. The large lot sizes of the development will also help ensure that most of the site will remain in its natural state.

Both Crow Lake and Bobs Lake will also be protected by large setbacks which will create a natural buffer area between the waters edge and proposed development. Sheet drainage of stormwater runoff over these large tracts of natural vegetation will provide further filtration and absorption.

Conveyance Control

Perhaps one of the best conveyance controls available is the use of low gradient grassed waterways having flattened sideslopes. The conveyance system proposed for this development is typically a grassed ditch having a minimum 3:1 sideslope ratio, set at a minimum gradient of 0.5% to 1%. The flat grades help to reduce flow velocities, reducing erosion potential. The grassed bottoms and sideslopes act as a filter for any suspended particulate matter as well as promote re-absorption. The net effect is that flows are attenuated, particulate matter is filtered and overall flow volumes are reduced.

Some of the site where the roadside ditches will be placed is underlain by sand, which again will assist in filtration, absorption and reduction of flow volumes which will minimize erosion. Where possible, rock flow check dams will be used to help remove suspended solids and attenuate peak flows. All erosion prone areas will be protected using rip rap. Areas disturbed by construction will be topsoiled and seeded in a timely manner.

The use of silt fence barriers and straw bale check dams during construction will help filter out suspended solids and promote absorption.

Since drainage patterns will be maintained, the stormwater discharge is expected to be within the allowable temperature change range (2°C). The existing dissolved oxygen levels and PH levels will also be preserved.

Oils resulting from driveways and the roads will be very small in amount and will not be a problem given that this is a rural residential project with oversized lots and very little traffic.

End of Pipe Control

It is anticipated that after using the above mentioned Lot Level Controls and Conveyance Controls, the runoff quality and quantity will be sufficiently treated.

3.3 Impact on Existing Drainage Outlets

As discussed, several methods of stormwater BMP's are planned for this project. Therefore, it is anticipated the impact on existing drainage outlets will be minimal. The existing downstream outlet ditches are well defined, and well vegetated and can easily accommodate the resultant surface runoff.

By developing large lots with single residential housing and using existing drainage patterns with low gradient grassed lined ditches, the pre-developed runoff quantity and quality has essentially been maintained.

Since the runoff will be kept essentially to the pre-development rate, it is anticipated that there will be no adverse effects on Crow Lake or Bobs Lake.

The following conditions shall be adhered to ensure downstream conditions are not affected by the development:

- Prior to construction of culverts, all sediment and erosion control measures must be installed across the channel to trap any potential sediment and left in place until disturbed areas are stabilized. All mitigation measures must be monitored and maintained as necessary to ensure good working order.
- Culverts to be installed 10% below existing grade and a 3 metre wide band of rip rap (rock) is to be placed both upstream and downstream of the culvert ends.
- To limit potential flooding during the 100 year storm, height of fill over road crossing culverts shall be limited to 1.0 metre or less.
- All disturbed areas shall be stabilized and/or re-vegetated upon completion of work and restored to pre-disturbed state or better.
- Maintenance and refuelling activities must be conducted away from the water. No machinery shall be allowed in the water.
- Fish shall be removed from work area under the supervision of qualified personnel prior to any de-watering operations and shall be released alive immediately downstream.
- Silt and debris that has accumulated around temporary mitigation measures shall be removed prior to their withdrawal.
- Work near or in water may not be undertaken between March 15 to July 1 of any given year.
- Any deviations during construction from the final approved design shall be reviewed and approved by the Rideau Valley Conservation Authority (RVCA) prior to implementation. Upon project completion, written notice shall be provided to the RVCA.

Since only 35 lots will be developed on the large 175 ha. site, very little area will be disturbed as most of the site will continue to sheet into the existing network of wetlands and ditches. With the removal of the cattle operations and 24 recreational trailer sites, and with the implementation of the new setbacks and BMP's, the nutrient and TSS loadings on the lakes can be expected to improve over time as predicted in the EIA.

Crow Lake has been identified as a trout lake, therefore runoff will require enhanced protection. Additional BMP's will be installed on the main outlet to the lake. Since a retention pond would be counter productive as it destroys a portion of the wetlands and warms the water prior to discharging into the cold water lake, we will place a series of rock flow check dams downstream between the proposed road and the lake to ensure the lake is protected. By using the above noted Best Management Practices we will ensure the runoff has been adequately treated before leaving the site.

3.4 Operation and Maintenance

After the subdivision has been completed and the road deeded to the Township, the Township assumes ownership of all the drainage facilities and will be responsible for all maintenance within both the Right-of-Way and registered drainage easements. The grassed channels and ditches proposed for this development will require occasional maintenance. Periodic grass trimming along roadside ditches and offtake swales represent the bulk of the maintenance required. It is anticipated that homeowners will assist in keeping roadside ditches free of excessive weed growth. Brushing and ditch cleanout operations will be required much less frequently.

Given the potential damage which could be caused by excessive sedimentation at the site, particular care should be taken by Township forces when performing clean out operations or culvert replacements. Erosion and sediment control measures should be installed as per Ontario Specification OPSS 577 prior to performing maintenance operations.

4.0 Conclusions and Recommendations

It is recommended that the proposed residential development be serviced as follows:

- Maintain existing drainage patterns and ditching, where possible.
- Drainage provided using grassed roadside ditches and rear yard swales as required.
- Culvert crossings to be designed to accommodate the one in ten year storm.
- Driveway culverts to be designed to accommodate the one in five year storm.
- Best management practices to be implemented to provide quality control.

In conclusion, this development will have minimal impact on waterbodies downstream.

On the basis of this report, we request that the review agencies provide approval for the recommended stormwater management design guidelines which has been completed in support of the plan subdivision application.

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