Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

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**Re: RM OF BJORKDALE NO. 426**
**MCRAE DRAINAGE STUDY**
**FINAL REPORT**

Dear Cherie:

The Rural Municipality of Bjorkdale No. 426 (RM) engaged Associated Engineering (AE) to complete a drainage assessment for the McRae Development at Marean Lake. This assessment included determining the current drainage patterns throughout the development and compiling an inventory of constructed and natural drainage infrastructure that are essential for the conveyance of runoff generated within the subdivision.

## 1 BACKGROUND

Marean Lake is located west of Greenwater Lake and the boundary for the Greenwater Provincial Park which is approximately 260 kilometers east of Saskatoon. Development along Marean Lake has occurred informally over the past 50 years on private land without formal subdivision. There are currently two developed areas known by the last name of the property owner, Woulfe and McRae. The Woulfe Development lies along the north side of the RM roadway entering the lake front, while the McRae Development is situated on the south side of the RM roadway.

The McRae Development is located entirely in the SE 12-41-12-W2M and was formally subdivided several years ago. At the time of the subdivision approval, the RM and Community Planning branch within the Ministry of Government Relations had not required preparation of a drainage plan for the area given that it was fully built-out at that time. Over time, and now that the separate titles have been created, property owners are undertaking site and building improvements including ad hoc independent drainage improvements which is causing drainage issues that are impacting adjacent property owners.

## 2 EXISTING DRAINAGE ASSESSMENT

The McRae Development naturally drains east towards Marean Lake. The lots have retained most of their natural vegetation with lot clearing occurring only in the cabin and access locations. Stormwater runoff mostly occurs as sheet flow due to the relatively steep grades. However, stormwater runoff within the drainage infrastructure located along the lake side lots could be considered channelized flow.

## 2.1 SITE TOUR AND SURVEY

On April 27, 2018, AE met with an RM Councilor, the Administrator, and a member of the local cabin association to tour the subdivision. During the tour, areas were identified where existing drainage works have been constructed and where known drainage issues have occurred. The notes and photos from the tour are attached in **Appendix A**. The existing drainage works are illustrated in **Figure 1** which is attached in **Appendix B** and have been summarized below:

- Catch basin (CB) between Lots 3 and 4.
- Constructed swale between Lots 9 and 10.
- Constructed swale between Lots 11 and 12.
- Catch basin between Lots 17 and 18.
- Swale/Pipe from MR1 to Lots 58 and 60.
- Constructed swale between Lots 29 and 30.
- Constructed swale between Lots 31 and 32.
- Constructed swale (trough) between Lots 33 and 34.
- Existing slough located on Lots 70, 71 and 72.

On May 10, 2018, AE conducted a GPS survey of the site to better define the locations of the existing drainage works and to pick up additional survey points along the roadways.

## 2.2 CATCHMENT DELINEATION

Using survey information collected by Meridian Surveys in 2009 along with the new GPS survey conducted by AE, the existing catchments and flow paths were delineated. The catchments were delineated based on their respective discharge locations, which were either the existing drainage items as listed in Section 2.1 or areas that were not as well defined that were deemed to drain directly to the lake. It should be noted that some assumptions were made due to the inability to survey through the heavily forested areas. Further, existing drainage was assumed to follow contours as shown. Due to the lack of ditches, existing drainage flows over the roads as contours dictate except for specific flow points that were picked up by AE's survey.

The existing catchment delineations are shown on **Figure 1** in **Appendix B**.

## 2.3 CATCHMENT RUNOFF CALCULATIONS

Using the catchment delineations shown in Figure 1, runoff flows were calculated for the 1 in 5 and 1 in 25-year design storms. The Intensity-Duration-Frequency (IDF) curve from Melfort and Hudson Bay were both considered, as Marean Lake is located roughly the same distance from the two locations. It was found that Hudson Bay's IDF curve is based off of more historical data than Melfort and produces higher intensity rainfalls. To err on the conservative side, Hudson Bay's IDF curve was used for all calculations.

Assumptions had to be made to calculate both the catchment runoff flows and the theoretical capacity of the existing drainage infrastructure. Some of these assumptions include:

- Developed lots are estimated to have a runoff coefficient of 0.40 (weighted average between roof tops 0.90 and treed areas of 0.2).
- Roadways were estimated to have a runoff coefficient of 0.70 (loose to medium compacted gravel).
- Outfalls/end points of existing drainage infrastructure were not surveyed due to the lack of access. As such, the slopes of the drainage components were conservatively estimated.
- Underground pipe sizes and their slopes had to be estimated based upon visual inspection as no record drawings were available.
- Depth, width, and length of the constructed swales had to be estimated.

Detailed calculations are provided in **Appendix C**. A summary of the calculated flows for the catchment areas and how they compare to the existing drainage infrastructure and their estimated capacities can be found in Table 2-1.

**Table 2-1: Calculated Peak Flows vs Theoretical Capacities**

| Location of Constructed Drainage Infrastructure | Catchment Area (ha) | 1:5-year Peak Flows ($m^3/s$) | 1:25-year Peak Flows ($m^3/s$) | Theoretical Capacity ($m^3/s$) |
|---|---|---|---|---|
| CB between Lots 3 and 4 | 0.467 | 0.0193 | 0.0307 | 0.0822 |
| Swale between Lots 9 and 10 | 0.654 | 0.0327 | 0.0524 | 0.1480 |
| Swale between Lots 11 and 12 | 0.867 | 0.0383 | 0.0611 | 0.3180 |
| CB between Lots 17 and 18 | 0.581 | 0.0295 | 0.0472 | 0.0671 |
| Swale/pipe from MR1 to Lots 58 and 60 | 0.406 | 0.0218 | 0.0352 | Ditch 0.2450<br>Pipe 0.0360 |
| Swale between Lots 29 and 30 | 0.872 | 0.0343 | 0.0546 | 0.2850 |
| Swale between Lots 31 and 32 | 0.128 | 0.0121 | 0.0198 | 0.2584 |
| Swale between Lots 33 and 34 | 0.805 | 0.0412 | 0.0661 | 0.2920 |

In summary, the existing constructed swales and catch basins are suitable for the existing catchment areas that they service based on the noted assumptions.

## 3 DRAINAGE RECOMMENDATIONS

Given that this area has been subdivided and is effectively fully developed, the ability to physically and comprehensively alter the means of conveying runoff not practical. We acknowledge that local community members expressed interest in making wholescale changes to the landscape to create a more formal means of managing drainage within the subdivision. The local topography and the current road network configuration would not effectively support the construction of formal drainage works in upland areas. Introducing ditches and culverts in upland areas could promote the consolidation of flows and given the size of the catchment areas, would necessitate increasingly more robust drainage infrastructure to be constructed along the valley bank, and in the lowland areas adjacent to the lake. It is our opinion that maintaining a meandering network of drainage runs in upland areas is the most cost effective for reducing downstream flows and velocities; enabling some local infiltration to occur in upland vegetated areas.

Given the topography of the area and the fact that it is fully built-out, we would suggest that to improve the current situation, the RM considers a combination of targeted constructed drainage works in publicly and privately-owned land. Execution of legal agreements with property owners would secure long term access and ensure the function of existing drainage improvements situated on private land. The adoption of policies to provide direction to landowners considering new development in the area should be considered. **Figure 2** in **Appendix B** illustrates how the suggested drainage improvements would alter/improve the catchment areas and drainage patterns. The following sections outlines the suggested actions.

### 3.1 LAKESIDE ROAD

To better define and control runoff along Lakeside Road, a constructed drainage improvement to be considered would be to raise the elevation of the road. This would create a ditch along the west (uphill) side of the road which would hold capture upstream flows and convey them in a northerly direction towards existing and planned road crossings (culverts) which would allow the flows to enter designated discharge points into the lake. The installation of strategically located culverts along the road would facilitate drainage from west to east. It is recommended that any existing or planned drainage works situated on privately owned land be protected by easement to ensure that these improvements remain accessible to the RM for repair and maintenance purposes.

The objective of this improvement would be to drain as much of the subdivision runoff to the north end of Lakeside Road to the new outfall constructed along the lakefront within the environmental reserve lands south of McRae Beach. This outfall would be located on publicly owned land and would minimize the need for negotiation with private property owners to secure new outfalls on privately owned land. We note that raising the elevation of Lakeside Road would impact how access would be provided to adjacent cabins and result in the need to more formally address driveway access including the placement of culverts. It is recommended that the RM consult with the cabin owners association to discuss the logistics related to undertaking and funding this project.

### 3.2 SLOUGH / STORM POND

There is an existing slough located within Block 1-Lots 70, 71, and 72, at the south end of the subdivision. The lot owners along the east edge of the slough, specifically Lots 44, 45, 46, and 48 have had to build up the back of their lots to act as a berm to stop the slough from draining into their lots. This caused a significant negative impact on Lot 47. As this lot is lower than the surrounding lots, it causes it to flood when the slough reaches its natural tipping point. This lot owner has been forced to demolish their existing cabin and rebuild because of flooding.

It is suggested that in conjunction with the redevelopment of Lot 47, that the site grade is raised to match the elevation of the adjacent lots (ensuring the back of lot matches Lots 46 and 48). It should be noted that the slough will find another tipping point unless a specific route is planned. It is recommended that a swale be constructed between lots 47 and 48. This swale would be designed to have a tipping point along the back corner of lots 47 and 48 and would allow the slough to discharge into the Lakeside Road ditch.

It is also recommended that the RM prohibit development on Lots 70, 71, and 72 and prohibit any development on upstream properties that would alter the storage capacity or function of the slough. A caveat could be placed on the title to these three lots to ensure that potential purchasers are made aware of the restriction to development. Consideration could also be made to initiate discussions with the owner of these lots to designate these three lots as environmental reserve if desired.

## 4 IMPLEMENTING DRAINAGE POLICIES

It is our understanding that the RM has a zoning bylaw in place but does not have an Official Community Plan or a building bylaw in place. It is also our understanding that the existing zoning bylaw does not contain regulations concerning drainage management associated with new development.

Typically, a community would adopt an Official Community Plan (OCP) which contains policies related to land use and development within the municipality. These policies are intended to assist Council in making decisions related to the topics represented in the OCP; providing for a more predictable and transparent decision-making process that endures over time as the composition of Council changes. The zoning bylaw is the tool for implementing the policies established in the OCP; containing more specific regulations to be used to regulate specific land use and development projects. The building bylaw is intended to establish a process and procedure for construction within the municipality and bridges the gap between land use and development which is governed by the OCP/zoning bylaw and application and enforcement of the National Building Code of Canada (NBCC).

We would recommend that the RM consider the preparation and adoption of an OCP and building bylaw to establish the full breadth of policy and regulatory governance needed to ensure that development occurs in a safe and orderly manner with minimal impact on public resources. In conjunction with the adoption of a building bylaw, we also recommend that the RM engage the services of a licensed building inspector to act

as an agent for the municipality in implementing the bylaw and ensuring that construction complies with the community land use regulations/policies and meets applicable NBCC standards.

As an interim or bridge solution, the RM may consider an amendment to its zoning bylaw to incorporate drainage regulations that provide direction concerning the development on lands within the lakeside resorts to ensure that new development does not negatively impact downstream properties. These regulations would seek to minimize lot clearing and the creation of non-pervious surfaces on lots by establishing a maximum lot coverage which represents the ratio of impervious surfaces on a lot to the total area of the lot. The intention of this would be to encourage property owners to only clear what is needed on the property to construct and occupy the site allowing vegetated areas to be maintained to allow local infiltration of water which subsequently reduces the volume of flows that would need to be managed through downstream constructed works. The regulations would need to be developed in consultation with the community to ensure that there is an appropriate level of public by-in. Engagement of the community also provides an opportunity to educate the public on the RM's broader requirements concerning the development of land within its jurisdiction.

### 4.1 EXISTING DRAINAGE INFRASTRUCTURE

The existing constructed swales and catch basins have become important features to assist controlling runoff as it passes through the lakeside lots. It is important that these works are protected and continue to function as they currently do. These features should be maintained, should be kept free of debris, and monitored to ensure that nothing is impeding the flow. A blocked swale or catch basin could result in significant damage to the neighboring lots.

### 4.2 VEGETATION

The development, for the most part, is heavily vegetated which is important to maintain as it allows water to infiltrate, thereby reducing runoff. Keeping the vegetation or re-establishing vegetation that has been removed, will be beneficial in protecting the area from erosion and sediment transportation from the higher areas to the lower areas. It will also help to increase infiltration and reduce the runoff that is being generated.

### 4.3 EXISTING RESERVE LANDS

It is suggested that existing ER lands are left in a natural state or revegetated as described in 4.2, to further support local infiltration. Consideration may be made in the future to construct small wetland areas within the ER lands to provide for the temporary detention of runoff, reducing the peak flows downstream. The logistics associated with the funding and construction of these works should be discussed with the local cabin owners association.

## 5 CLOSURE

This report was prepared for the RM of Bjorkdale No. 426 to complete a drainage assessment for the McRae Development at Marean Lake.

The services provided by Associated Engineering (Sask.) Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

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