EAGLE HEIGHTS COUNTRY RESIDENTIAL ESTATES COMPREHENSIVE DEVELOPMENT REVIEW

September 2020

Associated Engineering

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Development Summary	
Registered Property Owner	101120614 Saskatchewan Ltd.
Legal Land Location	W1/2 Section 11-37-4-W3M Parcel # 118557861 and 118557850
Gross Land Area	129.3 ha (319.5 acres)
Current Zoning	Agricultural (AG)
Proposed Zoning	Country Residential 1 (CR1)
Proposed Lots	84
Minimum Lot Area	0.65 ha (1.61 acres)
Maximum Lot Area	2.05 ha (5.07 acres)
Average Lot Area (Concept Plan)	1.01 ha (2.49 acres)
Projected Phases	2
Net Developable Area (for MR)	97.46 ha (240.83 acres)
Municipal Reserve Requirement (10%)	9.74 ha (24.08 acres)
Water Distribution	Highway 41 Water Utility (low pressure)
Wastewater Disposal	Private On-site Systems
Internal Road ROW	30 metres

1. PROJECT INTRODUCTION AND OVERVIEW

This Comprehensive Development Review (CDR) report is being submitted to support the rezoning and subdivision of the W ½ of Section 11-37-4-W3M for the purpose of establishing a new country residential development known as Eagle Heights Country Estates (Eagle Heights). The report provides an overview of the development and how it integrates physically, socially, and financially with the existing land use in the immediate vicinity. In addition to addressing matters of land use integration, this CDR is intended to assess the capacity of the supportive municipal and provincial infrastructure as it relates to the demand created by the proposed development.

The subject property is located in the Rural Municipality of Corman Park No. 344 (RM) and comprises 129.3 hectares (319.5 acres). Development of Eagle Heights is expected to occur over multiple phases with a total of 84 country residential parcels expected.

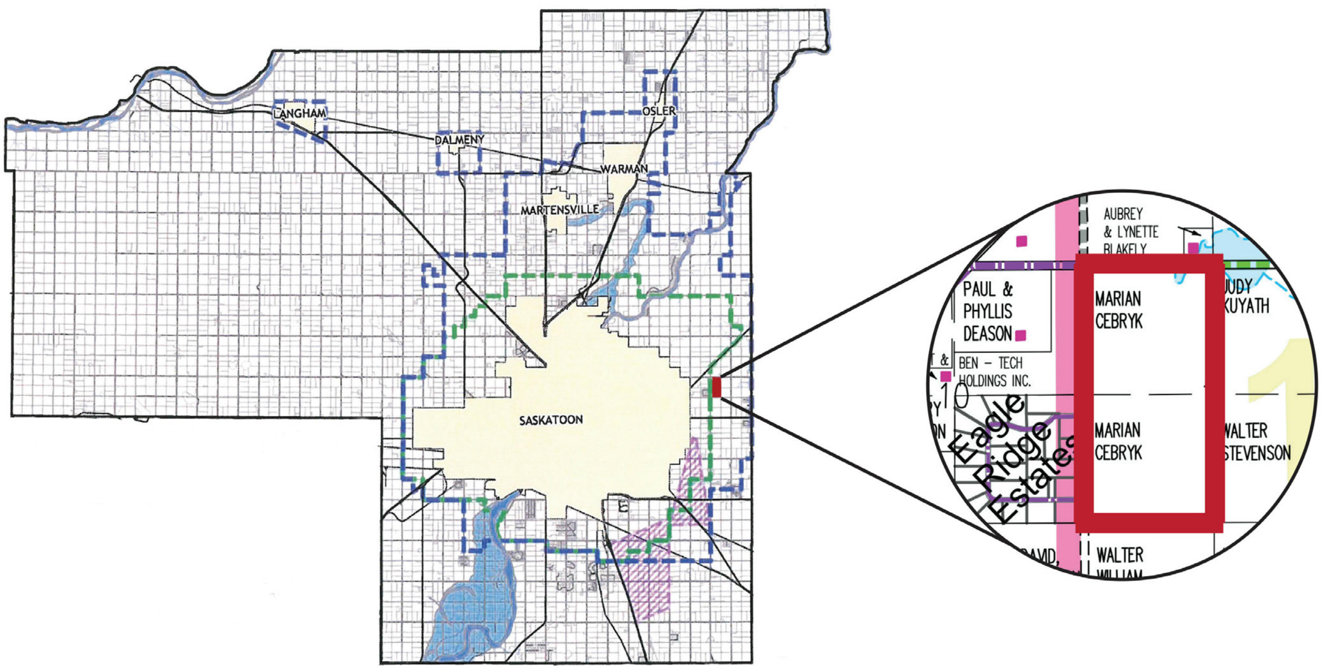


Figure 1 - Location Plan

The subject property is located at the plateau of the Strawberry Hills approximately 5 km east of the City of Saskatoon along Highway 41. The site has varying topography ranging from flat in the southeast corner to gently sloping across the site to the north. Currently the site is primarily farmland containing significant tree stands and bluffs along its eastern boundary and several centralized ponds.

The natural ponding areas have been considered in the design and layout of the site and are considered a functional and visual amenity for the development. The variable and undulating terrain within the site is expected to support a variety of housing styles and orientations which take full advantage of the natural vistas to the west. The development of Eagle Heights provides an opportunity to enjoy the rural lifestyle provided by the country while maintaining convenient access to urban amenities in Saskatoon.

2. LAND USE CONTEXT

This area has historically been in high demand for this form of development. Several existing residential communities located within the vicinity of the plan area include Eagle Ridge Estates, Discovery Ridge, Mission Ridges Estates, and Strawberry Hills Estates.

The Saskatoon North Partnership for Growth Regional Plan (P4G) supports this proposition as the subject property is designated for this type of use on the Future Land Use Map. The property is currently undeveloped and zoned Agricultural District (AG) reflecting the current use of the lands for agriculture. Development of the subject property will necessitate rezoning to a Country Residential 1 District (CR1).

Table 1 identifies the existing land uses located within 1.6 kilometres of the development site which are also illustrated on Figure 2:

Table 1 - Adjacent Land Use Context

Land Use	**Distance from Development Site**	
Intensive Livestock Operation	None	
Single Residences or Farmsteads	North	SW 14-37-4-W3 (160 m) SE 15-37-4-W3 (201 m) SW 13-37-4-W3 (900 m)
	East	None
	South	SW 2-37-4-W3 (1270 m)
	West	NE 10-37-4-W3 (345 m) SW 10-37-4-W3 (1550 m)
Existing Multi-parcel Country Residential Development	Eagle Ridge Country Estates (50 m)	
Landfill or Waste Disposal Site	None	
Urban Municipality	None	
Airport	None	
Lagoon	None	
Existing Commercial or Industrial Development	None	
Mineral Extraction Operations	None	

The water elevation within the natural ponding areas within the subject property fluctuate on a seasonal basis and within the broader water cycle. The development concept for the area considers the potential expansion of these ponds by establishing legal boundaries which consider their high water elevation; minimizing the potential for flooding on adjacent residential lots. This high water elevation has been used to establish a Safe Building Elevation for each lot in relation to the ponds.

The site does not exhibit any physical characteristics that would imply that slumping or soil instability will be an issue to consider in the design or layout of the site. The western portion of the subject property has been cultivated in the past whereas the eastern side of the property has been left relatively undisturbed over time due to the significant vegetation in this area.

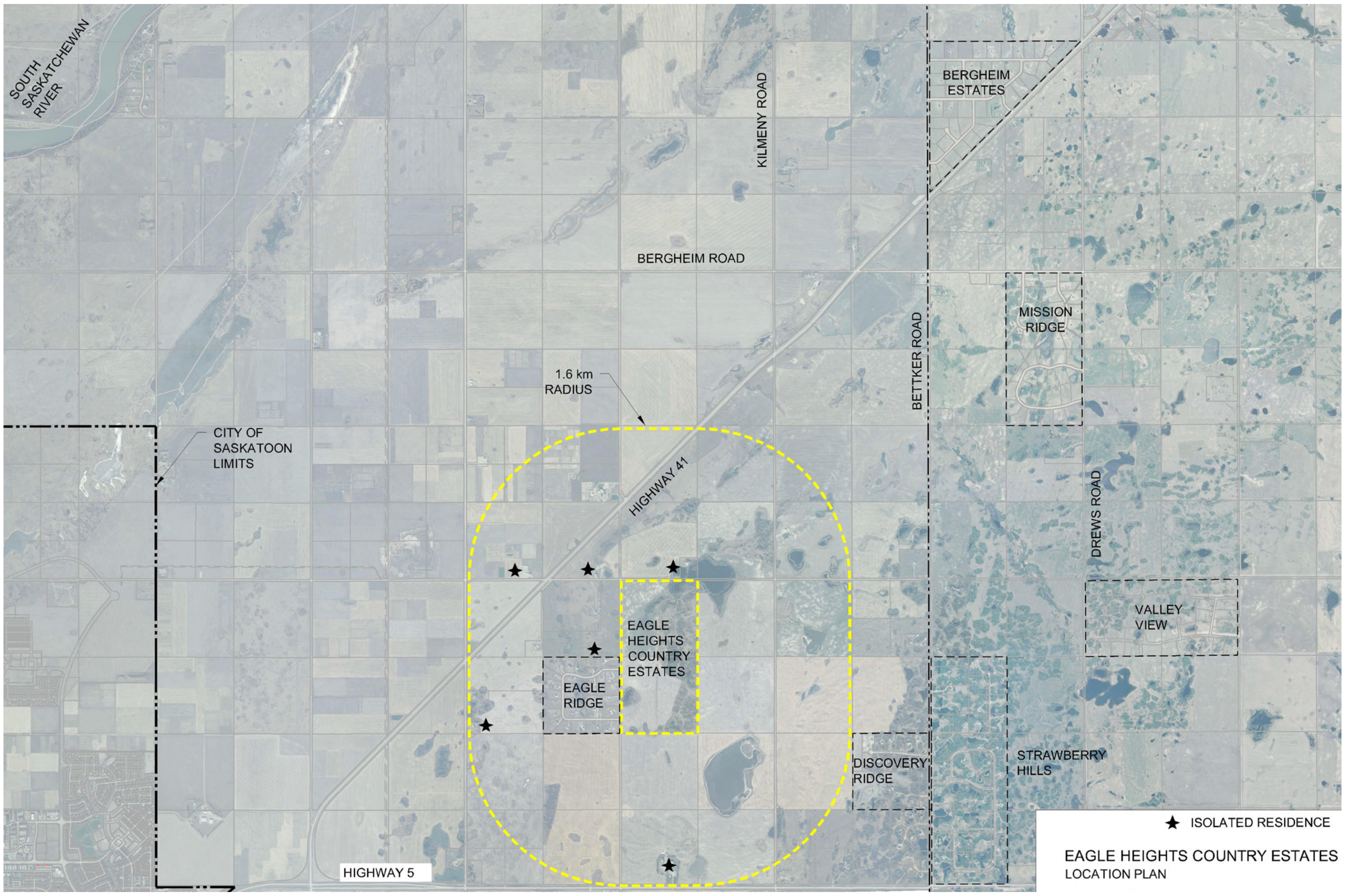


Figure 2 - Land Use Context

There is no evidence that any activities on the property or in the immediate vicinity would have created the potential for ground contamination. As such a Phase I Environmental Site Assessment was deemed to be unnecessary.

A preliminary geotechnical investigation was completed to confirm the site's suitability to accommodate the proposed residential development. The report describes the study area as consisting of rolling hills with local drainage trending towards several low lying areas. The local topography varies across the study area with a change in elevation of up to 16 metres from the height of land in the southeast corner of the site to the lowest point of elevation which is situated in the northeast corner of the property.

The Canada Land Inventory Soil Capability for Agriculture map indicates that the subject property is a Class 3 with moderately severe limitations that restrict the range of crops or require special conservation practices to counteract the soil's inability to retain moisture. Although the Class 3 soils indicate that the land would be considered prime, nearly 50% of the property is not actively farmed due to the natural ponds and vegetated areas.

The Heritage Conservation Branch of the Ministry of Culture, Heritage and Sport governs heritage resources in the province. The Heritage Conservation Branch provides an on-line searchable database, which can be used by developers to determine whether a parcel of land potentially contains heritage resources. Where this potential is identified, a copy of the development concept for the property must be submitted for comment by their office to confirm the need for any additional investigation.

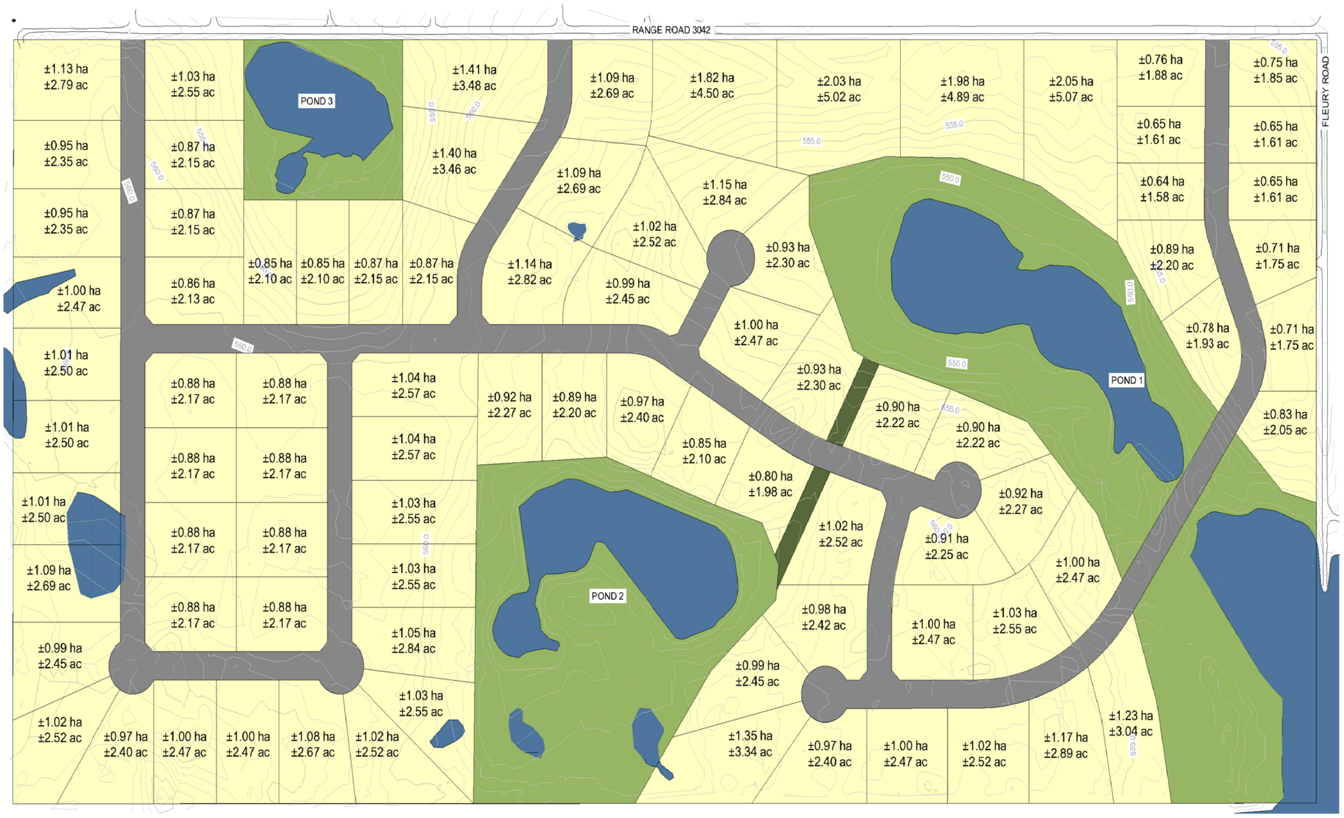
A review of this Ministry's on-line database resulted in the need for an additional level of consultation as described above. A copy of the development concept was forwarded to the Heritage Conservation Branch for comment and a written response was provided identifying the proposed subdivision may be in conflict with a known archaeological site.

Canada North Environmental Services (CanNorth) was contracted to conduct a Heritage Resource Impact Assessment (HRIA) for the area. The results of the HRIA confirmed that no new or previously recorded heritage resources were present in the proposed development area and that development would not conflict with recorded heritage sites. The Heritage Conservation Branch subsequently provided clearance to proceed with development. A copy of the HRIA report and the heritage clearance letter is attached as Appendix C.

A natural area screening report was also prepared to document and assess the current environmental assets present within the development area. This study concluded that the environmental impacts resulting from the planned activities on this site are expected to be low due to the dominance of non-native and invasive vegetation within the site and based upon the intention to maximize the retention of natural areas surrounding the sloughs. A copy of the screening report is attached in Appendix C.

3. DEVELOPMENT CONCEPT

At full build-out, the proposed development is intended to comprise 84 single family country residential lots ranging in size between 0.65 hectares (1.61 acres) and 2.05 hectares (5.07 acres), with an overall average lot size of 1.01 hectares (2.49 acres) which complies with the CR1 zoning regulations.



LEGEND		AREA (HA)
COUNTRY RESIDENTIAL		84.44
STORM PONDS		31.63
DRAINAGE CHANNEL		0.44
ROADS		12.79

Figure 3 - Land Use Concept

Land Use Statistics			
	Area (ha)	Area (ac)	Percent
Gross Development Area	129.30	319.51	100.0%
Country Residential Development	84.39	208.53	65.3%
Environmental Reserve/Municipal Utility	31.84	78.68	24.6%
Road Right-of-ways	13.07	32.30	10.1%

Based upon a net developable area of 97.46 hectares, the municipal reserve dedication required by *The Planning and Development Act, 2007* (the Act) is estimated to be 9.74 hectares. In determining the net development area, *The Planning and Development Act, 2007* allows for environmental reserve lands or lands set aside for the purpose of construction of municipal utilities to be exempted from the municipal reserve dedication calculation. Given the intention to subdivide the land for acreages, it is the developer's opinion that the properties are large enough to meet the outdoor recreational needs of local residents and as such has elected to provide cash in lieu of land dedication.

Eagle Heights is anticipated to be developed in at least two phases to allow for the incremental subdivision and development of the area in a manner which reflects and aligns with the changing market conditions and which provides for the alignment of lot revenues and the logical extension of property servicing. The proposed spatial extents of each phase are illustrated in Figure 4. The phasing plan is conceptual and the timing and composition of phases is subject to revision at the discretion of the landowner based upon market conditions. It is anticipated that rezoning and subdivision of Phase 1 will occur concurrently with Council's consideration of this CDR report with a holding provision applied to the balance of lands outside of the initial phase. It is noted that all of the technical reports and investigations have been completed to anticipate the full build-out of the property.

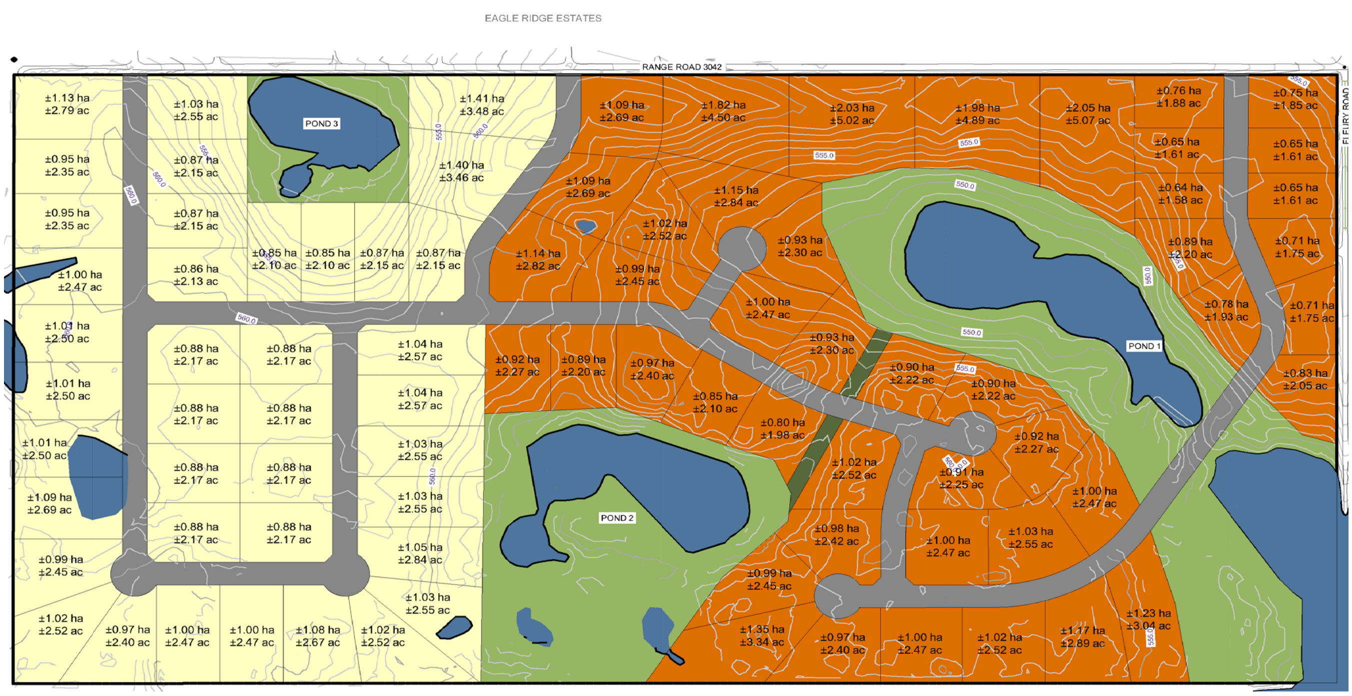


Figure 4 - Phasing Plan

LEGEND

	AREA (HA)
PHASE 1	46.06
FUTURE PHASES	38.38
STORM PONDS	31.63
DRAINAGE CHANNEL	0.44
ROADS	12.79

The proposed development employs a curvilinear road pattern to take advantage of the natural topography of the land and to minimize the disturbance within the heavily vegetated areas of the property. Curvilinear road patterns are common in country residential developments and promote slower vehicle travel speeds and traffic calming by reducing driver's sight distance.The internal road network is anticipated to be asphalt surfaced and constructed within a 30-metre ROW. Figure 5 illustrates the proposed internal road cross section. A road surfacing design has been completed and is attached in Appendix H.

A copy of the land use concept and phasing plan for the development is attached as Appendix A.

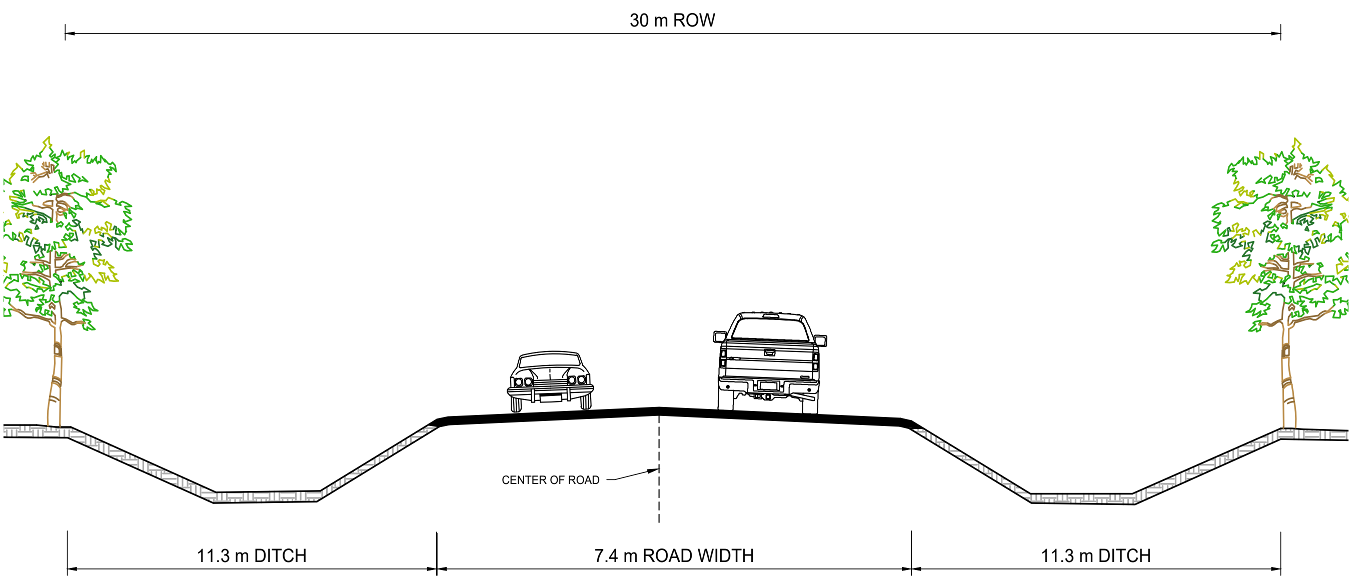


Figure 5 - Road Cross-Section

3.1 LAND USE INTEGRATION

Promoting development which is compatible and integrates well within its environment is one of the principle goals of development planning. Measuring land use compatibility is a highly subjective exercise with varying expectations from person to person in regards to the level of impact and the degree to which compatibility has been achieved.

The current land use pattern in this area can be grouped into three general categories including multi-parcel country residential development as represented by the neighbouring Eagle Ridge Estates development, single severance/farmstead residential developments and agricultural production. As illustrated in Figure 2, 90% of the lands within a 1.6 km radius are under agricultural production of some variety making this the predominant land use in this area.

Section 5.1.1 of the RM of Corman Park Official Community Plan (OCP) establishes the objective that country residential should not conflict with agricultural uses. Potential conflicts between rural residential uses and agricultural production are generally nuisance related with agricultural activities potentially having a negative impact on residential development through the production of noise, dust and odour. Alternatively residential development potentially creates traffic congestion that may interfere with farming operations during the spring and fall seasons.

The RM of Corman Park policies seek to protect productive agricultural land from being converted to another use. This ensures that the most productive areas of the RM where farming activities are most active are less impacted by potentially incompatible development. Alternatively non-agricultural development is directed to less productive land for the purpose of making the most efficient use of this land and to reduce potential conflict with other uses. The OCP uses the Canada Land Inventory Soil Capability Index as the primary basis for assessing the productivity of land.

A review of the soil classification map for the RM of Corman Park indicates that nearly all of the land located east of Saskatoon has a soil capability rating of Class 3 or better which is considered prime agricultural land. Defining the productivity of land for agriculture in this area should consider other factors including the topography of the site, land uses in the area and adopted policies that may influence land use decisions.

As illustrated on Figure 7, of the 129.3 gross hectares within the subject property, 64.11 hectares is not actively farmed due to the physical limitations of the site. This represents nearly 50% of the gross land area reinforcing that the physical conditions of the site makes this land less productive from an agricultural perspective.

As illustrated in Figure 2, there are 6 single severance/farmstead residences and 26 country residences within 1.6 kilometres of the subject property. This represents a dwelling density of nearly 16 dwellings per gross hectare which would be considered higher than other more rural areas of the municipality where farming presides.

The RM of Corman Park has recently endorsed the P4G Regional Land Use Map which has been reproduced as Figure 8. The subject property and immediate area surrounding the site has been designated for country residential development in the future.

Section 5.2.3.15 of the RM of Corman Park Official Community Plan (OCP) states that *" Where a multi-parcel country residential development is proposed on lands near or abutting an existing multi-parcel country residential development, the proposed development shall be designed to complement the existing development and respond to the reasonable concerns and interests of the residents of the existing development and where required by Council, shall provide visual buffering, house site separation, complementary lot sizing or any other measures necessary to achieve compatible land use and development."*

The policy statement above represents some of the ways in which residential development can successfully integrate with the same form of development on adjacent properties. Generally speaking compatible development should not unreasonably impact the use and enjoyment of other properties. Factors impacting the use and enjoyment of property are typically nuisance related including noise, dust, and traffic but can also include more significant concerns related to drainage and source water contamination. Through the public engagement process input was received from local landowners in the area to be used to obtain their perspectives on what constitutes a compatible form of development. The items noted from these consultations included:

- Efficient traffic management which includes ensuring that the local and provincial roadways are able to accommodate the increased traffic generated by new development.
- Having systems in place and confirmation from public service providers that these services are capable of

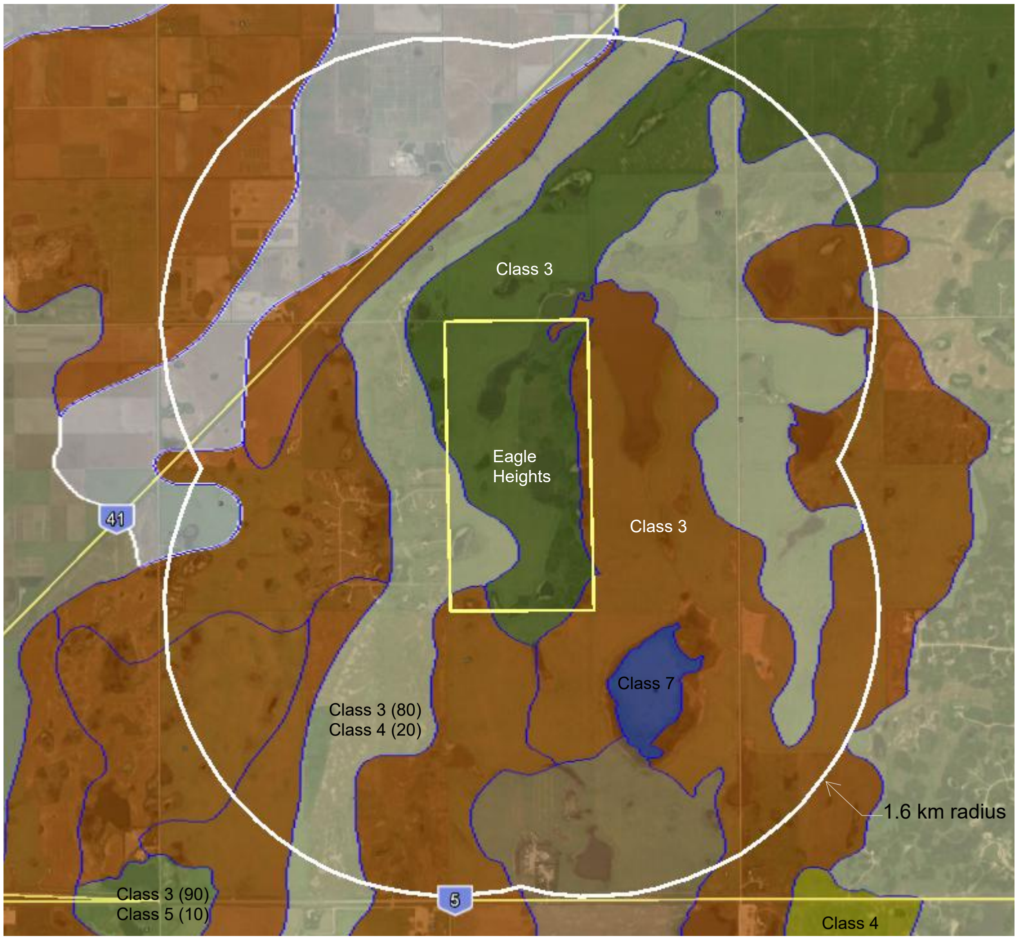


Figure 6 - Soil Capability Mapping

meeting the demands placed on them by the proposed new development.

- That planned water distribution and wastewater disposal will effectively respond to the demands of development with no measurable impact on existing water users.
- The proposed development will not have any more impact on the environment than other residential uses in the area.
- That the development will not substantially change the rural character of, or reduce the aesthetic value of the area.
- That additional development in the area will not result in increased incidences of criminal behavior.
- That the development will not reduce the value of existing properties in this area.

Traffic Management

Comments received from consultations with local residents relating to traffic management included the following:

- Concerns with the orientation and functional capacity of the Highway 41/Fluery Road Intersection;
- The lack of a second point of access/egress from this area;
- The public safety impacts of an increase in traffic on local roads;
- The deterioration of Range Road 3042 caused by construction traffic and an increase in residential traffic; and

Figure 7 - Non Arable Land Map

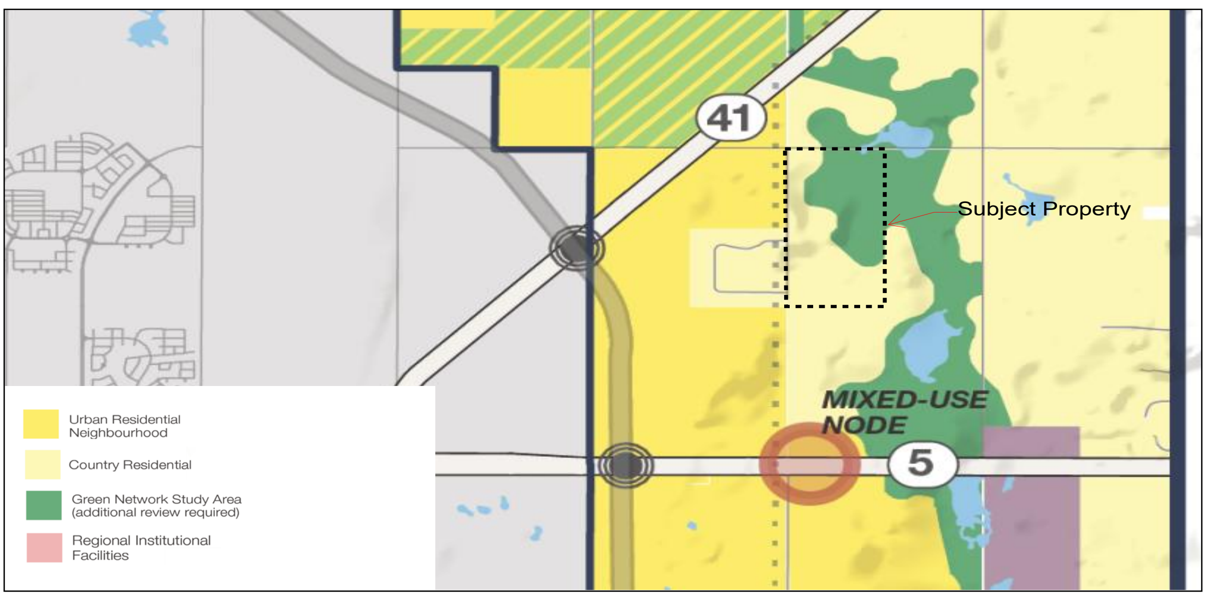


Figure 8 - P4G Regional Land Use Map

- An increase in traffic delays along local municipal roads and at the Highway 41 intersection.

A Traffic Impact Assessment (TIA) was commissioned by the developer to assess the adequacy of the existing Highway 41/Township Road 372 intersection in relation to the forecasted increase in traffic associated with the Eagle Heights development. We note that the Ministry of Highways and Infrastructure (MHI) had requested a concurrent study for another proposed development situated on the west side of the highway. The TIA included completion of a traffic count to estimate current traffic volumes sourced from development along the eastern leg of the intersection. This traffic count was used to establish a baseline condition as well as to confirm the trip generation rate to be used to forecast the increase in traffic associated with new development. Using the calculated rate, it was estimated that at full development, Eagle Heights will generate 50 trips during the peak hour morning commute and 67 trips during the peak hour evening commute.

A warrant analysis was completed based upon current and forecasted traffic volumes which resulted in the following recommendations:

1. Installation of intersection delineation lighting on the east side of Highway 41 before full build out.
2. Installation of a right turn lane for northeast bound traffic along Highway 41 before full build out.
3. Reconfiguration of Township Road 372 to meet Highway 41 at a right angle.

The TIA further concluded that the above noted intersection improvements are warranted under current traffic volumes. The MHI received and approved the TIA recognizing that the proposed improvements are warranted under current conditions and as a result, is currenlty completing construction of the highway improvements under their Safety Improvement Program with no contribution required from landowners. A copy of the TIA and correspondence from MHI is attached to this report as Appendix D.

Township Road 372 and Range Road 3042 provide municipal access to the development. Range Road 3042 terminates at the south entrance to Eagle Ridge and Township Road 372 terminates a half kilometer east of its intersection with Range Road 3042 as a result of a large pond which has expanded over the last decade to over-top the road, making it impassable. Prior to 2006, Township Road 372 provided a second means of access to this area and is currently categorized as a main farm access road on the RM map. Since 2006, residents of Eagle Ridge have been left with only one option for getting in and out of this area which is functional but not ideal from a traffic management perspective.

The TIA considered 100% of the forecasted traffic accessing the current highway intersection and confirmed that subject to the planned improvements, this intersection is fully capable of safely managing the increased volume of traffic represented by the proposed development of Eagle Heights.

The Community Planning Branch (CP) of the Ministry of Government Relations and MHI was consulted to discuss the need for and potential options to provide a secondary access to the area. Community Planning indicated that the developer should consider extending Range Road 3042 to the south connecting with Highway 5. After meeting with the MHI, it was determined that this is not an option given the access management plan for this highway and the proximity this new intersection would have to the existing permanent access point at Range Road 3040 leading into Discovery Ridge. Community Planning subsequently communicated that having multiple internal access points from within the existing and proposed residential developments would be acceptable for the purposes of this application but that additional discussion should occur with the RM to plan for a secondary access to this area in the future given the broader country residential designation represented for this area on the P4G Regional Land Use Map. The developer is in full agreement that a secondary means of access to this area would be beneficial to the existing and future residents of the area and would be willing to participate in a future project.

Both Range Road 3042 and Township Road 372 are chipped sealed pavement structures which was a common form of paving used for residential development in the past. In early 2018, the RM adopted new road standards which require all external municipal and internal subdivision roadways to be constructed to a full pavement standard. Policy 11.2.2 of the OCP provides Council with the ability to assign all or some of the cost of constructing roads to the developer as may be required by the subdivision. It is expected that if Council endorses the subdivision of Eagle Heights that a condition of this endorsement will be to make the necessary improvements to the segments of municipal road impacted by the development. This requirement is reflected in the cost of servicing estimate attached as Appendix I.

It is expected that the requirements for roadway improvements will align with the proposed phasing plan and that a servicing agreement will be executed for each phase which will define the developer's responsibilities for new road construction.

The internal access points to Eagle Heights have been situated exclusively along Range Road 3042 to reduce the road improvements required and to minimize the amount of traffic along Township Road 372 which would impact the flow of traffic at its intersection with Range Road 3042. Given that Range Road 3042 terminates at Eagle Ridge, consideration could be made to establish a local road equivalent speed limit along this segment, providing a safer environment for pedestrians and cyclists navigating the broader area.

Public Service Capacity

Local residents questioned the adequacy of current firefighting and police services in the area.

The developer contacted representatives from the Saskatoon Fire Department , the RM of Corman Park Police Service and the Prairie Spirit School Division and each organization confirmed their respective capacities to support the proposed development. Copies of this correspondence is attached as Appendix E.

The developer has also had discussions with the Community Planning Branch and is considering establishing a building caveat that would require the installation of a residential sprinkler system for all new homes. We note that this additional safeguard is not mandated by Community Planning or the RM of Corman Park zoning or building bylaws.

Water Supply and Wastewater Disposal

Comments received from consultations with local residents relating to water distribution and wastewater disposal included the following:

- Water service within Eagle Ridge has been occasionally interrupted/disrupted with regular pressure losses experienced within the system.
- Concern was expressed with the ability for the local soils to adequately support the operation of private on-site wastewater disposal systems and the impact of these systems on operating wells in the area.

Potable water service to the proposed development is planned to be provided by the Highway 41 Water Utility. The developer has contacted the provider and secured approval for the extension of new water infrastructure into the development. The service provider will design and install the entire distribution network to curb-stops situated at the front of all of the lots. The capital costs associated with this project will be assigned to the developer and recovered through lot sales. Each home owner is responsible for connecting to the distribution network. The service provider will manage all aspects of water distribution and billing and has provided written confirmation of their ability to supply water to the development at a rate of 0.33 imperial gallons per minute which is a typical low pressure rural level of service. A copy of the correspondence received from the Highway 41 Water Utility is attached as Appendix E.

A Hydrogeological Report was prepared to support the use of private on-site wastewater treatment systems (OWTS) to manage domestic sewage generated by the proposed development. This report involves both desktop and field investigations intended to characterize baseline local soil and groundwater conditions and assess the suitability of these conditions to provide an appropriate basis for treating domestic sewage generated by the proposed development.

The fieldwork comprised the installation of eight monitoring wells within the property and the acquisition of water samples over a 60 day period to obtain information related to ground water conditions. Several pump tests were completed to confirm the hydraulic conductivity of the soil which represents the speed at which fluids can move through the soil.

The report concluded that effluent generated from the OWTS will be appropriately isolated from the nearest regional aquifers which were estimated to be situated between 15 and 25 metres below ground surface and that the local soil conditions will successfully support the use of these systems within the development.

The report was submitted to the local Health Region for review and comment and was subsequently endorsed in support of the subdivision. It is noted that each property owner will be responsible for applying for and obtaining all necessary permits from the Health Region prior to installing or operating these systems. A copy of this report is attached as Appendix F.

Environmental Impacts

Comments received from consultations with local residents relating to environmental impacts resulting from the development of Eagle Heights included the potential destruction of natural habitat resulting from land clearing and the loss of wildlife habitat.

Land clearing within the subject property will be focused on construction of the internal road network, installation of shallow utilities and the planned stormwater management facilities. The developer has no intention of grading individual lots and development of these lots will be responsibility of the property owner. As with similar country residential developments in Corman Park, the necessity for broad scale land clearing to facilitate residency on acreages is minimal. The developer believes that the natural features of the site are an asset and will influence a person's decision to reside in the area so it is highly unlikely that a property owner would clear large expanses for yard development at the cost of destroying the asset that drew them to the area. To further reinforce the value of retaining the existing vegetation, the developer is considering establishing a caveat on the lots that would limit clearing to only what is needed to construct residential improvements.

Section 5.2.3.18 of the OCP requires developers to recognize and conserve areas containing significant wildlife habitat, cultural and historical resources. A natural area screening and a heritage resource impact assessment were completed for the subject property which confirmed that the site is not considered to contain any heritage resources or sensitive wildlife habitat.

Loss of Rural Character/Housing Values

Comments received from consultations with local residents relating to the potential change in the character and aesthetics of the area included the following:

- The development of Eagle Heights will depreciate the value of the homes in Eagle Ridge during construction and following completion of the subdivision as homes in the new development will be in direct competition to those in Eagle Ridge.
- Development of Eagle Heights will change the aesthetics of the area and result in more human activity that would detract from the use and enjoyment of properties within Eagle Ridge.
- Development to the east will affect the view of the sunrise to the east.

One of the key concerns expressed by existing residents was the difference in lot sizing within Eagle Heights relative to Eagle Ridge. The lots within Eagle Heights range between 0.65 ha and 2.05 ha whereas lots within Eagle Ridge range between 1 ha and 4 ha. Section 5.2.3.15 describes the use of visual buffering, house site separation and complementary lot sizing as potential ways in which compatible development may be achieved.

Eagle Heights was originally designed to comprise 95 lots as was represented in a mail-out distributed during the original call for proposals. Following the initial consultations and further conceptual planning for the site, the total number of lots was reduced to the current 84 being proposed which represents an 11% reduction in the lot yield.

The design and layout of the subject property recognizes that although the two developments are not abutting, the lots which share a common site line should have a comparable lot frontage, transitioning to smaller lots as the distance between existing and new development increases. Figure 9 illustrates how the two developments physically relate to one another across the common site line.

Eagle Heights proposes to establish four country residential lots along the common segment of Range Road 3042 which corresponds with six lots existing along the same length within Eagle Ridge. The north/south orientation of housing along this segment of road is the same as the neighbouring Eagle Ridge with lots maintaining frontage along the internal subdivision road. This is important as it relates to determining the visual impact presented by new development to the east. With the exception of the three internal lots in Eagle Ridge which have direct access to Range Road 3042 and face east, the view provided from the front yard of the other properties along the development interface will remain unchanged as a result of the development of Eagle Heights. We note that the three lots within Eagle Ridge that are orientated to the east face the planned storm retention pond which exists today, leaving this view relatively unchanged.

The developer acknowledges that the lot areas within Eagle Heights are smaller than what is provided in Eagle Ridge. Care has been taken to be sensitive to other aspects of compatibility including the views provided to existing development in the area as described above and promoting an internal road layout which functions well with the existing development. Providing the same lot area within Eagle Heights is not financially viable based upon the level of investment required to support the development.

Figure 9 - Community Interface

The cost of servicing the entire development is estimated to exceed $10,000,000.00 which equates to nearly $120,000.00 per lot based upon current infrastructure standards. A review of the current acreage market in the Saskatoon area suggests that there are significant differences in the value of lots based upon their size. The following table demonstrates the implications of enlarging the lots and further reducing the yield within Eagle Heights on development costs and revenues:

Average Lot Size (ha)	Maximum Yield (Lots)	Market Value per Lot[1] ($)	Projected Revenue ($)	Projected Development Costs ($)
2.0 (5 acres)	42	255,000	10,700,000	10,200,000
1.6 (4 acres)	52	237,000	12,324,000	10,200,000
1.0 (2.47 acres)	84	200,000	16,800,000	10,200,000

Note 1. Market values based upon a desktop review of current listings in the Saskatoon area.

Table 2 - Forecasted Development Revenues & Expenses

As illustrated in Table 2 above, enlarging the lots within the subdivision results in a significant reduction in the potential rate of return on the developer's investment, significantly increases the risk on investment and subsequently decreases the long term viability of the project depending upon the timing and final cost of site improvements.

The proposed development will undoubtedly increase the level of activity in the area but the introduction of additional development also strengthens the community, broadening its financial capacities to improve local conditions as needed and potentially expands the community's influence with the municipality. Clustering residential uses is encouraged by the OCP policies (See Section 5.2.1.6.b) and the proposed new development and the activities associated with this new development will correspond with the current uses represented in the Eagle Ride development.

Given the lot values represented in Table 2, new development will undoubtedly be of a high quality, on par with existing development in Eagle Ridge. The developer intends to prepare and adopt lot controls which will ensure a high level of development is maintained which is consistent with current development in the area. These lot controls will reflect and build upon the architectural controls currently enforced within Eagle Ridge.

Crime

Local residents indicated that increased population in the area would potentially increase the potential for criminal activities in the area.

There is no evidence to suggest that increasing the amount of development in a rural area will result in an increase in criminal behavior. It is the opinion of the proponent that the opposite holds true. Expanding the local population increases the number of eyes that are monitoring suspicious activity in the neighbourhood. New residents resulting from the development of Eagle Heights will surely share the same pride of ownership and of community as the residents of Eagle Ridge.

4. POLICY AND REGULATORY COMPLIANCE REVIEW

4.1 SASKATOON NORTH PARTNERSHIP FOR GROWTH REGIONAL PLAN

Regional Policy	Compliance Notes
Strategic Directions	
Settlement Patterns and Complete Communities: Meeting the needs for future growth will be done through efficient and well-organized development. Development will consider existing and planned infrastructure as well as life-cycle impacts. It will also meet the diverse needs and growth requirements for all communities as defined by consistent growth projections. Where possible, development shall be clustered in contiguous areas, corridors, and nodes. Interim uses may also be permitted where they will not impact future urban growth needs or development potential.	Eagle Heights is planned to situate near a permanent highway access point, along an existing paved roadway and adjacent to an existing country residential development. The subject property is also appropriately designated for country residential use on the Regional Land Use Map. This policy provides direct support to the proposed development location which seeks to cluster this type of use in a contiguous area.
Natural Environment and Drainage: The Plan will recognize sensitive ecological systems in the Region as important amenities and resources to be preserved for future generations. Key ecological areas will be conserved, enhanced, and connected to promote the health and sustainability of the regional landscape. Flooding and drainage issues will be linked with an understanding of natural systems and considered at local and regional levels, with a focus on reducing risks through integrated approaches.	The design and layout of Eagle Heights acknowledges the necessity of developing in conjunction with nature by incorporating the natural low-lying areas on the property within the drainage for the site. The site has been planned to mimic the natural collection and flow of water within the property and the internal road network has been planned with consideration of local slopes and vegetation to reduce the need for substantial site grading.
4. Natural and Heritage Resources	
4.05 Consideration of Impacts to Natural and Heritage Resources. Subdivisions and development shall be designed and constructed to ensure that alterations to the landscape or other natural conditions avoid or mitigate on and off-site impacts to natural and heritage resources.	A natural area and heritage resource screening was completed for the site confirming that the site is suitable for development without any restrictions. (See Section 2)

4.06 Integration of Natural Features. Development should integrate and complement natural features and landscapes including the incorporation of natural vegetation and conserved wetlands.	The design and layout of Eagle Heights acknowledges the necessity of developing in conjunction with nature by incorporating the natural low-lying areas on the property within the drainage plan for the site. The site has been planned to mimic the natural collection and flow of water within the property and the internal road network has been planned with consideration of local slopes and vegetation to reduce the need for substantial regrading. Consideration is being made by the developer to consider adoption of a regulation to limit the removal of vegetation on the properties as a condition of sale as a supplementary measure for limiting the environmental impact of development. (See Section 3.1 and 5.1)
5. Natural Hazards	
5.02 Subdivision and Development on Hazard Lands. Subdivision and development shall not be permitted on hazard lands unless mitigation of the hazard is proven to the satisfaction of the municipality.	The preliminary geotechnical investigation confirmed that the local slopes do not exhibit the potential for erosion and instability. The drainage plan for the development considers the natural hydrology for the area and establishes a high-water elevation for the existing ponds including a 0.5 metre free board to ensure that residential buildings are not constructed in areas with a propensity to flooding. (See Section 2)
5.04 Geotechnical Report Required for Development in Unstable Areas.	A preliminary geotechnical investigation was prepared and is attached as Appendix B.
6 Water Resources and Wetlands	
6.01 Source Water Protection and Development. Development shall not restrict the use of groundwater or surface water or alter the flow of surface water in a way that detrimentally affects other property or the ecology of the drainage system.	A hydrogeological investigation has been prepared to assess the local soil and ground water conditions concluding that the use of private on-site wastewater systems is acceptable for the disposal of domestic wastewater and is not expected to negatively impact the regional aquifer. (See Appendix F) The drainage plan for the site was developed to mimic the natural hydrological functions on the site. (See Section 5.1)

6.04 Wetlands Protection and Development. Development in the Region should strive to: a. avoid impacts to wetlands where reasonably possible; b. address impacts to wetlands where avoidance cannot be fully achieved; and c. undertake compensatory mitigation for any negative impacts to significant wetlands from development. **6.05 Least Disturbance to wetlands.** P4G shall encourage development and subdivision design that ensure the least possible disturbance and for alteration of retained wetlands	The conceptual drainage plan for the site was developed to retain and enhance the exiting wetlands and mimic the natural hydrological functions within the site. The planned storm retention ponds are intended to be returned to a naturalized state. (See Section 5.1) Based upon the observed conditions, the vegetative diversity in wetland areas can be considered low due to the existence of reed canary grass and other non-native species. It is common for wetlands that predominantly perform a stormwater management function to have a low ecological value. The Class 5 wetlands within the site serve an important function in flood attenuation and improving water quality. The wetlands are part of a terminal basin where significant runoff storage occurs (+4 meters deep) before water tips out of the wetlands and into adjacent low-lying areas. As a terminal basin, these wetlands offer semi-permanent storage which supports a high rate of biological activity; enabling the natural transformation of many of the common pollutants that occur in stormwater runoff into harmless by-products and essential nutrients that can be used to promote and support biological productivity.
6.06 Designating Environmental Reserve. Where subdivision is proposed adjacent to a watercourse or wetland, the municipality shall explore the designation of the water course or wetland, an associated buffer, any adjacent floodplain, and significant natural habitat as Environmental Reserve to protect sensitive areas and preserve the potential for public access where appropriate.	The concept plan for the development calls for the dedication of all lands adjacent to the wetlands up the estimated high-water elevation including an additional 0.5 metre free board. (See Section 5.1)
7. General Land Use	
7.06 Separation Distances for Residential Uses.	Please see Table 1.

7. 11 Intent of Land Use Categories b. The Country Residential category accommodates multi-parcel Country Residential subdivisions at rural densities. f. The Green Network Study Area includes connected areas of wetlands, swales, natural Areas, the south Saskatchewan River corridor, and other areas providing storm water storage and conveyance, groundwater recharge, viewshed protection, wildlife habitat, and, where applicable, multi functional green space.	Eagle Heights is a multi-parcel country residential development which complies with the target density of one lot per hectare as defined by the CR1 Zoning District. The layout for the development considers the retention of wetlands within the property. The wetlands will be enhanced as part of the property development to increase their storage capacity but naturalized to retain aquatic and riparian habitat. A natural area screening was completed to support the redefinition of the Green Network Study Area designation within the subject property.
9. Country Residential	
9.01 Designation on Regional map. Country Residential shall be sited in areas designated as Country Residential on the Regional Land Use Map.	The subject property is appropriately designated on the Regional Land Use Map.
9.02 Location Requirements for Country Residential Development. New Country Residential subdivisions shall not be located: a. on significant wildlife habitat. b. in locations where it may cause or contribute to the degradation of ecological and hydrological systems c. on hazard lands, unless mitigation of the hazard is proven to the satisfaction of the municipality d. within the separation distances as detailed in Policy 7.06.	A natural area study confirmed that there is no record of the subject property containing significant aquatic, wildlife or vegetative resources which would be impacted by development. (See Appendix C) Half of the development site is currently cultivated farmland. The remaining half is wetland and forested areas. The drainage plan calls for the retention of existing wetlands and the dedication of land up to the high-water elevation plus a 0.5 m free board to reduce the risk of flooding hazard. (See Section 5.1) The proposed development meets the separation distances defined in Policy 7.06.

9.03 Considerations for Country Residential Development. When reviewing a proposal, the RM should consider the capacity of existing schools and bus facilities or the feasibility of expanding capacities to accommodate the proposed development.	The Prairie Spirit School Division has been contacted and they confirmed sufficient capacity to accommodate the development both from a facilities and busing perspective. During the public engagement, it was identified that the bus routes had recently changed as children in this area are now expected to attend the Clavet School resulting in buses having to make a left hand turn onto Highway 41 instead of a right hand turn to travel to Aberdeen as was previously the case. Existing residents of Eagle Ridge expressed concern with the safety of this turning movement. The developer agrees that further discussion should occur between the municipality and the school division in this regard to assess the potential risk.
9.04 Preferences for Country Residential Development. a. Minimize pressure to develop, expand or upgrade services and infrastructure inconsistent with the Concept Plan and servicing plans b. include significant natural or built amenities or other features that provide a high-quality living environment. c. incorporate innovative features to promote environmental and social benefits to the community.	The proposed development is situated close to a permanent highway access point, along a paved municipal roadway and in an area where all required utilities are present or readily available. The enhanced wetland area combined with the natural beauty of this area and the vistas to the west offer significant community amenities. The developer is open to investigating the potential of requiring the installation of fire sprinkler systems within the new homes to increase the level of fire protection provided within the development.
9.05 Considerations for Country Residential Subdivision Design. a. the carrying capacity for the lands for development and the surrounding area based on site conditions, environmental considerations and potential impacts, and other factors that may warrant design considerations. b. minimizing impacts on regional drainage patterns and other regional ecological systems. c. the suitability and availability of municipal and other services and infrastructure necessary to support the development. d. Compatibility of the proposed development with that of the surrounding area.	See Section 3.1

9.06 Sustainable Country Residential Subdivision Design Principles. a. Protecting and incorporating existing features and landscapes including natural areas, natural vegetation buffers, habitat corridors for wildlife movement, important ecological areas, topographic features and environmentally sensitive lands, wetlands, drainage systems, and groundwater recharge areas. b. minimizing length of road construction within the subdivision.	The development layout provides for a dedicated corridor connecting hydraulically linked ponds, offering a continuous undeveloped corridor from the centre of the site to the northern boundary. Consideration is being made by the developer to consider adoption of a regulation to limit the removal of vegetation on the properties as a condition of sale as a means of limiting the loss of vegetation on the properties during housing development. The internal roadway network was developed to respond to the natural grade of the site and to minimize the disturbance to the vegetated areas along the eastern half of the subject property.
9.09 Consideration of Adjacent Development. Where a proposed Country Residential Development is adjacent to an existing country Residential Development, the RM shall require the proposed development to be designed to complement the existing development. This may include visual buffering, building site separation, complementary lot sizing or any other measures necessary to achieve compatible land use and development.	See Section 3.1
13 Green Network Study Area	
13.03 Refinement through Concept Plans. Prior to the development of a region-wide study, the GNSA may be refined by a concept plan or other detailed assessment. This refinement shall be consistent with the criteria under policy 13.02.	A natural area screening was completed and submitted to support the refinement of the Green Network Study area (GNSA) within the subject property. An additional field investigation will be performed prior to the initiation of any construction on the site to further verify the existence of sensitive habitat. The retention and dedication of the natural wetlands and associated riparian habitat for the storage and conveyance of stormwater is consistent with the intention of the GNSA.

13.04 Intended Uses in the GNSA: a. Agricultural b. Parks, open space, and protected areas c. Outdoor recreation d. Public utilities	The existing wetlands are intended to be dedicated as municipal utility parcels through the subdivision process which is consistent with the intended use of these areas as a public utility.
13.10 Integration with Stormwater Management. Wetlands in the GNSA should be integrated with the regional stormwater system.	The drainage plan for the site considered the impacts of development on the broader catchments area which extends beyond the subject property. (See Appendix G)
13.11 Wetland Buffers. Buffers are required to maintain and improve wetlands quality by reducing pollutant loading and other disturbances. A 30 m buffer shall be required around significant wetlands in the GNSA where no development shall occur.	In defining the areas intended to be dedicated as municipal utility parcels, the high-water elevation and an additional 0.5 m free board were included. The dedication of this area combined with the residential setback ensures that development cannot occur within these defined areas and that adjacent lands can be developed with minimal risk of flooding.
13.14 Riparian Buffers. 30 m buffers shall be required around ponds, lakes, rivers, creeks, brooks, or other watercourses in the GNSA where no development shall occur. Native vegetation should be maintained in this buffer.	See above. The drainage plan for the site includes the retention and incorporation of the natural ponding areas into the development. These ponds are to be left in a naturalized state.
13.15 Runoff from Site Development. Untreated storm water runoff from a multi-parcel development in the GNSA should be directed to a retention pond, or similar feature, to reduce sediment and pollutants inputs into surface water and wetlands.	Run-off generated within the subject property will be conveyed to one of three retention facilities per the drainage plan in Appendix G.
13.16 Minimize impacts to Vegetation. Imports to natural Vegetation and native habitat from development in the GNSA shall be minimized.	The dedication and naturalization of the wetland areas during site development will provide long term protection of natural aquatic and riparian habitat.
13.17 Habitat Corridors. They should be preserved in the GNSA to maintain connections for wildlife movement throughout the Region.	The development layout provides for a dedicated corridor connecting hydraulically linked ponds, offering a continuous undeveloped corridor from the centre of the site to the northern boundary.

4.2 RM OF CORMAN PARK OFFICIAL COMMUNITY PLAN

Municipal Policy	Compliance Notes
5.1.1. To ensure that country residential development does not conflict with agricultural uses.	See Section 3.1
5.1.2. To ensure that country residential development takes place in a planned manner	The proposed development is adjacent to other country residential developments, including Eagle Ridge Estates. The clustering of country residential services allows for the efficient and economical provision of services to these areas and reduces the fragmentation of agricultural land throughout the municipality.
5.1.3. To direct country residential development away from highly productive agricultural areas, and to allow for better utilization of agricultural land.	See Section 3.1
5.1.4. To minimize possible negative impact of country residential development on other land uses in the Municipality and on the environment.	See Section 3.1
5.1.5. To ensure that country residential development provides a high-quality living environment through appropriate design, density and location.	The development layout enables many lots to back onto natural areas. The development provides for a variety of lot sizes to support a variety of housing styles. The planned density of development is in alignment with the CR1 Zoning District, reflects the current market demands and gives due consideration to the costs of developing the property. The location provides a convenient option for people to enjoy the country lifestyle while still being near Saskatoon and its opportunities for employment and access to urban amenities.
5.1.6. To minimize the economic costs of country residential development to the Municipality.	Every attempt was made to minimize the length of internal roadways. The proposed development yield provides a strong basis for generating tax revenues to support ongoing maintenance of municipal facilities in the area.

5.2.1.1. Any new country residential development or subdivision for country residential use on parcels in the Municipality zoned Agricultural District (AG) will require an amendment to the Zoning Map to a District which provides for this activity. The proposals will be subject to all policies and criteria herein.	The land is currently zoned Agricultural District and is intended to be rezoned to a Country Residential 1 District. This will require a zoning map amendment.
5.2.1.5. Country Residential subdivisions shall not be allowed: a) within the distance of an intensive livestock operation as outlined in Section 4.2.3.; or b) on hazard lands, unless Council determines the lands are acceptable for remediation, and remedial measures and construction standards are prescribed by Council in accordance with Section 9.2.9 and registered as an interest on the title(s) to the lands.	See Section 2
5.2.1.6. Country Residential subdivisions should be directed to: a) locate on lands of “marginal” soil capability as defined by the Canada Land Inventory (CLI) Soil Class Rating System; b) locate contiguous to existing residential development on the quarter section to limit agricultural fragmentation and minimize the disruption of agricultural operations; and c) locations along existing municipally maintained roadways.	See Section 3.1
5.2.3.2 Council shall consider the current demand for and existing inventory of undeveloped multi-parcel country residential lots when reviewing multi-parcel country residential subdivision proposals.	The development property was considered by Council in conjunction with a call for proposals and authorized to proceed with the preparation and submission of a CDR.

5.2.3.5 The number and arrangement of approved lots shall be determined on a case by case basis and shall have consideration for: a. the carrying capacity of the lands proposed for development based on site conditions, environmental considerations and potential impacts, and other factors that may warrant consideration in the design of the proposal; b. the suitability and availability of municipal and other services and infrastructure necessary to support the proposal; and c. the compatibility of the proposed subdivision design with that of the surrounding area.	See Section 3.1
5.2.3.6 The Municipality will ensure that new multi-parcel country residential subdivision proposals incorporate environmentally sustainable subdivision design principles including but not limited to the following: a. the subdivision design shall respond to and incorporate existing natural resources including: wildlife corridors and habitat, topographic features and environmentally sensitive lands with attention to hydrologic features and systems; and b. the design of lots and internal roadways shall seek to minimize the length of roads constructed within the subdivision and to arrange house sites effectively relative to natural features and efficient roadway networks.	a. See Section 2 and Section 5.1 b. The internal roadways have been arranged to minimize new internal subdivision roads by using Range Road 3042 for access for several of the lots and then ensuring the internal roads are double loaded with development occurring on both sides.
5.2.3.7 The maximum size of the development area for an individual multi-parcel country residential development shall be 64.8 ha (160 acres).	The development of the area is intended to occur over at least two phases, with each phase comprising less than 64 hectares following the deduction of public dedications.
5.2.3.10 Comprehensive Development Reviews shall include a clear record of substantial public consultation including involvement in concept development, public review of the development options, and evidence of conflict resolution initiatives where necessary.	See Section 6 and Appendix J.

5.2.3.13 All new proposals for multi-parcel country residential subdivision shall be serviced by a common potable water system in a legal form that is acceptable to the Municipality.	See Section 5.2
5.2.3.14 All multi-parcel country residential developments shall be required as a condition of approval, to create and administrate a septic system utility in a legal form that is acceptable to the Municipality and the Saskatoon District Health Region to monitor the ongoing operation and maintenance of on-site wastewater systems within the proposed development, providing the Municipality with regular, qualified, reports at intervals determined by Council on a case by case basis. These reports shall confirm that all on-site wastewater systems are being adequately maintained and effectively operated or to identify necessary remedial works to be undertaken.	See Section 5.3 and Appendix F for details concerning wastewater management.
5.2.3.15 Where a multi-parcel country residential development is proposed on lands near or abutting an existing multi-parcel country residential development, the proposed development shall be designed to compliment the existing development and respond to the reasonable concerns and interests of the residents of the existing development and where required by Council, shall provide visual buffering, house site separation, complementary lot sizing or any other measures necessary to achieve compatible land use and development.	See Section 3.1

5.2.3.17 Subdivision for a multi-parcel country residential developmentshall not result in the creation of any residential parcel located: a) within the distance of an Intensive Livestock Operation as outlined in Section 4.2.3.; b) on Hazard Land; c) within 1 km (0.6 mile) of a Hazardous Industry measured from the property boundary of the Hazardous Industry to the property boundary of the closest developable parcel; d) within 1 km (0.6 mile) of a rural industrial park measured from the property boundary of the closest developable parcel located within the rural industrial park to the closest property boundary of a multi-parcel country residential parcel; e) within 457 m (1500 ft.) of the property boundary of a Solid Waste Disposal Facility or a Liquid Waste Disposal Facility measure from the property boundary of the Solid Waste Disposal Facility or the Liquid Waste Disposal Facility to the closest property boundary of a residential parcel; and f) on conservation lands	See Table 1.
5.2.3.18 Development must recognize and conserve areas containing significant wildlife habitat, cultural and historic resources.	See Section 2.
5.2.3.19 Multi-parcel country residential subdivisions shall not be permitted on lands predominantly identified as prime agricultural lands according to the Canada Land Inventory (C.L.I) Soil Class Rating System and under agricultural production except where food production is an essential component of the development or where the development requires location on prime lands.	See Section 3.1.

5.2.3.20 Multi-parcel country residential subdivisions proposed in the vicinity of a provincial highway shall consult and provide evidence of compliance with the requirements of the Saskatchewan Ministry of Highways and Infrastructure.	See Section 3.1 and Appendix D.
5.2.3.21 Council shall consider the capacity of existing school and bus facilities or the feasibility of expanding this capacity to suit a development when reviewing multi-parcel country residential subdivision proposals.	See Section 3.1, 5.7 and Appendix E.
5.2.3.22 Approved multi-parcel developments shall be phased to ensure that roadway development and the provision of other services does not unnecessarily precede lot development.	Eagle Heights is planned to be completed over four phases, so services are provided in a cost-effective manner and do not precede lot development unnecessarily.
9.1.3. To protect historic, archaeological, and other cultural features and sites from incompatible development.	See Section 2.
9.1.4. To preserve the natural character of conservation areas including critical wildlife habitat areas and tracts of significant vegetative growth.	See Section 2.
9.1.5. To restrict development in areas that could prove hazardous to development for reasons of flooding or ground stability.	See Section 2.
9.2.9. Any non-agricultural development proposed on flood prone lands shall be constructed at or above the 1:500 flood level as defined by the Saskatchewan Watershed Authority, and in compliance with remedial measures and development standards prescribed by Council in consultation with the Saskatchewan Watershed Authority and Government Relations and Aboriginal Affairs.	See Section 2 and Section 5.1.
11.1.1. To provide an effective and efficient road network throughout the Municipality to facilitate traffic flow generated by the variety of land uses.	See Section 5.4.

11.1.2. To minimize the financial burden on the residents of the Municipality, resulting from developments in the Municipality.	The development is located near an existing country residential development. Clustering these types of developments focuses municipal investments into road maintenance while expanding the tax revenues to better support maintenance costs.
11.1.4. To ensure services are provided in an economic and efficient manner.	As mentioned above, by clustering multi-parcel developments, it should help to support the maintenance costs.
11.2.1. All new development proposals in close proximity to any road in the Municipality shall allow for expansion of those roads to standards designated by Council.	Range Road 3042 is already a 30 - metre ROW.
11.2.2. Any person proposing a subdivision and/or development of land shall, as a condition of approval, construct at his or her own expense and to standards established by the Council such roads as may be required by the subdivision and/or development.	New road construction and improvements to existing roads will occur according to the RM's published road standards.
11.2.3. All development proposals shall have regard to existing school and school bus capacity.	The Prairie Spirit School Division was contacted and confirmed they have available capacity to service the site via buses.

4.3 RM OF CORMAN PARK ZONING BYLAW

Municipal Regulation	Compliance Notes
3.1 The minimum site area shall be 0.4 ha (1 acre) and the maximum site area shall be 4.05 ha (10 acres).	The smallest lot within the plan area is 0.65 ha and the largest is 2.05 ha.
4.1 The maximum residential density for multi-parcel residential development shall be one residential lot per acre, maintaining an overall average minimum lot size of 2.47 acres throughout the proposed subdivision.	The overall average lot size across all phases is 1.01 ha.
4.3. The maximum size of the development area for an individual multi-parcel country residential development shall be 64.8 ha (160 acres).	Separate applications will be made for each of the phases of development. Each of the phases comprise less than 64.8 ha net of public dedications.
5.2. The minimum frontage shall be 15 metres (49.2 ft).	The frontage of all lots within the development area exceeds the 15-metre minimum.

5. SERVICING

5.1 DRAINAGE

A preliminary drainage assessment was completed for the development to estimate the post development runoff, confirm the suitability of the existing ponds to manage these increased flows and to establish a Safe Building Elevation (SBE) for each catchment area. A copy of the conceptual drainage plan along with correspondence from the Water Security Agency is attached as Appendix G.

The development site consists of rolling hills with local drainage trending toward several natural low-lying areas. The site is separated into four natural catchment areas, which can be seen in Figure 4165-FG-102 attached as Appendix G.

Catchment Area 1 drains northeast into Catchment Area 4, which is a terminal basin for water. By terminal basin, we are referring to a location where significant runoff storage occurs (+4 meters deep) before water tips out of the natural slough/pond. Catchment Area 2 is also a terminal basin for water that potentially drains into Catchment 1 if runoff volumes are significant enough. Catchment Area 3 is the only typical catchment in that it has a defined outlet; a culvert across Range Road 3042.

The proposed country residential development is intended to be an acreage style development with little to no lot grading other than what is required to build an access and residential buildings. Some grading will be required to direct natural surface runoff along property lines through easements, as well as filling some of the natural depressions to allow for positive drainage away from houses.

Surface runoff is intended to be conveyed overland via ditches to adjacent roads, using culverts at driveways and intersections, as well as at locations of natural drainage paths which have been defined with easements. The conceptual plan for site drainage is to continue to collect the runoff water in the four natural storage ponds located within each catchment area. The lands surrounding the natural storage ponds will be designated as Municipal Utility Parcels.

The concept plan has been developed to work with the natural drainage. Consideration has been given to ensure that private properties are not located below tipping points or within potential storage basins. Post development drainage and the associated storage requirements were calculated based upon a 1:100-year 24-hour storm event. The active storage was calculated using the modified rational method to determine the difference between the average 100-year 24-hour pre-development rate, and the simulated design storm using a peak 100-year 24-hour post-development rate while also accommodating a 0.5 m freeboard between the high water level and the lowest back of lot elevation around the pond. To offer additional local storage, the conceptual drainage plan provides an additional 11,000 m^3 of permanent storage within Pond 1 to limit the burden placed on Pond 4 which extends outside of the subject property.

The existing topography of the ponds generally allows for adequate post development storage, with the exception of Pond 3 which will need to be deepened to allow for storm water storage without flooding adjacent lots.
WSA requires all permanent structures to be located above the 1:500-year flood level, which is referred to as the Safe Building Elevation (SBE) in the attached technical memo in Appendix G.

5.2 POTABLE WATER SUPPLY

The Highway No. 41 Water Utility has confirmed its capacity to supply potable water to the development from an existing line located along the Highway 41 right of way. This utility currently provides treated water to a number of developments in the area including Valley View Estates, Mission Ridge and Bergheim Estates.

The Highway 41 Water Utility will design and construct the water pipeline to each lot in Eagle Heights. The developer will be held responsible for all of the capital costs associated with the construction of the new water distribution network. The water distribution system will be a typical low volume rural drip system providing each residential lot up to 0.33 imperial gallons per minute. The extension of water distribution into the subject property will also require the construction of a new pumping facility at the top of the valley to overcome the challenges posed by the elevation of the development in relation to the existing supply line along the Highway 41 right-of-way.

Based upon an estimated three persons per household, this development will likely host a population of approximately 252 people. Daily water consumption is estimated to range between 225 and 300 litres per day per capita (Lpcd). A low pressure rural drip distribution system will necessitate the installation of a local storage tank or cistern on each property equipped with an in-house pressure system to provide sufficient water pressure for consumption within the home and for property irrigation where desired. Typical storage tanks range between 450 and 4,500 litres. The proposed water line will not have sufficient volume or pressure to provide firefighting support within the development. The developer is considering the addition of a covenant that would require the installation of a residential sprinkler system within new homes in the subdivision to supplement fire fighting services.

Correspondence from Highway 41 Water Utility is attached as Appendix E.

5.3 WASTEWATER DISPOSAL

Domestic wastewater generated within the Eagle Heights subdivision is intended to be managed by private on-site wastewater disposal systems. The Community Planning Branch requires the preparation and submission of a hydrogeological report for any new development which proposes the use of private on-site wastewater disposal systems. These reports are prepared in accordance with *Guidance Document for Developments and Subdivisions where On-site Wastewater Treatment Systems are Proposed*. The intention of the hydrogeological investigation is to obtain baseline soil and groundwater data for the development area to enable an assessment of the potential long-term impact of the use of private disposal systems on these resources. The investigation involves a combination of desktop research, field survey, drilling and soil and water testing.

A Level 1 investigation was completed for the site which included an evaluation of the local aquifers in relation to the area and intended volumes of domestic wastewater disposal. A development is considered low risk where it can be demonstrated that the effluent is isolated from existing water supply aquifers. The results of the investigation confirmed the suitability of using private on-site disposal. The report is attached as Appendix F.

The risk of elevated nitrate levels resulting from development within the storm retention ponds are also considered to be low. Nitrates are currently generated by agricultural activities on the subject property which are transferred to the existing sloughs within run-off. The development of the property will transfer the source of nitrates from agricultural activities to the operation of on-site waste water disposal systems and run-off from residential yards. On-site wastewater disposal systems are designed to utilize natural filtering processes to remove nitrates and other nutrients from wastewater prior to contact with surface and subsurface watercourses. It is assumed that these systems will work as designed and minimize the untreated volume of nitrates entering the storm retention ponds.

Expansion of the water storage capacity in the sloughs as they are converted to storm retention facilities increases the dilution of nitrates entering the water body. Recognizing the intention to naturalize the storm retention pond and that sloughs serve a natural filtration function, the naturalization process will enable the introduction of specific organisms to support the natural processing of nutrients including nitrogen.

In our opinion, the difference in nitrate loading within surface water bodies resulting from development will be negligible from current levels and given that the ponds are non-fish bearing and predominantly part of a closed basin, the risk to humans and animals is considered to be low.

The Saskatchewan Health Authority (SHA) has reviewed the hydrogeological investigation and confirmed that traditional mounds are a suitable method for wastewater management for this development. The correspondence from the SHA is appended to this document in Appendix F.

5.4 ROADWAYS

Primary access to the site is provided from Range Road 3042 which extends along the western boundary of the plan area and intersects with Township Road 372 (Fleury Road) which connects directly to Highway 41 to the west. This municipal road falls under the jurisdiction of the RM of Corman Park.

A Traffic Impact Assessment (TIA) was prepared by Associated Engineering for the Eagle Heights Estates. The TIA included forecasting anticipated traffic volumes generated as a result of the development, establishing the permanent highway access point along Highway 41, and making recommendations concerning necessary highway intersection upgrades to ensure efficient and safe vehicle movements following full development of the lands.

The TIA estimates that at full development, Eagle Heights will generate approximately 680 vehicles trips per day. The TIA was submitted to the Ministry of Highways and Infrastructure (MHI) for review. MHI confirmed the Fleury Road intersection as a permanent highway access point. The TIA recommended the following improvements to the Highway 41 and Fleury Road intersection:

1. Installation of intersection delineation lighting on the east side of Highway 41 before full build out.
2. Installation of a right turn lane for northeast bound traffic along Highway 41 before full build out.
3. Reconfigure Township Road 372 to meet Highway 41 at a right angle.

The MHI agreed with the analysis and recommendations included in the TIA report. They also confirmed that all of the recommended improvements are warranted under current traffic conditions and that the improvements will be completed by MHI under the Safety Improvement Program (SIP). The TIA report and correspondence from the MHI are attached as Appendix D.

Range Road 3042 and the segment of Fluery Road extending from Highway 41 to its intersection with Range Road 3042 is a chip sealed pavement.

Range Road 3042 terminates at the south entrance to Eagle Ridge while Fluery Road terminates a half kilometer east of its intersection with Range Road 3042 as a result of the expansion of a large pond which has expanded over the last decade to over-top the road, making it impassable. Prior to 2006, Fluery Road provided a second means of access into the area and is currently categorized as a main farm access road on the RM map. As a result, the subject property has only a single point of access and egress. The developer has investigated an opportunity to extend Range Road 3042 south to Highway 5, but this is not an option due to the proximity of a new highway intersection to the proposed Saskatoon Freeway route and the existing permanent highway access point situated at Highway 5/Range Road 3040 leading into Discovery Ridge. The developer is in full agreement that a secondary means of access to this area would be beneficial in the long term to the existing and future residents of the area and would be willing to participate in a future project.

It is the developer's understanding that a segment of Range Road 3042 was upgraded with chip sealed pavement at the expense of the residents of Eagle Ridge. Chipped sealed pavement was a common form of paving used for residential development in the past. In early 2018, the RM adopted new road standards which require all external municipal and internal subdivision roadways to be constructed with asphalt concrete. Policy 11.2.2 of the OCP provides Council with the ability to assign all or some of the cost of constructing roads as may be required by the subdivision. It is expected that if Council endorses the subdivision of Eagle Heights that a condition of this endorsement will be to make the necessary improvements to the segments of municipal road impacted by the development.

The internal roadways have been designed to align with the current RM standard for country residential roads. Approximately 4 kilometres of roadway will be required to enable the full development of the property. It is expected that the requirements for roadway improvements will align with the proposed phasing plan and that a servicing agreement will be executed for each phase which will define the developer's responsibilities for new road construction as well as repairs to the existing seal coated roads during site development. A copy of the applicable road construction standard and the proposed surfacing design is attached as Appendix H.

5.5 SOLID WASTE

Domestic solid waste disposal within the development is anticipated to be managed by individual lot owners as a contracted service from one of several service providers in the Saskatoon area. Loraas Disposal Services Ltd. (Loraas) was contacted to ensure a licensed hauler in the Saskatoon area could accommodate the developments domestic solid waste demands. Loraas confirmed the ability to provide recycling services to the development. Correspondence received from Loraas can be found in Appendix E.

5.6 SHALLOW UTILITIES

SaskEnergy, SaskPower, and SaskTel will provide shallow utilities for the development, which currently service adjacent developments, and there are no foreseen issues in accommodating the development. A summary of the property servicing for Phase 1 is attached as Appendix I.

5.7 MUNICIPAL AND PROTECTIVE SERVICES

Police and Fire Services have both been contacted and have identified no concerns with responding to new development in the area. Building construction will need to comply with the fire codes per the RM's building bylaw and future home owners will be expected to carry an appropriate level of insurance coverage recognizing the rural location. Correspondence from these protective service providers is attached in Appendix E.

The development is located in the Prairie Spirit School Division (PSSD) with schools in the Village of Clavet and Town of Aberdeen. The PSSD has been contacted and identified no concern with additional students at either of these schools. The PSSD confirmed there is available capacity and they can also provide bus service to this development.

Correspondence from the PSSD is attached in Appendix E.

6.0 PUBLIC CONSULTATION

Public engagement on this project was initiated in conjunction with the RM's Call for Proposals in December 2013 with the distribution of a mail-out to all property owners situated within 1.6 km of the subject property. This mail-out represented the developer's initial intentions for the development of the site which at the time included the subdivision of 95 country residential lots. This mail-out provided contact information for the developer's consultant and directed recipients to a Place Speak web page which was established as a portal for exchanging information related to the project and a basis for interested property owners to stay in touch with the project. Responses to this initial mailing were received in the form of a telephone call, a single post on the Place Speak forum page and by email. A copy of the mailing and related responses is attached as Appendix J.

Shortly after completing this initial engagement, the developer met with three members of the Eagle Heights Community Association Board to discuss their concerns regarding the project. Shortly following this meeting, the developer was informed that a regional planning study was being initiated and that consideration of all multi-parcel subdivision applications were being suspended pending completion of a Regional Land Use Map. As a result of this decision, the Place Speak web page associated with this project was shutdown in May 2014 and the project was suspended pending receipt of authorization to proceed from the RM of Corman Park.

In early 2018, the developer was informed that the draft regional plan was substantially complete and that work on the project could be re-initiated. Additional technical investigations were completed including the TIA and hydrogeological reporting. A public open house was organized and hosted at the Sunset Estates Community Hall on the evening of July 11, 2018. The come and go event included a series of display boards providing information on the development proposal. The developer and members of the consulting team were present and actively engaged in discussion with event participants. The public response to the proposed development was not overly supportive with similar concerns expressed as received following the 2013 mail out. All of the written comments received in association with this event are attached as Appendix J.

Section 3.1 of this report summarizes the concerns expressed from these consultations and provides responses to these concerns.

A fourth meeting was hosted with members of the Eagle Ridge Community Association Board, the developer and members of Associated Engineering on Monday December 10, 2018. The purpose of this meeting was to discuss the draft CDR and identify any remaining community concerns associated with the proposed Eagle Heights development. A written document was supplied by the Board outlining the following concerns and requests. A copy of this document is attached in Appendix J.

Concern #1 – Safety concerns related to a substantial increase in traffic from the development of Eagle Heights on the current Highway 41 intersection and the physical impacts of this increased traffic on the local road network.

Eagle Ridge Request # 1 *– Complete paving of all internal roadways extending from Highway 41 to the Eagle Ridge south access prior to initiating housing development within Eagle Heights.*

Developer Response – Section 11.2.2. of the OCP requires a proponent to construct roads necessary to support subdivision and/or development of the lands to the standards established by Council. The developer acknowledges that the RM of Corman Park has published country residential road standards that will apply to the development of Eagle Heights. The developer is proposing to subdivide and develop the land in four phases as per Section 5.2.3.22 of the OCP to ensure that the construction of services does not unnecessarily precede lot development. It is expected that a servicing agreement will be executed for each phase of subdivision which will define the responsibility and timing for road construction necessary to support each phase.

Eagle Ridge Request # 2 *– Complete all recommended improvements to the Highway 41 intersection prior to initiating housing development within Eagle Heights.*

Developer Response – The developer was responsible for preparing and submitting a Traffic Impact Assessment (TIA) to the Ministry of Highways and Infrastructure (MHI) which assessed the implications of the forecasted increase in traffic associated with the development of Eagle Heights on the level of service provided at the current highway intersection. This report and its recommendations was subsequently endorsed by MHI and used in conjunction with a TIA submitted for a proposed commercial development situated on the west side of the intersection to inform intended improvements to the intersection. As previously referenced, MHI has acknowledged that the recommended improvements are warranted under current traffic conditions and as such is taking sole responsibility for the construction project as part of its Safety Improvement Program. The approval of the TIA by MHI did not include any restriction to the timing for development of Eagle Heights and as a provincially managed project, the developer has no influence on the timing for this construction project. It is our understanding that the improvements are planned to be completed during the 2019 construction season.

Request # 3 *– Provide a temporary construction access for the initial phase of development from Fleury Road to limit the impact of this traffic on Range Road 3042.*

Developer Response – The developer is planning to construct a temporary approach from Fleury Road extending along the boundary of the municipal utility parcel situated directly east of the initial phase of subdivision to provide direct internal access to the property during construction. This will eliminate any construction traffic along Range Road 3042 during the initial phase of development. The details and coordination of this temporary internal access will be confirmed in conjunction with the execution of the servicing agreement.

Concern # 2 – The size and number of lots within Eagle Heights is not considered to be complementary to what is provided in Eagle Ridge.

Requests # 4 and 5 *– Apply a minimum lot size of 5.0 acres for all acreages along Range Road 3042 and a minimum lot size of 2.5 acres for the remaining internally situated lots.*

Developer Response – The RM of Corman Park policies suggest that complementary development may be achieved through a combination of visual buffering, house site separation and complementary lot sizing. Section 5.2.3.15 of the OCP states that a new multi-parcel development must seek to respond to the reasonable concerns and interests of existing abutting or nearby residents as it relates to achieving complementary development. We note that the policy does not imply that identical parcel size is the only way to ensure that a new development integrates positively with existing development.

Eagle Ridge consists of 26 lots ranging in size between 2.5 and 10 acres situated on 160 acres with an average lot size of 5.6 acres. As previously represented, Eagle Heights proposes 84 lots over 320 acres with sites ranging in size between 1.6 and 5.1 acres maintaining an average 2.47 acres through each and all phases.

The Eagle Heights subdivision has been refined over time in response to a variety of influences including a desire to maximize the retention of natural areas, to meet stormwater management requirements and to respond to initial public input. The original concept plan for the site as represented to the public in a mail out in 2013 proposed 95 lots over 320 acres. Since that time, the concept plan has been revised, reducing the total lot yield by 11% to the current proposal of 84 lots. We note that unlike Eagle Ridge which has only minimal public land dedication and no formal on site stormwater management facility, 25% of the gross land area in Eagle Heights is planned to be dedicated as municipal utility parcels in conjunction with the implementation of the stormwater management strategy, which reduces the net developable area by over 13 hectares.

The lots in Eagle Heights situated along the east side of Range Road 3042 range in size between 1.85 and 5.07 acres with the smaller lots planned to be situated at the northern end of the site, nearly 650 metres north of the closest residence in Eagle Ridge. Although the site areas are not identical between the two developments, it is noted that there are four residential lots planned to be situated directly east of Eagle Ridge, along the common road frontage and development interface. These lots range in size between 2.6 and 3.5 acres in size which are reasonably comparable to the 5.6-acre average lot area in Eagle Ridge. It is noted that there are more lots within Eagle Ridge (6) abutting this same segment of Range Road 3042 as there are proposed for Eagle Heights and that the plan provides for a transition to smaller lots as the distance from Eagle Ridge increases.

Four of the six lots along the development interface in Eagle Ridge are orientated to the east offering the greatest potential impact on their front yard view resulting from the development of Eagle Heights. These four properties are setback an average of 115 metres from the centreline of the roadway and three of these four sites have significant shelter belt plantings situated between the front of the dwellings and the roadway to the east, providing a visual buffer. The dwelling which does have an established tree line is setback approximately 170 metres from the road centreline. Given the minimum side yard setback of 45 metres applied to the new development in Eagle Heights, the closest a new dwelling could be to this dwelling is nearly 250 metres. It is noted that with the application of the RM's building setbacks, the closest a new dwelling in Eagle Heights could be to an existing dwelling in Eagle Ridge is approximately 115 metres which is a greater distance than is currently provided between adjacent sites within the Eagle Ridge subdivision.

Although the property sizes are not identical between the two communities, the developer contends that they have made decisions in designing a development concept that appropriately considers the impacts on existing residents of Eagle Ridge by:

- promoting larger lots along the common roadway frontage (Range Road 3042);
- transitioning to smaller lots as the distance from Eagle Ridge increases;
- orientating the lots to reduce the visual impact of development; and
- ensuring that a comparable separation is provided between existing and planned dwellings.

It is noted that consideration could be made to establish a tree line along the east side of Range Road 3042 to provide further visual separation between the two communities if desired by the RM Council. This decision would need to be vetted by the RM Director of Public Works considering the potential for such a tree line to impact the safe operation of the municipal road during winter months.

Concern # 3 and 4 – The length of time required to see full development of Eagle Heights will impact the quality of life for current residents.

Request # 6 *– Adopt architectural controls that are consistent with those employed in Eagle Ridge.*

Developer Response – The developer is willing to employ similar architectural controls as represented in Schedule A of the Eagle Ridge Community Association Bylaws.

Request # 7 *– Implement a condition that house construction must be initiated within one year of lot purchase and that the exterior of the house must be completed within one year of initiating construction.*

Developer Response – The developer is willing to consider this requirement within a purchase agreement subject to obtaining advice from a solicitor regarding the method and legal ramifications of enforcement of this requirement when a purchaser defaults on this obligation. It is noted that the RM of Corman Park does not enforce or have any involvement in this process outside of what the community zoning and building bylaws allow.

Request # 8 *– Provide evidence that there is sufficient demand for residential lots to support the proposal.*

Developer Response – At the time of this application the Saddle Ridge and Tuscan Ridge Estates subdivisions are the only known active multi-parcel country residential subdivisions in this area of the RM of Corman Park. According to the project website, there are 10 unsold lots available in the second phase of Saddle Ridge. Tuscan Ridge Estates is situated along Highway 394 near Hidden Ridge Estates and based upon the project website Phase 1 is 50% sold.

Request # 9 *– Provide evidence that the overall size and lot density of Eagle Heights will not depreciate the value of Eagle Ridge properties.*

Developer Response – Some competition between the two communities is inevitable and unavoidable to a certain extent. The opportunity exists to promote a form of development in Eagle Heights which offers something slightly different than what is provided in Eagle Ridge resulting in a broadening of the market interest in this area of the RM. Development of Eagle Heights will trigger significant investments into renewed transportation infrastructure in this area which will offer additional value to existing residents in Eagle Ridge and will certainly contribute to a coinciding appreciation in the value of their properties. By encouraging identical lot areas as represented by the Eagle Ridge community comments, greater and more direct competition will be created between the two communities, increasing the potential for newer homes in Eagle Heights to depreciate the relative value of older dwellings in Eagle Ridge. The opportunity exists for Eagle Heights to offer a slightly different residential option by offering lot sizes that cover off the lower end of the acreage size continuum enabling Eagle Ridge to offer an alternative for people looking for a larger, more mature acreage that is not available in the proposed new subdivision.

It is a fact that the market expectations and municipal standards for property servicing has dramatically increased the cost of country residential development in Corman Park in relation to what it was when Eagle Ridge was initially developed. The cost of development of Eagle Heights is estimated to be approximately $120,000.00 per lot meaning that new residents in this area are likely to invest well over $750,000.00 to construct a home and develop their property. Promoting a development that includes a variety of lot sizes and makes the most efficient use of the land is necessary for the development to be financially feasible for the developer and to maximize the accessibility of this type of housing in today’s market.

EAGLE HEIGHTS
Phase 1

PLAN OF PROPOSED SUBDIVISION OF PART OF W. 1/2 SEC. 11– TWP. 37 – RGE. 4 – W. 3rd M. RM OF CORMAN PARK NO 344 SASKATCHEWAN

SCALE 1:2000

Dimensions shown are in metres and decimals thereof.
Portion of this plan to be subdivided is outlined in red with a bold, dashed line and contains 82.46± ha (203.76± ac.) which includes 7.65± (18.91± ac) for streets.
Distances are approximate and may vary by ±5 metres.
Topographic survey performed October 2012.

Minumum building elevations:
Pond 1; 553.1 metres
Pond 2: 554.5 metres
Pond 3: 551.9 metres

B.J. Luey, September 1 , 2020
Saskatchewan Land Surveyor

SASKATCHEWAN LAND SURVEYORS ASSOC. B.J. LUEY 338 SLS Seal

Registered Owner dd/mm/yy
The signature above indicates that I (we) approve the Plan of Proposed Subdivision as presented.

Prepared by
Webb Surveys
12-2401cc CAS

Appendix A: Land Use Concept Plan

LEGEND

		AREA (HA)	# OF LOTS	TOTAL LENGTH OF ROAD (m)
COUNTRY RESIDENTIAL		84.44	84	4,030
STORM PONDS		31.63		
DRAINAGE CHANNEL		0.44		
ROADS		12.79		

PROJECT No. 20124165
DATE: 2020/08/31
APPROVED: B. DELAINEY
SCALE: 1: 5000
DWG. No. 4165-UP-CNT

Associated Engineering

EAGLE HEIGHTS
CORMAN PARK CDR

CONCEPT PLAN

\\s-sas-fs-01\projects\20124165\00_Cebryk_Res_Devel\Working_Dwgs\100_CivilPlanning\4165-00-up-cnt_pln_20200831.dwg
DATE: 2020-08-31, Mike Pawluski

Appendix B: Preliminary Geotechnical Investigation

SNC•LAVALIN Environment

Geotechnical Investigation
Proposed Residential Subdivision
W½-11-37-04-W3M
East of Saskatoon, Saskatchewan

Prepared for Chris Cebryk

Prepared By:

PROFESSIONAL ENGINEER
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SASKATCHEWAN

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Intermediate Geotechnical
Engineer

August 2013

Internal Ref: 613596

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NOTICE TO READERS

This report has been prepared and the work referred to in this report have been undertaken by MDH Engineered Solutions Corp. (MDH), Member of the SNC-Lavalin Group for the exclusive use of Chris Cebryk (the Client), who has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. MDH accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect MDH's best judgment based on information available at the time of preparation of this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered or project parameters change, modifications to this report may be necessary.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

The contents of this report are confidential and proprietary. Other than by the Client, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of the Client and MDH.

1.0 INTRODUCTION

This report presents the results of the geotechnical site investigation conducted for the proposed residential subdivision to be constructed within W½-11-37-04-W3M, east of Saskatoon, Saskatchewan. The report provides design considerations and recommendations for residential foundation construction and development of the subdivision utilities and roadways, and also provides an assessment of the subsurface conditions for the design of on-site wastewater disposal systems. The geotechnical investigation included the drilling program along with field and laboratory soil testing.

2.0 SITE DESCRIPTION AND CHARACTERIZATION

2.1 Site Location, Description

The proposed residential subdivision, which is currently utilized as farmland/grassland, will be constructed within W½-11-37-04-W3M, approximately 5 km northeast of Saskatoon, Saskatchewan. The subject site is bound by Fleury Road (gravel road) to the north, farmland to the east and south, and farmland/residential development to the west (farmland adjacent to the NW¼ -11-37-04-W3, residential subdivision adjacent to the SW¼ -11-37-04-W3). Provincial Highway No. 41 is located approximately 800 m to 2,500 m west of the western boundary of the proposed subdivision (highway runs diagonally in a southwest-northeast direction). The study area consists of rolling hills, with local drainage trending toward several low-lying areas. Based on topographic survey data provided by Webb Surveys, the ground surface elevation within the study area ranges from about 549 to 565 m above sea level (masl). The location of the study area and surrounding land usage has been shown as Figure II.1, Appendix II.

2.2 Physiography

The study area is situated in the physiographic region known as the Saskatchewan Rivers Plain (Acton et. al., 1960), which is characterized as gently undulating to rolling glacial-alluvial plains (glacial lake plains), Aeolian plains (dunes) and till plains. The surficial soil deposits typically consist of variable textured lacustrine and alluvial sands, silt and clays, Aeolian sands, glacial till and localized bedrock exposures in the South Saskatchewan River.

2.3 Topographic Setting

Based on topographic survey data provided by Webb Surveys, the ground surface elevation within the study area ranges from about 549 to 565 masl.

2.4 Geology

2.4.1 Regional Geological Setting

Successive marine transgression and regression in the Upper Cretaceous Period deposited a thick, complex sequence of marine silt and clay deposits across central Saskatchewan. The Upper Cretaceous aged Lea Park Formation shale constitutes the base of "freshwater" exploration associated with the shallow hydrostratigraphy in the study area; the Lea Park Formation (and its stratigraphic equivalent, the Pierre Formation) is a known marker horizon (i.e. it provides stratigraphic control) for most of southern Saskatchewan. The Lea Park Formation is composed of non-calcareous, grey, marine clay and silt ("shale") found across the entire Saskatoon area. There are no known receptors for contaminants below this formation in the study area.

Marine regression in the Upper Cretaceous Period resulted in the deposition of calcareous and non-calcareous stratified sands, silts, and clays over the Lea Park Formation shale. These stratified sands, silts, and clays are called the Judith River Formation. This unit is found only as erosional remnants in the study area.

The Bearpaw Formation is the uppermost "bedrock" unit encountered in the Saskatoon area. It is composed of non-calcareous, grey, marine clay, silt, and sand ("shale") which conformably overlies the Judith River Formation.

Prior to glaciation, the Saskatoon area was mature and well integrated with a complex series of water courses and deep valleys. Erosion and subsequent alluvial and colluvial deposition of Tertiary-aged sediments filled these valleys. These sediments are generally comprised of preglacial quartz and chert sands and gravels, interbedded with organic rich silts and clays. Millions of years of deposition resulted in these preglacial deposits partially infilling these valleys.

The preglacial Tyner and Battleford Valleys form the dominant bedrock features in the Saskatoon area. These valleys were cut into the bedrock surface primarily before and during the first glaciation (and to a lesser extent during subsequent glaciations) in the early Pliestocene Epoch. These valleys carried melt-water, depositing significant accumulations of clastic deposits within the lowland. The Tyner Valley runs from southwest to central Saskatchewan and the Battleford Valley runs from northwest to central Saskatchewan. These valleys have numerous tributaries, mesas, and plateaus and a complex hydrostratigraphy.

The stratified preglacial sediments deposited between the bedrock surface and the glacial sediments are formally called the Empress Group (Whitaker and Christiansen, 1972). These preglacial sediments sit unconformably on the bedrock surface and have been informally called the lower unit of the Empress Group. The sediments from the bedrock surface to the ground surface are collectively called "drift". They are divided into preglacial and postglacial drift.

Over the past 2 million years, Saskatchewan has undergone at least eight periods (and possibly ten periods) of significant glacial advance. The final deglaciation occurred in the Pleistocene Epoch between approximately 17,000 and 10,000 years ago (Christiansen, 1979). Glaciation in the Pleistocene resulted in a complex arrangement of proglacial and glacial sediments interbedded with non-glacial stratified sediments (fluvial, deltaic, lacustrine, aeolian, etc.) deposited between glaciations and during interstadal deglaciation. Erosional valleys produced during interglacial periods commonly intersect preglacial valleys forming complex stratigraphic arrangements. The glaciofluvial, fluvial, alluvial and colluvial sediments that were deposited during preglacial and interglacial periods in the valleys were covered by tills during the final stages of glaciation, forming deep buried valley aquifer systems that are often flanked by more regionally extensive blanket aquifer systems. These systems are now buried with deposits from subsequent glacial and non-glacial periods, with limited indication of their presence at depth. They form the most significant freshwater aquifers in the province.

The complex arrangement of glacial, glaciofluvial, and glaciolacustrine deposits within the study area are formally divided into two primary groups: 1) the Sutherland Group, and 2) the Saskatoon Group (Christiansen, 1992). Both the Saskatoon Group and the Sutherland Group are primarily comprised of unsorted till formed by glacial erosion and reworking of Precambrian igneous and metamorphic rocks, Paleozoic limestones, and Cretaceous marine shales during glacial advance. Significant intratill and intertill stratified deposits also comprise the Quaternary deposits.

The oldest till units of the Sutherland Group have a higher clay content compared to the overlying Saskatoon Group tills due to a higher percentage of marine shale being incorporated into the matrix of the till. Similarly, the Saskatoon Group tills have higher carbonate contents due to incorporation of more Paleozoic limestones and dolomites into the matrix. The lithological compilation, combined with carbonate content signatures, can be used to help identify each formation. The stratified deposits between these two groups, and between the individual till formations, represent the major aquifers across the study area.

Melting of the last glacier (between about 17,000 and 10,000 years ago) deposited a till plain characterized by a hummocky topography of kettles and eskers, covered with glacial and glaciofluvial/glaciolacustrine deposits and postglacial sediments (Surficial Stratified Deposits). These features form the surface topographic features in the area.

The complex stratigraphic arrangements of the Tertiary and Quaternary deposits were further complicated by extensive faulting due to either the dissolution of the deep evaporite deposits beneath the area and subsequent collapse of near surface sediments (Christiansen and Sauer, 2001), or by continental tectonic extension in the Cenozoic possibly combined with melting of gas hydrates during glacial retreat (Gendzwill and Stauffer, 2006). These depressions were infilled (generally with till) during subsequent glaciations, often resulting in discontinuous and hydraulically isolated accumulations of stratified deposits. Delineation of these collapse structures is important as they are often significant enough to displace aquifer units, resulting in lateral connectivity disruptions and significant aquifer boundary effects during water production.

The hydrostratigraphy of interest in the study area (in ascending order) is:

1. The Lea Park Formation;
2. The Judith River Formation;
3. The Bearpaw Formation;
4. The Empress Group;
5. The Sutherland Group:
    a. The Mennon Formation;
    b. The Dundurn Formation; and
    c. The Warman Formation;
6. The Saskatoon Group:
    a. The Floral Formation;
    b. The Battleford Formation; and
    c. The Surficial Stratified Deposits.

2.4.2 Geology of Study Site

Based on a review of available published geological information (Hydrogeology Mapping of NTS Mapsheet Saskatoon 73B, MDH Report No. M1890-1030109, dated April, 2011), the subsurface deposits in the study area consist of at least 100 m of surficial stratified deposits and glacial drift deposits (Saskatoon and Sutherland Group deposits), followed by Cretaceous aged bedrock of the Bearpaw Formation.

2.5 Hydrogeology

2.5.1 Regional Hydrogeological Setting

Deposits of silts, sands, gravels, and cobbles form relatively high hydraulic conductivity units that form the paths of least resistance for groundwater flow and solute transport. These units are called aquifers. An aquifer is defined as saturated geologic unit that is permeable enough to transmit significant quantities of water under ordinary hydraulic gradients, or as the term is commonly used in the water-well industry: an aquifer is a saturated geologic unit that is permeable enough to yield economic quantities of water to wells (e.g. Freeze and Cherry, 1979; Kruseman and de Ridder, 1990). Aquifers can be part of a geological formation, the entire formation or group of formations. Conversely, silt and clay rich deposits form low hydraulic conductivity units that impede groundwater flow and solute transport. An aquitard is a saturated geologic unit which is permeable enough to transmit water in significant quantities when viewed over large areas and long periods, but does not yield economic quantities of water to wells (Kruseman and de Ridder, 1990). These units are called aquitards and generally have hydraulic conductivities of less than $1x10^{-7}$ m/s. The spatial arrangement of aquifers and aquitards in three-dimensions form the hydrostratigraphy of a site. When combined with the physical characteristics of the hydrostratigraphic units, an overall view of the hydrogeology can be determined.

Gravel, sand, silt, and/or clay predominantly comprise the Surficial Stratified Deposits, the intertill stratified deposits, the Empress Group sediments, and the Upper Cretaceous sand/silt stratified units; the lithology of these stratified deposits can vary significantly over short distances and be aquifers or aquitards depending on lithology, hydraulic connectivity, potential well yields, etc. Although none of these horizons are comprised of laterally continuous gravels and sands, the complexities of the mappable stratified deposits do not preclude the potential of finding lithologies capable of supplying small quantities of water. The actual amount of water available will be based on the site specific hydraulic properties of the sediments, and the thickness and lateral continuity of higher permeability sediments.

Bedrock silts, sands, gravels, and preglacial valley fill sediments form major “freshwater” aquifers across Saskatchewan. The preglacial Battleford and Tyner Valleys are the major bedrock buried valley aquifer systems in the area.

In addition to the major buried valley aquifers incised into the marine shales, the overlying Quaternary aged stratum contains both blanket and channel deposits of sand and gravel that were deposited by retreating and/or advancing glaciers. These deposits are found between the major till units and are called intertill stratified deposits. These intertill stratified deposits can form broad, laterally extensive aquifers and/or small channel aquifers, depending on their depositional setting and subsequent erosion. Although intratill deposits are abundant, they generally form only isolated, discontinuous pockets, and are therefore not significant with respect to groundwater sourcing.

In the Saskatoon area, there are several major mappable horizons, above the Lea Park Formation, that may contain aquifer sediments, these are as follows (in ascending order):

1. The Judith River Formation Stratified Deposits (Judith River Aquifer);
2. The Ardkenneth Member Stratified Deposits (Ardkenneth Aquifer);
3. The Cruikshank Member Stratified Despoits (Cruikshank Aquifer);
4. The Empress Group Stratified Deposits (Empress Group Aquifer);
5. The Mennon Formation Stratified Deposits (Mennon Aquifer);
6. The Lower Dundurn Formation Stratified Deposits (Lower Dundurn Aquifer);
7. The Upper Dundurn Formation Stratified Deposits (Upper Dundurn Aquifer);
8. The Warman Formation Stratified Deposits (Warman Aquifer);
9. The Lower Floral Formation Stratified Deposits (Lower Floral Aquifer);
10. The Middle Floral Formation Stratified Deposits (Upper Floral Aquifer);
11. The Battleford Formation Stratified Deposits (Battleford Aquifer); and
12. The Surficial Stratified Deposits (Surficial Aquifer).

2.5.2 Hydrogeology of Study Area

Based on a review of available published geological information (Hydrogeology Mapping of NTS Mapsheet Saskatoon 73B, MDH Report No. M1890-1030109, dated April, 2011), the study area potentially overlies the Judith River, Ardkenneth, Empress, Lower Floral and Upper Floral Aquifers. The estimated depths to the respective aquifers are approximately as follows:

- Judith River and Ardkenneth Aquifers: >100 mbgl;
- Empress Aquifer: >85 mbgl;
- Lower Floral Aquifer: >60 mbgl;
- Upper Floral Aquifer: <25 mbgl.

The South Saskatchewan River (SSR) is located approximately 7 to 8 km west of the study area. The SSR is a regional discharge receptor for many of the aquifer systems in the area. As such, the expected direction of regional groundwater flow is toward the west.

2.6 Groundwater Wells, Dugouts

A review of the Saskatchewan Water Security Agency (WSA) database revealed that there are at least 163 registered water wells within a 5 km radius of the subject site. One water well was noted within the NW¼-11-37-04-W3M. Approximately 25% of the wells are relatively deep, small diameter wells whereas the remaining ~75% are relatively shallow, large diameter wells. The wells are typically concentrated in areas of higher residential development (i.e., residential subdivisions similar to the proposed subdivision), with spare distribution in areas of lower residential density. The distribution of the registered wells has been shown on Figure II.2, Appendix II.

A visual review of the subject site and the surrounding 10 quarter sections revealed 2 dugouts coinciding with individual residences, and multiple dugouts within the Eagle Ridge residential subdivision.

3.0 SCOPE

The general scope of work for this project was to complete a geotechnical investigation for the study area in support of development of the proposed residential subdivision, including residential foundations, subdivision utility installation, subdivision roadways and on-site wastewater disposal systems. The scope of work also included slope stability assessment.

The following work was completed:

- Drill 29 boreholes in a general grid pattern throughout the study area (32 boreholes were proposed, but 3 were eliminated (boreholes 613596-04, 28 and 32) due to practical site access constraints for a rubber-tired drill rig);
- Install piezometers in all boreholes for groundwater monitoring purposes;
- Log all boreholes, conduct geotechnical field tests and collect soil samples for laboratory testing;
- Perform laboratory testing of select soil samples obtained from boreholes, including water contents, grain size distribution analysis, Atterberg limits and unit weights; and,
- Produce a report that summarizes the field investigation and provides design considerations and recommendations for the proposed residential development.

4.0 GEOTECHNICAL INVESTIGATION DETAILS

4.1 Drilling Investigation

The drilling program was conducted between 2 and 11 July 2013. Boss Drilling Ltd. from Saskatoon, Saskatchewan utilized a truck-mounted CME 75 drill rig equipped with an automatic standard penetration test (SPT) hammer to drill the boreholes.

A total of 29 boreholes were drilled with depths ranging from 5.6 m to 12.1 mbgl. The Site Plan showing the location of the boreholes is presented on Figure III.1, Appendix III.

Disturbed soil samples were collected from the auger cuttings (grab samples) and from the SPT sampler. All soil samples were transported to the MDH soil testing laboratory in Saskatoon. The soil samples were stored in a humidity-controlled room at the MDH laboratory to prevent drying prior to testing. Soil samples collected for each borehole are shown on the borehole logs in Appendix IV.

Field testing included SPT's and pocket penetrometer tests (PP). The results of field tests are presented on the borehole logs in Appendix IV. The Terms, Symbols and Abbreviations used on the borehole logs are available in Appendix I.

The approximate borehole locations were determined using handheld GPS coordinates (ground surface elevations were not obtained).

Piezometers were installed in all boreholes. The boreholes were backfilled with bentonite chips (as directed by the Client). The piezometers were decommissioned (backfilled with bentonite, cut off below ground level) on 30 July 2013.

4.2 Geotechnical Laboratory Testing

Geotechnical laboratory tests were conducted on soil samples obtained from the boreholes. The basic soil characteristic tests included water contents, grain size distribution analysis, Atterberg limits and unit weights.

The detailed laboratory test results are provided in Appendix V. Select laboratory test results are also annotated on the borehole logs presented in Appendix IV. The results of the laboratory analysis have been used to establish the soil texture classification of the near-surface soils, which is required for the design of on-site wastewater disposal systems. The results of the soil texture classification, as per the "Saskatchewan Onsite Wastewater Disposal Guide", have been presented in Table 4.1.

Table 4.1 – Soil Texture Classification.

Borehole	Sample Depth (m)	Grain Size Analysis (%)			Soil Texture Classification
		Sand and Gravel	Silt	Clay	
613596-01	1.0	39	43	18	Loam
613596-02	1.0	3	60	37	Silty clay loam
613596-03	1.0	50	32	18	Loam
613596-05	1.0	59	30	11	Sandy loam
613596-06	1.0	24	55	21	Silt loam
613596-07	1.0	46	34	20	Loam
613596-08	1.0	44	36	20	Loam
613596-09	1.0	37	40	23	Loam
613596-10	0.5	21	55	24	Silt loam
613596-11	1.0	17	60	23	Silt loam
613596-12	1.0	9	55	36	Silty clay loam
613596-13	1.0	16	63	21	Silt loam
613596-14	1.0	10	47	43	Silty clay
613596-15	1.0	40	42	18	Loam
613596-16	1.0	2	62	36	Silty clay loam
613596-17	1.0	44	35	21	Loam
613596-18	1.2	30	50	20	Silt loam
613596-19	1.0	70	22	8	Sandy loam
613596-20	1.0	41	41	18	Loam
613596-21	1.1	31	49	20	Silt loam / loam
613596-22	1.0	12	60	28	Silty clay loam / silt loam
613596-23	1.2	9	59	32	Silty clay loam
613596-24	1.0	7	70	23	Silt loam
613596-25	1.0	41	37	22	Loam
613596-26	1.0	49	34	17	Loam
613596-27	1.1	29	49	22	Silt loam / loam
613596-29	1.0	25	56	19	Silt loam
613596-30	1.0	35	61	24	Loam
613596-31	1.0	53	33	14	Loam / sandy loam

5.0 SUBSURFACE CONDITIONS

5.1 Soil Profile

The general soil profile consisted of organic topsoil overlying variable deposits of silt/clay in the majority of the boreholes (to depths of approximately 0.2 to 3.0 mbgl), followed by an extensive deposit of glacial till, which extended to a depth of at least 12.1 mbgl, the maximum depth drilled. The surficial silt/clay deposits were not encountered in boreholes 613596-03, 08, 19, 25, 26, 27 and 31. Inter/intra till sand/silt deposits were encountered in boreholes 613596-01, 10 and 21. Extensive concentrations of cobbles/boulders were encountered in most boreholes during test drilling.

The silt/clay deposits were typically soft to firm, low to medium plasticity and moist. The glacial till soils were typically low to medium plasticity and moist. The upper portion of the glacial till soils was soft to firm and moist to wet at many locations, becoming progressively stiffer with depth (i.e., very stiff to hard). Where encountered, the inter/intra till sand/silt deposits were typically loose to compact/soft and wet (groundwater seepage/sloughing conditions).

5.2 Groundwater, Seepage and Sloughing

Standpipe piezometers were installed in all boreholes. The location of the piezometers has been shown on Figure III.1, Appendix III. The piezometers were constructed using ~ 1 m of horizontally slotted 50 mm diameter PVC screen attached to 50 mm diameter PVC riser pipe. The annular space surrounding the piezometer screen was filled with filter sand and/or native sand/silt (sloughed material). The annular space above the sand pack consisted of bentonite chips, extending to ground surface. The piezometer installation details are presented in Appendix IV following the corresponding borehole logs. The piezometers were decommissioned (backfilled with bentonite, cut off below ground level) on 30 July 2013.

The groundwater levels recorded during this investigation have presented in Table 5.1. A review of Table 5.1 reveals that the groundwater level was situated approximately 1.3 to 10.5 mbgl. It is noted that several sloughs exist within the study area (surface outcropping of the groundwater table). It must also be noted that higher and potentially perched groundwater levels should be expected during or following spring thaw or periods of precipitation, and that the groundwater levels will fluctuate seasonally.

The apparent direction of near-surface groundwater flow was variable, and generally mirrored the topographic surface (i.e., flow from high areas to low areas).

Table 5.1 – Groundwater monitoring results.

Piezometer ID	Groundwater Depth (mbgl) 30 July 2013
613596-01	2.25
613596-02	2.18
613596-03	1.71
613596-05	3.03
613596-06	1.57
613596-07	5.15
613596-08	3.40
613596-09	2.46
613596-10	1.66
613596-11	2.54
613596-12	1.58
613596-13	5.12
613596-14	2.47
613596-15	5.35
613596-16	2.56
613596-17	DRY (>6.1)
613596-18	3.19
613596-19	10.53
613596-20	3.30
613596-21	2.17
613596-22	4.70
613596-23	5.99
613596-24	2.00
613596-25	5.09
613596-26	5.56
613596-27	3.13
613596-29	1.32
613596-30	4.05
613596-31	1.72

Groundwater seepage and sloughing conditions were encountered during test drilling. The depths at which groundwater seepage and sloughing conditions were encountered have been shown on the borehole logs in Appendix IV.

5.3 Cobbles and Boulders

Cobbles and/or boulders were encountered in the majority of the boreholes during test drilling, with extensive concentrations being encountered at some locations (i.e., boulder pavements). Multiple drilling attempts were required to advance the borehole to the target depth at many locations (due to auger refusal on cobbles/boulders). The depths at which cobbles/boulders were encountered have been shown on the borehole logs in Appendix IV. Glacial till is comprised of a heterogeneous mixture of clay, silt, sand and gravel-sized particles. Due to the nature of formation and deposition, glacial till also inherently contains larger particle sizes (cobbles and boulders). Cobbles and boulders are often located randomly within glacial till deposits but can also form sorted layers, such as boulder pavements. The actual location and frequency of cobbles and boulders varies and the probability of encountering such deposits increases with the number of holes drilled, volume of soil excavated, number of piles installed, etc. Considering this, cobbles and boulders should be anticipated during excavation and installation of foundations at this site.

6.0 GEOTECHNICAL RECOMMENDATIONS

6.1 Geotechnical Considerations

The subsurface soil profile consisted of variable deposits of silt/clay (at the majority of the boreholes locations) overlying glacial till. The silt/clay deposits were soft to firm, as was the upper portion of the glacial till deposits at many locations. Groundwater seepage and sloughing were encountered during test drilling. The groundwater level was situated from at-surface (existing sloughs) to 10.5 mbgl at the time of the field investigation. Higher and potentially perched groundwater conditions may be encountered in the future.

It is anticipated that the majority of the proposed residences will have basements (where feasible) and attached garages/decks. It is understood that footings foundations will preferably be utilized for the majority of the residences, while pile foundations will likely be utilized for the garages and decks. It is anticipated that the residences and garages will utilize grade-supported concrete floor slabs.

It is recommended that basement floor elevations should be maintained a minimum of 600 mm above the current groundwater table (depth to groundwater varies appreciably across the site). Where it is not possible to maintain this clearance above the groundwater table (i.e., in close proximity to existing sloughs and in low-lying areas of the site), basements are not recommended due to the potential for flooding. It is anticipated that subdivision development could induce the development of perched groundwater conditions which will fluctuate seasonally depending on the amount of precipitation, surficial runoff, snow melt, irrigation etc. As such, maintaining adequate drainage adjacent to the residences and providing perimeter and sub-floor drainage systems will be critical to minimize the potential for water seepage through the foundations. Additionally, extending downspouts well away from the residences is essential.

The subgrade soil conditions at the typical footings depth (i.e., 1.2 to 3 mbgl) consisted of variable deposits of silt/clay and glacial till. Footings based below the depth of frost penetration on suitable naturally deposited, undisturbed soil (free of organics, deleterious materials or overly soft/weak soils) should perform satisfactorily. For continually heated residences with basements or for adequately insulated foundations (i.e., strategically placed rigid polystyrene insulation), it will be possible to base the footings at a higher elevation (minimum of 1.2 m below finished grade) provided that the footings are based on suitable naturally deposited, undisturbed soil. Soft/weak soils will be encountered at the design footing elevation at some locations. In these areas, it will be necessary to over-excavate and replace some of these soils with compacted structural fill, base the footings below these soils and/or widen the footings to reduce the bearing pressure exerted on the soil.

A deep foundation system consisting of drilled, cast-in-place concrete piles would perform satisfactorily as a foundation support. Temporary casing will be required to complete the installation of drilled piles at some locations. Helical screw piles are commonly used for residential foundations in the Saskatoon area. However, considering the frequency of cobbles/boulders encountered during test drilling, screw piles are not recommend due to the (high) potential for premature pile refusal and/or pile damage.

Design considerations and recommendations have been presented for frost action; site preparation; fill materials, placement and compaction; foundations; earth retaining structures; grade-supported concrete floor slabs; foundation concrete; grade beams; subdivision roads and parking structures; and, slope stability commentary.

6.2 Frost Action

The near-surface subgrade soils are considered to be susceptible to frost heaving if provided access to water. According to U.S. Corps of Engineers (USACE) Frost Design Soil Classification, the soil types encountered in this area can be classified as F3 or F4.

The estimated frost depth of the subgrade soils was calculated using the modified Berggren equation provided in the Canadian Foundation Engineering Manual (CFEM) under various surface covers. The estimated frost penetration depths are summarized in Table 6.1.

Table 6.1 – Estimated frost penetration depth under various surface covers.

Surface Cover	Design Return Period		
	Normal	10 Year Extreme	50 Year Extreme
	Estimated Frost Penetration Depth (m)		
Gravel	2.0	2.1	2.4
Asphalt	2.0	2.1	2.4
Concrete	1.9	2.0	2.2

6.2.1 Procedures to Mitigate Frost Action in Buried Utilities

The native soil near ground surface is considered to be frost susceptible. MDH recommends that buried utilities that are frost sensitive should have a minimum soil cover of 3.0 m. Frost sensitive utilities buried with less than the recommended soil cover should be protected with rigid polystyrene insulation to avoid frost effects that may cause damage to the utility pipes. Rigid insulation placed under areas subject to vehicular wheel loads should be provided with a minimum cover of 600 mm of compacted granular base and/or pavement. The design of the insulation system (depth, extent, thickness, etc.) will depend on several factors and should be determined in consultation with MDH.

6.2.2 Frost Action and Foundations

The volume increase that occurs when water changes to ice is one of the causes of frost heave. However it is also recognized that a phenomenon known as ice segregation is the predominant mechanism: water is drawn from unfrozen soil to the freezing zone where it accumulates to form layers of ice, forcing soil particles apart and causing the soil surface to heave. The magnitude of frost heave due to ice segregation can be much more severe than that of a simple state change in the soil porewater. As such, movement-sensitive foundations should be founded below the depth of frost penetration. Alternatively, measures to prevent ice segregation must be taken (i.e. dewatering, insulation, heating the area, replacement of frost-prone soil with stable fill, etc.) Such measures (if required) should be designed in consultation with MDH.

A different form of frost action, called 'adfreezing', occurs when soil freezes to the surface of a foundation. Heaving pressures developing at the base of the freezing zone are transmitted through the adfreezing bond to the foundation, producing uplift forces capable of appreciable vertical displacements. Relatively little is known of the magnitude of the forces that may be generated, but bond strengths of adfreezing in the order of 100 kPa for steel surfaces and 70 kPa for wood and concrete have been measured. Providing a bond-breaker between the foundation and the soil can reduce the potential for foundation movements due to adfreezing forces.

6.3 Site Preparation

6.3.1 General

Excess water should be drained from the work areas as quickly as possible both during and after construction. Initial grading operations should be focused on providing surface drainage, such that precipitation and surface run-off is directed away from work areas.

Following stripping of topsoil and excavation to design subgrade elevation, the exposed subgrade should be inspected by qualified MDH personnel to verify the removal of unsuitable materials and to provide additional recommendations, as appropriate. Unsuitable materials include topsoil, organic matter, vegetation, oversized material and other deleterious materials. Topsoil may be stockpiled and re-used for non-structural areas only, such as landscaping.

As a minimum (unless otherwise stated), all exposed subgrade soil within the proposed development areas should be scarified to a minimum depth of 200 mm, moisture conditioned (wetted or dried) to within ± 2% of optimum moisture content, and compacted to at least 96% of Standard Proctor Maximum Dry Density (SPMDD) tested in accordance with ASTM Method D 698. If weak soil conditions are encountered and scarification/compaction is not practical, subgrade stabilization techniques will be required (as discussed in the following section).

6.3.2 Proof Rolling

To verify that competent and uniform soil subgrade support conditions have been achieved, proof rolling of the subgrade should be performed by two passes of a dual-wheel truck (or comparable equipment) with a minimum of 80 kN single axle load. Soils which display rutting or appreciable deflections upon proof-rolling should be over-excavated to expose more competent soil and replaced with suitable engineered fill. Alternately, the use of geosynthetics (woven geotextile, geogrid in conjunction with non-woven geotextile, or, combination geotextile/geogrid products), possibly in conjunction with some over-excavation, may be an alternative. If geosynthetics are utilized, it is recommended that granular fill materials be placed directly over the geosynthetics. The geosynthetics should be placed in accordance with the manufacturer's recommendations. Construction techniques should be designed to minimize the potential for damage to the geosynthetics and underlying subgrade soils (i.e., end-dump and spread methods, use of long reach and/or low contact pressure equipment, etc.). MDH should be retained to provide guidance with respect to subgrade improvement measures.

Following efforts to stabilize the soil, proof rolling should be repeated. All proof rolling and compaction efforts should include documentation detailing the findings, including photographs where possible. All finished subgrades should be protected from construction traffic and erosion as soon as possible.

6.3.3 Roadways and Parking Areas

For subgrade support of the roadway and parking areas, a uniformly smooth subgrade surface should be prepared, containing no ruts, pot holes, loose soils, or any imperfections that can retain water on the surface. Isolated pockets of unsuitable material should be removed and replaced with similar material adjoining the excavation to allow for uniform performance. As a minimum, the soils in all areas supporting vehicle traffic should be excavated to provide a minimum 300 mm sub-cut below design subgrade elevations and re-compacted to provide a uniform bearing condition. The following soil subgrade recommendations should be followed, depending on whether the design soil subgrade is above or below the existing grade. The prepared subgrade should be crowned or cross-sloped to facilitate the flow of surface water off the roadway/parking area. A minimum of 3% cross-slope is recommended. Sub-surface drainage systems can be used to control the moisture profile within the subgrade soils and to improve the long-term performance of the structures.

6.3.3.1 Fill Sections

If the exposed subgrade surface is more than 300 mm below the design subgrade elevation, the subgrade should only be prepared by scarifying to a minimum depth of 200 mm, moisture conditioning (wetted or dried) to within ± 2% of optimum moisture content, and compacting to 98% of SPMDD.

If the exposed subgrade surface is less than 300 mm below the design subgrade elevation, the subgrade should be over-excavated to a minimum depth of 300 mm below the design subgrade surface. The lateral extent of over-excavation should be at least 1.5 m, or equal to the depth of over-excavation, whichever is greater. The exposed subgrade should then be scarified and compacted as outlined above. All fill soils placed to raise the subgrade elevation to design grade should be placed in loose lifts, moisture conditioned, and compacted as outlined above.

6.3.3.2 Excavation Sections

If the design subgrade elevation requires excavation, the subgrade should be over-excavated to a minimum depth of 300 mm below the design subgrade surface. The lateral extent of over-excavation should be at least 1.5 m, or equal to the depth of over-excavation, whichever is greater. The exposed soil subgrade should then be scarified and compacted as outlined above.

Subgrade preparation should not be performed on very soft, loose or wet subgrade as construction equipment may further weaken the subgrade. Subsequent to scarification and compaction, the prepared subgrade should be proof rolled as discussed in Section 6.3.2 to create a uniform bearing condition and firm even surface. Recommendations to stabilize saturated, yielding or pumping subgrade conditions, should they be encountered, should be determined in consultation with MDH. If any problems are encountered during the subgrade preparation, or if the site conditions deviate from those indicated by the boreholes, qualified MDH personnel should be notified to provide additional recommendations.

6.3.4 Temporary Excavations and Dewatering

The temporary slope angle of the excavations shall follow the recommendation stated in the Occupation Health and Safety Regulations, 1996 (OH&S). According to subsections (3) and (4) of part 260 of the OH&S Regulations, the majority of the subgrade soils within the anticipated depth of excavation may be classified as Type 4 soil. The maximum slope angle for temporary excavations in Type 4 soil shall be 3H:1V (18.4°). Variability in surface soils exists, and it is recommended that qualified MDH personnel conduct an inspection of any excavations prior to workers entering the excavated area, and written records of the inspections be maintained. The excavation slopes should be checked regularly for signs of spalling, cracking, tension cracks at crest, etc., particularly after periods of rain. Local flattening of the excavation slopes may be required if instabilities of the cut slopes are observed. For temporary excavations, equipment, spoil piles, rocks and construction materials should be kept at least 1 m from the edge of the excavation (as stated in OH&S Regulations part 260(1)). For excavations that will remain open for a relatively long time period, it is recommended that the stockpiling distance from the crest of the excavation should be equal to or greater than the depth of excavation.

Excavations that are made close to and beneath the level or elevation of existing footings or structures should be avoided if possible (if applicable). Where such excavations are unavoidable, the temporary excavation should be cut at a slope not steeper than 1H:1V, extending from a point at least 0.5 m away from the base of the existing footing. No vertical unsupported cuts shall be made. Shoring systems may be required in some areas. The design of the shoring system and all excavations adjacent to existing footings or structures should be reviewed and monitored by MDH.

Drainage trenches with periodic low points for standard sump pumps should be sufficient for dewatering shallow excavations at this site. As it is difficult to estimate the amount of water that will be encountered, close monitoring of groundwater ingress into the excavations is recommended. Other dewatering methods may be required if conventional methods prove to be insufficient. Surface drainage should be directed away from the crest of any excavation, particularly where workers and equipment will be present.

For permanent excavations, the required slope angle will vary. Slope stability analysis will be required to determine the recommended slope angle. MDH can provide this analysis, if required.

6.4 Fill Materials, Placement and Compaction

6.4.1 General

All proposed fill material should comply with the recommendations provided in this report and should be approved by MDH prior to use. All fill soils should be free of appreciable amounts of deleterious and/or organic materials, large particle sizes and contaminants. Fill soils should not be placed in a frozen state, or placed on a frozen subgrade. All lumps of materials should be broken down during placement.

Prior to placement of fill material, representative bulk samples (about 25 kg) should be taken of the proposed fill soils and laboratory tests should be conducted to determine (as applicable) Atterberg limits, natural moisture content, grain size-distribution and standard Proctor moisture-density relationship. These test results will be necessary for the proper control of construction for the engineered fill.

Prior to placing any fill, the exposed subgrade surface should be prepared in accordance with the preceding sections. It is important that the fill soils be compacted uniformly in order to maintain uniformity and minimize the potential of subsequent differential vertical movements.

6.4.2 Subgrade Fill

Subgrade fill, if required to achieve a uniformly level subgrade surface, should be placed in loose lifts (150 mm thickness, maximum), moisture conditioned (wetted or dried) to within ± 2% of optimum moisture content, and compacted to at least 96% of SPMDD tested in accordance with ASTM Method D 698. Subgrade fill, if required, should preferably consist of locally available glacial till soils or approved imported soil (granular soil or non-expansive (low plasticity) fine grained soil).

6.4.3 Structural Fill

Well-graded granular material is preferred as structural fill at this site due to the relative ease of compaction and more uniform/rapid settlement response (as compared to poorly graded granular soils or fine grained soils). If the use of well graded granular fill is cost prohibitive, then the use of locally available glacial till soils or suitable imported fill may be permissible. It should be noted that the settlement response of non-granular materials or poorly graded granular materials will be less uniform and will take longer to develop as compared to well graded granular materials. Additional time and effort will also be required to moisture condition and place these materials. Beneath hard-surfaced, grade-supported structures, a nominal thickness of structural granular fill (base course and sub-base course materials) will be required.

All structural fill should be placed in thin lifts (150 mm thickness, maximum), moisture conditioned (wetted or dried) to within ± 2% of optimum moisture content, and uniformly compacted to at least 98% of SPMDD tested in accordance with ASTM Method D 698. Where not contained by grade beams or suitable curbs, the structural fill should extend laterally 1 m or equal to the full depth of fill (whichever is the greater) beyond the footprint of grade-supported structures (asphalt surfacing, concrete slabs etc.).

The recommended gradation requirements for base course and sub-base course material have been presented in Table 6.2. Alternate gradations may be acceptable but should be approved by MDH prior to use.

For granular sub-base course material, the uppermost 300 mm of the fill should meet the gradation requirements presented above. For lower levels of sub-base fill, over-sized particles may be incorporated. For quality control testing of fill material containing over-sized particles, the gradation should be determined on samples with all over-sized materials (i.e., greater than 50 mm) removed.

Table 6.2 – Base and sub-base gradation specifications.

Sieve Size		Percent Passing by Weight	
		Base Course	Sub-Base
		Type 33	Type 6
50	**mm**		100
31.5	**mm**		
25	**mm**		
22.4	**mm**		
18	**mm**	100	
16	**mm**		
12.5	**mm**	75 -100	
9	**mm**		
5	**mm**	50 - 75	
2	**mm**	32 - 52	0 - 80
900	**µm**	20 - 35	
400	**µm**	15 - 25	0 - 45
160	**µm**	8 - 15	0 - 20
71	**µm**	6 - 11	0 - 6
Plasticity Index		0 - 6	0 - 6
Fractured Face %		Min 50	
Lightweight pieces %		Max 5	

Note: Adopted from Saskatchewan Highway and Transportation Design Manual.

6.4.4 Utility Trench Backfill

Utility bedding materials will vary depending on the type of utility. Utility bedding material gradation, placement, thickness, compaction, etc. should be in accordance with the utility manufacturer's specifications and recommendations. Care must be taken to ensure damage does not occur to the utilities as a result of placement/compaction of the bedding material and overlying fill materials.

Below buildings/structures and concrete-surfaced areas, the use of well graded granular fill is recommended above the bedding material (as discussed above) as this type of material will settle less and more uniformly as compared to common fill (i.e., locally excavated soil). Within all other areas (where some potential settlement of the excavation backfill material may be permissible), the use of locally excavated soil as backfill should be suitable. In areas where there will be no surface cover (asphalt, concrete etc.), it is recommended that the excavations be capped with low hydraulic conductivity soils to limit surface water ingress into the utility trench. In areas where there will be a permeable surface cover (i.e., graveled areas, landscape areas, etc.), the drainage adjacent to the utility trench should provide for positive drainage away from the trench.

6.4.5 Fill Settlement

Fill materials will tend to settle due to self weight and any imposed loading. The amount of settlement is unpredictable due to a number of variables associated with the properties of the fill material and underlying subsoils. The settlement of fill materials can be reduced by adhering to strict placement and compaction specifications for the entire fill thickness (i.e., utilizing thin uniform lifts, maintaining moisture content near optimum, compacting to a uniform, high density condition). Maintaining a uniform fill thickness will also serve to minimize differential movements across the fill area. The estimated settlements of cohesive and non-cohesive fill materials as a function of compaction level have been presented in Table 6.3.

Table 6.3 – Estimated fill settlement vs. compaction level.

Compaction Level (%SPMDD)	Estimated Fill Settlement (% of Fill Thickness)	
	Cohesive Soils	Non-Cohesive Soils
100	0.5	<0.5
98 to 100	1.0	0.5
95 to 98	1.5	1.0
90 to 95	4.0	3.0
<90	>4.0	>3.0

SPMDD = Standard Proctor Maximum Dry Density (± 2% of optimum moisture content).

6.5 Foundations

6.5.1 Limit States Versus Working Stress Design

MDH understands that working stress and/or limit states design methodologies may be considered for foundation design. For the purposes of this report, ultimate geotechnical design parameters have been presented. To determine factored parameters (limit states design), the ultimate parameters should be multiplied by the applicable geotechnical resistance factors (ϕ) as per the National Building Code of Canada 2010 (NBCC). The recommended geotechnical resistance factors (ϕ) as per the National Building Code of Canada 2010 (NBCC) are as follows:

1. Shallow Foundations
   (a) Vertical bearing resistance from semi-empirical analysis using laboratory and in-situ test data (ϕ = 0.5)
   (b) Sliding
      (i) based on friction [c = 0] (ϕ = 0.8)
      (ii) based on cohesion/adhesion [tan Ø = 0] (ϕ = 0.6)
2. Deep Foundations
   (a) Resistance to axial load
      (i) semi-empirical analysis using laboratory and in-situ test data (ϕ = 0.4)
      (ii) analysis using static loading test results (ϕ = 0.6)
      (iii) analysis using dynamic monitoring results (ϕ = 0.5)
      (iv) uplift resistance by semi-empirical analysis (ϕ = 0.3)
      (v) uplift resistance using loading test results (ϕ = 0.4)
   (b) Horizontal load resistance (ϕ = 0.5)

Ultimate geotechnical resistances to axial loads for deep foundations were calculated using semi-empirical analysis using laboratory and in-situ test data. Resistance factors of (ϕ = 0.4) for normal loading and (ϕ = 0.3) for uplift resistance need to be applied to the ultimate geotechnical resistances presented for deep foundations.

For working stress design, the ultimate geotechnical design parameters presented in this report should be divided by the appropriate F.S. (typically 2.5 to 3.5) to determine the “allowable” parameters.

6.5.2 Footings

A footing foundation system based within suitable naturally deposited, undisturbed soil (free of organics, deleterious materials or overly soft soils) should perform satisfactorily at this site.

Groundwater levels vary considerably across the site, and at some locations footings may be based below the groundwater table. Dewatering of the footing excavations at these locations will be required. The means of dewatering should be left to the contractor, but the techniques discussed in Section 6.3.4 should suffice.

The following recommendations should be considered in the design of a footing foundation system:

1) For residences with a heated basement, footings should be founded within suitable naturally deposited, undisturbed soil at a minimum depth of 1.2 m below finished grade. Footings not protected with a continuous heat source and a minimum of 1.2 m of ground cover should be based below the depth of frost penetration or protected with strategically placed rigid polystyrene insulation. In this case, MDH should review the proposed insulation details.

2) It is preferable that footings should be founded directly on firm (or stronger), suitable naturally deposited, undisturbed soil. If unsuitable soils (i.e., organics, deleterious materials, overly soft soils) are encountered at the design footing elevation, it will be necessary to completely remove/replace these soils with compacted granular fill or base the footings below these soils. If soft soils are encountered at the design footing elevation, it will be acceptable to over-excavate to more suitable soils (firm or stronger) and backfill with compacted granular fill or lean mix concrete to re-establish the design footing elevation, or, to widen the footings (see point #6 below). In this case, the uppermost 300 mm of the granular fill should consist of granular base course material, while lower lifts of granular fill may consist of granular sub-base material. The granular fill should be placed and compacted in thin lifts (150 mm maximum thickness) and the lateral extent of the fill should be at least equal to the vertical thickness of the fill.

3) A serviceability limit states (SLS) bearing pressure of 75 kPa may be utilized for design of the footings (to limit foundation settlement to 25 mm or less).

4) An ultimate limit states (ULS) bearing pressure of 200 kPa (unfactored) may be used for design of the footings (i.e., bearing capacity against soil shear failure).

5) Footing excavations should be cleaned to remove all loose, disturbed soil, and to expose suitable naturally deposited, undisturbed soil. If the subgrade soil is disturbed during excavation, the disturbed soil should be removed to an undisturbed, level surface. Over-excavated areas should be backfilled with lean mix concrete or compacted granular fill, as discussed above.

6) A minimum dimension of 1,000 mm is recommended for square and rectangular footings. A minimum width of 450 mm is recommended for strip footings. If soft soils are encountered at the design footing elevation and these soils are not over-excavated/replaced (as per point #2 above), then the footings dimensions should be increased by 50%.

7) A representative of MDH should inspect the prepared footing excavations prior to the construction of footings to ensure that suitable soil conditions exist.

8) The footings should not be constructed on loose, softened, desiccated, frozen or wet subgrade soil or fill. Cohesive subgrade soils should be covered as soon as possible after excavation to minimize the potential for drying/wetting of the soil. Where silt/sand soils are encountered at the footing elevation, a mud slab (lean mix concrete) is recommended to reduce the potential for disturbance of the silt/sand soils.

9) Frost should not be allowed to penetrate beneath the footings prior to, during or after construction. If the foundation is constructed during freezing conditions, the subgrade soil at the design footing elevation must be protected from freezing.

10) The finished grade should be landscaped to provide for positive site drainage away from the foundation.

6.5.3 Drilled, Cast-in-Place Concrete Piles

Drilled straight shaft, cast-in-place concrete piles may be designed on the basis of skin friction only.

The ultimate shaft resistance values of the subgrade soils are presented in Table 6.4.

Table 6.4 – Ultimate shaft resistance (drilled piles).

*Depth Below Existing Grade (m)	Ultimate Shaft Resistance (kPa)
0 to 2	0
2 to 3	40
Below 3	75

*Zone of zero skin friction may be reduced to 1.0 m for piles extending below basement levels (if applicable).

The following recommendations should be considered in the design of drilled, cast-in-place concrete piles:

1) To minimize frost heave potential, drilled straight shaft concrete piles should be extended to a minimum depth of 6 m below finished ground surface. Pile reinforcement must be adequate to withstand all vertical, lateral and tensile forces within the pile.

2) A minimum pile diameter of 300 mm is recommended. Larger auger sizes will likely be required at some locations to allow for the removal of cobbles/boulders.

3) A minimum centre-to-centre pile spacing of three pile diameters is recommended.

4) Casing will be required where groundwater seepage and sloughing conditions are encountered to maintain the pile holes open and dry for placement of the reinforcing steel and concrete. The annular space between the casing and drilled hole must be filled with concrete. As the casing is extracted, concrete in the casing must have adequate head to displace all water in the annular space. Water which accumulates on top of the pile upon removal of the casing must be removed to ensure the integrity of the concrete is not compromised. Concrete placement by tremie methods will be required if conventional concrete placement methods are insufficient.

5) Pile holes should be filled with concrete as soon as possible after drilling to reduce the risk of groundwater seepage and/or sloughing soil. Excess water should not be allowed to collect within the drilled hole. If excess water collects in the drilled hole, it will be necessary to remove the water (by pumping or bailing) prior to placing reinforcing steel and concrete. Vibration of the concrete in the upper 3 m of the pile shaft is required to produce uniform strength concrete.

6) Continuous monitoring by MDH during pile installation is recommended to document the installation of each drilled, straight shaft concrete pile installed at this site.

6.5.4 Lateral and Tension Forces

It is anticipated that the foundations may be required to withstand vertical compressive loading and tensile loading as well as lateral loading.

For drilled, cast-in-place straight shaft concrete piles the vertical tensile capacity can be determined using the skin friction values (tension) presented in Table 6.4. Concrete piles must be adequately reinforced throughout their entire length to withstand the vertical tensile forces within the pile.

If the piles designed to support the vertical loading conditions are inadequate to support the lateral loading conditions, it may be necessary to increase the pile diameter, utilize pile groups or incline (batter) the piles.

Pile deflection typically governs the design of laterally loaded piles. Horizontal subgrade reaction theory may be utilized to estimate lateral pile deflection. The estimated coefficients of horizontal subgrade reaction (k_h) have been presented in Table 6.5.

Table 6.5 – Modulus of horizontal subgrade reaction, K_h.

Zone (mbgl)	Modulus of Horizontal Subgrade Reaction, K_h (kN/m^3)
0 to 1.5D	0
1.5D to 3	2,500/D
3 to 5	5,000/D
Below 5	10,000/D

mbgl = metres below existing ground level. D = pile diameter in metres.
For pile diameters in excess of 1.0 m, the zone of zero horizontal subgrade reaction should not exceed 1.5 m.

Utilizing horizontal subgrade reaction theory, the parameters presented in Table 6.6 may be utilized for pile groups.

Table 6.6 – Recommended P-multiplier, P_m, values for design by row position.

	Design P-multiplier, Pm			
Pile Spacing (c-c)	**3D**	**4D**	**5D**	**6D**
Lead Row	0.7	0.85	1.0	1.0
2nd Row	0.5	0.65	0.85	1.0
3rd and Higher Rows	0.35	0.5	0.7	1.0

Where c -c = centre to centre, D = pile diameter. The reduction factors are for pile spacings in the direction of the applied load.

Where a more thorough lateral analysis is required, the p-y method of analysis is recommended. If required, MDH can conduct p-y analysis as part of the design process. Specific pile/pile group details will be required, including vertical and lateral pile loads, type of pile, diameter of pile, length/embedment of pile, pile cap/pile connection details, pile spacing, etc.

6.6 Earth Retaining Structures

The determination of lateral earth pressures will be required for the design of subsurface foundation walls, sumps, retaining walls, etc. (if applicable). Horizontal soil forces for structural design should be determined using the earth pressure coefficients presented in Table 6.7 and the following equation:

$$\sigma_h = K\sigma_v = K\gamma H$$

where:

σ_h = horizontal force,

K = earth pressure coefficient,

σ_v = vertical stress,

γ = soil unit weight,

H = height (retained soil thickness)

The recommended soil parameters are provided in Table 6.7.

Table 6.7 – Soil parameters for design.

Soil Type	*Effective Angle of Internal Friction	*K_p	*K_a	*K_o	**Coefficient of Sliding Friction	Total Unit Weight (γ) (kN/m^3)	Submerged Unit Weight (γ') (kN/m^3)	Undrained Shear Strength (kPa)
Silt/Clay	22°	2.20	0.45	0.63	0.28	18.5	8.7	0
Glacial Till	28°	2.77	0.36	0.53	0.37	22.0	12.2	(50/100)****
Granular Fill	33°	3.39	0.29	0.46	0.45	21.5	11.7	0
***Cohesive Fill	25°	2.46	0.41	1.0	0.33	21.0	11.2	75

* Friction angle and earth pressure coefficients = 0 for undrained analysis. The coefficients apply only if the slope angle behind the wall equals zero.

** For concrete cast directly against the subgrade soil.

*** For low plasticity cohesive backfill compacted in accordance with the report specifications.

**** Firm/stiff

For estimating the horizontal force on structures backfilled with granular fill, the width of the granular section should be at least 1 m and the granular backfill should be sloped upward at no steeper than 1H:1V away from the structure. If this width of granular backfill cannot be achieved, the native soil earth pressure coefficients should be utilized.

The shape of the lateral pressure distribution will depend on the degree of compaction achieved in the soil backfill against the wall. Where the backfill adjacent to the wall will be compacted to 95% of the SPMDD or greater, the design earth pressure should adopt a combined trapezoidal/triangular distribution as per Figure 6.1. The typical relationships to be used in calculating the lateral pressures for structural design are provided in Figure 6.1 and the load of typical compactors are provided in Table 6.8. Where subdrainage will not be provided, two cases should be considered in the calculation of the lateral pressures:

1) The case immediately following fill placement and compaction, where the groundwater level has not been re-established. In this case the total soil unit weights provided in Table 6.7 should be used.

2) The longer term case where the groundwater level is re-established. In this case buoyant soil unit weights ($\gamma' = \gamma - 9.8$ kN/m^3) should be used to calculate the horizontal stress below the depth of the groundwater level and a hydrostatic pressure component due to water pressure will need to be added.

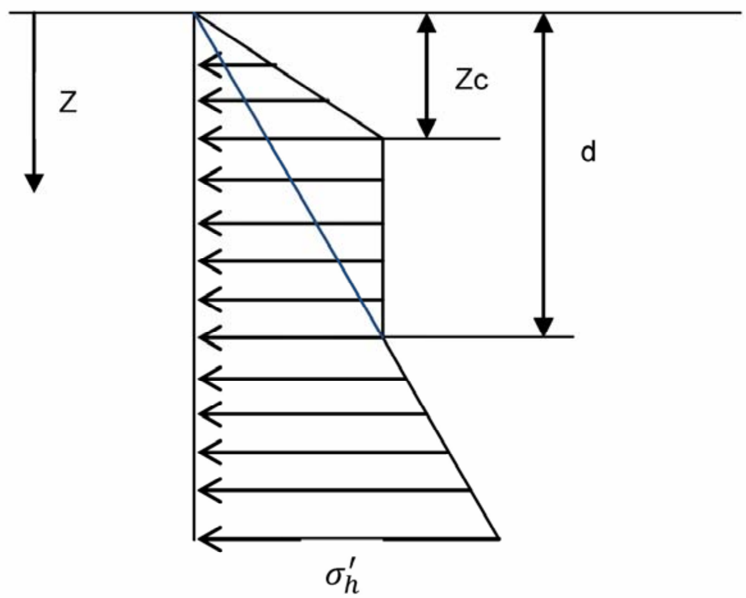
The greater of case 1) or 2) above should be used for design.

Table 6.8 – Typical compaction equipment data for estimating compaction-induced loads.

Equipment Type	Dead Weight of Roller (kN)	Centrifugal Force (kN)	Roller Width (mm)	P (kN/m)
Single-drum walk-behind	2.3	8.3	560	18.9
Dual-drum walk-behind	1.6	10.1	560	20.9
Dual-drum walk-behind	12.1	8.8	760	27.5
Dual-drum walk-behind	9.2	19.8	750	38.7

The above recommendations assume horizontal ground beyond the earth retaining structures. In addition to earth pressure, lateral stresses generated by line, point or surcharge loads, from such as equipment and/or embankment fill, also require consideration in the design of retaining structures. It is not, however, realistic to present recommendations within this report for all possible combinations of load conditions and soil conditions. MDH would be pleased to assist with the design of such cases upon request.

To reduce the potential for development of lateral hydrostatic or frost forces due to accumulation of water behind the wall, it is recommended that a zone of clean, free-draining, non-frost susceptible granular soil be provided behind the wall. The width of the free-draining fill zone should be at least 1.0 m, and the fill should contain less than 5% particles by weight smaller than 0.075 mm in size (Number 200 US Standard sieve). A perforated drainage pipe should be installed along the base of the walls with positive drainage to a discharge point. The structural engineer may present other options to deal with the effects of lateral hydrostatic or frost forces acting upon structures. In areas that are not paved, the upper 500 mm of backfill should consist of low permeability fill material to reduce the potential of surface water infiltration behind the wall. The ground or pavement surface should be graded to promote positive drainage away from the wall. A conceptual drawing showing a typical subsurface drainage arrangement of an earth retaining structure is presented as Figure 6.2.



$$Zc = K\sqrt{\frac{2P}{\pi\gamma}}$$

$$d = \frac{1}{K}\sqrt{\frac{2P}{\pi\gamma}}$$

$$For\ Zc \le Z \le d \quad \rightarrow \quad \sigma'_h = \sqrt{\frac{2P\gamma}{\pi}}$$

$$For\ Z > d \quad \rightarrow \sigma' = K_o \gamma Z$$

$$\gamma = Soil\ unit\ weight$$

$$K = K_0\ (See\ report\ text)$$

$$P^*_{(Roller\ Load)} = \frac{dead\ weight\ of\ roller + centrifugal\ force}{width\ of\ roller}$$

*See Table 6.8 for typical compactor loads.

LEGEND	REFERENCE DRAWINGS		
	DWG No	DATE	DESCRIPTION
	REVISIONS		
NOT TO SCALE	REV	DATE	DESCRIPTION

REV	DATE	DESCRIPTION	DRN	APP

SNC·LAVALIN

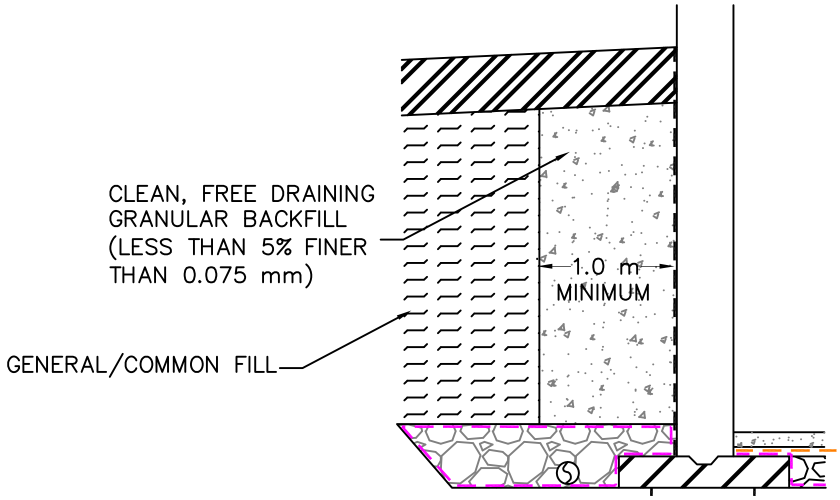
CLIENT: CHRIS CEBRYK

PROJECT LOCATION: W1/2-11-37-4-W3M

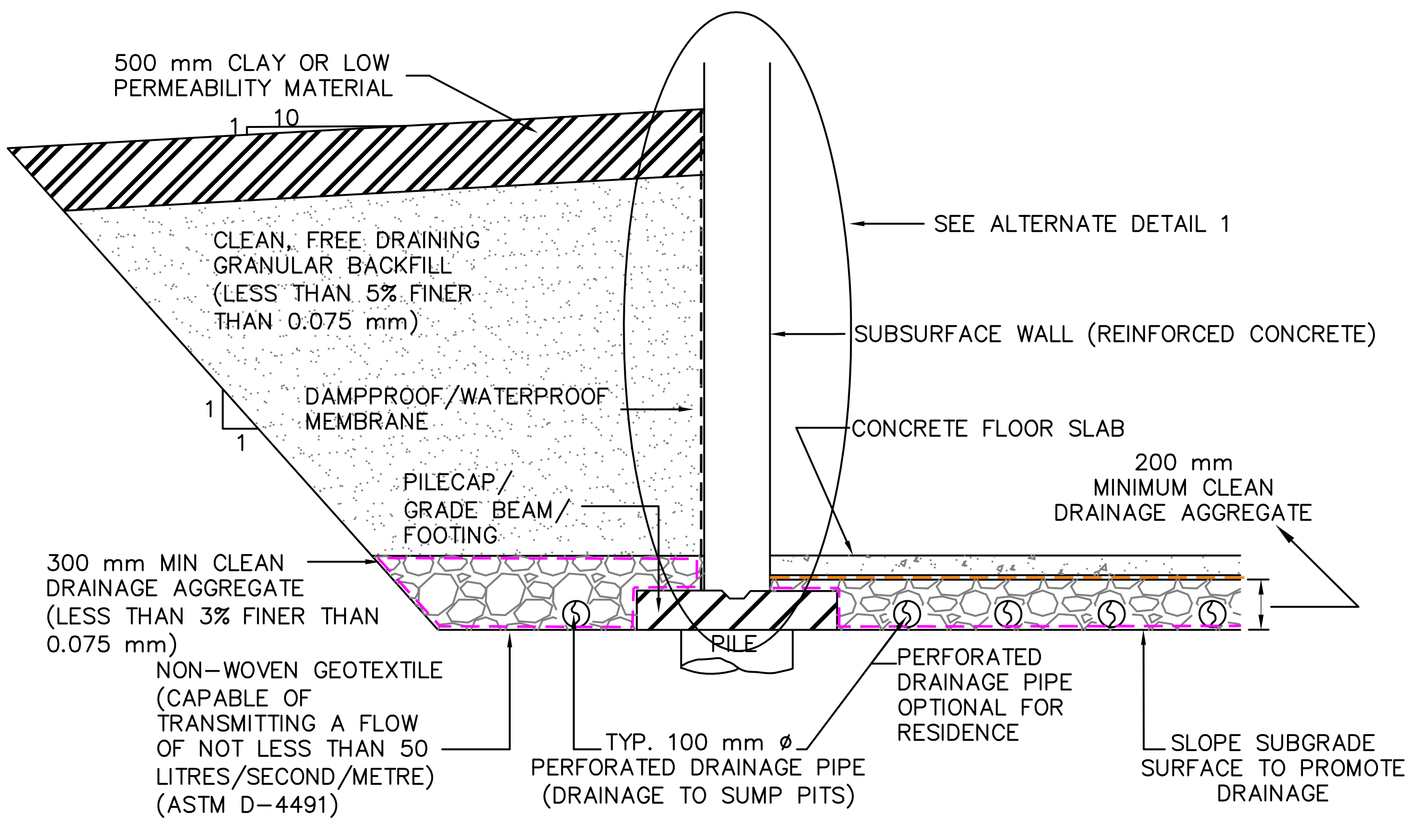
TITLE: HORIZONTAL PRESSURE ON WALLS INDUCED BY COMPACTION EFFORT

DES BY	CZ	DRN BY	CPS	CHK BY	CZ	APP BY	CZ
DATE	2013 08 19	DWG No	613596-63-2	FIG No	6.1	REV	0

8.5 X 11



ALTERNATE DETAIL 1
SCALE: NOT TO SCALE



LEGEND	
NON-WOVEN GEOTEXTILE	- - - - - - -
POLYETHYLENE VAPOUR BARRIER	— — — — — —

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REFERENCE DRAWINGS

DWG No	DATE	DESCRIPTION

REVISIONS

REV	DATE	DESCRIPTION	DRN	APP

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

TITLE CONCEPTUAL SUB-SURFACE DRAINAGE SYSTEM FOR EARTH RETAINING STRUCTURES AND GRADE-SUPPORTED FLOOR SLABS

DES BY	CZ	DRN BY	CPS	CHK BY	CZ	APP BY	CZ
DATE	2013 08 19	DWG No	613596-63-1	FIG No	6.2	REV	0

8.5 X 11

P:\Chris Cebryk\613596 Proposed Cebryk Development\2. Drafting\2. Drawings\613596-63-1.dwg

6.7 Grade Supported Concrete Floor Slabs

The near-surface subgrade soils consisted of variable deposits of silt/clay and glacial till. Grade-supported concrete slabs should perform satisfactorily provided that some floor slab movements can be tolerated and the recommendations presented in Sections 6.3 and 6.4 are adhered to. If some differential movements/floor cracking cannot be tolerated, then a structural slab should be constructed.

For continually heated areas, the following recommendations should be incorporated into the design of reinforced, grade-supported, cast-in-place concrete slabs at this site:

1) Prepare the site in accordance with Sections 6.3 and 6.4.
2) For basement floor slabs, over-excavate to allow for the placement of a minimum of 200 mm of clean, drainage aggregate below the floor slab. The drainage aggregate should be well graded granular material with a maximum aggregate size of 25 mm, and should contain less than 3% particles by weight smaller than 0.075 mm in size (Number 200 US Standard sieve). It is recommended that a continuous layer of high permeability, non-woven geotextile should be placed between the subgrade soils and the drainage aggregate. The subgrade surface should be graded to allow for free drainage to a sump pit(s). The sump pit should be perforated to allow water from the sub-slab drainage layer to be collected. All water discharged from the sump pit(s) should be directed well away from the residences, and must not be directed into the on-site wastewater disposal system. [Refer to Figure 6.2 for additional details].
3) For floor slabs constructed near existing grade, over-excavate, as required to allow for the placement of a minimum of 300 mm of approved structural fill between the subgrade soils and the underside of the concrete slab (thickness of over-excavation will need to be increased where unsuitable and/or overly soft soils are encountered). The uppermost 150 mm of the fill should consist of crushed, granular base course material. Lower lifts of fill may consist of granular sub-base material or approved fine grained soils. All structural fill should be placed in thin lifts (150 mm thickness, maximum), moisture conditioned (wetted or dried) to within ± 2% of optimum moisture content, and uniformly compacted to at least 98% of SPMDD tested in accordance with ASTM Method D 698.
4) Separation joints should be used to isolate the slab from foundation walls, columns, etc.
5) Reinforce the concrete slab and provide control joints at regular intervals to provide for controlled cracking.

6) The finished grade should be landscaped to provide for positive site drainage away from the structure.
7) Concrete slabs should not be constructed on loose, softened, desiccated, frozen or wet soil.
8) Frost should not be allowed to penetrate beneath the concrete slab just prior to, during or after construction.
9) Continuous quality control inspection by MDH should be provided during fill placement.
10) Separate the slab from the drainage aggregate by means of a polyethylene vapour barrier.
11) If insulation is to be utilized below the floor slab, a 1.0 m (minimum) width of un-insulated space should be retained around the perimeter of the residence to allow heat loss to the foundation.

6.7.1 Unheated Slabs

Grade-supported concrete slabs exposed to freezing conditions will be subject to differential movements associated with frost action. The potential for differential movements associated with frost action can be minimized by over-excavating and replacing a greater thickness of subgrade soil with low frost-susceptible granular fill (in the order of 1,000 to 1,500 mm is recommended), by placing sub-horizontal rigid polystyrene insulation below the slabs and/or by providing minimal heat (5 degrees celcius minimum) and air circulation within the building during freezing conditions (if applicable). If insulation is to be utilized, the insulation should have a minimum thickness of 100 mm and should extend below the slab and sub-horizontally away from the outer edges of the slab a minimum distance of 2.4 m. The insulation should be covered with a minimum of 300 mm of soil cover to provide protection against damage, and should be positively sloped away from the slab.

If differential movements cannot be tolerated, the slab should be constructed as a structural slab (i.e., pile supported) over a compressible void form.

6.8 Foundation Concrete

Water-soluble sulphate salts (gypsum crystals) exist in the geologic deposits in this region. Sulphate resistant cement is recommended for all foundation concrete in direct contact with the naturally occurring subgrade soils at this site. If imported fill material is utilized, it is recommended that the fill soil be tested for sulphate content to determine whether the above-stated recommendations remain valid. However, it should be noted that most fine grained soils encountered in Saskatchewan contain concentrations of sulphates.

The recommendations stated above for the subsurface concrete at this site may require further additions and/or modifications due to structural, durability, service life or other considerations which are beyond the geotechnical scope. A designer competent in concrete mix design should complete the specifications for the concrete mix.

6.9 Grade Beams

Grade beams should be constructed to allow for a minimum of 100 mm of net void space between the underside of the grade beam and the subgrade soil (compressible void form). The finished grade adjacent to each grade beam should be capped with hard-surfacing or well compacted, low permeable material and should be positively drained away from the grade beam so that surface runoff is not allowed to infiltrate and collect in the void space. If water is allowed to accumulate in the void space, the beneficial effect will be negated and frost heaving may occur.

6.10 Subdivision Roads and Parking Areas

Suitable borrow materials (i.e., glacial till) exist on site for the construction of subdivision road embankments (silt soils and soft glacial till soils are not recommended for roadway construction). It is anticipated that the majority of traffic will be light passenger vehicles, but that infrequent heavy truck traffic may enter the proposed subdivision. It is also anticipated that the subdivision access roads and parking structures will be gravel surfaced.

The following recommendations should be considered in the design of the subdivision access roads and parking areas.

1) Prepare the site in accordance with Sections 6.3 and 6.4.
2) The soaked CBR (California Bearing Ratio) rating of the compacted subgrade soil is estimated to be 3. Based on the estimated soaked CBR rating, the following access road structures have been presented.

Table 6.9 – Proposed graveled structure design thickness.

Structure	Light Traffic	Medium Traffic	Heavy Traffic
	Axle load ~35 kN	Axle load ~55 kN	Axle load ~80 kN
Base Course (mm)	150	200	200
Sub-Base Course (mm)	250	325	450
Geosynthetic	Recommended	Recommended	Recommended
Total Structure (mm)	**400**	**525**	**650**

3) The granular base and sub-base course material should meet the aggregate gradation requirements presented in Table 6.2.

4) Positive surface drainage is recommended to reduce the potential for moisture infiltration through the roadway/parking lot structures. A minimum cross-slope of 3% is recommended.

5) It is assumed that a subdivision grading/drainage plan will be prepared by others. To enhance the performance of roadway and parking structures, maintaining adequate drainage at all times will be critical. Adequate maintenance of culverts, ditches etc. will be required to ensure that the drainage systems are functioning as intended.

6) The subgrade surface should be graded to promote drainage to the outer edges of the roadway/parking areas. The roadway/parking lot grades should be designed such that the granular sub-base course material can freely discharge into ditches, thereby providing a capillary break to maintain an unsaturated condition in the overlying traffic structure (this will be particularly important in low-lying/wetland areas).

7) For glacial till borrow material, embankment/ditch sideslopes should be no steeper than 3 horizontal to 1 vertical (3H : 1V).

8) Erosion protection is recommended for all sideslopes and around drainage control structures. Rip-rap may be required at some locations.

9) Traffic areas should be separated on the basis of traffic loading (i.e., light, medium, heavy). If heavier traffic is allowed to travel on lighter traffic structures, premature distress/failure of the lighter traffic structures will occur.

10) Periodic maintenance such as grading and pothole filling will be required.

11) It is recommended that the roadway grades should be maintained at least 600 mm above the surrounding terrain to minimize snow accumulation on the roads, and that the shoulder of the road should be at least 1.2 m above the ditch bottom elevation.

12) Geosynthetics are recommended to provide material separation, subgrade stabilization, uniform structure thickness and extended/improved performance of the structure. Site-specific geosynthetic design details should be determined in consultation with MDH (intended application, type of geosynthetic, location within structure, depth of soil subcut required, etc.). Depending on the geosynthetic design details chosen, the actual graveled structure may vary from what is presented in Table 6.11.

6.11 Slope Stability Commentary

An assessment of slope stability was required for the proposed scope of work for this project. Based on the topographic information provided by Webb Surveys, the maximum slope height within the proposed development area (from top of hill to base of slope) is about 8 to 10 m, and the maximum slope angle is about 15 degrees. Based on these limiting scenarios, stability of the natural slopes within the proposed development area is not considered to be an issue.

Where natural slopes are proposed to be altered by construction and are greater than 3.0 m in height, slope stability should be assessed on a case-by-case basis. For example, where the slopes are steepened, material is excavated near the base of the slope, underground utilities are located within the slope, or where structures are proposed in the vicinity of the crest of the slope.

7.0 CONSTRUCTION CONTROL AND MONITORING

The recommendations presented in this report are based on the premise that full time inspection, monitoring, and control testing are provided by qualified MDH personnel during site development and construction. Hence, quality control should be provided as follows:

- Inspection during site grading, clearing/excavation and proof rolling to verify the removal of unsuitable materials;
- In-situ density and moisture content testing during subgrade preparation and placement of fill/backfill;
- Inspection during pile construction; and,
- Materials and concrete laboratory testing during construction.

APPENDIX I

Terms, Symbols and Abbreviations

Terms, Symbols and Abbreviations

Field geological description of a soil is achieved through a brief description of the following points. All points should be included to accurately describe a soil for geoenvironmental applications:

1) Lithology/texture (size, proportion, and shape);
2) Colour and oxidation;
3) Consistency and plasticity (cohesive soils);
4) Condition (non-cohesive soils);
5) Moisture; and
6) Other miscellaneous descriptors.

---

1) Lithology / Texture

The texture of a soil is a combination of the size and shape of the particles and the relative proportions of each of the constituents (eg. subrounded to subangular gravel, sandy, some silt, trace cobble).

Particle Size (ASTM D2487-85)

Boulder	300mm plus
Cobble	75 – 300 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75mm
Fine:	0.075 – 0.425 mm
Medium:	0.425 – 2 mm
Coarse:	2 – 4.75 mm

Relative Proportions (by weight)

Parent Material	>35%, main fraction
Modifier	20 – 35%
eg: gravely, sandy, silty, clayey, etc.	
Some	10 – 20%
Trace	0 – 10%

Particle Shape (coarse grained soils)

Rounded	No edges and smoothly curved sides
Subrounded	Well-rounded corners and edges, nearly plane sides
Subangular	Similar to angular but have rounded edges
Angular	Sharp edges and relatively plane sides with unpolished surfaces

Gradation (coarse grained soils)

Well Graded	Having a wide range of grain sizes and substantial amount of all intermediate sizes
Uniform (Poorly Graded)	Possessing particles of predominantly one size
Gap Graded	Possessing particles of several distinct sizes

2) Colour and Oxidation

A soil's colour may be described either qualitatively in the field at the soils natural moisture content using common colours (eg. light grey, light brown, dark grey, etc.) or quantitatively by comparison with a colour chart. Soil colour is typically quantified using the Munsell Book of Colour. The soil colour description is characterized by a combination of hue, value and chroma. The hue notation of a colour indicates its relation to red, yellow, green, blue and purple; the value notation indicates its lightness; and the chroma notation indicates its strength (or departure from a neutral of the same lightness (eg 2.5Y4/2). Quantitative determination of colour using a Munsell Book of Soil Colours is completed after the soil has been allowed to dry at a low temperature.

When a soil is exposed to an oxygen rich environment it oxidizes and the soils colour departs from neutral (eg from dark grey (5Y4/1) to dark reddish brown (5Y4/2)). The colour change is generally a result of iron oxidation and staining (red) or manganese staining (purple to black). The oxidation may occur throughout the entire soil mass or commonly as fracture and joint coatings and haloes.

3) Consistency and Plasticity (Cohesive Soils)

The consistency of a soil is a qualitative description of a cohesive soils ability to resist deformation and may be correlated to the undrained shear strength. Consistency and undrained shear strength (Su) of a soil may be field-tested using the thumb and thumbnail or more accurately with a pocket penetrometer.

The plasticity of a soil is a measure of the soils ability to deform without rupture. The plasticity of a cohesive soil should be estimated as low (LL<30), medium (30<LL<50), or high (LL>50) plasticity. The plasticity can be verified in the laboratory through Atterberg Limit testing.

Consistency	Undrained Shear Strength - Su (kPa) (CFEM, 2nd edition, 1985)	Field Identification (ASTM D 2488-84)
Very Soft	<12	Thumb will penetrate soil more than 25mm
Soft	12 – 25	Thumb will penetrate soil about 25mm
Firm	25 – 50	Thumb will indent soil about 6 mm
Stiff	50 – 100	Thumb will indent but penetrate only with great effort (CFEM)
Very Stiff	100 – 200	Readily indented by thumbnail (CFEM)
Hard	>200	Thumb will not indent but readily indented with thumbnail
Very Hard	N/A	Thumbnail will not indent soil

Note: 1) Pocket penetrometer readings can be used to measure Su directly where Su is equal to approximately ½ of the pocket penetrometer reading (i.e. The pocket penetrometer measures unconfined compressive strength (approx 2Su).
2) Torvane measures undrained shear strength (Su) directly.

4) Compactness Condition (Non-Cohesive Soils)

A Standard Penetration Test (SPT) is used to estimate the compactness condition of a soil.

Compactness Condition	SPT N-Index (Blows / 300mm)
Very Loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	>50

5) Moisture Conditions (ASTM D2488-84)

- Dry - No moisture, dusty, dry to touch
- Moist - Damp but contains no visible water
- Wet - Visible, free water, indicating soil is below water table

6) Other Descriptors

- Primary structure - structure formed during soil deposition (eg. stratified, laminated, lensed, bedded, massive, cross-bedded, etc.)
- Secondary structure - structure formed following original deposition (eg. cementation, salt crystallization, jointing, fissuring, fracturing, slickensides, blocky, brecciated, mottled, etc.)
- Carbonate content - weakly, moderately, or strongly calcareous (based on effervescence in dilute (10%) HCl acid)
- Organics (spongy feel, fibrous texture)
- Sensitivity (sands)
- Odour

7) Soil Type Symbols

- FILL
- SAND
- GYPSIFEROUS TILL
- TOPSOIL OR ORGANIC SOIL
- GRAVEL
- CALCAREOUS SHALE OR LIMESTONE
- CLAY OR SHALE
- COBBLES
- COAL
- SILT
- OXIDIZED TILL
- SALT
- SAND-SILT INTERBED
- UNOXIDIZED TILL
- DIAMICTON

8) Sampling Symbols *(left hand side of testhole log)*

- CORE (any type)
- SPLIT TUBE
- BAGGED CUTTINGS
- NO RECOVERY
- JAR
- SHELBY TUBE

9) Oxidized Zones *(right hand side of testhole log)*

- OXIDIZED ZONES
- UNOXIDIZED ZONES

10) Field and Laboratory Test Symbols

W_P W_N W_L

W_P PLASTIC LIMIT
W_N NATURAL MOISTURE CONTENT
W_L LIQUID LIMIT

▲ POCKET PENETROMETER

× SIEVE ANALYSIS

11) Piezometer and Inclinometer Symbols

- GROUT
- BENTONITE CHIPS OR PELLETS
- CUTTINGS
- FRAC SAND

STATIC WATER LEVEL ▼

Common Abbreviations

Pale = pl.
Olive = ol.
Light = lt.
Yellow = ylw.
Brown = br
Grey = gr.
Green = grn.
Pink = Pk.
Dark = dk.
Very = v.
Large = lg.
Strongly = st.
Weakly = wkly.
Subrounded = sbrnd.
Subangular = sbang.
Rounded = rnd.
Angular = ang.
Medium = m.
Fine = f.
Coarse = c.

Calcareous = calc.
Non-Calcareous = noncalc.
Laminated = lam.
Predominantly = predom.
Carbonate = carb.
Quartz = qz.
Ablation = abl.
Weathered = wthrd.
Material = mat.
Mottled (Mottling) = mot.
Fracture = frac.
Iron = Fe
Manganese = Mn

Examples

1. SILT TILL: sandy, some gravel, trace clay, pale yellow (2.5Y7/4), to dark greyish brown (2.5Y4/2), oxidized, soft to very soft, calcareous, moderate Fe staining along fractures

2. SILT TILL: trace sand, some clay, trace to some gravel, grey (5Y5/1), unoxidized, stiff to very stiff, medium plasticity, calcareous

3. SILT TILL: clayey, some sand, some gravel, grey (5Y6/1) to greyish brown (2.5Y5/2) to light brownish grey (2.5Y6/2), oxidized to unoxidized, high plasticity, calcareous

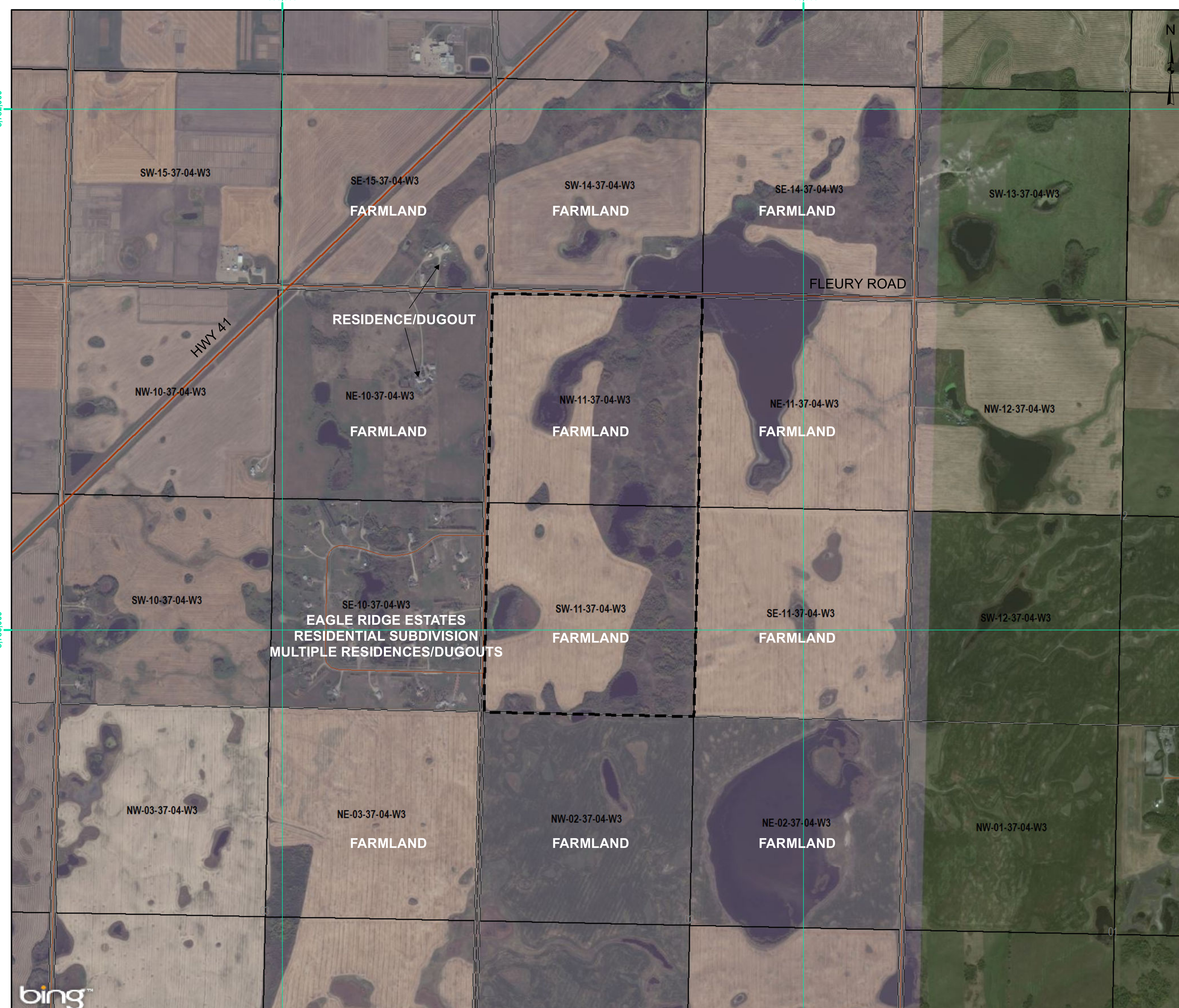
4. SAND: predominantly medium grained, trace to some gravel (rounded to subrounded), moderately graded, trace silt, carbonate and igneous lithos

5. GRAVEL: subrounded to subangular, some sand to sandy (coarse grained), poorly to moderately graded, igneous and carbonate lithos

6. CLAY SHALE: trace silt, grey (5Y4/1), hard, non-calcareous, laminated

APPENDIX II

Surrounding Land Usage and Registered Water Wells



LEGEND

HIGHWAY
ROAD
RESOURCE/RECREATION ROAD
RAILWAY
STUDY AREA

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 13N.
2. IMAGERY: © 2010 DIGITALGLOBE IMAGE COURTESY OF USGS © 2010 GEOEYE © 2013 MICROSOFT CORPORATION

REFERENCE DRAWINGS		
DWG No.	DATE	DESCRIPTION

REVISIONS				
REV	DATE	DESCRIPTION	DRN BY	CHK

0 95 190 380 570 760
Metres

SCALE: 1:15,000

SNC · LAVALIN

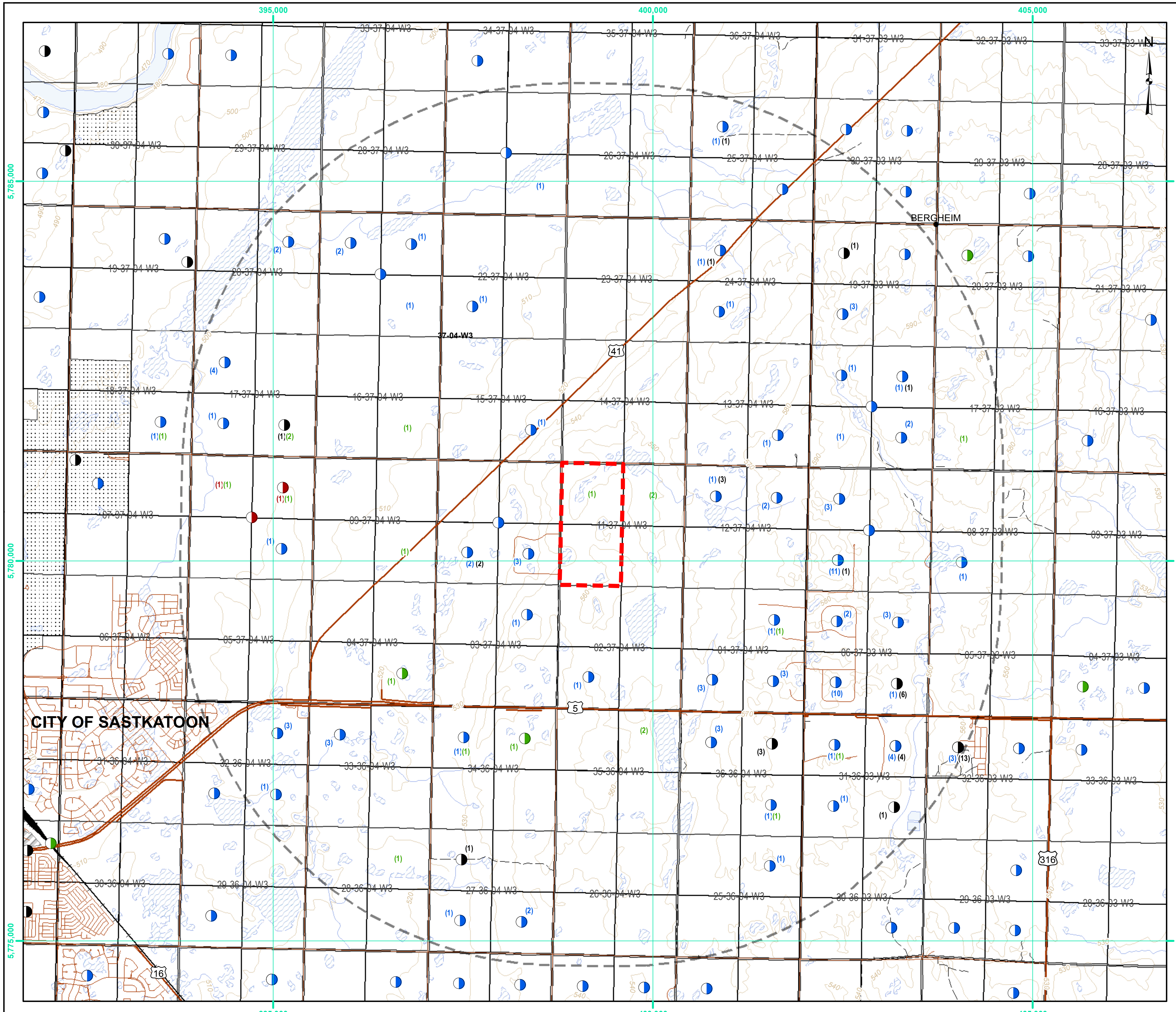
CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W½-11-37-04-W3M

TITLE

SURROUNDING LAND USAGE

DES BY	CZ	DRN BY	KG	DATE	2013 07 17	FIG No.	II.1	REV	0
CHK BY	CZ	APP BY	CZ	DWG No.	613596-G-21-E-001			11x17	

Path: P:\Chris Cebryk\613596 Proposed Cebryk Development\3. GIS\2. Drawings\P613596-G-21-E-001 (Land Use).mxd



LEGEND

- WSA OBSERVATION WELL
- WSA WITHDRAWAL WELL
- WSA WATER TEST HOLE
- WSA OTHER WELL
- HIGHWAY
- ROAD
- RESOURCE/RECREATION ROAD
- SERVICE LANE
- RAILWAY
- WATERCOURSE
- 10 METER ELEVATION CONTOUR (masl)
- PARK
- FIRST NATIONS LANDS
- WATERBODY
- WATERBODY (INTERMITTENT)
- STUDY AREA
- 5 KM PERIMETER OF STUDY AREA

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 13N.
2. WATER SECURITY AGENCY OF SASKATCHEWAN (WSA) WATER WELL DRILLER'S RECORDS (WWDR) OBTAINED FROM THE WSA WELLS DATABASE AND MAY BE SUBJECT TO ERROR. DRILLER'S RECORDS ARE PLACED IN THE GEOGRAPHIC CENTER OF THE AVAILABLE LAND DESCRIPTION AND LOCATION WILL BE SUBJECT TO ERROR.
3. COLORED LABELS REFLECT THE NUMBER OF RECORD TYPE PER QUARTER SECTION.

REFERENCE DRAWINGS

DWG No.	DATE	DESCRIPTION

REVISIONS

REV	DATE	DESCRIPTION	DRN BY	CHK

0 320 640 1,280 1,920 2,560 Metres

SCALE: 1:50,000

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W½-11-37-04-W3M

TITLE

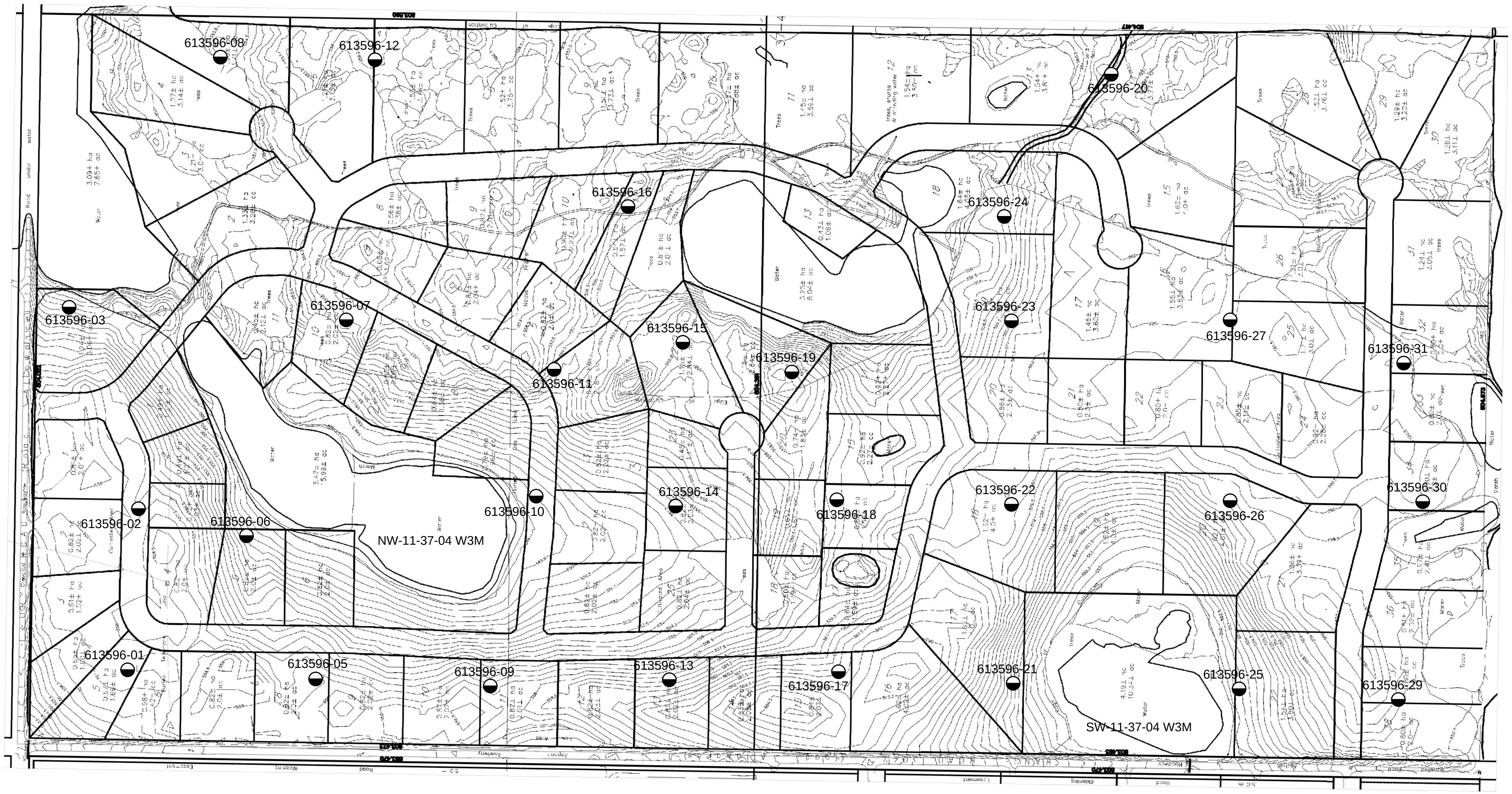
REGISTERED WATER WELLS

DES BY	CZ	DRN BY	KG	DATE	2013 08 07	FIG No.	II.2	REV	0
CHK BY	CZ	APP BY	CZ	DWG No.	613596-G-01-E-001				11x17

Path: P:\Chris Cebryk\613596 Proposed Cebryk Development\3. GIS\2. Drawings\P613596-G-01-E-001 (WSA Records).mxd

APPENDIX III

Site Plan – Borehole Locations



LEGEND

MONITOR WELL LOCATION

NOTES

REVISIONS

REV	DATE	DESCRIPTION	DRN	APP
-	-		-	-

REFERENCE DRAWINGS

DWG No	DATE	DESCRIPTION
1	2012 10	WEBB SURVEYS PLAN SHOWING TOPOGRAPHY ON W1/2 11-37-4 W3 RM OF CORMAN PARK No 344

0 5 10 15 20 m

SCALE 1:500

SNC·LAVALIN

CLIENT

CHRIS CEBRYK

PROJECT LOCATION

W1/2-11-37-4 W3M

TITLE

SITE PLAN - BOREHOLE LOCATIONS

DES BY	CZ	DRN BY	C. WU	DATE	2013 07 23	FIG No	III.1	REV
CHK BY	CZ	APP BY	CZ	DWG No	613596-61-1			11X17

P:\Chris Cebryk\613596 Proposed Cebryk Development\2. Drafting\2. Drawings\613596-61-1.dwg

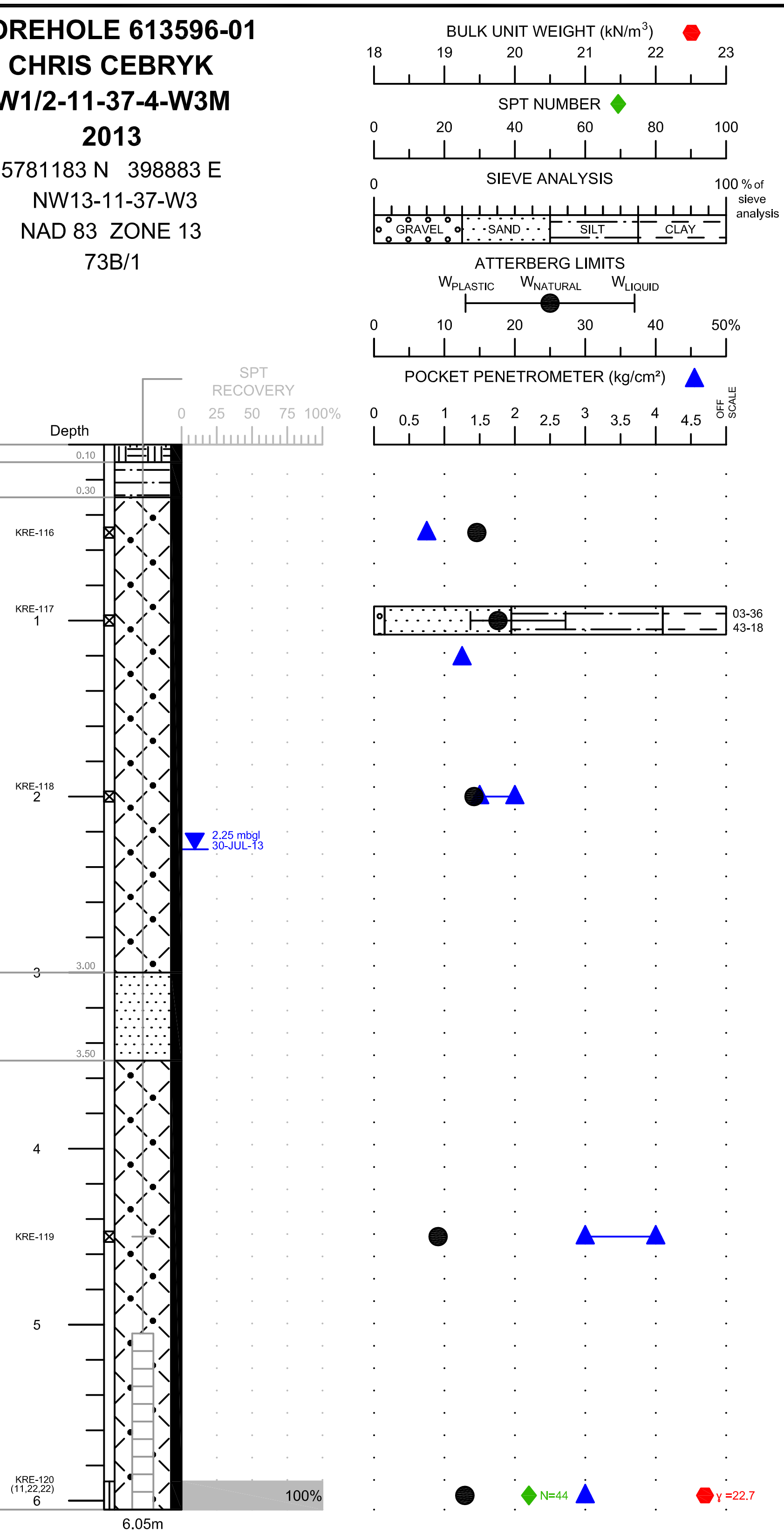
Appendix IV

Borehole Logs

BOREHOLE 613596-01
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781183 N   398883 E
NW13-11-37-W3
NAD 83 ZONE 13
73B/1

Depth	
0.10	TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets
0.30	SILT: sandy (fine to coarse), brown, oxidized, soft, low plasticity, moist
3.00	SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, firm, low plasticity, moist, trace Fe staining - below 2.0 m: some gravel (fine to corase), stiff, increased Fe staining
3.50	SAND: (fine to coarse), silty, brown, oxidized, loose to compact, wet, seepage, sloughing
6.05m	SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, very soft to hard, medium plasticity, moist, trace Fe staining



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depth are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

SNC·LAVALIN

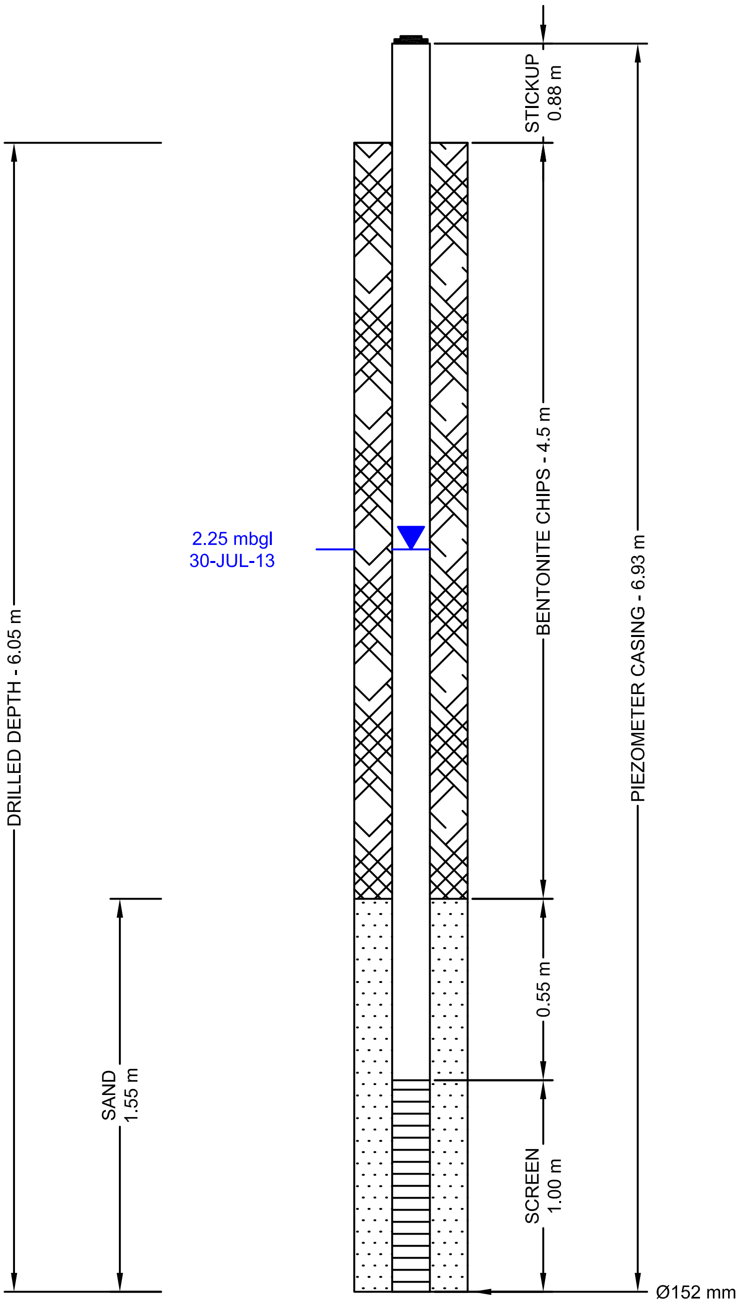
CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 09	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 09	**SCALE**	1:40 **DATE** 2013 08 19

P:\Chris Cebryk\613596 Proposed Cebryk Development\2. Drafting\1. Boreholes\BH-613596-01.dwg

PIEZOMETER 613596-01
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781183 N   398883 E
NW13-11-37-04-W3
NAD 83 ZONE 13
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 09
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C .WU
	PROJECT No.	613596
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	SCALE	NOT TO SCALE DATE 2013 08 08

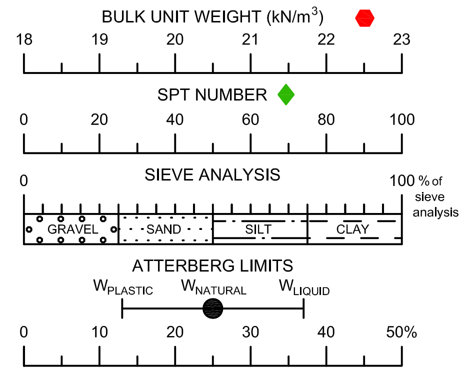
SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

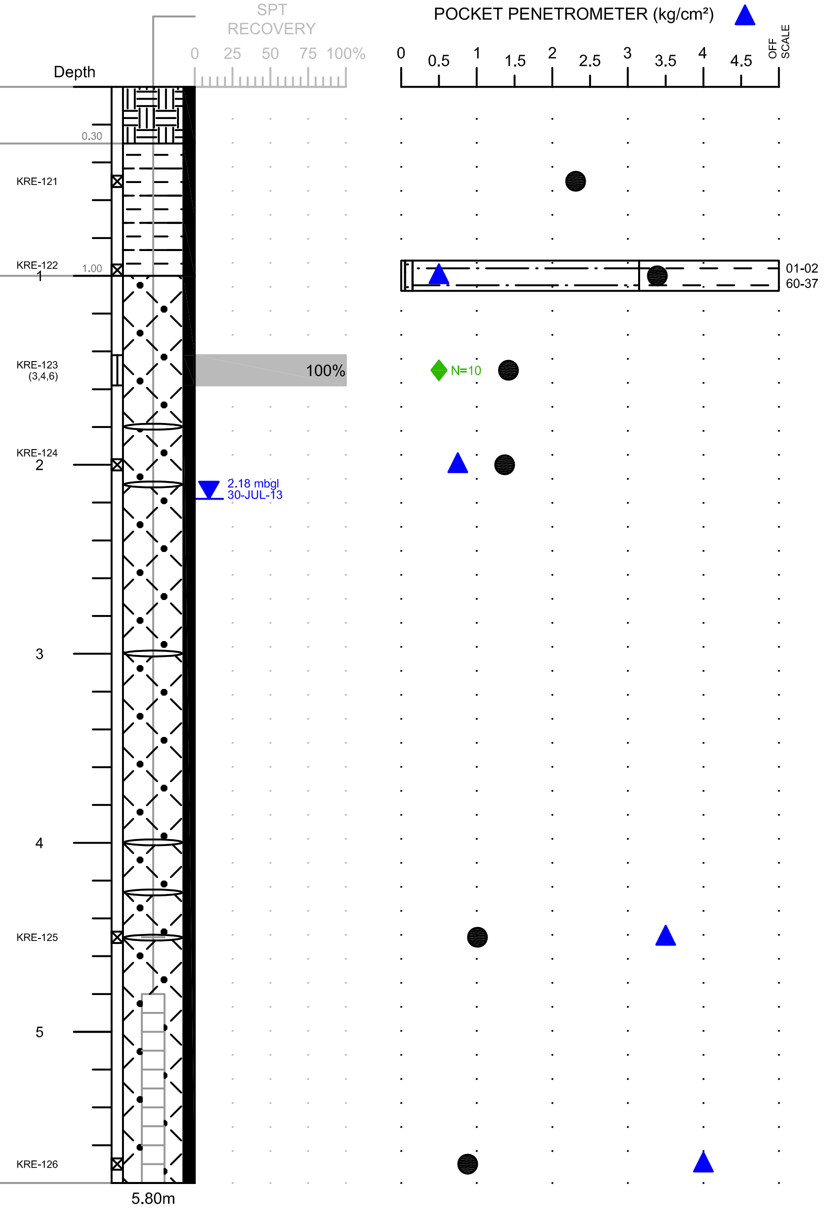
P:\Chris Cebryk\613596 Proposed Cebryk Development\2. Drafting\1. Boreholes\PS-613596-01.dwg

BOREHOLE 613596-02
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781171 N 399062 E
NE13-11-37-04-W3
NAD 83 ZONE 13
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets	
SILT AND CLAY: trace sand (fine), brown, oxidized, soft, medium plasticity, moist	-organics / topsoil to 0.7m
SILT TILL: sandy (fine to coarse), trace gravel (fine to medium), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining	-at 1.8 m: cobbles / boulders -at 2.1 m: cobbles / boulders -at 3.0 m: cobbles / boulders -at 4.0 m: cobbles / boulders -at 4.26 m: cobbles / boulders -at 4.5 m: cobbles / boulders -below 4.5 m: very stiff to hard



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

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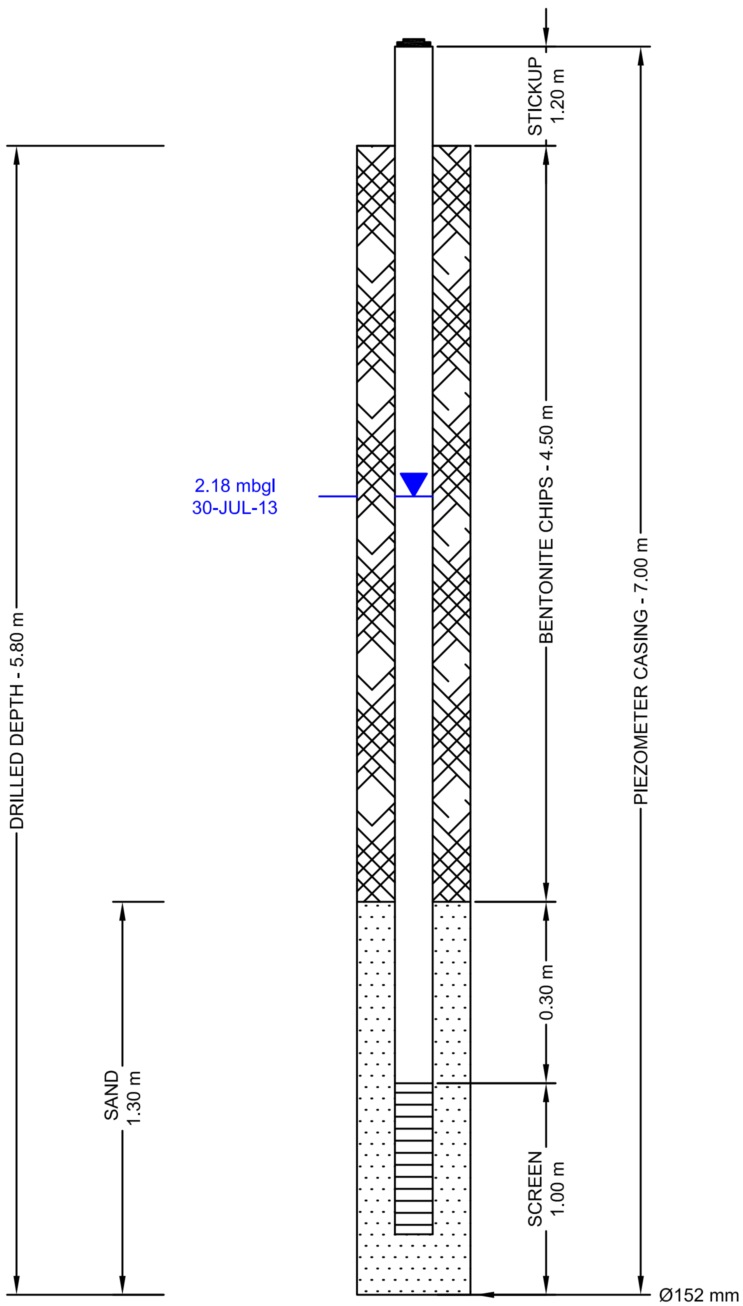
LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above and properties described above will vary between locations and may vary with time.

CLIENT	CHRIS CEBRYK		**PROJECT LOCATION**	W1/2-11-37-4-W3M	
CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 10	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 10	**SCALE**	1:40 **DATE** 2013 08 19

PIEZOMETER 613596-02
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781171 N   399062 E
NE13-11-37-04-W3
NAD 83 ZONE 13
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 09
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C .WU
	PROJECT No.	613596
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	SCALE	NOT TO SCALE DATE 2013 08 08

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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BOREHOLE 613596-03
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781248 N 399286 E
NW14-11-37-04-W3
NAD 83 ZONE 13
73B/1

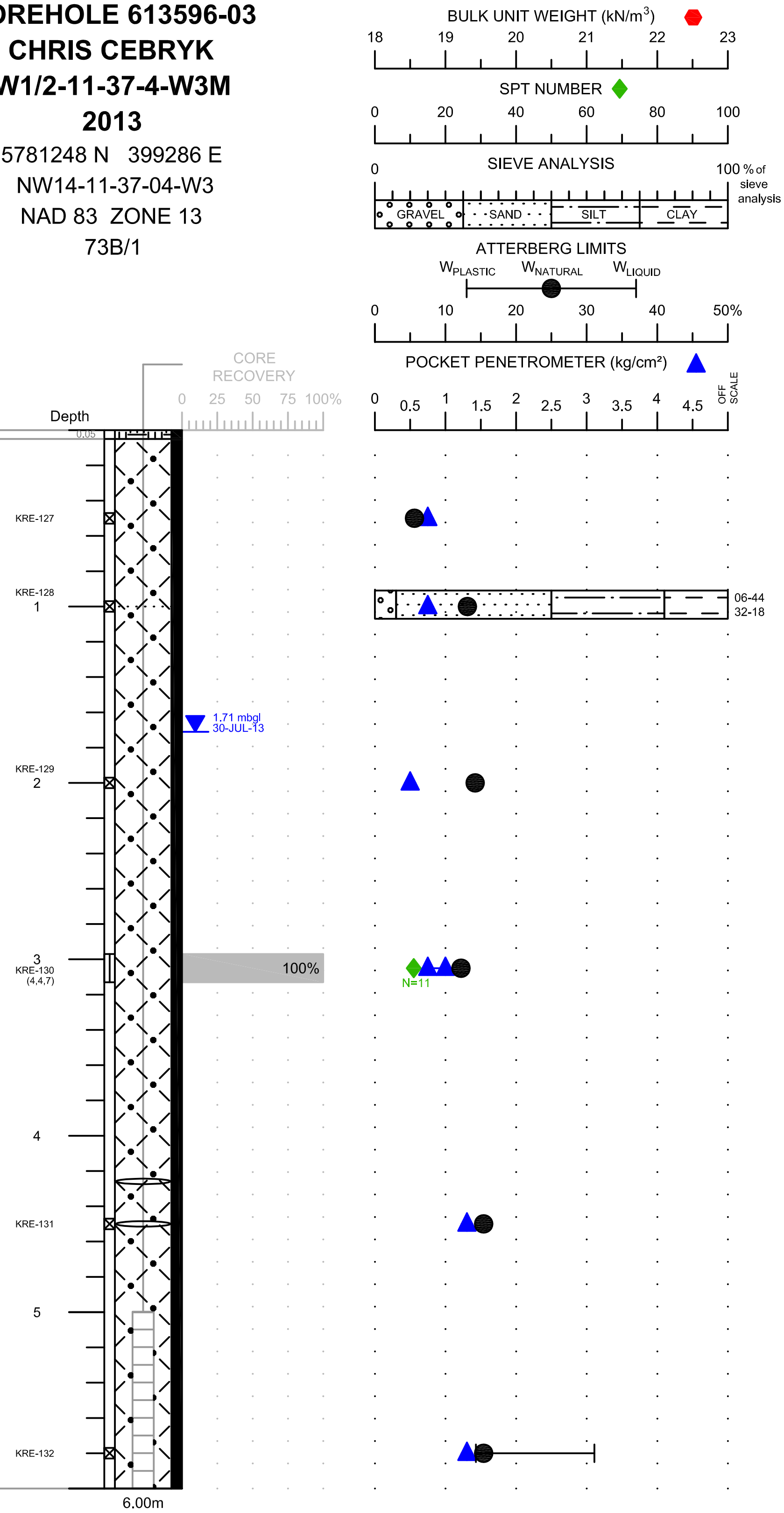
TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining

-at 1.0 m: sand seam, wet, seepage

-at 4.26 m: cobbles / boulders

-at 4.5 m: cobbles / boulders



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground leve l(mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	SUPERVISOR	K. EBEL, B.Sc., G.I.T.	APPROVED BY	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	LOGGED BY	K. EBEL, B.Sc., G.I.T.	DRAWN BY	C. SAULNIER / C. WU		
DRILL RIG TYPE	CME 75	DATE DRILLED	2013 07 13	PROJECT No.	613596		
ABANDONMENT	BENTONITE CHIPS	DATE INSTALLED	2013 07 13	SCALE	1:40	DATE	2013 08 19

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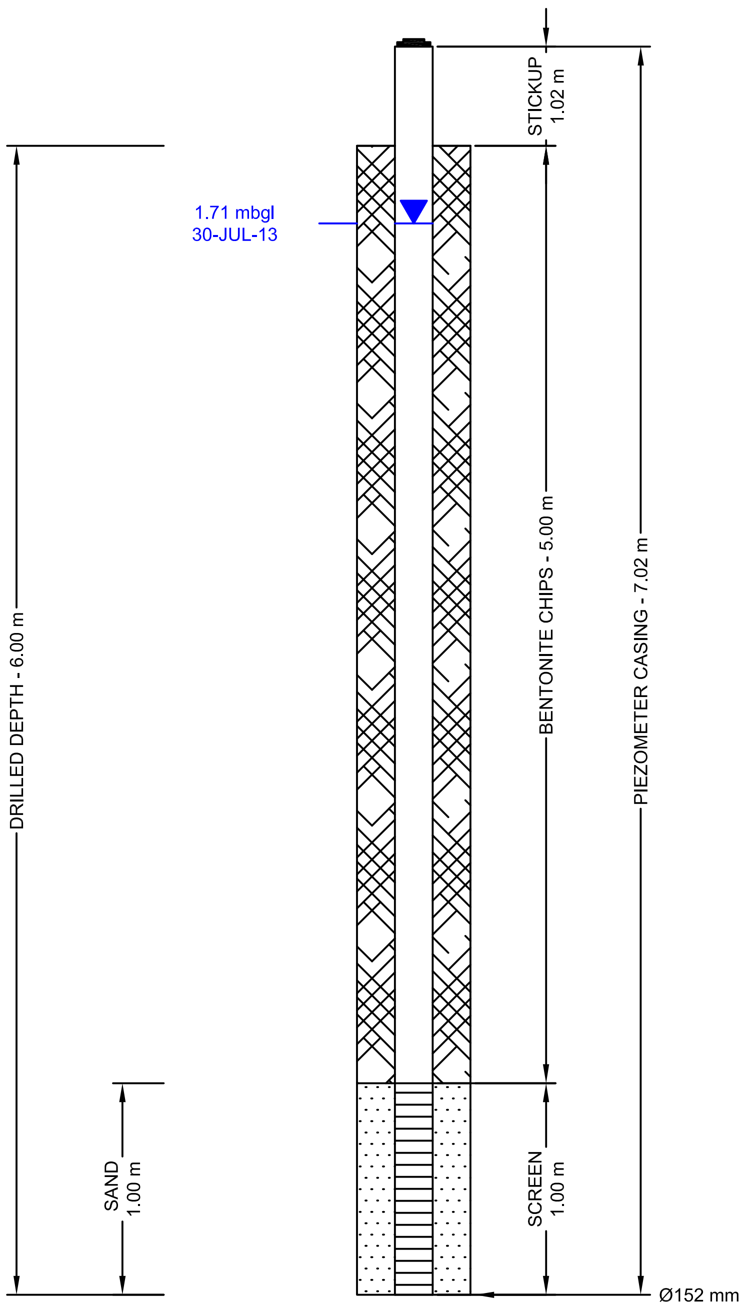
PIEZOMETER 613596-03
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781248 N 399286 E
NW14-11-37-04-W3
NAD 83 ZONE 13
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR	K. EBEL, B.Sc., G.I.T.
CONTRACTOR	BOSS DRILLING
OPERATOR	C. OLEKSUIK
DRILL RIG TYPE	CME 75
DATE INSTALLED	2013 07 13
APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C .WU
PROJECT No.	613596
SCALE	NOT TO SCALE
DATE	2013 08 08

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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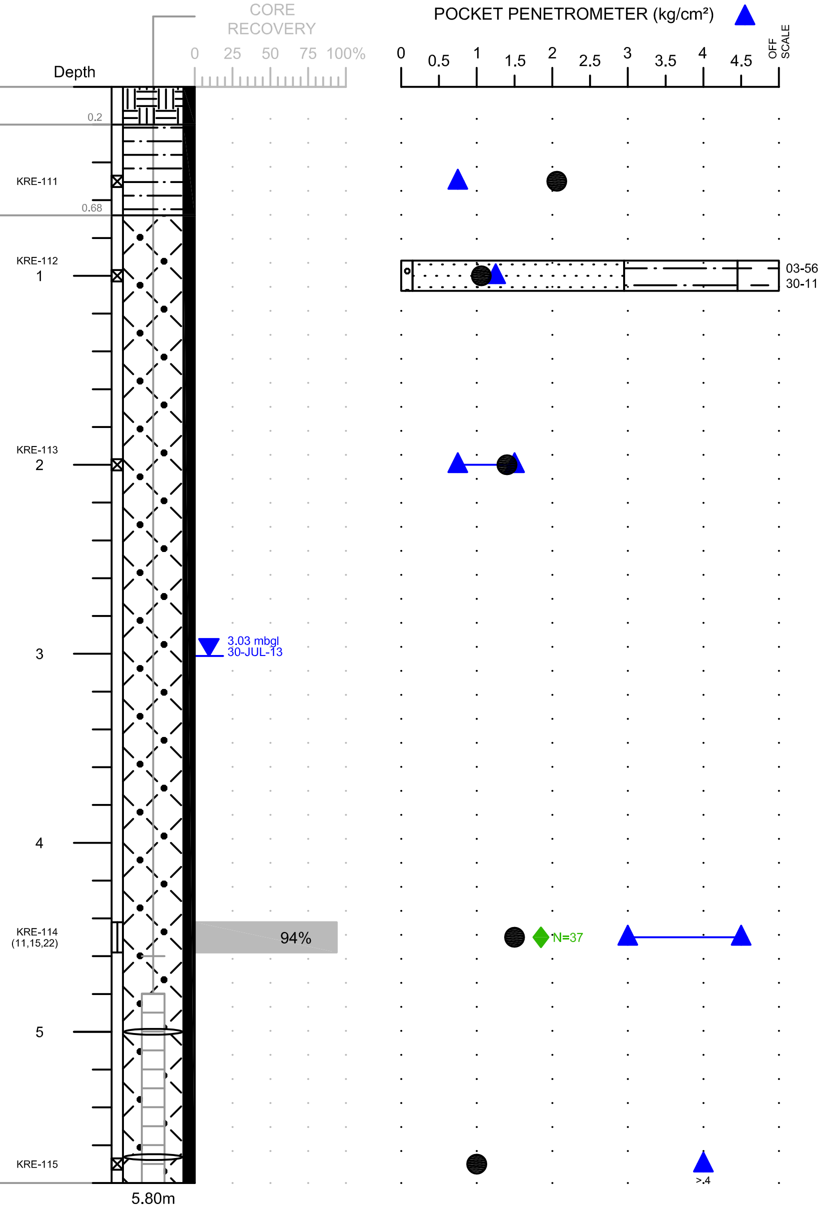
BOREHOLE 613596-05
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780974 N 398873 E
SW13-11-37-04-W3
NAD 83 ZONE 13
73B/1

BULK UNIT WEIGHT (kN/m^3): 18, 19, 20, 21, 22, 23
SPT NUMBER: 0, 20, 40, 60, 80, 100
SIEVE ANALYSIS: 0 – 100 % of sieve analysis (GRAVEL, SAND, SILT, CLAY)
ATTERBERG LIMITS: $W_{PLASTIC}$, $W_{NATURAL}$, W_{LIQUID}: 0, 10, 20, 30, 40, 50%
POCKET PENETROMETER (kg/cm^2): 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, OFF SCALE
CORE RECOVERY: 0, 25, 50, 75, 100%



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse), trace gravel, trace clay, brown, oxidized, firm, low plasticity, moist
- at 0.5 m: trace Fe staining

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining
- below 1.2 m: moist to wet
- below 3.0 m: some sand, mottled brown / grey, hard, moist
- below 5.0 m, cobbles / boulders
- below 5.6 m: brown
- at 5.64 m: cobbles / boulders

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
OPERATOR	C. OLEKSUIK	LOGGED BY	K. EBEL, B.Sc., G.I.T.
DRILL RIG TYPE	CME 75	DATE DRILLED	2013 07 09
ABANDONMENT	BENTONITE CHIPS	DATE INSTALLED	2013 07 09

APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C. SAULNIER / C. WU
PROJECT No.	613596
SCALE	1:40
DATE	2013 08 19

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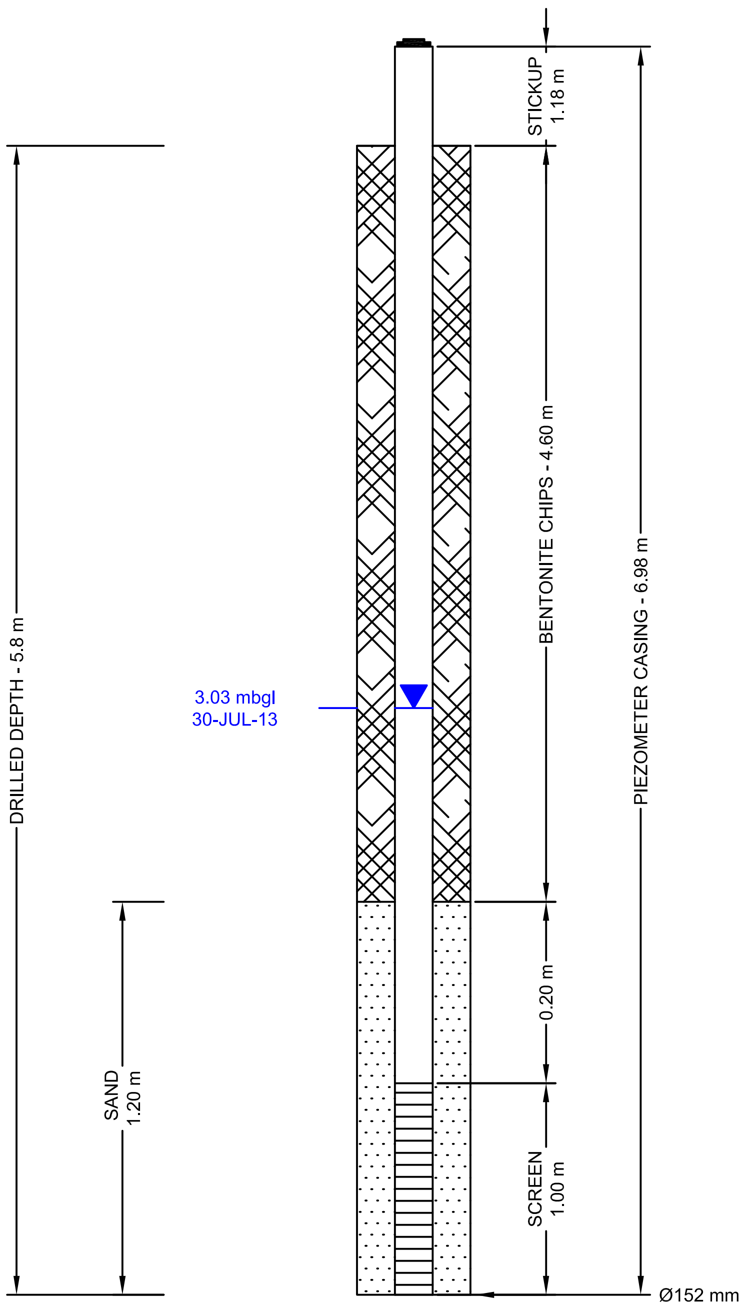
PIEZOMETER 613596-05
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780974 N   398873 E
SW13-11-37-04-W3
NAD 83 ZONE 13
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES				
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.	SNC • LAVALIN	
	CONTRACTOR	BOSS DRILLING		
	OPERATOR	C. OLEKSUIK		
	DRILL RIG TYPE	CME 75		
	DATE INSTALLED	2013 07 09	CLIENT	PROJECT LOCATION
	APPROVED BY	C. ZUBROWSKI, P.Eng.		
	DRAWN BY	C .WU	CHRIS CEBRYK	W1/2-11-37-4-W3M
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596		
	SCALE	NOT TO SCALE	DATE	2013 08 08

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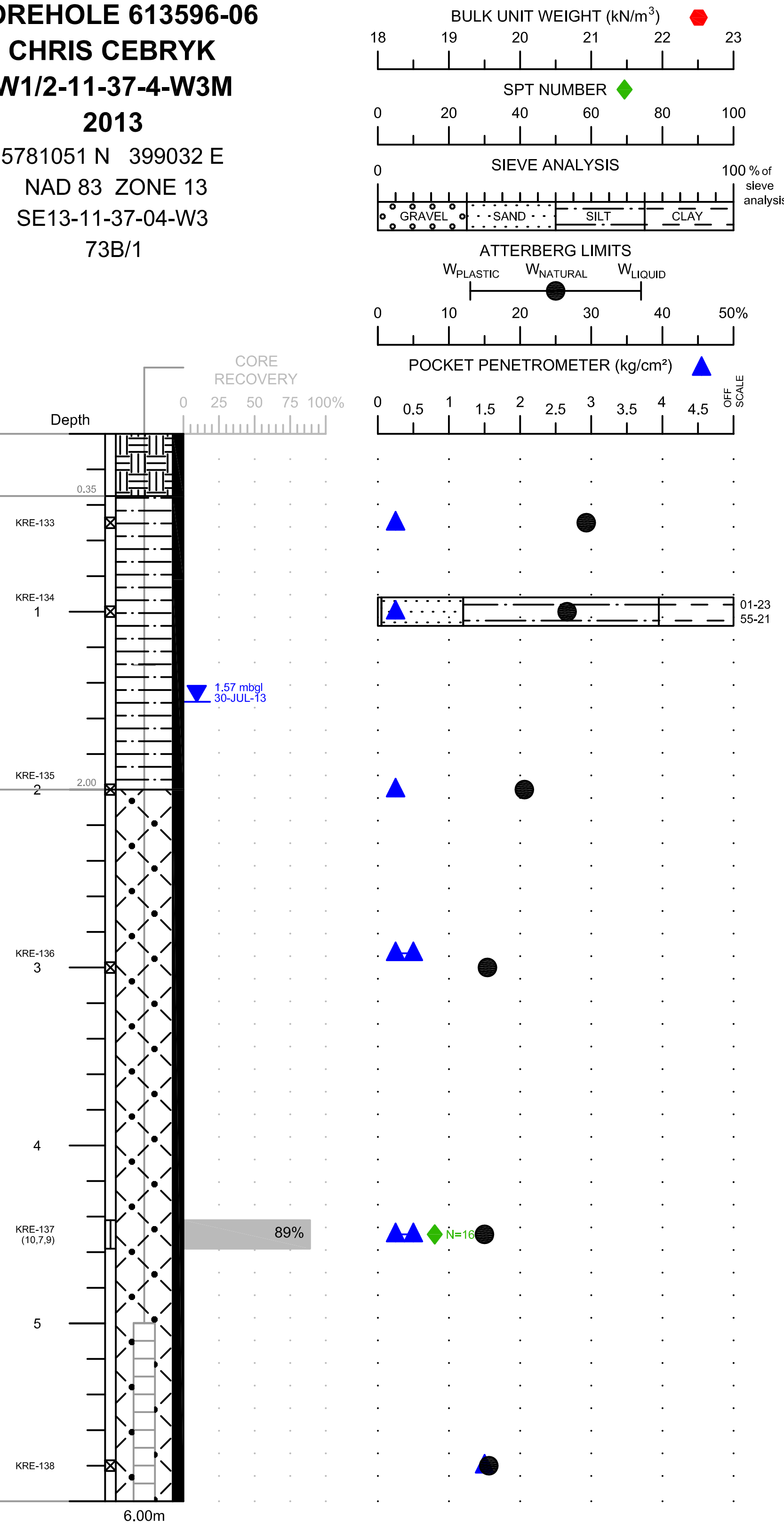
BOREHOLE 613596-06
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781051 N 399032 E
NAD 83 ZONE 13
SE13-11-37-04-W3
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine), some clay, dark brown/black, oxidized, soft, low plasticity, moist

-organics/topsoil to 0.8 m
-below 0.8 m: brown, moist, Fe staining

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, soft, low to medium plasticity, moist to wet, Fe staining

-below 2.2 m: wet sand layer (fine to coarse) approximately 3 to 5 cm thick, Fe staining

-below 3.0 m: stiff, moist

-below 5.0 m: mottled, grey/brown

NOTES

1. Borehole sloughed to 2.3 m immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 10	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 10	**SCALE**	1:40 **DATE** 2013 08 19

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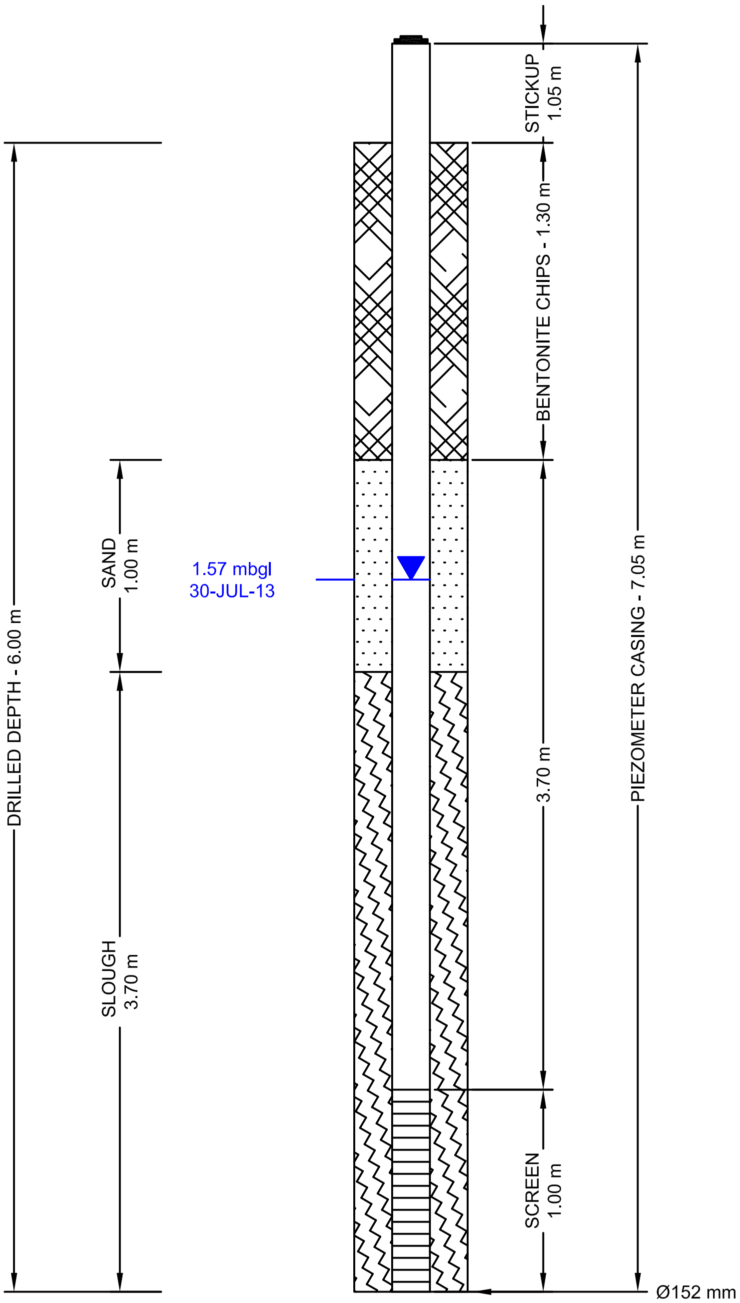
PIEZOMETER 613596-06
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781051 N   399032 E
NAD 83 ZONE 13
SE13-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 10
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C .WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE — DATE 2013 08 08

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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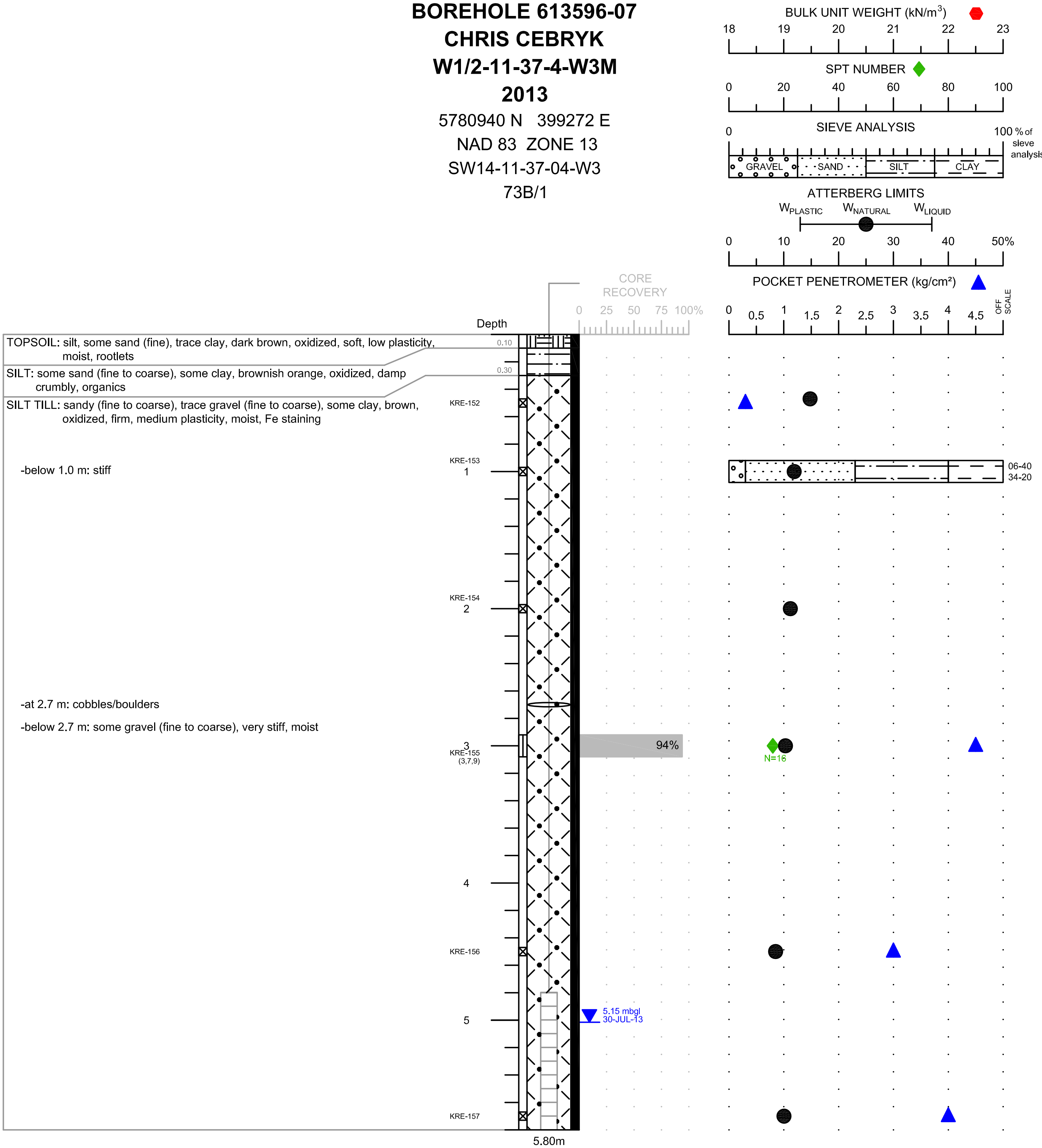
BOREHOLE 613596-07
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780940 N 399272 E
NAD 83 ZONE 13
SW14-11-37-04-W3
73B/1



NOTES
1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

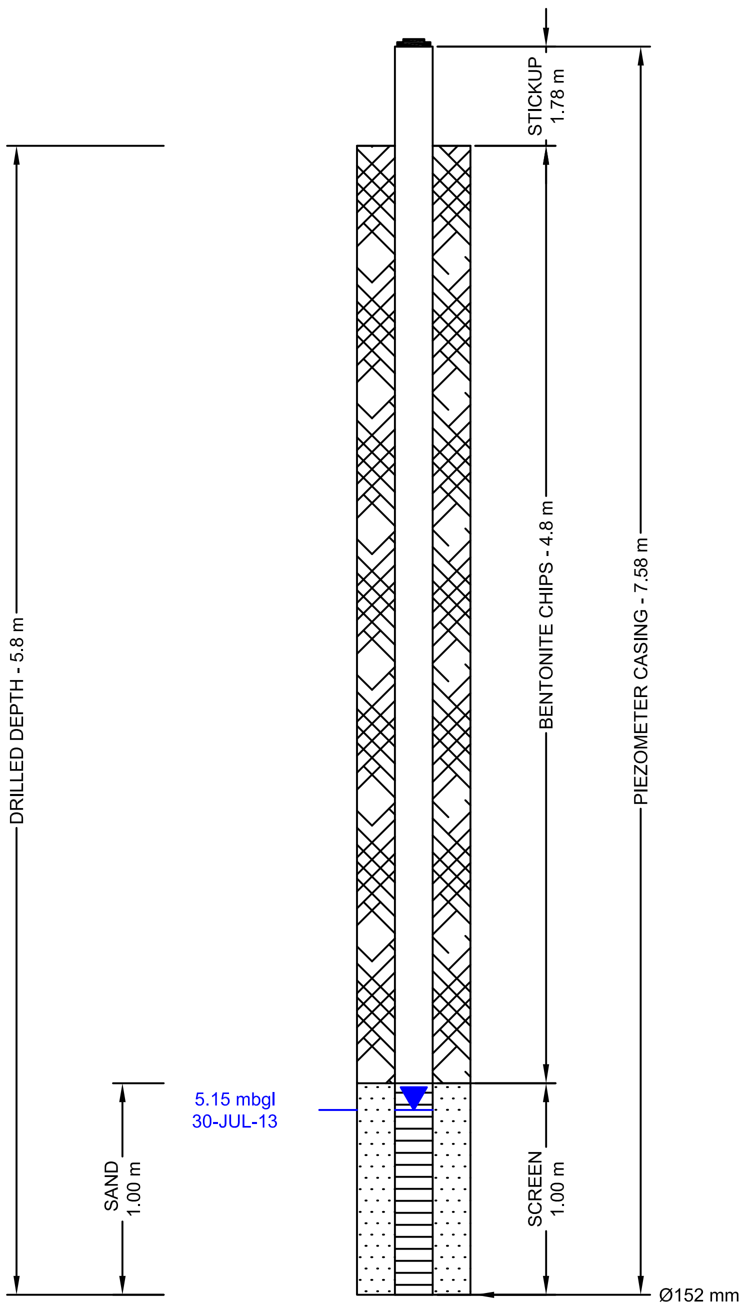
LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 10	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 10	**SCALE**	1:40 **DATE** 2013 08 19

PIEZOMETER 613596-07
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780940 N   399272 E
NAD 83 ZONE 13
SW14-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR	K. EBEL, B.Sc., G.I.T.
CONTRACTOR	BOSS DRILLING
OPERATOR	C. OLEKSUIK
DRILL RIG TYPE	CME 75
DATE INSTALLED	2013 07 09
APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C .WU
PROJECT No.	613596
SCALE	NOT TO SCALE
DATE	2013 08 08

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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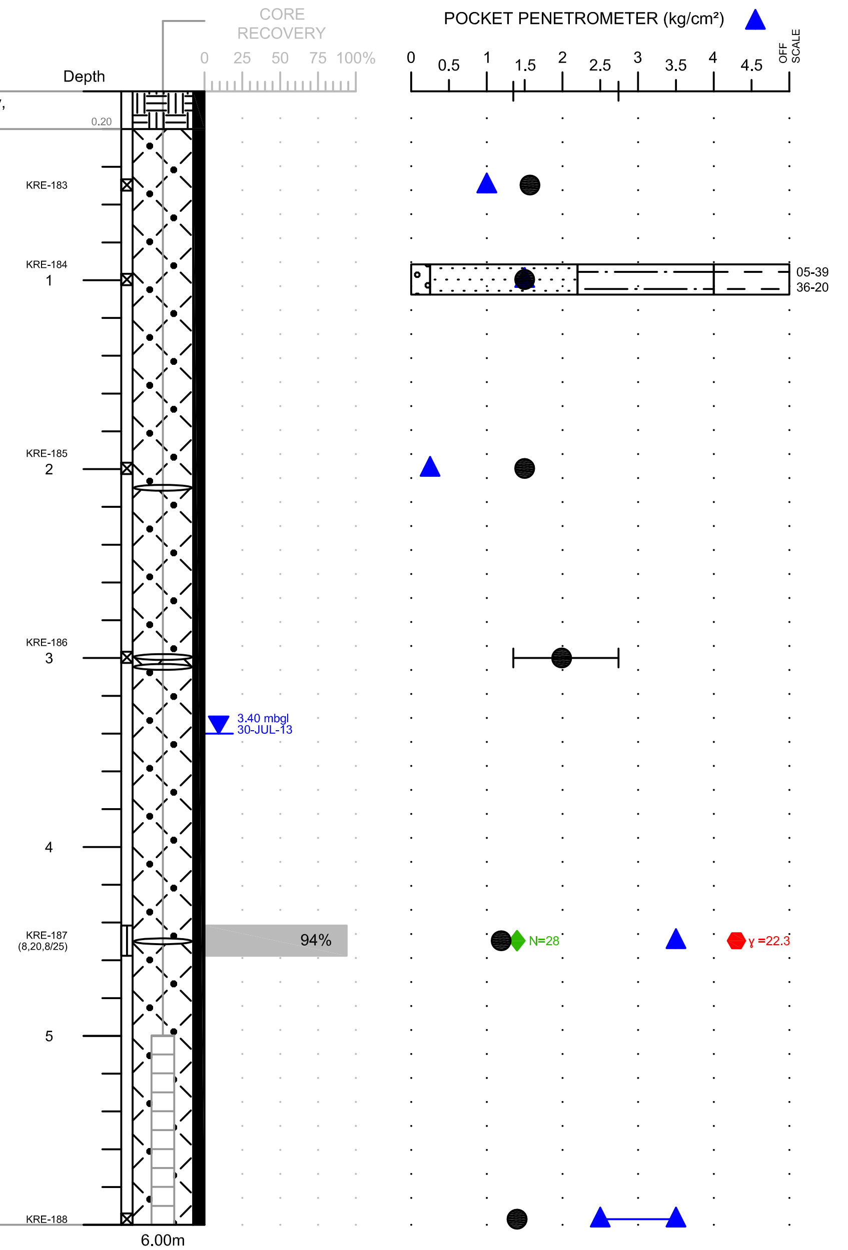
BOREHOLE 613596-08
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781080 N   399564 E
NAD 83 ZONE 13
NE14-11-37-04-W3
73B/1

BULK UNIT WEIGHT (kN/m^3): 18, 19, 20, 21, 22, 23
SPT NUMBER: 0, 20, 40, 60, 80, 100
SIEVE ANALYSIS: 0 – 100 % of sieve analysis (GRAVEL, SAND, SILT, CLAY)
ATTERBERG LIMITS: $W_{PLASTIC}$, $W_{NATURAL}$, W_{LIQUID} — 0, 10, 20, 30, 40, 50%
POCKET PENETROMETER (kg/cm²): 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, OFF SCALE

	Depth
TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets	0.20
SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, low plasticity, moist	
- below 1.0 m: trace Fe staining	1
- below 1.5 m: soft to firm	
-at 2.1 m: cobbles/boulders	2
-below 3.0 m: some sand, very stiff	3
-at 3.0 to 3.1 m: cobbles/boulders	
	4
-at 4.5 m: cobbles/boulders	
-below 4.5 m: very stiff, medium plasticity	5
	6.00m



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

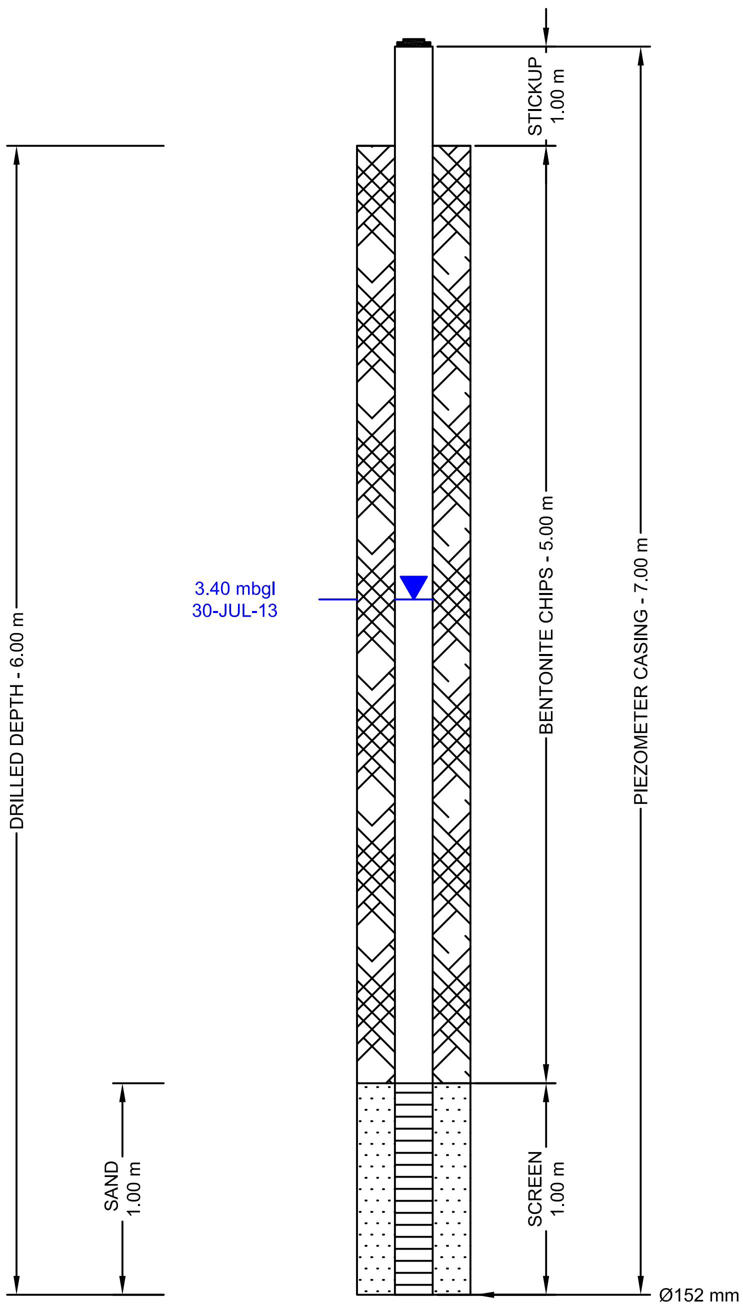
LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	SUPERVISOR	K. EBEL, B.Sc., G.I.T.	APPROVED BY	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	LOGGED BY	K. EBEL, B.Sc., G.I.T.	DRAWN BY	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	DATE DRILLED	2013 07 11	PROJECT No.	613596
ABANDONMENT	BENTONITE CHIPS	DATE INSTALLED	2013 07 11	SCALE	1:40 — DATE 2013 08 19

PIEZOMETER 613596-08
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5781080 N 399564 E
NAD 83 ZONE 13
NE14-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 11
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C .WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE — DATE 2013 08 08

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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BOREHOLE 613596-09
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780780 N 398865 E
NAD 83 ZONE 13
NW12-11-37-04-W3
73B/1

BULK UNIT WEIGHT (kN/m^3) — 18 19 20 21 22 23

SPT NUMBER — 0 20 40 60 80 100

SIEVE ANALYSIS — 0 … 100 % of sieve analysis — GRAVEL SAND SILT CLAY

ATTERBERG LIMITS — $W_{PLASTIC}$ $W_{NATURAL}$ W_{LIQUID} — 0 10 20 30 40 50%

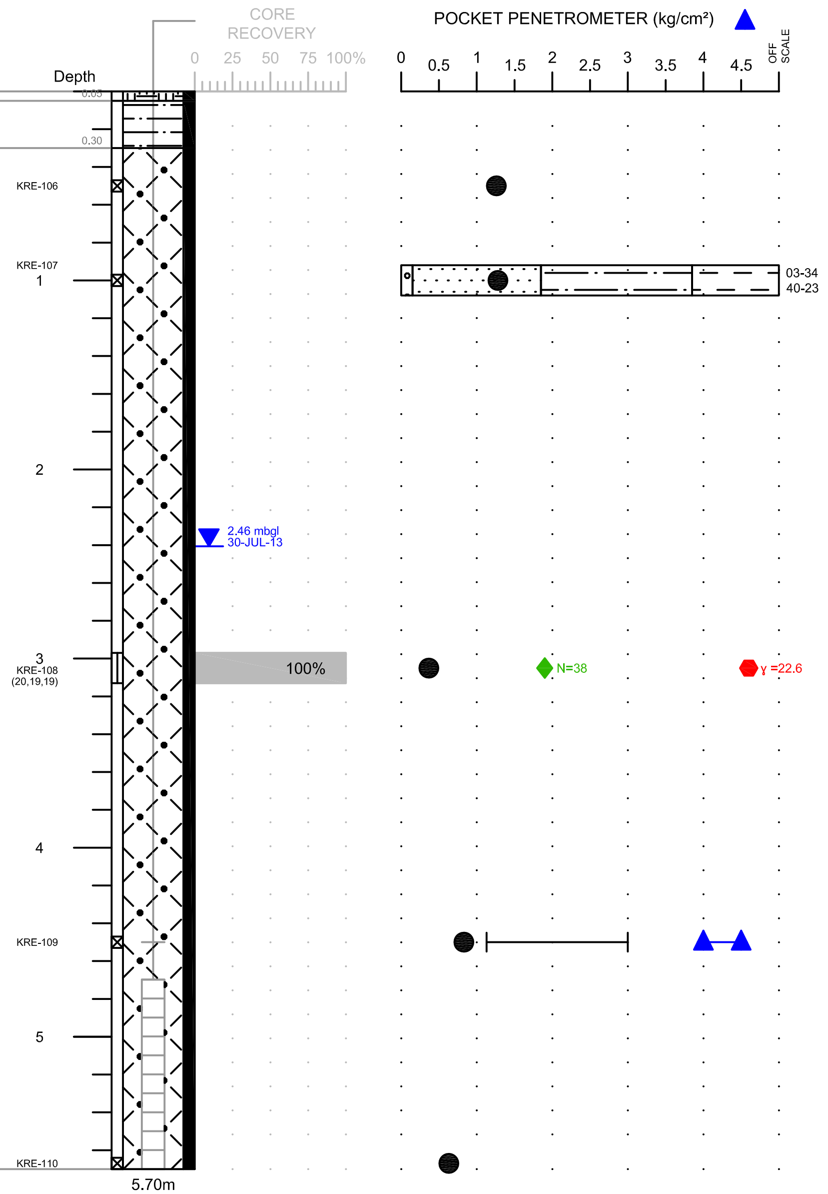
POCKET PENETROMETER (kg/cm²) — 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 OFF SCALE

TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse), some clay, light brown, oxidized, low to medium plasticity, damp to moist
-below 0.3 m: damp crumbly

SILT TILL: some sand to sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, very stiff, medium plasticity, moist, trace Fe staining

-below 3.0 m: hard



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 09	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 09	**SCALE**	1:40 **DATE** 2013 08 19

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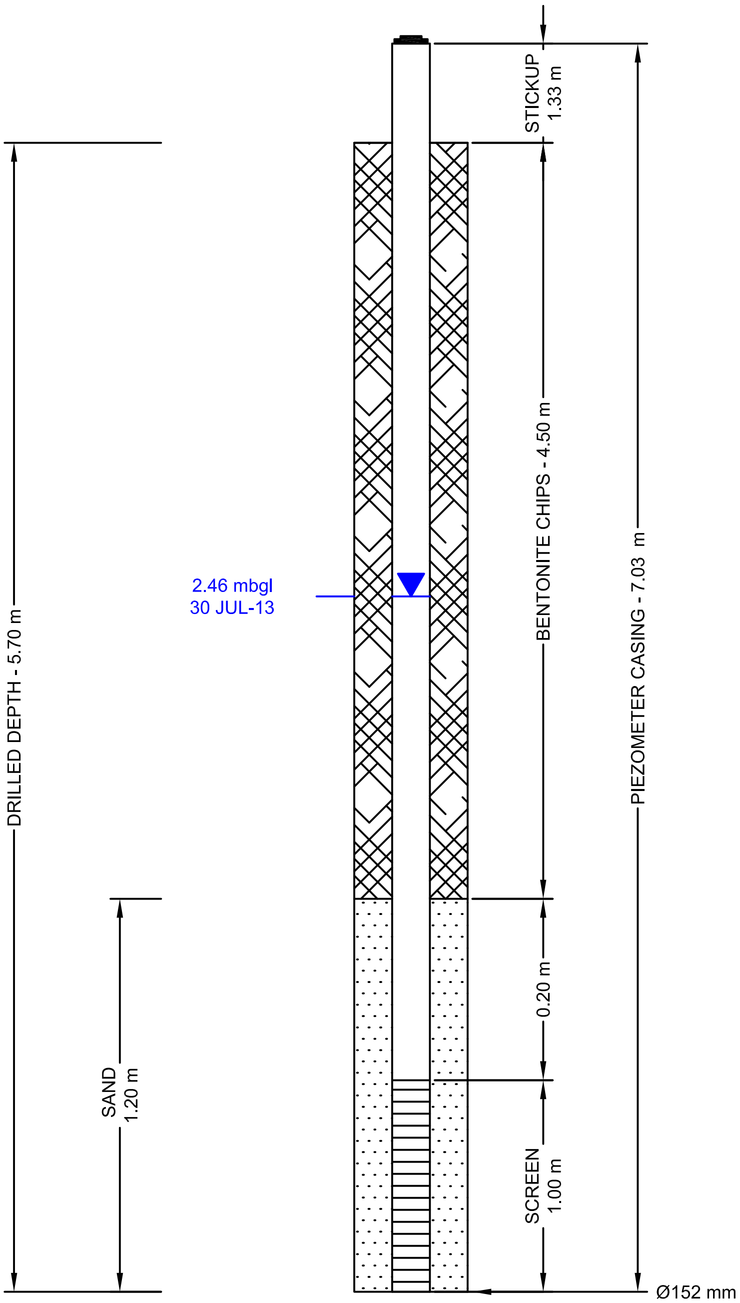
PIEZOMETER 613596-09
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780729 N   399076 E
NAD 83 ZONE 13
NE12-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR	K. EBEL, B.Sc., G.I.T.
CONTRACTOR	BOSS DRILLING
OPERATOR	C. OLEKSUIK
DRILL RIG TYPE	CME 75
DATE INSTALLED	2013 07 09
APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C .WU
PROJECT No.	613596
SCALE	NOT TO SCALE **DATE** 2013 08 08

SNC • LAVALIN

CLIENT	**PROJECT LOCATION**
CHRIS CEBRYK	W1/2-11-37-4-W3M

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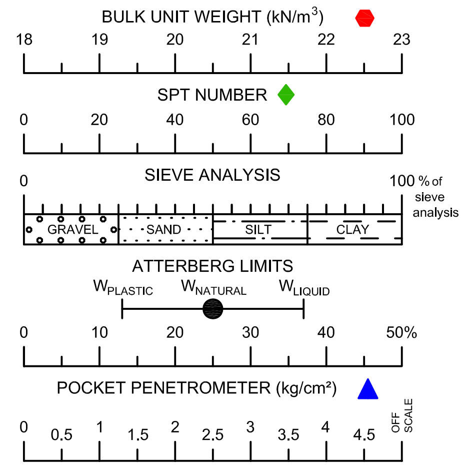
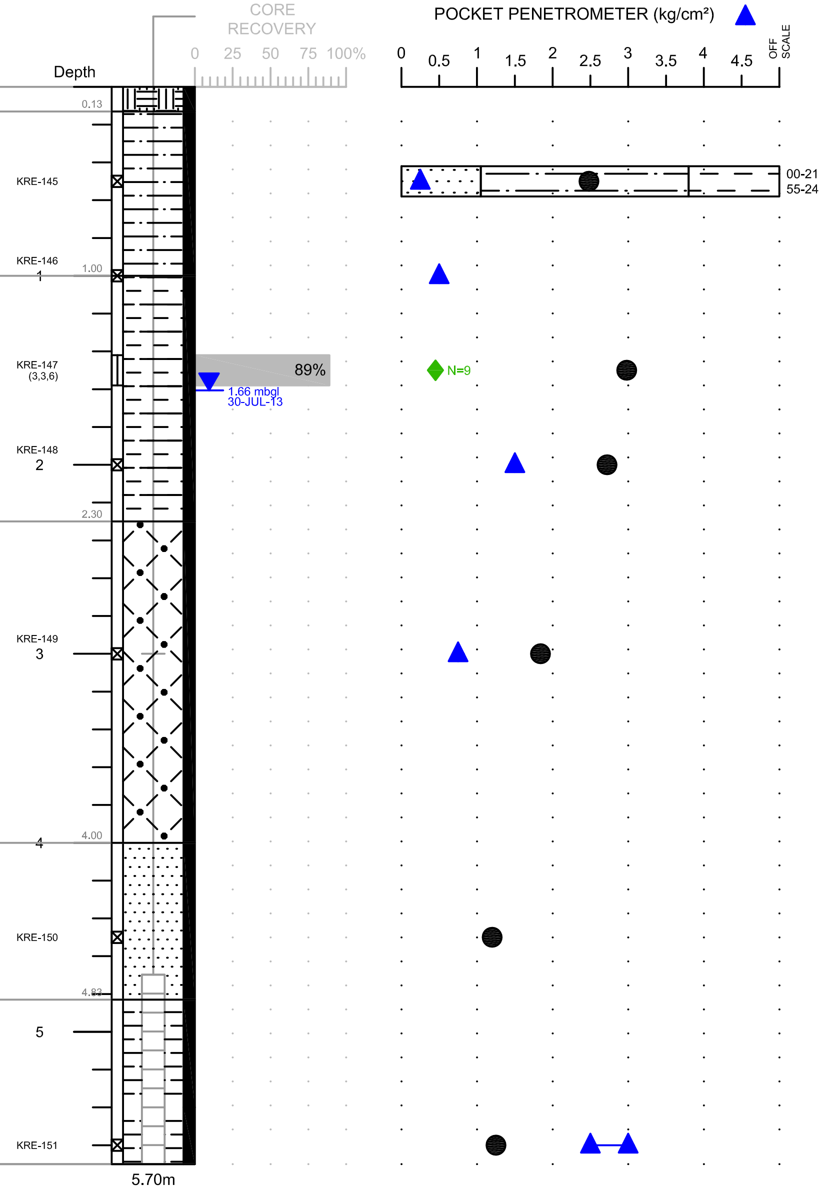
BOREHOLE 613596-10
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780729 N 399076 E
NAD 83 ZONE 13
NE12-11-37-04-W3
73B/1





TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse),some clay, brown, oxidized, soft, low to medium plasticity, moist, trace Fe staining,

SILT AND CLAY: brown, oxidized, stiff, medium plasticity, moist, trace organics

SILT TILL: some sand (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, firm, medium plasticity, moist, trace Fe staining

SAND: (fine to coarse), silty, trace gravel (fine to medium), brown, oxidized, loose to compact, wet, seepage, sloughing

SILT: sandy (fine), some clay laminations, brown, oxidized, soft, non-plastic, wet, seepage, sloughing

-below 5.4 m: some clay

NOTES

1. Borehole sloughed to 3.0 m immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 10	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 10	**SCALE**	1:40 **DATE** 2013 008 19

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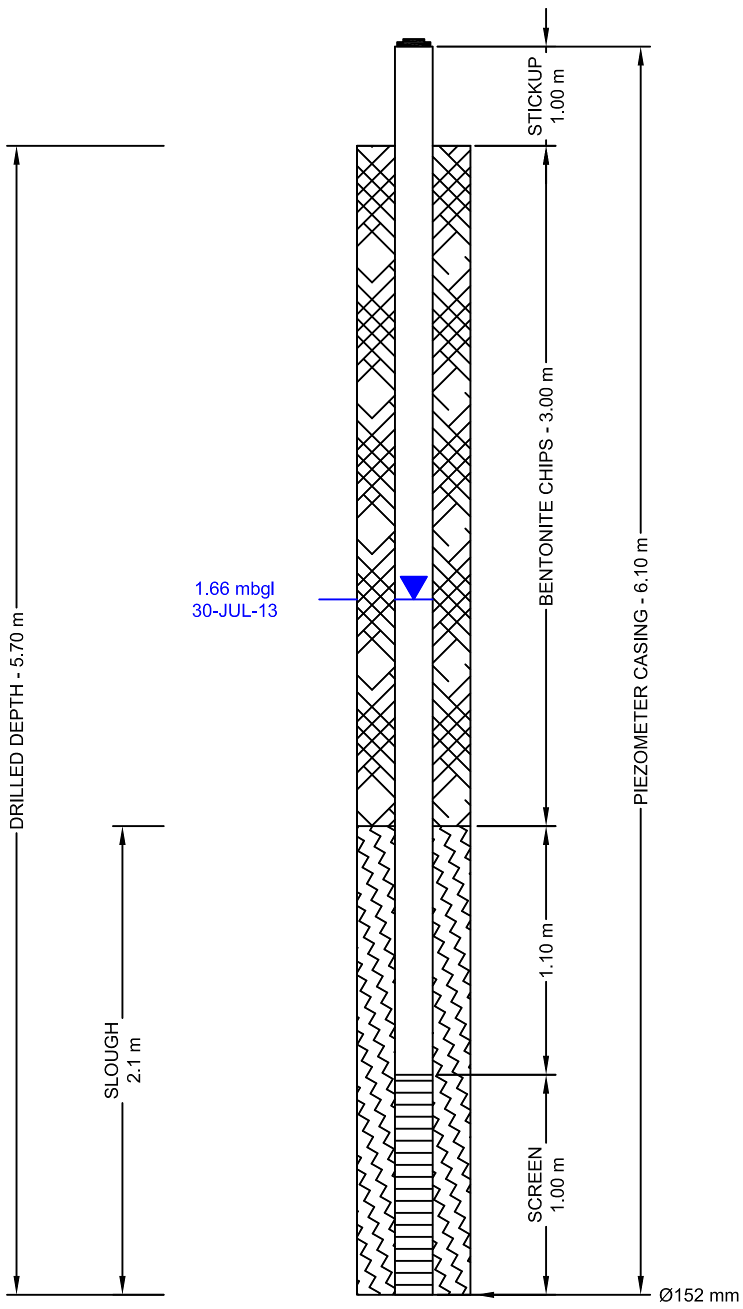
PIEZOMETER 613596-10
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780729 N   399076 E
NAD 83 ZONE 13
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR	K. EBEL, B.Sc., G.I.T.
CONTRACTOR	BOSS DRILLING
OPERATOR	C. OLEKSUIK
DRILL RIG TYPE	CME 75
DATE INSTALLED	2013 07 10
APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C .WU
PROJECT No.	613596
SCALE	NOT TO SCALE
DATE	2013 08 08

SNC • LAVALIN

CLIENT	**PROJECT LOCATION**
CHRIS CEBRYK	W1/2-11-37-4-W3M

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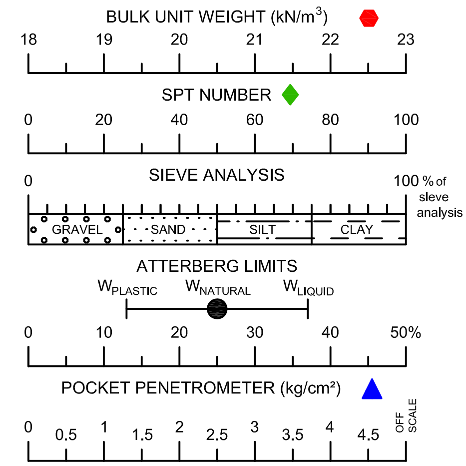
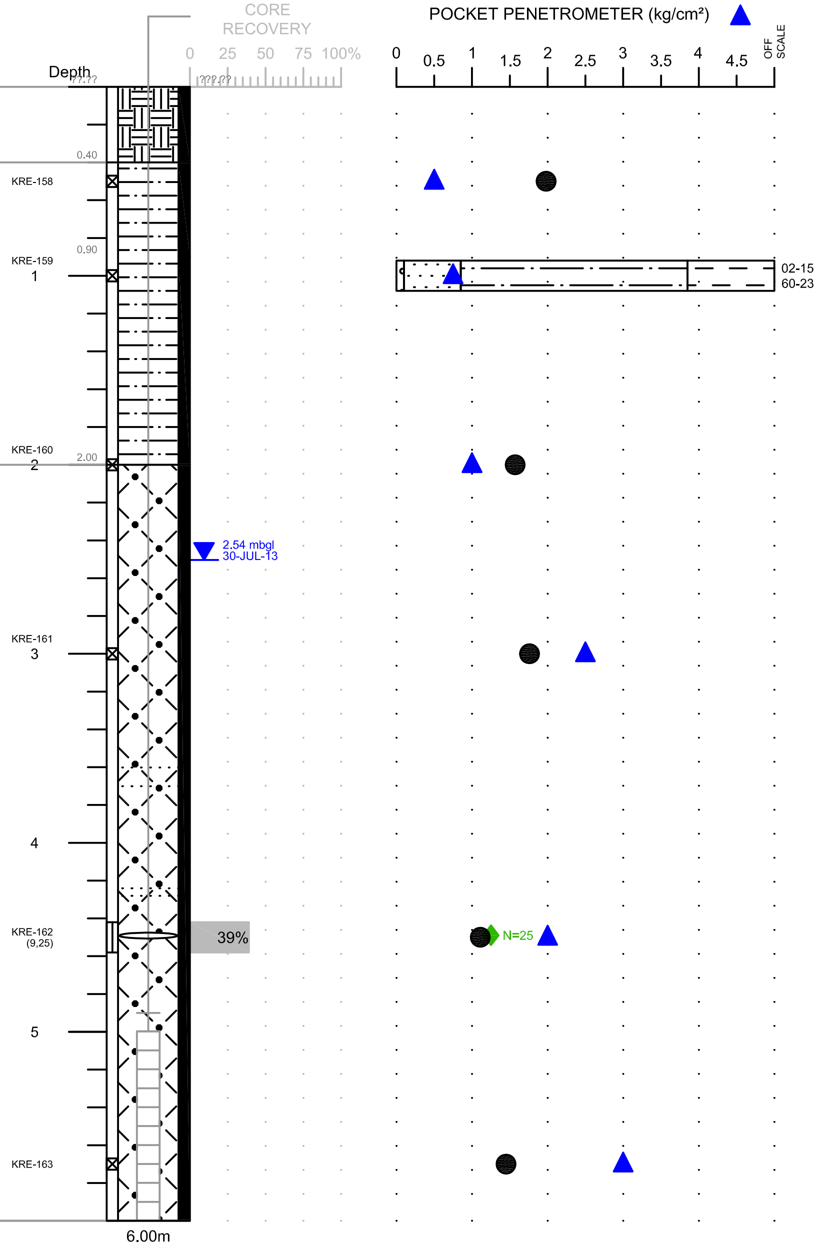
BOREHOLE 613596-11
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780709 N   399217 E
NAD 83 ZONE 13
NW11-11-37-04-W3
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets	
SILT: some sand (fine to coarse), some clay, brown, oxidized, soft, medium plasticity, moist, organics -below 0.9 m: firm to stiff	
SILT TILL: some sand (fine to coarse),trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining -below 3.0 m: very stiff -3.6 to 3.7 m: sand lenses -4.24 to 4.28 m: sand lenses -at 4.5m: cobbles/boulders -below 5.0m: Fe staining	



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C. WU		
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 10	**PROJECT No.**	613596		
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 10	**SCALE**	1:40	**DATE**	2013 08 19

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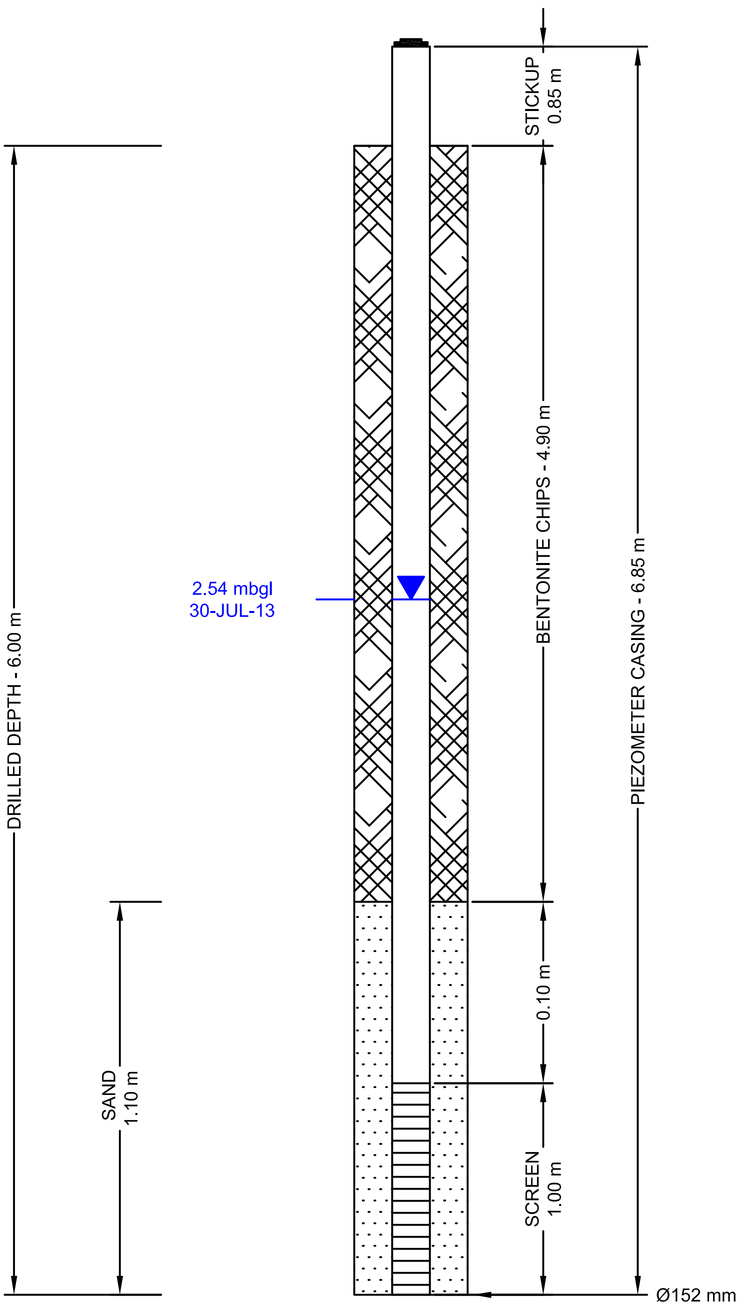
PIEZOMETER 613596-11
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780709 N 399217 E
NAD 83 ZONE 13
NW11-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES					
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.			
	CONTRACTOR	BOSS DRILLING		SNC·LAVALIN	
	OPERATOR	C. OLEKSUIK			
	DRILL RIG TYPE	CME 75			
	DATE INSTALLED	2013 07 10			
	APPROVED BY	C. ZUBROWSKI, P.Eng.		CLIENT	PROJECT LOCATION
	DRAWN BY	C . SAULNIER / C. WU			
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596		CHRIS CEBRYK	W1/2-11-37-4-W3M
	SCALE	NOT TO SCALE	DATE 2013 08 09		

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BOREHOLE 613596-12
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

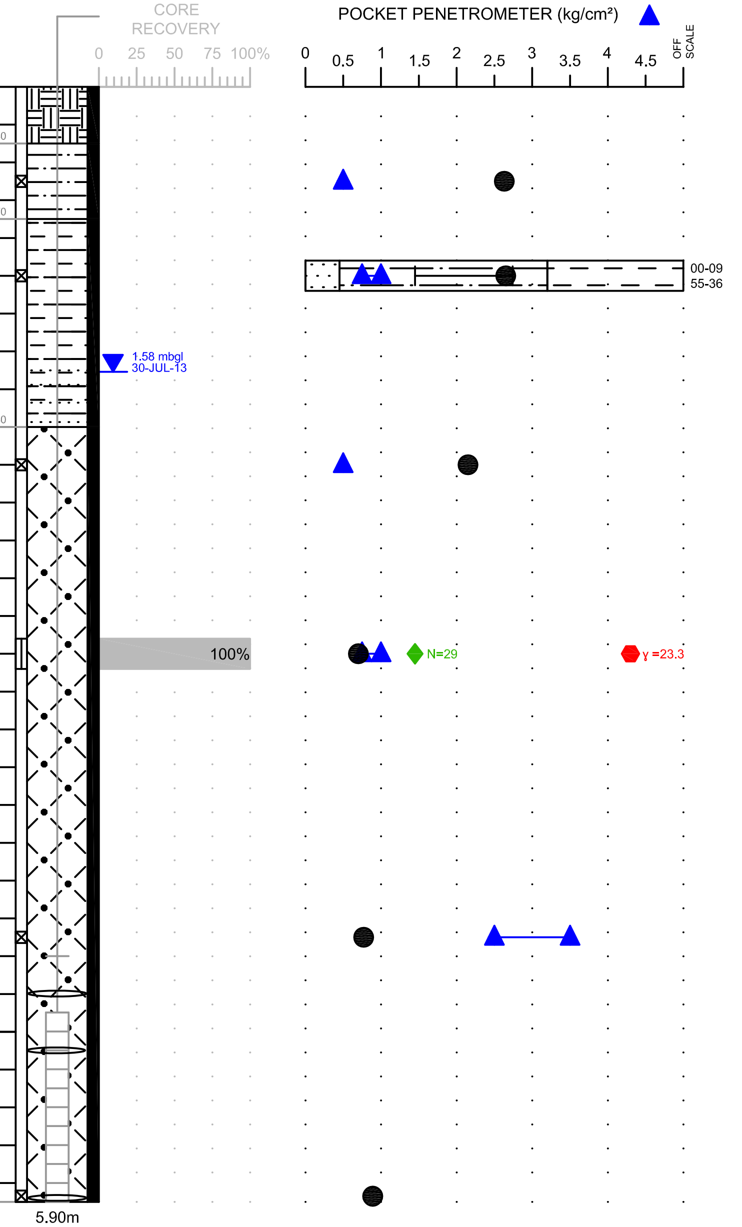
5780908 N 399561 E
NAD 83 ZONE 13
SE14-11-37-04-W3
73B/1

BULK UNIT WEIGHT (kN/m^3) — 19, 20, 21, 22, 23, 24
SPT NUMBER — 0, 20, 40, 60, 80, 100
SIEVE ANALYSIS — 0 … 100 % of sieve analysis (GRAVEL, SAND, SILT, CLAY)
ATTERBERG LIMITS — $W_{PLASTIC}$, $W_{NATURAL}$, W_{LIQUID} — 0, 10, 20, 30, 40, 50%
POCKET PENETROMETER (kg/cm²) — 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, OFF SCALE

Depth

TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets	0.30
SILT: some sand (fine to coarse), some clay, brown, oxidized, firm, medium plasticity, moist	KRE-177; 0.70
SILT AND CLAY: trace sand (fine), brown, oxidized, soft to firm, low to medium plasticity, moist -trace organics to 1.5 m -below 1.5m: interbedded wet sand, lenses	KRE-178; 1; 1.80
SILT TILL: some sand to sandy (fine to coarse), trace gravel (fine to coarse), some clay, brownish-grey, oxidized, firm to stiff, medium plasticity, moist, trace Fe staining -below 3.6 m : light brown, very stiff to hard -at 4.8 m: cobbles/boulders -5.1 m: cobbles/boulders -at 5.9 m: cobbles/boulders	KRE-179; 2; 3; KRE-180 (8,13,16); 4; KRE-181; 5; KRE-182

5.90m



NOTES
1. Borehole open and dry immediately after drilling (I.A.D.). 2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches). 3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches). 4. Depths are in metres below ground level (mbgl). 5. Coordinates are from a handheld GPS, +/- 3 m.

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	SUPERVISOR	K. EBEL, B.Sc., G.I.T.	APPROVED BY	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	LOGGED BY	K. EBEL, B.Sc., G.I.T.	DRAWN BY	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	DATE DRILLED	2013 07 11	PROJECT No.	613596
ABANDONMENT	BENTONITE CHIPS	DATE INSTALLED	2013 07 11	SCALE	1:40 — DATE 2013 08 19

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

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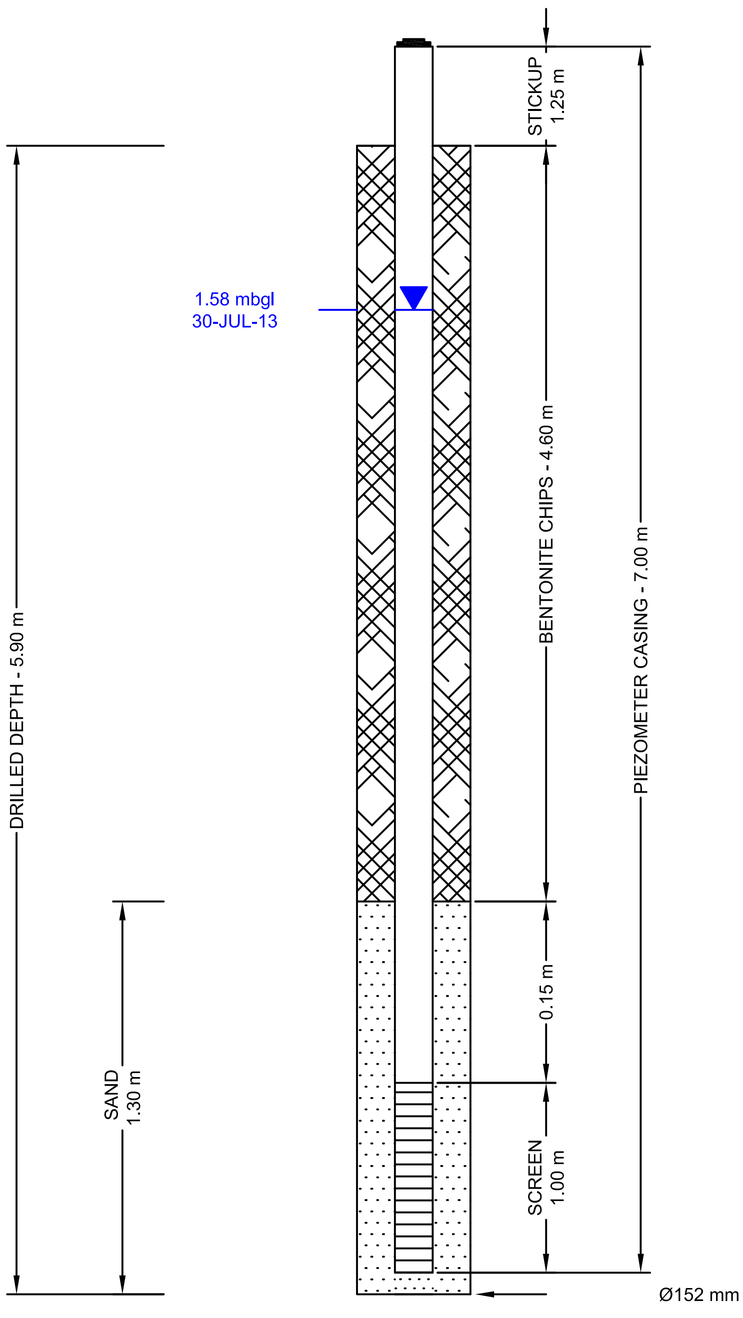
PIEZOMETER 613596-12
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780908 N 399561 E
NAD 83 ZONE 13
SE14-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES				
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.		
	CONTRACTOR	BOSS DRILLING		
	OPERATOR	C. OLEKSUIK		
	DRILL RIG TYPE	CME 75		
	DATE INSTALLED	2013 07 10		
	APPROVED BY	C. ZUBROWSKI, P.Eng.	CLIENT	PROJECT LOCATION
	DRAWN BY	C . SAULNIER / C. WU		
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596	CHRIS CEBRYK	W1/2-11-37-4-W3M
	SCALE	NOT TO SCALE — DATE 2013 08 09		

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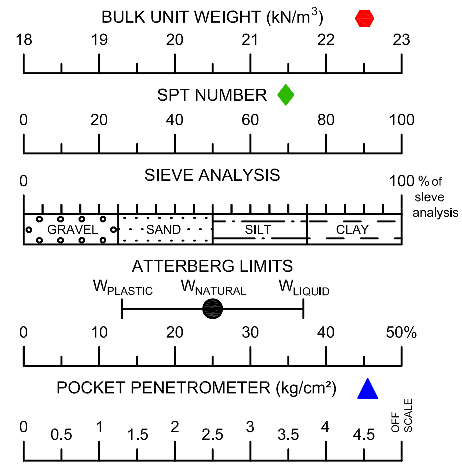
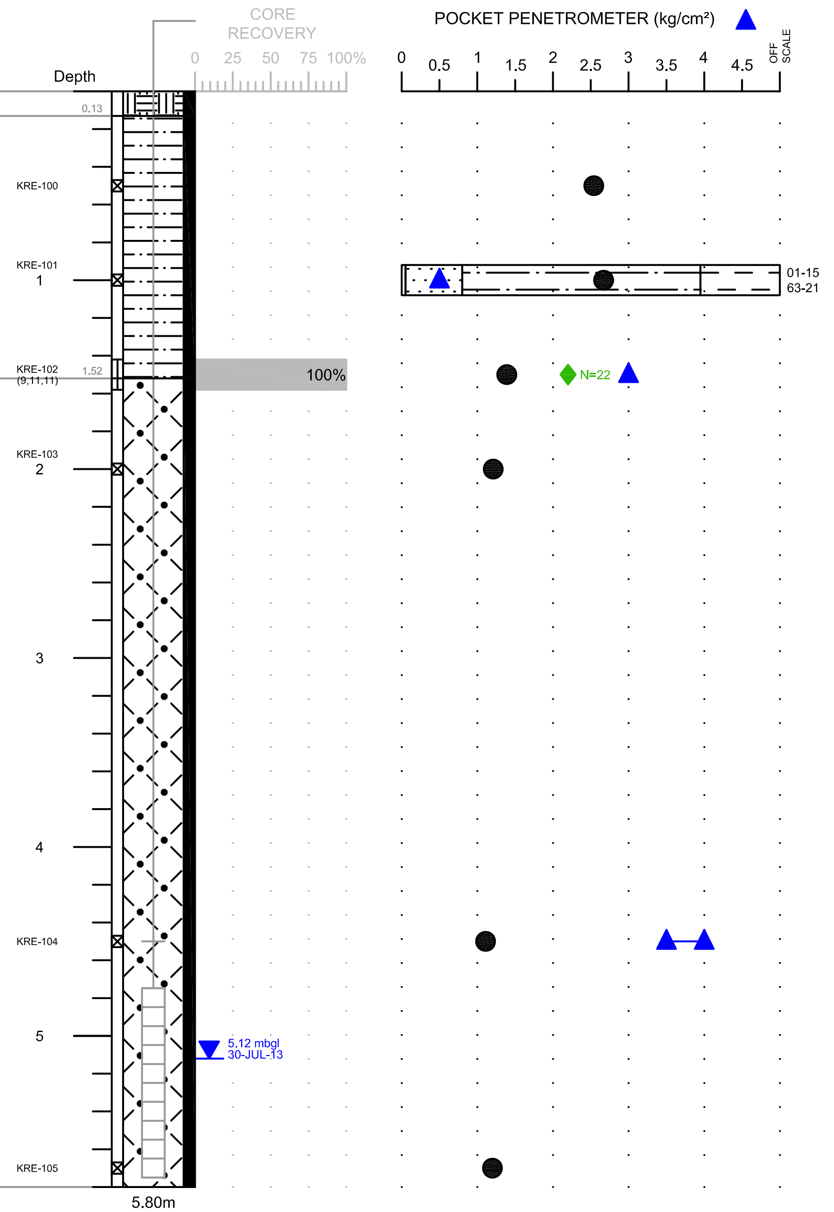
BOREHOLE 613596-13
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780581 N 398872 E
NAD 83 ZONE 13
SW12-11-37-04-W3
73B/1



Depth	
0 – 0.13	TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets
0.13 – 1.52	SILT: some sand (fine), some clay, light brown, oxidized, firm, medium plasticity, moist -below 0.8 m: trace gypsum -below 1.0 m: trace gravel (fine to coarse), Fe staining
1.52 – 5.80	SILT TILL: sandy (fine to coarse), trace cobble, trace to some gravel (fine to coarse), some clay, brown, oxidized, very stiff, low plasticity, damp to moist, crumbly, Fe staining, trace gypsum crystals



LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 09	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 09	**SCALE**	1:40 **DATE** 2013 08 09

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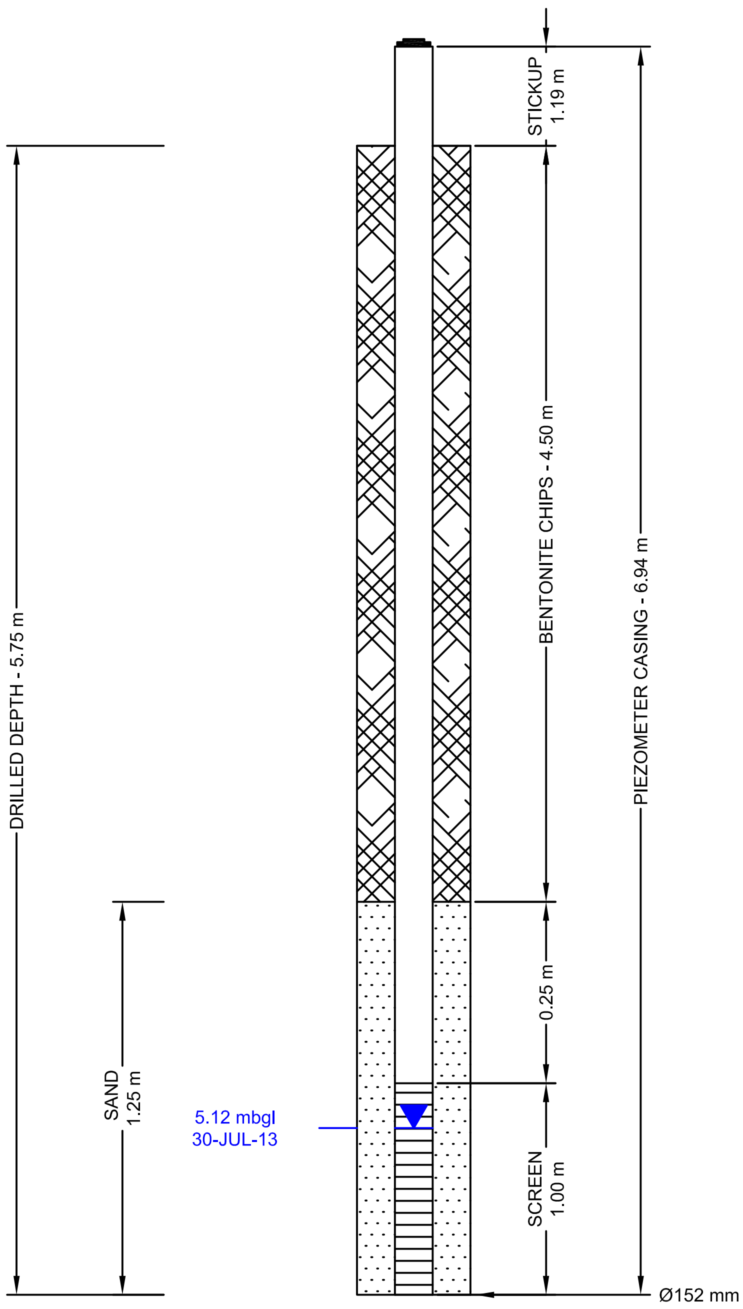
PIEZOMETER 613596-13
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780581 N   398872 E
NAD 83 ZONE 13
SW12-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR	K. EBEL, B.Sc., G.I.T.		
CONTRACTOR	BOSS DRILLING		
OPERATOR	C. OLEKSUIK		
DRILL RIG TYPE	CME 75		
DATE INSTALLED	2013 07 09		
APPROVED BY	C. ZUBROWSKI, P.Eng.		
DRAWN BY	C . SAULNIER / C. WU		
PROJECT No.	613596		
SCALE	NOT TO SCALE	DATE	2013 08 09

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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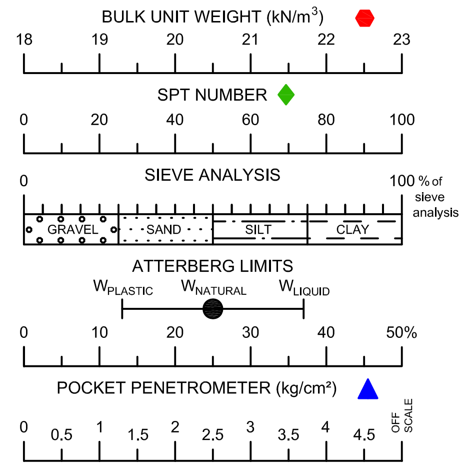
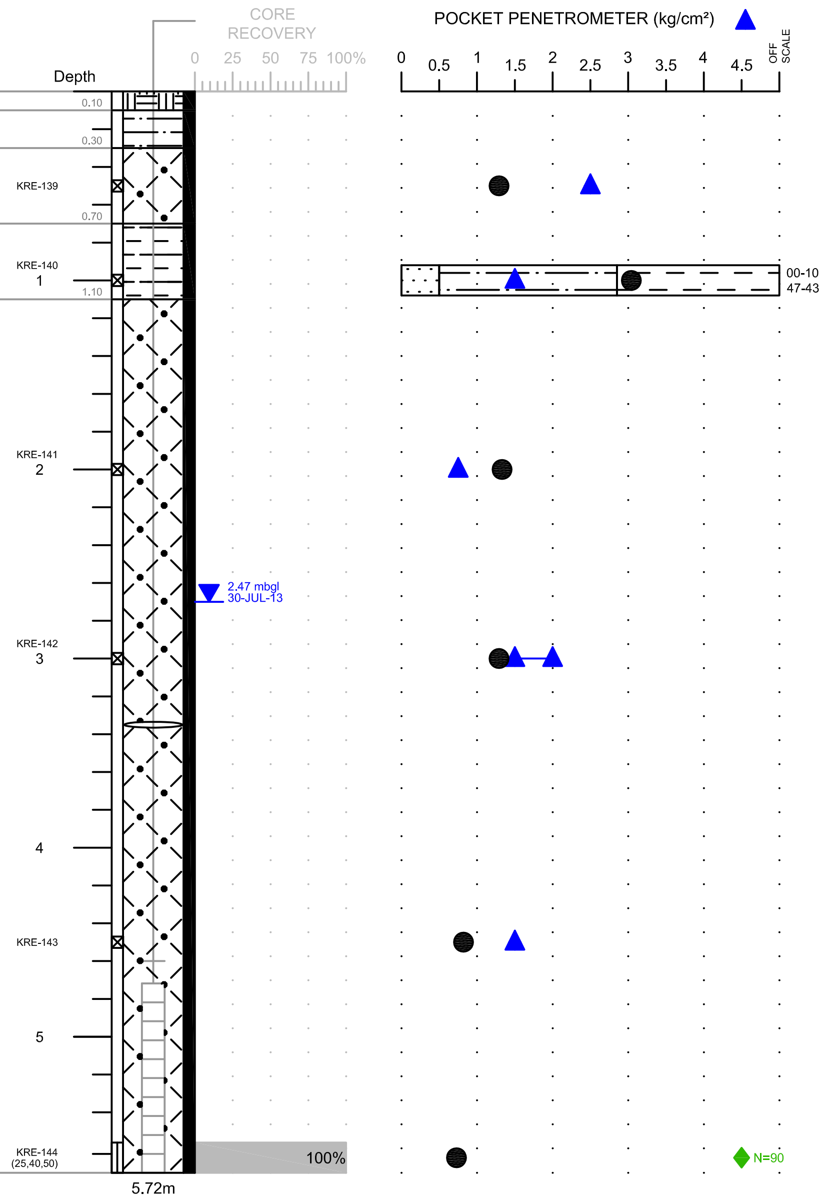
BOREHOLE 613596-14
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780574 N   399065 E
NAD 83 ZONE 13
SE12-11-37-04-W3
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets
SILT: some sand (fine to coarse), some clay, brown, oxidized, firm, low plasticity, moist
SILT TILL: some sand to sandy (fine to coarse), trace gravel (fine to medium), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining
CLAY AND SILT: trace to some sand (fine to coarse), brown, oxidized, stiff, medium plasticity, moist, trace Fe staining
SILT TILL: some sand (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, plasticity, moist, trace Fe staining -below 3.0 m: very stiff -at 3.35m: cobbles/boulders -below 5.0 m: hard



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C. WU		
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 10	**PROJECT No.**	613596		
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 10	**SCALE**	1:40	**DATE**	2013 08 19

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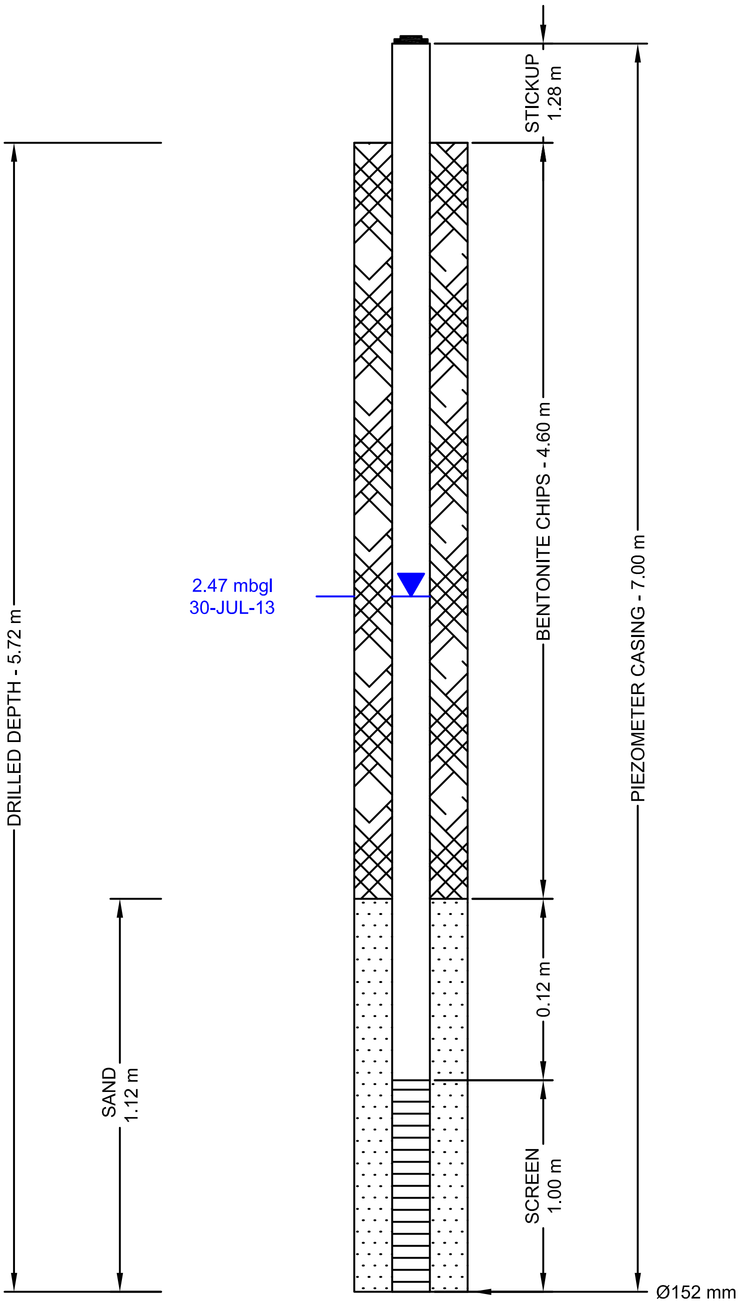
PIEZOMETER 613596-14
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780574 N 399065 E
NAD 83 ZONE 13
SE12-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 10
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C . SAULNIER / C. WU
All depths are expressed in metres above or below Natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE — DATE 2013 08 09

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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BOREHOLE 613596-15
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780566 N 399247 E
NAD 83 ZONE 13
SW11-11-37-04-W3
73B/1

TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse), some clay, brown, oxidized, firm, low plasticity, moist, trace Fe staining

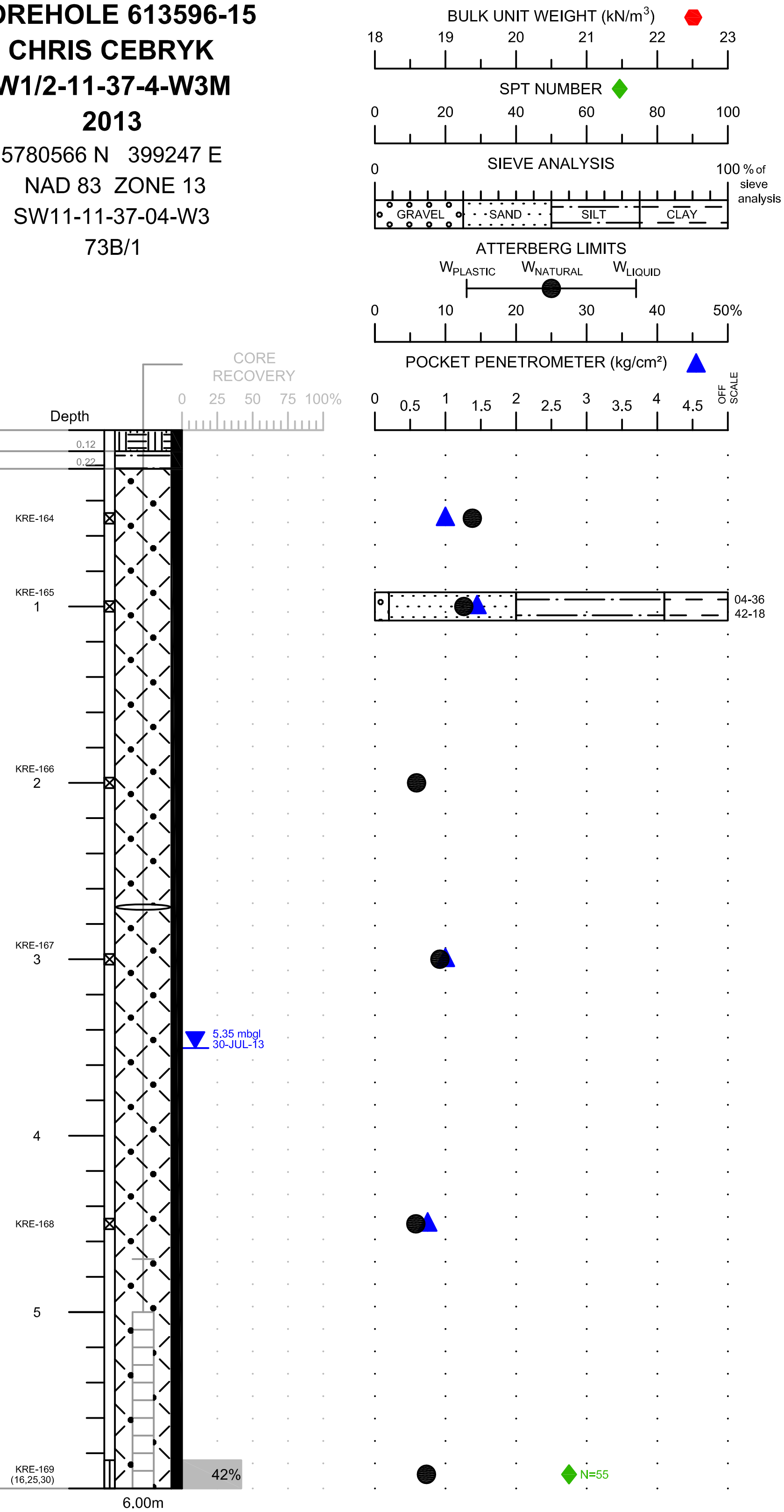
SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining

-below 1.5m: low plasticity, damp to moist

-at 2.7 m: cobbles/boulders

-below 4.0 m: hard

-below 5.0 m: trace Fe staining



NOTES
1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK / C. WU	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER		
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 11	**PROJECT No.**	613596		
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 11	**SCALE**	1:40	**DATE**	2013 08 19

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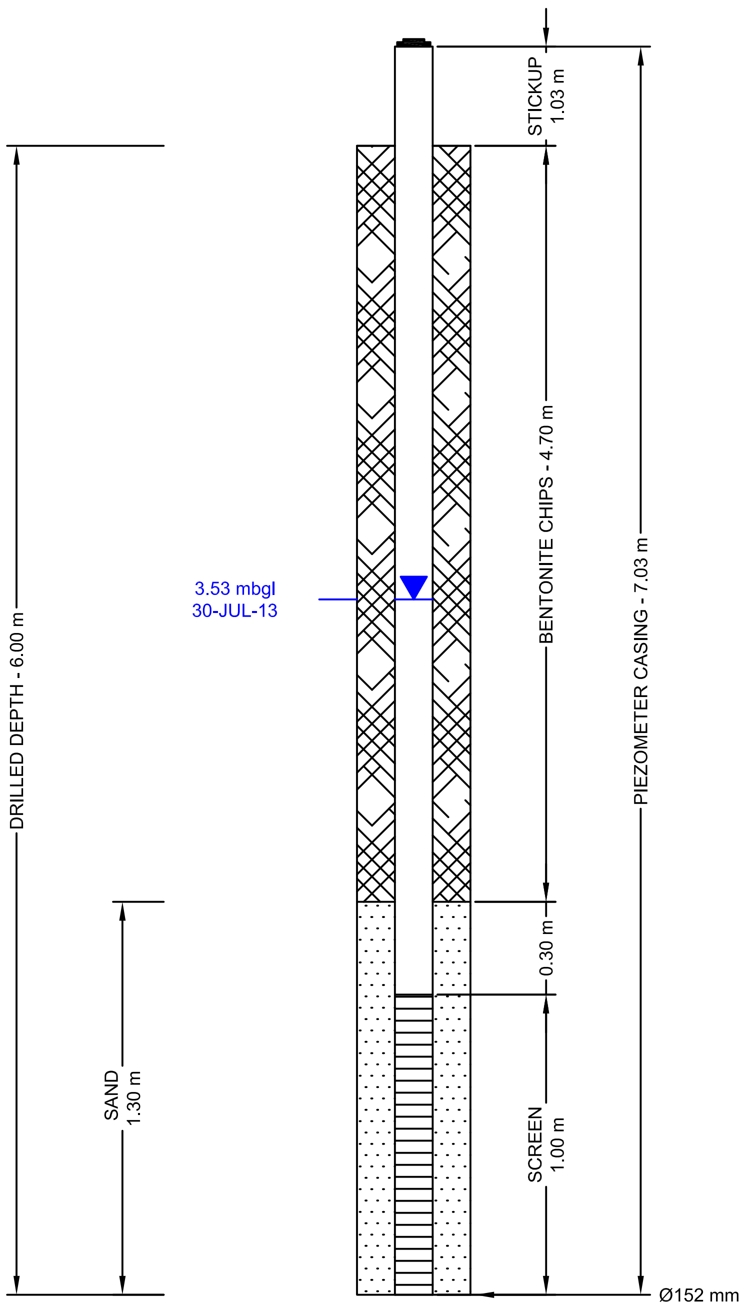
PIEZOMETER 613596-15
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780566 N   399247 E
NAD 83 ZONE 13
SW11-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 11
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
	PROJECT No.	613596
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	SCALE	NOT TO SCALE DATE 2013 08 09

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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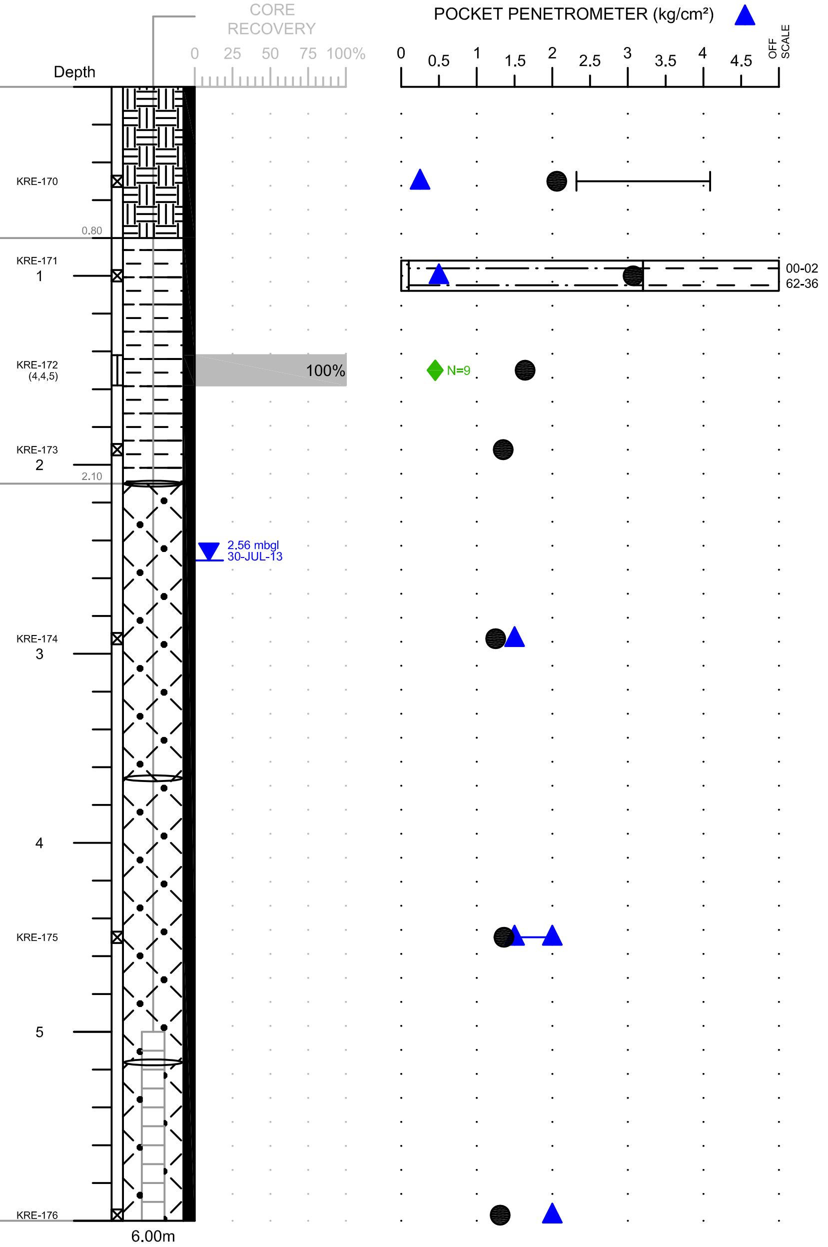
BOREHOLE 613596-16
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780627 N 399398 E
NAD 83 ZONE 13
SE11-11-37-04-W3
73B/1

BULK UNIT WEIGHT (kN/m^3): 18, 19, 20, 21, 22, 23
SPT NUMBER: 0, 20, 40, 60, 80, 100
SIEVE ANALYSIS: 0 – 100 % of sieve analysis (GRAVEL, SAND, SILT, CLAY)
ATTERBERG LIMITS: $W_{PLASTIC}$, $W_{NATURAL}$, W_{LIQUID}: 0, 10, 20, 30, 40, 50%
POCKET PENETROMETER (kg/cm²): 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, OFF SCALE



TOPSOIL: silt, some clay, some sand (fine), dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT AND CLAY: trace sand (fine to coarse), brown, oxidized, firm, medium plasticity, moist

-below 1.5m: trace Fe staining

SILT TILL: some sand to sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, medium plasticity, moist, trace Fe staining

-at 2.1 m: cobbles/boulders

-at 3.66 m: cobbles/boulders

-at 5.18 m: cobbles/boulders

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC·LAVALIN

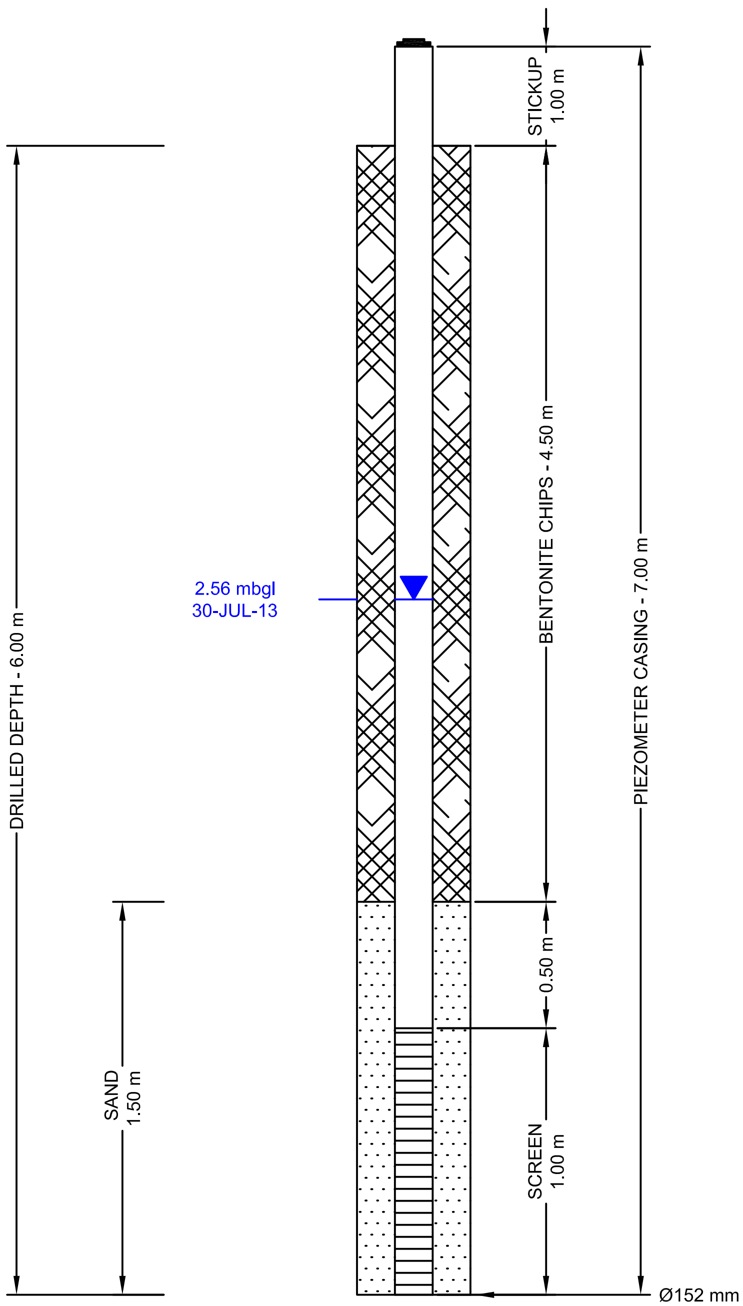
LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above and will vary between locations and may vary with time.

CLIENT	CHRIS CEBRYK	**PROJECT LOCATION**	W1/2-11-37-4-W3M		
CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 11	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 11	**SCALE**	1:40 **DATE** 2013 08 19

PIEZOMETER 613596-16
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780627 N 399398 E
NAD 83 ZONE 13
SE11-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 11
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE DATE 2013 08 09

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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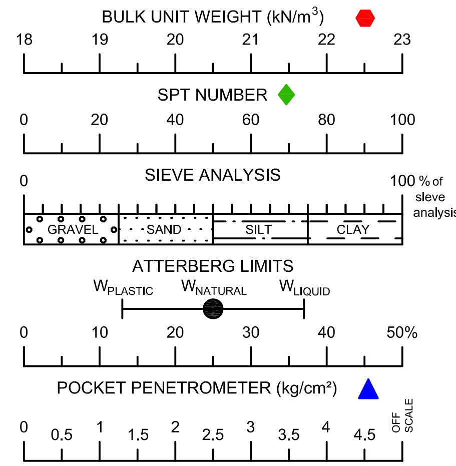
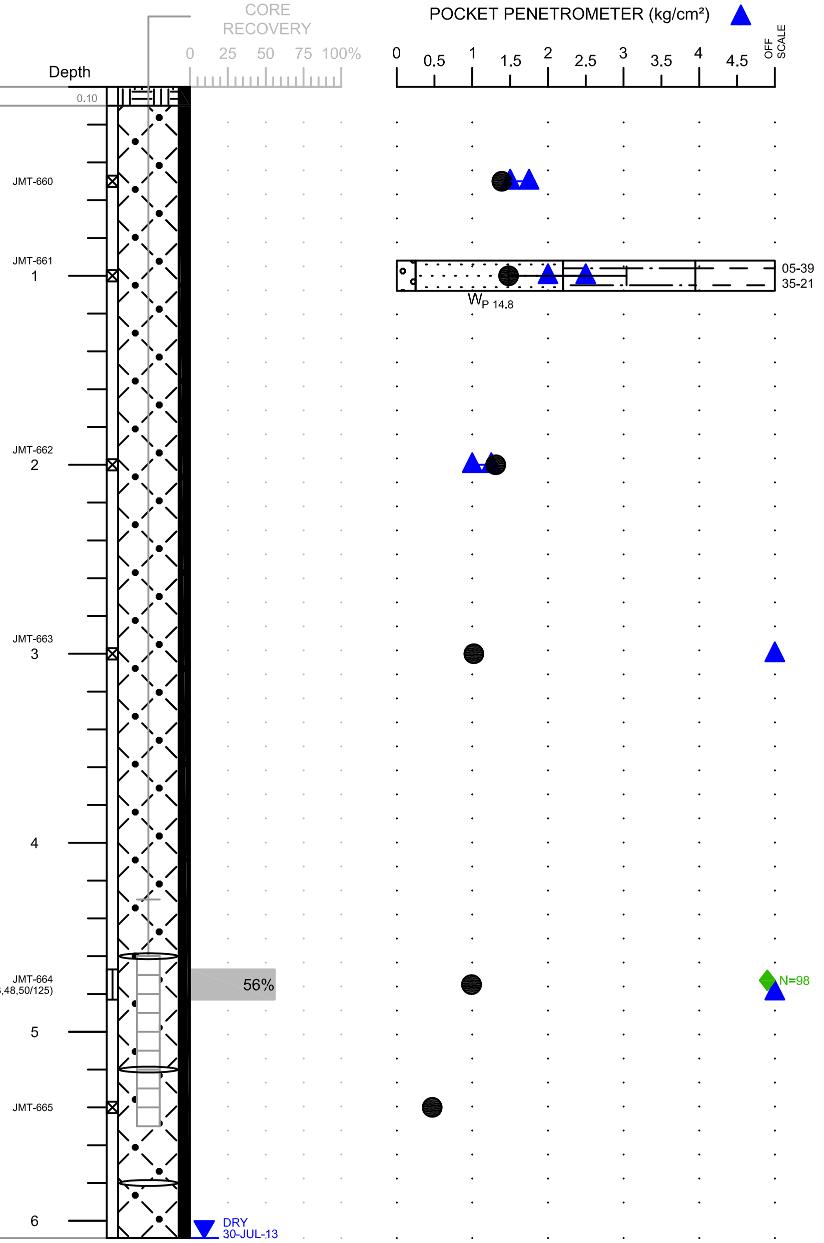
BOREHOLE 613596-17
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780393 N 398881 E
NAD 83 ZONE 13
NW05-11-37-04-W3
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT TILL: some sand (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, low to medium plasticity, damp, Fe staining
- -below 0.4 m: moist
- -below 1.0 m: very stiff
- -below 2.7 m: damp to moist, crumbly
- -below 3.0 m: hard
- -at 4.6 m: cobbles/boulders
- -bleow 4.6 m: trace to some gravel (fine to coarse)
- -at 5.2 m: cobbles/boulders
- -at 5.8 m: cobbles/boulders



NOTES

1. Borehole sloughed to 5.5 m (18.0 ft)immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC·LAVALIN

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	SUPERVISOR	J. TIPMAN, B.E., E.I.T.	APPROVED BY	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	LOGGED BY	J. TIPMAN, B.E., E.I.T.	DRAWN BY	C. SAULNIER / C. WU		
DRILL RIG TYPE	CME 75	DATE DRILLED	2013 07 04	PROJECT No.	613596		
ABANDONMENT	BENTONITE CHIPS	DATE INSTALLED	2013 07 04	SCALE	1:40	DATE	2013 08 19

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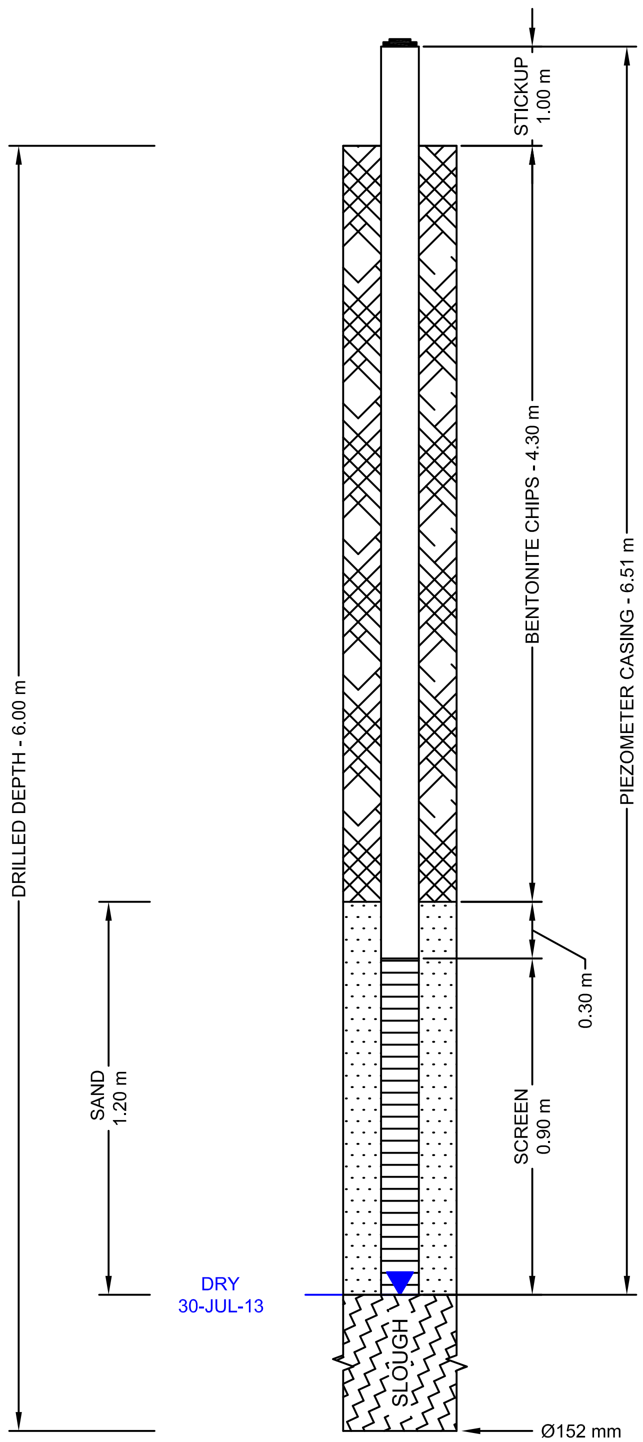
PIEZOMETER 613596-17
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780393 N   398881 E
NAD 83 ZONE 13
NW05-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

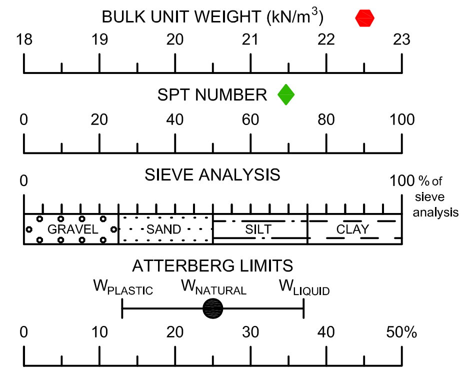
NOTES		
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 04
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE — DATE 2013 08 19

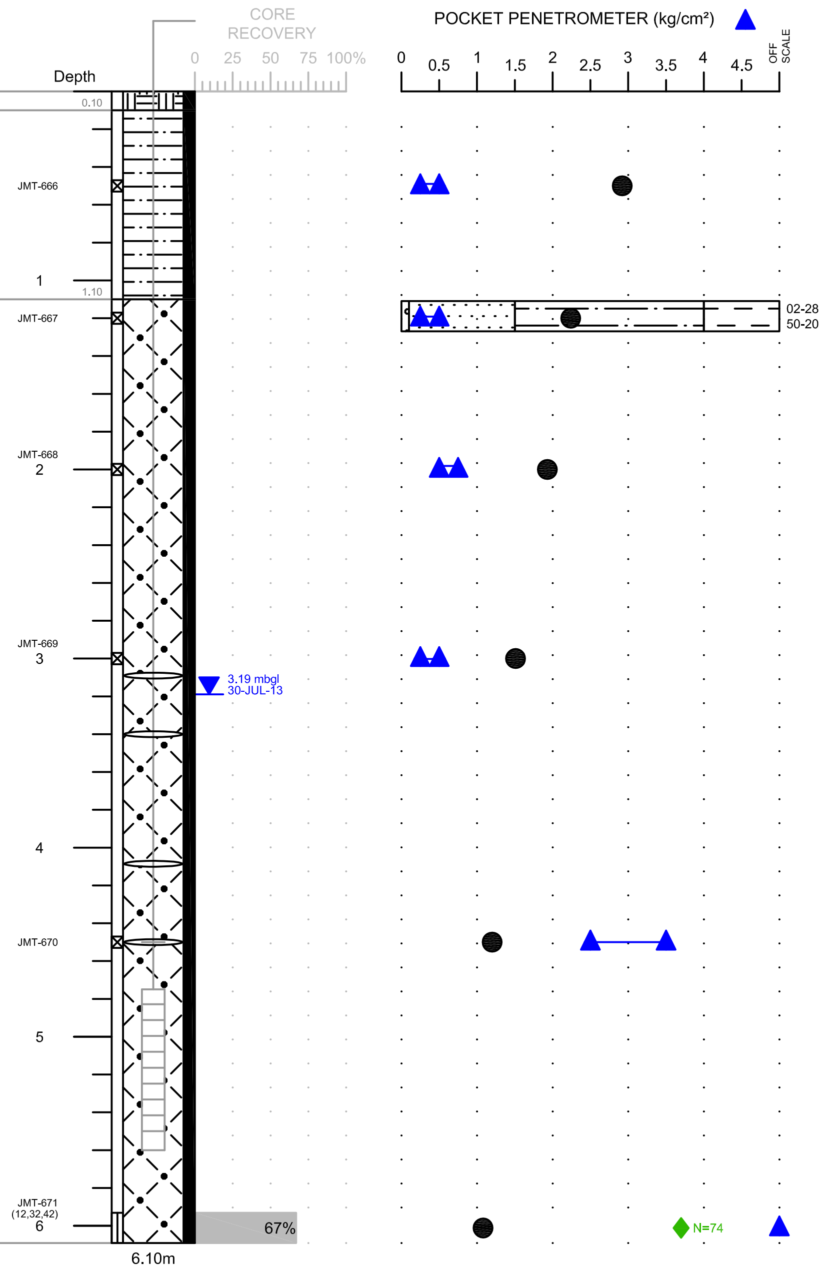
SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

BOREHOLE 613596-18
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780395 N   399072 E
NAD 83 ZONE 13
NE05-11-37-04-W3
73B/1





TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: clayey, some sand (fine), brown, oxidized, soft, medium plasticity, moist

SILT TILL: some sand to sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, soft, medium plasticity, moist, Fe staining

-below 2.5 m: sandy (fine to coarse), firm, low to medium plastiicity, Fe staining

-below 3.0 m: soft to firm
-at 3.1 m: cobbles/boulders

-at 3.4 m: cobbles/boulders
-below 3.4 m: dark brown, stiff, low plasticity, damp to moist, crumbly

-at 4.1 m: cobbles/boulders

-below 4.5 m: some gravel (fine to coarse), very stiff, cobbles/boulders

-below 6.0 m: hard

NOTES

1. Borehole sloughed to 5.6 m (18.4 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. SAULNIER / C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 04	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 04	**SCALE**	1:40 **DATE** 2013 08 19

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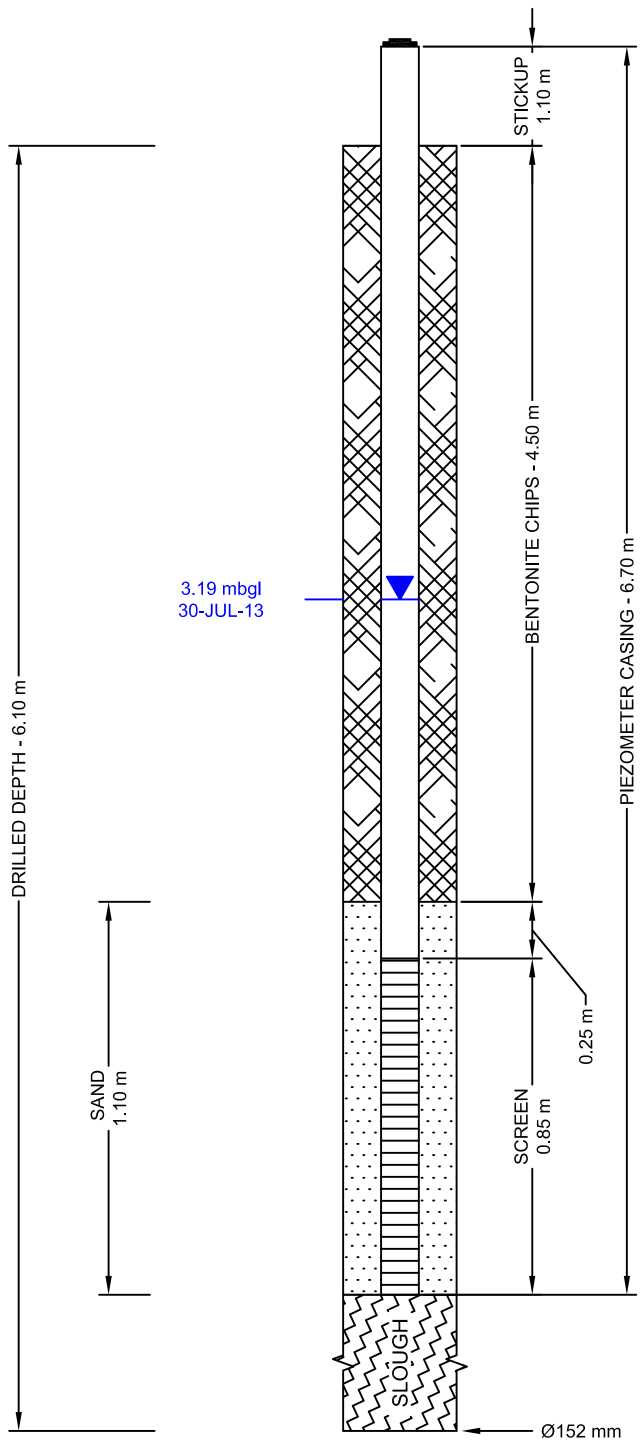
PIEZOMETER 613596-18
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780395 N 399072 E
NAD 83 ZONE 13
NE05-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 04
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE — DATE 2013 08 19

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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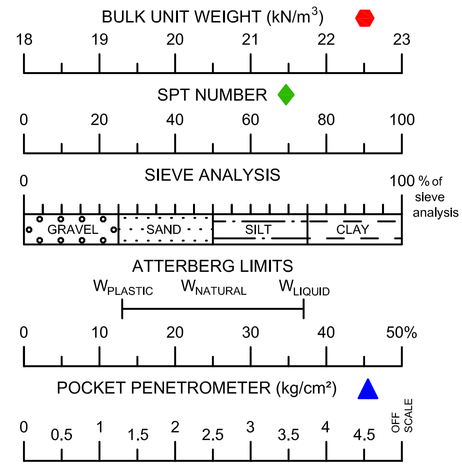
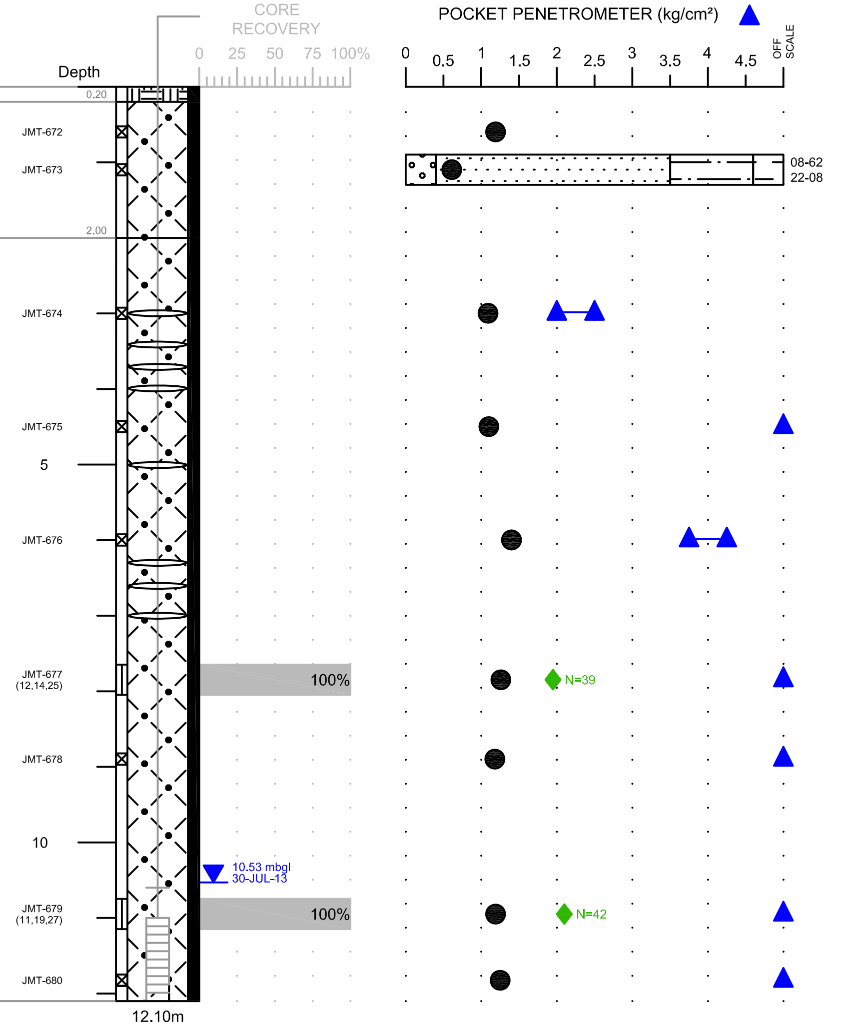
BOREHOLE 613596-19
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780445 N 399214 E
NAD 83 ZONE 13
NW06-11-37-04-W3
73B/1



Depth	
0.20	TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets
2.00	SAND TILL: (fine to coarse), silty, some gravel (fine to coarse), trace to some clay, dark brown , oxidized, compact, moist -below 1.1 m m: trace Fe staining, moist -at 1.6 m: cobbles/boulders
12.10m	SILT TILL: sandy (fine to coarse), some clay, trace gravel (fine to coarse), dark brown, oxidized, very stiff, low plasticity, moist -at 3.0 m: cobbles/boulders -at 3.4 m: cobbles/boulders -at 3.7 m: cobbles/boulders -at 4.0 m: cobbles/boulders -below 4.5 m: hard -below 4.6 m: some sand, brown -at 5.0 m: cobbles/boulders -from 6.3 to 7.0 m: cobbles/boulders -at 6.6 m: cobbles/boulders



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK / C. WU	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. SAULNIER
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 04	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 04	**SCALE**	1:100 **DATE** 2013 08 19

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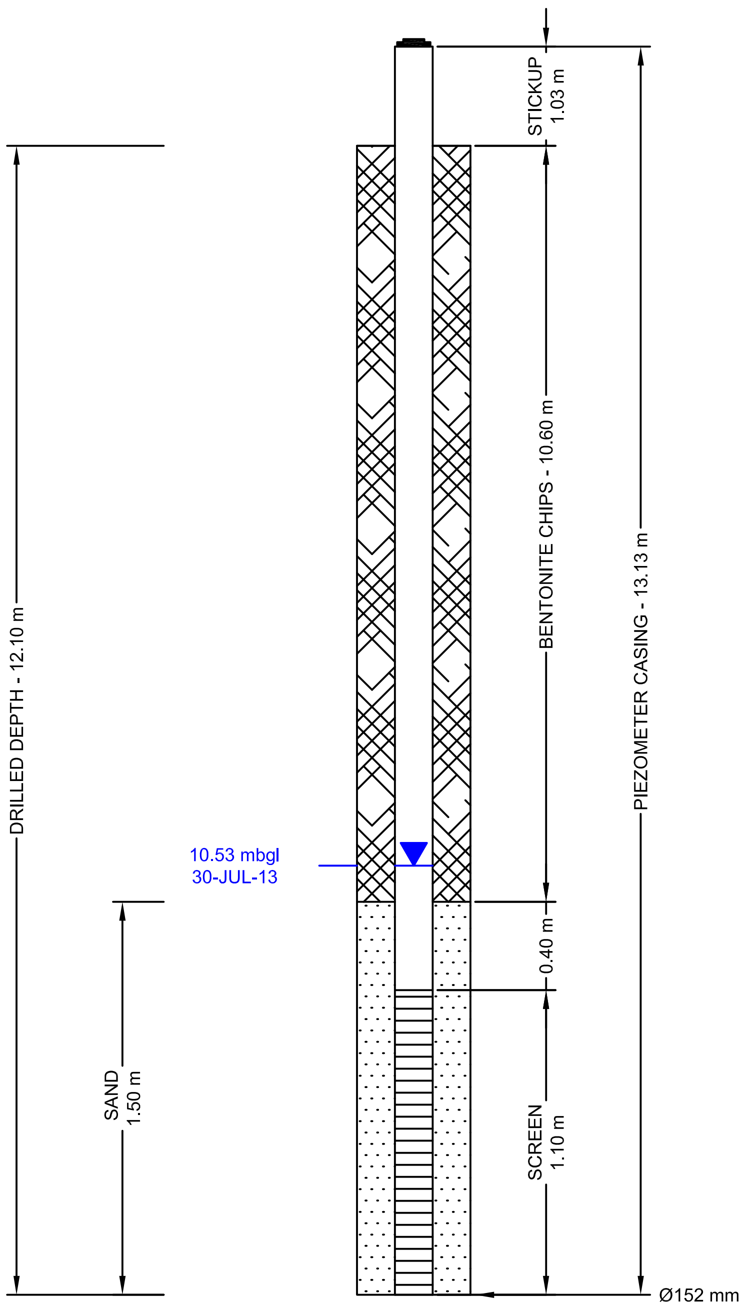
PIEZOMETER 613596-19
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780445 N   399214 E
NAD 83 ZONE 13
NW06-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 04
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
	PROJECT No.	613596
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	SCALE	NOT TO SCALE DATE 2013 08 09

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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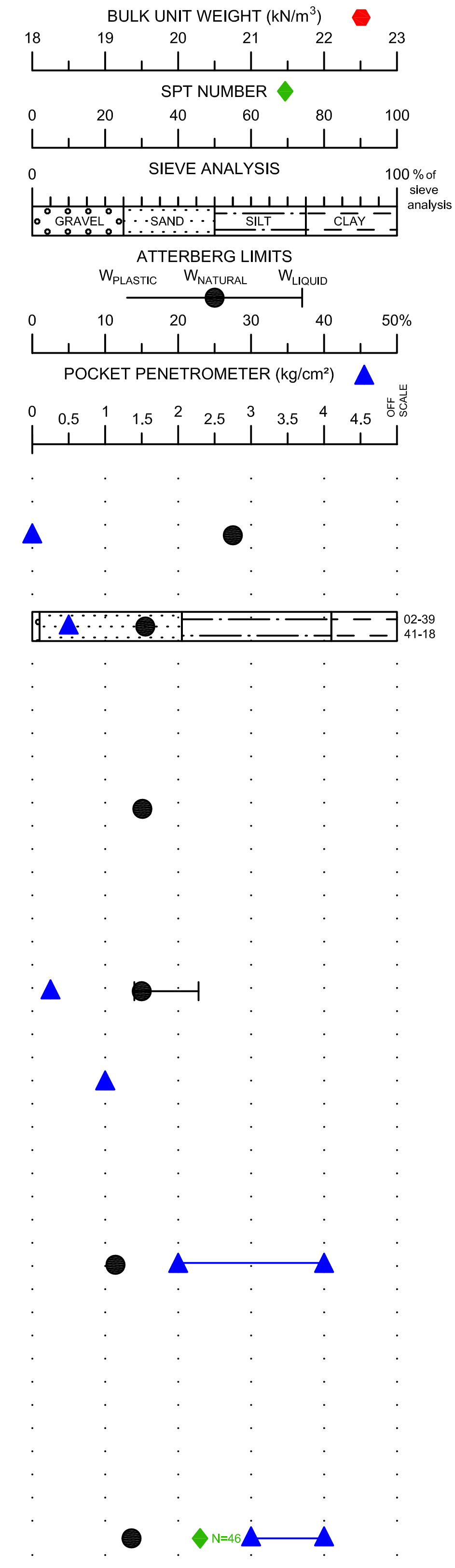
BOREHOLE 613596-20
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780090 N 399545 E
NAD 83 ZONE 13
SE06-11-37-04-W3
73B/1



Depth

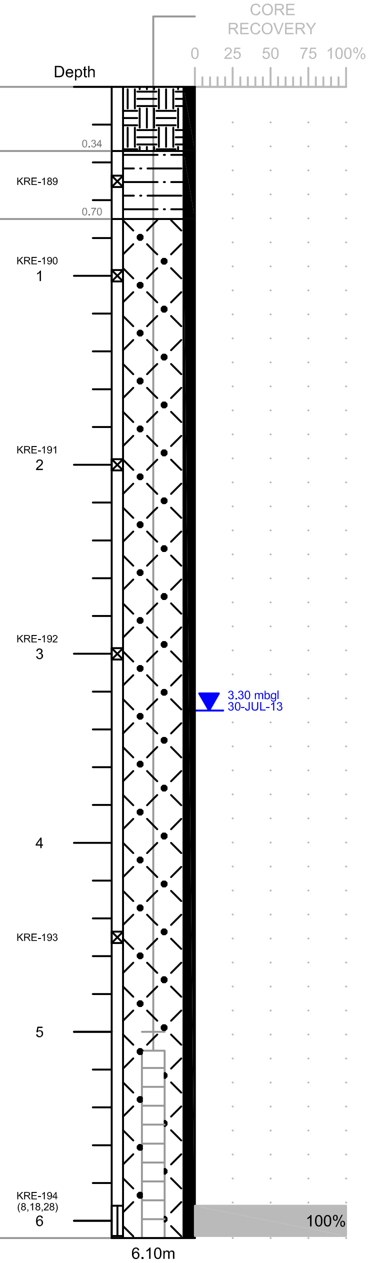
TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine to coarse), some clay, brown, oxidized, very soft, low plasticity, moist

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, firm, low plasticity, moist, trace Fe staining

-at 3.0 m: cobbles/boulders.
-below 3.0 m: stiff, some gravel

-below 4.5 m: very stiff



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	K. EBEL, B.Sc., G.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	K. EBEL, B.Sc., G.I.T.	**DRAWN BY**	C. SAULNIER / C.WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 11	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 11	**SCALE**	1:40 **DATE** 2013 08 12

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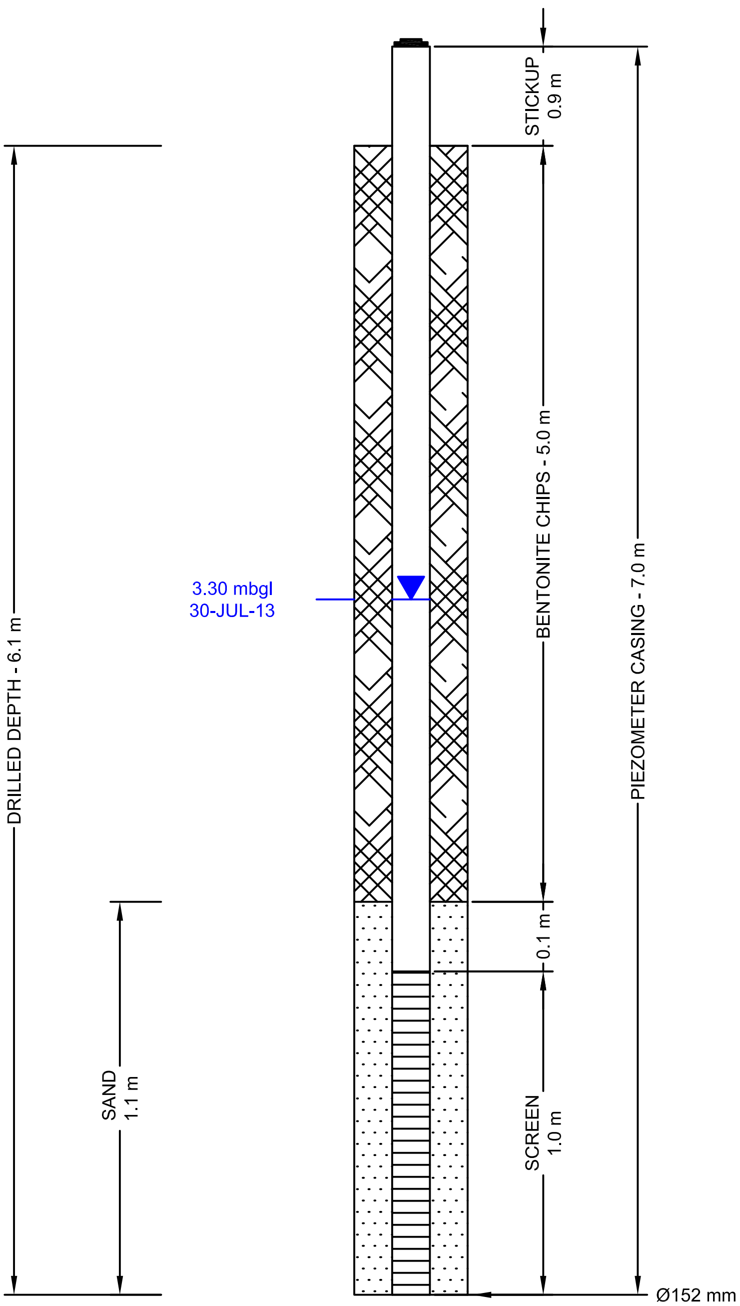
PIEZOMETER 613596-20
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780090 N 399545 E
NAD 83 ZONE 13
SE06-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	K. EBEL, B.Sc., G.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 11
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C . SAULNIER / C. WU
	PROJECT No.	613596
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	SCALE	NOT TO SCALE — DATE 2013 08 09

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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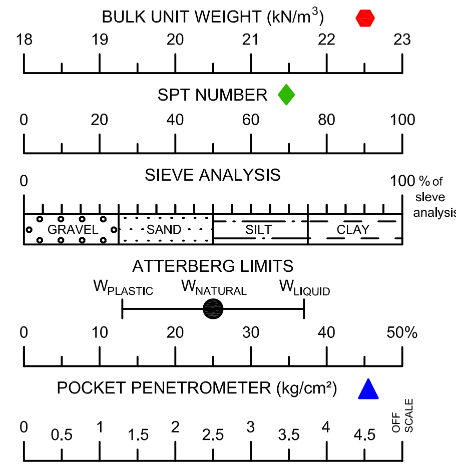
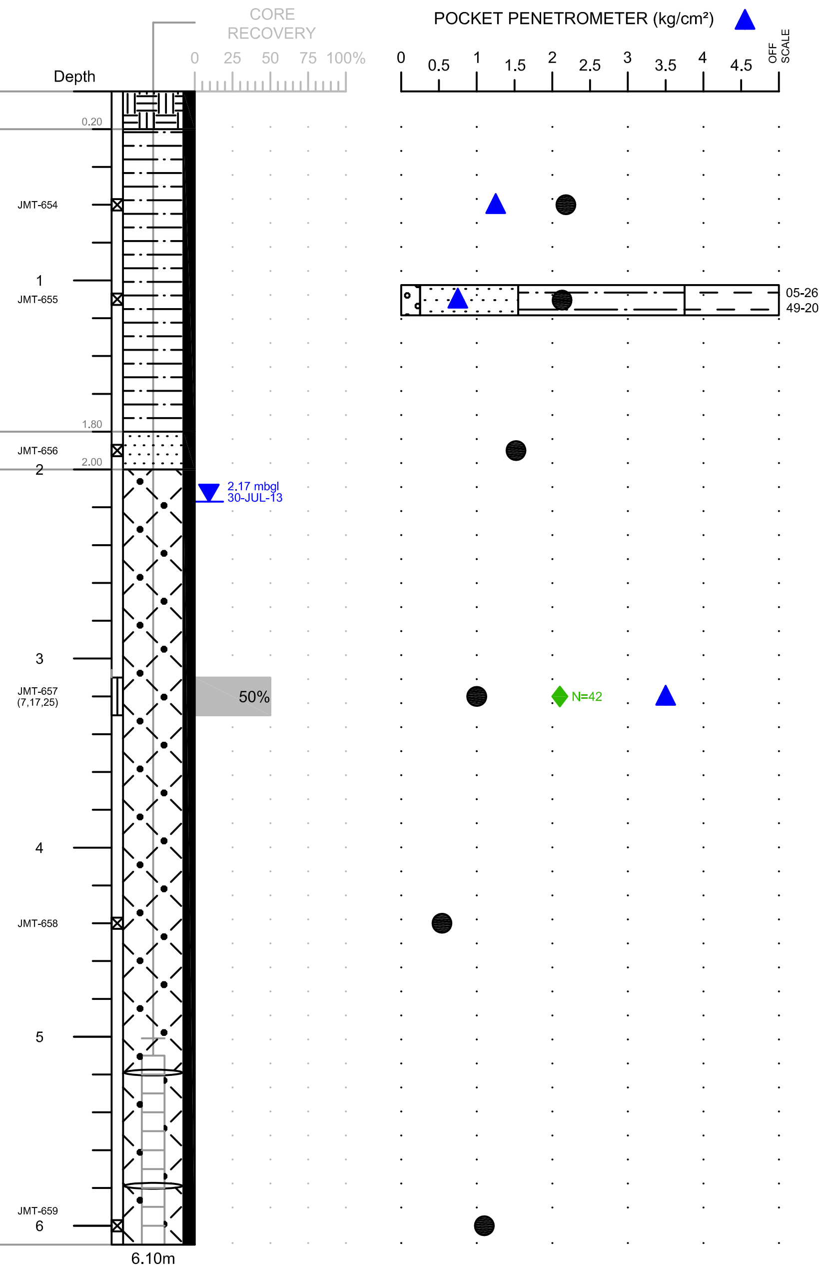
BOREHOLE 613596-21
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780199 N   398868 E
NAD 83 ZONE 13
SW05-11-37-04-W3
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets
SILT: sandy (fine), some clay, tan, oxidized, firm to stiff, low plasticity, moist
SAND: fine to coarse, silty, trace gravel (fine), trace clay, brown, oxidized, loose to compact, wet, seepage, sloughing
SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, hard, low plasticity, moist -at 5.2 m: cobbles/boulders -at 5.8 m: cobbles/boulders



NOTES

1. Borehole sloughed to 1.9 m (6.2 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl)..
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	SUPERVISOR	J. TIPMAN, B.E., E.I.T.	APPROVED BY	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	LOGGED BY	J. TIPMAN, B.E., E.I.T.	DRAWN BY	C. SAULNIER / C. WU		
DRILL RIG TYPE	CME 75	DATE DRILLED	2013 07 03	PROJECT No.	613596		
ABANDONMENT	BENTONITE CHIPS	DATE INSTALLED	2013 07 03	SCALE	1:40	DATE	2013 08 19

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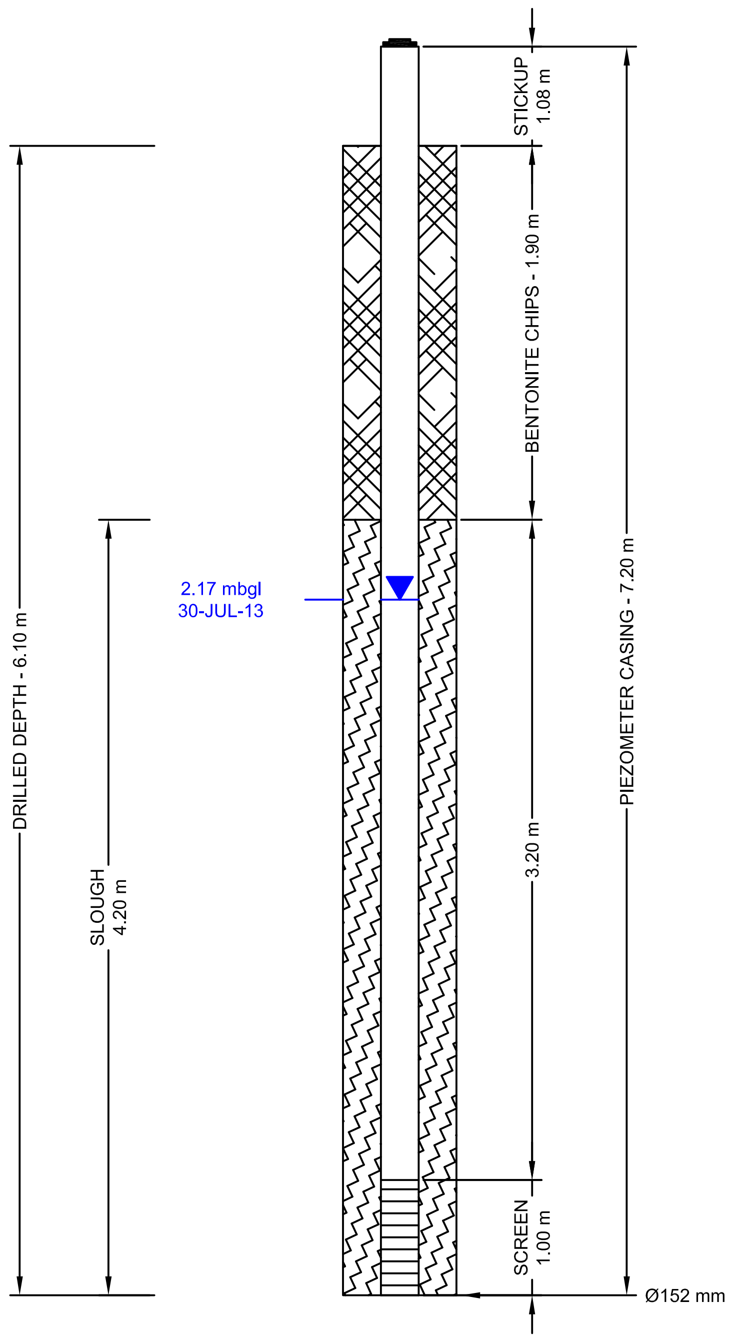
PIEZOMETER 613596-21
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780199 N 398868 E
NAD 83 ZONE 13
SW05-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES						
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.			SNC·LAVALIN	
	CONTRACTOR	BOSS DRILLING				
	OPERATOR	C. OLEKSUIK				
	DRILL RIG TYPE	CME 75				
	DATE INSTALLED	2013 07 03			CLIENT	PROJECT LOCATION
	APPROVED BY	C. ZUBROWSKI, P.Eng.				
	DRAWN BY	C. WU			CHRIS CEBRYK	W1/2-11-37-4-W3M
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596				
	SCALE	NOT TO SCALE	DATE	2013 08 09		

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BOREHOLE 613596-22
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780201 N # 399067
NAD 83 ZONE 13
SE05-11-37-04-W3
73B/1

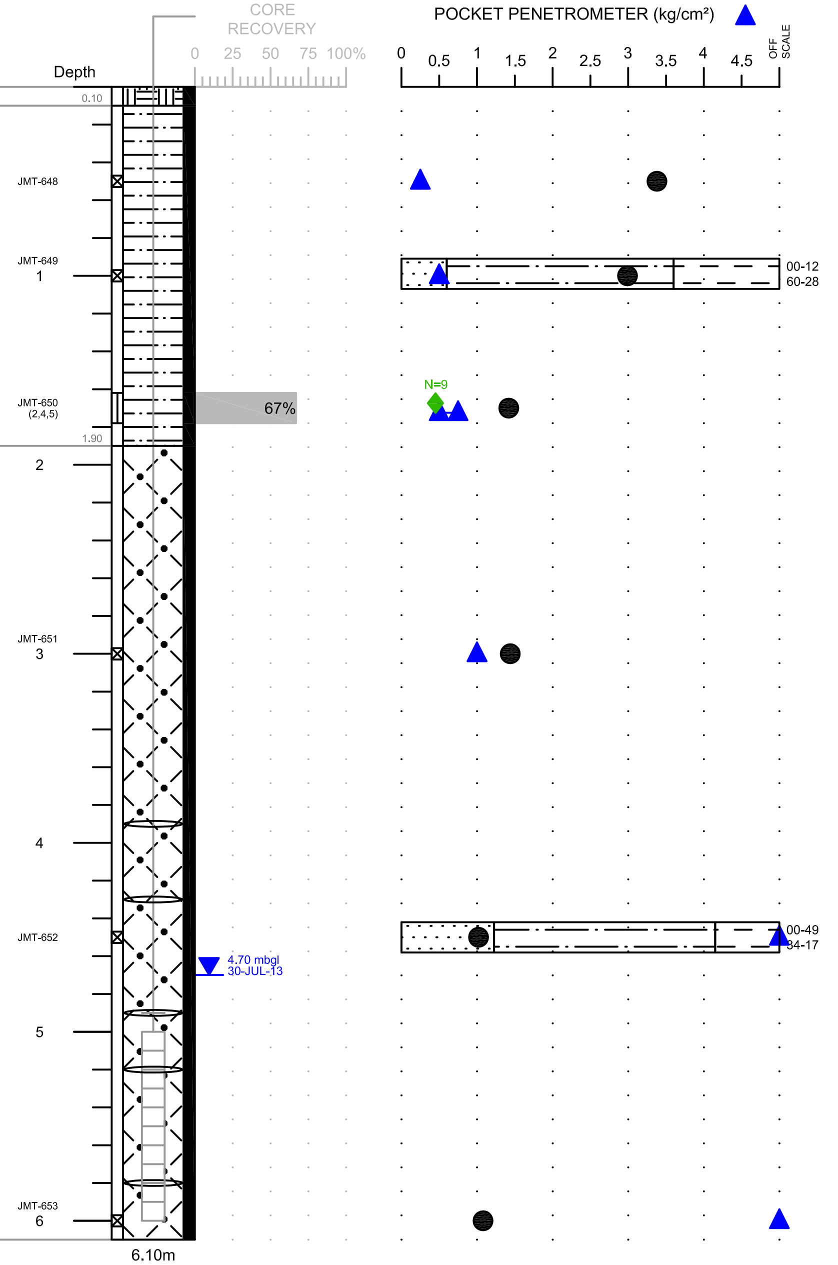
BULK UNIT WEIGHT (kN/m³): 18, 19, 20, 21, 22, 23

SPT NUMBER: 0, 20, 40, 60, 80, 100

SIEVE ANALYSIS: 0 – 100 % of sieve analysis (GRAVEL, SAND, SILT, CLAY)

ATTERBERG LIMITS: $W_{PLASTIC}$, $W_{NATURAL}$, W_{LIQUID}; 0, 10, 20, 30, 40, 50%

POCKET PENETROMETER (kg/cm²): 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, OFF SCALE



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: some sand (fine), some clay to clayey, brown, oxidized, soft, medium plasticity, moist
- -below 0.5 m: tan
- -below 1.5 m: stiff
- -at 1.9 m: thin sand seam, seepage

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, low plasticity, moist
- -at 3.9 m: cobbles/boulders
- -below 3.9 m: dark brown, damp to moist
- -at 4.3 m: cobbles/boulders
- -below 4.5 m: hard
- -at 4.9 m: cobbles/boulders
- -at 5.2 m: cobbles/boulders
- -at 5.8 m: cobbles/boulders

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

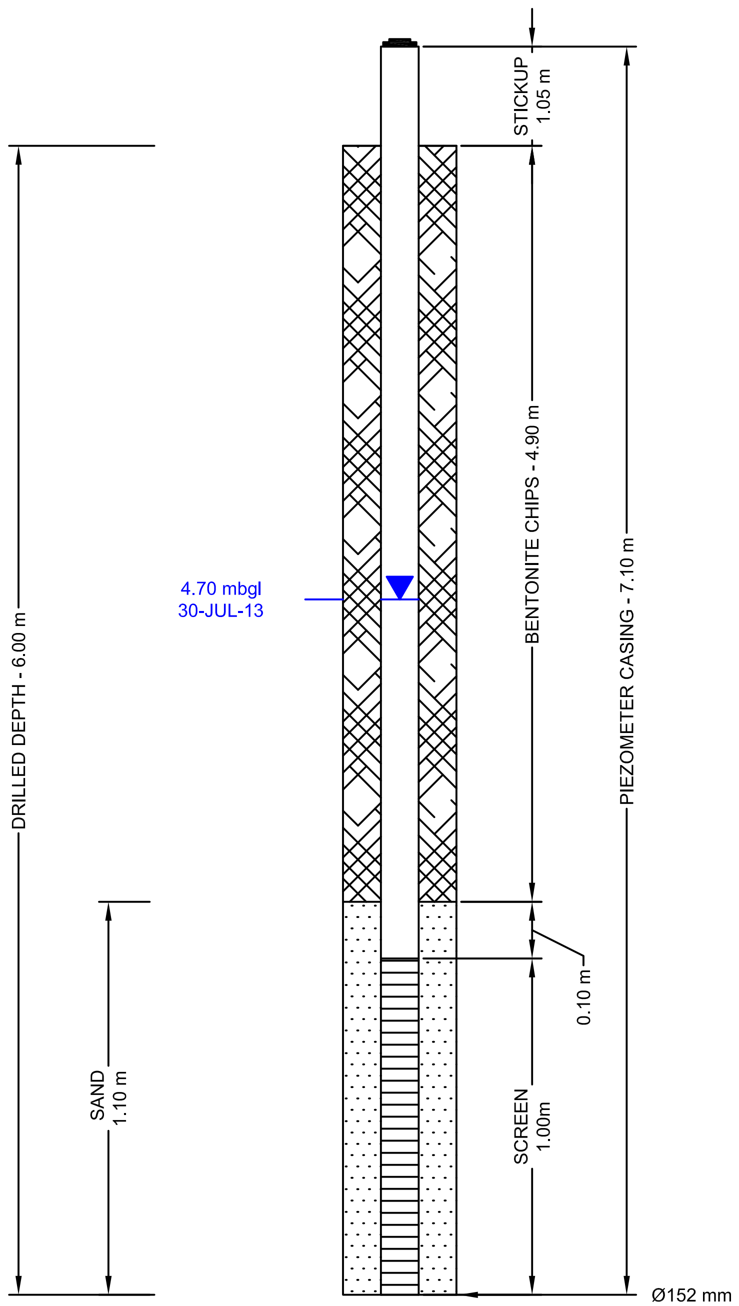
SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	SUPERVISOR	J. TIPMAN, B.E., E.I.T.	APPROVED BY	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	LOGGED BY	J. TIPMAN, B.E., E.I.T.	DRAWN BY	C. SAULNIER / C. WU		
DRILL RIG TYPE	CME 75	DATE DRILLED	2013 07 03	PROJECT No.	613596		
ABANDONMENT	BENTONITE CHIPS	DATE INSTALLED	2013 07 03	SCALE	1:40	DATE	2013 08 12

PIEZOMETER 613596-22
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780201 N 399067 E
NAD 83 ZONE 13
SE05-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 03
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	**PROJECT No.**	613596
	SCALE	NOT TO SCALE **DATE** 2013 08 09

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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BOREHOLE 613596-23
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780201 N 399271 E
NAD 83 ZONE 13
SW06-11-37-04-W3
73B/1

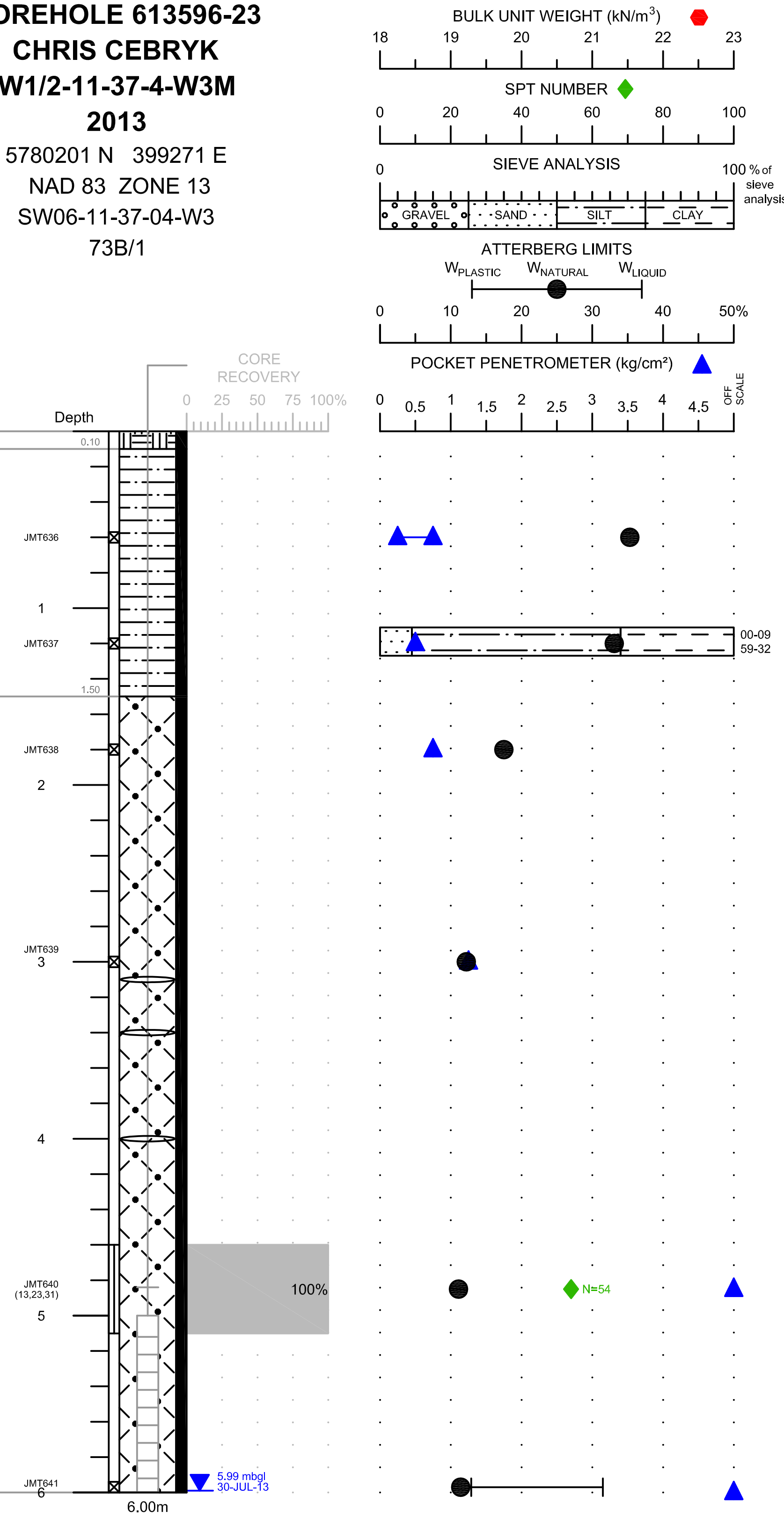
Depth

TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: trace to some sand (fine), clayey, tan, oxidized, soft, medium plasticity, moist

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, firm, medium plasticity, moist

- below 3.0 m: stiff
- at 3.1 m: cobbles/boulders
- at 3.4 m: cobbles/boulders
- at 4.0 m: cobbles/boulders
- below 4.5 m: hard



NOTES
1. Borehole open and dry immediately after drilling (I.A.D.). 2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches). 3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches). 4. Depths are in metres below ground level (mbgl). 5. Coordinates are from a handheld GPS, +/- 3 m.

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. WU		
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 03	**PROJECT No.**	613596		
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 03	**SCALE**	1:40	**DATE**	201308 12

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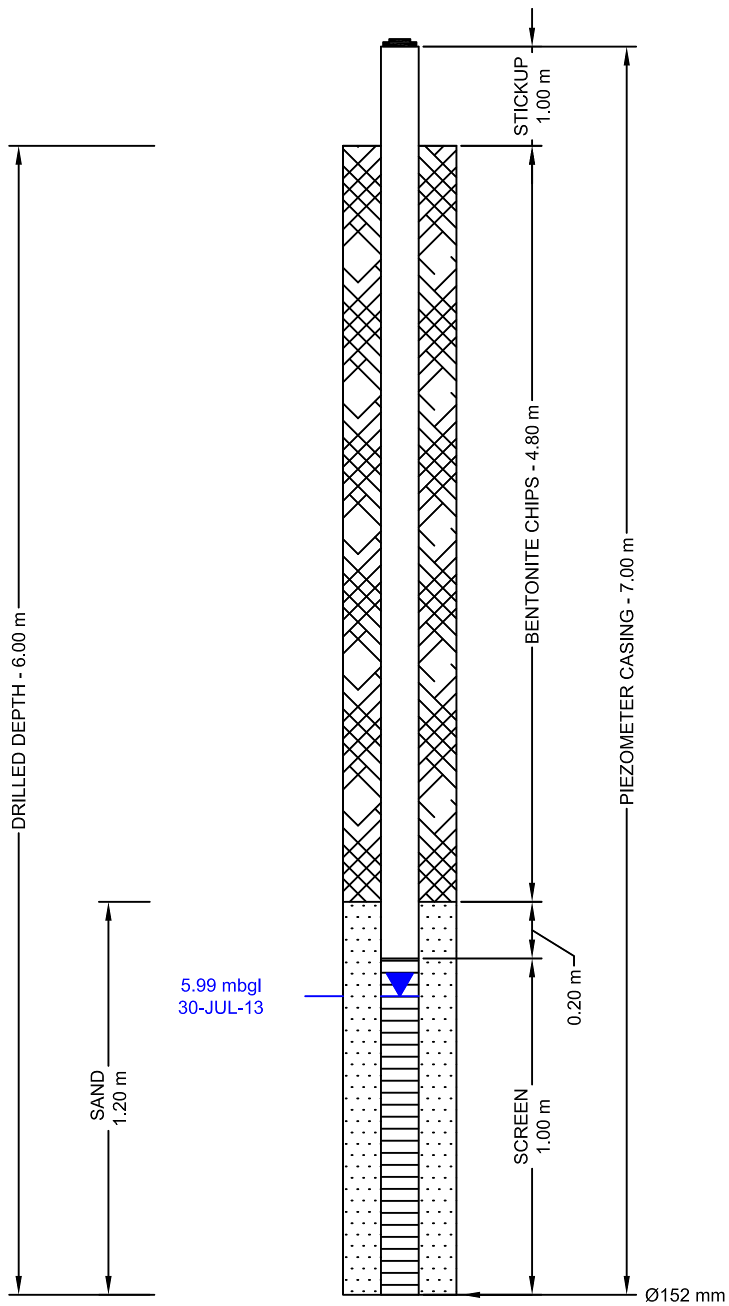
PIEZOMETER 613596-23
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780201 N   399271 E
NAD 83 ZONE 13
SW06-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR	J. TIPMAN, B.E., E.I.T.
CONTRACTOR	BOSS DRILLING
OPERATOR	C. OLEKSUIK
DRILL RIG TYPE	CME 75
DATE INSTALLED	2013 07 03
APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C. WU
PROJECT No.	613596
SCALE	NOT TO SCALE
DATE	2013 08 09

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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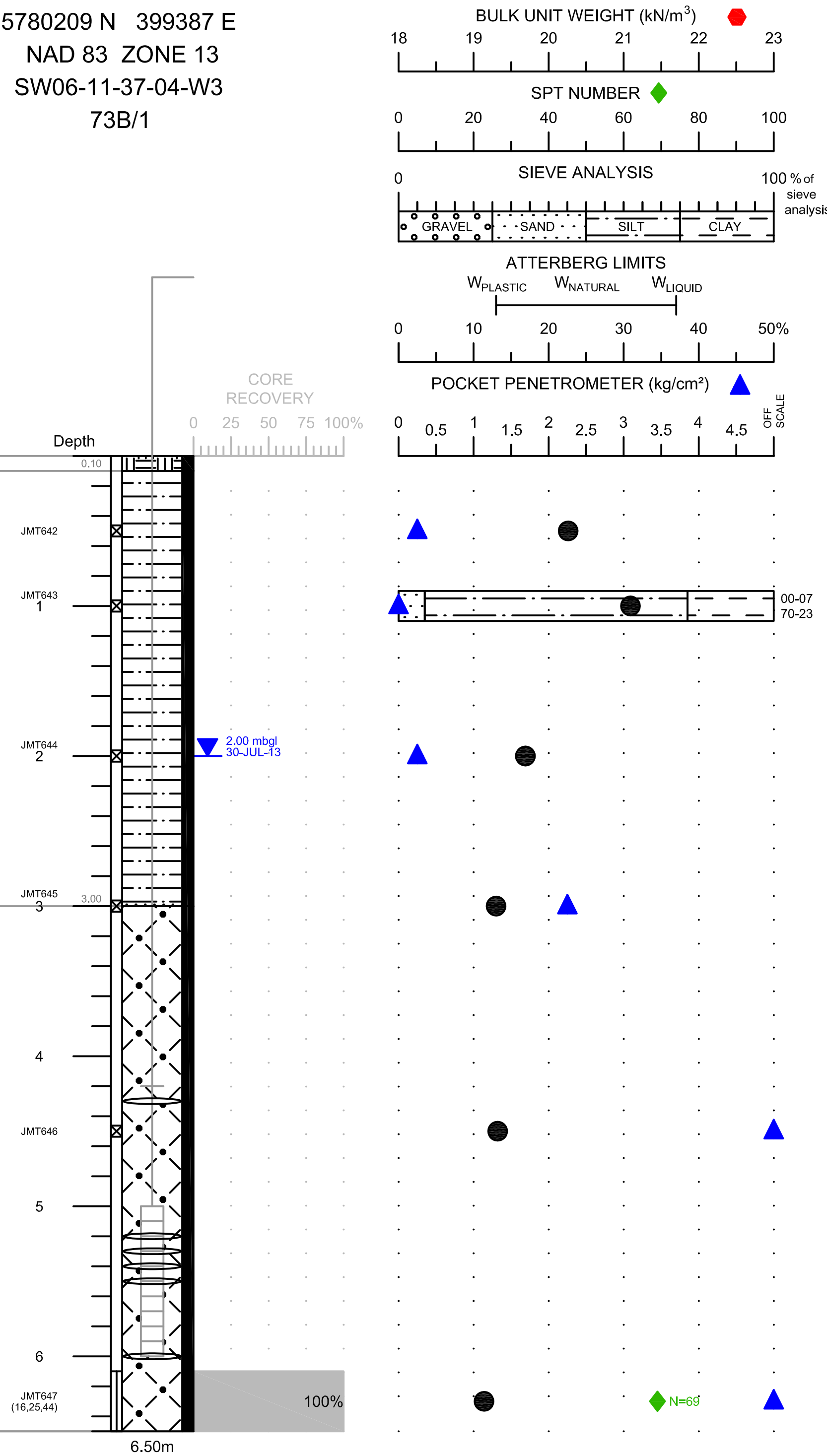
BOREHOLE 613596-24
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780209 N 399387 E
NAD 83 ZONE 13
SW06-11-37-04-W3
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT: trace sand (fine), some clay, dark brown, oxidized, soft, low to medium plasticity, moist
- below 0.5 m: very soft, tan, sloughing
- below 1.0 m: brown
- below 2.0 m: soft

SILT TILL: sandy (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, very stiff, medium plasticity, moist
- at 3.0 m: sand lenses, wet, seepage, sloughing
- at 4.3 m: cobbles/boulders
- below 4.5 m: hard
- from 5.2 to 5.5 m: cobbles/boulders
- at 6.0 m: cobbles/boulders

NOTES

1. Borehole sloughed to 1.8 m (5.9 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 03	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 03	**SCALE**	1:50 **DATE** 2013 08 19

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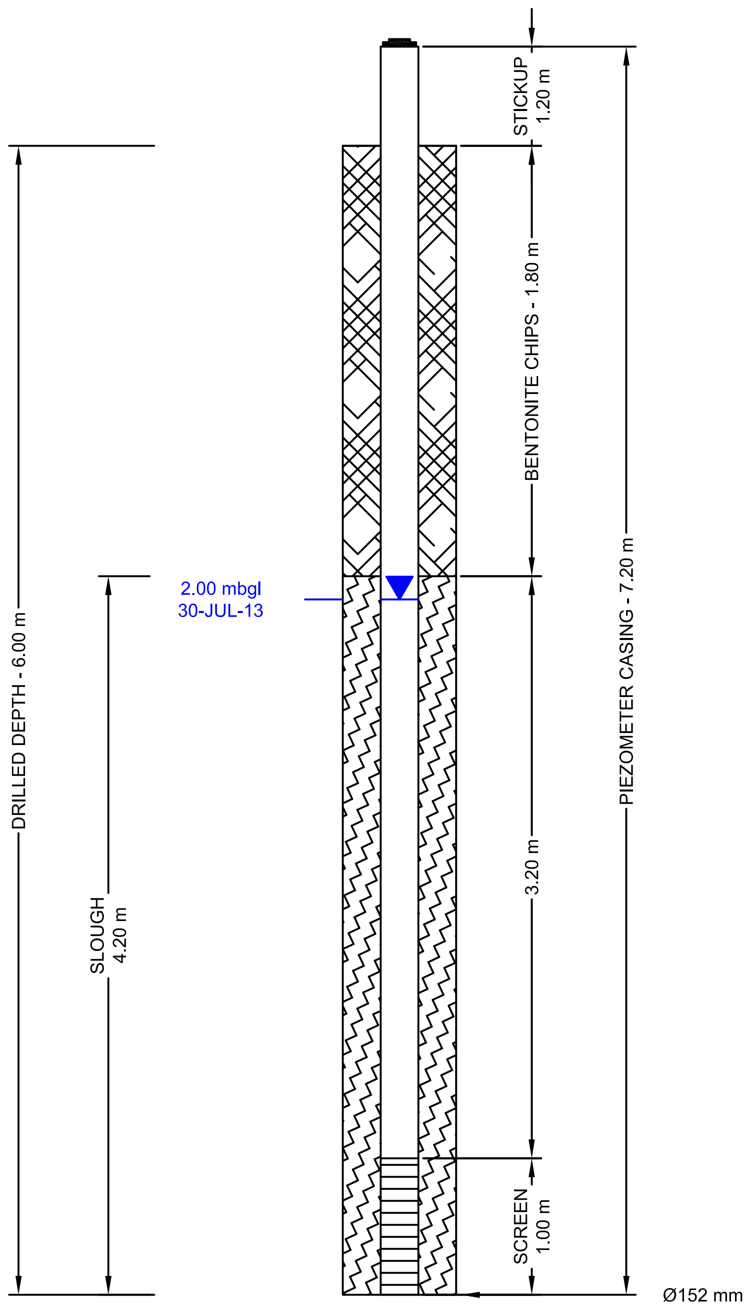
PIEZOMETER 613596-24
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5780209 N 399387 E
NAD 83 ZONE 13
SW06-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 03
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE — DATE 2013 08 09

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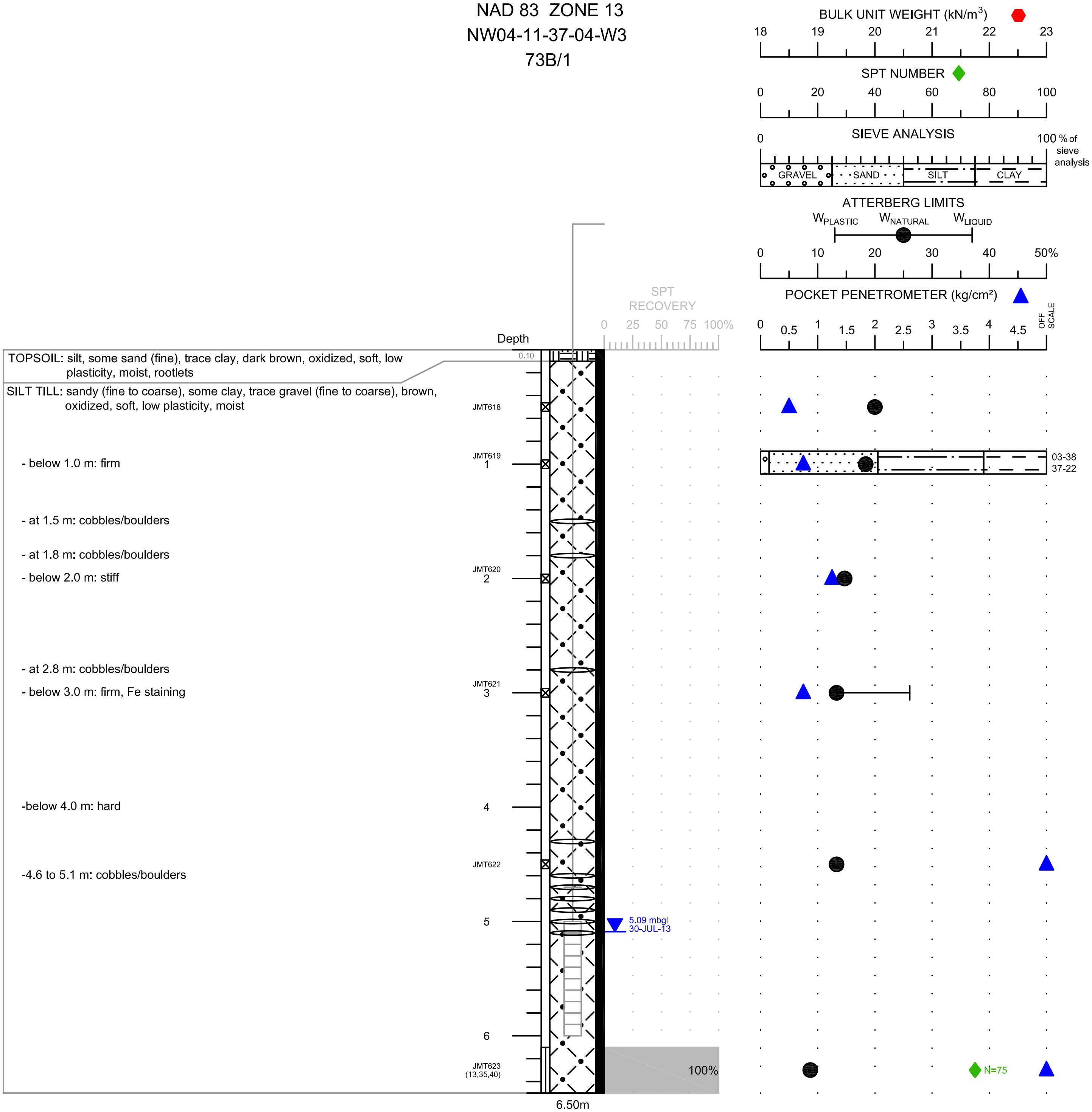
CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

P:\Chris Cebryk\613596 Proposed Cebryk Development\2. Drafting\1. Boreholes\PS-613596-24.dwg

BOREHOLE 613596-25
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779948 N 398862 E
NAD 83 ZONE 13
NW04-11-37-04-W3
73B/1



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	SUPERVISOR	J. TIPMAN, B.E., E.I.T.	APPROVED BY	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	LOGGED BY	J. TIPMAN, B.E., E.I.T.	DRAWN BY	C. WU		
DRILL RIG TYPE	CME 75	DATE DRILLED	2013 07 03	PROJECT No.	613596		
ABANDONMENT	BENTONITE CHIPS	DATE INSTALLED	2013 07 03	SCALE	1:50	DATE	2013 08 19

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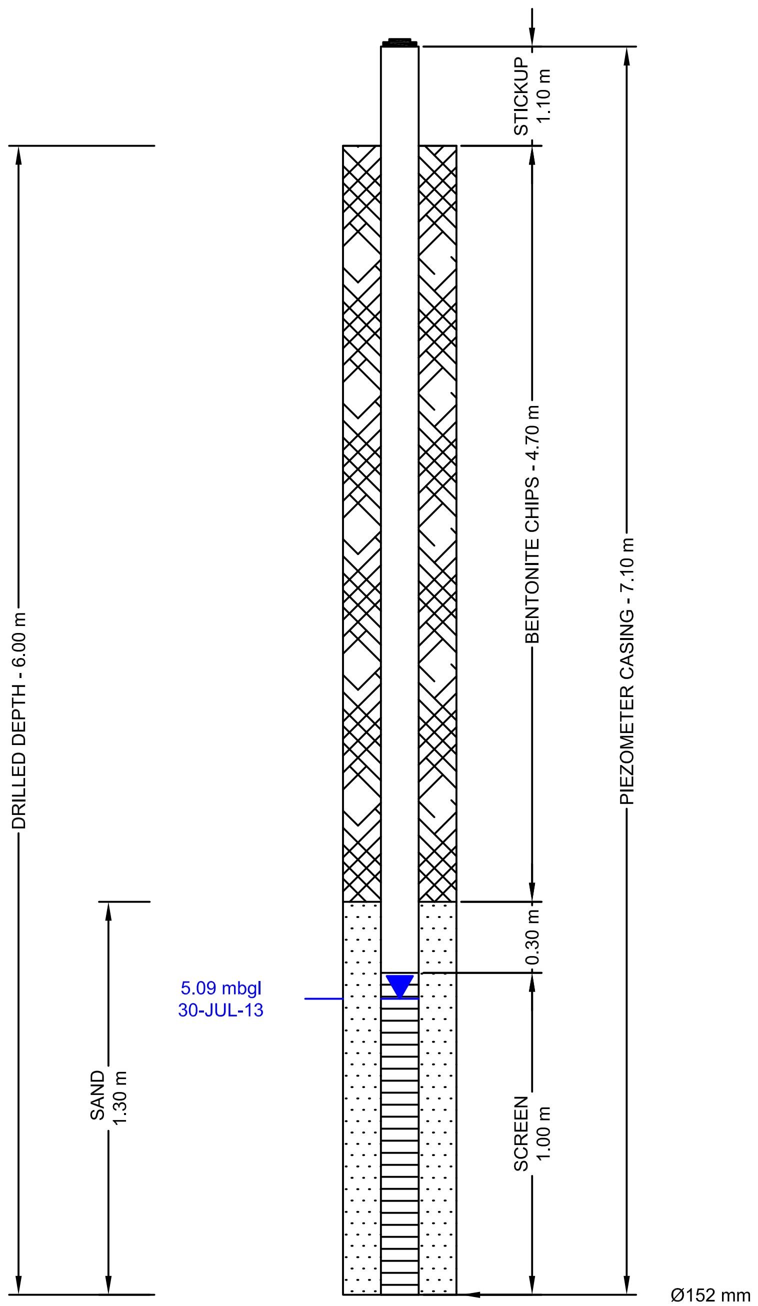
PIEZOMETER 613596-25
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779948 N   398862 E
NAD 83 ZONE 13
NW04-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 03
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE — DATE 2013 08 09

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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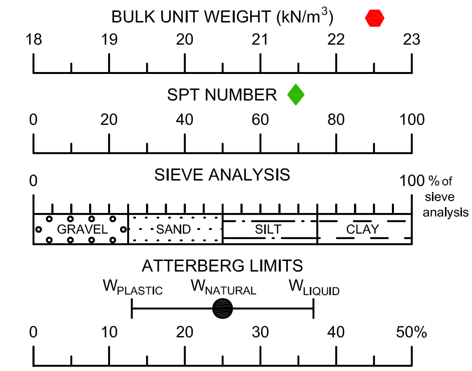
BOREHOLE 613596-26
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779958 N 399071 E
NAD 83 ZONE 13
NE04-11-37-04-W3
73B/1



TOPSOIL: silt, some sand (fine), trace clay, dark brown, oxidized, soft, low plasticity, moist, rootlets

SILT TILL:sandy (fine to coarse), some clay, trace gravel (fine to coarse), brown, oxidized, firm, low plasticity, moist

-at 1.0 m: sand lenses, trace seepage

-below 1.5 m: stiff

-below 2.1 m: dark brown, some gravel

-2.1 to 2.7 m: cobbles/boulders

-below 3.0 m: hard

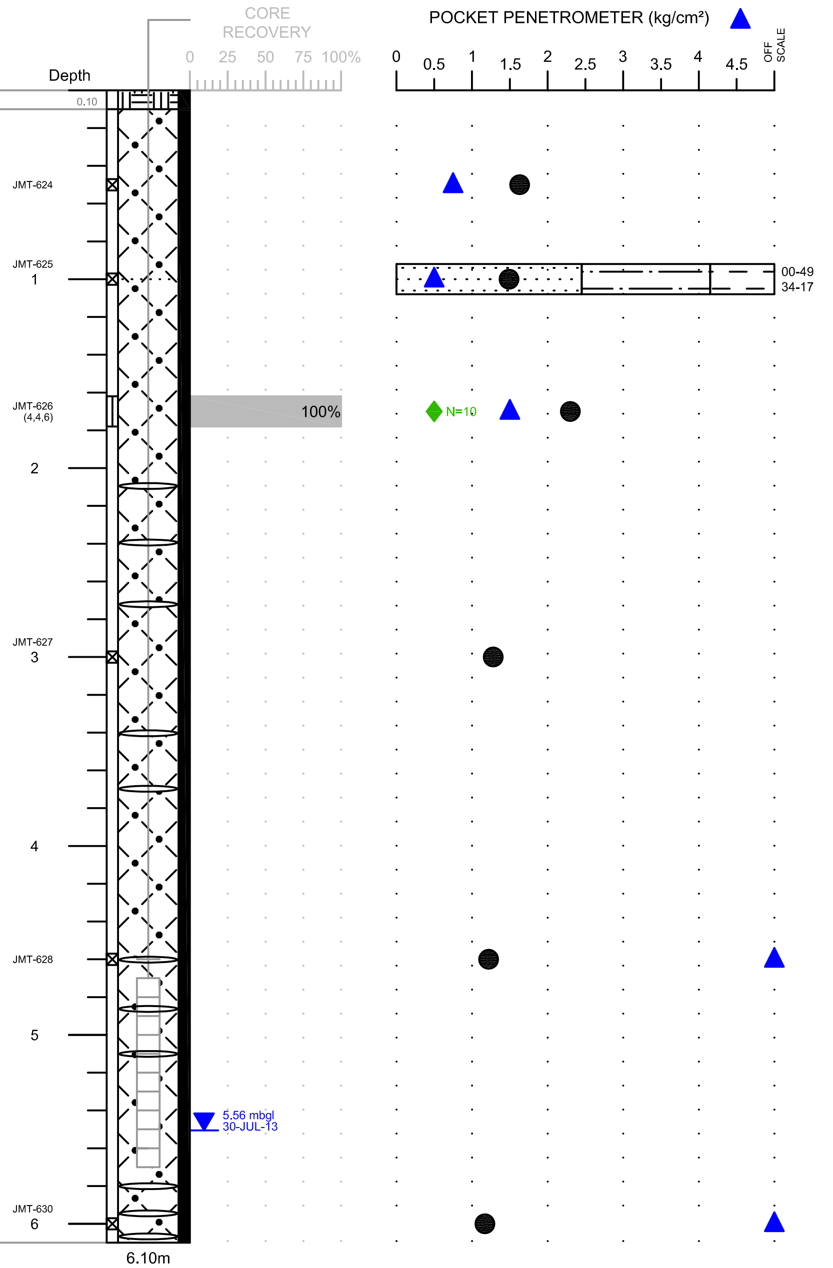
-at 3.4 m: cobbles/boulders

-at 3.7 m: cobbles/boulders

-at 4.6 m: cobbles/boulders

-4.6 to 5.1 m: cobbles/boulders

-below 5.8 m: cobbles/boulders



NOTES

1. Borehole sloughed to 5.7 m (18.7 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. SAULNIER / C. WU		
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 03	**PROJECT No.**	613596		
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 03	**SCALE**	1:40	**DATE**	2013 08 19

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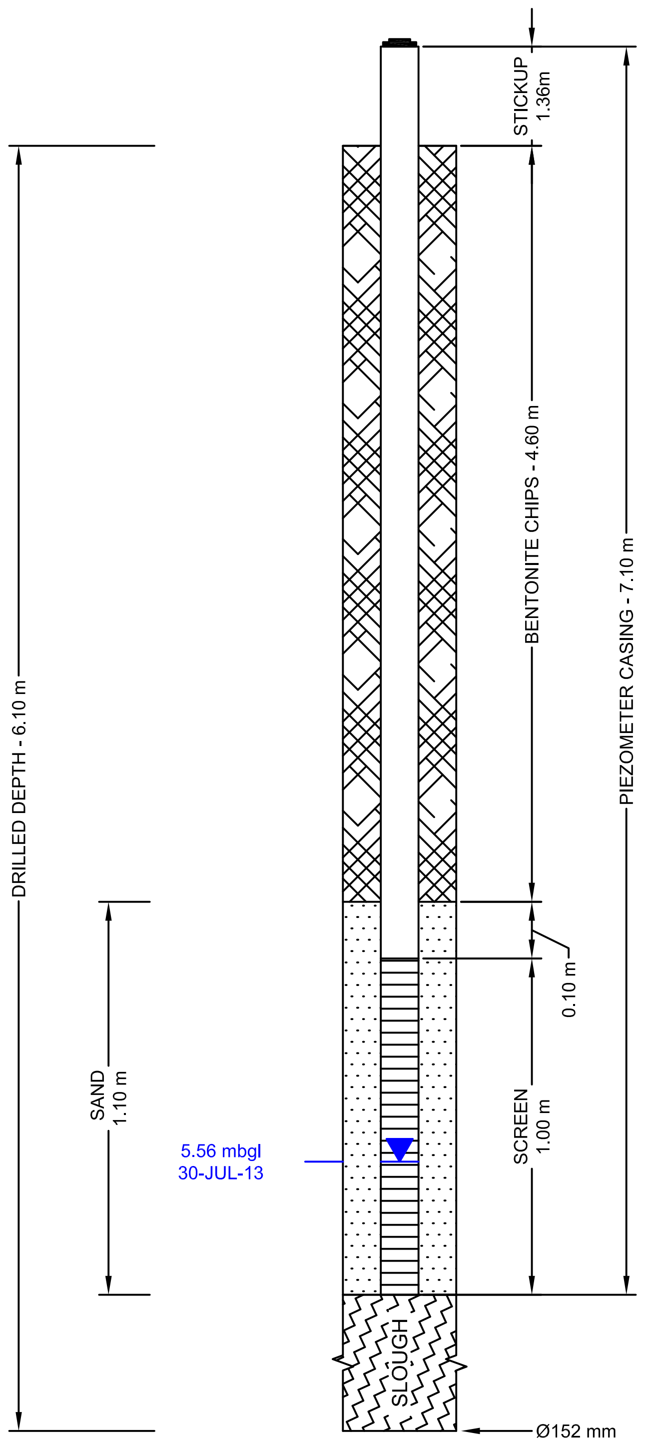
PIEZOMETER 613596-26
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779958 N 399071 E
NAD 83 ZONE 13
NE04-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR	J. TIPMAN, B.E., E.I.T.
CONTRACTOR	BOSS DRILLING
OPERATOR	C. OLEKSUIK
DRILL RIG TYPE	CME 75
DATE INSTALLED	2013 07 03
APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C. WU
PROJECT No.	613596
SCALE	NOT TO SCALE
DATE	2013 08 19

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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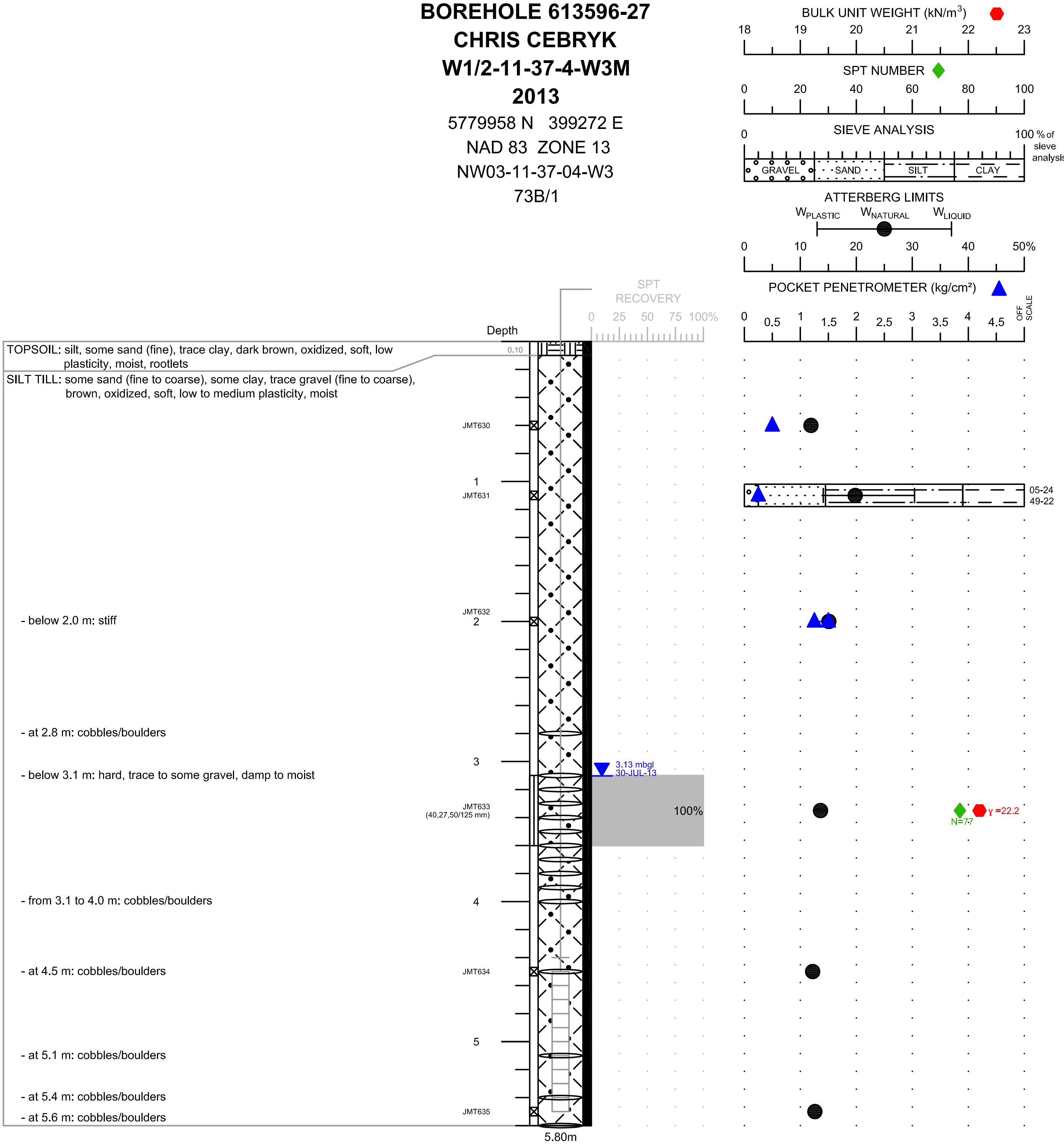
BOREHOLE 613596-27
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779958 N 399272 E
NAD 83 ZONE 13
NW03-11-37-04-W3
73B/1



NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level(mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.
6. Poor auger recovery from 1.5 - 3.0 m

SNC • LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. WU		
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 03	**PROJECT No.**	613596		
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 03	**SCALE**	1:40	**DATE**	2013 08 12

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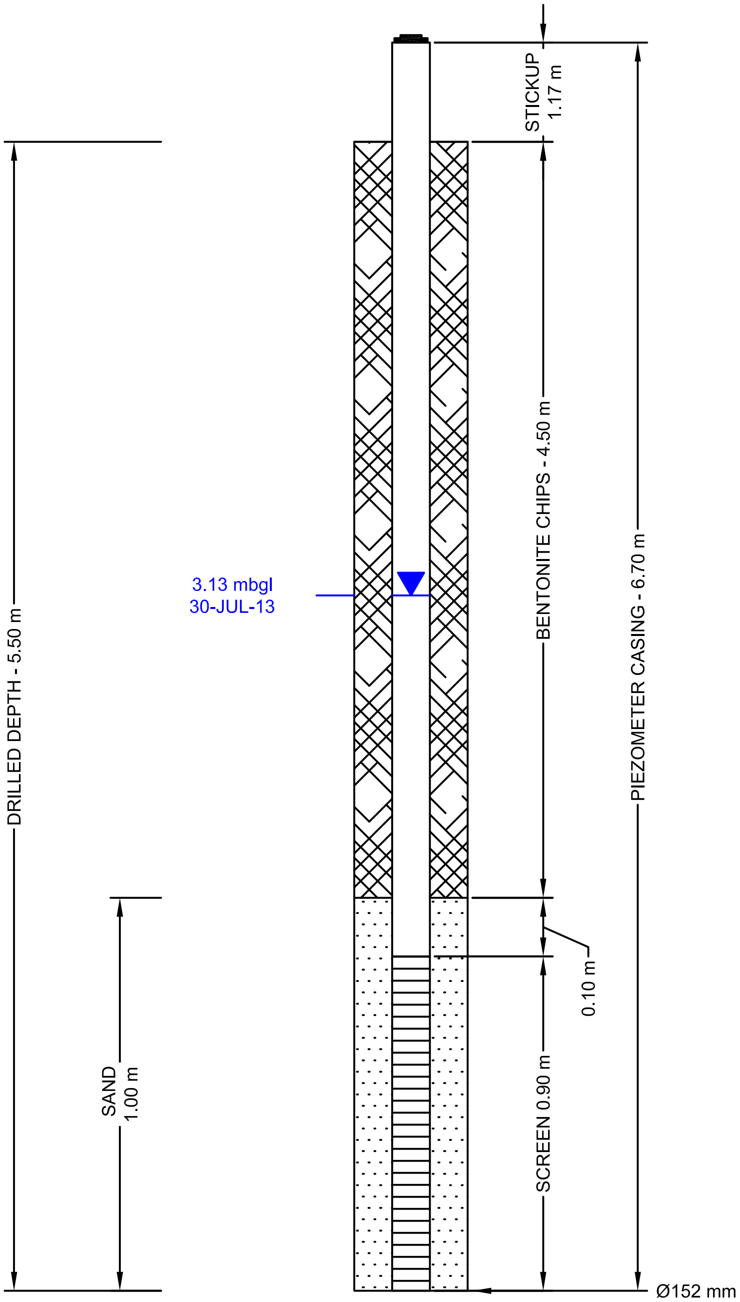
PIEZOMETER 613596-27
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779958 N   399272 E
NAD 83 ZONE 13
SW04-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES		
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.
	CONTRACTOR	BOSS DRILLING
	OPERATOR	C. OLEKSUIK
	DRILL RIG TYPE	CME 75
	DATE INSTALLED	2013 07 02
	APPROVED BY	C. ZUBROWSKI, P.Eng.
	DRAWN BY	C. WU
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596
	SCALE	NOT TO SCALE — DATE 2013 08 09

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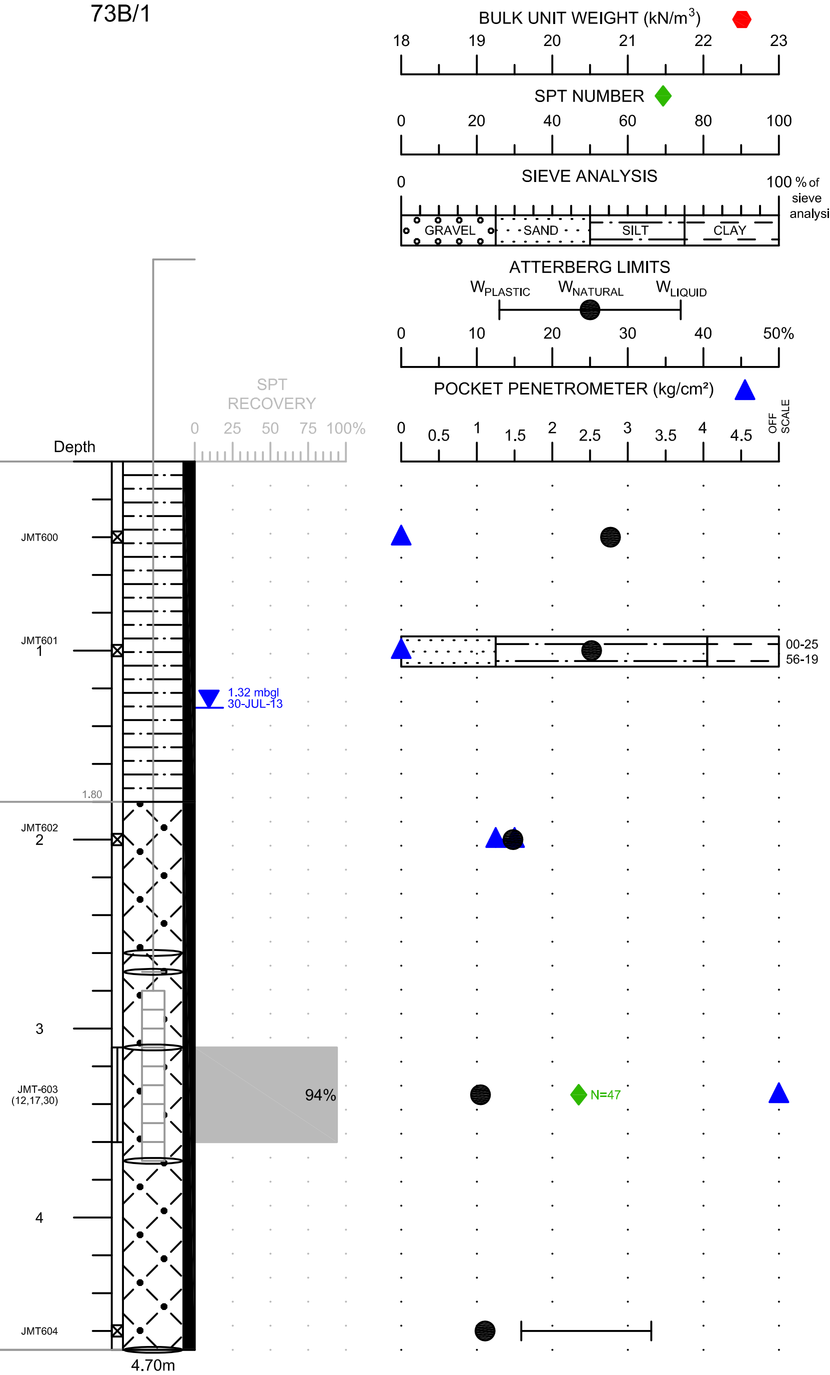
CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

BOREHOLE 613596-29
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779771 N 398850 E
NAD 83 ZONE 13
SW04-11-37-04-W3
73B/1



SILT: sandy (fine), some clay, dark brown, oxidized, soft, low plasticity, moist
- below 0.2 m: brown

SILT TILL: sandy (fine to coarse), some clay, trace gravel (fine to coarse), brown, oxidized, stiff, medium plasticity, moist
- at 1.8 m: wet, seepage, sloughing
- at 2.6 m: cobbles/boulders
- at 2.7 m: cobbles/boulders
- below 3.1 m: hard
- at 3.7 m: cobbles/boulders
- at 4.7 m: cobbles/boulders

NOTES

1. Borehole sloughed to 3.5 m (11.5 ft) immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.
7. Drilling was attempted 6 times, shallow refusal during 5 attempts. 8. Poor auger recovery from 3.1 - 4.6 m.

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 02	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 02	**SCALE**	1:40 **DATE** 2013 08 19

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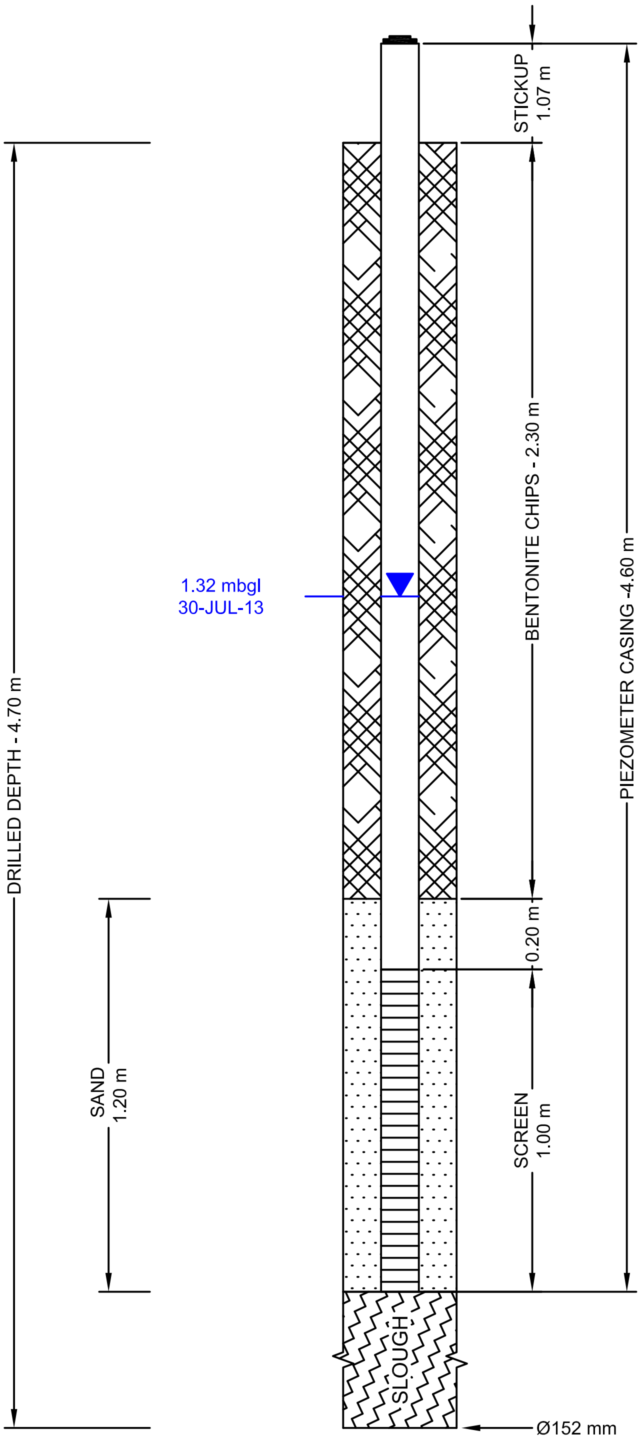
PIEZOMETER 613596-29
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779771 N 398850 E
NAD 83 ZONE 13
NW03-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES					
	SUPERVISOR	J. TIPMAN, B.E., E.I.T.			SNC · LAVALIN
	CONTRACTOR	BOSS DRILLING			
	OPERATOR	C. OLEKSUIK			
	DRILL RIG TYPE	CME 75			
	DATE INSTALLED	2013 07 02			
	APPROVED BY	C. ZUBROWSKI, P.Eng.		CLIENT	PROJECT LOCATION
	DRAWN BY	C. WU		CHRIS CEBRYK	W1/2-11-37-4-W3M
All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.	PROJECT No.	613596			
	SCALE	NOT TO SCALE	DATE 2013 08 19		

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BOREHOLE 613596-30
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779744 N   399070 E
NAD 83 ZONE 13
SE04-11-37-04-W3
73B/1

BULK UNIT WEIGHT (kN/m^3): 18, 19, 20, 21, 22, 23
SPT NUMBER: 0, 20, 40, 60, 80, 100
SIEVE ANALYSIS: 0 – 100 % of sieve analysis (GRAVEL, SAND, SILT, CLAY)
ATTERBERG LIMITS: $W_{PLASTIC}$, $W_{NATURAL}$, W_{LIQUID}: 0, 10, 20, 30, 40, 50%
POCKET PENETROMETER (kg/cm²): 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, OFF SCALE
SPT RECOVERY: 0, 25, 50, 75, 100%

Depth

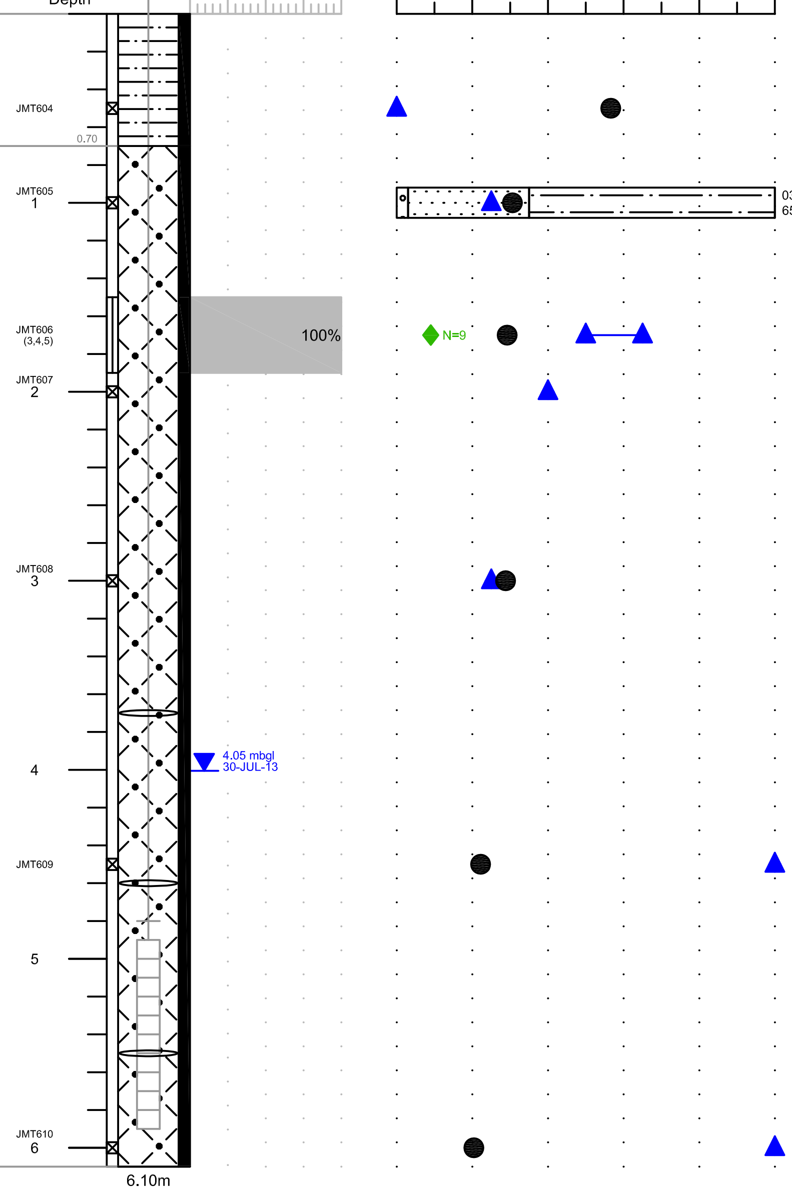
SILT: some sand (fine), some clay, dark brown, oxidized, soft, low plasticity, moist
- below 0.1 m: brown

SILT TILL: some sand (fine to coarse), trace gravel (fine to coarse), some clay, brown, oxidized, stiff, low plasticity, moist
-at 0.7 m: 5 cm sand (fine) seam, wet, seepage, sloughing

- at 3.7 m: cobbles/boulders
- below 3.7 m: hard, damp to moist

- at 4.6 m: cobbles/boulders

- at 5.5 m: cobbles/boulders



NOTES
1. Borehole sloughed to 5.9 m (19.4 ft) immediately after drilling (I.A.D.). 2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches). 3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches). 4. Depths are in metres below ground level (mbgl). 5. Coordinates are from a handheld GPS, +/- 3 m.

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CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

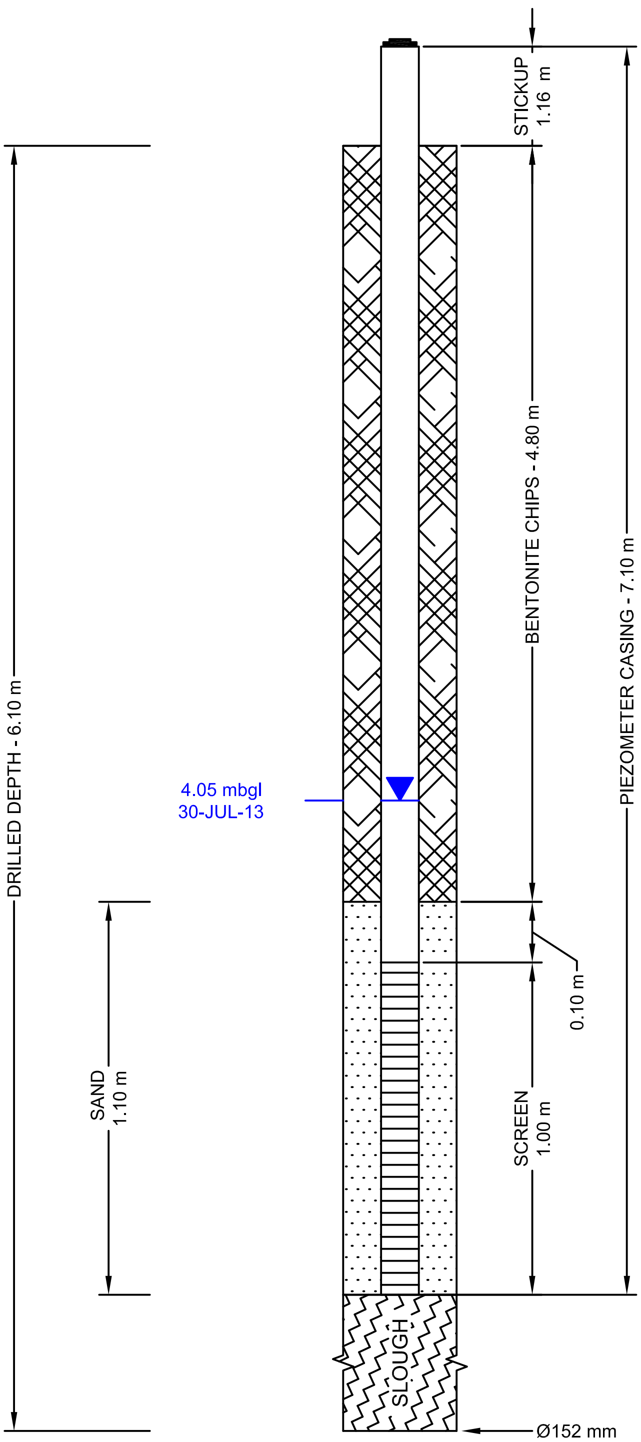
LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.		
OPERATOR	C. OLEKSUIK	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. WU		
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 03	**PROJECT No.**	613596		
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 03	**SCALE**	1:40	**DATE**	2013 08 19

PIEZOMETER 613596-30
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779744 N   399070 E
NAD 83 ZONE 13
SE04-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

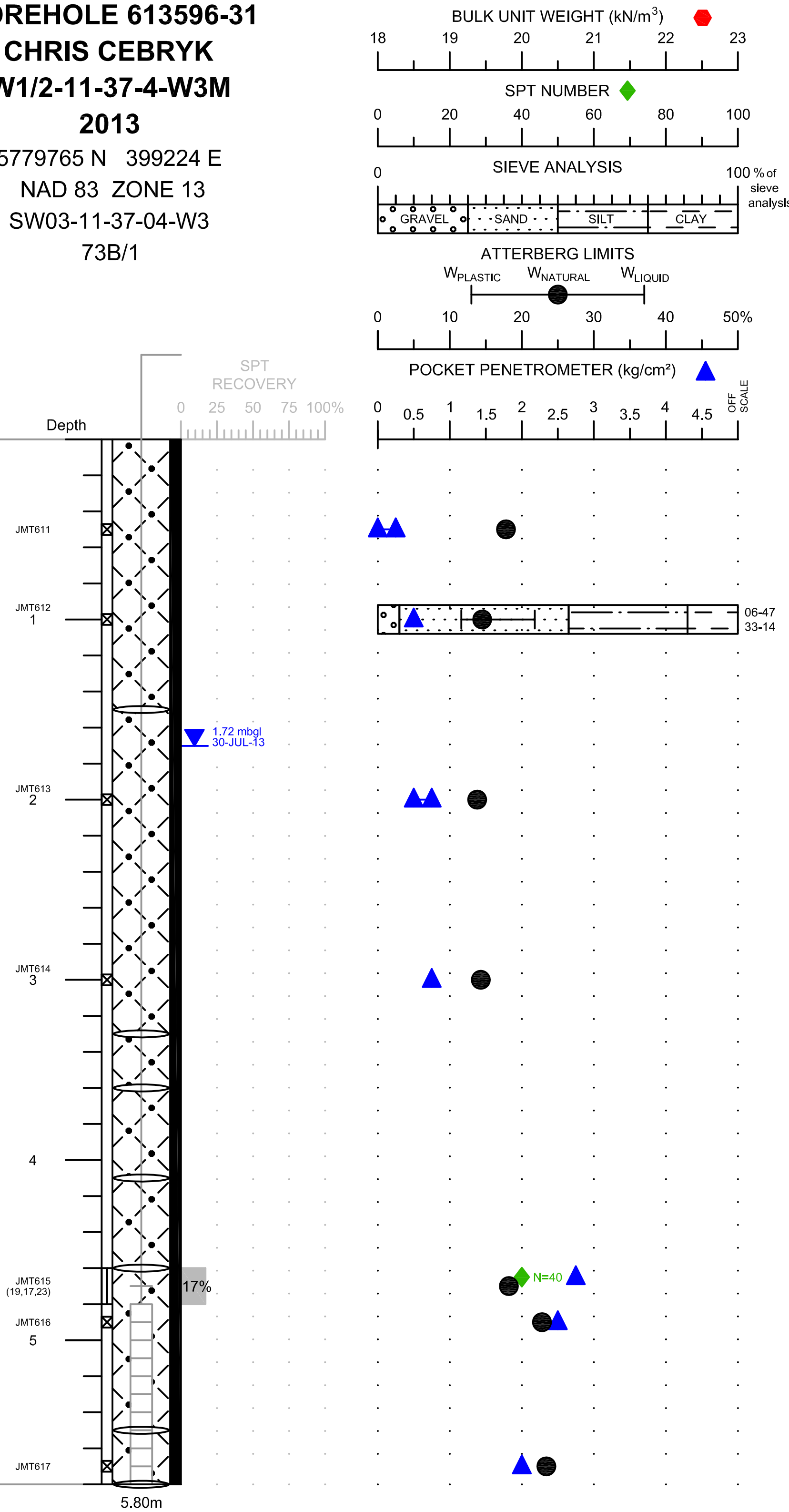
SUPERVISOR	J. TIPMAN, B.E., E.I.T.
CONTRACTOR	BOSS DRILLING
OPERATOR	C. OLEKSUIK
DRILL RIG TYPE	CME 75
DATE INSTALLED	2013 07 03
APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C. WU
PROJECT No.	613596
SCALE	NOT TO SCALE
DATE	2013 08 19

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

BOREHOLE 613596-31
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779765 N 399224 E
NAD 83 ZONE 13
SW03-11-37-04-W3
73B/1



SILT TILL: sandy (fine to coarse), some clay, trace gravel (fine to coarse), brown, oxidized, soft to firm, low plasticity, moist

- -0.1 to 1.5 m: trace seepage
- below 1.0 m: firm
- at 1.5 m: cobbles/boulders
- below 3.0 m: stiff
- at 3.3 m: cobbles/boulders
- at 3.6 m: cobbles/boulders
- below 3.6 m: dark brown, stiff, damp to moist, trace to some gravel
- at 4.1 m: cobbles/boulders
- below 4.6 m: hard, seepage
- at 5.5 m: cobbles/boulders
- at 5.8 m: cobbles/boulders

NOTES

1. Borehole open and dry immediately after drilling (I.A.D.).
2. Standard Penetration Tests (SPT) conducted with 63.5 kg (140 lb) automatic trip hammer falling 762 mm (30 inches).
3. (#,#,#) denotes SPT blows per 152 mm (6.0 inches).
4. Depths are in metres below ground level (mbgl).
5. Coordinates are from a handheld GPS, +/- 3 m.

LIMITATION

This drill log is a summary of the conditions estimated by the field personnel at the specific location and properties described above will vary between locations and may vary with time.

SNC·LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

CONTRACTOR	BOSS DRILLING	**SUPERVISOR**	J. TIPMAN, B.E., E.I.T.	**APPROVED BY**	C. ZUBROWSKI, P.Eng.
OPERATOR	C. OLEKSUIK	**LOGGED BY**	J. TIPMAN, B.E., E.I.T.	**DRAWN BY**	C. WU
DRILL RIG TYPE	CME 75	**DATE DRILLED**	2013 07 03	**PROJECT No.**	613596
ABANDONMENT	BENTONITE CHIPS	**DATE INSTALLED**	2013 07 03	**SCALE**	1:40 **DATE** 2013 08 19

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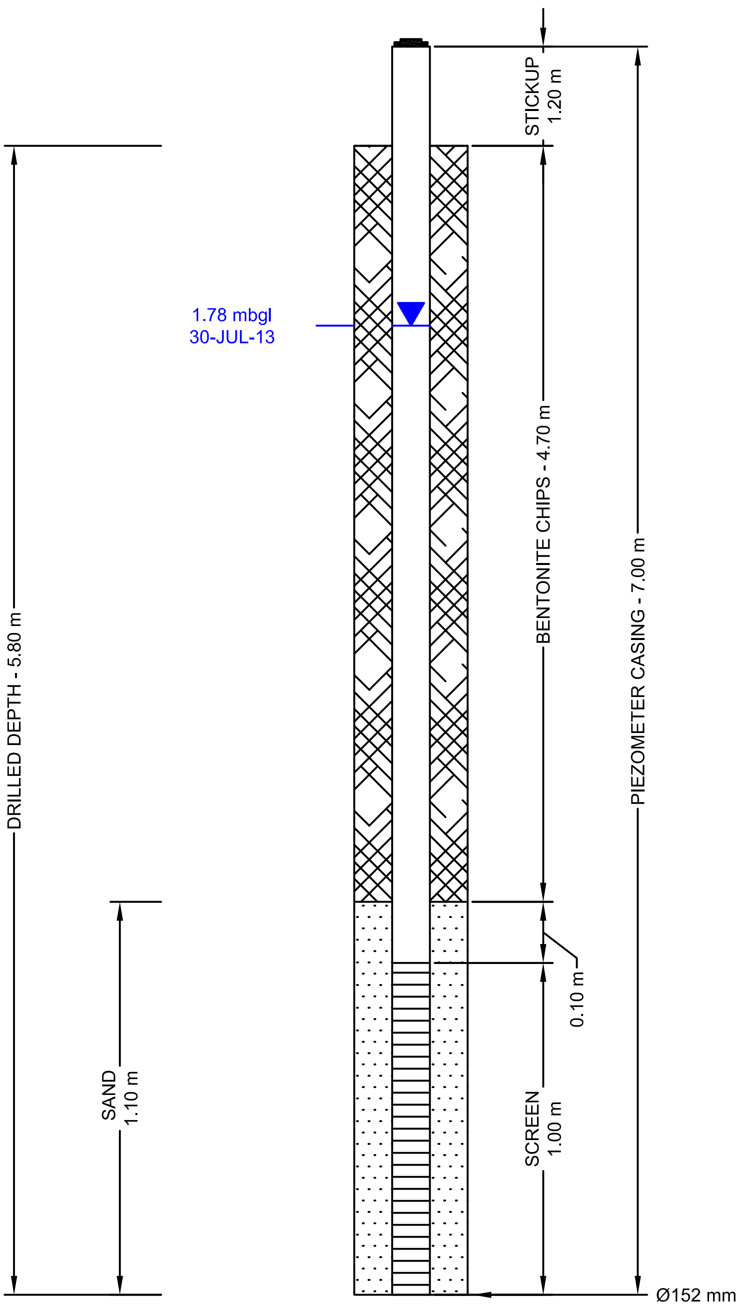
PIEZOMETER 613596-31
CHRIS CEBRYK
W1/2-11-37-4-W3M
2013

5779765 N 399224 E
NAD 83 ZONE 13
SW03-11-37-04-W3
73B/1



FILTER PACK SEAL SPECIFICATIONS:
- bentonite chips

FILTER PACK SPECIFICATIONS:
- target filter sand

SCREEN SPECIFICATIONS:
- 2 inch 10 slot PVC

CASING SPECIFICATIONS:
- 2 inch Schedule 40 PVC
- belled couplings

NOTES

All depths are expressed in metres above or below natural ground surface, unless otherwise indicated.

SUPERVISOR	J. TIPMAN, B.E., E.I.T.
CONTRACTOR	BOSS DRILLING
OPERATOR	C. OLEKSUIK
DRILL RIG TYPE	CME 75
DATE INSTALLED	2013 07 03
APPROVED BY	C. ZUBROWSKI, P.Eng.
DRAWN BY	C. WU
PROJECT No.	613596
SCALE	NOT TO SCALE
DATE	2013 08 09

SNC · LAVALIN

CLIENT	PROJECT LOCATION
CHRIS CEBRYK	W1/2-11-37-4-W3M

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Appendix V

Laboratory Testing Results

SNC•LAVALIN Environment

WATER CONTENTS

Client:	Chris Cebryk
Project:	Proposed Resedential Development
Project No:	613596
Tech	RG
Date:	25-Jul-13

Sample #	KRE-116	KRE-117	KRE-118	KRE-119	KRE-120	KRE-121
Test Hole #	1	1	1	1	1	2
Depth	0.5	1	2	4.5	6	0.5
Tare #	ENG-110	Scout1	BenF2	Oddish4	SNC-02	Misty
Tare Mass (g)	40.47	40.20	38.15	38.93	41.55	37.98
Wet sample + tare (g)	138.83	125.22	144.42	160.32	189.82	139.40
Dry sample + tare (g)	126.29	112.49	131.23	150.17	172.84	120.34
Wt. Dry sample (g)	85.82	72.29	93.08	111.24	131.29	82.36
Water Content (%)	14.61	17.61	14.17	9.12	12.93	23.14
Sample #	KRE-122	KRE-123	KRE-124	KRE-125	KRE-126	KRE-111
Test Hole #	2	2	2	2	2	5
Depth	1	1.5	2	4.5	5.7	0.5
Tare #	Rough05	Pet1	Pika2	BenF4	AbeL3	Mao1
Tare Mass (g)	41.46	40.48	37.90	37.80	38.29	37.40
Wet sample + tare (g)	136.20	156.57	139.17	152.76	147.08	137.12
Dry sample + tare (g)	112.21	142.10	126.94	142.18	138.25	120.06
Wt. Dry sample (g)	70.75	101.62	89.04	104.38	99.96	82.66
Water Content (%)	33.91	14.24	13.74	10.14	8.83	20.64
Sample #	KRE-112	KRE-113	KRE-114	KRE-115		
Test Hole #	5	5	5	5		
Depth	1	2	4.5	5.7		
Tare #	JBond4	Pika3	AbeL5	BenF1		
Tare Mass (g)	37.04	38.20	38.88	38.34		
Wet sample + tare (g)	166.96	143.45	150.79	153.11		
Dry sample + tare (g)	154.55	130.50	136.19	142.62		
Wt. Dry sample (g)	117.51	92.30	97.31	104.28		
Water Content (%)	10.56	14.03	15.00	10.06		

Comments:

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Sample #	KRE-133	KRE-134	KRE-135	KRE-136	KRE-137	KRE-138
Test Hole #	6	6	6	6	6	6
Depth	0.5	1	2	3	4.5	5.8
Tare #	Digi25	WATCH	EHEM	JFK2	JaCol	MLK10
Tare Mass (g)	37.13	40.60	38.29	38.41	38.18	38.11
Wet sample + tare (g)	138.67	139.08	149.80	152.57	152.33	143.04
Dry sample + tare (g)	115.64	118.37	130.74	137.37	137.45	128.86
Wt. Dry sample (g)	78.51	77.77	92.45	98.96	99.27	90.75
Water Content (%)	29.33	26.63	20.62	15.36	14.99	15.63
Sample #	KRE-152	KRE-153	KRE-154	KRE-155	KRE-156	KRE-157
Test Hole #	7	7	7	7	7	7
Depth	0.5	1	2	3	4.5	5.4
Tare #	F.Sinatra	Char1	E.Hem3	JB007	Totoro1	SNC-08
Tare Mass (g)	37.40	39.16	37.01	37.56	38.33	39.81
Wet sample + tare (g)	121.93	139.33	141.44	151.96	144.35	149.34
Dry sample + tare (g)	111.02	128.72	130.91	141.25	136.09	139.12
Wt. Dry sample (g)	73.62	89.56	93.90	103.69	97.76	99.31
Water Content (%)	14.82	11.85	11.21	10.33	8.45	10.29
Sample #	KRE-183	KRE-184	KRE-185	KRE-186	KRE-187	KRE-188
Test Hole #	8	8	8	8	8	8
Depth	0.5	1	2	3	4.5	6
Tare #	Char3	N0	BiBA	NBohr9	PaulA7	E.Hem4
Tare Mass (g)	38.73	36.68	41.65	37.87	37.65	38.87
Wet sample + tare (g)	148.36	141.42	152.83	140.19	145.19	146.03
Dry sample + tare (g)	133.46	127.79	138.33	126.96	133.74	132.89
Wt. Dry sample (g)	94.73	91.11	96.68	89.09	96.09	94.02
Water Content (%)	15.73	14.96	15.00	14.85	11.92	13.98

Comments:

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Sample #	KRE-106	KRE-107	KRE-108	KRE-109	KRE-110	KRE-158
Test Hole #	9	9	9	9	9	11
Depth	0.5	1	3.05	4.5	5.7	0.5
Tare #	Oddish2	BeF5	MEAT	NBohr8	Hami1	JL10
Tare Mass (g)	38.40	38.06	41.46	38.45	38.58	39.08
Wet sample + tare (g)	149.79	133.72	159.57	159.51	152.16	151.17
Dry sample + tare (g)	137.35	122.86	151.57	150.26	145.40	132.67
Wt. Dry sample (g)	98.95	84.80	110.11	111.81	106.82	93.59
Water Content (%)	12.57	12.81	7.27	8.27	6.33	19.77
Sample #	KRE-160	KRE-161	KRE-162	KRE-163	KRE-177	KRE-178
Test Hole #	11	11	11	11	12	12
Depth	2	3	4.5	6	0.5	1
Tare #	AnFr2	DBo48	Pika5	F.Sinatra2	F.Sinatra	SQUASH
Tare Mass (g)	38.58	40.75	38.17	38.40	38.01	39.45
Wet sample + tare (g)	151.41	155.28	145.25	144.94	135.56	136.06
Dry sample + tare (g)	136.09	138.13	134.55	131.46	115.26	115.80
Wt. Dry sample (g)	97.51	97.38	96.38	93.06	77.25	76.35
Water Content (%)	15.71	17.61	11.10	14.49	26.28	26.54
Sample #	KRE-179	KRE-180	KRE-181	KRE-182		
Test Hole #	12	12	12	12		
Depth	2	3	4.5	5.9		
Tare #	E.Hem2	MIC-09	RaRaO	SNC-14		
Tare Mass (g)	38.95	40.19	40.83	41.22		
Wet sample + tare (g)	147.32	151.77	143.49	159.08		
Dry sample + tare (g)	128.11	144.48	136.12	149.47		
Wt. Dry sample (g)	89.16	104.29	95.29	108.25		
Water Content (%)	21.55	6.99	7.73	8.88		

Comments:

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Sample #	KRE-100	KRE-101	KRE-102	KRE-103	KRE-104	KRE-105
Test Hole #	13	13	13	13	13	13
Depth	0.5	1	1.5	2	4.5	5.7
Tare #	BNC	KFC-1	CheCha	MFC	Apple	Wich1
Tare Mass (g)	40.17	37.59	41.43	40.92	37.91	38.03
Wet sample + tare (g)	139.13	140.71	130.47	140.09	137.49	141.67
Dry sample + tare (g)	119.09	118.96	119.93	129.42	127.58	130.58
Wt. Dry sample (g)	78.92	81.37	78.50	88.50	89.67	92.55
Water Content (%)	25.39	26.73	13.43	12.06	11.05	11.98
Sample #	KRE-139	KRE-140	KRE-141	KRE-142	KRE-143	KRE-144
Test Hole #	14	14	14	14	14	14
Depth	0.5	1	2	3	4.5	5.7
Tare #	Oddish3	KFC-2	MIC-03	F.Sinatra	KFC-5	KFC-4
Tare Mass (g)	38.89	36.73	37.95	38.85	40.40	39.01
Wet sample + tare (g)	143.10	136.64	144.18	154.00	151.44	153.15
Dry sample + tare (g)	131.23	113.35	131.73	140.84	143.00	145.43
Wt. Dry sample (g)	92.34	76.62	93.78	101.99	102.60	106.42
Water Content (%)	12.85	30.40	13.28	12.90	8.23	7.25
Sample #	JMT-630	JMT-631	JMT-632	JMT-633	JMT-634	JMT-635
Test Hole #	27	27	27	27	27	27
Depth	0.6	1.1	2	3.1-3.6	4.5	5.5
Tare #	MFC-1	KFC-6	KFC-4	PaulA10	PaulA8	MIC-08
Tare Mass (g)	41.27	39.48	39.01	39.57	37.80	37.66
Wet sample + tare (g)	166.65	159.34	126.04	156.99	156.26	136.69
Dry sample + tare (g)	144.15	139.51	114.68	142.92	143.38	125.58
Wt. Dry sample (g)	102.88	100.03	75.67	103.35	105.58	87.92
Water Content (%)	21.87	19.82	15.01	13.61	12.20	12.64

Comments:

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Client: Chris Cebryk

Project: Proposed Resedential Development

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Sample #	JMT-642	JMT-643	JMT-644	JMT-645	JMT-646	JMT-647
Test Hole #	24	24	24	24	24	24
Depth	0.5	1	2	3	4.5	6.1-6.5
Tare #	MK-05	JBond3	Totoro4	MIC-07	BenF3	JL9
Tare Mass (g)	37.21	38.36	38.28	38.36	38.51	37.47
Wet sample + tare (g)	142.75	130.96	138.77	141.33	138.70	146.76
Dry sample + tare (g)	123.29	109.23	124.21	129.51	127.01	135.55
Wt. Dry sample (g)	86.08	70.87	85.93	91.15	88.50	98.08
Water Content (%)	22.61	30.66	16.94	12.97	13.21	11.43
Sample #	KRE-145	KRE-147	KRE-148	KRE-149	KRE-150	KRE-151
Test Hole #	10	10	10	10	10	10
Depth	0.5	1.5	2	3	4.5	5.6
Tare #	MIC-06	MIC-04	SNC-10	Wich3	NBohr10	F.Sinatra4
Tare Mass (g)	37.99	38.21	41.10	37.66	40.50	38.24
Wet sample + tare (g)	131.97	136.06	134.71	137.31	146.01	134.44
Dry sample + tare (g)	113.28	113.59	114.69	121.80	134.72	123.72
Wt. Dry sample (g)	75.29	75.38	73.59	84.14	94.22	85.48
Water Content (%)	24.82	29.81	27.20	18.43	11.98	12.54
Sample #						
Test Hole #						
Depth						
Tare #						
Tare Mass (g)						
Wet sample + tare (g)						
Dry sample + tare (g)						
Wt. Dry sample (g)						
Water Content (%)						

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Client: Chris Cebryk

Project: Proposed Resedential Subdivison

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Sample #	KRE-127	KRE-128	KRE-129	KRE-130	KRE-131	KRE-132
Test Hole #	3	3	3	3	3	3
Depth	0.5	1	2	3.05	4.5	6
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	42.50	45.86	42.50	47.64	43.67	49.76
Wet sample + tare (g)	186.97	189.12	207.29	197.86	214.77	184.56
Dry sample + tare (g)	174.31	172.54	186.76	181.58	191.92	167.74
Wt. Dry sample (g)	131.81	126.68	144.26	133.94	148.25	117.98
Water Content (%)	9.60	13.09	14.23	12.15	15.41	14.26
Sample #	KRE-164	KRE-165	KRE-166	KRE-167	KRE-168	KRE-169
Test Hole #	15	15	15	15	15	15
Depth	0.5	1	2	3	4.5	6
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	53.03	43.07	55.82	30.86	41.43	63.59
Wet sample + tare (g)	187.35	175.18	169.05	172.50	192.85	256.37
Dry sample + tare (g)	171.11	160.44	162.76	160.63	184.53	243.33
Wt. Dry sample (g)	118.08	117.37	106.94	129.77	143.10	179.74
Water Content (%)	13.75	12.56	5.88	9.15	5.81	7.25
Sample #	KRE-189	KRE-190	KRE-191	KRE-192	KRE-193	KRE-194
Test Hole #	20	20	20	20	20	20
Depth	0.5	1	2	3	4	6
Tare #	XBX2	N03	B16	6HH	BB7	KTH
Tare Mass (g)	68.85	58.13	56.73	61.70	37.91	91.37
Wet sample + tare (g)	249.62	280.60	246.93	252.59	220.22	330.60
Dry sample + tare (g)	210.68	250.74	221.99	227.74	201.62	301.89
Wt. Dry sample (g)	141.83	192.61	165.26	166.04	163.71	210.52
Water Content (%)	27.46	15.50	15.09	14.97	11.36	13.64

Comments:

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Client:	Chris Cebryk
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Sample #	KRE-170	KRE-171	KRE-172	KRE-173	KRE-174	KRE-175
Test Hole #	16	16	16	16	16	16
Depth	0.5	1	1.5	2	3	4.5
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	66.29	68.05	67.99	58.36	40.82	89.30
Wet sample + tare (g)	134.57	160.90	274.76	243.52	240.63	356.98
Dry sample + tare (g)	123.20	139.07	245.68	221.54	218.45	324.94
Wt. Dry sample (g)	56.91	71.02	177.69	163.18	177.63	235.64
Water Content (%)	19.98	30.74	16.37	13.47	12.49	13.60
Sample #	KRE-176	JMT-660	JMT-661	JMT-662	JMT-663	JMT-664
Test Hole #	16	17	17	17	17	17
Depth	6	0.5	1	2	3	4.6
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	48.89	37.13	37.96	37.86	38.46	38.72
Wet sample + tare (g)	349.51	193.66	206.09	205.06	199.02	140.06
Dry sample + tare (g)	314.69	174.60	187.08	185.67	184.15	130.96
Wt. Dry sample (g)	265.80	137.47	149.12	147.81	145.69	92.24
Water Content (%)	13.10	13.86	12.75	13.12	10.21	9.87
Sample #	JMT-665	JMT-666	JMT-667	JMT-668	JMT-669	JMT-670
Test Hole #	17	18	18	18	18	18
Depth	5.4	0.5	1.2	2	3	4.5
Tare #	XBX2	N03	B16	6HH	BB7	KTH
Tare Mass (g)	37.83	38.51	37.28	37.59	39.98	38.44
Wet sample + tare (g)	185.12	163.21	215.86	188.24	207.18	238.63
Dry sample + tare (g)	173.30	135.04	183.19	163.83	185.22	217.19
Wt. Dry sample (g)	135.47	96.53	145.91	126.24	145.24	178.75
Water Content (%)	8.73	29.18	22.39	19.34	15.12	11.99

Comments:

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Client:	Chris Cebryk
Project:	Proposed Resedential Subdivison
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Sample #	JMT-671	JMT-672	JMT-673	JMT-674	JMT-675	JMT-676
Test Hole #	18	19	19	19	19	19
Depth	6.1-6.4	0.6	1.1	3	4.5	6
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	38.75	37.03	38.30	38.21	38.14	38.69
Wet sample + tare (g)	231.76	203.77	154.82	174.48	265.56	240.44
Dry sample + tare (g)	212.90	186.08	148.08	161.04	242.97	215.69
Wt. Dry sample (g)	174.15	149.05	109.78	122.83	204.83	177.00
Water Content (%)	10.83	11.87	6.14	10.94	11.03	13.98
Sample #	JMT-656	JMT-657	JMT-658	JMT-659	JMT-648	JMT-649
Test Hole #	21	21	21	21	22	22
Depth	1.9	3.3	4.4	6	0.5	1
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	38.70	38.17	41.56	41.03	40.38	38.43
Wet sample + tare (g)	204.27	147.98	220.64	274.95	251.34	233.29
Dry sample + tare (g)	182.49	137.98	205.19	251.71	198.10	188.41
Wt. Dry sample (g)	143.79	99.81	163.63	210.68	157.72	149.98
Water Content (%)	15.15	10.02	9.44	11.03	33.76	29.92
Sample #	JMT-650	JMT-651	JMT-652	JMT-653	JMT-636	JMT-637
Test Hole #	22	22	22	22	23	23
Depth	1.9	3	4.5	6	0.6	1.2
Tare #	XBX2	N03	B16	6HH	BB7	KTH
Tare Mass (g)	38.37	37.43	38.33	37.81	37.85	38.23
Wet sample + tare (g)	220.42	248.83	203.70	257.85	200.44	222.72
Dry sample + tare (g)	197.79	221.68	188.45	236.38	158.01	176.85
Wt. Dry sample (g)	159.42	184.25	150.12	198.57	120.16	138.62
Water Content (%)	14.20	14.74	10.16	10.81	35.31	33.09

Comments:

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Client: Chris Cebryk

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Sample #	JMT-677	JMT-678	JMT-679	JMT-680	JMT-654	JMT-655
Test Hole #	19	19	19	19	21	21
Depth	7.6-8.1	89.9	11.2	11.9	0.6	1.1
Tare #	WATCH	SQH	KFC-5	KFC-6	JL9	PAU
Tare Mass (g)	40.72	39.51	40.54	39.72	37.75	39.68
Wet sample + tare (g)	265.29	265.67	274.39	329.62	270.23	205.01
Dry sample + tare (g)	240.21	241.73	249.53	297.43	228.55	176.01
Wt. Dry sample (g)	199.49	202.22	208.99	257.71	190.80	136.33
Water Content (%)	12.57	11.84	11.90	12.49	21.84	21.27

Sample #						
Test Hole #						
Depth						
Tare #						
Tare Mass (g)						
Wet sample + tare (g)						
Dry sample + tare (g)						
Wt. Dry sample (g)						
Water Content (%)						

Sample #						
Test Hole #						
Depth						
Tare #						
Tare Mass (g)						
Wet sample + tare (g)						
Dry sample + tare (g)						
Wt. Dry sample (g)						
Water Content (%)						

Comments:

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Sample #	JMT-638	JMT-639	JMT-640	JMT-641	JMT-618	JMT-619
Test Hole #	23	23	23	23	25	25
Depth	1.8	3	5.1	6	0.5	1
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	38.92	39.07	38.35	39.00	38.41	38.33
Wet sample + tare (g)	271.79	259.75	282.47	228.96	241.13	287.63
Dry sample + tare (g)	237.14	235.74	258.13	209.56	207.40	248.84
Wt. Dry sample (g)	198.22	196.67	219.78	170.56	168.99	210.51
Water Content (%)	17.48	12.21	11.07	11.37	19.96	18.43
Sample #	JMT-620	JMT-621	JMT-622	JMT-623	JMT-624	JMT-625
Test Hole #	25	25	25	25	26	26
Depth	2	3	4.5	4.9	0.5	1
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	39.32	38.23	40.64	36.79	38.53	38.48
Wet sample + tare (g)	229.09	256.50	302.23	248.24	285.28	318.74
Dry sample + tare (g)	204.78	230.84	271.71	229.58	250.63	282.48
Wt. Dry sample (g)	165.46	192.61	231.07	192.79	212.10	244.00
Water Content (%)	14.69	13.32	13.21	9.68	16.34	14.86
Sample #	JMT-626	JMT-627	JMT-628	JMT-630	JMT-600	JMT-601
Test Hole #	26	26	26	26	29	29
Depth	1.5	3	4.6	6	0.4	1
Tare #	XBX2	N03	B16	6HH	BB7	KTH
Tare Mass (g)	39.20	40.31	38.18	38.01	38.38	38.17
Wet sample + tare (g)	294.61	215.58	183.04	221.41	280.88	270.60
Dry sample + tare (g)	246.86	195.68	167.26	202.23	228.36	223.77
Wt. Dry sample (g)	207.66	155.37	129.08	164.22	189.98	185.60
Water Content (%)	22.99	12.81	12.22	11.68	27.65	25.23

Comments:

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Client:	Chris Cebryk
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Sample #	JMT-602	JMT-603	JMT-604	JMT-604	JMT-605	JMT-606
Test Hole #	29	29	29	30	30	30
Depth	2	3.1	4.6	0.5	1	1.5-1.9
Tare #	QUACK	L2R	COLD	XBV	XBN	ZXI
Tare Mass (g)	41.78	38.92	38.35	37.92	37.01	41.64
Wet sample + tare (g)	213.67	128.85	282.47	249.31	258.51	247.10
Dry sample + tare (g)	191.54	120.34	258.13	202.68	229.15	224.35
Wt. Dry sample (g)	149.76	81.42	219.78	164.76	192.14	182.71
Water Content (%)	14.78	10.45	11.07	28.30	15.28	12.45
Sample #	JMT-607	JMT-608	JMT-609	JMT-610	JMT-611	JMT-612
Test Hole #	30	30	30	30	31	31
Depth	2	3	4.5	6	0.5	1
Tare #	S11	NO5	GAH	L9R	BOSA	GI
Tare Mass (g)	40.88	41.29	40.26	37.89	39.12	39.36
Wet sample + tare (g)	258.76	223.51	213.36	212.35	256.98	244.52
Dry sample + tare (g)	230.99	200.55	196.08	195.80	224.02	218.60
Wt. Dry sample (g)	190.11	159.26	155.82	157.91	184.90	179.24
Water Content (%)	14.61	14.42	11.09	10.48	17.83	14.46
Sample #	JMT-613	JMT-614	JMT-615	JMT-616	JMT-617	
Test Hole #	31	31	31	31	31	
Depth	2	3	4.6	4.9	5.7	
Tare #	XBX2	N03	B16	6HH	BB7	
Tare Mass (g)	38.54	41.66	39.28	37.27	40.69	
Wet sample + tare (g)	250.49	285.88	104.08	167.14	172.27	
Dry sample + tare (g)	224.82	255.39	94.10	143.01	147.29	
Wt. Dry sample (g)	186.28	213.73	54.82	105.74	106.60	
Water Content (%)	13.78	14.27	18.21	22.82	23.43	

Comments:

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Development
Project #:	613596
Technician:	JA
Date:	31-Jul-2013

Sample: KRE-109 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	MVP	13A	
Tare Wt, g	14.39	14.11	
Wet + Tare, g	22.24	21.08	
Dry + Tare, g	21.45	20.37	average
M%	11.2%	11.3%	11.3%

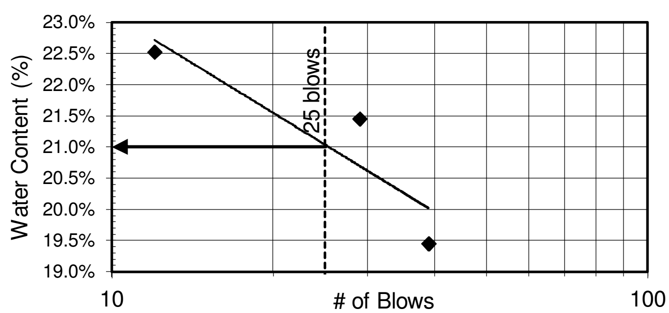
Liquid Limit (method A)

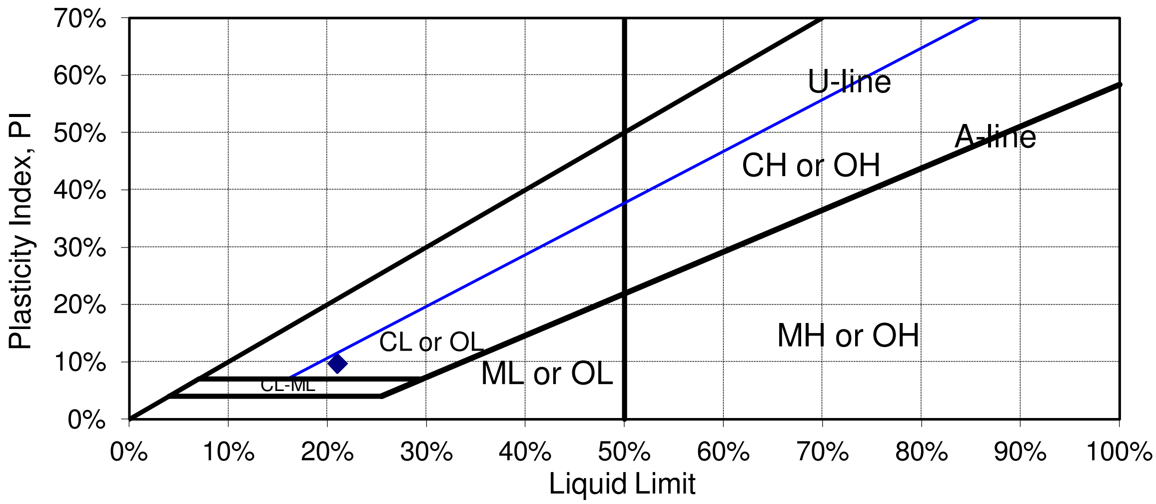
# of Blows	12	29	39
Tare #	A26	B2	A9
Tare Wt, g	12.32	14.11	12.77
Wet + tare, g	22.60	28.83	24.93
Dry + tare, g	20.71	26.23	22.95
Water content	22.5%	21.5%	19.4%

SUMMARY

Plastic Limit:	11.3%
Liquid Limit:	21.0%
Plasticity Index:	9.7%
Classification:	CL

Natural Water Content: 8.3%





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Development
Project #:	613596
Technician:	JA
Date:	28-Jul-2013

Sample: KRE-117 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	40A	52A	
Tare Wt, g	13.13	12.77	
Wet + Tare, g	19.78	21.10	
Dry + Tare, g	18.99	20.08	average
M%	13.5%	14.0%	13.7%

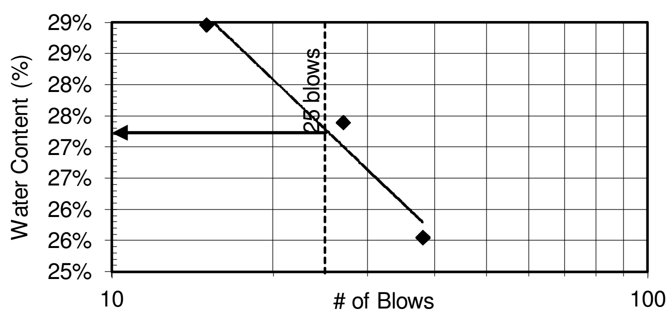
Liquid Limit (method A)

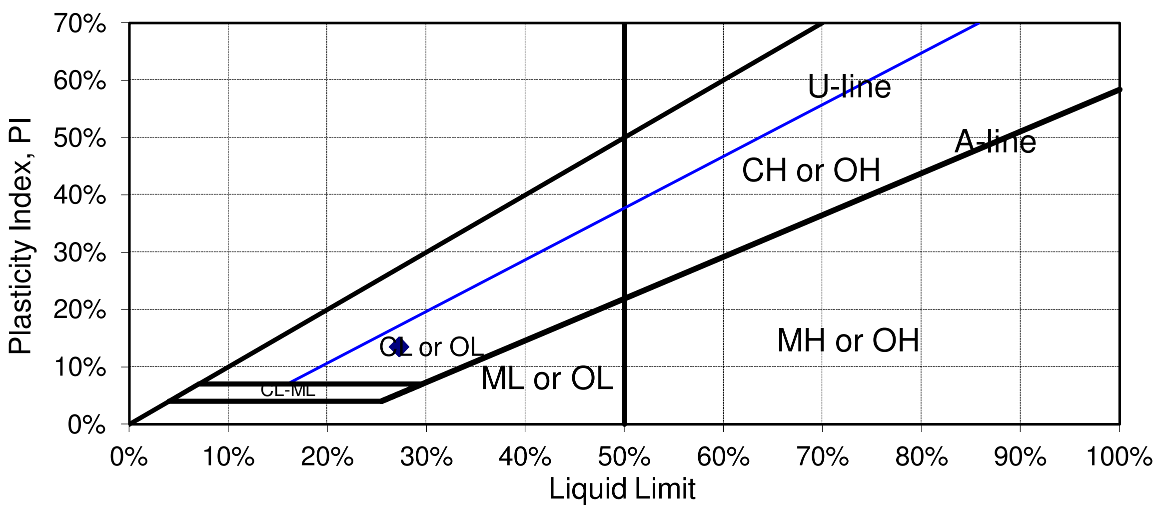
# of Blows	15	27	38
Tare #	29A	Z5	B2
Tare Wt, g	14.18	13.98	14.10
Wet + tare, g	23.13	21.42	21.52
Dry + tare, g	21.12	19.82	20.01
Water content	29.0%	27.4%	25.5%

SUMMARY

Plastic Limit:	13.7%
Liquid Limit:	27.2%
Plasticity Index:	13.5%
Classification:	CL

Natural Water Content: 17.6%





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Subdivison
Project #:	613596
Technician:	JA
Date:	1-Aug-2013

Sample: KRE-132 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	21A	37A	
Tare Wt, g	14.4	13.97	
Wet + Tare, g	23.75	21.85	
Dry + Tare, g	22.50	20.80	average
M%	15.4%	15.4%	15.4%

Liquid Limit (method A)

# of Blows	20	34	42
Tare #	TRN	63A	31A
Tare Wt, g	13.86	14.08	14.21
Wet + tare, g	23.13	26.30	24.62
Dry + tare, g	20.89	23.47	22.23
Water content	31.9%	30.1%	29.8%

SUMMARY

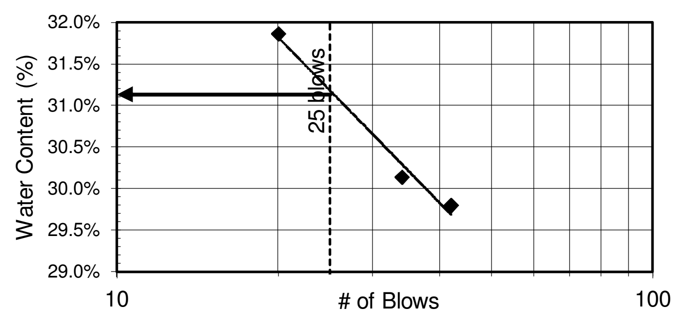
Plastic Limit: 15.4%

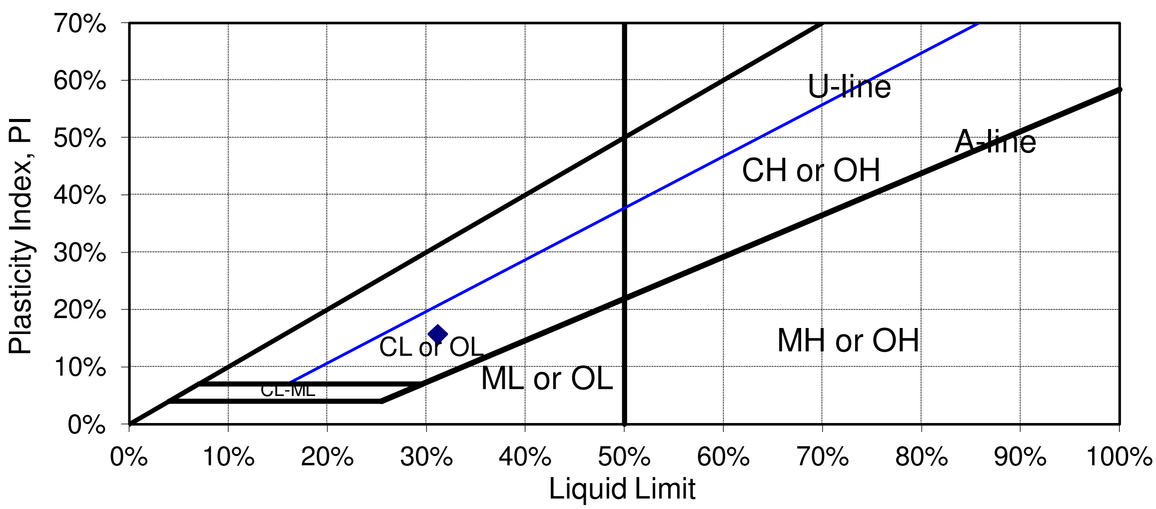
Liquid Limit: 31.1%

Plasticity Index: 15.7%

Classification: CL

Natural Water Content: -





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Subdivison
Project #:	613596
Technician:	RG
Date:	2-Aug-2013

Sample: KRE-170 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	Z1	55A	
Tare Wt, g	14.38	14.05	
Wet + Tare, g	21.58	20.78	
Dry + Tare, g	20.23	19.51	average
M%	23.1%	23.3%	23.2%

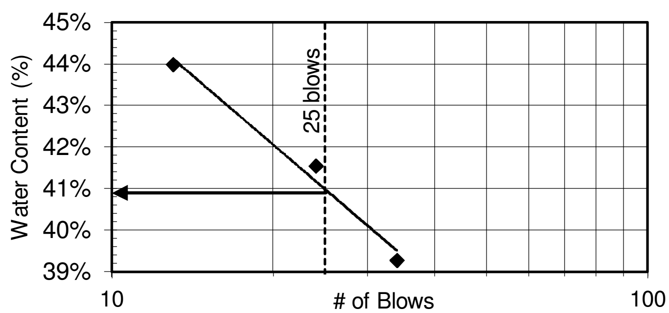
Liquid Limit (method A)

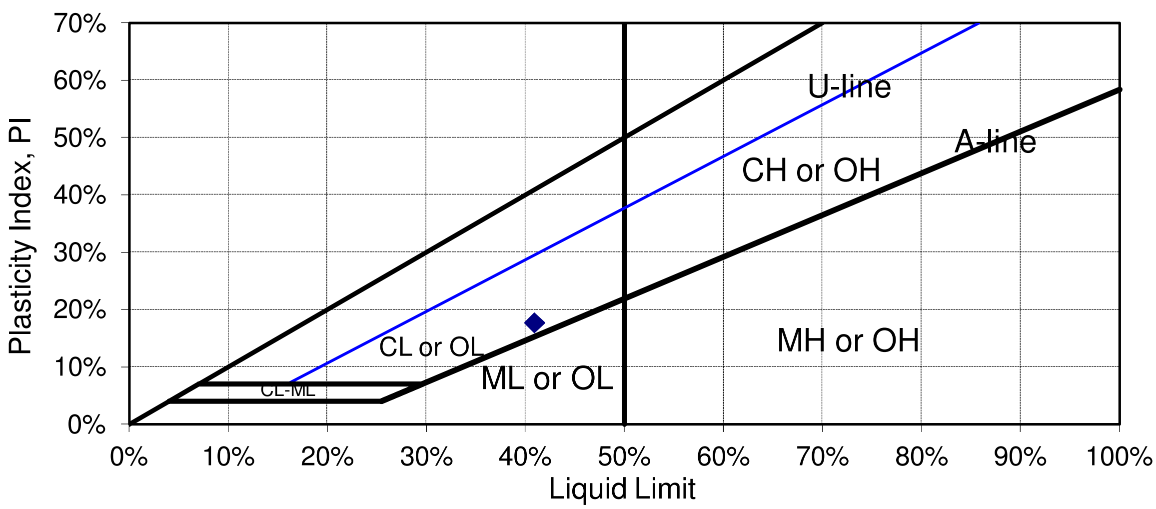
# of Blows	13	24	34
Tare #	A26	T6	47A
Tare Wt, g	12.33	14.06	14.27
Wet + tare, g	22.87	22.68	24.27
Dry + tare, g	19.65	20.15	21.45
Water content	44.0%	41.5%	39.3%

SUMMARY

Plastic Limit:	23.2%
Liquid Limit:	40.9%
Plasticity Index:	17.7%
Classification:	CL

Natural Water Content: -





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Development
Project #:	613596
Technician:	RG
Date:	29-Jul-2013

Sample: KRE-178 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	A19	T7M	
Tare Wt, g	14.19	14.44	
Wet + Tare, g	21.25	19.47	
Dry + Tare, g	20.31	18.87	average
M%	15.4%	13.5%	14.5%

Liquid Limit (method A)

# of Blows	14	23	38
Tare #	A24	27A	B3
Tare Wt, g	12.71	14.18	13.92
Wet + tare, g	25.05	26.13	24.95
Dry + tare, g	22.23	23.57	22.66
Water content	29.6%	27.3%	26.2%

SUMMARY

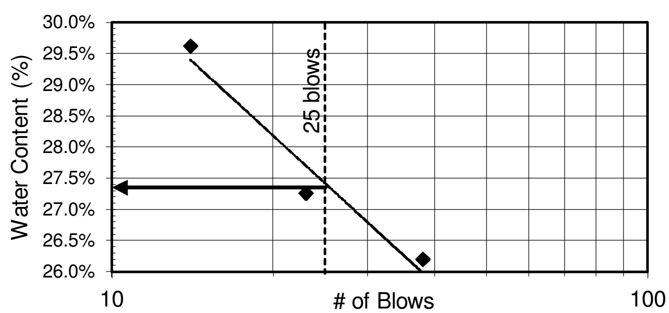
Plastic Limit: 14.5%

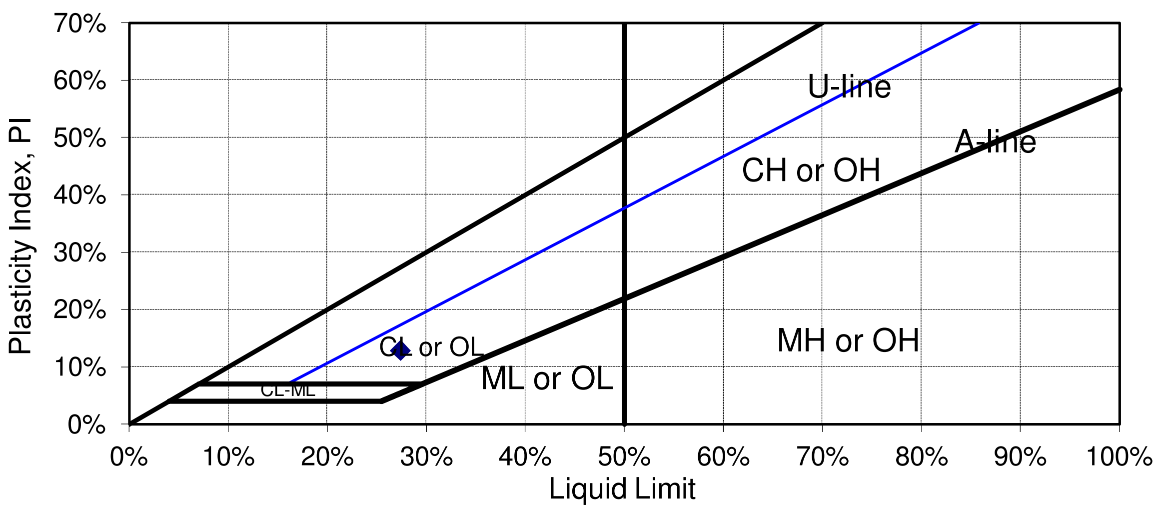
Liquid Limit: 27.4%

Plasticity Index: 12.9%

Classification: CL

Natural Water Content: 26.5%





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Development
Project #:	613596
Technician:	RG
Date:	29-Jul-2013

Sample: KRE-186 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	A26	47A	
Tare Wt, g	12.31	14.28	
Wet + Tare, g	18.86	21.53	
Dry + Tare, g	18.08	20.67	average
M%	13.5%	13.5%	13.5%

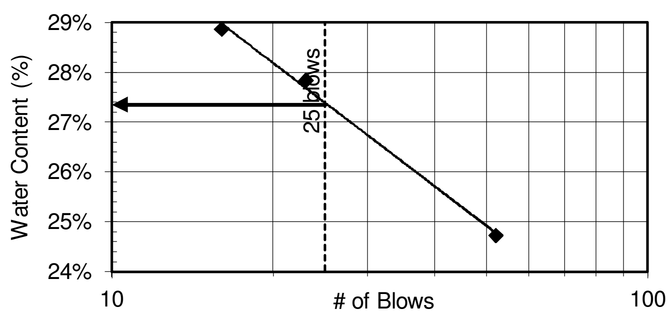
Liquid Limit (method A)

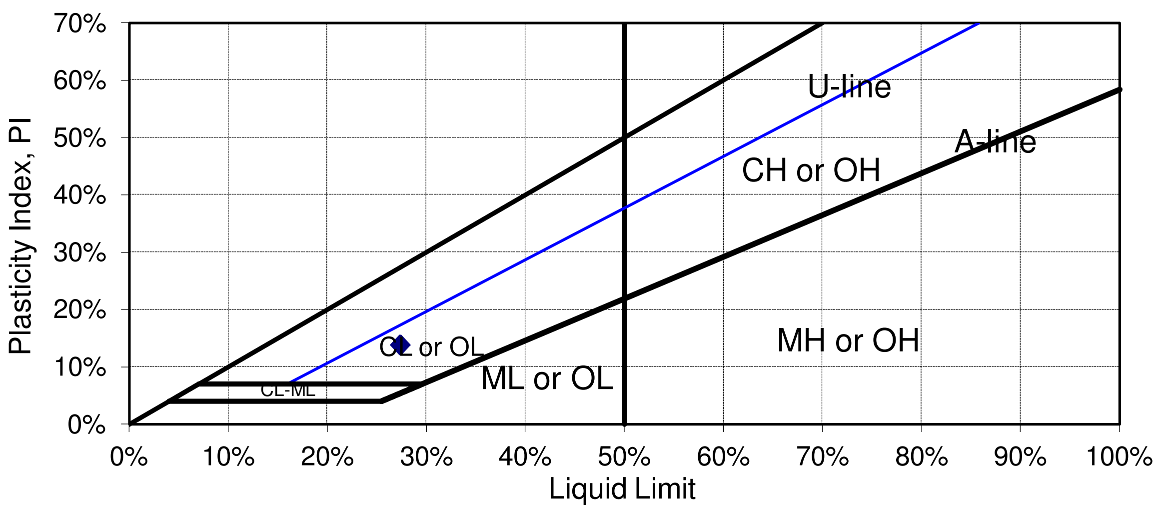
# of Blows	16	23	52
Tare #	38A	31A	TLL
Tare Wt, g	14.20	14.20	14.01
Wet + tare, g	22.28	27.47	24.40
Dry + tare, g	20.47	24.58	22.34
Water content	28.9%	27.8%	24.7%

SUMMARY

Plastic Limit:	13.5%
Liquid Limit:	27.4%
Plasticity Index:	13.9%
Classification:	CL

Natural Water Content: 19.9%





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Subdivison
Project #:	613596
Technician:	JA
Date:	1-Aug-2013

Sample: KRE-192 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	T9B	A31	
Tare Wt, g	14.04	13.42	
Wet + Tare, g	23.33	21.86	
Dry + Tare, g	22.20	20.82	average
M%	13.8%	14.1%	14.0%

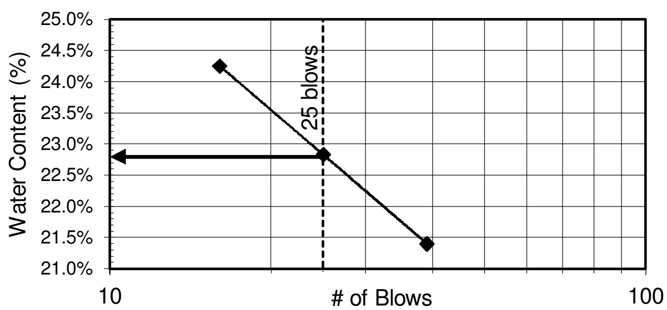
Liquid Limit (method A)

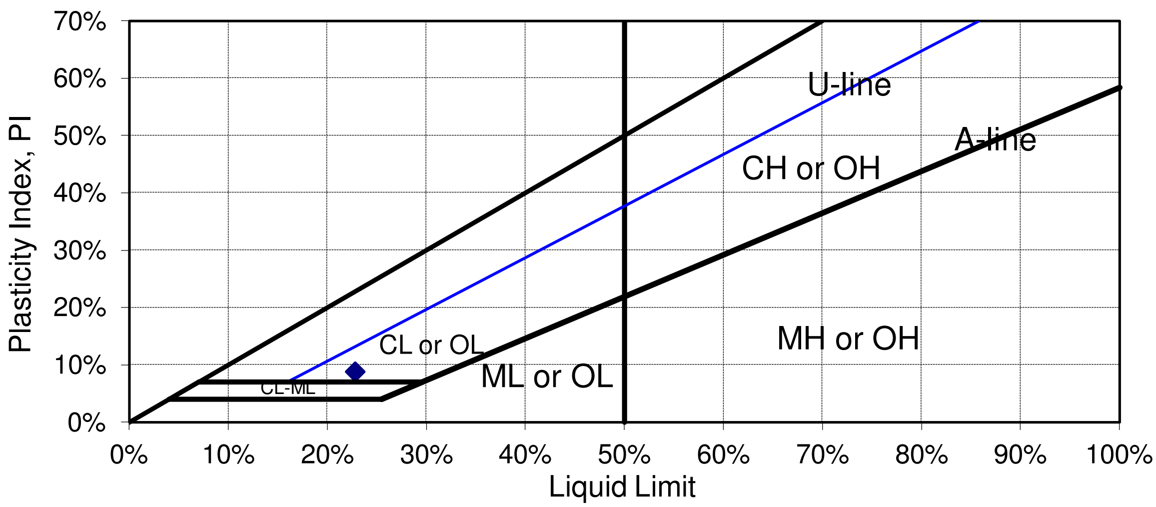
# of Blows	16	25	39
Tare #	1A	54A	38A
Tare Wt, g	14.10	14.54	14.22
Wet + tare, g	23.27	23.90	23.92
Dry + tare, g	21.48	22.16	22.21
Water content	24.3%	22.8%	21.4%

SUMMARY

Plastic Limit:	14.0%
Liquid Limit:	22.8%
Plasticity Index:	8.8%
Classification:	CL

Natural Water Content: -





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Subdivison
Project #:	613596
Technician:	RG
Date:	1-Aug-2013

Sample: JMT-604 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	B3	9A	
Tare Wt, g	13.9	14.31	
Wet + Tare, g	19.88	21.20	
Dry + Tare, g	19.06	20.25	average
M%	15.9%	16.0%	15.9%

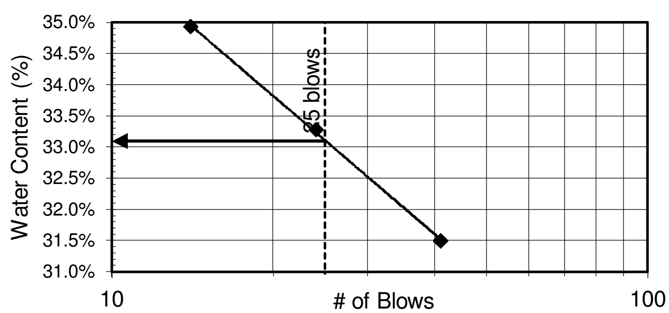
Liquid Limit (method A)

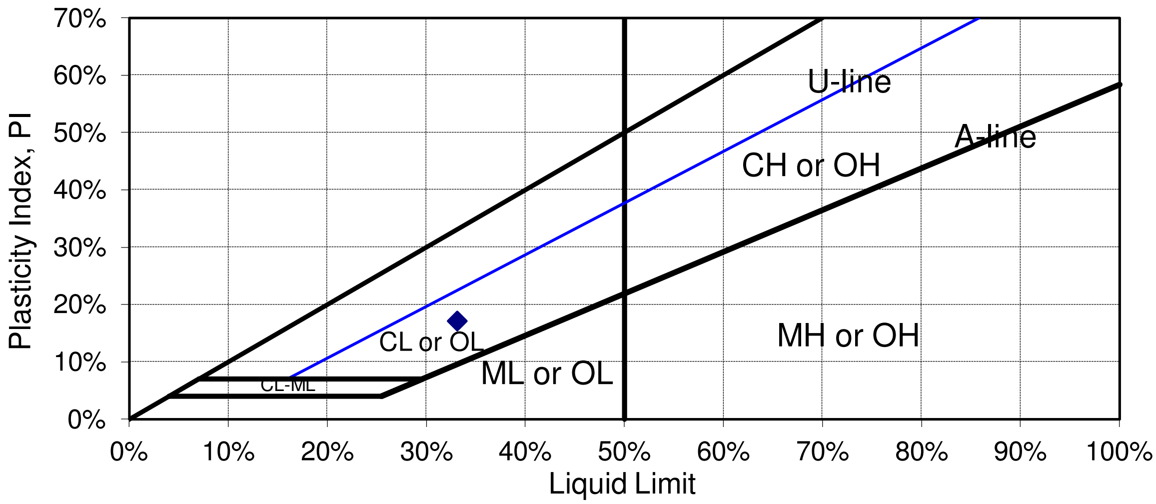
# of Blows	14	24	41
Tare #	B7	T8A	MDH
Tare Wt, g	14.26	14.44	14.57
Wet + tare, g	24.65	23.17	24.13
Dry + tare, g	21.96	20.99	21.84
Water content	34.9%	33.3%	31.5%

SUMMARY

Plastic Limit:	15.9%
Liquid Limit:	33.1%
Plasticity Index:	17.2%
Classification:	CL

Natural Water Content: -





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Development
Project #:	613596
Technician:	RG
Date:	1-Aug-2013

Sample: JMT-612 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	46A	13A	
Tare Wt, g	13.38	14.13	
Wet + Tare, g	19.86	19.36	
Dry + Tare, g	19.21	18.80	average
M%	11.1%	12.0%	11.6%

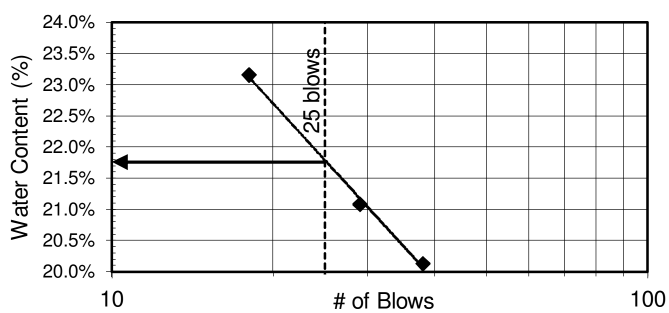
Liquid Limit (method A)

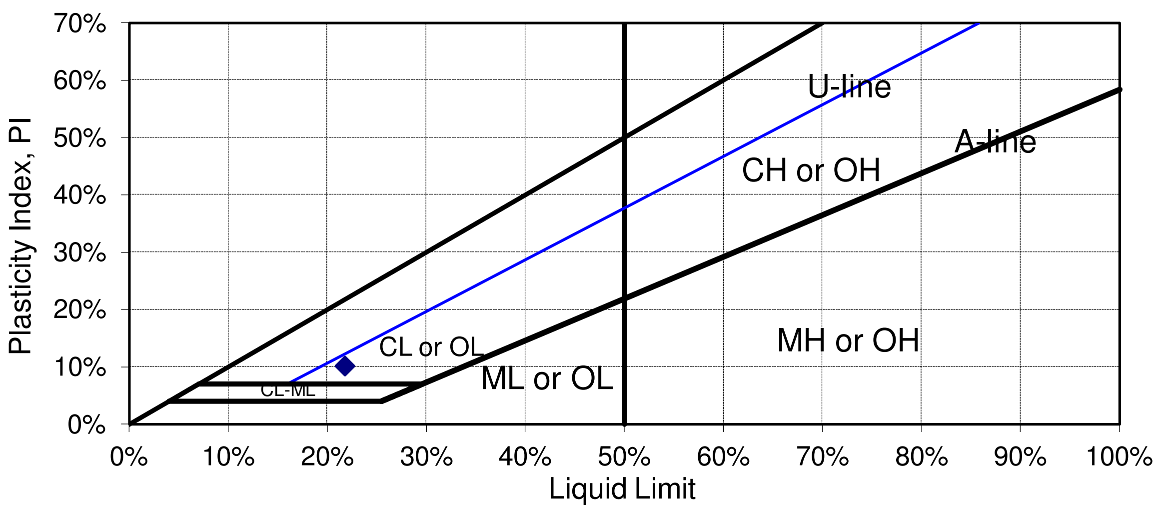
# of Blows	18	29	38
Tare #	2J	C3	69A
Tare Wt, g	14.20	14.02	14.21
Wet + tare, g	21.06	22.29	21.49
Dry + tare, g	19.77	20.85	20.27
Water content	23.2%	21.1%	20.1%

SUMMARY

Plastic Limit:	11.6%
Liquid Limit:	21.8%
Plasticity Index:	10.2%
Classification:	CL

Natural Water Content: -





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

Client:	Chris Cebryk
Project	Proposed Resedential Development
Project #:	613596
Technician:	RG
Date:	1-Aug-2013

Sample: JMT-621 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	a19	YN	
Tare Wt, g	12.93	14.25	
Wet + Tare, g	18.67	21.06	
Dry + Tare, g	18.02	20.29	average
M%	12.8%	12.7%	12.8%

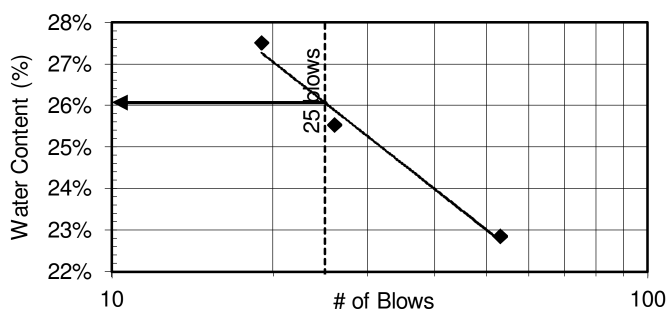
Liquid Limit (method A)

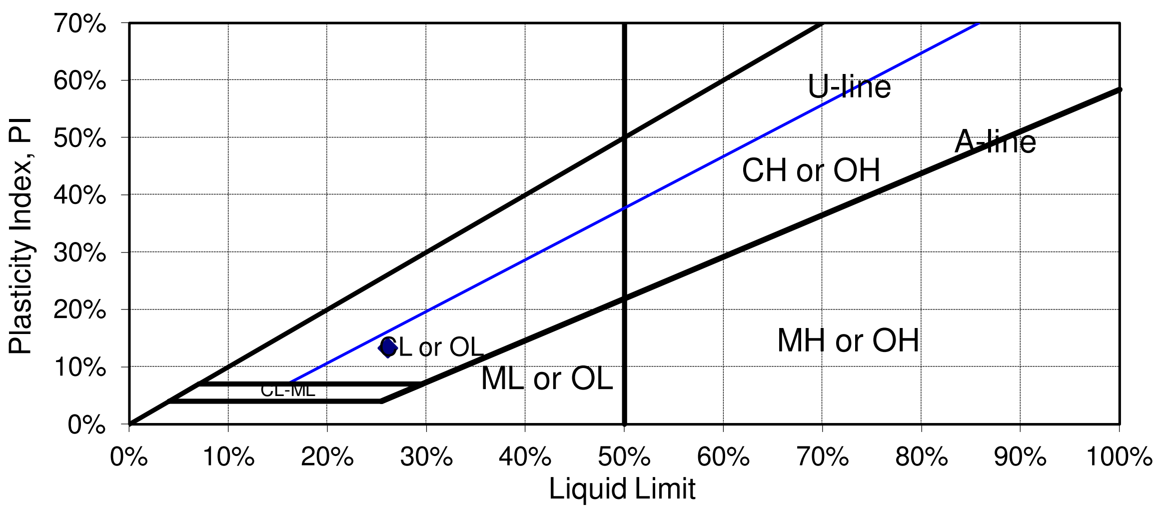
# of Blows	19	26	53
Tare #	6A	A17	21A
Tare Wt, g	13.81	12.32	13.10
Wet + tare, g	23.96	23.43	25.57
Dry + tare, g	21.77	21.17	23.25
Water content	27.5%	25.5%	22.9%

SUMMARY

Plastic Limit:	12.8%
Liquid Limit:	26.1%
Plasticity Index:	13.3%
Classification:	CL

Natural Water Content: -





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Development
Project #:	613596
Technician:	JA
Date:	28-Jul-2013

Sample: JMT-632 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	40A	52A	
Tare Wt, g	14.27	13.87	
Wet + Tare, g	20.03	21.99	
Dry + Tare, g	19.34	20.95	average
M%	13.6%	14.7%	14.1%

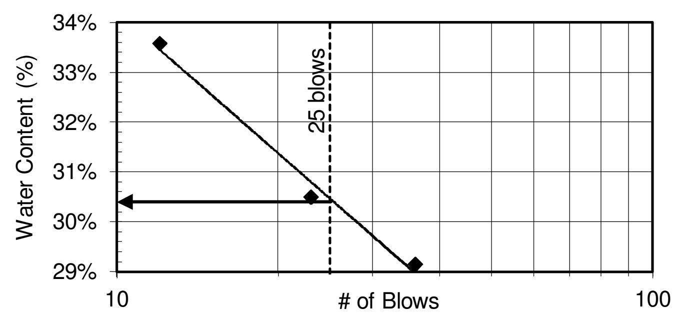
Liquid Limit (method A)

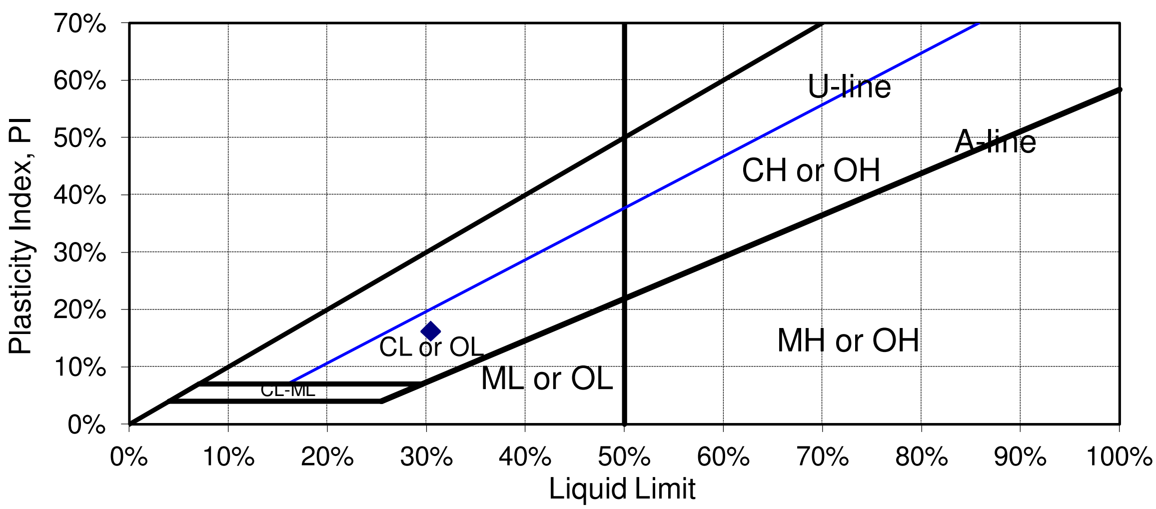
# of Blows	12	23	36
Tare #	MCA	65a	B7
Tare Wt, g	14.53	14.16	14.27
Wet + tare, g	23.52	21.99	21.58
Dry + tare, g	21.26	20.16	19.93
Water content	33.6%	30.5%	29.2%

SUMMARY

Plastic Limit:	14.1%
Liquid Limit:	30.4%
Plasticity Index:	16.3%
Classification:	CL

Natural Water Content: 15.1%





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Subdivison
Project #:	613596
Technician:	RG
Date:	1-Aug-2013

Sample: JMT-641 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	T10	TRN	
Tare Wt, g	14.45	13.86	
Wet + Tare, g	21.41	21.76	
Dry + Tare, g	20.62	20.85	average
M%	12.8%	13.0%	12.9%

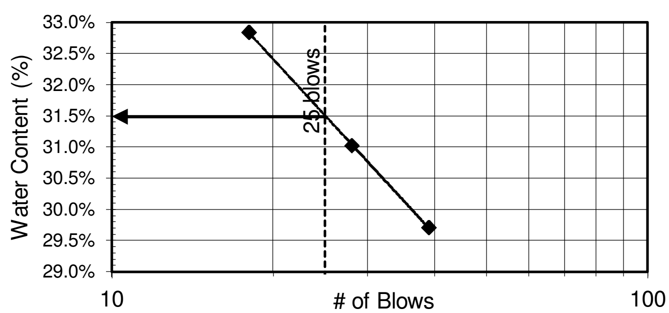
Liquid Limit (method A)

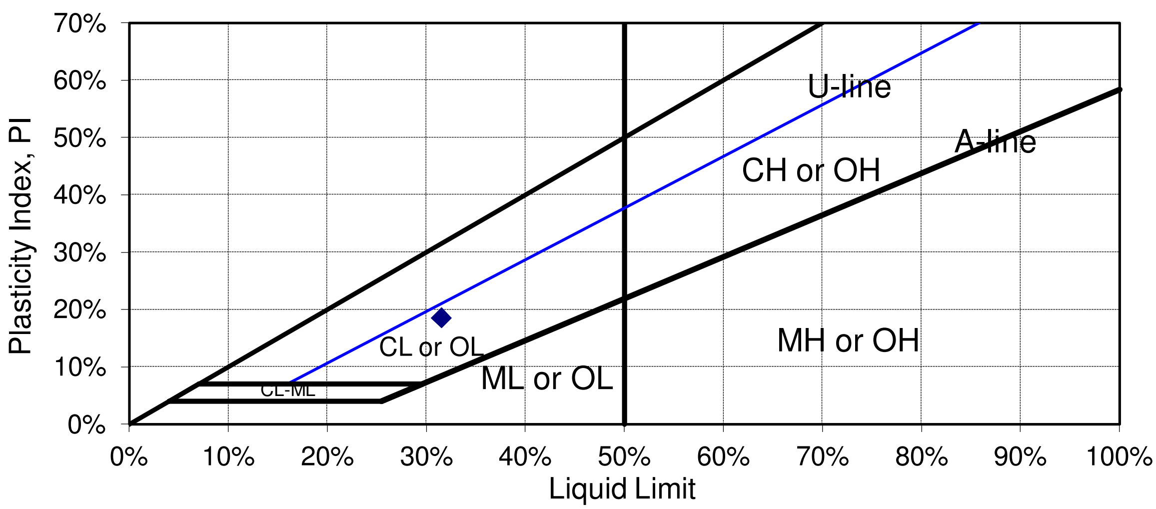
# of Blows	18	28	39
Tare #	2J	54A	9A
Tare Wt, g	14.18	14.52	14.31
Wet + tare, g	20.49	20.39	20.16
Dry + tare, g	18.93	19.00	18.82
Water content	32.8%	31.0%	29.7%

SUMMARY

Plastic Limit:	12.9%
Liquid Limit:	31.5%
Plasticity Index:	18.6%
Classification:	CL

Natural Water Content: -





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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Subdivison
Project No:	613596
Technician:	JA
Date:	1-Aug-2013

Sample: JMT-656 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #			
Tare Wt, g			
Wet + Tare, g			
Dry + Tare, g			average
M%			

Liquid Limit (method A)

# of Blows			
Tare #			
Tare Wt, g			
Wet + tare, g			
Dry + tare, g			
Water content			

Non-Plastic

SUMMARY

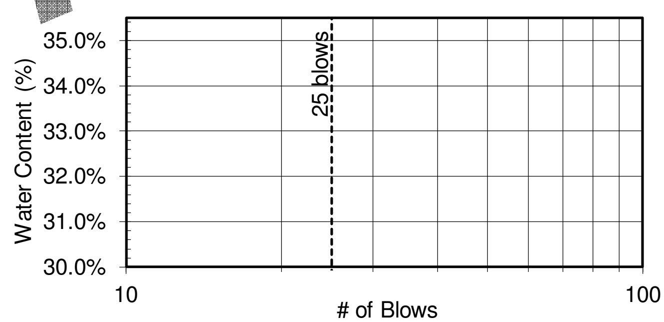
Plastic Limit:

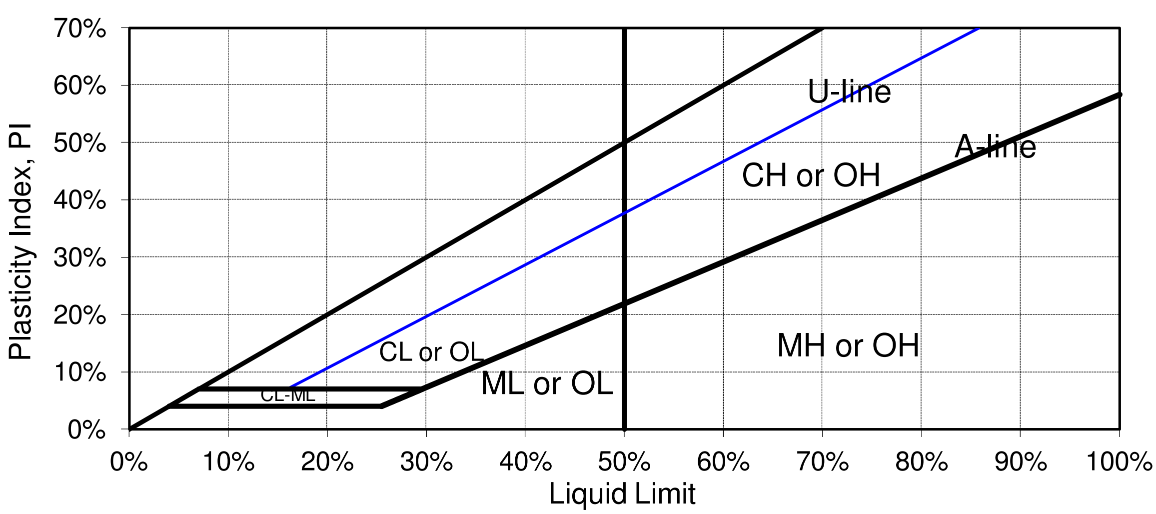
Liquid Limit:

Plasticity Index:

Classification:

Natural Water Content: N/A





Comments: Non-Plastic

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ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC•LAVALIN Environment

Client:	Chris Cebryk
Project	Proposed Resedential Development
Project #:	613596
Technician:	RG
Date:	1-Aug-2013

Sample: JMT-661 (air-dried)

Percentage of sample retained on 425-um (No. 40) sieve: N/A

Plastic Limit

Tare #	T10	66A	
Tare Wt, g	14.45	14.49	
Wet + Tare, g	21.05	21.10	
Dry + Tare, g	20.24	20.21	average
M%	14.0%	15.6%	14.8%

Liquid Limit (method A)

# of Blows	13	29	48
Tare #	R2	A18	A35
Tare Wt, g	14.21	13.09	12.67
Wet + tare, g	25.78	24.63	23.13
Dry + tare, g	22.85	22.01	20.88
Water content	33.9%	29.4%	27.4%

SUMMARY

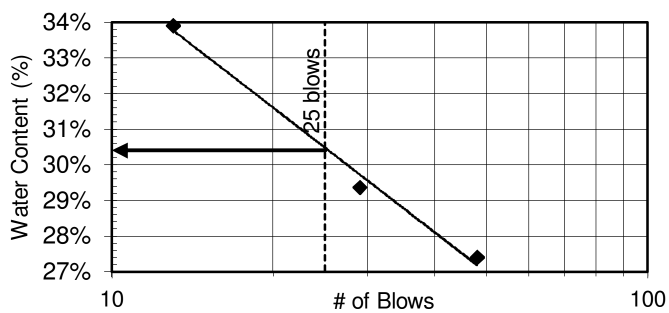
Plastic Limit: 14.8%

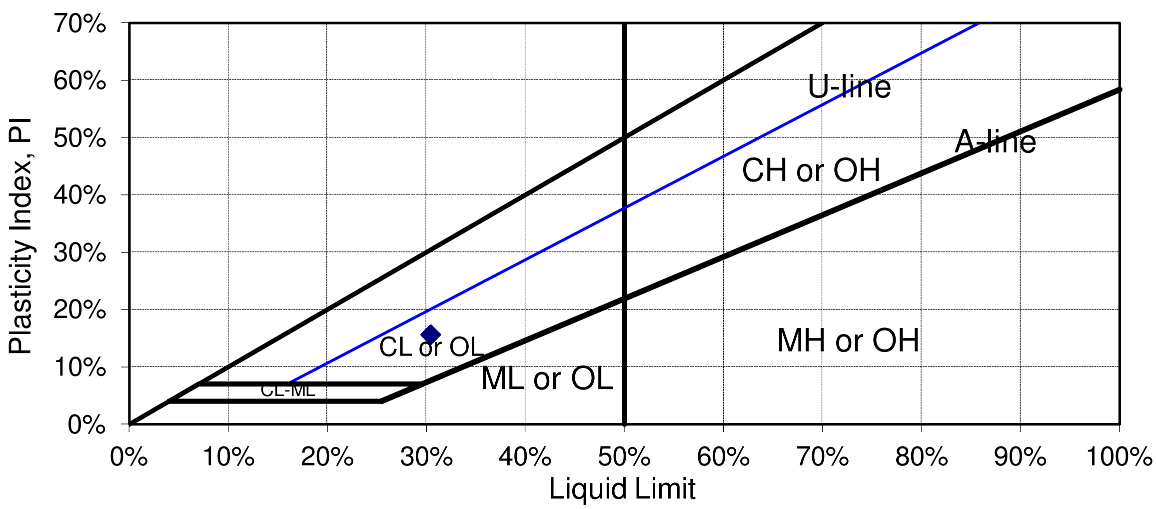
Liquid Limit: 30.4%

Plasticity Index: 15.6%

Classification: CL

Natural Water Content: -





Comments: -

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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Subdivison
MDH Job No:	613596
SAMPLE:	KRE-101
DATE:	1-Aug-13

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	99
# 4	4.75	99
# 10	2.00	98
# 20	0.850	97
# 40	0.425	96
# 60	0.250	94
# 100	0.150	92
# 200	0.075	84

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

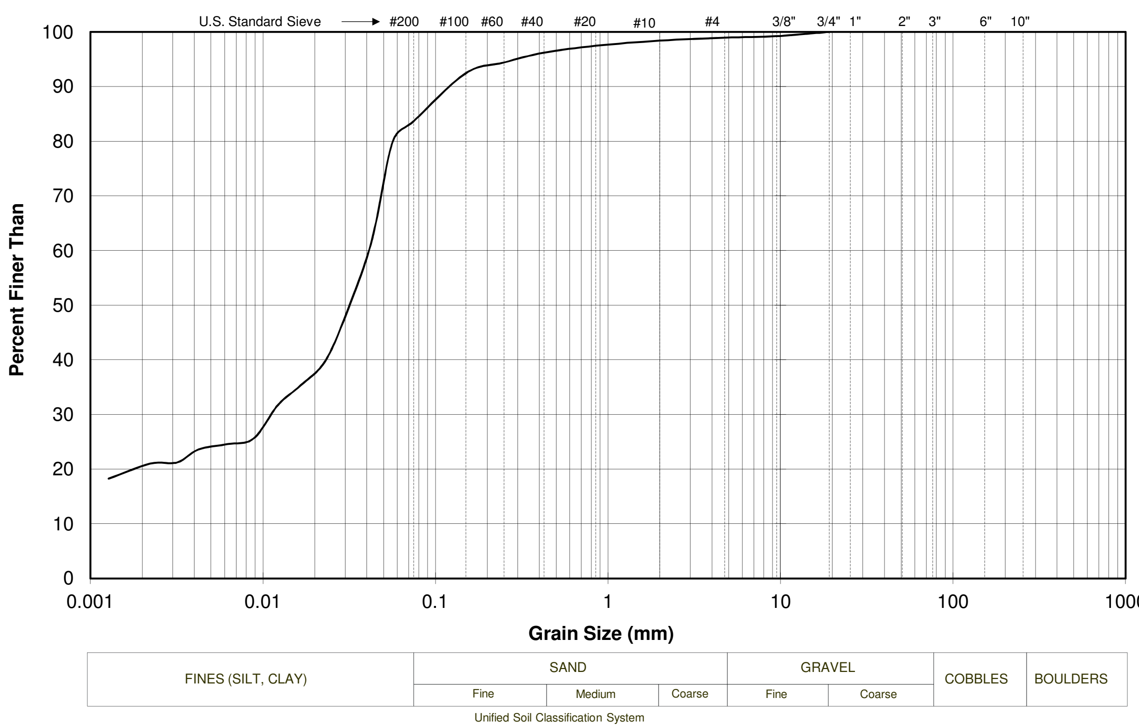
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0565	79.9
0.0429	62.0
0.0317	49.8
0.0231	39.9
0.0166	35.3
0.0122	31.7
0.0088	25.5
0.0063	24.6
0.0042	23.6
0.0032	21.2
0.0022	21.0
0.0013	18.2

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	1
% SAND	15
% FINES (SILT, CLAY)	84

COMMENTS:



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

Sieve Analysis Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	99
# 4	4.75	97
# 10	2.00	94
# 20	0.850	91
# 40	0.425	86
# 60	0.250	80
# 100	0.150	71
# 200	0.075	63

Hydrometer Analysis	Diameter (mm)	% Finer
	0.0612	60.3
	0.0442	55.0
Dispersing agent:	0.0320	48.4
Sodium Hexametaphosphate	0.0228	46.2
	0.0163	43.1
Dosage of dispersing agent:	0.0121	39.7
40 g/L	0.0086	35.8
	0.0062	32.5
	0.0044	29.7
	0.0032	26.1
	0.0025	24.2
	0.0013	21.1

CLIENT: Chris Cebryk

PROJECT: Proposed Resedential Development

MDH Job No: 613596

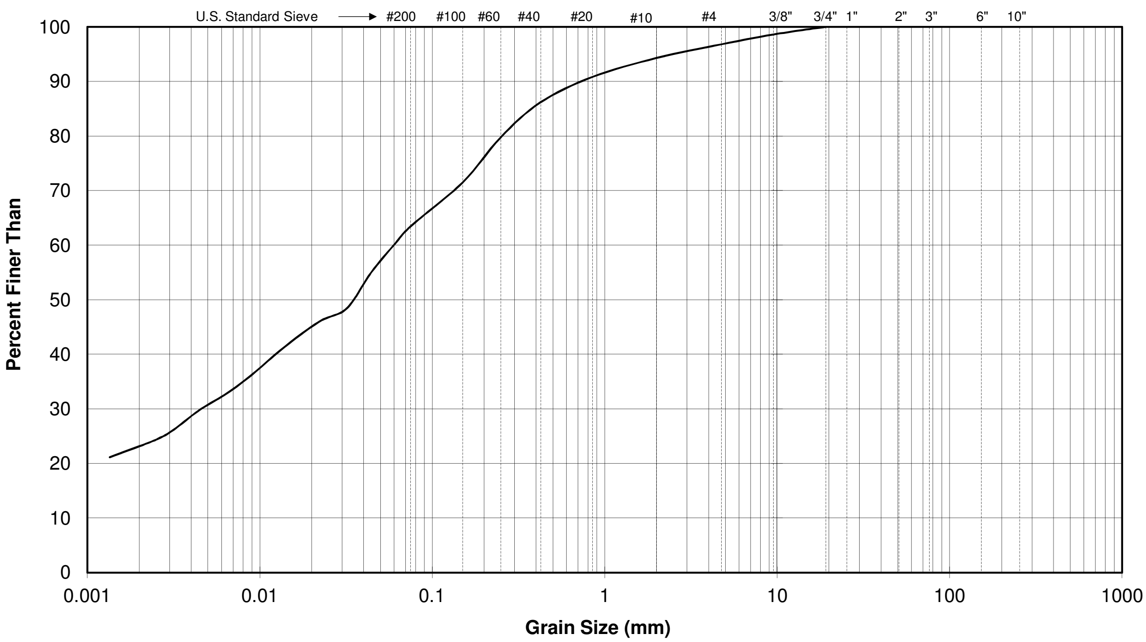
SAMPLE: KRE-107

DATE: 30-Jul-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	3
% SAND	34
% FINES (SILT, CLAY)	63

COMMENTS:



FINES (SILT, CLAY)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Unified Soil Classification System

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

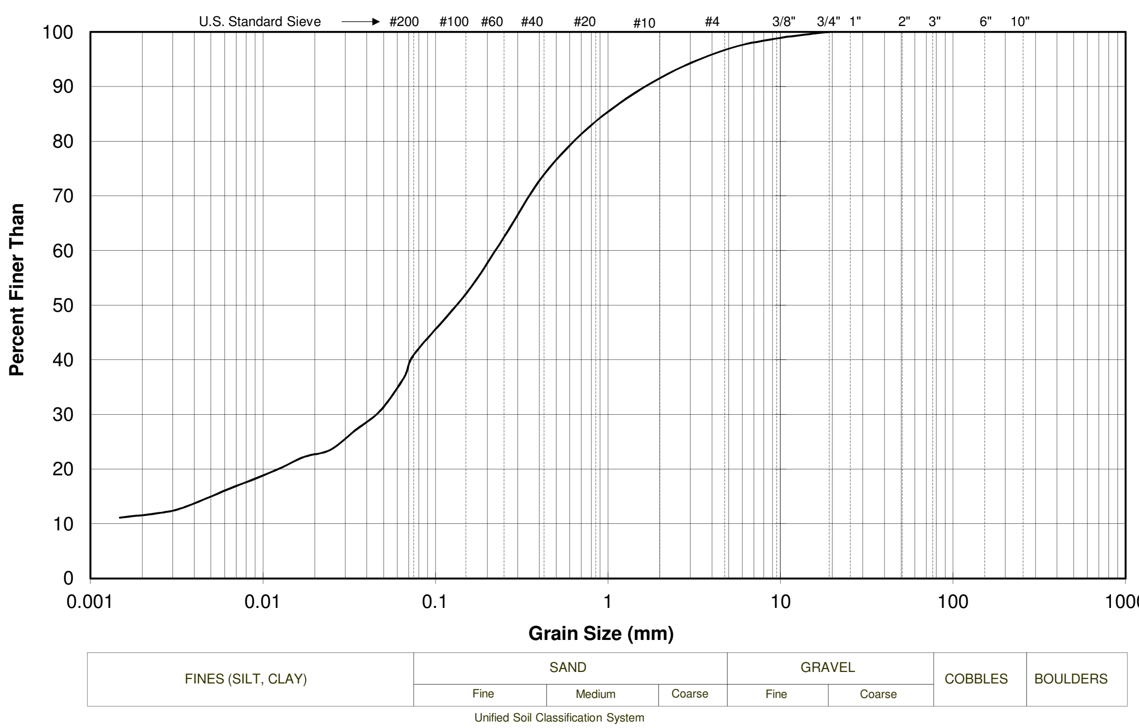
Sieve Analysis Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	99
# 4	4.75	97
# 10	2.00	92
# 20	0.850	84
# 40	0.425	74
# 60	0.250	62
# 100	0.150	52
# 200	0.075	41
Hydrometer Analysis	0.0664	37.0
	0.0480	30.7
Dispersing agent:	0.0344	27.1
Sodium Hexametaphosphate	0.0246	23.5
	0.0175	22.2
Dosage of dispersing agent:	0.0128	20.3
40 g/L	0.0091	18.3
	0.0065	16.5
	0.0046	14.5
	0.0033	12.7
	0.0025	11.9
	0.0015	11.1

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Development
MDH Job No:	613596
SAMPLE:	KRE-112
DATE:	30-Jul-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	3
% SAND	56
% FINES (SILT, CLAY)	41

COMMENTS:



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Resedential Subdivison	
MDH Job No:	613596	
SAMPLE:	KRE-117	
DATE:	1-Aug-13	

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	98
# 4	4.75	97
# 10	2.00	95
# 20	0.850	91
# 40	0.425	86
# 60	0.250	78
# 100	0.150	70
# 200	0.075	61

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

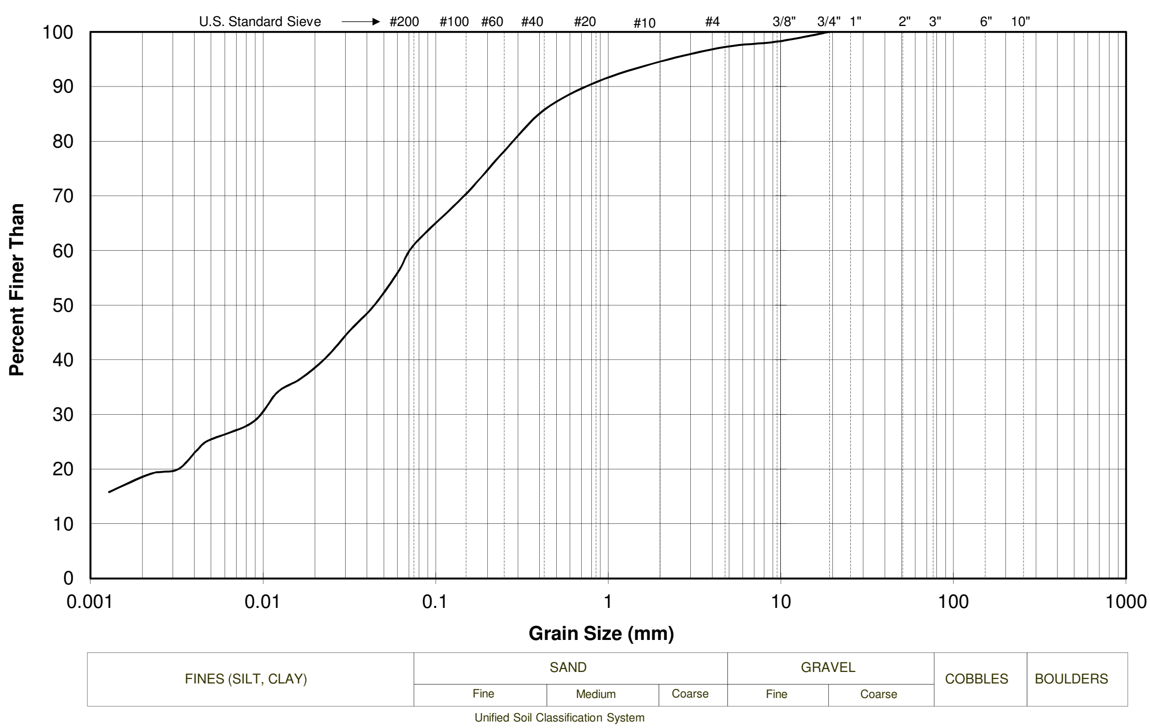
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0612	56.3
0.0443	50.1
0.0319	45.4
0.0229	40.3
0.0164	36.5
0.0121	34.0
0.0087	28.6
0.0048	25.2
0.0041	23.3
0.0032	19.9
0.0022	19.1
0.0013	15.8

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	3
% SAND	36
% FINES (SILT, CLAY)	61

COMMENTS:



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Resedential Development	
Project No:	613596	
SAMPLE:	KRE-122	
DATE:	26-Jul-13	

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	1
% SAND	2
% FINES (SILT, CLAY)	97

COMMENTS:

Sieve Analysis

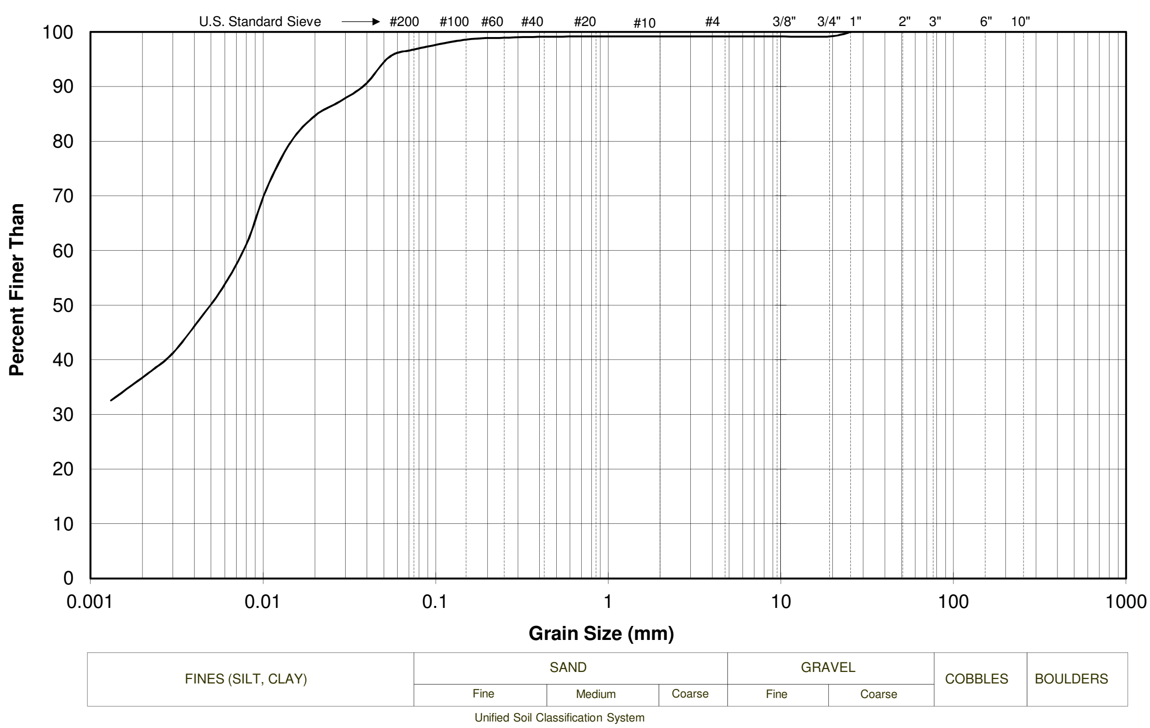
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	99
3/8"	9.5	99
# 4	4.75	99
# 10	2.00	99
# 20	0.850	99
# 40	0.425	99
# 60	0.250	99
# 100	0.150	99
# 200	0.075	97

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0540	95.4
0.0391	90.4
0.0280	87.3
0.0200	84.7
0.0145	79.8
0.0104	71.1
0.0080	61.2
0.0058	53.1
0.0042	47.0
0.0030	41.2
0.0022	37.9
0.0013	32.5



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

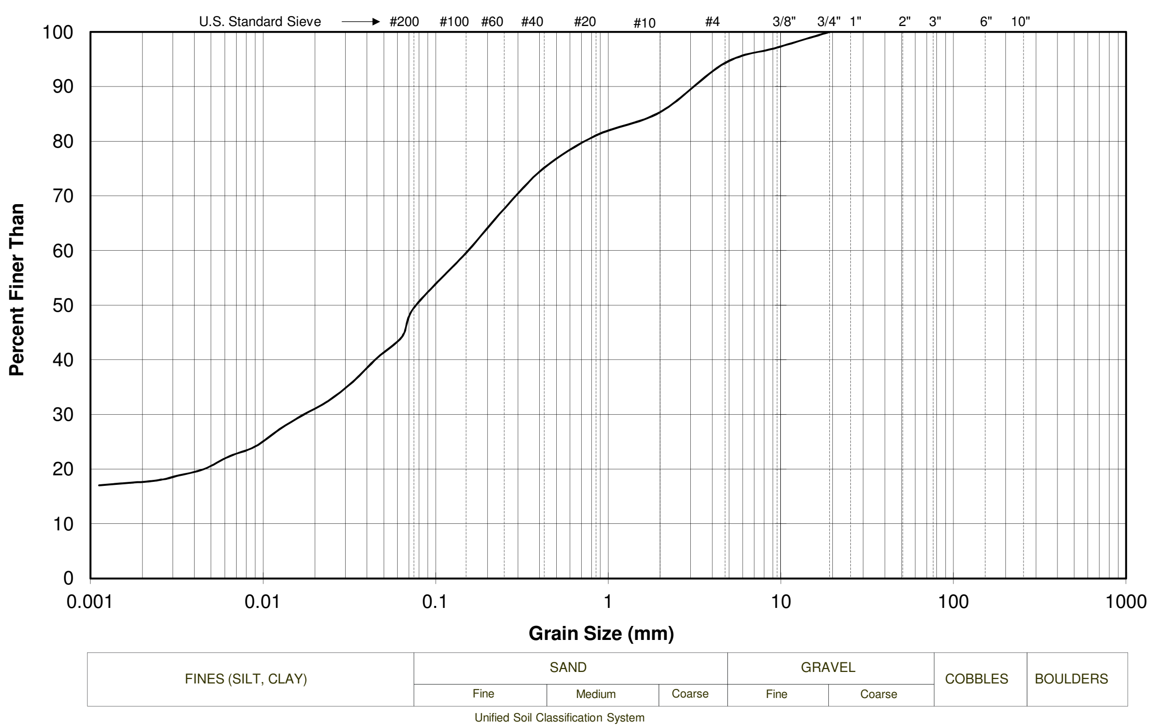
Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	97
	# 4	4.75	94
	# 10	2.00	85
	# 20	0.850	81
	# 40	0.425	75
	# 60	0.250	68
	# 100	0.150	60
	# 200	0.075	50
Hydrometer Analysis		0.0640	44.3
		0.0460	40.4
Dispersing agent:		0.0331	36.0
Sodium Hexametaphosphate		0.0237	32.4
		0.0169	29.9
Dosage of dispersing agent:		0.0125	27.3
40 g/L		0.0089	24.1
		0.0064	22.4
		0.0045	20.0
		0.0032	18.8
		0.0024	17.9
		0.0011	17.0

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Subdivison
Project No:	613596
SAMPLE:	KRE-128
DATE:	2-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	6
% SAND	44
% FINES (SILT, CLAY)	50

COMMENTS:



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Development
Project No:	613596
SAMPLE:	KRE-134
DATE:	30-Jul-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	1
% SAND	23
% FINES (SILT, CLAY)	76

COMMENTS:

Sieve Analysis

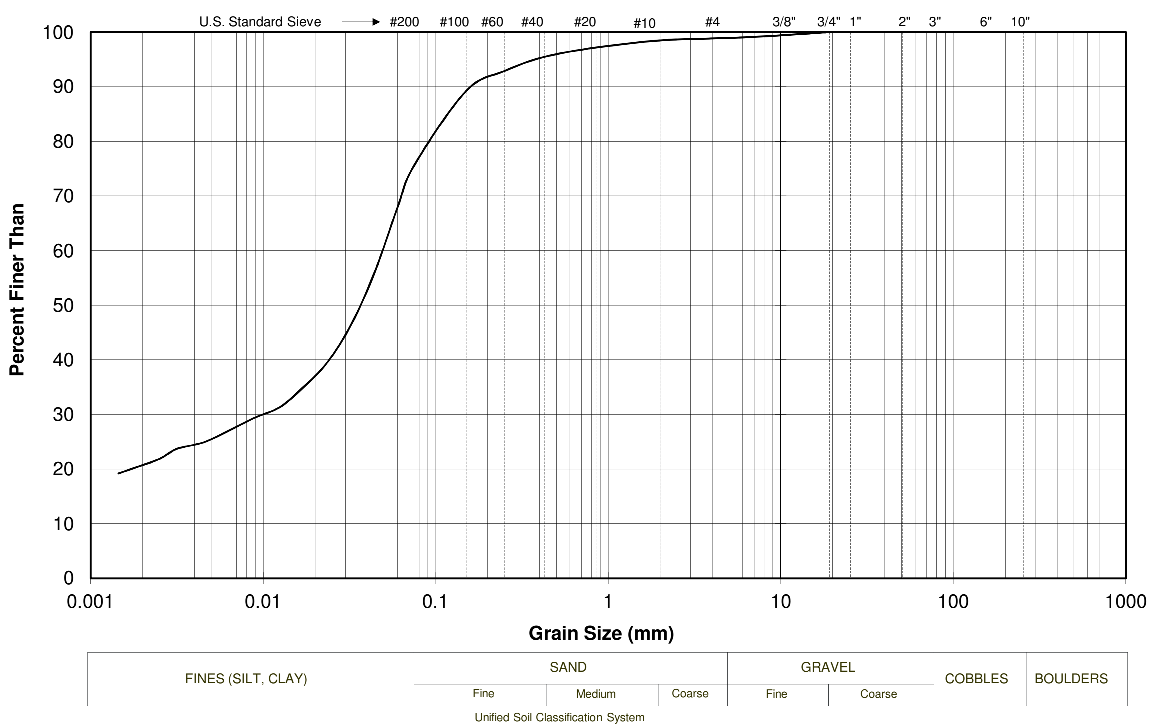
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	99
# 4	4.75	99
# 10	2.00	98
# 20	0.850	97
# 40	0.425	95
# 60	0.250	93
# 100	0.150	89
# 200	0.075	76

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0600	67.8
0.0443	56.1
0.0324	46.5
0.0235	39.5
0.0169	34.8
0.0124	31.3
0.0089	29.3
0.0063	27.0
0.0045	24.8
0.0032	23.7
0.0024	21.7
0.0014	19.2



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Development
MDH Job No:	613596
SAMPLE:	KRE-140
DATE:	30-Jul-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	
% SAND	10
% FINES (SILT, CLAY)	90

COMMENTS:

Sieve Analysis

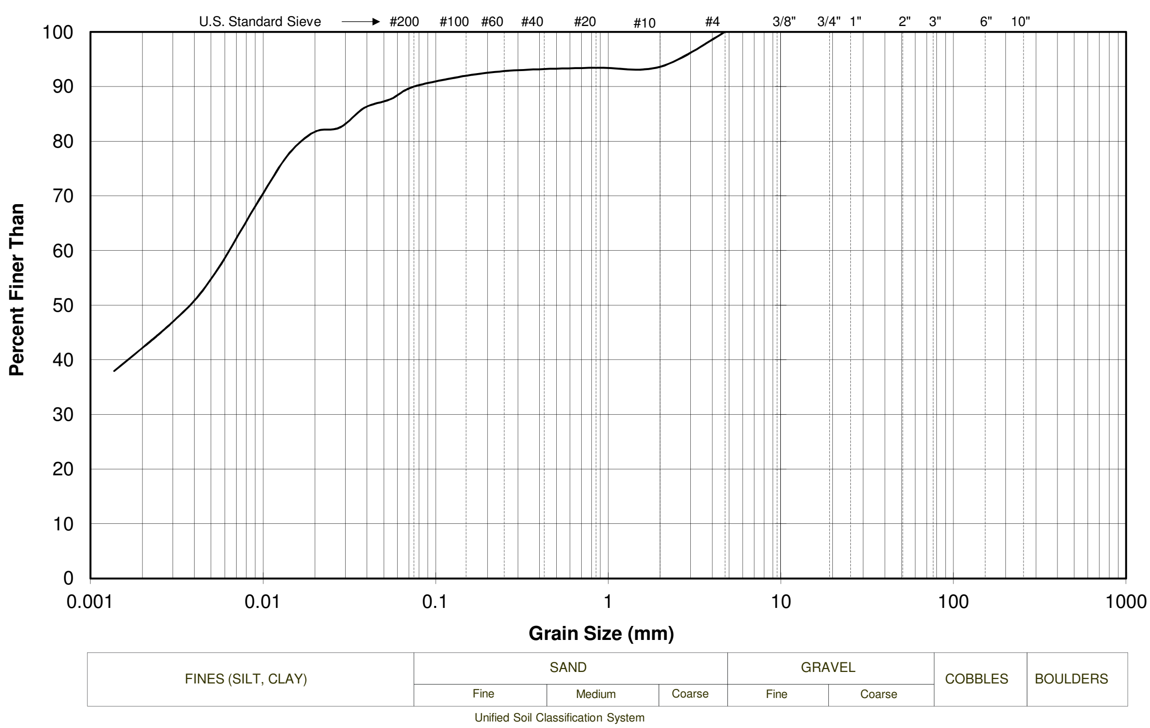
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	100
# 10	2.00	94
# 20	0.850	93
# 40	0.425	93
# 60	0.250	93
# 100	0.150	92
# 200	0.075	90

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0545	87.7
0.0388	86.1
0.0279	82.5
0.0198	81.7
0.0143	77.9
0.0107	72.0
0.0078	64.8
0.0057	57.5
0.0041	51.3
0.0029	46.7
0.0023	43.7
0.0014	38.0



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Subdivison
Project No:	613596
SAMPLE:	KRE-146
DATE:	1-Aug-13

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	100
# 10	2.00	100
# 20	0.850	100
# 40	0.425	100
# 60	0.250	99
# 100	0.150	98
# 200	0.075	79

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

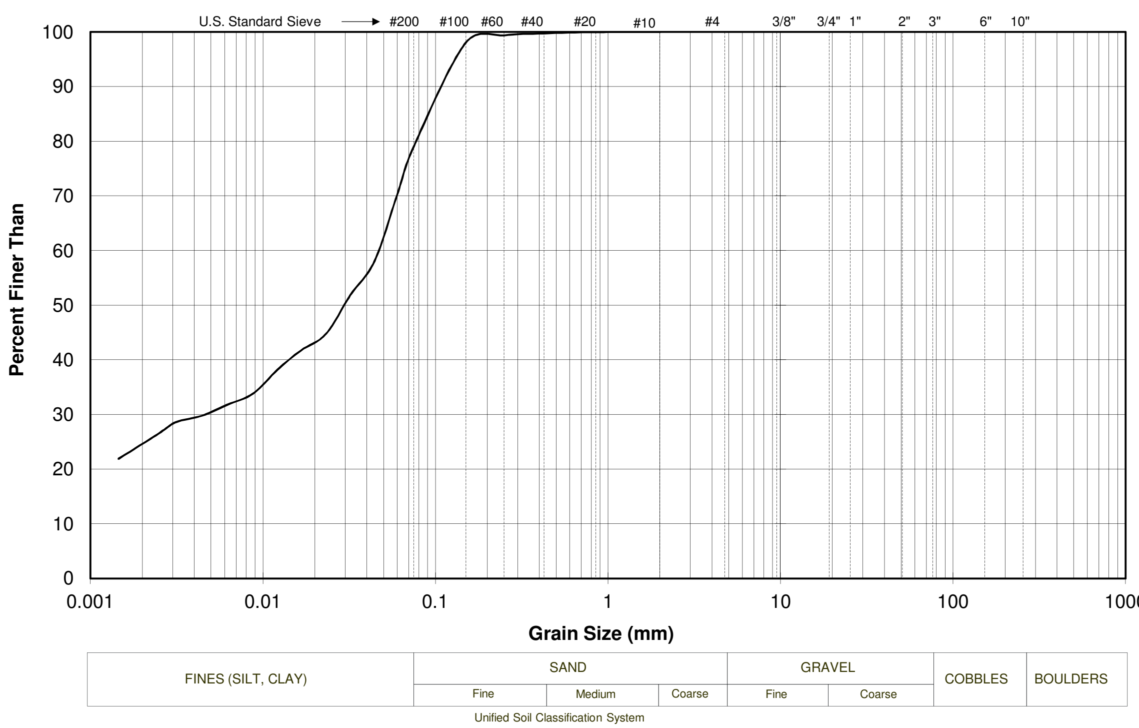
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0600	70.2
0.0443	58.1
0.0320	51.8
0.0232	44.7
0.0166	41.7
0.0122	38.2
0.0088	33.8
0.0062	31.8
0.0044	29.7
0.0031	28.5
0.0025	26.5
0.0015	21.9

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	
% SAND	21
% FINES (SILT, CLAY)	79

COMMENTS:



PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Resedential Development	
MDH Job No:	613596	
SAMPLE:	KRE-153	
DATE:	30-Jul-13	

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	6
% SAND	40
% FINES (SILT, CLAY)	54

COMMENTS:

Sieve Analysis

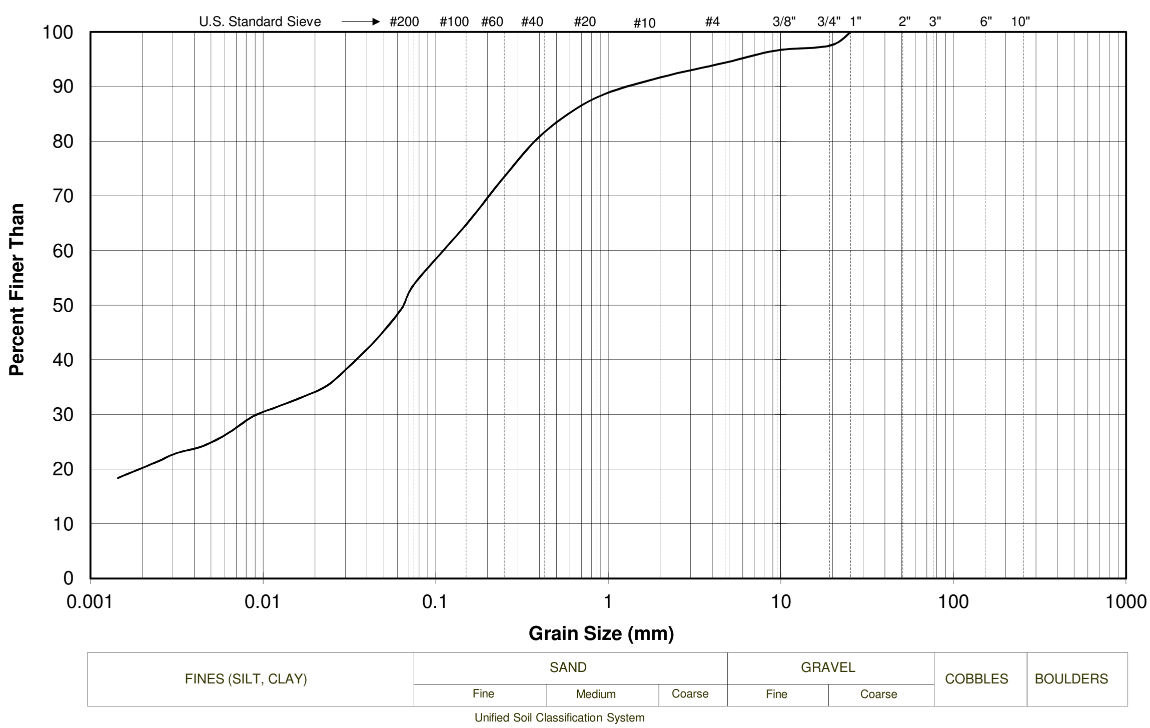
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	97
3/8"	9.5	97
# 4	4.75	94
# 10	2.00	92
# 20	0.850	88
# 40	0.425	82
# 60	0.250	74
# 100	0.150	65
# 200	0.075	54

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0636	49.4
0.0459	43.9
0.0330	39.4
0.0237	35.4
0.0169	33.2
0.0124	31.5
0.0088	29.7
0.0063	26.6
0.0045	24.2
0.0032	22.9
0.0024	21.3
0.0014	18.4



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Subdivison
Project No:	613596
SAMPLE:	KRE-159
DATE:	1-Aug-13

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	99
# 4	4.75	98
# 10	2.00	95
# 20	0.850	95
# 40	0.425	94
# 60	0.250	93
# 100	0.150	92
# 200	0.075	83

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

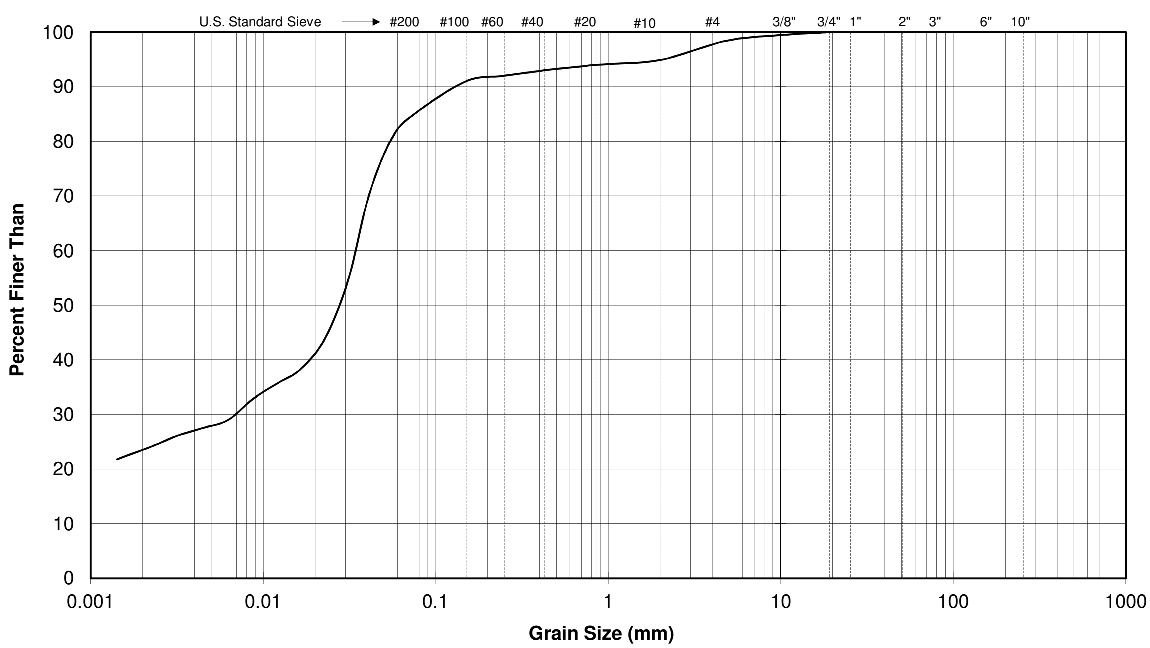
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0556	80.5
0.0412	70.4
0.0311	54.7
0.0229	44.0
0.0165	38.3
0.0122	35.8
0.0087	32.8
0.0062	28.9
0.0044	27.5
0.0031	26.0
0.0024	24.4
0.0014	21.8

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	2
% SAND	15
% FINES (SILT, CLAY)	83

COMMENTS:



FINES (SILT, CLAY)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Unified Soil Classification System

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Residential Subdivision	
MDH Job No:	613596	
SAMPLE:	KRE-165	
DATE:	6-Aug-13	

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	98
# 4	4.75	96
# 10	2.00	94
# 20	0.850	90
# 40	0.425	85
# 60	0.250	78
# 100	0.150	70
# 200	0.075	60

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

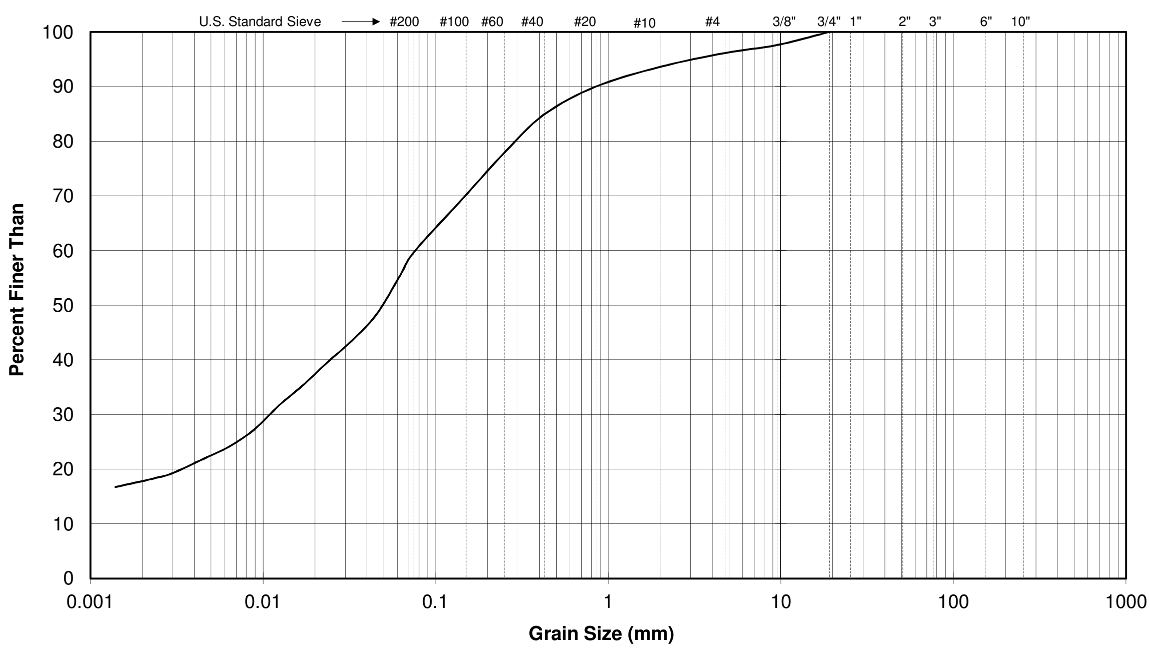
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0623	55.4
0.0453	48.2
0.0326	43.5
0.0234	39.4
0.0168	35.2
0.0124	31.6
0.0089	27.2
0.0063	24.1
0.0045	21.9
0.0030	19.3
0.0023	18.3
0.0014	16.7

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	4
% SAND	36
% FINES (SILT, CLAY)	60

COMMENTS:



FINES (SILT, CLAY)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Unified Soil Classification System

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Residential Subdivision
Project No:	613596
SAMPLE:	KRE-171
DATE:	6-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	
% SAND	2
% FINES (SILT, CLAY)	98

COMMENTS:

Sieve Analysis

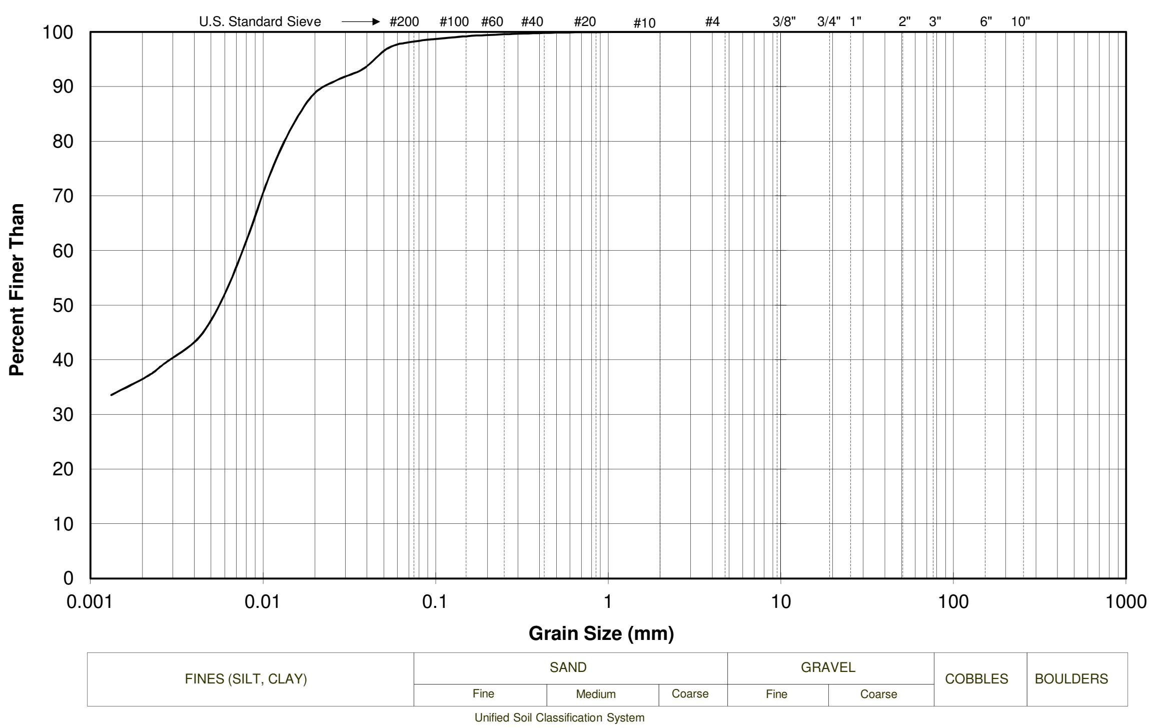
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	100
# 10	2.00	100
# 20	0.850	100
# 40	0.425	100
# 60	0.250	100
# 100	0.150	99
# 200	0.075	98

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0530	97.0
0.0382	93.3
0.0272	91.3
0.0195	88.5
0.0142	81.8
0.0108	73.3
0.0080	61.6
0.0059	51.5
0.0042	44.0
0.0027	39.4
0.0021	37.0
0.0013	33.5



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Development
MDH Job No:	613596
SAMPLE:	KRE-178
DATE:	26-Jul-13

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	100
# 10	2.00	100
# 20	0.850	99
# 40	0.425	98
# 60	0.250	97
# 100	0.150	95
# 200	0.075	91

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

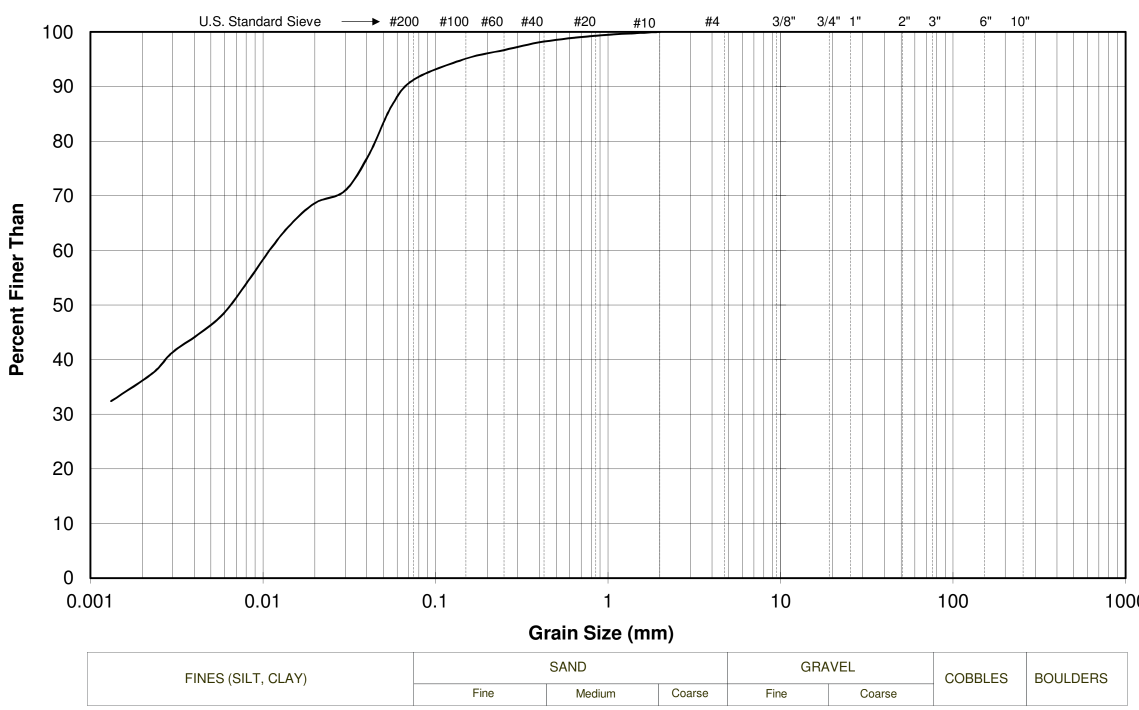
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0559	86.5
0.0411	77.5
0.0298	70.9
0.0201	68.7
0.0144	64.7
0.0113	60.7
0.0082	54.4
0.0059	48.4
0.0042	44.6
0.0030	41.3
0.0023	37.4
0.0013	32.4

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	
% SAND	9
% FINES (SILT, CLAY)	91

COMMENTS:



PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Resedential Subdivison	
MDH Job No:	613596	
SAMPLE:	KRE-184	
DATE:	1-Aug-13	

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	5
% SAND	39
% FINES (SILT, CLAY)	56

COMMENTS:

Sieve Analysis

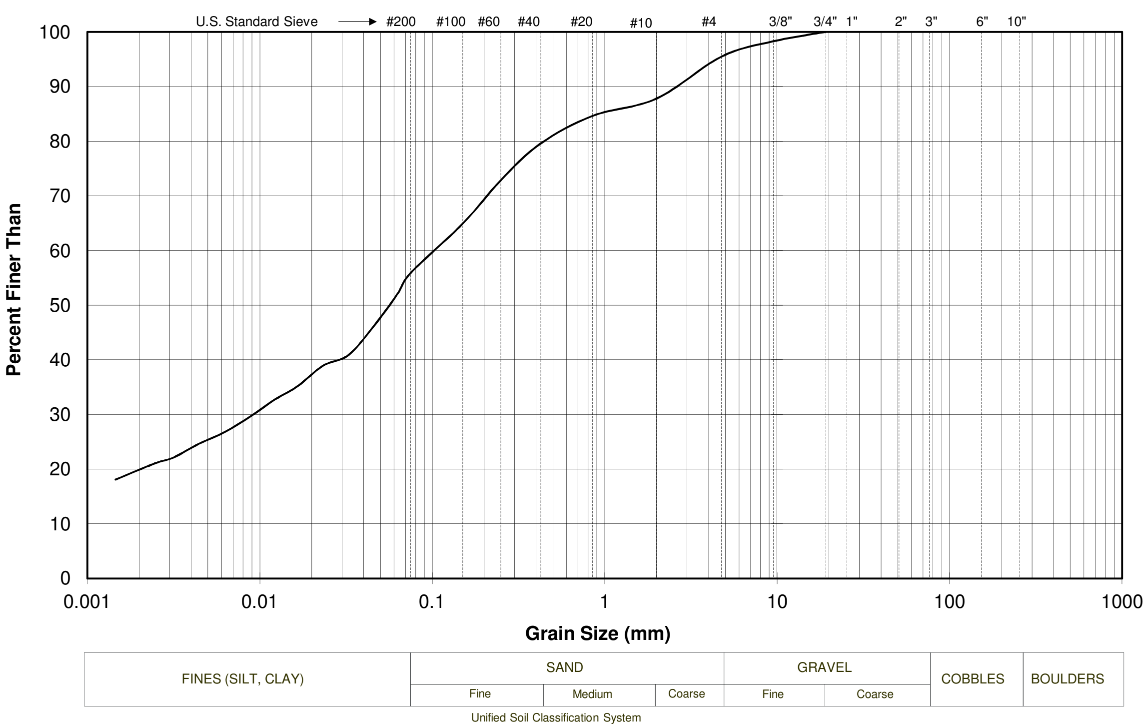
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	98
# 4	4.75	95
# 10	2.00	88
# 20	0.850	85
# 40	0.425	80
# 60	0.250	73
# 100	0.150	65
# 200	0.075	56

Hydrometer Analysis

Dispersing agent: *Sodium Hexametaphosphate*

Dosage of dispersing agent: *40 g/L*

Diameter (mm)	% Finer
0.0625	51.9
0.0452	45.9
0.0326	40.8
0.0232	38.9
0.0166	35.2
0.0123	32.7
0.0088	29.6
0.0063	26.7
0.0045	24.6
0.0032	22.1
0.0025	21.0
0.0015	18.1



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	99
	# 4	4.75	98
	# 10	2.00	95
	# 20	0.850	91
	# 40	0.425	85
	# 60	0.250	77
	# 100	0.150	68
	# 200	0.075	59

Hydrometer Analysis	Diameter (mm)	% Finer
	0.0632	53.3
	0.0456	47.8
Dispersing agent:	0.0327	44.0
Sodium Hexametaphosphate	0.0233	41.0
	0.0168	36.4
Dosage of dispersing agent:	0.0123	33.8
40 g/L	0.0089	29.2
	0.0063	25.2
	0.0045	23.1
	0.0030	20.2
	0.0023	18.8
	0.0014	17.2

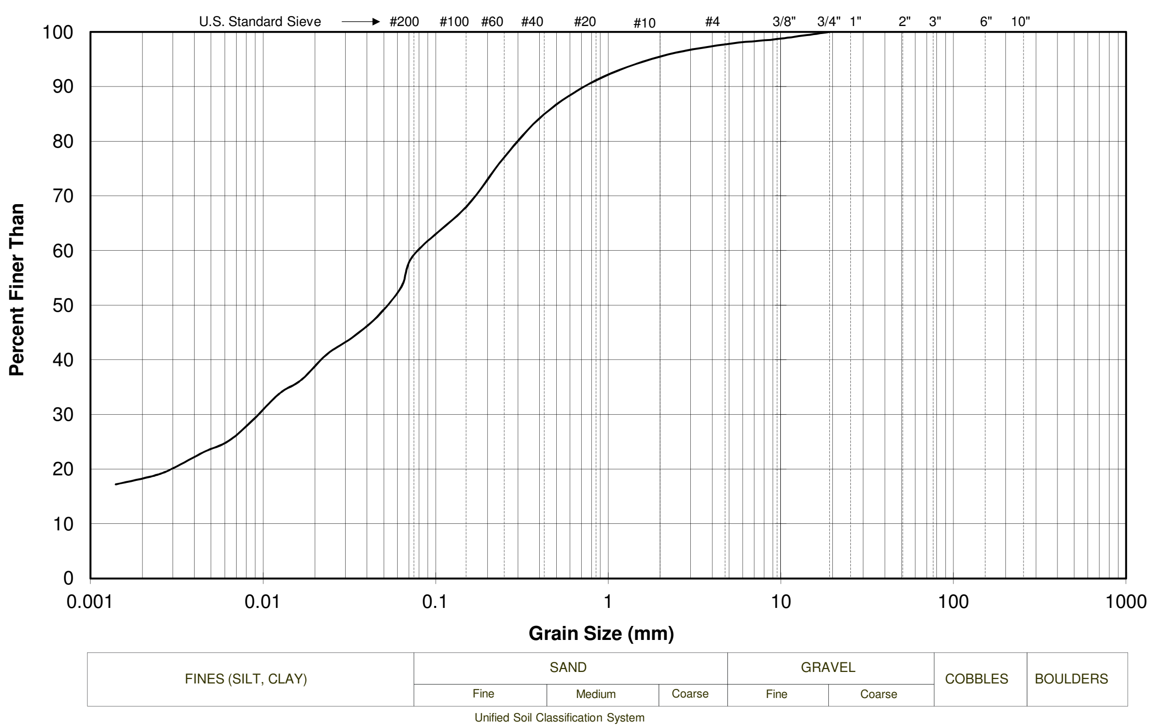
SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Residential Subdivision
Project No:	613596
SAMPLE:	KRE-190
DATE:	6-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	2
% SAND	39
% FINES (SILT, CLAY)	59

COMMENTS:



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Residential Subdivision
Project No:	613596
SAMPLE:	JMT-601
DATE:	6-Aug-13

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	100
# 10	2.00	100
# 20	0.850	99
# 40	0.425	97
# 60	0.250	93
# 100	0.150	90
# 200	0.075	75

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

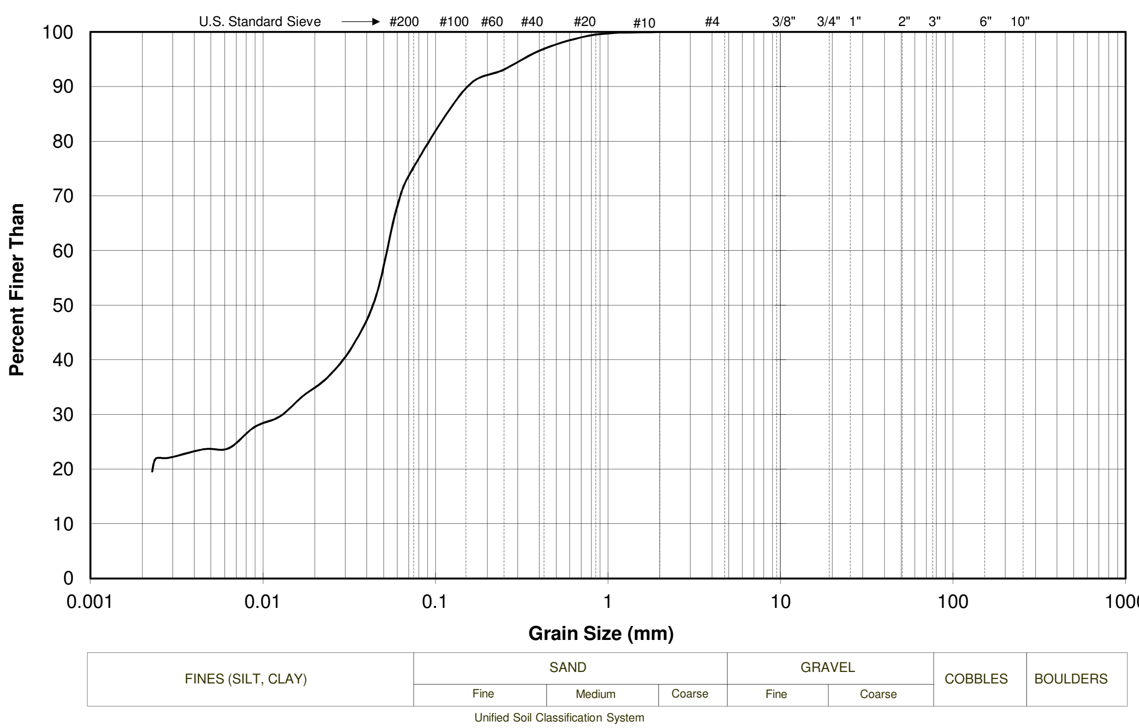
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0600	68.0
0.0451	51.5
0.0329	42.4
0.0237	36.8
0.0170	33.3
0.0125	29.6
0.0089	27.7
0.0063	23.8
0.0045	23.6
0.0028	22.0
0.0024	21.9
0.0023	19.5

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	
% SAND	25
% FINES (SILT, CLAY)	75

COMMENTS:



PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Subdivison
MDH Job No:	613596
SAMPLE:	JMT-605
DATE:	2-Aug-13

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	99
# 4	4.75	97
# 10	2.00	95
# 20	0.850	93
# 40	0.425	89
# 60	0.250	82
# 100	0.150	74
# 200	0.075	65

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

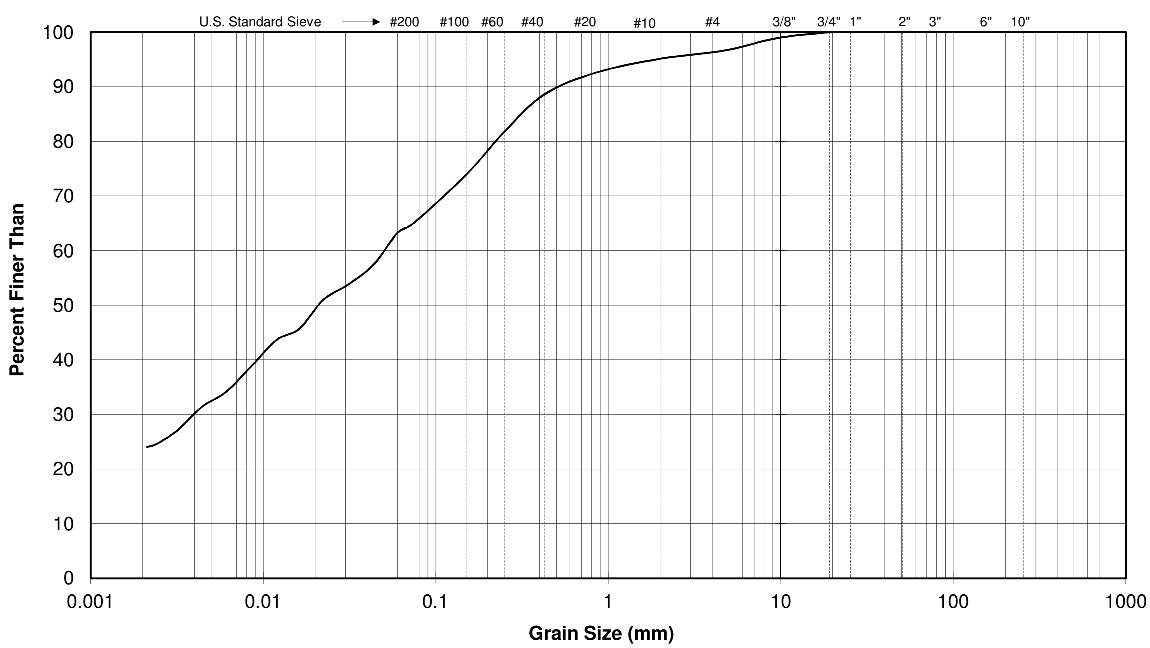
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0602	63.3
0.0435	57.4
0.0312	53.8
0.0223	51.0
0.0162	45.7
0.0119	43.6
0.0086	38.9
0.0061	34.2
0.0044	31.3
0.0032	27.0
0.0024	24.5
0.0021	24.1

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	3
% SAND	32
% FINES (SILT, CLAY)	65

COMMENTS:



FINES (SILT, CLAY)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Unified Soil Classification System

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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Residential Subdivision
Project No:	613596
SAMPLE:	JMT-612
DATE:	6-Aug-13

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	98
3/8"	9.5	97
# 4	4.75	94
# 10	2.00	90
# 20	0.850	85
# 40	0.425	78
# 60	0.250	69
# 100	0.150	59
# 200	0.075	47

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

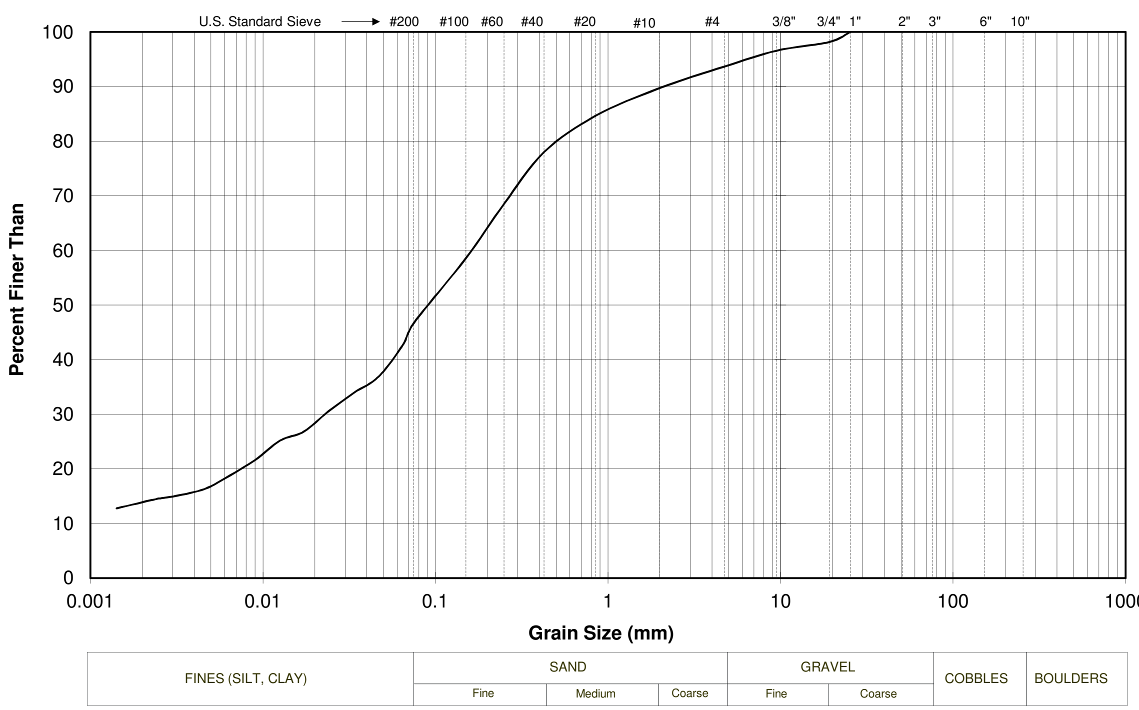
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0649	42.7
0.0469	36.9
0.0335	33.9
0.0240	30.5
0.0172	26.8
0.0126	25.2
0.0090	21.6
0.0064	18.8
0.0046	16.3
0.0031	15.0
0.0024	14.4
0.0014	12.7

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	6
% SAND	47
% FINES (SILT, CLAY)	47

COMMENTS:



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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Resedential Subdivison	
MDH Job No:	613596	
SAMPLE:	JMT-619	
DATE:	2-Aug-13	

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	98
# 4	4.75	97
# 10	2.00	95
# 20	0.850	91
# 40	0.425	85
# 60	0.250	77
# 100	0.150	69
# 200	0.075	59

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

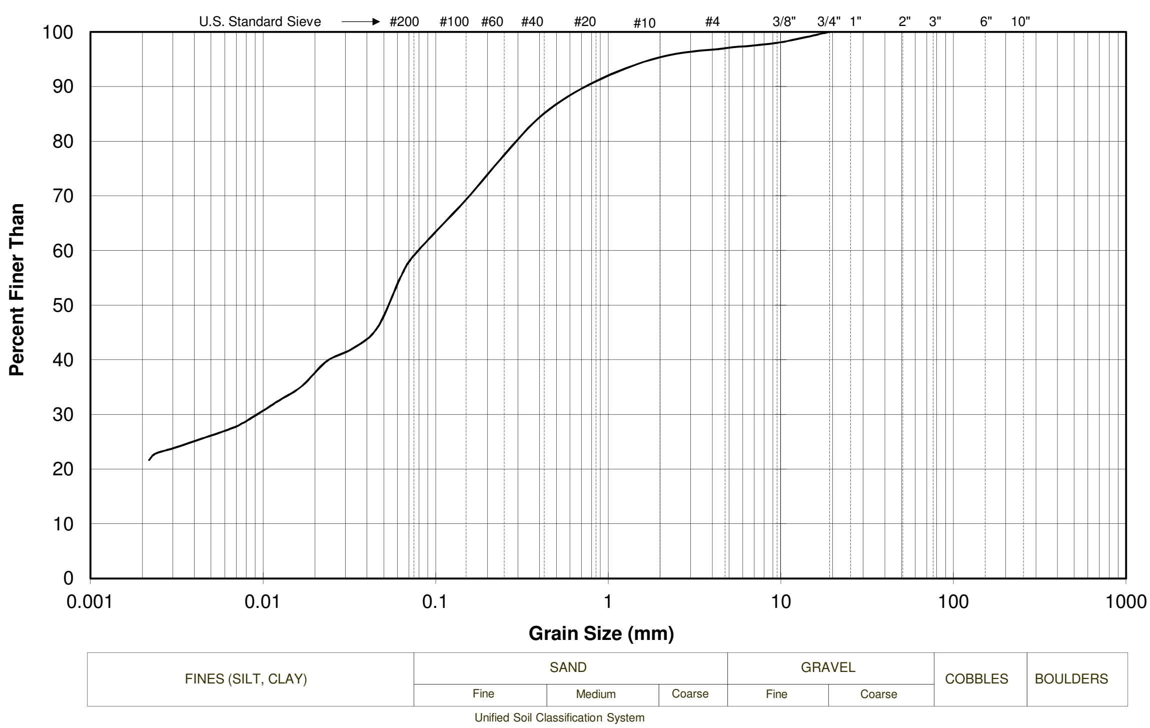
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0627	55.1
0.0459	45.8
0.0329	42.0
0.0234	39.8
0.0168	35.2
0.0124	32.5
0.0078	28.6
0.0063	27.2
0.0044	25.6
0.0032	24.0
0.0024	22.8
0.0022	21.7

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	3
% SAND	38
% FINES (SILT, CLAY)	59

COMMENTS:



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PARTICLE-SIZE ANALYSIS REPORT

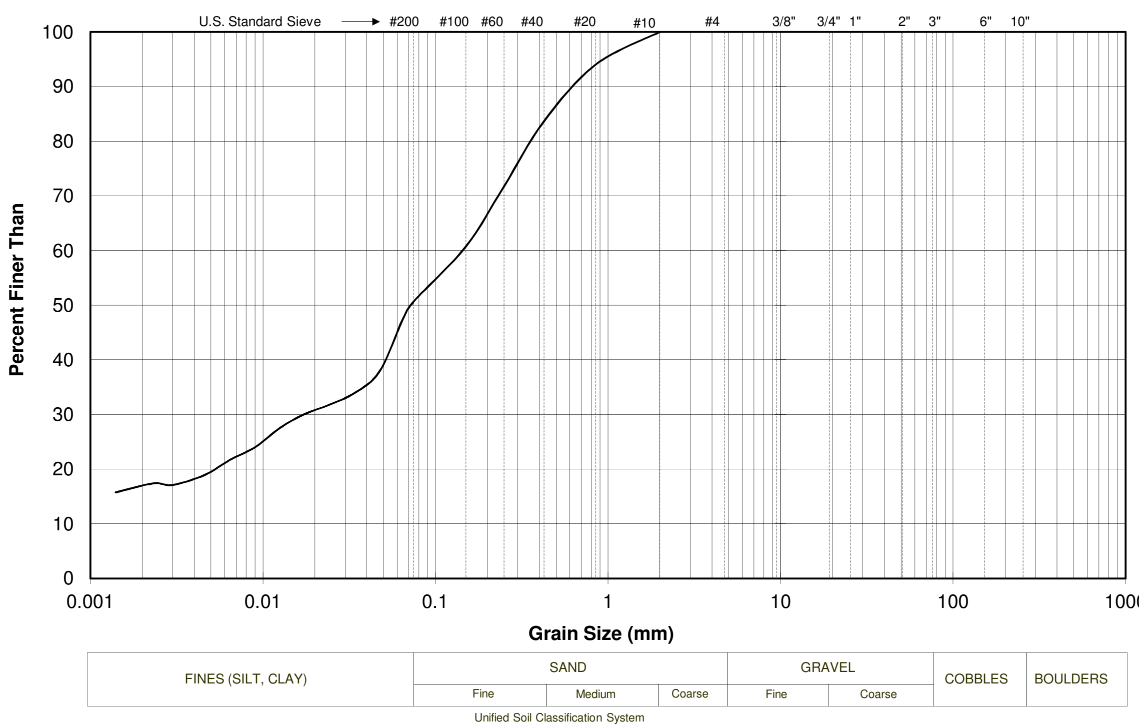
(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Residential Subdivision	
Project No:	613596	
SAMPLE:	JMT-625	
DATE:	6-Aug-13	
PARTICLE SIZE DISTRIBUTION SUMMARY		
% GRAVEL		
% SAND		49
% FINES (SILT, CLAY)		51

COMMENTS:

Sieve Analysis	Sieve	Diameter (mm)	% Finer
	3"	76.2	100
	2"	50.8	100
	1"	25.4	100
	3/4"	19.1	100
	3/8"	9.5	100
	# 4	4.75	100
	# 10	2.00	100
	# 20	0.850	94
	# 40	0.425	84
	# 60	0.250	72
	# 100	0.150	61
	# 200	0.075	51
Hydrometer Analysis		0.0649	47.6
		0.0474	37.9
Dispersing agent:		0.0339	33.9
Sodium Hexametaphosphate		0.0241	31.8
		0.0172	30.0
Dosage of dispersing agent:		0.0126	27.6
40 g/L		0.0090	24.0
		0.0064	21.7
		0.0046	18.9
		0.0030	17.1
		0.0023	17.4
		0.0014	15.7



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Resedential Subdivison	
MDH Job No:	613596	
SAMPLE:	JMT-631	
DATE:	1-Aug-13	

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	98
3/8"	9.5	96
# 4	4.75	95
# 10	2.00	92
# 20	0.850	90
# 40	0.425	86
# 60	0.250	81
# 100	0.150	77
# 200	0.075	71

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

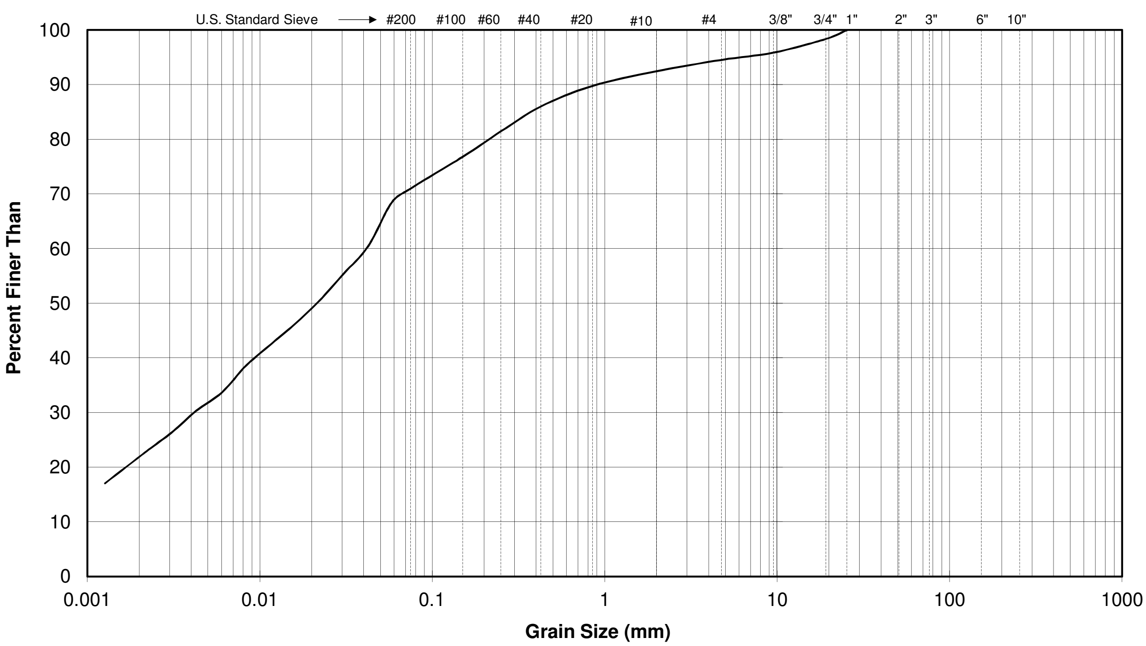
Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0581	68.3
0.0425	60.4
0.0306	55.4
0.0221	50.4
0.0158	46.1
0.0117	42.6
0.0084	38.7
0.0060	33.7
0.0043	30.3
0.0031	26.2
0.0022	22.9
0.0013	17.0

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	5
% SAND	24
% FINES (SILT, CLAY)	71

COMMENTS:



FINES (SILT, CLAY)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Unified Soil Classification System

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PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Subdivison
MDH Job No:	613596
SAMPLE:	JMT-637
DATE:	2-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	
% SAND	9
% FINES (SILT, CLAY)	91

COMMENTS:

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	100
# 10	2.00	100
# 20	0.850	99
# 40	0.425	98
# 60	0.250	97
# 100	0.150	95
# 200	0.075	91

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0556	87.4
0.0402	82.0
0.0290	77.6
0.0208	74.5
0.0150	68.9
0.0113	61.8
0.0082	53.7
0.0060	46.1
0.0043	40.0
0.0030	36.4
0.0023	32.6
0.0021	32.0

FINES (SILT, CLAY)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Unified Soil Classification System

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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk		
PROJECT:	Proposed Resedential Development		
MDH Job No:	613596		
SAMPLE:	JMT-643		
DATE:	31-Jul-13		

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	100
# 10	2.00	100
# 20	0.850	100
# 40	0.425	100
# 60	0.250	99
# 100	0.150	99
# 200	0.075	93

Hydrometer Analysis

Dispersing agent: *Sodium Hexametaphosphate*

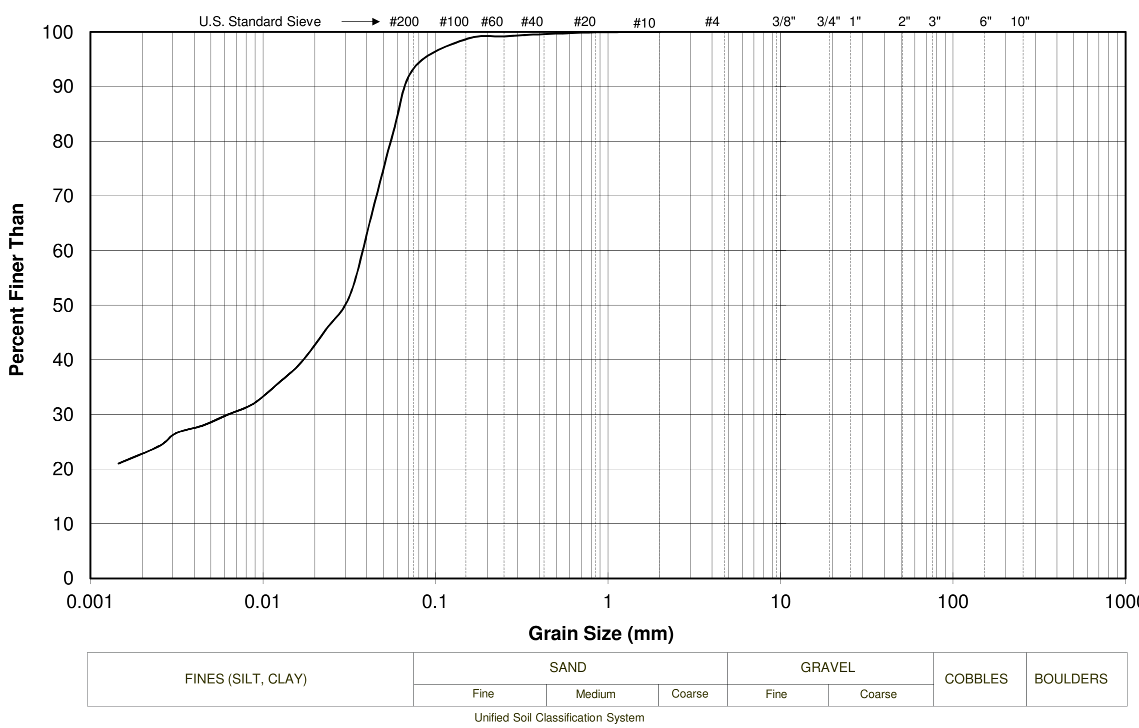
Dosage of dispersing agent: *40 g/L*

Diameter (mm)	% Finer
0.0571	81.7
0.0429	66.8
0.0320	51.9
0.0231	45.5
0.0167	39.5
0.0123	35.8
0.0088	32.0
0.0063	30.0
0.0045	27.9
0.0031	26.6
0.0025	24.2
0.0015	21.0

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	
% SAND	7
% FINES (SILT, CLAY)	93

COMMENTS:



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Resedential Subdivison	
Project No:	613596	
SAMPLE:	JMT-649	
DATE:	2-Aug-13	

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	
% SAND	12
% FINES (SILT, CLAY)	88

COMMENTS:

Sieve Analysis

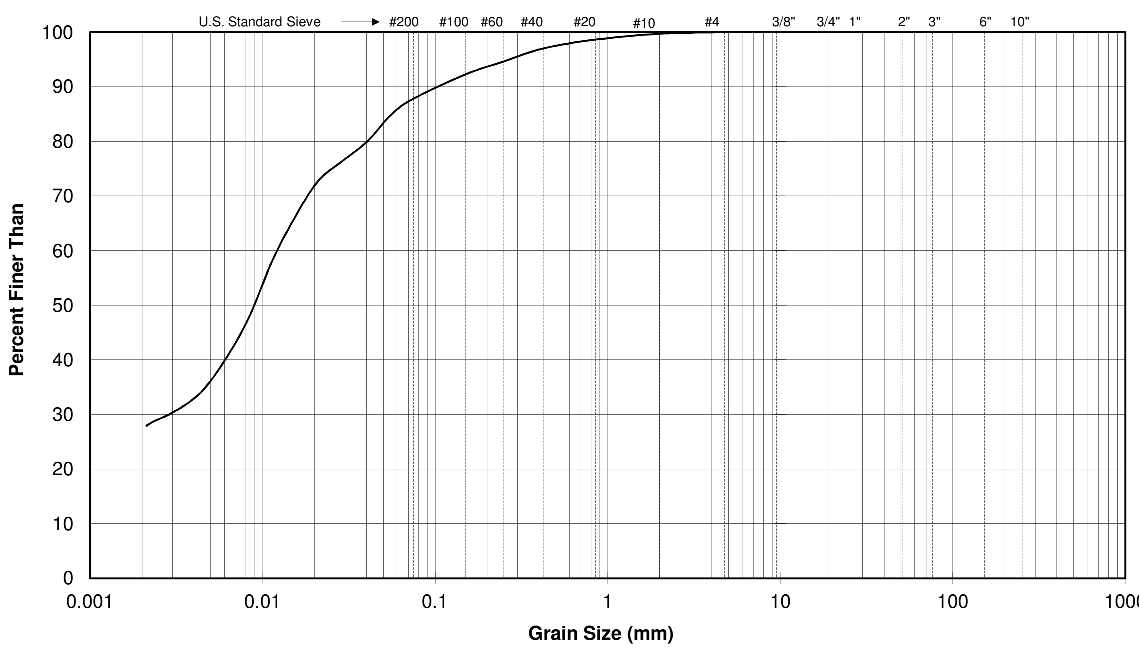
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	100
# 10	2.00	100
# 20	0.850	99
# 40	0.425	97
# 60	0.250	95
# 100	0.150	92
# 200	0.075	88

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0558	84.9
0.0403	80.0
0.0289	76.4
0.0208	72.6
0.0151	65.6
0.0113	58.1
0.0083	47.7
0.0060	39.7
0.0044	34.0
0.0031	30.6
0.0024	28.8
0.0021	27.9



FINES (SILT, CLAY)	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

Unified Soil Classification System

The testing services reported here have been performed in accordance with accepted local industry standards.

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This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.

Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Residential Subdivision
MDH Job No:	613596
SAMPLE:	JMT-655
DATE:	6-Aug-13

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	96
# 4	4.75	95
# 10	2.00	94
# 20	0.850	92
# 40	0.425	89
# 60	0.250	85
# 100	0.150	81
# 200	0.075	69

Hydrometer Analysis

Dispersing agent: *Sodium Hexametaphosphate*

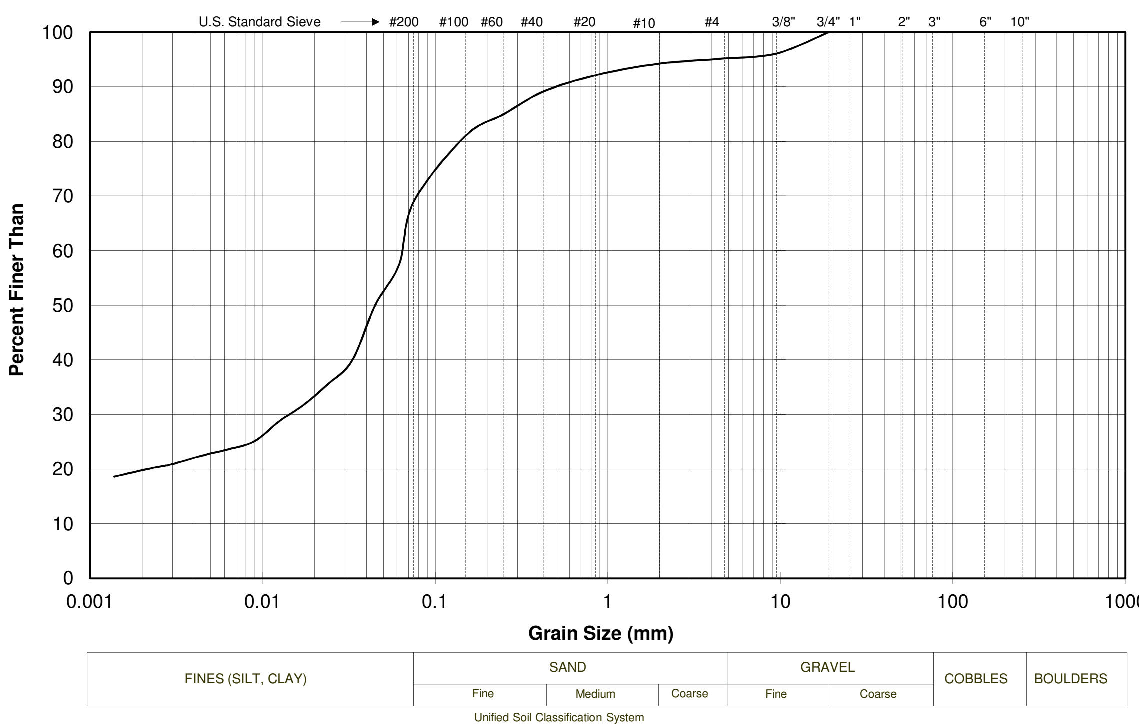
Dosage of dispersing agent: *40 g/L*

Diameter (mm)	% Finer
0.0618	57.5
0.0450	50.1
0.0330	39.9
0.0237	35.5
0.0170	31.6
0.0125	28.8
0.0089	25.1
0.0063	23.6
0.0045	22.5
0.0029	20.8
0.0023	20.2
0.0014	18.6

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	5
% SAND	26
% FINES (SILT, CLAY)	69

COMMENTS:



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk	
PROJECT:	Proposed Residential Subdivision	
MDH Job No:	613596	
SAMPLE:	JMT-661	
DATE:	6-Aug-13	

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	5
% SAND	39
% FINES (SILT, CLAY)	56

COMMENTS:

Sieve Analysis

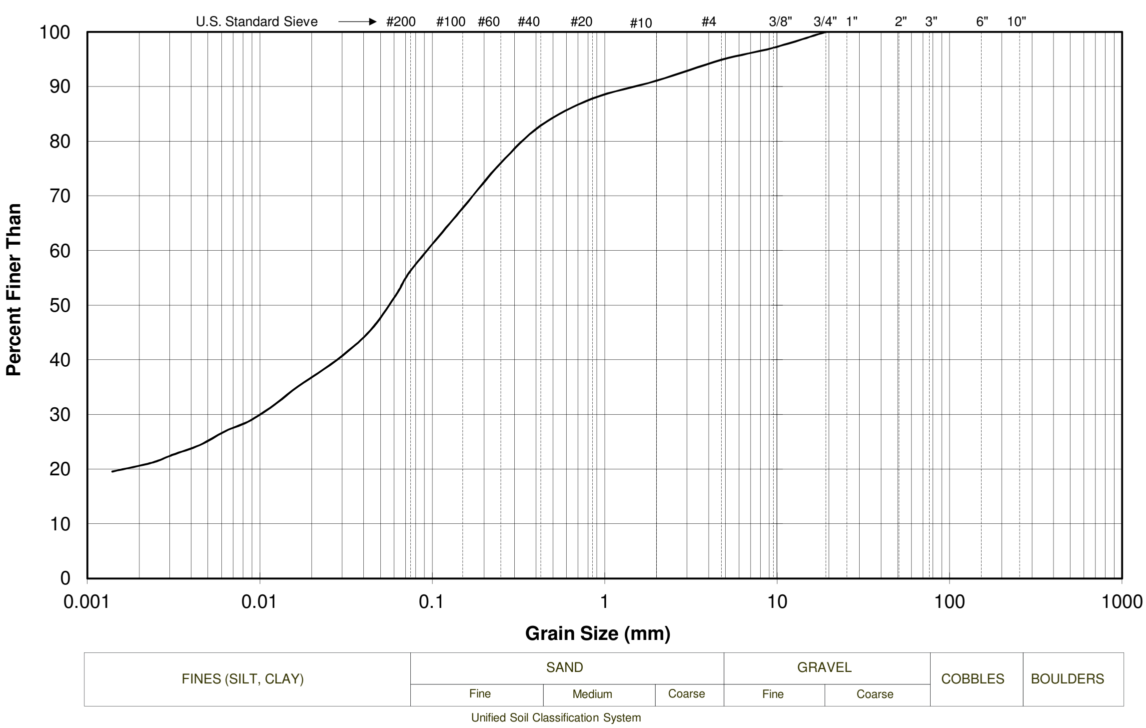
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	97
# 4	4.75	95
# 10	2.00	91
# 20	0.850	88
# 40	0.425	83
# 60	0.250	76
# 100	0.150	68
# 200	0.075	56

Hydrometer Analysis

Dispersing agent: *Sodium Hexametaphosphate*

Dosage of dispersing agent: *40 g/L*

Diameter (mm)	% Finer
0.0627	52.2
0.0454	45.9
0.0327	41.6
0.0234	38.2
0.0167	35.2
0.0123	31.9
0.0088	28.9
0.0063	26.9
0.0045	24.4
0.0031	22.6
0.0024	21.1
0.0014	19.5



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

Sieve Analysis

Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	98
# 10	2.00	96
# 20	0.850	93
# 40	0.425	89
# 60	0.250	84
# 100	0.150	78
# 200	0.075	70

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

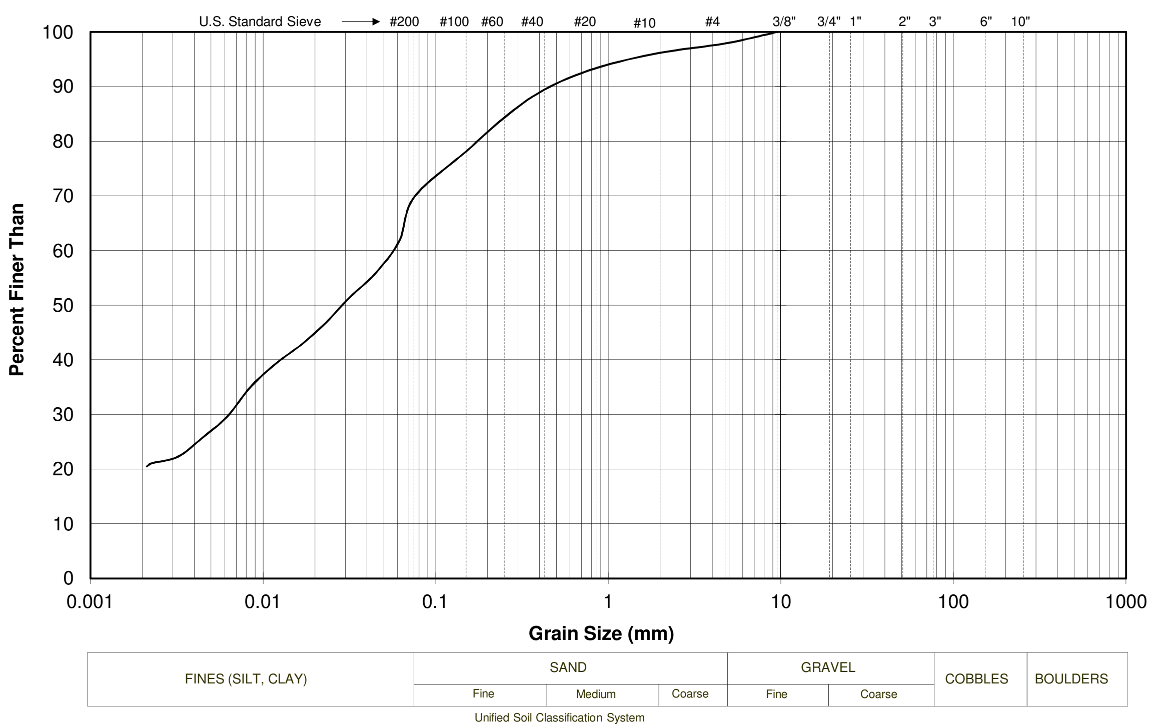
Diameter (mm)	% Finer
0.0613	61.7
0.0444	55.7
0.0319	51.5
0.0229	46.7
0.0164	42.6
0.0121	39.6
0.0086	35.3
0.0062	29.5
0.0044	25.7
0.0032	22.2
0.0023	21.1
0.0021	20.5

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Subdivison
MDH Job No:	613596
SAMPLE:	JMT-667
DATE:	2-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	2
% SAND	28
% FINES (SILT, CLAY)	70

COMMENTS:



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

PARTICLE-SIZE ANALYSIS REPORT

(Test Reference: ASTM D 422)

SNC•LAVALIN Environment

CLIENT:	Chris Cebryk
PROJECT:	Proposed Resedential Subdivison
Project No:	613596
SAMPLE:	JMT-673
DATE:	2-Aug-13

PARTICLE SIZE DISTRIBUTION SUMMARY

% GRAVEL	8
% SAND	62
% FINES (SILT, CLAY)	30

COMMENTS:

Sieve Analysis

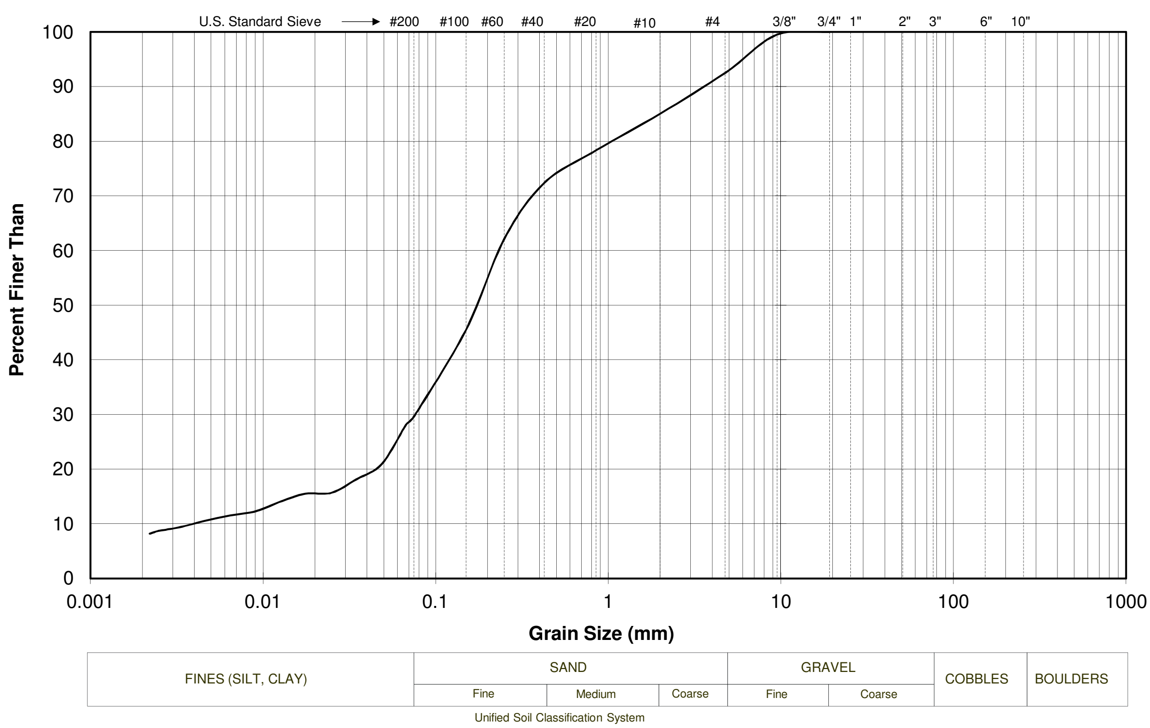
Sieve	Diameter (mm)	% Finer
3"	76.2	100
2"	50.8	100
1"	25.4	100
3/4"	19.1	100
3/8"	9.5	100
# 4	4.75	92
# 10	2.00	85
# 20	0.850	78
# 40	0.425	72
# 60	0.250	62
# 100	0.150	46
# 200	0.075	30

Hydrometer Analysis

Dispersing agent:
Sodium Hexametaphosphate

Dosage of dispersing agent:
40 g/L

Diameter (mm)	% Finer
0.0673	28.1
0.0488	21.0
0.0349	18.2
0.0249	15.7
0.0176	15.5
0.0129	14.2
0.0092	12.4
0.0065	11.5
0.0046	10.5
0.0033	9.4
0.0025	8.7
0.0022	8.2



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Engineering interpretation will be provided by MDH Engineered Solutions Corp upon request.

SNC·LAVALIN Environment

WATER CONTENTS & BULK DENSITIES

Client:	Chris Cebryk
Project:	Proposed Resedential Development
MDH #	613596
Tech:	RG
Date:	25-Jul-13

Sample #	KRE-187-SPT	KRE-120-SPT	JMT-633	KRE-108-SPT	KRE-180-SPT	
Borehole						
Tare #	SAP-06	Unicorn	CE-2	M	CE-6	
Tare Mass (g)	30.92	30.98	30.86	30.89	31.02	
Wet sample + tare (g)	117.42	124.44	127.04	126.18	118.97	
Dry sample + tare (g)	108.83	113.77	117.02	119.50	112.86	
Wt. Dry sample (g)	77.91	82.79	86.16	88.61	81.84	
Water Content (%)	11.03	12.89	11.63	7.54	7.47	
Bulk Density						
Sample #	KRE-187-SPT	KRE-120-SPT	JMT-633	KRE-108-SPT	KRE-180-SPT	
Mass of sample in air (g):	114.64	192.16	170.03	89.74	180.39	
Mass of sample + wax in air (g):	118.33	195.37	175.18	93.00	185.89	
Mass of sample + wax in water (g):	63.82	108.82	94.21	50.30	103.63	
Wet density (kg/m^3):	2276	2317	2262	2299	2371	
Dry density (kg/m^3):	2050	2052	2026	2138	2206	
Sample #						
Borehole						
Tare #						
Tare Mass (g)						
Wet sample + tare (g)						
Dry sample + tare (g)						
Wt. Dry sample (g)						
Water Content (%)						
Bulk Density						
Sample #						
Mass of sample in air (g):						
Mass of sample + wax in air (g):						
Mass of sample + wax in water (g):						
Wet density (kg/m^3):						
Dry density (kg/m^3):						

Comments:

Appendix C: Heritage & Environmental Screening

Ministry of Parks,
Culture and Sport

Heritage Conservation Branch
2nd Floor 3211 Albert Street
Regina, Saskatchewan
S4S 5W6

(306) 787-5774
nathan.friesen@gov.sk.ca

June 3, 2013

Our File: 13-770

Ms. Kendra Raymond
Associated Engineering
1-225 Northridge Drive
SASKATOON SK S7L 6X6
Phone: (306) 653-2137 ext 484
Email: raymondk@ae.ca

ORIGINAL E-MAILED
6/4/13

Dear Ms. Raymond:

RE: 95 Lot Country Residential Subdivision – RM of Corman Park: W ½ 11-37-4 W3M; HERITAGE RESOURCE REVIEW

Thank you for referring this development proposal to our office for heritage resource review.

In determining the need for, and scope of, heritage resource impact assessment (HRIA) pursuant to S. 63 of *The Heritage Property Act*, the following factors were considered: the presence of previously recorded heritage sites, the area's overall heritage resource potential, the extent of previous land disturbance, and the scope of new proposed land development.

The proposed subdivision is in conflict with one known archaeological site (called FbNo-9), as well as being in close proximity to four other known sites (FbNo-8 and FaNo-10, 16 and 17). The development will impact both native prairie and land disturbed by cultivation. The site FbNo-9 may have been impacted by cultivation and little is known about its size or scientific significance. The amount of disturbance caused by cultivation is also unknown. The potential to find intact, significant sites in the areas of native prairie is moderate to high. As well, the site FbNo-9 should be assessed for significance before the development occurs. Therefore, an HRIA is required for the areas of native prairie in the W ½ 11, as well as the immediate area (including cultivated areas) around FbNo-9.

The HRIA study, including systematic pedestrian survey and sub-surface test exploration, is a proponent responsibility. The study will first establish the presence of heritage sites within the project area, as well as where suitable site avoidance measures (including the right-of-way relocation) may be implemented. The study

...2

will also establish the content, structure, and importance of those heritage sites located in unavoidable conflict with development. On that basis, both the need for and scope of any mitigation follow-up (including archaeological salvage excavation or other preservation action) will be determined. The HRIA must be carried out by qualified personnel under an approved investigation permit issued through this office. Normally, two days are required to process a heritage contractor's permit application.

If you have any questions regarding this project, please do not hesitate to contact me or Kim Weinbender at the above address or by calling 787-8157.

Sincerely,

KWeinbender

Nathan Friesen
Senior Archaeologist
Archaeological Resource Management

CanNorth

Canada North Environmental Services
Limited Partnership

Associated Engineering
Eagle Heights Country Estates
W ½ 11-37-4 W3M
Heritage Resources Impact Assessment
Permit No. 13-224

Final Report

Prepared by:

Canada North Environmental Services
Saskatoon, Saskatchewan

Prepared for:

Associated Engineering
Saskatoon, Saskatchewan

Project No. 1806

November 2013

211 Wheeler Street, Saskatoon, Saskatchewan, Canada S7P 0A4
Telephone: (306) 652-4432 Facsimile: (306) 652-4431 E-mail: info@cannorth.com

TABLE OF CONTENTS

LIST OF FIGURES

PROJECT CREDITS

Project Manager…………………………………………………………..Mike Markowski, M.A.

Permit Holder…………………………………………………………..Mike Markowski, M.A.

Field Assistant……………...…………………………………………………Alan Korejbo, M.A.

Field Assistant…………………………………………………………...……...Kara Wolfe, M.A.

Report Author…………………………………………………………..Mike Markowski, M.A.

Report Author……………………………………………………………….…...Kara Wolfe, M.A.

Report Maps…………………………………………………………...….Chad Coziahr, B.A.

EXECUTIVE SUMMARY

A Heritage Resources Impact Assessment (HRIA) was completed on October 31st, 2013 for Associated Engineering's proposed Eagle Heights Country Estates residential subdivision development (W ½ 11-37-4 W3M) east of Saskatoon, Saskatchewan. Upon review of the proposed subdivision development, the Heritage Conservation Branch (HCB) determined that the subdivision will impact a heritage sensitive area and is in conflict with FbNo-9 (HCB File No. 13-770). As a result, an HRIA was required (HCB File No. 13-770).

The heritage assessment was completed under Archaeological Resource Investigation Permit No. 13-224. Areas of native vegetation in W ½ 11-37-4 W3M were assessed using a combination of pedestrian reconnaissance and the excavation of subsurface shovel probes. No archaeological sites were identified.

Using limited site information from the Saskatchewan Archaeological Resource Record (SARR) form for FbNo-9, the general site area around FbNo-9 was assessed. The site assessment included detailed pedestrian reconnaissance and the excavation of subsurface shovel probes in areas of native vegetation and the cultivated field. No artifacts were observed in the reported location of FbNo-9. Therefore, there are no further concerns with FbNo-9.

As a result, it is recommended that Associated Engineering be provided with regulatory approval as per Section 63 of The Heritage Property Act for the Eagle Heights Country Estates residential subdivision development to proceed as planned. This report fulfills the permitting requirements necessary for the completion of this HRIA.

1.0 INTRODUCTION

A Heritage Resource Impact Assessment (HRIA) was carried out for Associated Engineering's proposed Eagle Heights Country Estates residential subdivision development (the Project) located east of Saskatoon, Saskatchewan. Canada North Environmental Services (CanNorth) completed the field assessment on October 31st, 2013 under Archaeological Resources Investigation Permit No. 13-224 issued to Mike Markowski (CanNorth Archaeologist). Despite the moderate to high heritage potential of the Project area, no heritage resources, including archaeological site FbNo-9, were identified in conflict.

The following Sections discuss the results of the HRIA. A Description of the Project is included in Section 2, while Section 3 discusses methodology. The results of the field assessment are included in Section 4, and recommendations are discussed in Section 5. Photographs are included in Appendix A, shovel probe locations are documented in Appendix B, and a survey plan is included in Appendix C.

1.1 Heritage Conservation Branch Screening Criteria

In Saskatchewan, heritage resources include Precontact Period and Historic Period archaeological sites, built heritage sites and structures of historical and/or architectural interest, and palaeontological sites. Heritage resources are the property of the Provincial Crown and are protected under the *Heritage Property Act.*

The Heritage Conservation Branch (HCB) has identified two primary triggers for determining if an HRIA is required for a project (per section 63 of *The Heritage Property Act*). An area is considered heritage sensitive based on the presence of known heritage resources and the potential for new heritage resources to be discovered. The extent of previous land disturbance (e.g. cultivation) and nature and scope of the proposed project is also taken into consideration. Additional screening criteria for southern Saskatchewan include:

- within the same quarter-section of a Site of Special Nature (e.g. burials, medicine wheels, effigies);
- within 1 km of a permanent water course (e.g. rivers, streams);
- within 1 km of a well-formed valley;

- within 1 km of a permanent or seasonal waterbody;
- hummocky terrain;
- within (or on the periphery of) sand dune complexes; and,
- on escarpments, prominent uplands, and hills/ridges.

A Heritage Resource Review for the proposed Eagle Heights Country Estates residential subdivision development was completed by the HCB. Based on the above screening criteria, it was determined that the Project will impact a heritage sensitive area and an HRIA was required (HCB File No. 13-770). Areas of native vegetation and the immediate area surrounding the reported location of FbNo-9 (including the cultivated field) was required to be assessed (HCB File No. 13-770).

2.0 PROJECT DESCRIPTION

2.1 Project Area and Local Environment

The Eagle Heights Country Estates is located in the Minichinas Upland Landscape Area of the Moist Mixed Grassland Ecoregion of central Saskatchewan (Acton et al. 1998). The rolling elevated landscape offers commanding views of the surrounding prairie and, to the west, the City of Saskatoon. The Minichinas Upland consists of a moderately to steeply sloping hummocky morainal landscape characterized by small shallow ponds and glacial kettle lakes (Acton et al. 1998).

The Project area is located in the RM of Corman Park No. 344, approximately three kilometres east of Highway No. 41 (Figure 1). An existing residential subdivision development, known as Eagle Ridge, is located to the west of the Project Area. A total of 95 residential lots and roads will be developed in the W ½ 11-37-4 W3M utilizing natural contours. Environmental Reserves and Municipal Reserves are located throughout the Project area along water bodies (Appendix C).

The Project area consists of cultivated fields and native vegetation characterized by hummocky knob and kettle terrain. The west half of W ½ 11-37-4 W3M is almost entirely cultivated (approximately 68 ha), while the east half of W ½ 11-37-4 W3M consists primarily of native vegetation (approximately 60 ha). Native vegetation in the Project area consists of tall native grasses, wolf willow (*Elaeagnus commutate*), wild rose (*Rosa acicularis*), trembling aspen (*Populus tremulides*), and various species of willow that are located primarily along water bodies. Unnamed water bodies, characterized by small kettle lakes and seasonal water features, are located throughout the Project area, including the southwestern extent of a large unnamed waterbody (the largest in the surrounding region) to the northeast of the Project area.

2.2 Potential Impacts to Heritage Resources

Heritage resources are considered a non-renewable resource. Context is important to the archaeologist for proper recording and interpretation. Construction activities associated with the Project have the potential to negatively impact heritage resources. Heavy equipment can impact heritage resources in a variety of ways. Surface features may be crushed and/or displaced by the weight of machinery, while buried cultural materials (e.g.

artifacts and features) may be impacted during construction activities and the excavation and/or levelling of subsoil (e.g. roads, developing residential lots, underground utilities).

If heritage resources are identified in the Project area, prior to construction activities, they can be successfully mitigated by avoidance; however, if unavoidable, the archaeological site and/or surface feature (e.g. stone circle, stone cairn, cellar depression) will be recorded in detail, tested, and the results will be discussed with the HCB. The HCB will determine if the heritage resource has been adequately mitigated; however, further mitigation (e.g. test excavation) may be required. If a Site of Special Nature (SSN) (e.g. burial, medicine wheel, effigy, pictograph, petroglyph) is discovered in the Project area, avoidance may be the only option since SSN are offered explicit protection under Section 63 of *The Heritage Property Act*.

3.0 METHODOLOGY

3.1 Previous Archaeological Research

The HCB's archaeological site database was consulted to determine the type and number of known sites recorded near the Project. In addition, the extent of previous archaeological work in the Project area was reviewed.

In total, nine known heritage resources are located within a three kilometre radius of the Project. These sites have been identified as artifact finds (n=7), an artifact scatter (n=1), and a recurrent feature (n=1). Although all of the sites have been recorded as Precontact Period sites, no diagnostic artifacts have been identified at these sites to indicate temporal age and cultural affiliation.

Known Heritage Resources within a 3 km radius of the Project Area			
Borden No.	**Site Type**	**Cultural Affiliation**	**Permit No.**
FaNo-5	Artifact Scatter	Unknown Precontact Period	78-000
FaNo-9	Artifact Find	Unknown Precontact Period	78-000
FaNo-10	Artifact Find	Unknown Precontact Period	78-000
FaNo-11	Artifact Find	Unknown Precontact Period	78-000
FaNo-16	Artifact Find	Unknown Precontact Period	98-030
FaNo-17	Artifact Find	Unknown Precontact Period	98-030
FaNo-18	Recurrent Feature	Unknown Precontact Period	01-031
FbNo-8	Artifact Find	Unknown Precontact Period	78-000
FbNo-9	Artifact Find	Unknown Precontact Period	78-000

The HCB identified FbNo-9 in conflict with the Project (HCB File No. 13-770). FbNo-9 is an artifact find site located in NE/NW 11-37-4-W3M. Very little information is known about this site; however, the Saskatchewan Archaeological Resource Record (SARR) form indicates that quartzite flakes were discovered in the cultivated field during the Fort Carlton Survey in 1975.

3.2 Field Assessment

The goal of the field assessment is to identify all heritage resources, if any, within the proposed project area (McManamon 1984). The field assessment typically consists of pedestrian reconnaissance and the excavation of subsurface shovel probes. Pedestrian reconnaissance focuses on the identification of surface feature (e.g. stone circles, stone cairns, cellar depression), areas considered to have high heritage potential (e.g. landforms, coulee crests), and subsurface exposures (e.g. cattle trails, rodent disturbances, cut banks). Shovel probes, approximately 40 cm by 40 cm are judgementally excavated in the project area with the goal of discovering buried artifacts and/or features (e.g. hearth, post holes). In general, the greater frequency of shovel probes is the key to improving the likelihood of discovering small sites (McManamon 1984).

Once a site is discovered, the archaeologist must determine the size, function, and significance of the site. Shove tests measuring 50 cm by 50 cm are excavated in the site area. All excavated soils are screened through a quarter-inch wire mesh. If surface features (e.g. stone circle, cairn) are in conflict with the proposed project, they may be tested, photographed, and mapped in detail.

4.0 RESULTS

An HRIA was completed for Eagle Heights Country Estates. The heritage assessment was completed on October 31st, 2013 under Archaeological Resource Investigation Permit 13-224. Survey plans and handheld GPS units easily defined the Project area. The results of the HRIA are described below.

4.1 Eagle Heights Country Estates

The Project area was assessed for heritage resources and to determine if archaeological site FbNo-9 was in conflict with the Project. In total, approximately 65 ha were assessed (60 ha of native vegetation and 5 ha of cultivated terrain) using a combination of pedestrian reconnaissance and the excavation of subsurface shovel probes. Pedestrian transects were spaced approximately 50 m apart and were walked in a zig-zag pattern to optimize coverage. In addition, 130 shovel probes were excavated throughout the heritage sensitive areas (Figure 2; Appendix B, Table 1).

Shovel probes were judgementally excavated every 70 m in areas considered to have the greatest heritage potential including elevated landforms and in areas adjacent to kettle lakes (Appendix A; Photos 1 to 4). Shovel probe stratigraphy in areas of native vegetation consisted of a silt/loam and clay matrix with interspersed gravels and is summarized below:

- 0 cm to 5 cm sod;
- 5 cm to 18 cm brown silty loam;
- 18 cm to 30 cm tan clay; and,
- 30 cm to 45 cm grey clay.

Shovel tests were also excavated in the cultivated field near the reported location of FbNo-9. A well-defined plough zone was observed in the shovel probes and is summarized below:

- 0 cm to 2 cm sod;
- 2 cm to 11 cm dark brown loam;
- 11 cm to 20 cm tan clay; and,

- 20 cm to 30 cm grey clay.

A historic trail (currently used as an ATV trail) was observed oriented north/south along the eastern edge of W ½ 11-37-4 W3M (Appendix A, Photo 5). Dominion Land Surveyor fieldbooks were examined for additional information on this trail. This trail was documented and identified in a 1918 re-survey of school sections as a trail to a farm (ISC Fieldbook No. 16548). Based on its identification, this trail has little historical significance and no interpretive value and, therefore, was not recorded as an archaeological site.

In general, good surface visibility was noted throughout the Project area. Subsurface exposures, including rodent disturbances, game trails, historic trails and the adjacent cultivated field, were also examined for cultural materials. Surface cobbles and boulders were observed in all areas of native vegetation but were more prominent on elevated areas. No cultural material or surface features were identified during the HRIA.

4.1.1 FbNo-9

FbNo-9 is an artifact find site located in NE/NW 11-37-4 W3M. Limited site information is available for this site; however, the SARR form, which was barely legible, reports that quartzite flakes were discovered in a cultivated field during the Fort Carlton Survey in 1975. Although vague, the site sketch map indicates that the site is near a waterbody. According to the HCB's archaeological site database, the UTM coordinates for FbNo-9 place this site near the northern edge of the Project adjacent to a waterbody (Figure 2).

During the HRIA, three possible site locations were identified based on the HCB's UTM location (Figure 3, Location 1), site map (Figure 3, Location 2), and professional judgement (Figure 3, Location 3). These areas were assessed in detail using a combination of pedestrian reconnaissance and the excavation of 25 shovel probes (Figures 2 and 3). In addition, areas along the boundary of the cultivated field and native vegetation portions of the Project area were recently cultivated resulting in excellent surface visibility.(Appendix A: Photo 6)

Location 1 was assessed based on the HCB's UTM coordinates. During the HRIA, it was determined that the UTM coordinates place FbNo-9 in a waterbody and therefore was considered inundated (Appendix A, Photo 7). However, as a precautionary measure, 11 shovel tests were excavated in areas of native vegetation and the adjacent cultivated field north of the waterbody and UTM coordinates (Figure 3). No cultural materials or buried palaeosols were identified at Location 1.

Location 2 is located to the south of the HCB's UTM coordinates on the south side of a small drainage in between two waterbodies (Figure 3; Appendix A, Photo 8). A total of 10 shovel tests were excavated along an elevated ridge adjacent to the waterbodies in areas of native vegetation and in the cultivated field. No cultural materials or buried palaeosols were identified at Location 2.

Location 3 is located on the eastern edge of a small waterbody. A total of four shovel tests were excavated in the cultivated field. No areas of native vegetation were present at this location and, therefore, the assessment of Location 3 primarily focused on pedestrian reconnaissance of the recently cultivated field. No cultural materials or buried palaeosols were identified at Location 3.

Based on the SARR's limited site information, three locations (Locations 1 to 3) were assessed to determine if FbNo-9 was in conflict with the Project. No evidence of FbNo-9 was discovered at these locations. The SARR fails to mention if the site was reported by a local informant and recorded by the Fort Carlton Survey or if the site was actually visited and recorded by the Fort Carlton Survey. Furthermore, based on the information in the SARR form, FbNo-9 is not considered a significant archaeological site. Based on the results of the site assessment, FbNo-9 has been adequately assessed and no further archaeological work is recommended at this site.

5.0 SUMMARY AND RECOMMENDATIONS

An HRIA was completed for the Associated Engineering's proposed Eagle Heights Country Estates residential subdivision under Archaeological Resource Investigation Permit No. 13-224. Despite the moderate to high heritage potential of the Project area, no heritage resources, including FbNo-9, were identified in conflict with the Project.

As a result, it is recommended that Associated Engineering be provided with regulatory approval as per section 63 of *The Heritage Property Act* for the Eagle Heights Country Estates residential subdivision to proceed as planned. If Project plans are altered, or if heritage resources are discovered during construction, the HCB must be notified immediately. In the event that human remains are discovered during construction activities, please contact the local RCMP detachment and the HCB (306-787-2817).

6.0 CLOSURE

If you have any questions or require additional information regarding this HRIA, please contact the undersigned.

Sincerely,

Mike Markowski, M.A.
Heritage Division Manager / Senior Archaeologist
Canada North Environmental Services

7.0 LITERATURE CITED

Acton, D.F., G.A. Padbury, and C.T. Stushnoff. 1998. The ecoregions of Saskatchewan. Canadian Plains Research Center, University of Regina, Regina, Saskatchewan.

Information Services Corporation (ISC). 2013. Dominion Lands Surveyor Fieldbook No. 16548. Electronic document: https://www.isc.ca/SignedInHome/Pages/FieldBookSearch.aspx.

McManamon, F.P. 1984. Discovering sites unseen. *In* Advances in archaeological method and theory, Vol. 7. Academic Press, New York, New York. pp. 223-292

8.0 MAP SOURCES AND DISCLAIMERS

CanNorth has exercised all reasonable care in the compilation, interpretation, and production of the map figures contained in this document. However, it is not possible to warrant or guarantee the accuracy, precision, currency, suitability, or reliability of any of the displayed or underlying data contained in the figures. Therefore, these are presented for reference and/or illustrative purposes; they are neither intended for legal delineation of any geographic feature nor for navigational use. The user must accept the data “as is" and CanNorth assumes no responsibility for loss or damage incurred as a result of any user reliance on this data.

Map figures produced using ESRI ArcGIS 10.0 Service Pack 4.

Canada/U.S. border. National Atlas of the United States of America. 2012. 1:1,000,000. “1:1,000,000-Scale State Boundaries of the United States.”

Communities. Information Services Corporation of Saskatchewan. 2013. Adapted from “Administrative Boundary Overlays.” The incorporation of data sourced from the Information Services Corporation of Saskatchewan within this product shall not be construed as constituting an endorsement by the Information Services Corporation of Saskatchewan of such product.

Digital topographic raster background images. ©Department of Natural Resources Canada (NRC). 2013. 1:50,000. CanMatrix digital topographic maps. All rights reserved. Data served by Saskatchewan Ministry of Environment.

Heritage resources. Government of Saskatchewan Ministry of Parks Culture and Sport-Heritage and Conservation Branch. 2013.

Provincial boundary. Information Services Corporation of Saskatchewan. 2013. Adapted from “Administrative Boundary Overlays.” The incorporation of data sourced from the Information Services Corporation of Saskatchewan within this product shall not be construed as constituting an endorsement by the Information Services Corporation of Saskatchewan of such product.

Road network. Her Majesty the Queen in right of Saskatchewan. 2011. “Saskatchewan Road Network dataset of 2011, (SRN11).” The incorporation of data sourced from Her Majesty the Queen in Right of Saskatchewan within this product shall not be construed as constituting an endorsement by Her Majesty the Queen in Right of Saskatchewan of such product. Reproduced with the permission of Her Majesty the Queen in Right of Saskatchewan.

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Sections. Information Services Corporation of Saskatchewan. 2011. “SaskGrid TFM.” The incorporation of data sourced from the Information Services Corporation of Saskatchewan within this product shall not be construed as constituting an endorsement by the Information Services Corporation of Saskatchewan of such product.

Waterbodies. ©Department of Natural Resources Canada. 2004. “North American Atlas – Hydrography.” 1:10,000,000. All rights reservedGeopolitical Boundaries, Inter-Provincial/Territorial Boundary. GeoBase®. Scale 1:100,000. Ottawa, Ontario: Natural Resources Canada, Centre for Topographic Information.

FIGURES

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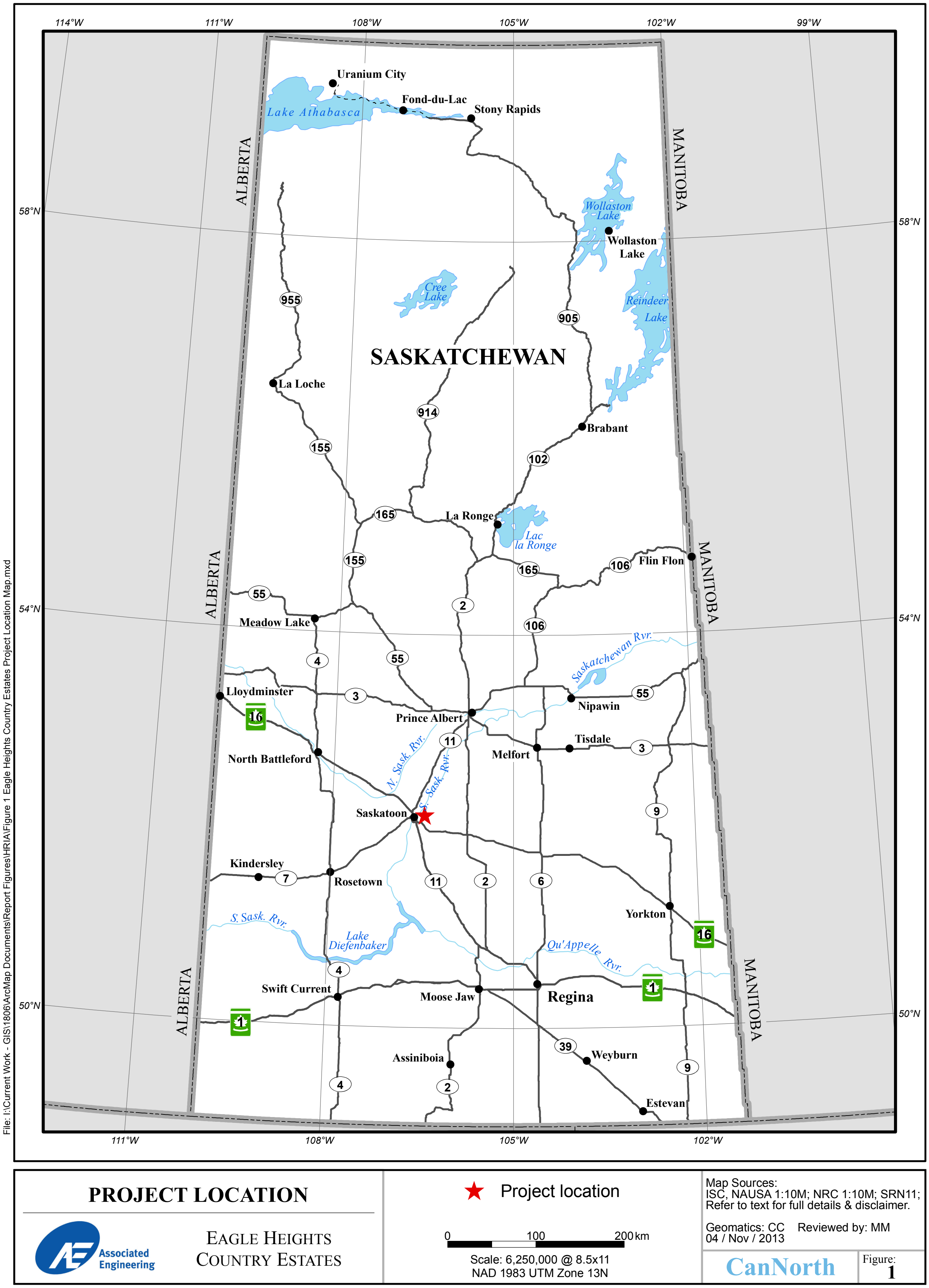
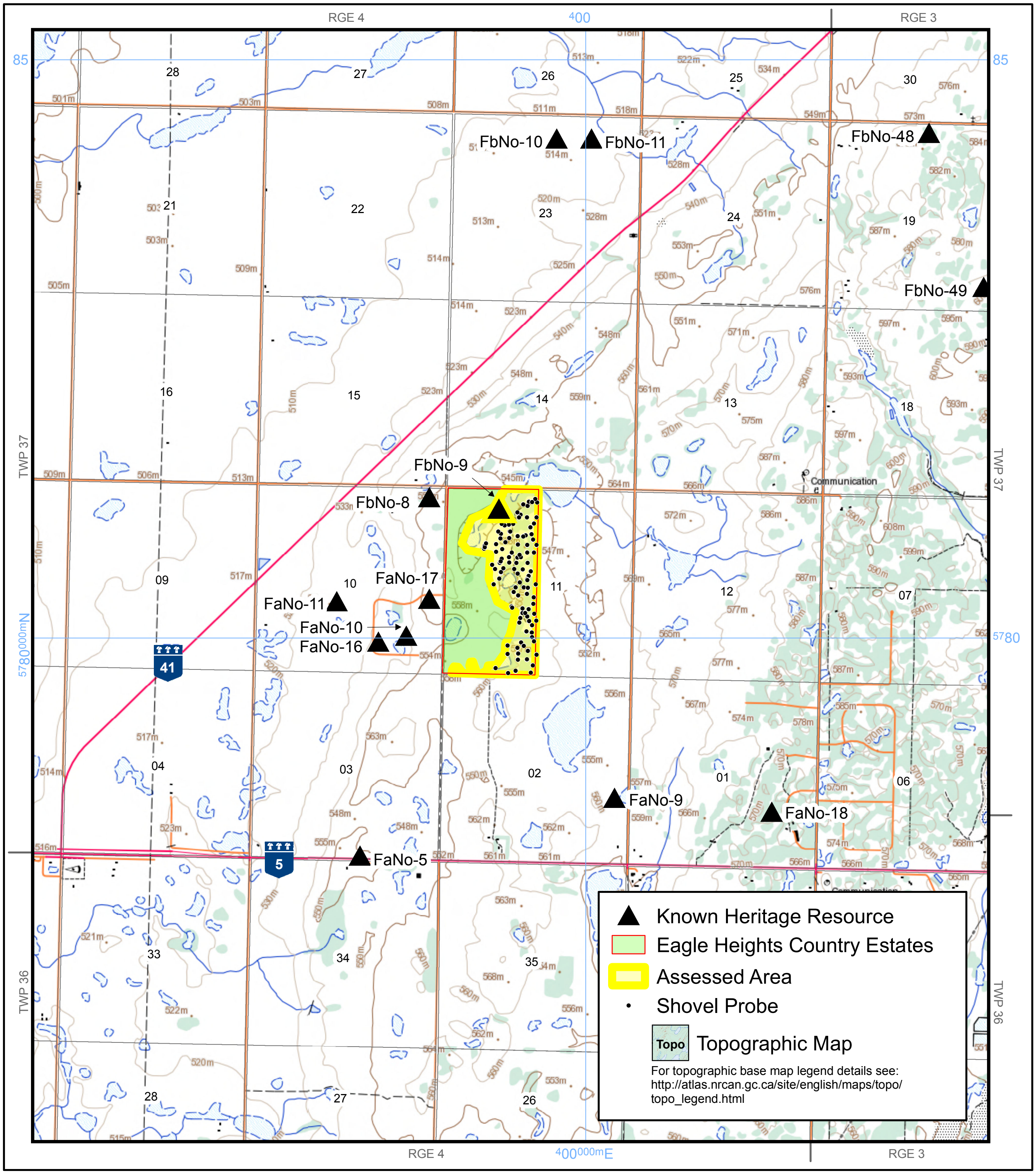


Figure 1. Eagle Heights Country Estates project location map.



File: I:\Current Work - GIS\1806\ArcMap Documents\Report Figures\HRIA\Figure 2 Eagle Heights Country Estates HRIA.mxd

PROJECT AREA

Associated Engineering

EAGLE HEIGHTS COUNTRY ESTATES

N

0 1 2km

Scale 50,000 @ 8.5x11
NAD 1983 UTM Zone 13N

Map Sources:
NRC 1:50K; HCB
Refer to text for full details & disclaimer.

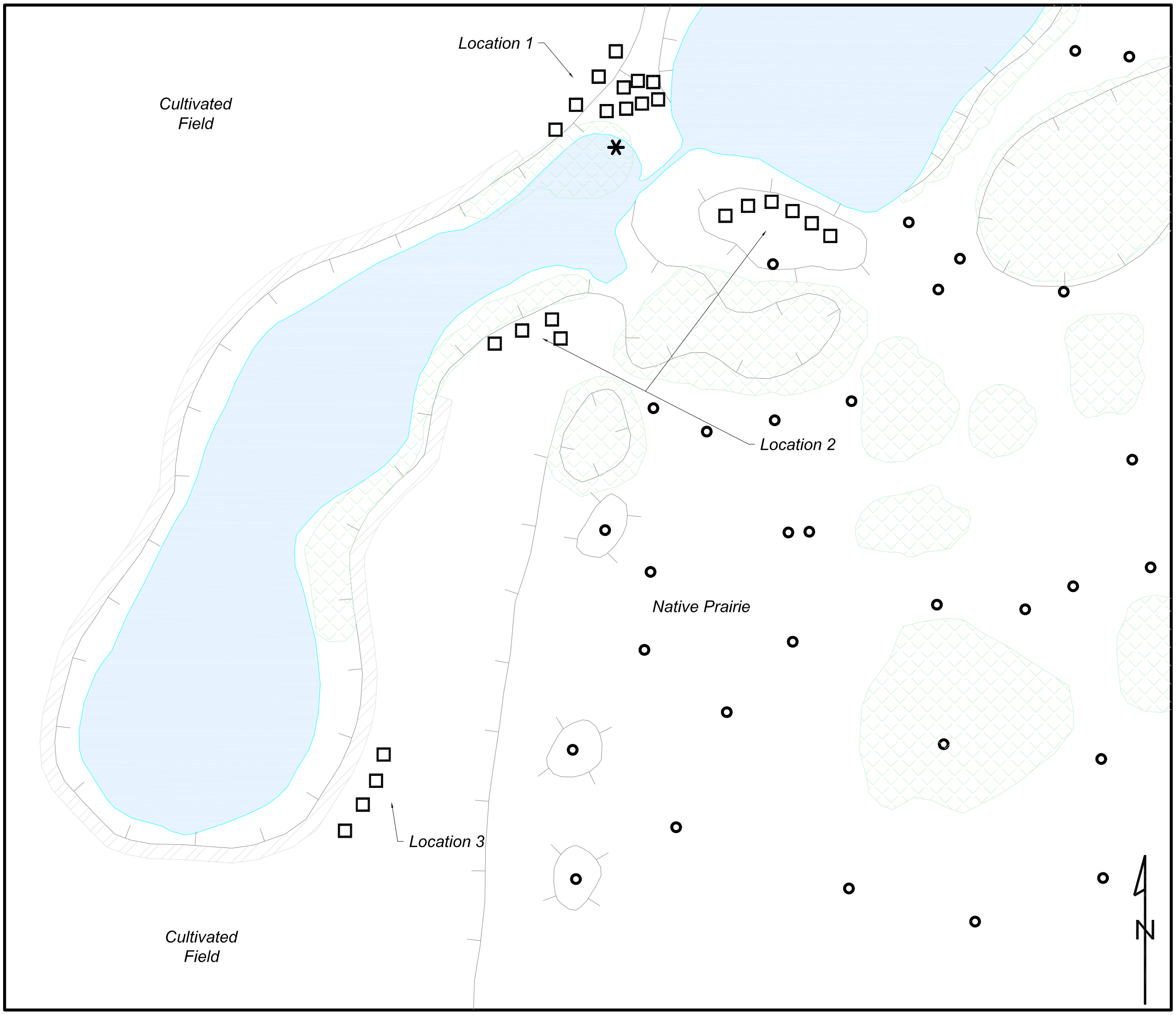
Geomatics: CC Reviewed by: MM

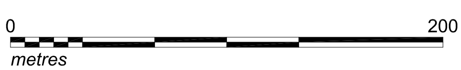
04 / Nov / 2013

CanNorth

Figure 2

Figure 2. Eagle Heights Country Estates Heritage Resources Impact Assessment.





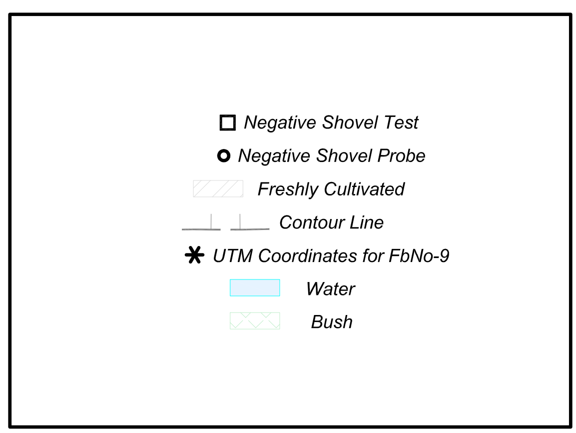


Figure 3 Site map of FbNo-9.

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APPENDIX A

PHOTOGRAPHS

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Photo 1. View southwest of small waterbody in 6-11-37-4 W3M (from shovel probe C10) (October 31st, 2013).

Photo 2. View south of rolling terrain and seasonal waterbodies in 11-11-37-4-W3M (from shovel probe C14) (October 31st, 2013).

Photo 3. View north of rolling terrain and cultivated fields in 6-11-37-4 W3M (from shovel probe A18) (October 31st, 2013).

Photo 4. View east of kettle lake in 11-11-37-4 W3M (from shovel probe B16) (October 31st, 2013).

Photo 5. View east along the historic trail observed in 6-11-37-4 W3M (from shovel probe B02) (October 31st, 2013).

Photo 6. View north assessing cultivated field near FbNo-9 (October 31st, 2013).

Photo 7. View west of reported UTM location of FbNo-9 in 14-11-37 W3M. Note: shovel is placed at the HCB's UTM coordinates (October 31st, 2013).

Photo 8. View north near FbNo-9 (from shovel probe B42 at Location 2) (October 31st, 2013).

APPENDIX B

SHOVEL PROBES AND TESTS

APPENDIX B, TABLE 1

Geographical location of shovel probes and tests in W ½ 11-37-4 W3M.

Probe/Test	Zone (NAD 83)	UTM Easting	UTM Northing
A01	13U	399534	5780049
A02	13U	399538	5780007
A03	13U	399554	5779972
A04	13U	399466	5779932
A05	13U	399410	5779916
A06	13U	399418	5779867
A07	13U	399502	5779891
A08	13U	399576	5779856
A09	13U	399493	5779815
A10	13U	399414	5779814
A11	13U	399396	5779716
A12	13U	399527	5779700
A13	13U	399543	5779765
A14	13U	399331	5779700
A15	13U	399222	5779741
A16	13U	399325	5779862
A17	13U	399325	5779935
A18	13U	399366	5780263
A19	13U	399206	5780466
A20	13U	399254	5780513
A21	13U	399269	5780570
A22	13U	399193	5780634
A23	13U	399266	5780662
B01	13U	399489	5780057
B02	13U	399496	5780188
B03	13U	399442	5779962
B04	13U	399454	5780217
B05	13U	399478	5780218
B06	13U	399556	5780208
B07	13U	399508	5780249
B08	13U	399359	5780273
B09	13U	399455	5780257
B10	13U	399395	5780440
B11	13U	399465	5780437
B12	13U	399500	5780434
B13	13U	399507	5780538
B14	13U	399493	5780509
B15	13U	399413	5780558
B16	13U	399269	5780562
B17	13U	399275	5780686
B18	13U	399338	5780701
B19	13U	399411	5780697
B20	13U	399440	5780700
B21	13U	399429	5780720
B22	13U	399554	5780740
B23	13U	399496	5780741
B24	13U	399362	5780738

APPENDIX B, TABLE 1

Geographical location of shovel probes and tests in W ½ 11-37-4 W3M.

Probe/Test	Zone (NAD 83)	UTM Easting	UTM Northing
B25	13U	399278	5780771
B26	13U	399227	5780747
B27*	13U	399123	5780773
B28*	13U	399129	5780799
B29	13U	399269	5780901
B30	13U	399246	5780922
B31	13U	399342	5780920
B32	13U	399349	5780920
B33	13U	399482	5780888
B34	13U	399532	5780899
B35	13U	399555	5780991
B36	13U	399523	5780958
B37	13U	399375	5780988
B38	13U	399336	5780980
B39	13U	399300	5780975
B40	13U	399275	5780989
B41*	13U	399271	5781084
B42	13U	399307	5781093
B43*	13U	399227	5781013
B44*	13U	399208	5781030
B45	13U	399438	5781066
B46	13U	399498	5781142
B47	13U	399582	5781172
B48	13U	399566	5781201
B49*	13U	399264	5781128
B50*	13U	399274	5781128
B51*	13U	399277	5781137
B52*	13U	399265	5781138
B53*	13U	399237	5781138
B54*	13U	399224	5781135
C01	13U	399537	5780110
C02	13U	399428	5780135
C03	13U	399437	5780174
C04	13U	399512	5780146
C05	13U	399574	5780149
C06	13U	399547	5780297
C07	13U	399553	5780354
C08	13U	399493	5780383
C09	13U	399416	5780369
C10	13U	399379	5780397
C11	13U	399431	5780483
C12	13U	399497	5780501
C13	13U	399570	5780463
C14	13U	399527	5780578
C15	13U	399457	5780593
C16	13U	399383	5780598
C17	13U	399289	5780603

APPENDIX B, TABLE 1

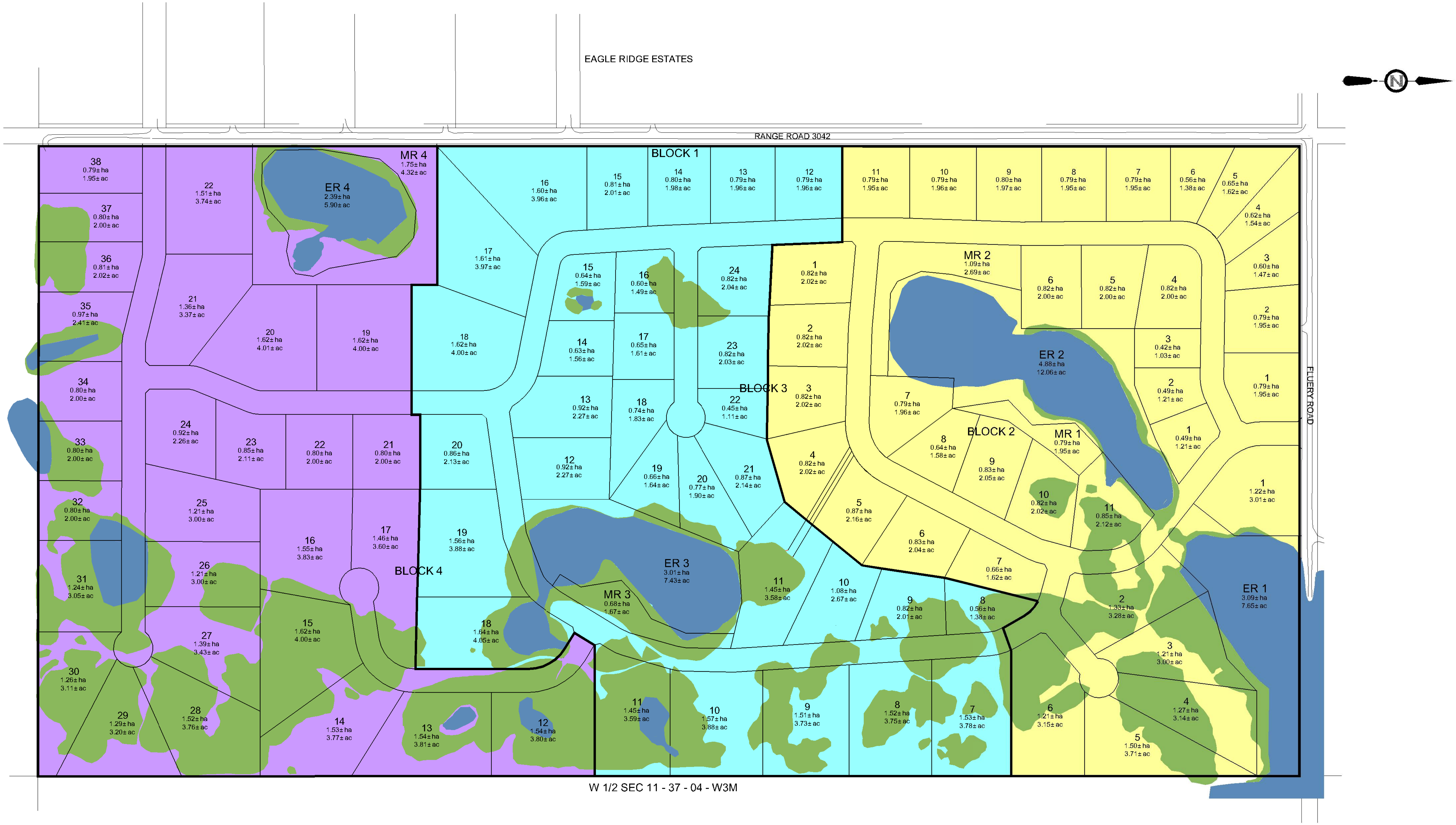
Geographical location of shovel probes and tests in W ½ 11-37-4 W3M.

Probe/Test	Zone (NAD 83)	UTM Easting	UTM Northing
C18	13U	399217	5780599
C19	13U	399258	5780651
C20	13U	399340	5780654
C21	13U	399402	5780651
C22	13U	399500	5780651
C23	13U	399576	5780804
C24	13U	399495	5780804
C25	13U	399414	5780810
C26	13U	399306	5780830
C27	13U	399227	5780812
C28*	13U	399130	5780785
C29*	13U	399139	5780820
C30	13U	399265	5780862
C31	13U	399341	5780865
C32	13U	399413	5780881
C33	13U	399462	5780877
C34	13U	399546	5780851
C35	13U	399576	5781042
C36	13U	399493	5781043
C37	13U	399426	5781046
C38	13U	399337	5781069
C39*	13U	399266	5781082
C40*	13U	399284	5781096
C41*	13U	399294	5781095
C42*	13U	399312	5781091
C43*	13U	399222	5781027
C44*	13U	399188	5781024
C45	13U	399411	5781086
C46	13U	399462	5781157
C47	13U	399509	5781179
C48	13U	399537	5781177
C49*	13U	399274	5781140
C50*	13U	399253	5781135
C51*	13U	399245	5781138
C52*	13U	399253	5781147
C53*	13U	399247	5781156
C54*	13U	399252	5781166

*shovel test

APPENDIX C

SURVEY PLANS



LEGEND:

PHASE 1

PHASE 2

PHASE 3

EXISTING PONDING AREAS

EXISTING TREE AREAS

EAGLE HEIGHTS COUNTRY ESTATES

CONCEPT PLAN

Associated Engineering

GLOBAL PERSPECTIVE. LOCAL FOCUS.

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DATE: 2013-06-20, Ryan Seabrook

Saskatchewan

Ministry of
Tourism, Parks,
Culture and Sport

Heritage Conservation Branch
2nd Floor 3211 Albert Street
Regina, Saskatchewan
S4S 5W6

(306) 787-5774
nathan.friesen@gov.sk.ca

December 4, 2013

Our File: 13-770

Ms. Kendra Raymond
Associated Engineering
1-225 Northridge Drive
SASKATOON SK S7L 6X6
Phone: (306) 653-2137 ext 484
Email: raymondk@ae.ca

Dear Ms. Raymond:

RE: 95 Lot Country Residential Subdivision – RM of Corman Park: W ½ 11-37-4 W3M; HERITAGE RESOURCE IMPACT ASSESSMENT RESULTS

Please be advised we received (November 28, 2013) a report from CanNorth Environmental their heritage resource impact assessment (HRIA) of this project completed under Investigation Permit #13-224.

No new or previously recorded heritage sites were observed in the course of pedestrian survey and testing of the development area, despite the high potential of the area. Therefore, this office has no further concerns relating to this project.

On behalf of the Heritage Conservation Branch, please accept our appreciation for having commissioned this investigation, and for your continuing assistance and support in preserving Saskatchewan's archaeological heritage.

Sincerely,

Nathan Friesen
Senior Archaeologist
Archaeological Resource Management

REPORT

Chris Cebryk

Eagle Heights
Country Residential Estates
Natural Area Screening

JANUARY 2020

TABLE OF CONTENTS

1 INTRODUCTION

A natural area (environmental) screening was requested by the RM of Corman Park Administration in conjunction with the consideration of an application to rezone and subdivide 84 country residential lots situated in the W ½ 11-37-04-03M known as Eagle Heights Country Residential Estates (the Site).

The objective of this screening is to document and inventory the current environmental, natural, cultural and historical assets that are present within the development area as a means of refining the boundaries of the Green Network Study as stated in Section 13.01 of the Saskatoon North Partnership for Growth Regional Plan.

2 REGULATORY CONTEXT

The following federal and provincial acts, regulations and policies influence development within the Site.

2.1 Federal

Species at Risk Act

The purposes of the *Species at Risk Act* are to prevent wildlife species in Canada from disappearing, to provide for the recovery of wildlife species that are extirpated (no longer exist in the wild in Canada), endangered, or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened. The Act legislates the protection of these species and the designation of critical habitat through agreement, permits, public registry and land dedication.

Migratory Birds Convention Act

This Federal Act provides policies and authorizes the Federal Minister of Environment to control activities that potentially disturbs migratory birds, their eggs and nests. The Act stipulates that no active nesting site or habitat of a migratory bird species shall be disturbed during nesting or rearing periods which generally occurs between April and August.

The Canadian Environmental Protection Act

The Canadian Environmental Protection Act is aimed at preventing pollution and protecting the environment and human health. The goal of the Act is to contribute to sustainable development - development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Discharges of pollution into the environment fall under the jurisdiction of this Act.

The Canada Wildlife Act

The Canada Wildlife Act covers the protection of at-risk plant and animal species. The Act prohibits actions that would impact species at risk and allows for the designation of these species as extirpated, endangered, threatened, or vulnerable.

2.2 Provincial

Saskatchewan Wetland Policy

This policy which was adopted in 1995, encourages sustainable management of wetlands and the restoration and rehabilitation of degraded wetland areas.

The Weed Control Act

The Weed Control Act requires that every owner or occupant of land shall, under the supervision of a designated municipal weed inspector, take measures to control or eradicate any prohibited, noxious and nuisance weeds as designated by the Act.

The Wildlife Act

The Wildlife Act prohibits anyone from killing, injuring, possessing, disturbing, taking, capturing, harvesting, genetically manipulating or interfering with any wild species at risk. Where a breeding site for a species at risk is identified within a study area, the Saskatchewan Ministry of Environment should be consulted to confirm a recommended setback distance at the time of development.

The Planning and Development Act/Dedicated Lands Regulations

The Planning and Development Act establishes the basis for responsible land management in the province. The Act defines what characteristics of land justify its designation as Environmental Reserve and/or a Municipal Utility Parcel. Environmental Reserve is deemed to be an appropriate designation where the land consists of:

a. a ravine, coulee, swamp, natural drainage course or creek bed;
b. wildlife habitat or areas that:
    - are environmentally sensitive;
    - or contain historical features or significant natural features;
c. land that is subject to flooding or is, in the opinion of the approving authority, unstable; or
d. land that abuts the bed and shore of any lake, river, stream or other body of water and that is required for the purpose of:
    - the prevention of pollution;
    - the preservation of the bank; or
    - the protection of the land to be subdivided against flooding.

The Act also recognizes and accounts for the dedication of land for the purposes of locating a public work which includes drainage systems and facilities.

Environmental Assessment Act

The Environmental Assessment Act states that a proponent of a 'development' shall conduct an environmental impact assessment. A 'development' under the Act is defined as any project, operation or activity that is likely to:

- have an affect on any unique, rare or endangered feature of the environment;
- substantially utilize any provincial resource and in so doing pre-empt the use, or potential use, of that resource for any other purpose;
- cause the emission of any pollutants or create by-products, residual or waste products which require handling and disposal in a manner that is not regulated by any other Act or regulation;
- cause widespread public concern because of potential environmental changes;
- involve a new technology that is concerned with resource utilization and that may induce significant environmental change; or
- have a significant impact on the environment or necessitate a further development which is likely to have a significant impact on the environment.

Environmental Management and Protection Act

Pursuant to the above noted Act, no person shall discharge or allow the discharge of a substance into the environment in an amount, concentration or level or at a rate of release that may cause an adverse effect. The Act also regulates shoreline alteration activities and states that a permit is required if any of the following are to occur:

- alter or cause to be altered the configuration of the bed, bank or boundary of any river, stream, lake, creek, marsh or other watercourse or water body;
- remove, displace or add any sand, gravel or other material from, in or to the bed, bank or boundary of any river, stream, lake, creek, marsh or other watercourse or water body; or
- remove vegetation from the bed, bank or boundary of any river, stream, lake, creek, marsh or other watercourse or water body.

3 ASSESSMENT METHODS

The methods used to complete this screening include:

- A desktop study to gather available background data using readily available information about the Project area (i.e. plans, maps, figures, aerial photographs) and existing databases (e.g. the Saskatchewan Conservation Data Center, the Biodiversity Website (HABISask), GeoSask, the Committee on the Status of Endangered Wildlife in Canada status reports, Schedule 1 of Species at Risk (SARA), the Government of Saskatchewan's Bird's Atlas, the Water Security Agency's Water Well Information Database); and
- A preliminary heritage and archaeological screening assessment using the Government of Saskatchewan, Ministry of Parks, Culture and Sports, Developer's Online Screening Tool.

Designated areas would consist of National or Provincial Park Lands, Historic Parks, Water Security Agency, Game Preserve, National Wildlife Area, Migratory Bird Sanctuary, Conservation Easements, Crown Conservation Easements, Crown Land Subdivisions, Ecological Reserves, Fish and Wildlife Development Fund Lands, Community Pastures – Federal, Ramsar Wetland, Reservoir Development Areas, Representative Areas, Community Pastures – Provincial, Special Management Areas, Wildlife Habitat Protection (WHPA), Wildlife Refuge, Private Stewardship Agreement, Wind turbine Avoidance Zone

The study area for the screening consists of 2 km radius from the approx. center of the Site that is being considered, unless otherwise noted.

In addition to the desktop screening, a visit field was conducted by Wade Sumners, P.Biol. on October 25, 2019 to confirm the land use and dominant plant communities.

4 SCREENING RESULTS

4.1 Land Use Designation

Obtained from HabiSask - http://biodiversity.sk.ca/HABISask.htm

Surrounding Land Use: Treed, wetland, cropland, residences

Designated areas: none

The nearest Agricultural Crown Land can be found 8.5 km west of the property, adjacent to the South Saskatchewan River, while the nearest Migratory Bird Sanctuary is located at the Saskatoon Forestry Farm Park and Zoo which is 6.9 km to the west.

Nearest Aboriginal Lands: Asimakaniseekan Askiy I.R. 102 - Urban reserve within the City limits of Saskatoon - 8.4 km southwest of the Site.

4.2 Soil and Topography

Obtained from The Soils of the Saskatoon Map Area (73B) – http://sis.agr.gc.ca/cansis/publications/surveys/sk/sks4/index.html

Chernozemic Dark Brown soils (formed under a grassland vegetation) - developed from a parent material that is medium to moderately fine textured, moderately to strongly calcareous, being comprised of unsorted glacial till and silty glacio-lacustrine deposits.

Map Units (dominant): W4, E3
Texture: loam
Landform: knob and kettle
Slope: 6 - 9 % moderately sloping or gently rolling (class 4)

4.3 Ecoregion and Terrestrial Vegetation

Ecozone: Prairie
Ecoregion: Moist Mixed Grassland

Obtained from http://biodiversity.sk.ca/HABISask.htm and Acton, D.F., G.A. Padbury, C.T. Stushnoff. 1998. Ecoregions of Saskatchewan. Canadian Plains Research Center, University of Regina, Regina, SK.

Trees and shrubby vegetation in this region generally occur along stream courses and permanent sloughs. The margins of the wetlands and small lakes are typically dominated by cattails, bulrushes, and sedges. The remaining land base is mostly agricultural crops and grasses with a number of flowering plants and shrubs found in the lower, moister areas (Acton et al. 1998). Native vegetation in this ecoregion is limited to non-arable pasture lands, where spear grasses (Hesperostipa spp.) and wheatgrasses (Agropyron and Elymus spp.), along with deciduous shrubs such as snowberry (Symphoricarpos albus), rose (Rosa spp.), chokecherry (Prunus virginiana), and wolf willow (Elaeagnus commutate) are among the more common species. Small aspen groves are typically found around the sloughs and are a characteristic feature of the landscape.

During the field visit it was observed that the vegetation types included modified grassland (dominated by smooth brome grass (Bromus inermis), Kentucky bluegrass (Poa pratensis), snow berry and wolf willow), treed areas, and wetlands. A couple small hill tops did have elements of native grassland (e.g. speargrass, wheatgrass, and june grass (Koeleria macrantha)) but these areas have been invaded by the invasive grasses and shrubs that are dominant at the site. Treed areas were comprised of trembling aspen (Populus tremuloides), balsam popular (Populus balsamifera), and the following shrubs: Saskatoon (Amelanchier alnifolia), willow (Salix spp.), dogwood, chokecherry, rose, wolf willow, and snowberry. Cattails (Typha latifolia), trembling aspen, willow (Salix spp.), sow thistle (Sonchus arvensis), slough grass (Beckmannia syzigachne), foxtail barley (Hordeum jubatum), reed canary grass (Phalaris arundinacea), and rushes (Juncus spp.) were found associated with low and seasonally wet areas throughout the Site.

As well, a moderately sized (area of approx. 1,300 m^2) stand of European buckthorn (Rhamnus cathartica) was observed near a temporary wetland in the northern portion of the Site. This species is invasive often forming dense, even-aged thickets, crowding and shading out native shrubs and herbs. A carpet of buckthorn seedlings often occurs and was present in this stand; preventing native tree and shrub establishment. This species is spread by seed and often acts as a diuretic for birds that eat its berries. Approx. 10,000+ individuals were estimated to occupy this stand.

4.4 Groundwater Wells and Groundwater

Water well drilling records near the Site (Obtained from - https://gis.wsask.ca/Html5Viewer/index.html?viewer=WaterWells.WellsViewer/

10 water wells were identified within 1.6 km of the Parcel, two wells (soil test holes for research purposes) are within the Site.

It is important to note that the database does not contain or identify all the wells completed in the province, only those records that were submitted by drillers.

4.5 Aquatic Resources

Aquatic Resources present:

11 wetlands were observed within and crossing the Site. Wetlands were classified according to Stewart and Kantrud's (1971) wetland classification system (https://pubs.usgs.gov/rp/092/report.pdf) which identifies specific vegetation zones surrounding the wetland and assigns a class based on the vegetation present.

Area ID	Area (ha)	Class	Description	Concerns	Potential Mitigation
PW01	0.46	5	Permanent wetland	Affected by farming activities	Stormwater Management Plan
PW02	3.24	5	Permanent wetland	Affected by farming activities	Stormwater Management Plan
TW01	0.44	2	Temporary wetland	none	Lost
TW02	0.13	2	Temporary wetland	Affected by farming activities	Lost
PW03	8.43	5	Permanent wetland	Affected by farming activities	Stormwater Management Plan
TW03	0.25	2	Temporary wetland	None	Lost
TW04	0.21	2	Temporary wetland	None	Lost
TW05	0.13	2	Temporary wetland	None	Lost
TW06	0.01	2	Temporary wetland	None	Lost
PW04	1.47	5	Permanent wetland	Affected by farming activities	Lost
PW05	4.48	5	Permanent wetland	Affected by farming activities	Stormwater Management Plan

Permanent Wetland (PW) - An open-water zone dominates the deepest part of the wetland area while the presence of vascular plants in this zone is rare. Peripheral deep-marsh, shallow-marsh, wet-meadow, and low-prairie zones are often present surround this open water zone. These ponds and lakes maintain fairly stable water levels throughout the year.

Temporary Wetland (TW) – Vegetation occupies the central areas of shallower pond basins and commonly occurs as a peripheral band in most of the deeper ponds and lakes. The wet-meadow zone dominates the deepest part of the wetland area. A peripheral low-prairie zone is usually present. Water loss from bottom seepage is fairly rapid in this wetland and is maintained for only a few weeks after the spring snowmelt and occasionally for several days after heavy rainstorms in late spring, summer, and fall.

There are no watercourses (i.e. creeks) on the Site and there is no evidence that any of the wetland complexes contain fish or provide fish habitat.

4.6 Wildlife and Wildlife Habitat

The east portion of the Site has not been cultivated – likely due to an undulating landform in this area. Wildlife and signs of wildlife (e.g. scat, bark rubbing, twig browsing, numerous burrows) were present throughout this uncultivated area. Six white tail deer were observed during the survey. Although few birds were observed during this visit, it can be expected that this area is heavily used by migratory bird species due to the fruit bearing shrubs and suitable habitat in this portion of the Site. Wildlife trails were well established, in this area, which may also be contributed to by nearby resident usage (i.e. for walking).

4.7 Protected Species

Historic records of occurrence of protected species obtained from http://biodiversity.sk.ca/HABISask.htm

Table 4-1
Historic Occurrences of Protected Species within 2 km of the Site

Common Name	Species	Ranking	Preferred Habitat
Plains rough fescue	*Festuca hallii*	S3 (uncommon)	dry grassland[1]
White-top	*Erigeron strigosus*	S3 (uncommon)	open, disturbed sites[2]
Whooping crane	*Grus americana*	S1 (very rare)	marshes, bogs, and shallow lakes[3]

4.8 Heritage Resources

A Heritage Resources Impact Assessment (HRIA) was completed in the Site, on October 31st, 2013, by CanNorth. Areas were assessed using a combination of pedestrian reconnaissance and the excavation of subsurface shovel probes. No archaeological sites were identified, and it has been recommended that the Project be provided with regulatory approval, according to Section 63 of *The Heritage Property Act*, allowing the residential subdivision development to proceed as planned.

If Project plans are altered, or if heritage resources are discovered during construction, the Heritage Conservation Branch (HCB) must be notified immediately. In the event that human remains are discovered during construction activities, the local RCMP detachment and the HCB (306-787-2817) will need to be contacted.

---

[1] Moss, 1983. Flora of Alberta. 2nd Ed (J.G. Packer Editor) University of Toronto Press, Toronto.

[2] http://www.efloras.org/flora_page.aspx?flora_id=1

[3] https://wildlife-species.canada.ca/species-risk-registry/species/speciesDetails_e.cfm?sid=34

5 SUMMARY AND RECOMMENDATIONS

The environmental impacts resulting from the planned activities on this Site are expected to be low because of the dominance of non-native and invasive vegetation and the plan to incorporate portions of these natural areas in the development. Cultivated land, modified grassland, trees and wetlands form the predominant vegetation types on the Site. Modified grassland is dominated by the aggressive expansion of smooth brome grass, Kentucky bluegrass, and shrubs; which are common and widespread in Saskatchewan. The species present in this modified grassland often change growing conditions (e.g. increasing leaf litter and retaining surface moisture) for native species, limiting their establishment. Areas with elements of native grassland on the Site are being invaded by these species, thereby limiting its designation as native prairie. It is expected that these areas will transition into the surrounding modified grassland vegetation type.

European buckthorn should be removed from the Site, by active management or partnering with a group that is managing this species. Meewasin Valley Authority has conducted an eradication program for this species along the South Saskatchewan River for several years (10+) and an agreement could be made to reduce the stand at the Site. This species is designated as a noxious weed in Saskatchewan and some form of control is required pursuant to *The Weed Control Act*. Leaving this stand idle will allow this species to continue to dominate the understory and spread beyond this Site.

The development plan for the site proposes the retention of approximately 25% of the gross land area to be publicly dedicated and maintained in a naturalized state in conjunction with a stormwater management plan for the site. This plan includes three parcels that have the largest wetlands within the property and are intended to be enhanced to provide greater delineation of the wetland boundaries and to increase their storage capacity in relation to the proposed development of the remaining areas of the Site. Naturalization of these stormwater retention areas will support the preservation of natural habitat and offer continued public access to these areas.

Construction activities should be conducted outside of the avian breeding period (before April 15 to August 30) as per *The Migratory Birds Convention Act*. If land clearing must take place during this period, a qualified person should be present to confirm that there are no active nests in the area within seven days of clearing. Construction activities should also seek to minimize the disturbance to the natural vegetation, provide erosion and sediment control and should be scheduled to avoid sensitive periods such as bird nesting. Where disturbance is inevitable, the site should be restored to a natural state through the reintroduction of compatible and complementary plant species.

The RM of Corman Park Zoning Bylaw encourages the retention of trees and vegetation during lot development and outright restricts the removal of trees or other vegetation within 20 metres of a water body where the removal could have a negative impact on the water body. This undeveloped buffer along the back of lots supports continued wildlife access and movement within the area while also providing substantial benefits for enhancing water quality. For bank stability, temperature control, minimization of direct impacts, and pollutant removal capacities, substantial benefits are achieved within the first 15 metres of vegetated buffer width. Studies indicate that marginal increases in benefits may accrue when buffer widths are increased beyond this distance.[4] The application of stormwater best management practices (BMPs), when used in conjunction with riparian and wetland buffer strips, can result in a significant increase in water-quality benefits from vegetated buffers.

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[4] https://www.stormh2o.com/home/article/13004950/riparian-and-wetland-buffers-for-waterquality-protection

Based upon the observed conditions, the vegetative diversity in wetland areas can be considered low due to the existence of reed canary grass and other non-native species and the surrounding agricultural activities. It is common for wetlands that predominantly perform a stormwater management function to have a low ecological value. The Class 5 wetlands within the Site serve an important function in flood attenuation and improving water quality. The wetlands are part of a terminal basin where significant runoff storage occurs (+4 meters deep) before water tips out of the wetlands and into adjacent low-lying areas. As a terminal basin, these wetlands offer semi-permanent storage which supports a high rate of biological activity; enabling the natural transformation of many of the common pollutants that occur in stormwater runoff into harmless by-products and essential nutrients that can be used to promote and support biological productivity.[5]

[5] City of Moncton, 2015. Naturalized Stormwater Management Guidelines, Public Report. Moncton NB.

6 NATURAL AREA INVENTORY

Legend

PW - Permanent Wetland
TW - Temporary Wetland
MG - Modified Grassland
TR - Trees
A- European Buckthorn
B - Elements of Native Grassland

Project No. 2012-4165
Date: 2019/12/20
Scale: 1:5000

Associated Engineering

Eagle Heights Country Estates

Natural Area Inventory

7 SITE PHOTOS

Photograph 1: Modified grassland, wetlands and cultivated fields were the dominant vegetation types on the Site

Photograph 2: Modified grassland was comprised of smooth brome grass, Kentucky bluegrass and shrubs

Photograph 3: European buckthorn (a noxious plant) was present in a moderately sized stand near a temporary wetland

Photograph 4: European buckthorn seedings in the understory of the stand

Photograph 5: Several tree rubbings were observed

Photograph 6: Several burrows were observed on the site

Photograph 7: A temporary wetland observed at the Site

CERTIFICATION PAGE

This report presents our findings regarding the Natural Area Screeening for the proposed Eagle Heights Country Residential Estates Development.

Respectfully submitted,

Prepared by:

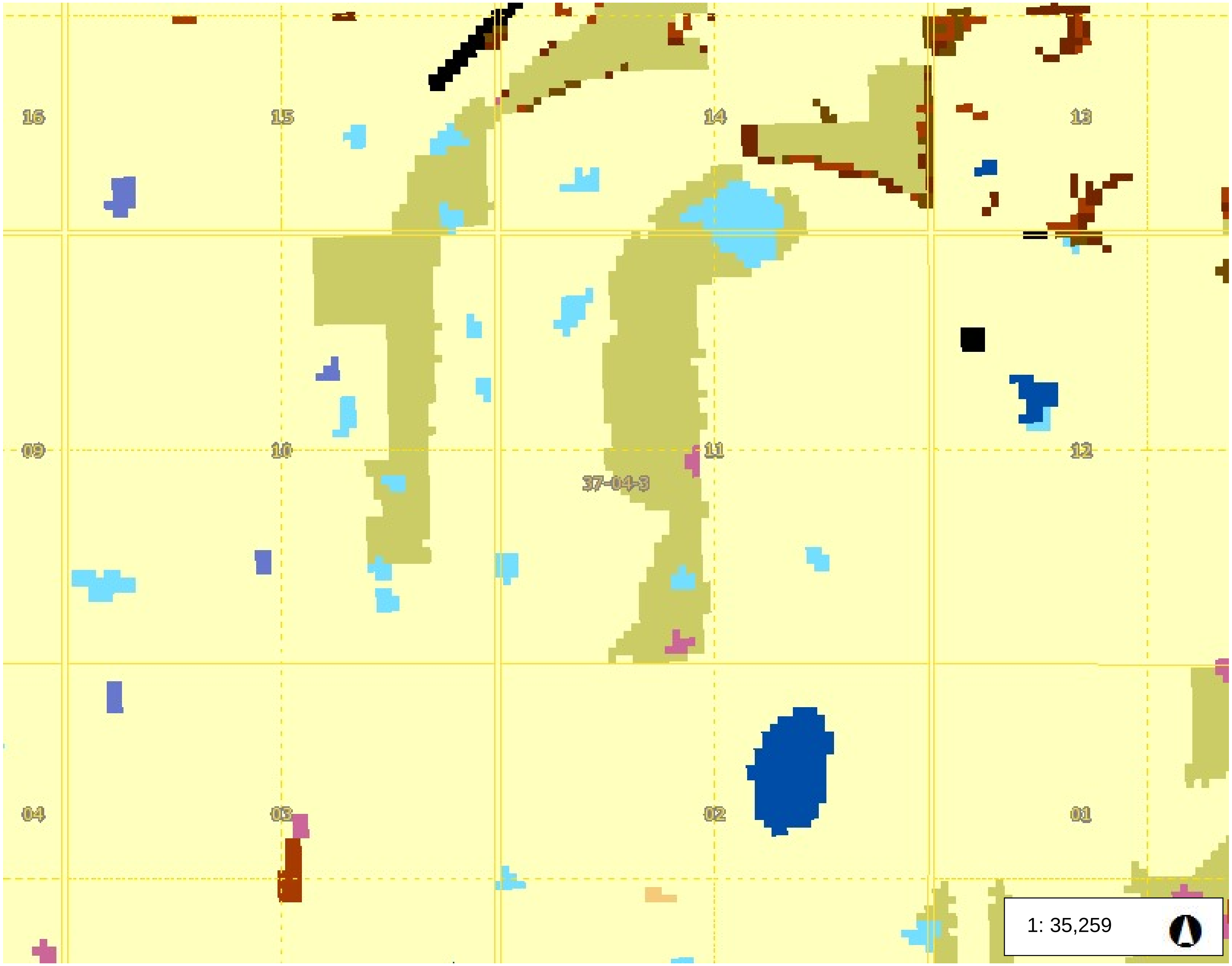
Wade Sumners, P.Biol.
Senior Biologist

Reviewed by:

Bill Delainey, RPP
Project Manager

Eagle Heights

HABISask
hunting | angling | biodiversity



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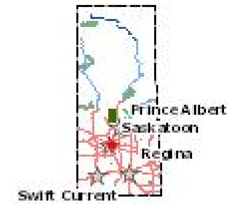


Legend

- Township
- Section
- Quarter Section

Sask Digital Land Cover

- Agriculture
- Hay Crops (Forage)
- Native Dominant Grasslands
- Tall Shrubs
- Pasture (Seeded Grass Lands)
- Hardwoods (Open Canopy)
- Hardwoods (Closed Canopy)
- Jackpine (Closed Canopy)
- Jackpine (Open Canopy)
- Spruce (Closed Canopy)
- Spruce (Open Canopy)
- Mixed Woods
- Treed Rock
- Recent Burns
- Revegetating/Regeneration Burn
- Cutovers
- Water
- Marsh
- Herbaceous Fen
- Mud/Sand/Saline
- Shrub Fen (Treed Swamp)
- Treed Bog

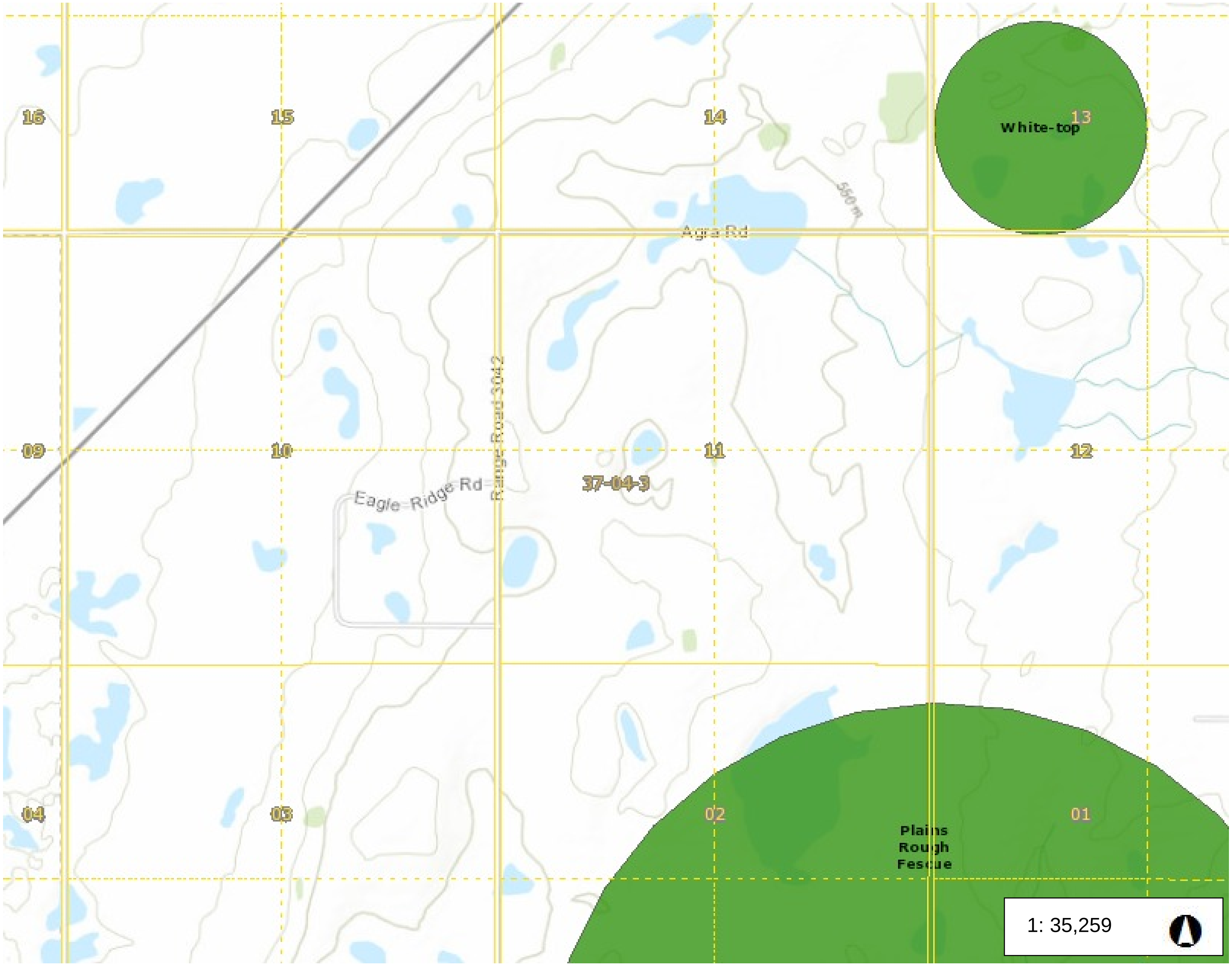
Notes

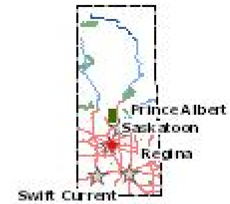
1.8 0 0.90 1.8 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.
THIS MAP IS NOT TO BE USED FOR NAVIGATION

Eagle Heights Identified Species





Legend

- Bird Species
- Township
- Section
- Quarter Section
- Rare and Endangered Species
  - Vertebrate Animal
  - Invertebrate Animal
  - Animal Assemblage
  - Vascular Plant
  - Nonvascular Plant
  - Other (Botanical)
  - Fungus

Notes

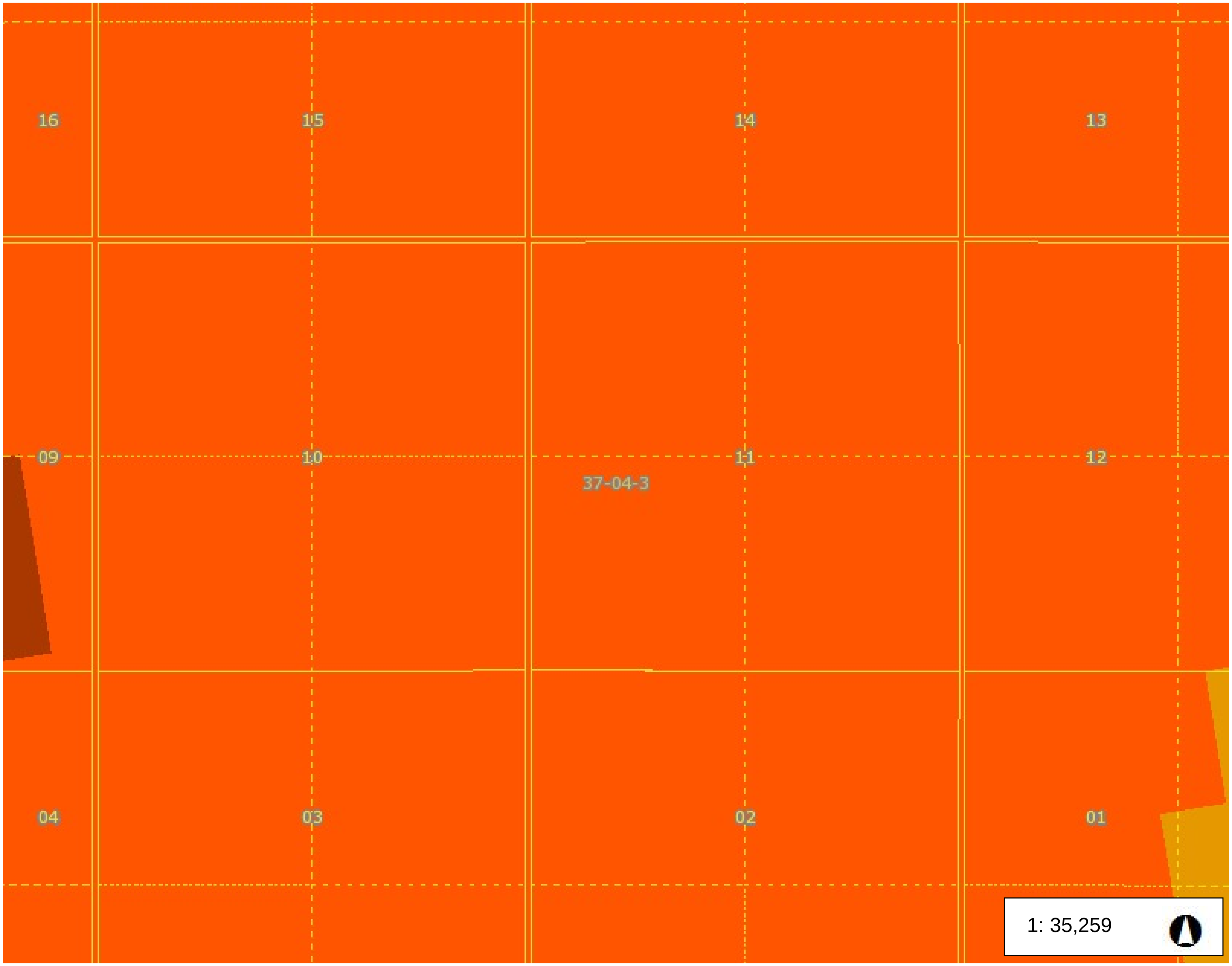
1.8 0 0.90 1.8 Kilometers

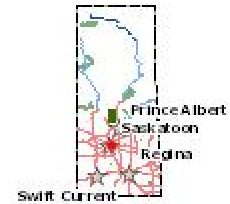
WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Eagle Heights Soil Classification





Legend

- Township
- Section
- Quarter Section
- Saskatchewan Soil Capability (
  - Class 1
  - Class 2
  - Class 3
  - Class 4
  - Class 5
  - Class 6
  - Class 7
  - Organic

Notes

1.8 0 0.90 1.8 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

Appendix D: Traffic Impact Assessment

Associated Engineering
GLOBAL PERSPECTIVE.
LOCAL FOCUS.

REPORT

101120614 Saskatchewan Ltd.

Eagle Heights
Traffic Impact Assessment

April 2018

CANADA'S BEST MANAGED COMPANIES
Platinum member

Table of Contents

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1 Introduction

Associated Engineering, on behalf of the developer of Eagle Heights, studied the traffic impacts of a proposed 83-lot country residential community located in the W ½ 11-37-4-W3, approximately four kilometers west of the City of Saskatoon. The site is located one kilometer to the east of Highway 41 which is designated as a major arterial highway by the Saskatchewan Ministry of Highways and Infrastructure (MHI). The study location is shown in Figure 1-1 (Background Image: Google).

Figure 1-1
Study Location

Since the site is located outside City limits and is adjacent to a provincial highway, MHI design standards apply to this report. This report is designed to meet MHI traffic impact study requirements and focuses on motor vehicle traffic at the intersection of Highway 41 and Agra Road. As this site is a rural location, the site is excepted to have negligible active transportation and no transit services.

2 Background

2.1 SPEED LIMITS AND DESIGN SPEEDS

The speed limit on Highway 41 is 100 km/h and the speed limit on Agra Road is 80 km/h. The design speed of Highway 41 is 130 km/h based on Annual Average Daily Traffic (AADT) and outlined in Ministry Standard Plan 20020. The grid road design speed is 80 km/h in accordance with the Saskatchewan Association of Rural Municipalities (SARM) guidelines.

2.2 CROSS SECTIONS AND GEOMETRY

Both Highway 41 and Agra Road have rural cross sections. There are no sidewalks, curbs, or gutters adjacent to the road structure.

The intersection of Highway 41 and Agra Road lies on a skew angle of approximately 45°.

2.3 SURROUNDING LAND USE

Surrounding land uses are predominately agricultural. The rural residential subdivision of Eagle Ridge lies directly to the west of the proposed development. Both developments use Agra Road as their sole access to Highway 41. The development is approximately 4 km west of Saskatoon.

2.4 SIGHT DISTANCE

Sight distance was observed in the field during the manual count. The surrounding terrain is flat with a slight rise to the east of Highway 41. Sight distance from the proposed development access on Agra Road to the northeast and southwest exceeds 1 kilometer, well over the MHI minimum sight distance.

Standard Plans 20630 and 20632 outline the entering sight distance standards for passenger vehicles and trucks. Both Standard Plan requirements are met with sight distances over 1 km in both directions.

2.5 ACCESS MANAGEMENT

Highway 41 is an undivided highway with Access Management Level R-3. No new access to Highway 41 is contemplated as part of the proposed development. No changes to the access management plan are proposed as a result of this study.

2.6 DRAINAGE

No changes to highway ditch drainage geometries are proposed. On-site storage and other drainage considerations are the subject of a separate study by Associated Engineering.

3 Traffic Volumes

3.1 DESIGN HOUR AND HORIZON YEAR

The proposed country residential community consists of an 83-lot single family dwelling subdivision. The half section development will be completed in four phases over the course of 20 years.

Traffic at the study intersection was obtained by manually counting for two hours in the morning and two hours in the afternoon of January 11, 2018 at the intersection of Highway 41 and Agra Road. The peak hour within each count period was used in the analysis as the design hour. The AM peak hour was observed from 7:15 AM to 8:15 AM and the PM peak hour was observed from 4:30 PM to 5:30 PM.

The expected project completion year is 2038, which is used as the design horizon year in this report.

3.2 BACKGROUND TRAFFIC

Background traffic volumes were obtained through a manual traffic count. The detailed count can be found in Appendix A. The volumes obtained through the count were adjusted to annual averages based on day of week and month of count using MHI document *Travel on Saskatchewan Highways*. A count-date factor of 1.24 was used for the study intersection.

A 15-year growth factor of 1.35 was provided by MHI for this portion of Highway 41. Using the MHI Equation SKS 2.3.1-C-Eq.10, the traffic volumes from the 2018 manual count were converted to background traffic volumes for the design horizon year using a factor of 1.47.

Traffic counts identified between 1.5% and 10.0% heavy trucks on Highway 41 in peak periods, depending on direction of travel and time of day. An average value of 6.0% was used for all through movements on Highway 41.

The west leg of the intersection, Agra Road, is currently a low volume grid road. During the count period nine vehicles were observed on Agra Road west of Highway 41. There is no plan for Agra Road to connect to the North Commuter Parkway and become an access point to the City of Saskatoon transportation network. Because of the low traffic volume, the west leg was not considered in detail.

Background traffic volumes in the AM and PM peak hours in the base year are summarized in Figure 3-1. Projected background traffic volumes in the AM and PM peaks hours of design year are summarized in Figure 3-2.

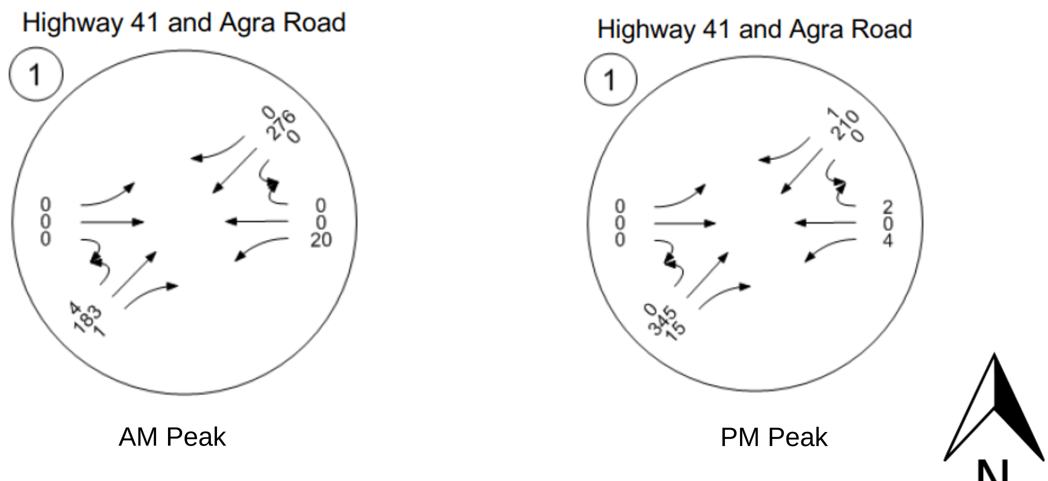

Figure 3-1
Background Traffic Volume, 2018

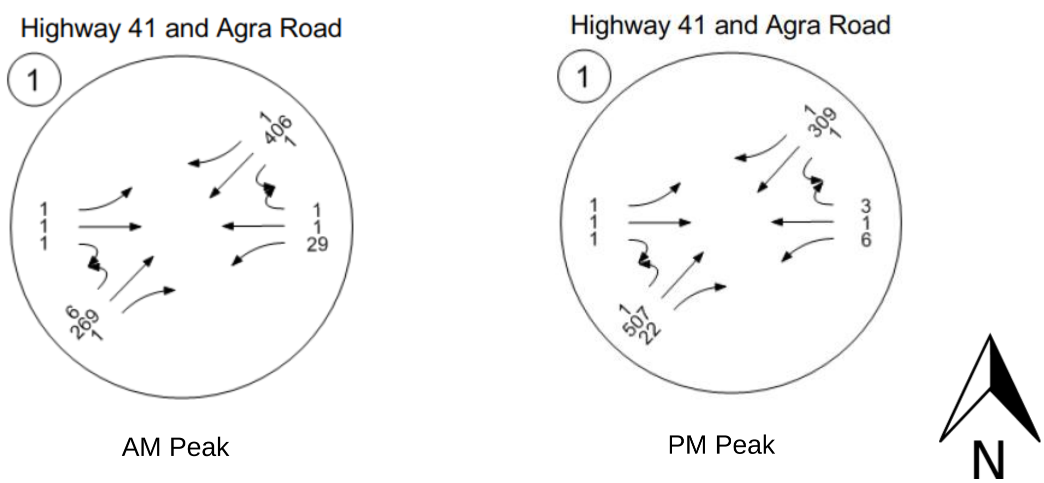

Figure 3-2
Background Traffic Volume, 2038

3.3 DAILY TRAFFIC VOLUMES

MHI uses annual average daily traffic (AADT) volumes on Highway 41 and the minor leg when calculating lighting warrants and flared intersection treatment warrants. 2016 daily traffic volumes for Highway 41 are available through MHI. The AADT values provided were grown to 2018 and 2038 using the growth factor supplied by MHI. AADT along Agra Road was estimated by converting the manual four-hour count to daily traffic based on the MHI distribution graphs for hour of day. The manual count represents an estimated 24.8% of daily traffic; a factor of 4.03 was used to convert hourly data to daily traffic. Table 3-1 summarizes the estimated AADT for Highway 41 and Agra Road.

Table 3-1
Estimated Annual Average Daily Traffic

Year	Highway 41 (vpd)	Agra Road East of Highway 41 (vpd)	Agra Road West of Highway 41 (vpd)
2016 from MHI	4,900	NA	NA
2018 Background	5,100	160	8
2038 Background	7,500	240	10
2038 Full Buildout	8,500	680	10

3.4 DEVELOPMENT TRIP GENERATION

Eagle Heights trip generation was estimated using the Institute of Transportation Engineer's *Trip Generation Manual*, 8th Edition. The proposed 83-lot country residential development is expected to generate traffic similar to Single Family Detached Housing, Land Use Code 210. A factor of 0.8 was applied to the average trip generation rate of adjacent street traffic to represent the expected lower trip generation of a country residential unit relative to the published case of a typical U.S. suburb. The percent traffic entering and exiting remained consistent with Land Use Code 210 in the TGM. This assumption was compared to the traffic volumes generated by the nearby 27-lot country residential development of Eagle Ridge and the TGM specified trip generation rates for the AM and PM peak hours. Table 3-2 summarizes the trip generation rate comparison for the existing country residential community.

Table 3-2
Trip Generation Comparison

	AM Peak hour WB Left Turns		Total AM Trips	PM Peak hour NB Right Turns		Total PM Trips
	Rate (Trips/ Dwelling Unit)	Trips Exiting		Rate (Trips/ Dwelling Unit)	Trips Entering	
Count Data, Eagle Ridge	0.63	16	17	0.63	12	17
ITE TGM Land Use Code 210	0.75	15	20	1.01	17	27
Adjusted Country Residential	0.60	12	16	0.81	14	22

The trips generated by the existing development of Eagle Ridge more closely resemble the trips generated by the adjusted TGM rates. In the PM scenario, the adjusted rates remain conservative relative to the counted rates.

Using the adjusted rates, the results of the total trip generation for the proposed development of Eagle Heights are illustrated in Table 3-3.

Table 3-3
Trip Generation for Eagle Heights

	Inbound Trips	Outbound Trips	Total Trips
AM Peak Hour	12	38	50
PM Peak Hour	42	25	67

3.5 PASS-BY, DIVERTED LINK, AND INTERNAL CAPTURE

Pass-by, diverted link and internal capture were considered negligible due to land use type and distance from commercial or industrial areas. These trip types were not considered further in this study.

3.6 TRIP DISTRIBUTION AND ASSIGNMENT

All site generated traffic was assigned to the intersection of Highway 41 and Agra road as the only viable exit from the development, with 0% of vehicles continuing to Agra Road, 3% travelling towards Aberdeen, and the remaining 97% towards Saskatoon. Inbound vehicles are expected to arrive from the same direction from which they departed.

3.7 TOTAL TRAFFIC

The combined traffic volume for 2038 was calculated by adding the development traffic to the future background traffic. To avoid zero-volume movements an additional 1 vehicle per hour (vph) was added to any traffic movement without existing volume. This addition facilitates traffic analysis and acknowledges the possibility of traffic on lower volume roads. Figure 3-3 shows the total traffic volume for both peak hours. Appendix B includes detailed traffic volumes at the study intersection.

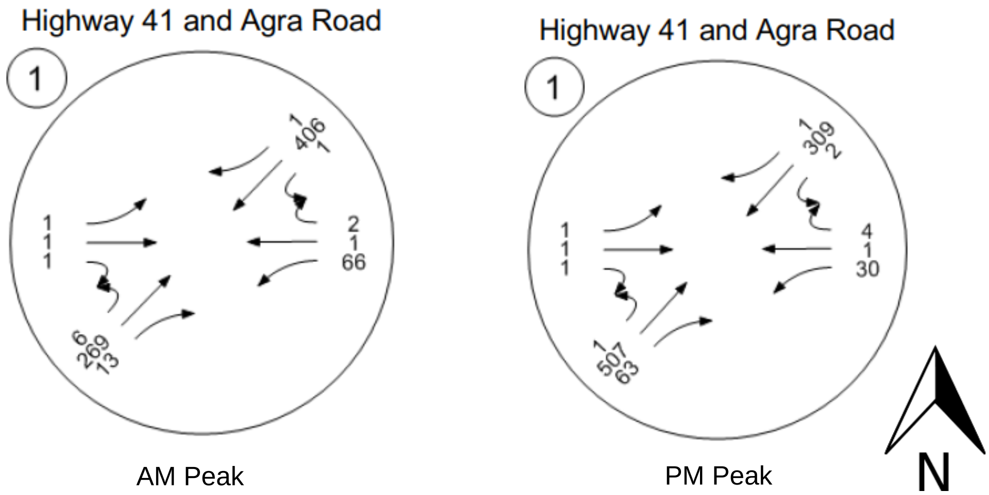

Figure 3-3
Combined Future Volume, 2038

4 Traffic Analysis

4.1 ANALYSIS METHOD

The study intersection was analysed using PTV Vistro ™ software and methods from the *Highway Capacity Manual*, 6th Edition (HCM) to determine level of service (LOS) and delays for background and combined traffic volumes for the design year. Appendix B contains the results of the traffic analysis.

A number of assumptions were made based off the manual traffic count or to facilitate analysis in Vistro. The following assumptions were made:

- Trip generation is 80% of the TGM average rate for Single Family Detached Housing.
- The heavy truck proportion is 6.0% for Highway 41 through movements.
- The peak hour factor is 0.96 for the study intersection.
- A minimum traffic volume of 1 vph was used.

Level of service analysis and MHI warrant analyses were completed for the current year, the 2038 background traffic conditions, and combined traffic volumes.

4.2 LEVEL OF SERVICE

The level of service for all movements in each scenario is within acceptable limits. Level of service for all movements, including turning movements, on Highway 41 remain A across all scenarios. Movement from the stop controlled Agra Road range between B to C, with average delays no worse than 19.5 s. Table 4-1 summarizes the LOS and delay for the worst approach in each scenario. Appendix B includes detailed level of service reports for each scenario.

Table 4-1
Capacity Analysis for Study Intersection

		Worst Approach			
Scenario	**Control**	**Approach**	**Delay**	**LOS**	**v/c**
2018 Background Traffic					
AM Peak	Stop	WB	12.6 s	B	0.04
PM Peak	Stop	WB	12.7 s	B	0.01
2038 Background Traffic					
AM Peak	Stop	WB	16.3 s	C	0.09
PM Peak	Stop	WB	16.3 s	C	0.02
2038 Full Build-out Traffic					
AM Peak	Stop	WB	18.1 s	C	0.20
PM Peak	Stop	WB	19.5 s	C	0.12

4.3 MHI WARRANTS

4.3.1 Traffic Control

The intersection of Highway 41 and Agra Road has stop signs installed on the minor leg for Agra Road eastbound and westbound. No traffic control changes are recommended as part of this study.

4.3.2 Intersection Lighting

The junction of Highway 41 and Agra Road does not currently have any lighting. MHI provides warrants for intersection delineation and intersection area lighting. The warrant sheets for all three scenarios are included in Appendix C.

Intersection delineation lighting refers to a single street light placed over the minor leg on an intersection, typically above the traffic control device. According to MHI DM 2621-01, intersection lighting is warranted at highway intersections where the minor leg AADT is 150 or higher. As discussed in Section 3.3, the four-hour manual count was assumed to account for 24.8% of the daily traffic volume. The estimated background traffic on Agra Road exceeds 150 vpd in both the background 2018 and 2038 scenarios. The addition of new site trips brings the estimated AADT to 680 vpd. Table 4-2 summarizes the delineation lighting warrant results. Delineation lighting is deemed warranted on the east side of the study intersection.

Table 4-2
Delineation Lighting Warrant

	Agra Road East of Highway 41	Agra Road West of Highway 41
2018 Background Traffic	Warranted	Not Warranted
2038 Background Traffic	Warranted	Not Warranted
2038 Full Build-Out	Warranted	Not Warranted

Intersection area lighting is more extensive than delineation lighting, and includes several streetlights adjacent to the highway to illuminate the through and auxiliary lanes of the main highway. According to DM 2621-2, intersection area lighting is warranted if the average through highway AADT exceeds 1,500 vpd, and the intersecting roadway AADT sum is greater than 1,000 vpd. The first condition is met as the average forecasted volumes on both legs is 5100 vpd in 2018. The second condition is not met with an estimated total AADT of 680 vpd. Intersection area lighting is not warranted.

4.3.3 Intersection Treatment

A warrant analysis was carried out for the study intersection on Highway 41 using MHI standard plans 20611 through 20614 for channelization intersection treatment, bypass intersection treatment, flared intersection treatment, and right turn lanes. The turning lane warrant calculations for all three scenarios are included in Appendix D.

Table 4-3 summarizes the results of the intersection warrant analysis. A northeast-bound right turn lane is warranted in all PM peak hour scenarios and its installation is recommended.

Table 4-3
Turning Lane Warrant Analysis Summary

	AM Peak Hour		PM Peak Hour	
	Northeast-bound	Southwest-bound	Northeast-bound	Southwest-bound
2018 Background Traffic	Nil	Nil	Right Turn Lane	Nil
2038 Background Traffic	Nil	Nil	Right Turn Lane	Nil
2038 Full Build-Out	Right Turn Lane	Nil	Right Turn Lane	Nil

4.4 GEOMETRIC GUIDELINES

The intersection of Highway 41 and Agra road lies on a right intersection skew of approximately 45°. The Transportation Association of Canada (TAC) *Geometric Design Guide to Canadian Roads*, 2017 Edition

(GDG) Section 9.4.5 recommends that design domain range from 70° to 90°. The MHI *Geometric Design Guide Supplement* SKS 2.3.2-B recommends intersection angles between 64° and 105°. Realignment of the grid road is recommended to align with these criteria.

5 Recommendations

Based on the analysis described in this report, the following is recommended:

1. Install intersection delineation lighting on east side of Highway 41 before full build-out. Intersection delineation lighting is warranted under baseline conditions.
2. Install a right turn lane for northeast-bound traffic on Highway 41 before full build-out. A right turn lane is warranted under baseline conditions.
3. Reconfigure Agra Road to meet with Highway 41 at a right-angle intersection.

Certification Page

This report presents our findings regarding the Traffic Impact Assessment for 101120614 Saskatchewan Ltd.

Respectfully Submitted,

Prepared By

Ellen McLaughlin

Ellen McLaughlin, B.Sc.

Reviewed By

PROFESSIONAL ENGINEER
K.R. STURGEON
MEMBER 12890
2018 04 10
SASKATCHEWAN

Kevin Sturgeon, P.Eng.

ASSOCIATION OF PROFESSIONAL ENGINEERS
AND GEOSCIENTISTS OF SASKATCHEWAN
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ASSOCIATED ENGINEERING (SASK.) LTD.
NUMBER
C116
Permission to Consult Held By:

Discipline	Sask. Reg. No.	Signature
Transportation Planning	06372	

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF

Signature:

Date: April 11/18

Appendix A – Detailed Traffic Count

Traffic Count Data Summary

Associated Engineering

Hwy 41 & Agra Road		Northbound						Southbound						Eastbound						Westbound						Total	Pedestrians (Crossing in front of vehicles facing)				Departure Leg Vehicle Totals			
Date: January 11, 2018		Left		Through		Right		Left		Through		Right		Left		Through		Right		Left		Through		Right			E/W	E/W	N/S	N/S	NB	SB	EB	WB
Time Interval		Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck	Car	Truck		(NB)	(SB)	(EB)	(WB)				
6:30	6:45																									0					0	0	0	0
6:45	7:00																									0					0	0	0	0
7:00	7:15			14	6	1				48	2									2						73					20	52	1	0
7:15	7:30			19	5					65	1									3						93					24	69	0	0
7:30	7:45			30	1					67	1									3						102					31	71	0	0
7:45	8:00	1		51	3	1				41	1									3						101					54	45	1	1
8:00	8:15	2		35	4					45	2									7						95					39	54	0	2
8:15	8:30	1		26	5					46	2									5						85					31	53	0	1
8:30	8:45	1		16	9	1				52										5						84					25	57	1	1
8:45	9:00			15	2					37	3									5						62					17	45	0	0
9:00	9:15																									0					0	0	0	0
9:15	9:30																									0					0	0	0	0
9:30	9:45																									0					0	0	0	0
9:45	10:00																									0					0	0	0	0
10:00	10:15																									0					0	0	0	0
10:15	10:30																									0					0	0	0	0
10:30	10:45																									0					0	0	0	0
10:45	11:00																									0					0	0	0	0
11:00	11:15																									0					0	0	0	0
11:15	11:30																									0					0	0	0	0
AM Peak Subtotal		3	0	135	13	1	0	0	0	218	5	0	0	0	0	0	0	0	0	16	0	0	0	0	0		0	0	0	0	148	239	1	3
AM Peak Total (non-PCE)		**3**		**148**		**1**		**0**		**223**		**0**		**0**		**0**		**0**		**16**		**0**		**0**										
AM Peak %Truck			0%		9%		0%		0%		2%		0%		0%		0%		0%		0%		0%		0%									
15:00	15:15																									0					0	0	0	0
15:15	15:30																									0					0	0	0	0
15:30	15:45																									0					0	0	0	0
15:45	16:00																									0					0	0	0	0
16:00	16:15			40	1	2				40	7							2								92					41	49	2	0
16:15	16:30			45	5			1		34	5									1	2					93					50	42	1	0
16:30	16:45			58	2	3				49	6	1								1				1		121					61	56	3	1
16:45	17:00			62		2				41	5															110					62	46	2	0
17:00	17:15			82	1	5				27	3									1						119					83	31	5	0
17:15	17:30			73	1	2				35	4									1				1		117					75	40	2	0
17:30	17:45			76	1	3				29	1	1														111					77	30	3	1
17:45	18:00			62	2	3				20	3													1		91					65	23	3	0
18:00	18:15																									0					0	0	0	0
18:15	18:30																									0					0	0	0	0
18:30	18:45																									0					0	0	0	0
18:45	19:00																									0					0	0	0	0
PM Peak Subtotal		0	0	275	4	12	0	0	0	152	18	1	0	0	0	0	0	0	0	3	0	0	0	2	0		0	0	0	0	281	173	12	1
PM Peak Total (non-PCE)		**0**		**279**		**12**		**0**		**170**		**1**		**0**		**0**		**0**		**3**		**0**		**2**										
PM Peak %Truck			0%		1%		0%		0%		11%		0%		0%		0%		0%		0%		0%		0%									

Appendix B - Traffic Volumes and Capacity Analysis

Eagle Heights TIA

Vistro File: \...\Eagle_Heights_TIA_20180305.vistro

Report File: \...\AM_2018_no_dev.pdf

Scenario 1 AM Peak

3/29/2018

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Highway 41 and Agra Road	Two-way stop	HCM 6th Edition	WB Thru	0.002	12.8	B

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. for all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 1: Highway 41 and Agra Road

Control Type:	Two-way stop	Delay (sec / veh):	12.8
Analysis Method:	HCM 6th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.002

Intersection Setup

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Approach	Eastbound			Westbound			Northeastbound			Southwestbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
Speed [km/h]	80.00			80.00			100.00			100.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Base Volume Input [veh/h]	0	0	0	20	0	0	4	183	1	0	276	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00	6.00	0.00
Growth Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	1	1	1	0	1	1	0	0	0	1	0	1
Total Hourly Volume [veh/h]	1	1	1	20	1	1	4	183	1	1	276	1
Peak Hour Factor	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	5	0	0	1	48	0	0	72	0
Total Analysis Volume [veh/h]	1	1	1	21	1	1	4	191	1	1	288	1
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

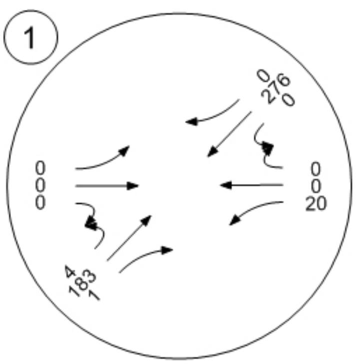
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	Yes	Yes		
Storage Area [veh]	2	2	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	12.39	12.53	9.79	12.71	12.84	9.54	7.81	0.00	0.00	7.59	0.00	0.00
Movement LOS	B	B	A	B	B	A	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.01	0.01	0.01	0.14	0.14	0.14	0.54	0.54	0.54	0.78	0.78	0.78
95th-Percentile Queue Length [m]	0.09	0.09	0.09	1.08	1.08	1.08	4.10	4.10	4.10	5.97	5.97	5.97
d_A, Approach Delay [s/veh]	11.57			12.58			0.16			0.03		
Approach LOS	B			B			A			A		
d_I, Intersection Delay [s/veh]	0.71											
Intersection LOS	B											

Traffic Volume - Base Volume

Highway 41 and Agra Road



Eagle Heights TIA

Vistro File: \...\Eagle_Heights_TIA_20180305.vistro

Report File: \...\AM_2038_no_dev.pdf

Scenario 1 AM Peak

3/29/2018

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Highway 41 and Agra Road	Two-way stop	HCM 6th Edition	WB Left	0.087	16.5	C

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. for all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 1: Highway 41 and Agra Road

Control Type:	Two-way stop	Delay (sec / veh):	16.5
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.087

Intersection Setup

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Approach	Eastbound			Westbound			Northeastbound			Southwestbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
Speed [km/h]	80.00			80.00			100.00			100.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Base Volume Input [veh/h]	0	0	0	20	0	0	4	183	1	0	276	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00	6.00	0.00
Growth Rate	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	1	1	1	0	1	1	0	0	0	1	0	1
Total Hourly Volume [veh/h]	1	1	1	29	1	1	6	269	1	1	406	1
Peak Hour Factor	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	8	0	0	2	70	0	0	106	0
Total Analysis Volume [veh/h]	1	1	1	30	1	1	6	280	1	1	423	1
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

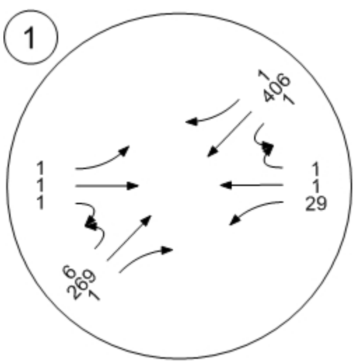
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	Yes	Yes		
Storage Area [veh]	2	2	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.09	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	15.53	15.20	10.71	16.50	16.16	10.72	8.16	0.00	0.00	7.79	0.00	0.00
Movement LOS	C	C	B	C	C	B	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.02	0.02	0.02	0.30	0.30	0.30	0.99	0.99	0.99	1.45	1.45	1.45
95th-Percentile Queue Length [m]	0.13	0.13	0.13	2.25	2.25	2.25	7.57	7.57	7.57	11.04	11.04	11.04
d_A, Approach Delay [s/veh]	13.81			16.31			0.17			0.02		
Approach LOS	B			C			A			A		
d_I, Intersection Delay [s/veh]	0.83											
Intersection LOS	C											

Traffic Volume - Future Total Volume

Highway 41 and Agra Road



Eagle Heights TIA

Vistro File: \...\Eagle_Heights_TIA_20180305.vistro

Scenario 1 AM Peak

Report File: \...\AM_2038_w_dev.pdf

3/29/2018

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Highway 41 and Agra Road	Two-way stop	HCM 6th Edition	WB Left	0.203	18.3	C

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. for all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 1: Highway 41 and Agra Road

Control Type:	Two-way stop	Delay (sec / veh):	18.3
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.203

Intersection Setup

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Approach	Eastbound			Westbound			Northeastbound			Southwestbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
Speed [km/h]	80.00			80.00			100.00			100.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Base Volume Input [veh/h]	0	0	0	20	0	0	4	183	1	0	276	0
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00	6.00	0.00
Growth Rate	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	37	0	1	0	0	12	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	1	1	1	0	1	1	0	0	0	1	0	1
Total Hourly Volume [veh/h]	1	1	1	66	1	2	6	269	13	1	406	1
Peak Hour Factor	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	17	0	1	2	70	3	0	106	0
Total Analysis Volume [veh/h]	1	1	1	69	1	2	6	280	14	1	423	1
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

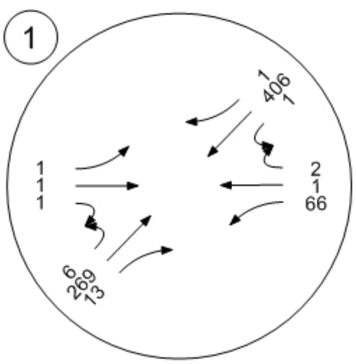
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	Yes	Yes		
Storage Area [veh]	2	2	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.20	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	15.66	15.37	10.71	18.25	17.90	12.41	8.16	0.00	0.00	7.82	0.00	0.00
Movement LOS	C	C	B	C	C	B	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.02	0.02	0.02	0.76	0.76	0.76	1.05	1.05	1.05	1.47	1.47	1.47
95th-Percentile Queue Length [m]	0.13	0.13	0.13	5.80	5.80	5.80	8.03	8.03	8.03	11.22	11.22	11.22
d_A, Approach Delay [s/veh]	13.92			18.09			0.16			0.02		
Approach LOS	B			C			A			A		
d_I, Intersection Delay [s/veh]	1.75											
Intersection LOS	C											

Traffic Volume - Future Total Volume

Highway 41 and Agra Road



Eagle Heights TIA

Vistro File: \...\Eagle_Heights_TIA_20180305.vistro

Report File: \...\PM_2018_no_dev.pdf

Scenario 2 PM Peak

3/29/2018

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Highway 41 and Agra Road	Two-way stop	HCM 6th Edition	WB Left	0.010	13.7	B

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. for all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report

Intersection 1: Highway 41 and Agra Road

Control Type:	Two-way stop	Delay (sec / veh):	13.7
Analysis Method:	HCM 6th Edition	Level Of Service:	B
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.010

Intersection Setup

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Approach	Eastbound			Westbound			Northeastbound			Southwestbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
Speed [km/h]	80.00			80.00			100.00			100.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Base Volume Input [veh/h]	0	0	0	4	0	2	0	345	15	0	210	1
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00	6.00	0.00
Growth Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	1	1	1	0	1	0	1	0	0	1	0	0
Total Hourly Volume [veh/h]	1	1	1	4	1	2	1	345	15	1	210	1
Peak Hour Factor	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	1	0	1	0	90	4	0	55	0
Total Analysis Volume [veh/h]	1	1	1	4	1	2	1	359	16	1	219	1
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

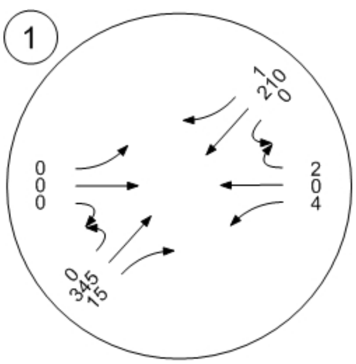
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	Yes	Yes		
Storage Area [veh]	2	2	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	13.63	13.65	9.39	13.66	13.61	10.35	7.65	0.00	0.00	8.02	0.00	0.00
Movement LOS	B	B	A	B	B	B	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.01	0.01	0.01	0.04	0.04	0.04	1.13	1.13	1.13	0.68	0.68	0.68
95th-Percentile Queue Length [m]	0.11	0.11	0.11	0.28	0.28	0.28	8.64	8.64	8.64	5.16	5.16	5.16
d_A, Approach Delay [s/veh]	12.23			12.71			0.02			0.04		
Approach LOS	B			B			A			A		
d_I, Intersection Delay [s/veh]	0.23											
Intersection LOS	B											

Traffic Volume - Base Volume

Highway 41 and Agra Road



Eagle Heights TIA

Vistro File: \...\Eagle_Heights_TIA_20180305.vistro | Scenario 2 PM Peak

Report File: \...\PM_2038_no_dev.pdf | 3/29/2018

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Highway 41 and Agra Road	Two-way stop	HCM 6th Edition	WB Left	0.022	18.4	C

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. for all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report

Intersection 1: Highway 41 and Agra Road

Control Type:	Two-way stop	Delay (sec / veh):	18.4
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.022

Intersection Setup

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Approach	Eastbound			Westbound			Northeastbound			Southwestbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
Speed [km/h]	80.00			80.00			100.00			100.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Base Volume Input [veh/h]	0	0	0	4	0	2	0	345	15	0	210	1
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00	6.00	0.00
Growth Rate	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	1	1	1	0	1	0	1	0	0	1	0	0
Total Hourly Volume [veh/h]	1	1	1	6	1	3	1	507	22	1	309	1
Peak Hour Factor	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	2	0	1	0	132	6	0	80	0
Total Analysis Volume [veh/h]	1	1	1	6	1	3	1	528	23	1	322	1
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

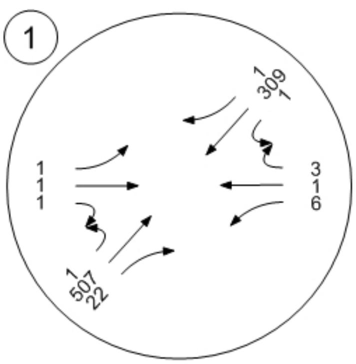
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	Yes	Yes		
Storage Area [veh]	2	2	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	18.29	17.55	10.04	18.39	17.54	11.83	7.89	0.00	0.00	8.50	0.00	0.00
Movement LOS	C	C	B	C	C	B	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.02	0.02	0.02	0.08	0.08	0.08	2.32	2.32	2.32	1.36	1.36	1.36
95th-Percentile Queue Length [m]	0.16	0.16	0.16	0.59	0.59	0.59	17.66	17.66	17.66	10.35	10.35	10.35
d_A, Approach Delay [s/veh]	15.29			16.34			0.01			0.03		
Approach LOS	C			C			A			A		
d_I, Intersection Delay [s/veh]	0.25											
Intersection LOS	C											

Traffic Volume - Future Total Volume

Highway 41 and Agra Road



Eagle Heights TIA

Vistro File: \...\Eagle_Heights_TIA_20180305.vistro

Scenario 2 PM Peak

Report File: \...\PM_2038_w_dev.pdf

3/29/2018

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Highway 41 and Agra Road	Two-way stop	HCM 6th Edition	WB Left	0.118	20.3	C

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. for all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report
Intersection 1: Highway 41 and Agra Road

Control Type:	Two-way stop	Delay (sec / veh):	20.3
Analysis Method:	HCM 6th Edition	Level Of Service:	C
Analysis Period:	15 minutes	Volume to Capacity (v/c):	0.118

Intersection Setup

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Approach	Eastbound			Westbound			Northeastbound			Southwestbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [m]	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [m]	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48	30.48
Speed [km/h]	80.00			80.00			100.00			100.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	No			No			No			No		

Volumes

Name	Agra Road			Agra Road			Highway 41			Highway 41		
Base Volume Input [veh/h]	0	0	0	4	0	2	0	345	15	0	210	1
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00	6.00	0.00
Growth Rate	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	24	0	1	0	0	41	1	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	1	1	1	0	1	0	1	0	0	1	0	0
Total Hourly Volume [veh/h]	1	1	1	30	1	4	1	507	63	2	309	1
Peak Hour Factor	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	0	0	0	8	0	1	0	132	16	1	80	0
Total Analysis Volume [veh/h]	1	1	1	31	1	4	1	528	66	2	322	1
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

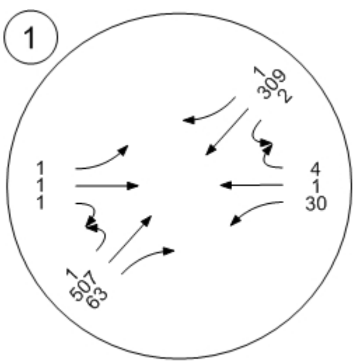
Priority Scheme	Stop	Stop	Free	Free
Flared Lane	Yes	Yes		
Storage Area [veh]	2	2	0	0
Two-Stage Gap Acceptance	No	No		
Number of Storage Spaces in Median	0	0	0	0

Movement, Approach, & Intersection Results

V/C, Movement V/C Ratio	0.00	0.00	0.00	0.12	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
d_M, Delay for Movement [s/veh]	18.84	18.35	10.05	20.32	19.38	13.44	7.89	0.00	0.00	8.64	0.00	0.00
Movement LOS	C	C	B	C	C	B	A	A	A	A	A	A
95th-Percentile Queue Length [veh]	0.02	0.02	0.02	0.41	0.41	0.41	2.65	2.65	2.65	1.44	1.44	1.44
95th-Percentile Queue Length [m]	0.17	0.17	0.17	3.11	3.11	3.11	20.17	20.17	20.17	10.95	10.95	10.95
d_A, Approach Delay [s/veh]	15.75			19.53			0.01			0.05		
Approach LOS	C			C			A			A		
d_I, Intersection Delay [s/veh]	0.81											
Intersection LOS	C											

Traffic Volume - Future Total Volume

Highway 41 and Agra Road



Appendix C - Lighting Warrants

Warrants for Intersection Lighting

MHI Design Manual 2621-01

Intersection Description	**Highway 41 and Agra Road - 2018 Background**

Through Highway	**Highway 41**	Highway Class	Major Arterial		5
Minor Leg 1	**Agra Road E**	Road Type	Other All-Season Road (AADT >150)		OK
Minor Leg 2	**Agra Road W**	Road Type	Other All-Season Road (AADT <150)		NO

☑ Intersection is skewed (<70° or >110°)	2	Night Collision Rate	**0.0**	crash/year	0
Other Nearby Lighting		**Traffic Volumes**			
None	0	On Through Highway	**5100**	AADT	25
☐ Urban street light within 25 m of Minor Leg 1	OK	On Minor Leg 1	**160**	AADT	8
☐ Urban street light within 25 m of Minor Leg 2	OK	On Minor Leg 2	**150**	AADT	8
Existing Intersection Channelization		**Intersection Road Surface Visible from...**			
☐ On Through Highway	0	On Through Highway	> 370 m		0
☐ On Minor Leg 1	0	On Minor Leg 1	> 180 m		0
☐ On Minor Leg 2	0	On Minor Leg 2	> 180 m		0
Divided Roadway		**Proximity to Horizontal Curves**			
☐ On Through Highway	0	On Through Highway	> 100 m		0
☐ On Minor Leg 1	0	On Minor Leg 1	> 60 m		0
☐ On Minor Leg 2	0	On Minor Leg 2	> 60 m		0
Hospital Access Routes		**Obstructed Sight Triangles**			
☐ Minor Leg 1	0	On Minor Leg 1	None		0
☐ Minor Leg 2	0	On Minor Leg 2	None		0

Notes:

1. Delineation lighting has no minimum warrant score. Lights are warranted for the following cases:
   - All Provincial Highway intersections
   - All designated Community Access roads (Control Section 40-series)
   - All roads where AADT>150
   - All seasonal/recreational roads where SADT>250
   - Never when an urban streetlight is within 25m
2. For Night Collision Rate use the average annual night time intersection collisions over the last 3 years
3. For sight distances use eye height of 1.15m and object height at the road surface

	Result	Score
Leg 1 Delineation	**Warranted**	**40**
Leg 2 Delineation	**Not Warranted**	**40**
Intersection Area	*Not calculated*	**N/A**

Warrants for Intersection Lighting

MHI Design Manual 2621-01

Intersection Description	**Highway 41 and Agra Road - 2038 Background**			

Through Highway	**Highway 41**	Highway Class	Major Arterial	5
Minor Leg 1	**Agra Road E**	Road Type	Other All-Season Road (AADT >150)	OK
Minor Leg 2	**Agra Road W**	Road Type	Other All-Season Road (AADT <150)	NO

☑ Intersection is skewed (<70° or >110°) — 2

Night Collision Rate **0.0** crash/year — 0

Other Nearby Lighting

None	0	
☐ Urban street light within 25 m of Minor Leg 1	OK	
☐ Urban street light within 25 m of Minor Leg 2	OK	

Traffic Volumes

On Through Highway	**7500**	AADT	25
On Minor Leg 1	**240**	AADT	12
On Minor Leg 2	**150**	AADT	8

Existing Intersection Channelization

☐ On Through Highway	0
☐ On Minor Leg 1	0
☐ On Minor Leg 2	0

Intersection Road Surface Visible from...

On Through Highway	> 370 m	0
On Minor Leg 1	> 180 m	0
On Minor Leg 2	> 180 m	0

Divided Roadway

☐ On Through Highway	0
☐ On Minor Leg 1	0
☐ On Minor Leg 2	0

Proximity to Horizontal Curves

On Through Highway	> 100 m	0
On Minor Leg 1	> 60 m	0
On Minor Leg 2	> 60 m	0

Hospital Access Routes

☐ Minor Leg 1	0
☐ Minor Leg 2	0

Obstructed Sight Triangles

On Minor Leg 1	None	0
On Minor Leg 2	None	0

Notes:

1. Delineation lighting has no minimum warrant score. Lights are warranted for the following cases:
   - All Provincial Highway intersections
   - All designated Community Access roads (Control Section 40-series)
   - All roads where AADT>150
   - All seasonal/recreational roads where SADT>250
   - Never when an urban streetlight is within 25m
2. For Night Collision Rate use the average annual night time intersection collisions over the last 3 years
3. For sight distances use eye height of 1.15m and object height at the road surface

	Result	Score
Leg 1 Delineation	**Warranted**	**44**
Leg 2 Delineation	**Not Warranted**	**40**
Intersection Area	*Not calculated*	**N/A**

Warrants for Intersection Lighting

MHI Design Manual 2621-01

Intersection Description: **Highway 41 and Agra Road - 2038 with Development**

Through Highway	**Highway 41**	Highway Class	Major Arterial	5
Minor Leg 1	**Agra Road E**	Road Type	Other All-Season Road (AADT >150)	OK
Minor Leg 2	**Agra Road W**	Road Type	Other All-Season Road (AADT <150)	NO

☑ Intersection is skewed (<70° or >110°)	2	Night Collision Rate	**0.0** crash/year	0

Other Nearby Lighting		**Traffic Volumes**		
None	0	On Through Highway	**8500** AADT	25
☐ Urban street light within 25 m of Minor Leg 1	OK	On Minor Leg 1	**680** AADT	34
☐ Urban street light within 25 m of Minor Leg 2	OK	On Minor Leg 2	**150** AADT	8
Existing Intersection Channelization		**Intersection Road Surface Visible from...**		
☐ On Through Highway	0	On Through Highway	> 370 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 180 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 180 m	0
Divided Roadway		**Proximity to Horizontal Curves**		
☐ On Through Highway	0	On Through Highway	> 100 m	0
☐ On Minor Leg 1	0	On Minor Leg 1	> 60 m	0
☐ On Minor Leg 2	0	On Minor Leg 2	> 60 m	0
Hospital Access Routes		**Obstructed Sight Triangles**		
☐ Minor Leg 1	0	On Minor Leg 1	None	0
☐ Minor Leg 2	0	On Minor Leg 2	None	0

Notes:

1. Delineation lighting has no minimum warrant score. Lights are warranted for the following cases:
   - All Provincial Highway intersections
   - All designated Community Access roads (Control Section 40-series)
   - All roads where AADT>150
   - All seasonal/recreational roads where SADT>250
   - Never when an urban streetlight is within 25m
2. For Night Collision Rate use the average annual night time intersection collisions over the last 3 years
3. For sight distances use eye height of 1.15m and object height at the road surface

	Result	Score
Leg 1 Delineation	**Warranted**	**66**
Leg 2 Delineation	**Not Warranted**	**40**
Intersection Area	*Not calculated*	**N/A**

Appendix D - Turning Lane Warrants

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2018 Background Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**1**	188
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	4	191	1	196
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	4	191	1	196
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

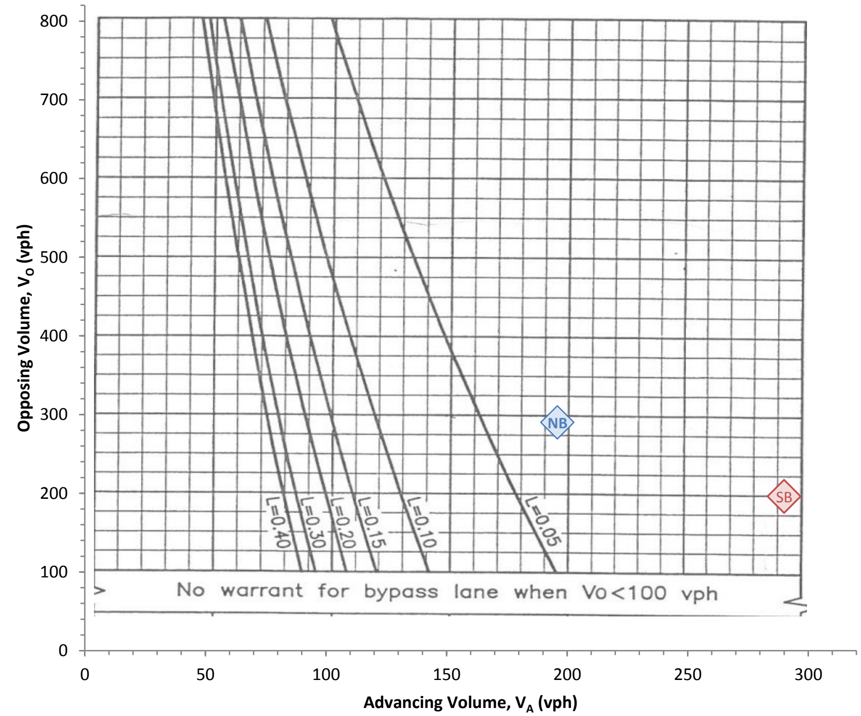
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	1	288	1	290
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Bypass Lane
Standard Plan 20612

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	196	290	196	290
Opposing Volume, V_O	290	196	290	196
L (V_L / V_A)	0.02	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2018 Background Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**1**	188
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	4	191	1	196
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	4	191	1	196
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

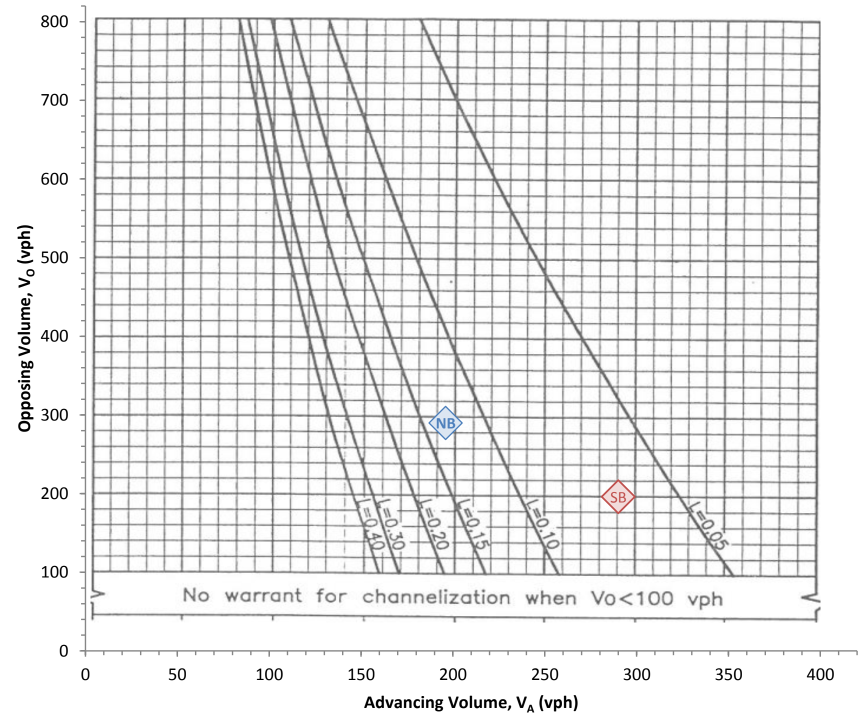
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	1	288	1	290
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Channelized Intersection
Standard Plan 20611

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	196	290	196	290
Opposing Volume, V_O	290	196	290	196
L (V_L / V_A)	0.02	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2018 Background Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

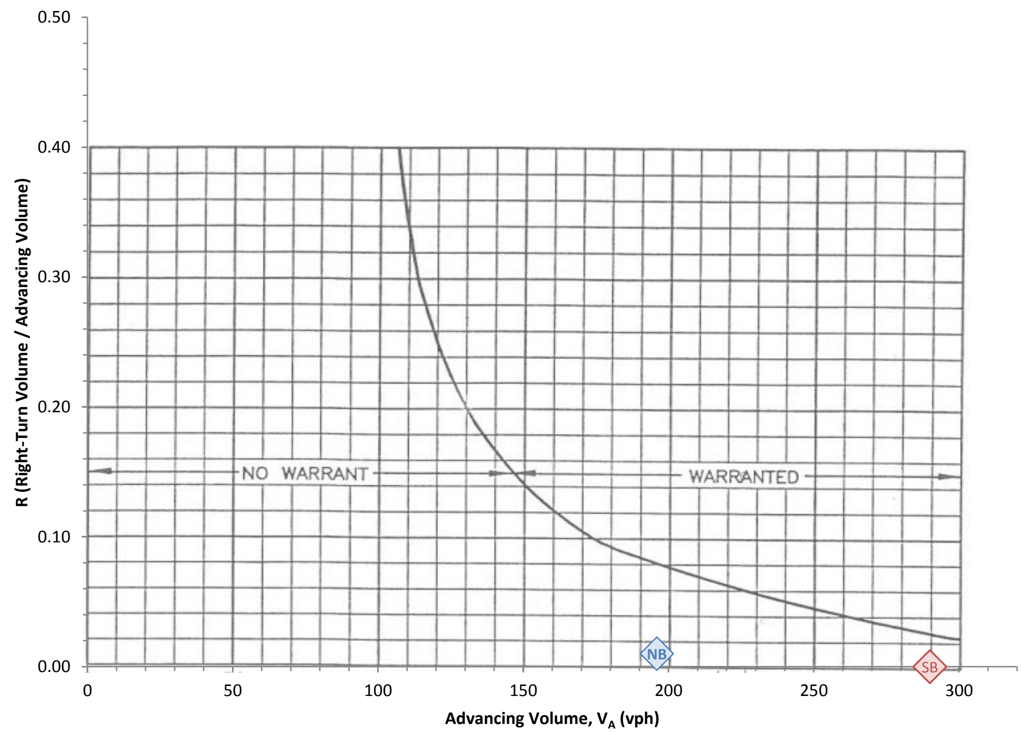
NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**1**	188
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	4	191	1	196
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	4	191	1	196
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	1	288	1	290
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:
- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	196	290	196	290
R (V_R / V_A)	0.01	0.00	0.01	0.00

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2018 Background Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**0**	**345**	**15**	360
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	0	359	15	374
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	0	359	15	374
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

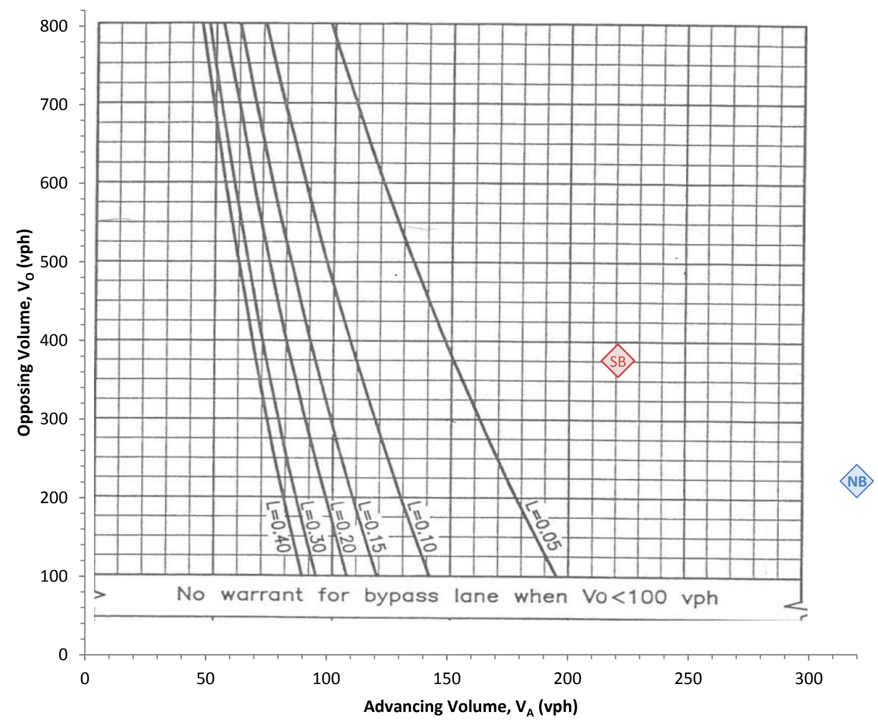
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	1	219	1	221
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Bypass Lane
Standard Plan 20612

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	374	221	320	221
Opposing Volume, V_O	221	374	221	374
L (V_L / V_A)	0.00	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2018 Background Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

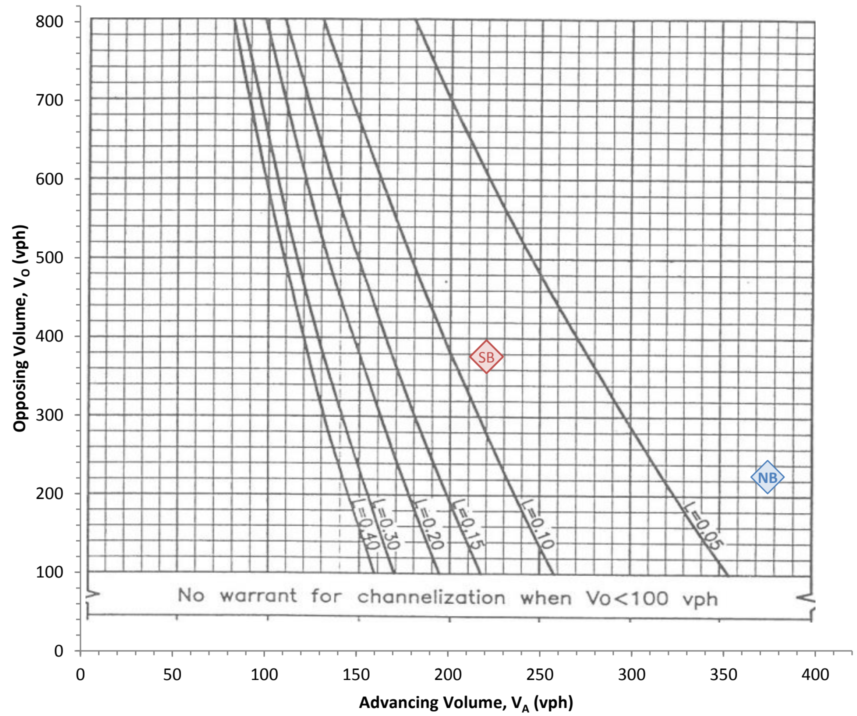
NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**0**	**345**	**15**	360
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	0	359	15	374
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	0	359	15	374
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	1	219	1	221
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:
- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Channelized Intersection
Standard Plan 20611

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	374	221	374	221
Opposing Volume, V_O	221	374	221	374
L (V_L / V_A)	0.00	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2018 Background Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**0**	**345**	**15**	360
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	0	359	15	374
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	0	359	15	374
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

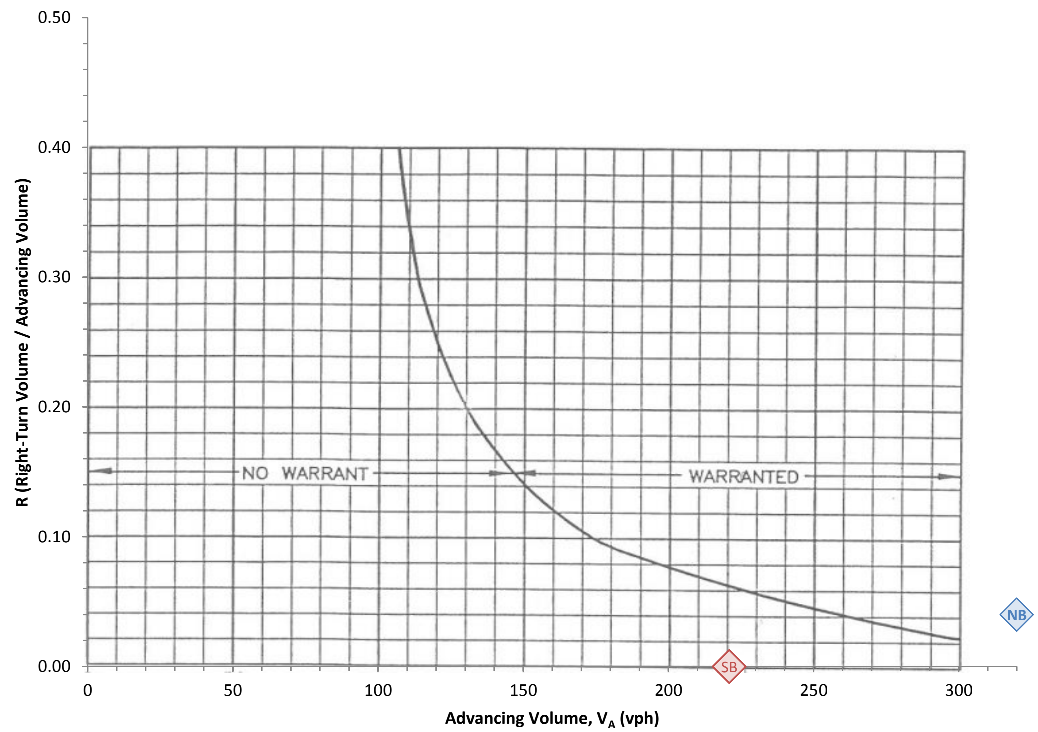
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.00**	**1.00**	
Future Equiv Vol (pce/h)	1	219	1	221
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	374	221	320	221
R (V_R / V_A)	0.04	0.00	0.04	0.00

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 Background Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

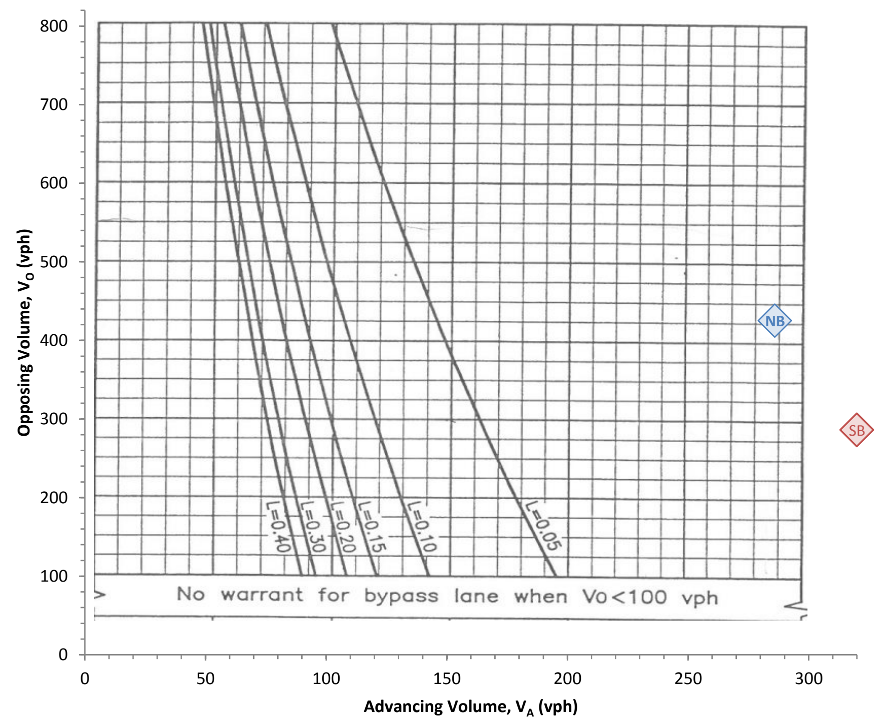
NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**1**	188
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	4	191	1	196
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	4	281	1	286
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	423	1	425
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:
- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Bypass Lane
Standard Plan 20612

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	286	425	286	320
Opposing Volume, V_O	425	286	425	286
L (V_L / V_A)	0.01	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 Background Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

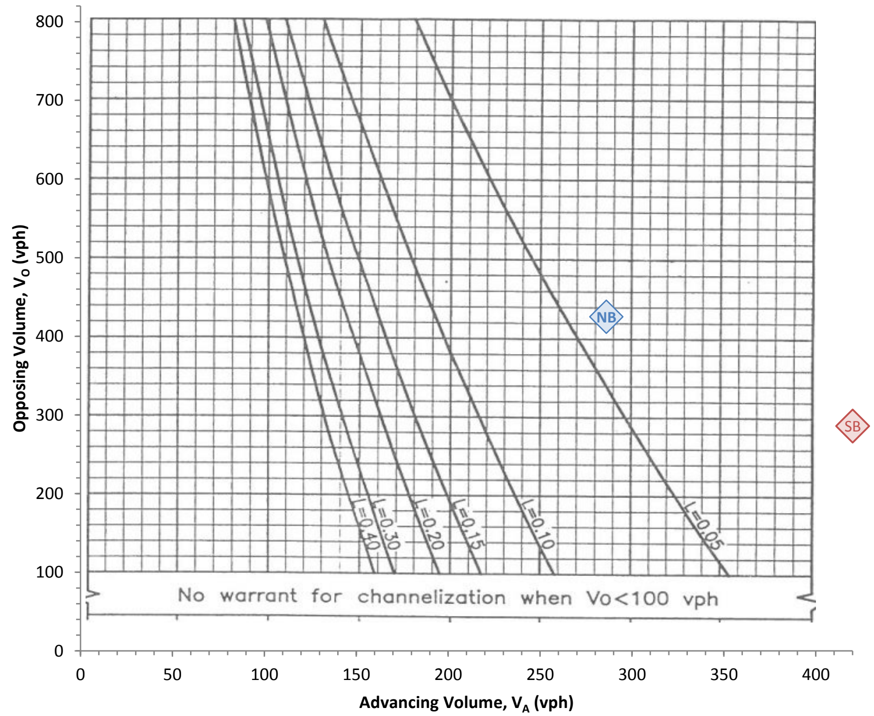
NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**1**	188
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	4	191	1	196
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	4	281	1	286
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	423	1	425
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:
- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Channelized Intersection
Standard Plan 20611

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	286	425	286	420
Opposing Volume, V_O	425	286	425	286
L (V_L / V_A)	0.01	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 Background Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

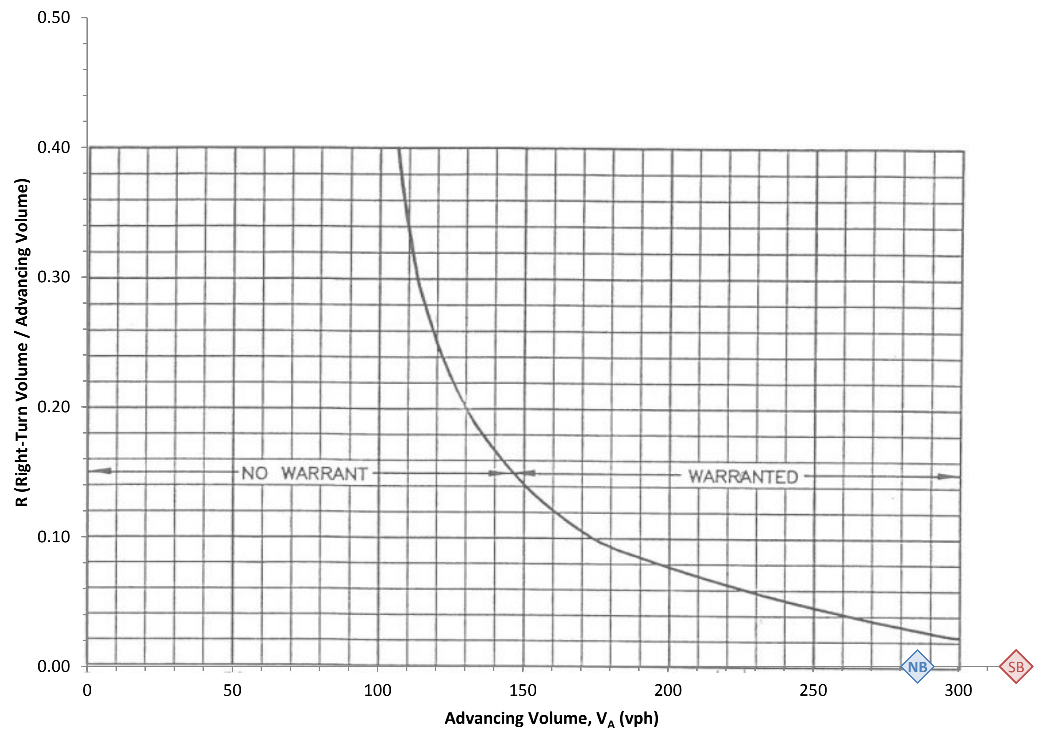
NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**1**	188
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	4	191	1	196
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	4	281	1	286
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	423	1	425
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:
- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	286	425	286	320
R (V_R / V_A)	0.00	0.00	0.00	0.00

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 Background Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**0**	**345**	**15**	360
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	0	359	15	374
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	0	528	15	543
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

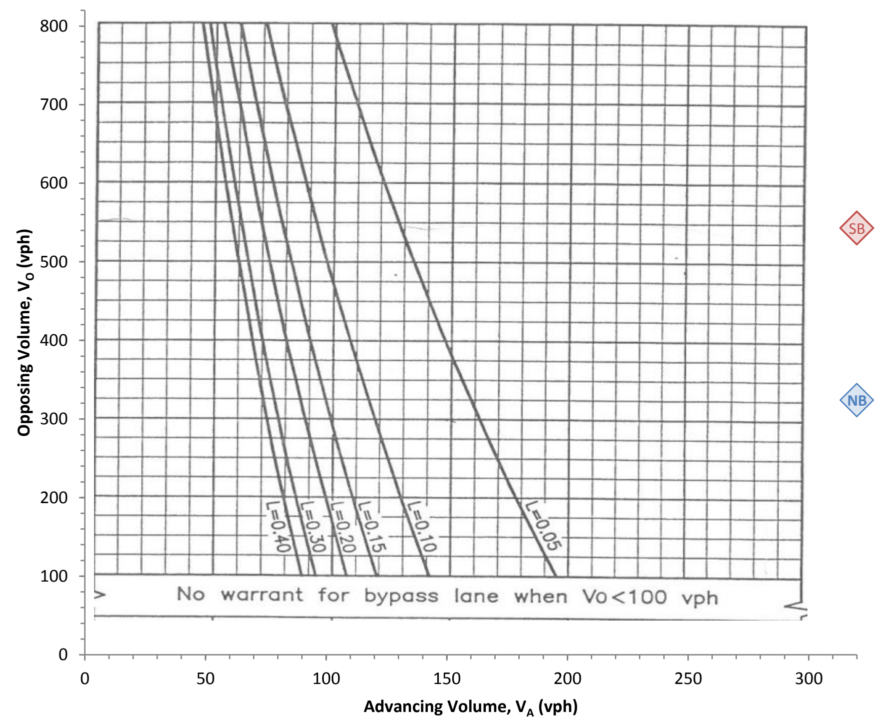
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	322	1	324
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Bypass Lane
Standard Plan 20612

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	543	324	320	320
Opposing Volume, V_O	324	543	324	543
L (V_L / V_A)	0.00	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 Background Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**0**	**345**	**15**	360
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	0	359	15	374
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	0	528	15	543
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

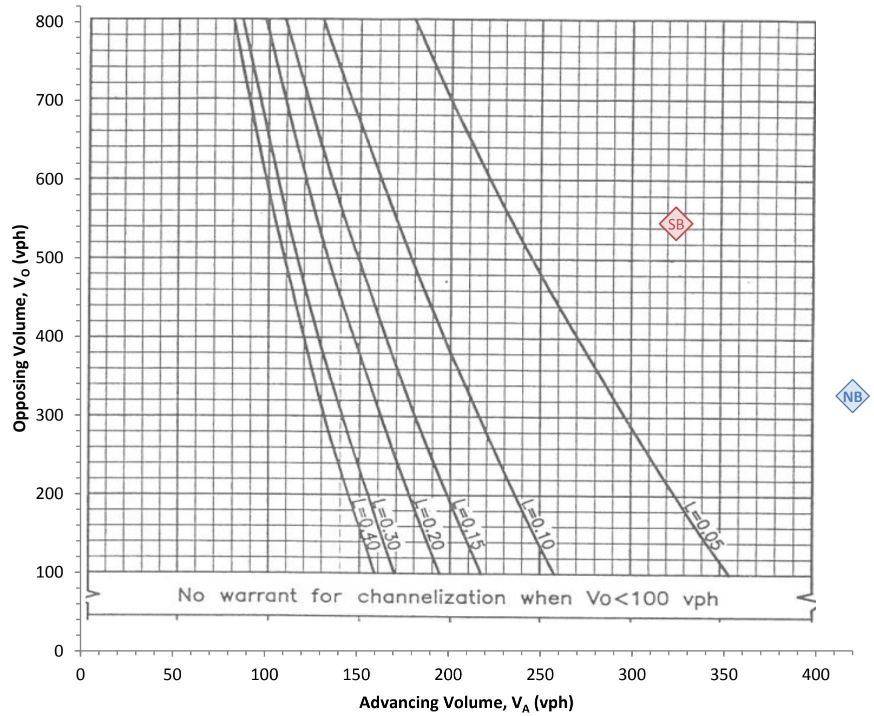
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	322	1	324
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Channelized Intersection
Standard Plan 20611

Associated Engineering



	Calculated NB	Calculated SB	Plotted NB	Plotted SB
Advancing Volume, V_A	543	324	420	324
Opposing Volume, V_O	324	543	324	543
L (V_L / V_A)	0.00	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 Background Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

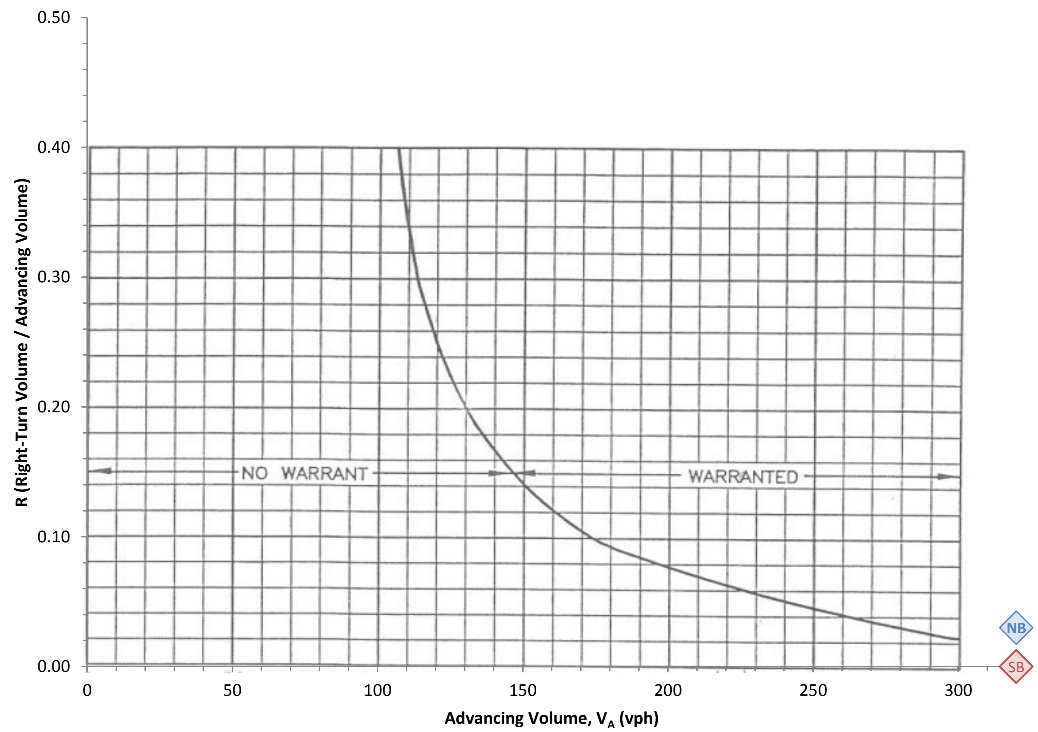
NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**0**	**345**	**15**	360
Truck %	**0.0%**	**6.0%**	**0.0%**	6%
Equiv Vol (pce/h)	0	359	15	374
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	0	528	15	543
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	322	1	324
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:
- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	543	324	320	320
R (V_R / V_A)	0.03	0.00	0.03	0.00

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 w Development Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**13**	200
Truck %	**0.0%**	**6.0%**	**0.0%**	5%
Equiv Vol (pce/h)	4	191	13	208
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	4	281	13	298
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

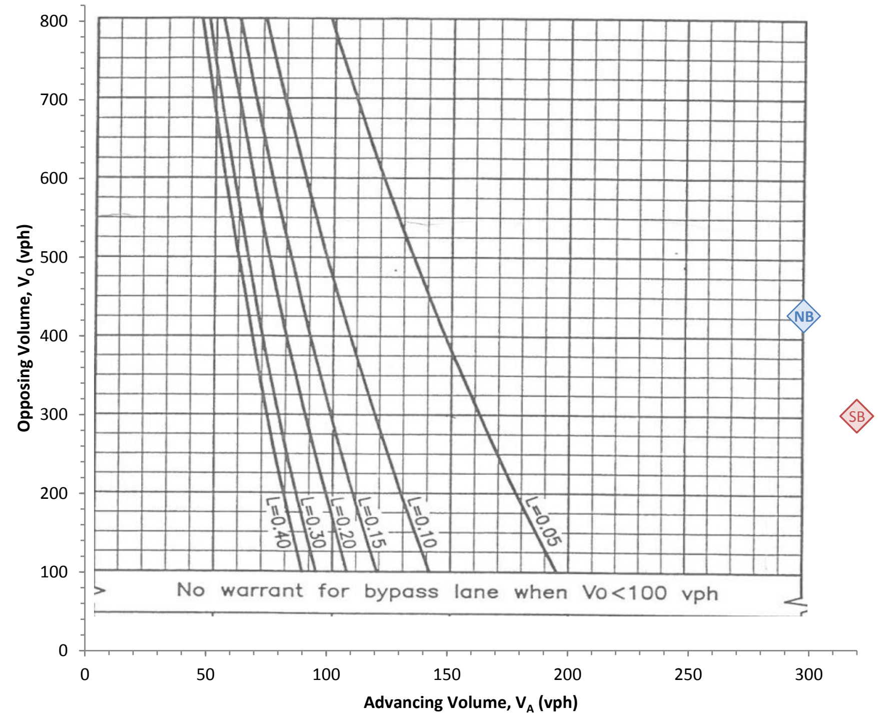
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	423	1	425
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Bypass Lane
Standard Plan 20612

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	298	425	298	320
Opposing Volume, V_O	425	298	425	298
L (V_L / V_A)	0.01	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 w Development Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**13**	200
Truck %	**0.0%**	**6.0%**	**0.0%**	5%
Equiv Vol (pce/h)	4	191	13	208
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	4	281	13	298
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

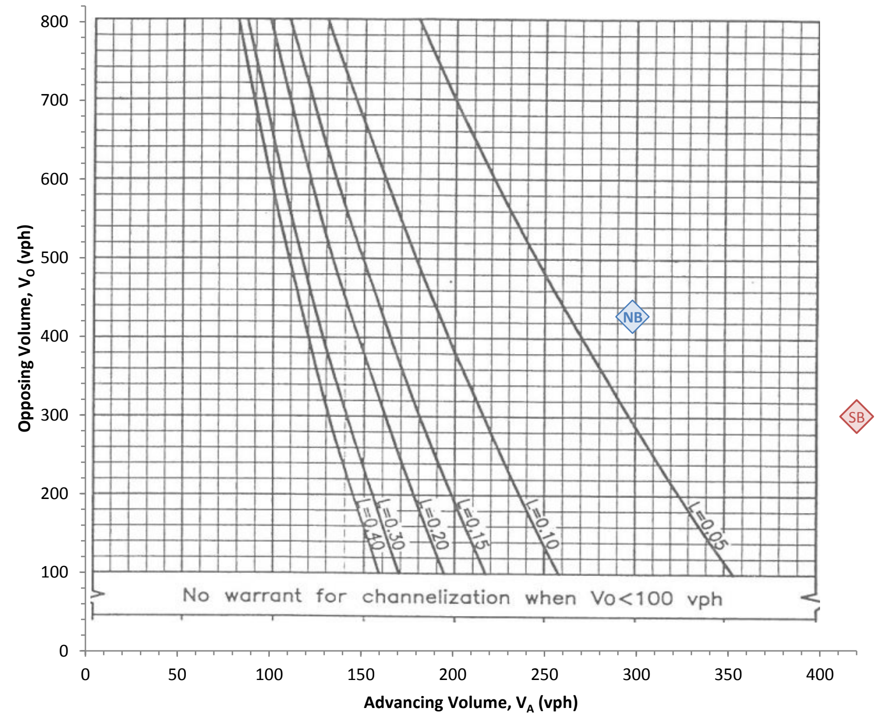
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	423	1	425
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Channelized Intersection
Standard Plan 20611

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	298	425	298	420
Opposing Volume, V_O	425	298	425	298
L (V_L / V_A)	0.01	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 w Development Scenario - AM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

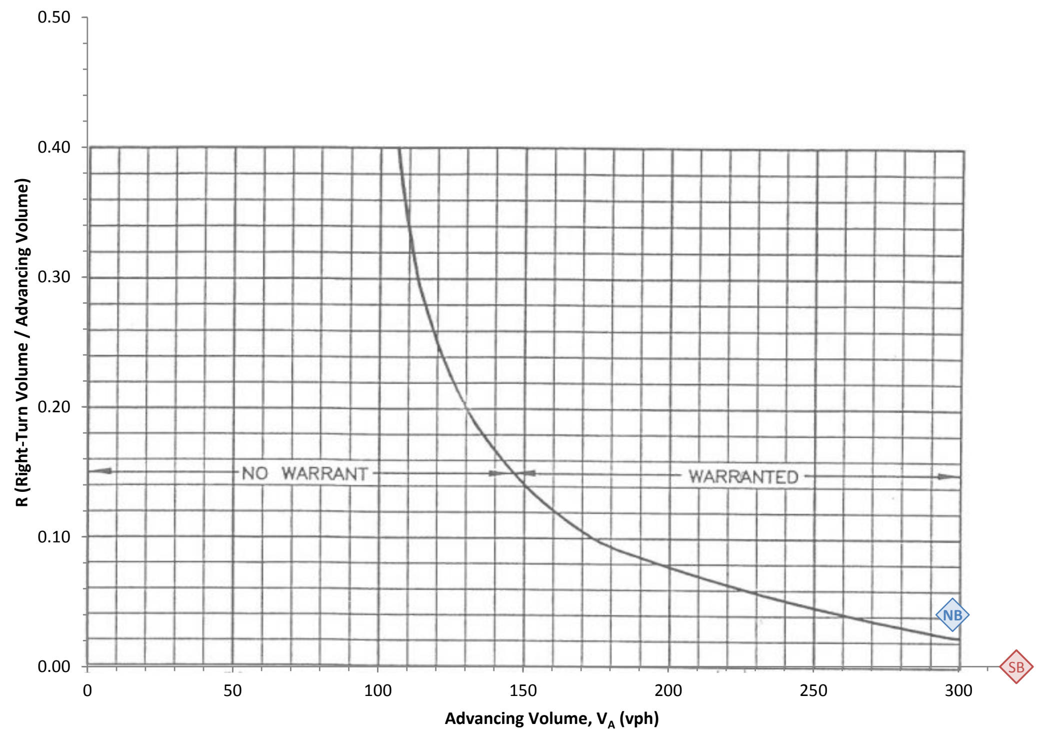
NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**4**	**183**	**13**	200
Truck %	**0.0%**	**6.0%**	**0.0%**	5%
Equiv Vol (pce/h)	4	191	13	208
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	4	281	13	298
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**276**	**1**	278
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	288	1	290
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	423	1	425
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	298	425	298	320
R (V_R / V_A)	0.04	0.00	0.04	0.00

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 w Development Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**345**	**56**	402
Truck %	**0.0%**	**6.0%**	**0.0%**	5%
Equiv Vol (pce/h)	1	359	56	416
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	528	56	585
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

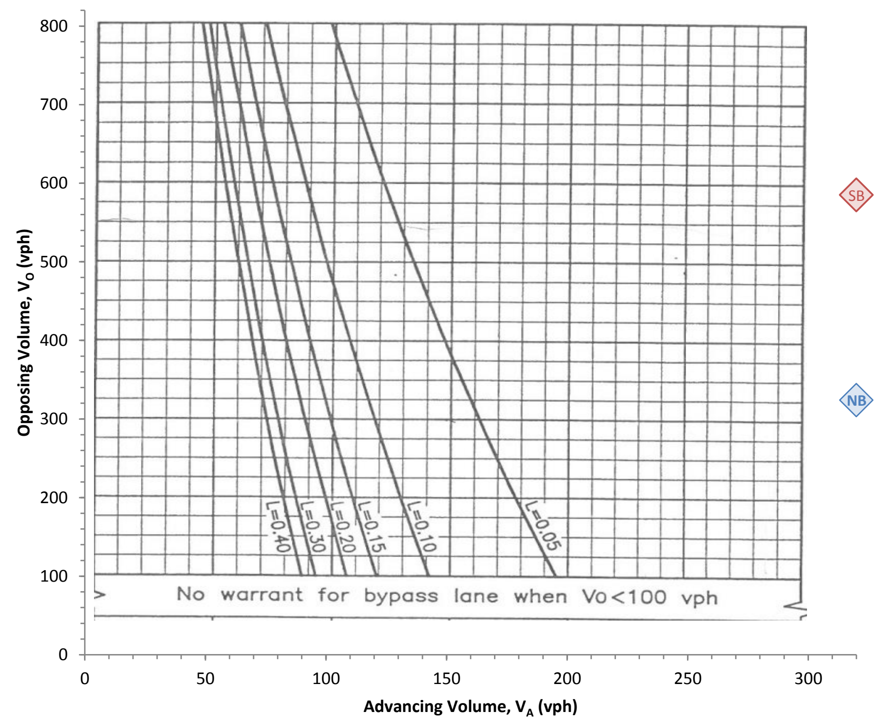
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	322	1	324
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Bypass Lane
Standard Plan 20612

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	585	324	320	320
Opposing Volume, V_O	324	585	324	585
L (V_L / V_A)	0.00	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 w Development Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

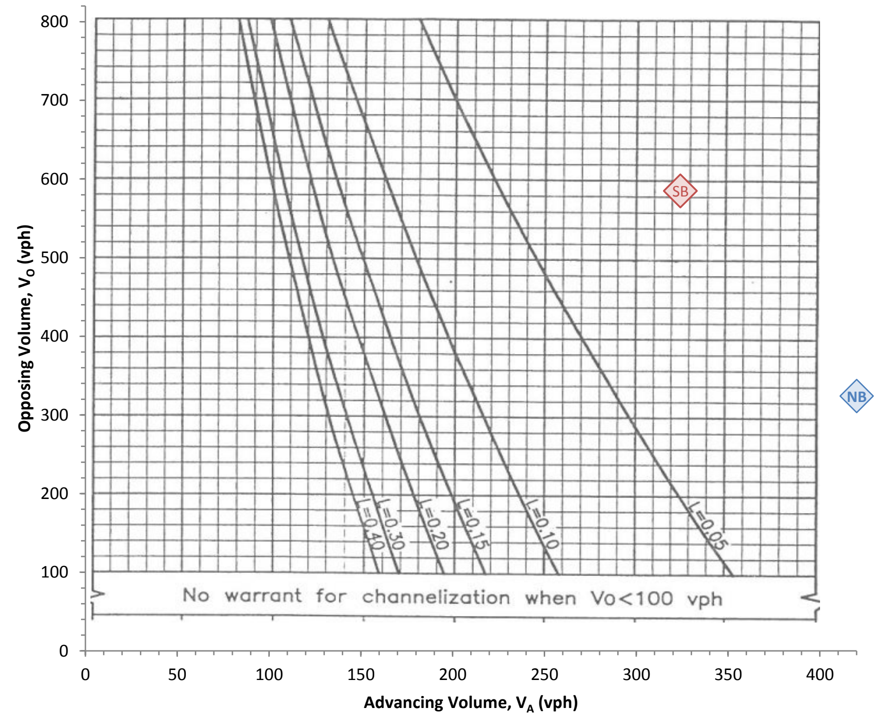
NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**345**	**56**	402
Truck %	**0.0%**	**6.0%**	**0.0%**	5%
Equiv Vol (pce/h)	1	359	56	416
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	528	56	585
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	322	1	324
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:
- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Channelized Intersection
Standard Plan 20611

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	585	324	420	324
Opposing Volume, V_O	324	585	324	585
L (V_L / V_A)	0.00	0.00		

Turning Lane Warrants
Worksheet for Two Lane Rural Highways

Highway:	**Highway 41**
Crossroad:	**Agra Road**
Scenario:	**2038 w Development Scenario - PM Design Hour**

Highway Direction A:	**NB**	Usually WB or NB
Highway Direction B:	**SB**	Usually EB or SB
Truck Equivalency (E_T)	**1.7**	MHI Standard: 1.7

NB Data	NBL	NBT	NBR	NB Total
Hourly Vol (veh/h)	**1**	**345**	**56**	402
Truck %	**0.0%**	**6.0%**	**0.0%**	5%
Equiv Vol (pce/h)	1	359	56	416
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	528	56	585
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

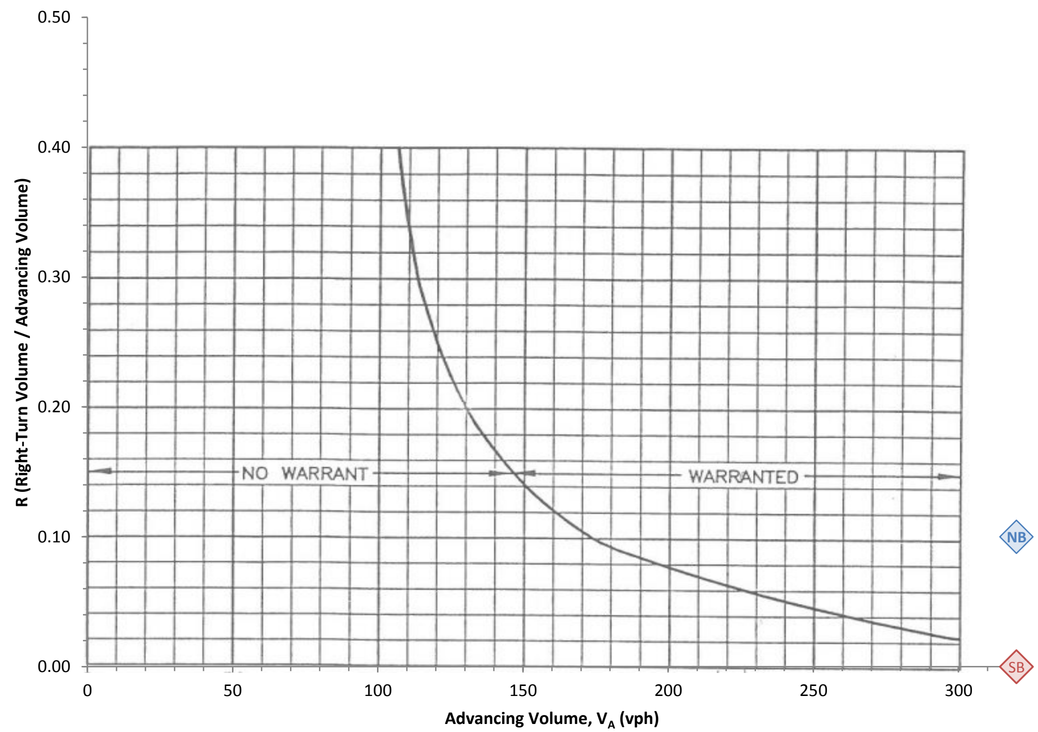
SB Data	SBL	SBT	SBR	SB Total
Hourly Vol (veh/h)	**1**	**210**	**1**	212
Truck %	**0%**	**6%**	**0%**	6%
Equiv Vol (pce/h)	1	219	1	221
Growth Factor	**1.00**	**1.47**	**1.00**	
Future Equiv Vol (pce/h)	1	322	1	324
Advancing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0
Opposing Conflict?	**1**	**1**	**1**	Yes: 1 No: 0

Notes:

- No warrant if the plotted point falls to the left of the applicable line
- No warrant for bypass/channelization if L <0.05
- Right turn lanes are warranted at:
  - -Intersections with other Provincial Highways
  - -Industrial Access Roads
  - -Provincial Campgrounds and Picnic Sites
- Length of right turning lane is related to speed. See SP 20618.
- Use the corrected peak hour volumes (vph) projected to the 10th year after construction. See SKS 2.3.1-C (formerly DM 502-3) for correction factors.

Saskatchewan Ministry of Highways and Infrastructure
Warrants for Right Turn Lanes - Rural Highways
Standard Plan 20614

Associated Engineering



	Calculated		Plotted	
	NB	SB	NB	SB
Advancing Volume, V_A	585	324	320	320
R (V_R / V_A)	0.10	0.00	0.10	0.00

Mike Pawluski

From:	Bill Delainey
Sent:	Monday, May 14, 2018 1:11 PM
To:	Mike Pawluski
Subject:	FW: Eagle Heights TIA - 20124165.00.A.02.00
Categories:	AE FILED EMAIL

From: Petras, Julian HI [mailto:julian.petras@gov.sk.ca]
Sent: Monday, May 14, 2018 12:41 PM
To: Bill Delainey <delaineyb@ae.ca>
Cc: Landell, Andrea HI <andrea.landell@gov.sk.ca>
Subject: RE: Eagle Heights TIA

Good Afternoon Bill,

The Ministry has completed its review of the Eagle Heights Traffic Impact Assessment and we do not have any comments or questions regarding the content. We agree with the analysis and recommendations you have included in the report. All three of the recommended improvements would be required without the Eagle Heights development traffic; therefore, they will be entered into the Ministry's Safety Improvement Program (SIP). Since the Ministry is responsible for all improvements, a partnership agreement will not be required for this development.

Is there any specific information your client requires for the comprehensive development review? I have not yet completed an assessment of the intersection that includes all future development traffic, but I can give you a list of all the current improvements that are in SIP at this location.

Regards,

Julian Petras, Engineer-In-Training
Government of Saskatchewan
Operations Project Engineer
Traffic Engineering and Development , Ministry of Highways and Infrastructure

Unit #18 – 3603 Millar Avenue
Saskatoon, SK S7P 0B2

Bus: 306-933-5340
Fax: 306-933-5188

From: Bill Delainey [mailto:delaineyb@ae.ca]
Sent: Thursday, May 10, 2018 3:54 PM
To: Petras, Julian HI
Subject: Eagle Heights TIA

Good afternoon Julian. You may recall receiving a Traffic Impact Assessment report several weeks ago for the proposed Eagle Heights subdivision situated along Highway 41 in W ½ 11-37-4-W3. When we met with you, Andrea and the client (Chris Cebryk) we were informed that your office had received or anticipated receipt of a TIA for a proposed development on the west side of Highway 41 which proposed to utilize the same municipal highway access point at Fluery Road. You had asked us to prepare our TIA independent of this additional development and you further indicated that MHI would refer to both reports in order to define the scope of improvements that would be required to accommodate the proposed additional development in the area. Are you able to update me on the status of your office's review of the TIA and what you see as the next steps as they relate to our client's ability to submit a Comprehensive Development Review report to Corman Park which relies on this highway access point?

Thanks for your consideration of this request.

If it is more convenient to call me in this regard, feel free – my cellular number is provided below.

Regards,

Bill Delainey, RPP
Group Manager, Urban Planning
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969 | Cel: 306.261-.9612 | Dir: 306.653.2137 Ext. 5489

Appendix E: General Correspondence

Loraas
Disposal
Services Ltd.

Associated Engineering
1-2225 Northridge Drive
Saskatoon, SK S7L6X6

February 16, 2018

Attn: Mike Pawluski

Please accept this letter of confirmation in providing Waste and Recycle services in the future for the proposed Eagle Heights development W ½ 11-37-4-W3M.

Any further questions, please feel free to contact us.

Thank you,

Christine McTavish
Sales Representative
Loraas Disposal Service

805 47th Street East • Saskatoon Saskatchewan • S7K 8G7 • Tel: (306) 242-2300 • Fax: (306) 242-4994 • Email: loraas@loraas.ca

From: Kerry Donst <kerry.donst@spiritsd.ca>
Sent: Monday, March 19, 2018 3:32 PM
To: Mike Pawluski
Subject: RE: Available School Capacities for Proposed Development - 20124165.00.E.01.00

Categories: AE FILED EMAIL

Mike,

Bussing is available for your proposed development.

Our schools have capacity to accommodate your request.

Thanks,

Kerry Donst
Facilities Planner, Prairie Spirit School Division
Box 809 |523 Langley Avenue, Warman, SK, S0K 4S0
T 306.683.2917| C 306.260.9666 | Learners for life

From: Mike Pawluski <pawluskim@ae.ca>
Sent: Monday, March 19, 2018 11:48 AM
To: Kerry Donst <kerry.donst@spiritsd.ca>
Subject: Available School Capacities for Proposed Development

Hi Kerry,

My name is Mike Pawluski and I work for Associated Engineering. We represent a client who has asked us to prepare a Comprehensive Development Review report in support of a residential subdivision in the RM of Corman Park on the W ½ Section 11-37-4-W3M.

As part of our due diligence, it is our responsibility to contact the local school district to confirm available school capacities and busing services to accommodate the anticipated growth of enrollment from the development. The reason I am contacting you is based on the location of the proposed subdivision, we anticipate the Aberdeen and Clavet schools to see the increased enrollment numbers. The proposed development is expected to create up to 84 new lots and we anticipate an average of 3 persons per household. Based on these numbers, it is likely the local enrollments could increase by around 84 students. As our clients proposed development is intended to be developed over four phases, it is expected this growth will be slow and staggered over a number of years.

Questions are:

- Do either of these schools have available capacity to support the anticipated growth?
- Is there busing services available to accommodate the growth?

I have attached a figure to identify where our clients land is in relation to these communities.

If you require additional information, please contact me.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

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Mike Pawluski

From:	Blaine Tomolak H41 Water Utility <h41wumaint@gmail.com>
Sent:	Tuesday, April 24, 2018 3:51 PM
To:	Mike Pawluski
Subject:	RE: Proposed Multi-lot Country Residential Development - 20124165.00.E.01.00
Attachments:	Eagle Heights IP agreement form.pdf
Categories:	AE FILED EMAIL

Hi Mike,

Attached is the IP agreement form signed for your records.

Blaine Tomolak
Operator
306-270-7457

Highway 41 Water Utility

Box 178 • Aberdeen, SK • S0K 0A0

From: Mike Pawluski <pawluskim@ae.ca>
Sent: April 23, 2018 1:51 PM
To: Blaine Tomolak H41 Water Utility <h41wumaint@gmail.com>
Subject: RE: Proposed Multi-lot Country Residential Development

Hi Blaine,

Your assumption is correct in that the Highway 41 Water Utility would construct the infrastructure, complete with a water supply curb stop to each lot. Individual home owners would then be responsible to have the metering assembly installed as per the Highway 41 Water Utility requirements.

The 0.33 imperial gallons per minute will be sufficient and the Individual lot owners would be responsible for having their own local storage tank and pressurised system for water distribution on their properties. Please disregard a previous communication I sent you earlier today regarding high pressure flows as we have informed our client that the only way this can be accomplished would be through the construction of a reservoir and pump station on their property – essentially replacing the individual cisterns and pressure systems that would typically be supplied by the homeowner.

As for the electronic drawing, attached is an electronic release form. Please fill it out and send it back to me. Following receipt of the executed release form, I will send you the electronic file of the concept plan.

As for a timeline to construct, I will reach out to the client to confirm when they plan on constructing Phase 1 of the development.

If you need anything else, please let me know.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

From: Blaine Tomolak H41 Water Utility [mailto:h41wumaint@gmail.com]
Sent: Tuesday, April 17, 2018 10:15 AM
To: Mike Pawluski <pawluskim@ae.ca>; h41wuadmin@gmail.com
[redacted]
Subject: RE: Proposed Multi-lot Country Residential Development

Hi Mike,

Some questions and assumptions arose from our conversations regarding this development. They are:

1. Highway 41 Water Utility will design and construct the water pipeline to each lot in Eagle Heights. The purchasers of the lots will then be responsible for connecting to the utility. Is this assumption correct?
2. Delivery flow rate to each lot is based on assuming the lots are residential, delivering 0.33 imperial gallons per minute. Is this sufficient?
3. Preliminary discussions were held with our engineers. For them to further work on your project, an electronic map of legal fabric is needed. Is this possible?
4. Is there a timeline for permit to construct?

Regards,

Blaine Tomolak
Operator
306-270-7457

Highway 41 Water Utility
Box 178 • Aberdeen, SK • S0K 0A0

From: Mike Pawluski <pawluskim@ae.ca>
Sent: March 27, 2018 12:25 PM
To: Blaine Tomolak H41 Water Utility <h41wumaint@gmail.com>; Janet Buhler - Administrator <h41wuadmin@gmail.com>
Subject: Proposed Multi-lot Country Residential Development

Hi Blaine and Janet,

Associated Engineering is currently working with Chris Cebryk on a project to develop country residential acreages along the east side of Highway No. 41 and adjacent to Eagle Ridge Estates in the RM of Corman Park. We are currently working on the planning and conceptual design for the development and it is estimated that the development will comprise 84 residential lots within two ¼ sections (W½ 11-37-04-W3M) in 4 phases. A proposed layout for the development is attached for reference. It is my understanding that there have been communications in the past from both Chris and other individuals from our organization in regards to this development and supplying water.

I have a few questions and requests from the Water Utility as we move forward with the project.

- Would the water utility be able to provide the developer with a letter of intent to provide water service to the development? This letter will be used as part of the Comprehensive Development Review we have undertaken to show that the developer has secured a source of potable water for the homes.
- Would the Utility be able to complete a review of the demand required for the development and let us know what type of upgrades may be required or limitations that we may run into as a result of the increased water demand for the area?
- From my understanding, the water system will function as a trickle system. What would the Highway 41 Water Utility normally provide on a per lot basis?

These questions were asked in the past and I am cannot find any correspondence that suggests these questions were ever answered. If there is something in your files regarding this project which you could provide me with that would be much appreciated. If you require more information, please advise me and I will try track down the details you need.

If you have any questions, please feel free to contact me.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

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You may unsubscribe from Associated's electronic communications at any time.

Mike Pawluski

From: J. Garnet <garnet@rmcormanpark.ca>
Sent: Tuesday, April 24, 2018 11:51 AM
To: Corman Park Police Service; Mike Pawluski
Subject: Re: Police Servicing Capability for Proposed Development - 20124165.00.E.01.00

Categories: AE FILED EMAIL

Good morning Mike,

The Corman Park Police mandate is primarily Provincial statute and Municipal bylaw enforcement. The addition of a new subdivision has a negligible impact on the work we do. Our members would perform routine patrols through the subdivision and perform violator enforcement and traffic monitoring as required in the normal course of their duties.

Criminal matters within the RM are handled by the RCMP and I would suggest you contact the Saskatoon detachment of the RCMP at 975 5173 for their comments on whether there would be an impact on criminal activity by the addition of the development.

Regards,

John Garnet
Chief, Corman Park Police

From: Corman Park Police Service
Sent: Tuesday, April 24, 2018 11:03:15 AM
To: J. Garnet
Subject: FW: Police Servicing Capability for Proposed Development

---

From: Mike Pawluski [mailto:pawluskim@ae.ca]
Sent: April-24-18 10:06 AM
To: Corman Park Police Service
Subject: Police Servicing Capability for Proposed Development

Hello,

My name is Mike Pawluski and I work for Associated Engineering.

We represent a client who has asked us to complete a Comprehensive Development Review (CDR) for the RM of Corman Park. One of the requirements for the CDR is consultation with protective service agencies to confirm they have the capability/capacity to service the proposed development. Our development is located on the W½ 11-37-4-W3M (adjacent to the east side of the Eagle Ridge Estates along Highway 41) which is within the RM of Corman Park.

Can you pleases confirm if the RM of Corman Park Police Service has the capability/capacity to service our clients proposed development within this location?

Attached is one of the concept plan designs for the proposed development.

If you have any questions or comments please feel free to contact us.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

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City of Saskatoon

Saskatoon Fire Department
125 Idylwyld Drive South
Saskatoon SK S7M 1L4

www.saskatoon.ca
tel (306) 975.2578
fax (306) 975.2589

April 27, 2018

Associated Engineering (Sask.) Ltd.
1 – 2225 Northridge Drive
Saskatoon, SK S7L 6X6

Attention: Mike Pawluski

Re: RM of Corman Park Development
W ½ 11-37-4-W3M

The City of Saskatoon has an agreement with the Rural Municipality of Corman Park to provide firefighting, dangerous goods response, and rescue services. The obligations of the Saskatoon Fire Department under this agreement are subject to the availability of firefighters and firefighting equipment, and the availability of suitable road access to the location of the emergency.

The decision whether to respond to any emergency is entirely within the discretion of the Saskatoon Fire Department. This agreement acknowledges that the response time to an incident may be up to 30 minutes or more depending on the location of the incident and road or weather conditions at the time.

Sincerely,

Wayne Rodger
Assistant Chief

WR/pc

Mike Pawluski

From: Blaine Tomolak <h41wumaint@gmail.com>
Sent: Monday, August 13, 2018 12:07 PM
To: Mike Pawluski
Cc: Dawn Bragg - Administrator; Graham White; Ken & Mary Kruger; Kim C. Huffman; Robert or Vonne Macpherson; [redacted] Wayne and Alice Mason
Subject: RE: Proposed Multi-lot Country Residential Development - 20124165.00.E.01.00 - 20124165.00.U.01.00 - 20124165.00.E.01.00

Categories: AE FILED EMAIL

Hi Mike,
The answers to your questions are in red below.

Regards,
Blaine Tomolak
Highway 41 Water Utility
306-270-7457
h41wumaint@gmail.com

Highway 41
Water Utility

Box 178 • Aberdeen, SK • S0K 0A0

From: Mike Pawluski <pawluskim@ae.ca>
Sent: August 10, 2018 2:40 PM
To: Blaine Tomolak <h41wumaint@gmail.com>
Subject: RE: Proposed Multi-lot Country Residential Development - 20124165.00.E.01.00 - 20124165.00.U.01.00

Hi Blaine,

We are in the process of finalizing a CDR report for the RM of Corman Park Council consideration. I just want to clarify the service being provided from Highway 41 Water Utility.

- Highway 41 Water Utility will design and construct the water pipeline to each lot in Eagle Heights. This is possible after a service agreement is completed with the Eagle Heights development team.
- The water utility will cover the costs of constructing the water distribution system. The cost of construction will be covered by Highway 41 water utility. The utility will then invoice the Eagle Heights development team for that cost of construction.
- The purchasers of the lots will then be responsible for connecting to the utility and covering any costs the water utility requires for the construction of the system. The Eagle Heights development will pay for the design, planning and cost of construction at a minimum cost of $16,500 per lot, depending on final costs. Construction of the pipeline will occur after the road construction and lot survey is complete, and before any other utility service is brought in. The lot purchasers will then work with their own water/sewer contractor to connect to the curb stop that will be placed on each lot during the pipeline construction phase. The initial $5,000 deposit

paid by the Eagle Heights team in 2013 was used for planning and conceptual design up to this point. The balance of funds will be put towards creating a probable cost estimate of water utility infrastructure, including the booster station. Once complete I will send this cost estimate to you so the Eagle Heights team can make the decision of how to proceed. An invoice for any related expenses above the $5,000 deposit will be sent at the same time.

If you could let me know that would be great.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

From: Blaine Tomolak [mailto:h41wumaint@gmail.com]
Sent: Wednesday, July 18, 2018 11:59 AM
To: Mike Pawluski <pawluskim@ae.ca>
Cc: Dawn Bragg - Administrator <h41wuadmin@gmail.com>; h41wumaint@gmail.com[redacted] Graham White [redacted] Ken & Mary Kruger [redacted] Kim C. Huffman [redacted]
Robert or Vonne Macpherson [redacted] Wayne and Alice Mason [redacted]
Subject: RE: Proposed Multi-lot Country Residential Development - 20124165.00.E.01.00 - 20124165.00.U.01.00

Hi Mike,
As a status update on this project, we met with our engineer and with Sask Water to discuss the feasibility of providing water to Eagle Heights. It was determined it is possible to provide water to this country residential development, but not without booster pumps to move the water to the high elevation of this development.

To answer your questions below:
1. Our engineers will be responsible for designing the water system for Eagle Heights.
2. Our contractor will be responsible for constructing the water system for Eagle Heights.
3. Highway 41 Water Utility will be the owner of the underground water infrastructure.

We can move ahead with the feasibility study of designing the main line tie in location, the booster pumphouse configuration and underground infrastructure when you are ready. Just let me know.

Regards,
Blaine

Blaine Tomolak
Highway 41 Water Utility
306-270-7457

h41wumaint@gmail.com

Highway 41
Water Utility

Box 178 • Aberdeen, SK • S0K 0A0

From: Mike Pawluski <pawluskim@ae.ca>
Sent: July 12, 2018 2:51 PM
To: Blaine Tomolak <h41wumaint@gmail.com>
Subject: RE: Proposed Multi-lot Country Residential Development - 20124165.00.E.01.00

Hi Blaine,

It has been a while since I followed up with you regarding the Eagle Heights Country Residential development. As a quick refresher, our clients are in the process of finalizing a comprehensive development review report to submit to the RM of Corman Park for consideration. As part of our clients due diligence they need to illustrate a source of water is available. You request some additional information from me to continue working on the file and I had sent you the electronic file so this work could continue.

I was wondering if you could provide me with a status update on where this project is at with you folks and your engineers. Also, I was wondering if you could answer a couple additional questions:

1. Will your engineers be responsible for designing the water system for Eagle Heights?
2. Who is responsible for constructing the water system for Eagle Heights? Highway 41 or the developer?
3. Who owns the waterline infrastructure underground?

If you could provide me with an update and answers to these questions that would be much appreciated.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

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From: Blaine Tomolak [mailto:h41wumaint@gmail.com]
Sent: Thursday, April 26, 2018 9:57 PM
To: Mike Pawluski <pawluskim@ae.ca>
Subject: RE: Proposed Multi-lot Country Residential Development - 20124165.00.E.01.00

Thanks for the electronic map of the project Mike.

I will begin work with our engineer on this. Ill get back to you shortly with a clearer timeline.

Blaine

From: Mike Pawluski [mailto:pawluskim@ae.ca]
Sent: April 26, 2018 11:04 AM
To: Blaine Tomolak H41 Water Utility <h41wumaint@gmail.com>
Subject: RE: Proposed Multi-lot Country Residential Development - 20124165.00.E.01.00

Hi Blaine,

Once the Highway 41 Water Utility has reviewed the Eagle Heights project with the existing water system, can you have a letter put together stating the Highway 41 Water Utility has the ability to provide water services to Eagle Heights Estates. The RM of Corman Park and Community Planning will both be looking for something formal from you folks during their review process.

The letter should contain information on what the Highway 41 Water Utility will be providing in terms of flow rates and volumes and that there is sufficient capacity in the system to service the development.

If you have any questions, please let me know.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

From: Blaine Tomolak H41 Water Utility [mailto:h41wumaint@gmail.com]
Sent: Tuesday, April 24, 2018 3:51 PM
To: Mike Pawluski <pawluskim@ae.ca>
Subject: RE: Proposed Multi-lot Country Residential Development - 20124165.00.E.01.00

Hi Mike,

Attached is the IP agreement form signed for your records.

Blaine Tomolak
Operator
306-270-7457

Highway 41 Water Utility

Box 178 • Aberdeen, SK • S0K 0A0

From: Mike Pawluski <pawluskim@ae.ca>
Sent: April 23, 2018 1:51 PM
To: Blaine Tomolak H41 Water Utility <h41wumaint@gmail.com>
Subject: RE: Proposed Multi-lot Country Residential Development

Hi Blaine,

Your assumption is correct in that the Highway 41 Water Utility would construct the infrastructure, complete with a water supply curb stop to each lot. Individual home owners would then be responsible to have the metering assembly installed as per the Highway 41 Water Utility requirements.

The 0.33 imperial gallons per minute will be sufficient and the Individual lot owners would be responsible for having their own local storage tank and pressurised system for water distribution on their properties. Please disregard a previous communication I sent you earlier today regarding high pressure flows as we have informed our client that the only way this can be accomplished would be through the construction of a reservoir and pump station on their property – essentially replacing the individual cisterns and pressure systems that would typically be supplied by the homeowner.

As for the electronic drawing, attached is an electronic release form. Please fill it out and send it back to me. Following receipt of the executed release form, I will send you the electronic file of the concept plan.

As for a timeline to construct, I will reach out to the client to confirm when they plan on constructing Phase 1 of the development.

If you need anything else, please let me know.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

Associated Engineering GLOBAL PERSPECTIVE. LOCAL FOCUS. CANADA'S BEST MANAGED COMPANIES Platinum member

From: Blaine Tomolak H41 Water Utility [mailto:h41wumaint@gmail.com]
Sent: Tuesday, April 17, 2018 10:15 AM
To: Mike Pawluski <pawluskim@ae.ca>; h41wuadmin@gmail.com
Cc: [redacted] Bob Macpherson [redacted]

[redacted]
Subject: RE: Proposed Multi-lot Country Residential Development

Hi Mike,

Some questions and assumptions arose from our conversations regarding this development. They are:

1. Highway 41 Water Utility will design and construct the water pipeline to each lot in Eagle Heights. The purchasers of the lots will then be responsible for connecting to the utility. Is this assumption correct?
2. Delivery flow rate to each lot is based on assuming the lots are residential, delivering 0.33 imperial gallons per minute. Is this sufficient?
3. Preliminary discussions were held with our engineers. For them to further work on your project, an electronic map of legal fabric is needed. Is this possible?
4. Is there a timeline for permit to construct?

Regards,

Blaine Tomolak
Operator
306-270-7457

Highway 41 Water Utility

Box 178 • Aberdeen, SK • S0K 0A0

From: Mike Pawluski <pawluskim@ae.ca>
Sent: March 27, 2018 12:25 PM
To: Blaine Tomolak H41 Water Utility <h41wumaint@gmail.com>; Janet Buhler - Administrator <h41wuadmin@gmail.com>
Subject: Proposed Multi-lot Country Residential Development

Hi Blaine and Janet,

Associated Engineering is currently working with Chris Cebryk on a project to develop country residential acreages along the east side of Highway No. 41 and adjacent to Eagle Ridge Estates in the RM of Corman Park. We are currently working on the planning and conceptual design for the development and it is estimated that the development will comprise 84 residential lots within two ¼ sections (W½ 11-37-04-W3M) in 4 phases. A proposed layout for the development is attached for reference. It is my understanding that there have been communications in the past from both Chris and other individuals from our organization in regards to this development and supplying water.

I have a few questions and requests from the Water Utility as we move forward with the project.

- Would the water utility be able to provide the developer with a letter of intent to provide water service to the development? This letter will be used as part of the Comprehensive Development Review we have undertaken to show that the developer has secured a source of potable water for the homes.
- Would the Utility be able to complete a review of the demand required for the development and let us know what type of upgrades may be required or limitations that we may run into as a result of the increased water demand for the area?
- From my understanding, the water system will function as a trickle system. What would the Highway 41 Water Utility normally provide on a per lot basis?

These questions were asked in the past and I am cannot find any correspondence that suggests these questions were ever answered. If there is something in your files regarding this project which you could provide me with that would be much appreciated. If you require more information, please advise me and I will try track down the details you need.

If you have any questions, please feel free to contact me.

Regards,

Mike Pawluski, RPP
Project Planner
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969

Associated Engineering GLOBAL PERSPECTIVE. LOCAL FOCUS. CANADA'S BEST MANAGED COMPANIES Platinum member

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Appendix F: Hydrogeological Report

Issue Date:	February 26, 2018	**File:**	E.01
To:	Saskatoon Health Region		
From:	Gord Will, P.Eng.		
Client:	Chris Cebryk		
Project Name	Cebryk Residential Development - Eagle Heights Subdivision		
Project No.	20124165.00		
Subject:	Preliminary Assessment of the Fate of OWTS Effluent		

TECHNICAL MEMORANDUM

1 INTRODUCTION

Associated Engineering (Sask.) Ltd. (AE) has been engaged by Chris Cebryk to complete a subdivision development site assessment (site assessment) for the proposed Eagle Heights country residential development. The proposed residential development is located on the W1/2 11-37-04 W3M, approximately 5.5 km northeast of Saskatoon in the Rural Municipality of Corman Park (Figure 1). The objective of the site assessment is to assess the potential adverse effects to groundwater from the use of onsite wastewater treatment systems (OWTS).

The site assessment was completed in accordance with the *Guidance Document for the Developments and Subdivision Where Onsite Wastewater Treatment Systems are Proposed* (Government of Saskatchewan, 2012) and the *Saskatchewan Onsite Wastewater Disposal Guide* (Saskatchewan Ministry of Health, 2009). The information presented in this Technical Memorandum will be used to support the Eagle Heights subdivision application to the approving authorities.

AE assessed the subdivision using the risk-based process presented in the Guidance Document (2012) by completing the following steps:

- screening for inclusion
- completing a desktop review and field program
- assessing if the OWTS can be isolated from a groundwater source.

The proposed subdivision area is approximately 128 hectares occupying almost the entire half section. It is planned to comprise of 83 lots with an average lot size of 1 hectare (2.5 acres) (Figure 2). As such, the proposed residential development is categorized under Scenario A of the Inclusion Criteria (Government of Saskatchewan, 2012) indicating that an assessment is required. The following sections provide the results of the desktop review, field program and hydrogeological study.

2 PRELIMINARY ASSESSMENT OF THE FATE OF OWTS EFFLUENT

2.1 Site Characteristics

The characteristics of the proposed subdivision are summarized as follows:

- The development area is currently undeveloped farmland with no buildings or other improvements present. The proposed land use is country residential with single family dwellings maintaining a minimum average lot size of 1 hectare.
- Other existing developments near this project include the 27 lot Eagle Ridge country residential subdivision located directly to the west on SE-10-037 -04 -W3M. Additionally, there are three isolated single severance farmsteads situated directly north of the development area. Agricultural lands represent the balance of land use surrounding the project area including a combination of cultivated and pasture lands.
- The subdivision site is located along the western side of the Strawberry Hills. Natural surface drainage on the site consists of three enclosed catchments (one in the SW quarter, one straddling the SW and NW quarter, and a larger catchment on the NW quarter that drains to the NE corner of the development (Figure 3)). The lowest elevations of each enclosed catchment are occupied by natural sloughs/ponds. The subdivision conceptual drainage plan intends to utilize the natural ground slope, field drains and the road layout to convey surficial runoff to the natural ponds in the three enclosed catchments. The three natural ponds will be maintained as stormwater retention facilities that will retain post development runoff for up to a 1:100 year 24-hour storm event.
- The natural slough/ponds described in the bullet point above will be designated Environmental Reserves. Vegetation is typical of prairie sloughs/ponds (surrounding fringe of low shrubs and grasses, and emergent macrophytes within the pond). There are no other public reserve lands intended within the development area.
- Inspection of satellite images indicate there are no cuts, banks or steep slopes on the development site that might have stability concerns related to effluent input from OWTS.
- There are no existing sewage systems on the development site. Proposed domestic wastewater systems will be OWTS mounds servicing individual lots. Set-backs requirements for the mounds will be as follows: 9 m from a basement/building; 1.5 m above the groundwater table; 3 m from a cut embankment; 3 m from a property boundary; 1.5 m from a walkway; 15 m from a water course; 15 m from a water source; and 60 m from a recreational area. In addition, the sewage mound on each lot should be located down gradient (in the direction of the groundwater flow) from the dwelling with the maximum possible distance to the down gradient boundary of the lot while observing the set-backs requirements.
- There are no existing wells on the development site listed in the Water Security Agency (WSA) well database. Two test holes are listed (one from 1967, the other from 1968) but no wells were developed because of the exploration. There are no proposed or anticipated uses of groundwater for water supply at the development site. Water will be supplied via a pipeline and service connections to individual parcels.
- Water usage at each lot is estimated to be 1245 L per site/day based upon average occupancy of three people per lot (249 people in the subdivision) and an estimated wastewater production rate of 415 L per capita per day (LPCD).

2.2 Site Hydrogeological Characteristics

Hydrogeological investigations (desktop and field) were conducted by AE. The key findings of the investigation are summarized as follows:

- A previous geotechnical investigation (SNC 2013) drilled 29 boreholes distributed over the site (Figure 4), sampled and logged the borehole lithology, and conducted engineering soil testing on the borehole samples. The results of the SNC investigation indicated:
    - The subdivision area is covered by a thin layer of top soil 0 to 800 mm thick, avg. 170 mm (Table1).
    - The top soils are followed by deposits of silt/clay materials to depths of 0 to 2.90, avg. 0.89 m below ground level (mbgl). The surficial silt/clay layer was not present in 7 of the 29 boreholes (Table 1)
    - Samples taken from the boreholes from 0.5 to 1.2 m depth were classified as silty clay loam, silt loam, loam or sandy loam based upon grain size analysis. The materials had 13%-34% clay content and 57%-80% passing through a number of 200 sieve (“fines” or material less than 0.075 mm)
    - The topsoil/silt/clay surface materials overlay silt till deposits to a depth of at least 12.1 mbgl (the maximum depth of the boreholes). The silt till deposits were extensive and found at every borehole location (Table 1).
    - Three of the 29 boreholes (SNC-01, SNC-10, and SNC-21; Figure 4) encountered a layer of silty sand at depths of 3.0, 4.0 and 1.8 mbgl, with thicknesses of 0.50 m, 0.83 m, 0.20 m, respectively (Table 1).
    - Groundwater was observed at depths ranging from 1.32 m to 5.99 mbgl, avg. 3.16 mbgl in piezometers installed in the boreholes (Table 1).
- A hydrogeological field investigation was conducted by AE October – November 2017. A total of eight monitoring wells were installed at distributed locations over the site (Figure 4)[1]. The monitoring wells were sampled and logged for lithology and were used to determine groundwater surface elevations and gradient. Pump tests were conducted on three of the monitoring wells to determine the hydraulic conductivity of the glacial till materials that overlay the site. The results of the AE hydrotechnical investigation indicated that:
    - The lithology of the AE monitoring well boreholes (Table 2) were in close agreement with previous investigation by SNC (SNC 2013).
    - Thin surface layer of top soil (100 to 200 mm) was present in three of the eight AE boreholes.
    - In two of the eight AE boreholes, top soil was followed by deposits of silt/clay materials with thickness of 400 and 900 mm respectively.
    - The topsoil/silt/clay surface materials overlay silt till deposits to a depth of at least 10.6 mbgl (the maximum depth of the boreholes). The silt till deposits were extensive and found at every AE borehole location.
    - No sand layers were encountered in any of the AE boreholes.

[1] The SNC boreholes and piezometers installed in 2013 had been decommissioned and therefore were unavailable for groundwater monitoring in 2017.

- Groundwater was observed in the monitoring wells at depths ranging from 1.88 m to 6.17 mbgl, avg. 3.49 mbgl in piezometers installed in the boreholes (Table 2).
- Falling head slug testing was conducted in AE monitoring wells 03, 05 and 06D to measure the hydraulic conductivity of the surficial till materials. The test results indicated the hydraulic conductivities were in the range 1.91 x 10-9 to 1.82 x 10-8 m/s (1.65 x 10-4 to 1.57 x.10-3 m/day).
- The sand layers that were found in three (3) of the 29 SNC boreholes (Table 1), but none of the 8 AE monitoring well boreholes (Table 2), are likely discontinuous and limited in extent based upon their low frequency of occurrence and the dispersed nature of their occurrence (Figure 4) (i.e. the sand lense occurrences were not found in proximity to each other).
- Groundwater gradient on the subdivision site is strongly correlated with ground surface elevation (Figure 5). Locally shallow groundwater likely moves toward the low spot in each of the three surface runoff catchments (Figure 3), but overall the deep groundwater moves in the direction of the lowest surface elevations near the large pond in the NE corner of the subdivision site.
- Local horizontal groundwater gradient on the subdivision site ranged from 0.01 to 0.003 based upon AE monitoring well observations, and horizontal groundwater velocity was calculated to range from 0.015 m/year to 0.00048 m/year based upon till material properties and monitoring well bail response testing.
- Mean annual precipitation at the site is expected to be approximately of 355 mm/year and potential evapotranspiration 565 mm/year (SRC 2016). Due to the annual moisture deficit the groundwater recharge rate is estimated to be only a few mm/yr (Ryan and Chu 2009, Keller et al. 1988) and recharge is likely to occur during wet periods only.
- A total of 8 driller’s logs located in the ten quarter sections bordering the subdivision half section site were available in the WSA well database (Figure 6 and Table 3). Two of the 8 drill logs were for undeveloped test holes. Three were for bored wells completed in gravels at depths in the range of 11.0 to 19.5 mbgl. Three were for drilled wells completed in sands at depths in the range of 57.9 to 71.0 mbgl. The shallowest well completion
- (11 mbgl) was located to the NW, downslope of the subdivision site at a much lower elevation near Highway 41. The gravel materials that the bored wells were completed in were all overlain by layers of sandy clays and tills.
- A total of 10 additional driller’s logs are located within the next ring of 18 quarter sections that surround the subdivision site and the 10 immediately adjoining quarter sections (Figure 6 and Table 3). Four of the 10 drill logs were for undeveloped test holes, but each had lithology records. The 6 drill logs for wells indicate completion in sand and/or gravel layers at 5.8 to 14.3 mbgl. The shallowest wells are located to the east and southeast at higher elevations than the subdivision site.

Regional groundwater aquifers are described as follows based upon descriptions and maps presented in SNC (2013), MDH (2011) Main Report and MDH (2011) Appendix F:

- Surficial stratified deposits may occur near the site. However, WSA mapping of the surficial stratified deposits (MDH (2011)) indicates the subdivision site is outside of the interpreted extend of the deposits.

- The subdivision site overlies the Saskatoon Group that contains the Lower and Middle Floral Formation stratified deposits. These stratified deposits are referred to as the inter-till Upper and Lower Floral Aquifers, or collectively as the Forestry Farm Aquifer (MDH (2011)). The surface of the Upper Floral Aquifer is located at depths ranging from approximately 20 to 25 m below grade near the subdivision site. The surface of the Lower Floral Aquifer is located at depths ranging from 60 to 62 m below grade near the subdivision site.
- The Tyner Valley Aquifer could potentially underlie the subdivision site at depths over 80 m below grade. However, WSA mapping of the Tyner Valley aquifer (MDH (2011)) indicates the subdivision site is outside of the interpreted extend of the aquifer.
- The Judith River Formation, a large bedrock aquifer, is located at depths greater than 140 m below grade near the subdivision site.

Interpretation of the WSA well logs in the area surrounding the subdivision indicated that no domestic wells have been completed in surficial aquifer deposits. The WSA well logs in the surrounding area do indicate the presence of domestic wells at depths of 6 to 19 mbgl and at depth 58 to 71 mbgl. Those depths correspond closely to the mapping descriptions of the Upper and Lower Floral formation aquifers (i.e. the Forestry Farm Aquifer).

2.3 Monitor Well Water Quality

Water quality samples were collected from 6 of the 8 recently installed monitor wells. The remaining 2 monitor wells were dry. Full analytical results are presented in Appendix A. The water quality indicates a wide and varied concentration of many of the typical indicator parameters showing little if any consistency between samples (Table 4).

There is little to no consistency between the water quality samples indicating that there is no shallow usable groundwater supply. With some of the wells being installed near existing sloughs, some within the agricultural zone and some located adjacent roadways (subject to winter salt spray) the water collected is a reflection of localized conditions and not from external influences. This type of water is a result of pour water pressure leaching from the adjacent soils and not from a groundwater supply. Water of this nature is not a sustainable supply and will rapidly dry out during times of drought.

This result, plus the findings from the hydrogeological assessment, supports the use of OWTS within the subdivision.

2.4 Conceptual Hydrogeological Model

A conceptual hydrogeological model for the subdivision site and vicinity was formulated based upon results of the hydrogeological investigation. The conceptual model is shown schematically in Figure 7. The proposed subdivision site is covered by low hydraulic conductivity silt till materials to a depth of 11 meters or more. Therefore, it is believed that effluent from OWTS on the site would be effectively isolated from the regional aquifers (Forestry Farm Aquifer in the upper and medium Floral Formation, located approximately 15 to 25 mbgl and 58 to 71 mbgl, respectively, near the site), and from discontinuous thin layer pockets of coarser materials potentially containing groundwater at depths of 2 to 4 meters mixed amongst the surficial tills as indicated by the SNC borehole logs. OWTS effluent is likely to move very slowly down gradient in the surficial tills toward local lower elevations on the site, and eventually toward the lowest elevation on the NE corner of the subdivision and then downslope toward Highway 41. Along that pathway the effluent components such as nitrate will be subjected to natural attenuating processes such as physical adsorption, microbial degradation and plant uptake. Effluent in the subsurface that eventually reaches the lower elevations down gradient will be subjected to dilution from infiltration of accumulated surface runoff in downslope surface depressions.

3 HYDROGEOLOGICAL ISOLATION OF OWTS EFFLUENT FROM WATER SUPPLY AQUIFERS

Based upon the hydrogeological site investigation and the conceptual hydrogeological model described above, it is AE's view that nitrate and other effluent components from OWTS located on the subdivision site (designed according to Saskatchewan Health guidelines) will be isolated from the nearest regional groundwater aquifers (estimated to be located 15 to 25 mbgl at the site) by the low hydraulic conductivity surficial silt till materials (> 11 m thick). Also, the surficial till materials will isolate the OWTS effluent from smaller scale discontinuous pockets of course materials potential containing groundwater located approximately 2 to 4 mbgl.

Preliminary calculations for an individual lot in the subdivision based on the per lot wastewater flow estimates of 1245 L per day and a loading rate of 13.72 L/m^2 show that mounds with a size of 91 m^2 should be sufficient to allow natural attenuation of nitrogen parameters through a combination of adsorption and biological uptake in the vadose zone.

Based on the conceptual hydrogeological model presented in this memorandum, AE requests that the proposed OWTS for the Eagle Heights Subdivision be designated as isolated from regional water supply aquifers, and that the subdivision Application for Approval be granted. We recommend traditional mounds, as described above, be used to dispose of effluent.

4 CLOSURE

This memo was prepared for the Saskatoon Health Region to provide a preliminary assessment of the fate of OWTS effluent for the Vista Ridge Development, to aid in the Application for Approval.

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.

Respectfully submitted,

Prepared by:

Gordon Putz, Ph.D., P.Eng.
GP/GW/np

Reviewed by:

Gordon Will, P.Eng.

REFERENCES

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TABLES

Table 1
SNC Borehole Lithology and Groundwater Depths and Elevations

Borehole No.	Top Soil Thickness (m)	Silt/Clay Thickness (m)	Till 1 Thickness (m)	Sand Thickness (m)	Till 2 Thickness (m)	Borehole Depth (m)	Depth to GW (m)	Ground Surf. Elev.† (m)	GW Surf. Elev. (m)
SNC-01	0.10	0.20	2.70	0.50	2.55	6.05	2.25	557.90	555.65
SNC-02	0.30	0.70	-	-	4.80	5.80	2.18	557.25	555.07
SNC-03	0.05	-	-	-	5.95	6.00	1.71	550.50	548.79
SNC-05	0.20	0.48	-	-	5.12	5.80	3.03	557.40	554.37
SNC-06	0.35	1.65	-	-	4.00	6.00	1.57	551.25	549.68
SNC-07	0.10	0.20	-	-	5.50	5.80	5.15	565.50	560.35
SNC-08	0.20	-	-	-	5.80	6.00	3.40	554.00	550.60
SNC-09	0.05	0.25	-	-	5.40	5.70	2.46	557.40	554.94
SNC-10	0.13	2.17	1.70	0.83	0.87	5.70	1.66	549.50	547.84
SNC-11	0.40	1.60	-	-	4.00	6.00	2.54	556.50	553.96
SNC-12	0.30	1.50	-	-	4.10	5.90	1.58	558.30	556.72
SNC-13	0.13	1.39	-	-	4.28	5.80	5.12	558.60	553.48
SNC-14	0.10	1.00	-	-	4.62	5.72	2.47	552.90	550.43
SNC-15	0.12	0.10	-	-	5.78	6.00	5.35	558.40	553.05
SNC-16	0.80	1.30	-	-	3.90	6.00	2.56	556.00	553.44
SNC-17	0.10	-	-	-	6.00	6.10	-	561.70	-
SNC-18	0.10	1.00	-	-	5.00	6.10	3.19	558.20	555.01
SNC-19	0.20	1.80	-	-	10.10	12.10	-	561.00	-
SNC-20	0.34	0.36	-	-	5.40	6.10	3.30	563.20	559.90
SNC-21	0.20	1.60	-	0.20	4.10	6.10	2.17	565.75	563.58
SNC-22	0.10	1.80	-	-	4.20	6.10	4.70	560.40	555.70
SNC-23	0.10	1.40	-	-	4.50	6.00	5.99	560.50	554.51
SNC-24	0.10	2.90	-	-	3.50	6.50	2.00	557.70	555.70
SNC-25	0.10	-	-	-	6.40	6.50	5.09	552.25	547.16

Borehole No.	Top Soil Thickness (m)	Silt/Clay Thickness (m)	Till 1 Thickness (m)	Sand Thickness (m)	Till 2 Thickness (m)	Borehole Depth (m)	Depth to GW (m)	Ground Surf. Elev.† (m)	GW Surf. Elev. (m)
SNC-26	0.10	-	-	-	6.00	6.10	5.56	558.75	553.19
SNC-27	0.10	-	-	-	5.70	5.80	3.13	561.60	558.47
SNC-29	-	1.80	-	-	2.90	4.70	1.32	558.75	557.43
SNC-30	-	0.70	-	-	5.40	6.10	4.05	559.80	555.75
SNC-31	-	-	-	-	5.80	5.80	1.72	559.50	557.78
avg	**0.19**	**1.18**		**0.51**		**6.15**	**3.16**		
min	**0.05**	**0.10**		**0.20**		**4.70**	**1.32**		
max	**0.80**	**2.90**		**0.83**		**12.10**	**5.99**		
number	**26**	**22**		**3**		**29**	**27**		

GW – Groundwater

† based upon ground surface contours from site topographic surveys

Table 2
AE Monitoring Well Borehole Lithology and Groundwater Depths and Elevations

Borehole No.	Top Soil Thickness (m)	Silt/Clay Thickness (m)	Till 1 Thickness (m)	Sand Thickness (m)	Till 2 Thickness (m)	Borehole Depth (m)	Depth to GW (m)	Ground Surf. Elev. (m)	GW Surf. Elev. (m)
MW17-01	0.10	-	-	-	4.00	4.10	3.37	558.34	554.97
MW17-02	0.20	0.90	-	-	1.90	3.00	2.15	560.62	558.47
MW17-03	-	-	-	-	10.60	10.60	6.17	562.40	556.23
MW17-04	-	-	-	-	4.50	4.50	-	552.87	-
MW17-05	0.10	0.40	-	-	8.60	9.10	4.03	555.03	551.00
MW17-06	-	-	-	-	7.00	7.00	3.23	552.38	549.15
MW17-06D	-	-	-	-	7.00	7.00	3.58	552.37	548.78
MW17-07	-	-	-	-	7.60	7.60	1.88	554.25	552.37
avg	0.13	0.65				6.61	3.49		
min	0.10	0.40				3.00	1.88		
max	0.20	0.90				10.60	6.17		
count	3	2				8	7		

GW – Groundwater

Table 3
Characteristics of Wells and Test Holes in the WSA Database near the Proposed Eagle Heights Subdivision

Group	Relative Position to Site	Land Description	Well No.	Year	Elevation (m)	Well Depth (m)	Water Depth (m)	Installation Type	Dia. (mm)	Use	Comments
Eagle Heights 1/2 Section	on-site	NW-11-037 -04 -W3	219323	1968	551.1	6.1	0.0	Augered	n/a	Soil Test Hole	No lithology
			219325	1967	548.0	6.1	0.0	Augered	n/a	Soil Test Hole	No lithology
Wells and test holes in the 1st ring of ten surrounding 1/4 sections	NW	SE-15-37 -04 -W3	090914	1988	533.4	18.3	9.8	Bored	1118	Domestic	9.8 m brown till; 11.0 m brown gravel; 18.3 m brown till
	E	NE-11-37-04-W3	219324	1968	547.1	14.3	0.0	Augered	n/a	Soil Test hole	No lithology
	SW	NE-03-37-04-W3	201875	2004	559.9	67.1	39.6	Drilled	130	Domestic	4.3 m brown till sandy; 4.6 m rock; 5.5 m till brown; 17.7 m grey till stoney; 18.3 m grey sand; 21.3 m grey clay soft; 22.6 m grey sand coarse; 28.0 m grey silty clay soft; 29 m grey sand medium; 51.2 m grey till; 57.9 m grey, black sand, fine; 67.1 m grey till clayey
	W	SE-10-37-04-W3	104450	1994	541.0	22.3	6.7	Bored	1067	Domestic	0.3 m topsoil; 3.0 m clay sandy; 7.6 m brown till; 16.8 m grey till; 18.9 m grey till with sand streaks;19.5 m gravel; 22.9 m grey till
			108001	1997	509.9	22.9	10.4	Bored	1067	Domestic	6.1 m brown till; 9.8 m grey till; 12.2 m grey till with sand streaks; 16.5 m brown till soft; 19.8 m brown till hard; 22.9 m grey till hard
			109357	1998	548.6	73.2	40.5	Drilled	130	Domestic	2.4 m brown sandy clay silty; 7.6 m brown till; 9.1 m brown till; 16.8 m grey till firm; 23.5 m grey clay silty; 28.0 m brown till sandy; 30.5 m brown till sandy; 51.8 m grey till rocky; 59.4 m grey sand with clay streaks; 73.2 m grey till with clay streaks
	W	-10-37-04-W3	099157	1990	533.4	85.3	0.0	Drilled	119	Test Hole	7.3 m brown till with boulders; 22.9 m grey till with cobblestones, 26.8 m gravel coarse; 61.6 m till grey; 70.4 m sand fine-medium; 77.4 m grey till; 85.3 m till oxidized.
			099158	1990	533.4	91.4	45.1	Drilled	119	Domestic	7.3 m brown till; 21.3 m grey till with cobblestones; 25.9 m gravel coarse; 60.4 m grey till; 71.0 m sand fine-medium; 78.9 m grey till;87.2 m till clayey, 91.4 m clay
Wells and test holes in 2nd ring of 18 surrounding 1/4 sections	E	NW-12-37 -04 -W3	031805	1961	563.9	18.3	0.0	Bored	914	Test Hole	0.3 m topsoil; 8.5 m brown clay; 18.3 m blue clay.
			031806	1961	563.9	15.2	0.0	Bored	914	Test Hole	0.3 m topsoil; 6.7 m brown clay; 15.2 m blue clay.
			031807	1961	563.9	17.4	0.0	Bored	914	Test Hole	0.3 m topsoil; 5.5 m brown clay; 17.4 m blue clay.
			056430	1978	563.9	12.2	4.6	Bored	1067	Domestic	0.3 m topsoil, 4.6 m yellow clay stoney; 5.8 m gravel coarse; 12.2 m blue clay.
	SE	SW-01-37 -04 -W3	087135	1987	556.3	12.8	0.0	Bored	914	Domestic	0.3 m topsoil; 5.2 m brown clay; 7.0 m grey clay; 8.2 m grey clay with gravel streaks; 8.8 m gravel, 12.8 m grey clay
			060654	1979	571.5	12.2	2.4	Bored	1067	Domestic	0.3 m topsoil; 2.4 m yellow clay with boulders; 6.7 m sand and gravel; 12.2 m blue
			064225	1980	556.3	80.8	28.7	Drilled	157	Domestic	7.3 m brown till stoney; 10.4 m blue clay; 11.3 m sand; 25.9 m grey till stoney; 62.5 m grey clay hard; 74.4 m sand with clay streaks; 80.8 m grey clay
	S	SW-02-37 -04 -W3	088787	1988	548.6	17.4	4.6	Bored	1118	Domestic	3.0 m brown till; 6.1 m brown till sandy; 7.3 m brown sand coarse; 13.7 m grey till sandy; 17.4 m grey till
	W	SW-10-37 -04 -W3	060826	1980	518.2	16.5	0.0	Augered	n/a	Test Hole	0.3 m topsoil; 2.7 m blue clay; 12.5 m brown clay sandy; 14.3 m sand; 16.5 m brown clay.
			060850	1980	518.2	21.9	6.4	Bored	1219	Domestic	0.3 m topsoil; 6.4 m yellow clay;16.2 m clay fractured; 21.9 m blue clay with boulders.

n/a not available

Table 4

Parameter	Total Nitrogen	Chloride	Dissolved Solids (TDS)
MW17-02	5.90	11.6	5150
MW17-03	76.2	135	8530
MW17-05	17.9	53.0	1050
MW17-06	1.77	16.5	1160
MW17-06D	1.24	16.1	505
MW17-07	24.5	45.2	4870

Note – all values are in mg/l

FIGURES

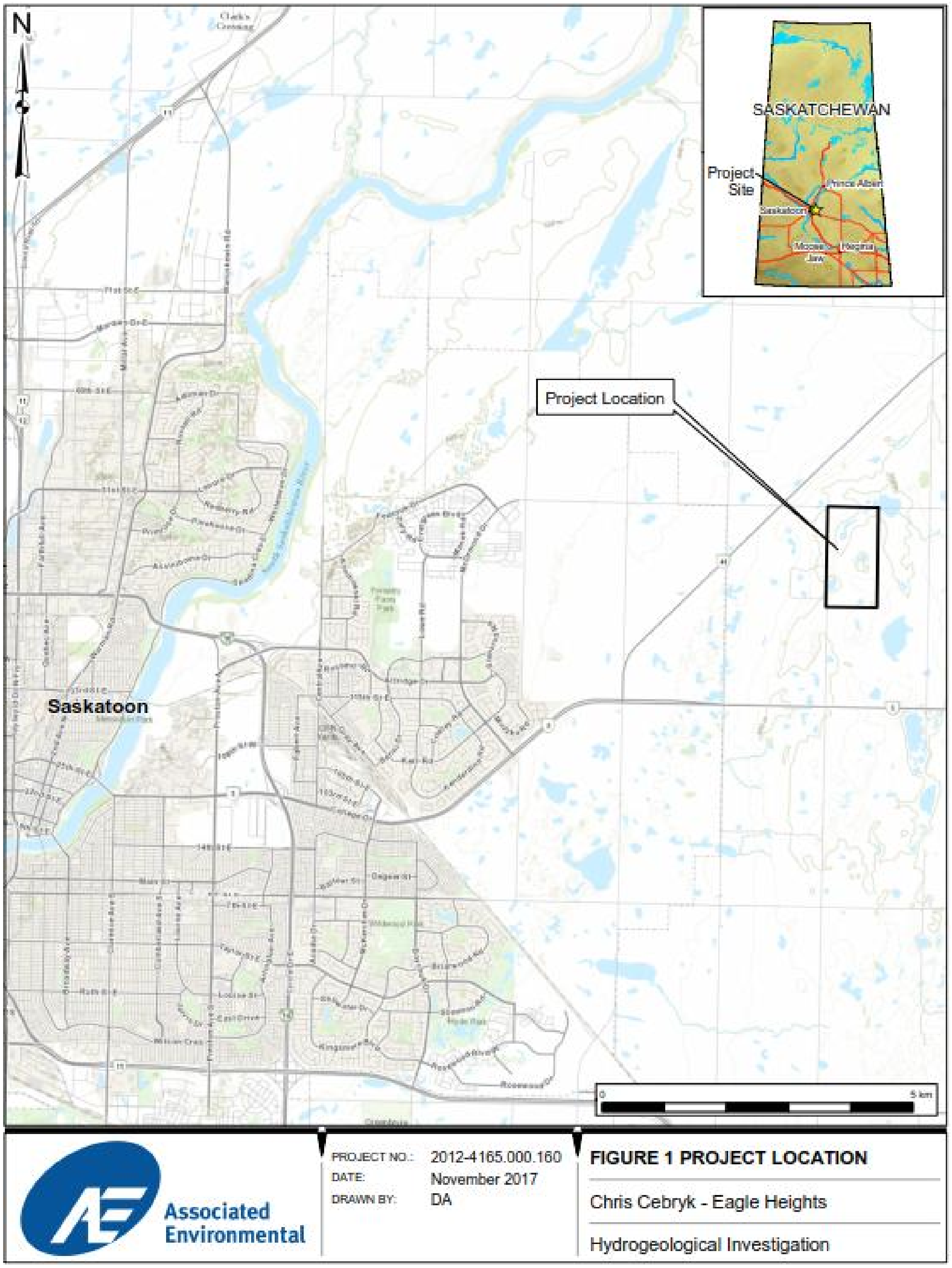


Figure 1
Location of Eagle Heights Subdivision

Figure 2
Eagle Heights Subdivision Concept Plan

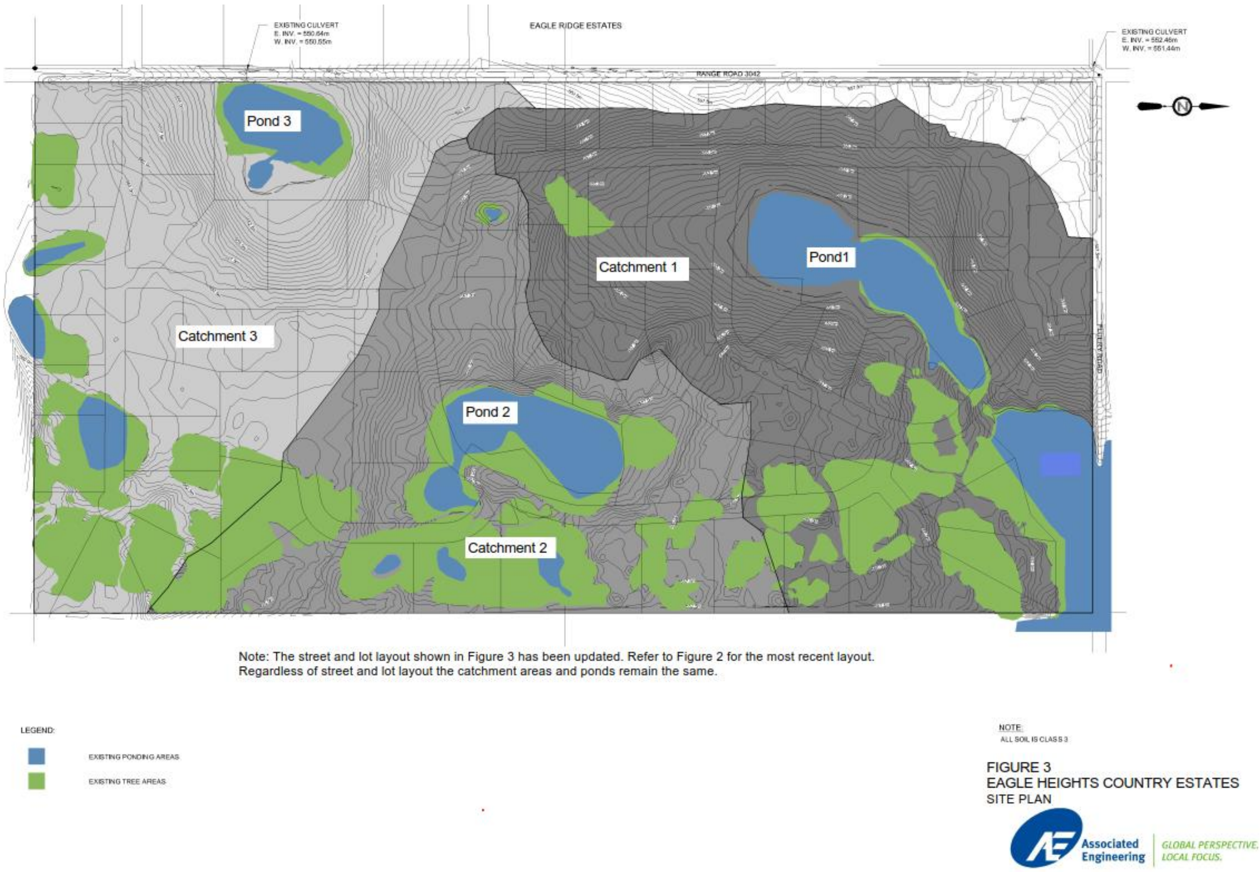


Figure 3
Eagle Heights Surface Drainage Concept

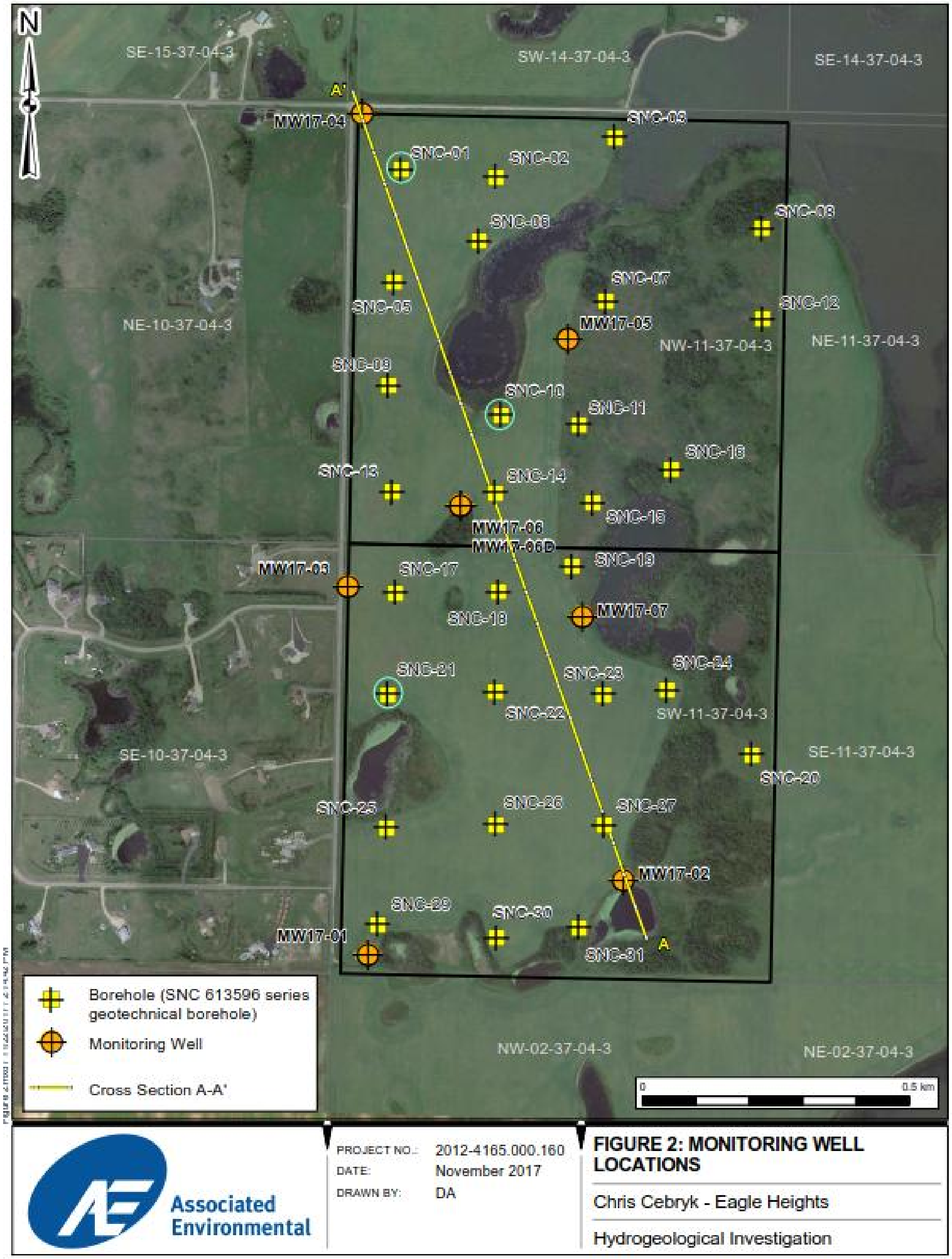


Figure 4
SNC Borehole and AE Monitoring Well Locations
Note: SNC 01, 10 and 21 denoted with green circles encountered thin sand layers

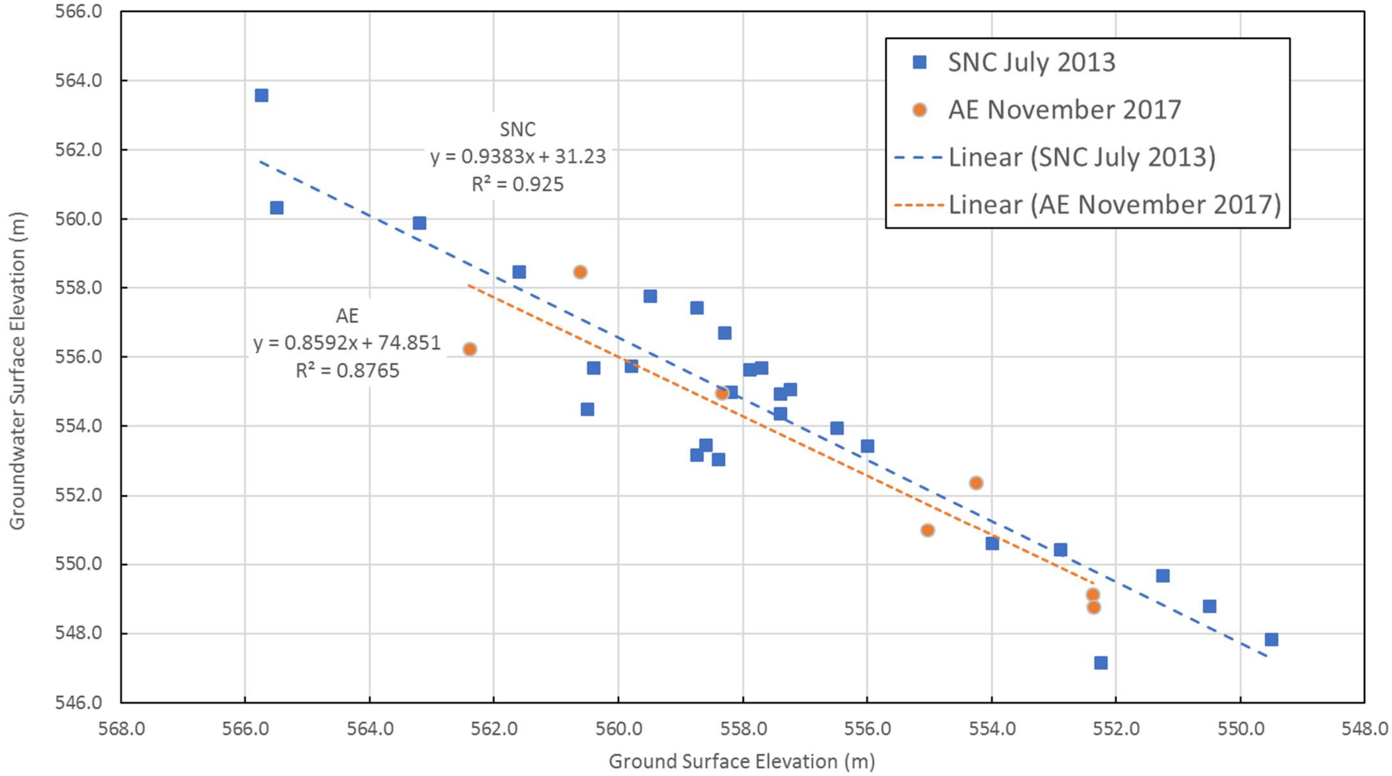


Figure 5
Groundwater Surface Elevations vs. Ground Surface Elevations

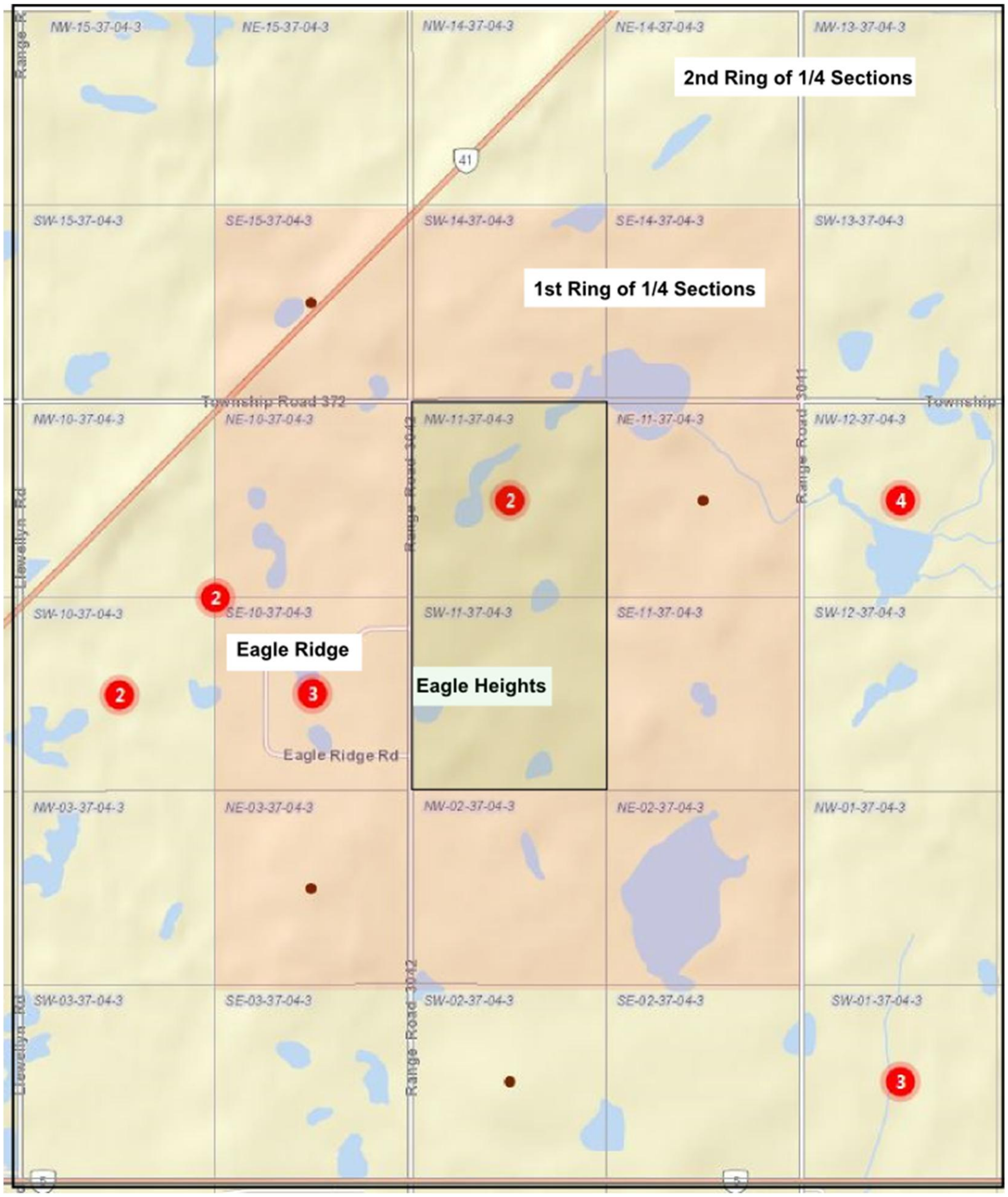


Figure 6

Quarter Sections with Well Log Information near the proposed Eagle Heights Subdivision Site. Red dots indicate ¼ section or section with well logs, number indicates number of logs, no number a single log. Adapted from WSA online database at

https://gis.wsask.ca/Html5Viewer/index.html?viewer=WaterWells.WellsViewer

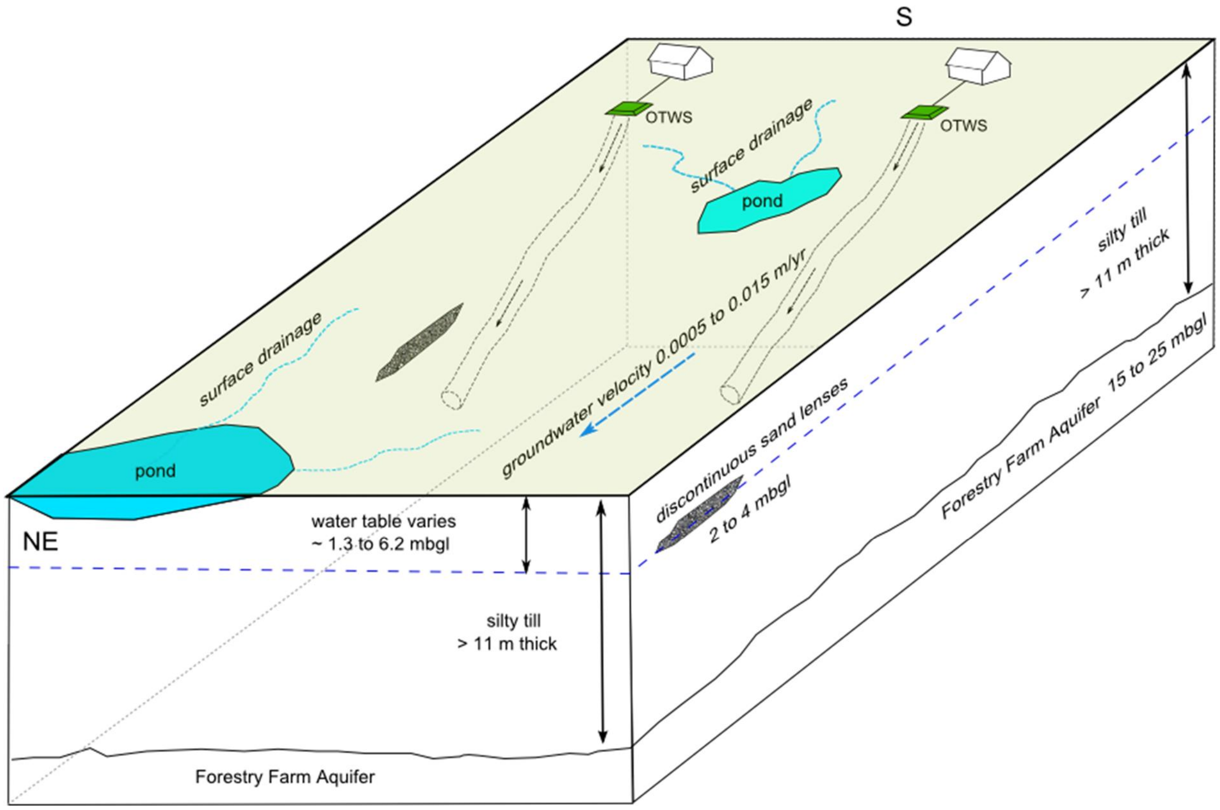


Figure 7
Conceptual Hydrogeological Model for the Eagle Heights Subdivision Site

APPENDIX A – CERTIFICATE OF ANALYSIS

Associated Environmental Consultants Inc.
ATTN: Dan McCrank
1 - 2225 Northridge Drive
Saskatoon SK S7L 6X6

Date Received: 24-OCT-17
Report Date: 07-NOV-17 15:06 (MT)
Version: FINAL

Client Phone: 306-715-3581

Certificate of Analysis

Lab Work Order #: L2012694

Project P.O. #: NOT SUBMITTED
Job Reference: 2012-4165
C of C Numbers: 15-540861
Legal Site Desc:

Brian Morgan, B.Sc. Hons.
Client Services Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2012694-1 MW17-02							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Single Metal in Water by ICPMS (Diss.)							
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	LAB	SFP				01-NOV-17	R3872832
Iron (Fe)-Dissolved	<0.050	DLDS	0.050	mg/L		02-NOV-17	R3873502
Miscellaneous Parameters							
Ammonia, Total (as N)	1.03		0.050	mg/L	02-NOV-17	02-NOV-17	R3874267
Ferric Iron, Dissolved	<0.050		0.050	mg/L		31-OCT-17	
Phosphorus (P)-Total	0.59		0.30	mg/L	27-OCT-17	27-OCT-17	R3869361
Total Coliform, E. Coli - Quanti-Tray							
Total Coliforms	>200.5		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Escherichia Coli	0		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Diss. Ferrous Iron in Water by Colour							
Ferrous Iron, Dissolved	<0.020		0.020	mg/L	31-OCT-17	31-OCT-17	R3871051
Dissolved Fe2 Filtration Location	FIELD					31-OCT-17	R3870866
Total Nitrogen							
Nitrate, Nitrite and Nitrate+Nitrite-N							
Nitrate-N	2.48		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrite-N	0.052		0.050	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrate+Nitrite-N	2.53		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
TKN in Water by Colour							
Total Kjeldahl Nitrogen	3.37		0.20	mg/L	30-OCT-17	31-OCT-17	R3871346
Total Nitrogen (Calculation)							
Total Nitrogen	5.90		0.54	mg/L		01-NOV-17	
Routine Water Analysis (no Fluoride)							
Alkalinity by Auto. Titration							
Bicarbonate (HCO3)	581.		20	mg/L		26-OCT-17	R3866566
Hydroxide (OH)	<10.		10	mg/L		26-OCT-17	R3866566
Carbonate (CO3)	<10.		10	mg/L		26-OCT-17	R3866566
Alkalinity, Total (as CaCO3)	476		20	mg/L		26-OCT-17	R3866566
Chloride (Cl)							
Chloride (Cl)	11.6	DLDS	2.0	mg/L	30-OCT-17	30-OCT-17	R3869677
Conductivity (Automated)							
Conductivity	5260		10	uS/cm		26-OCT-17	R3866566
ICP Cations							
Calcium (Ca)	410	DLDS	10	mg/L	27-OCT-17	27-OCT-17	R3869618
Potassium (K)	50	DLDS	10	mg/L	27-OCT-17	27-OCT-17	R3869618
Magnesium (Mg)	706	DLDS	10	mg/L	27-OCT-17	27-OCT-17	R3869618
Sodium (Na)	132	DLDS	20	mg/L	27-OCT-17	27-OCT-17	R3869618
Sulfur (as SO4)	3540	DLDS	30	mg/L	27-OCT-17	27-OCT-17	R3869618
Ion Balance Calculation							
Cation - Anion Balance	1.1			%		30-OCT-17	
TDS (Calculated)	5150			mg/L		30-OCT-17	
Hardness (as CaCO3)	3930			mg/L		30-OCT-17	
pH by Meter (Automated)							
pH	7.68		0.10	pH		26-OCT-17	R3866566
L2012694-2 MW17-03							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Single Metal in Water by ICPMS (Diss.)							
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	LAB	SFP				01-NOV-17	R3872832
Iron (Fe)-Dissolved	<0.10	DLDS	0.10	mg/L		02-NOV-17	R3873502
Miscellaneous Parameters							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2012694-2 MW17-03							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Ammonia, Total (as N)	1.04	DLHC	0.10	mg/L	02-NOV-17	02-NOV-17	R3874267
Ferric Iron, Dissolved	<0.10		0.10	mg/L		31-OCT-17	
Phosphorus (P)-Total	<0.30		0.30	mg/L	27-OCT-17	27-OCT-17	R3869361
Total Coliform, E. Coli - Quanti-Tray							
Total Coliforms	145		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Escherichia Coli	0		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Diss. Ferrous Iron in Water by Colour							
Ferrous Iron, Dissolved	<0.020		0.020	mg/L	31-OCT-17	31-OCT-17	R3871051
Dissolved Fe2 Filtration Location	FIELD					31-OCT-17	R3870866
Total Nitrogen							
Nitrate, Nitrite and Nitrate+Nitrite-N							
Nitrate-N	76.1	DLHC	5.0	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrite-N	0.129		0.050	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrate+Nitrite-N	76.2	DLHC	5.0	mg/L	25-OCT-17	25-OCT-17	R3866688
TKN in Water by Colour							
Total Kjeldahl Nitrogen	2.42	TKNI	0.20	mg/L	30-OCT-17	31-OCT-17	R3871346
Total Nitrogen (Calculation)							
Total Nitrogen	78.7		5.0	mg/L		01-NOV-17	
Routine Water Analysis (no Fluoride)							
Alkalinity by Auto. Titration							
Bicarbonate (HCO3)	811.		20	mg/L		26-OCT-17	R3866566
Hydroxide (OH)	<10.		10	mg/L		26-OCT-17	R3866566
Carbonate (CO3)	<10.		10	mg/L		26-OCT-17	R3866566
Alkalinity, Total (as CaCO3)	665		20	mg/L		26-OCT-17	R3866566
Chloride (Cl)							
Chloride (Cl)	135	DLDS	10	mg/L	30-OCT-17	30-OCT-17	R3869677
Conductivity (Automated)							
Conductivity	8170		10	uS/cm		26-OCT-17	R3866566
ICP Cations							
Calcium (Ca)	498	DLDS	20	mg/L	27-OCT-17	27-OCT-17	R3869618
Potassium (K)	31	DLDS	20	mg/L	27-OCT-17	27-OCT-17	R3869618
Magnesium (Mg)	1290	DLDS	20	mg/L	27-OCT-17	27-OCT-17	R3869618
Sodium (Na)	234	DLDS	40	mg/L	27-OCT-17	27-OCT-17	R3869618
Sulfur (as SO4)	5610	DLDS	60	mg/L	27-OCT-17	27-OCT-17	R3869618
Ion Balance Calculation							
Cation - Anion Balance	0.9			%		30-OCT-17	
TDS (Calculated)	8530			mg/L		30-OCT-17	
Hardness (as CaCO3)	6560			mg/L		30-OCT-17	
pH by Meter (Automated)							
pH	7.48		0.10	pH		26-OCT-17	R3866566
L2012694-3 MW17-05							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Single Metal in Water by ICPMS (Diss.)							
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	LAB	SFP				01-NOV-17	R3872832
Iron (Fe)-Dissolved	<0.010		0.010	mg/L		02-NOV-17	R3873502
Miscellaneous Parameters							
Ammonia, Total (as N)	0.348		0.050	mg/L	02-NOV-17	02-NOV-17	R3874267
Ferric Iron, Dissolved	<0.030		0.030	mg/L		31-OCT-17	
Phosphorus (P)-Total	0.31		0.30	mg/L	27-OCT-17	27-OCT-17	R3869361
Total Coliform, E. Coli - Quanti-Tray							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2012694-3 MW17-05							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Total Coliform, E. Coli - Quanti-Tray							
Total Coliforms	15		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Escherichia Coli	0		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Diss. Ferrous Iron in Water by Colour							
Ferrous Iron, Dissolved	<0.020		0.020	mg/L	31-OCT-17	31-OCT-17	R3871051
Dissolved Fe2 Filtration Location	FIELD					31-OCT-17	R3870866
Total Nitrogen							
Nitrate, Nitrite and Nitrate+Nitrite-N							
Nitrate-N	17.9		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrite-N	<0.050		0.050	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrate+Nitrite-N	17.9		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
TKN in Water by Colour							
Total Kjeldahl Nitrogen	1.88		0.20	mg/L	30-OCT-17	31-OCT-17	R3871346
Total Nitrogen (Calculation)							
Total Nitrogen	19.8		0.54	mg/L		01-NOV-17	
Routine Water Analysis (no Fluoride)							
Alkalinity by Auto. Titration							
Bicarbonate (HCO3)	349.		20	mg/L		26-OCT-17	R3866566
Hydroxide (OH)	<10.		10	mg/L		26-OCT-17	R3866566
Carbonate (CO3)	<10.		10	mg/L		26-OCT-17	R3866566
Alkalinity, Total (as CaCO3)	286		20	mg/L		26-OCT-17	R3866566
Chloride (Cl)							
Chloride (Cl)	53.0		1.0	mg/L	30-OCT-17	30-OCT-17	R3869677
Conductivity (Automated)							
Conductivity	1480		10	uS/cm		26-OCT-17	R3866566
ICP Cations							
Calcium (Ca)	202		1.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Potassium (K)	9.3		1.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Magnesium (Mg)	83.7		1.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Sodium (Na)	19.7		2.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Sulfur (as SO4)	435		3.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Ion Balance Calculation							
Cation - Anion Balance	1.4			%		30-OCT-17	
TDS (Calculated)	1050			mg/L		30-OCT-17	
Hardness (as CaCO3)	849			mg/L		30-OCT-17	
pH by Meter (Automated)							
pH	7.75		0.10	pH		26-OCT-17	R3866566
L2012694-4 MW17-06							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Single Metal in Water by ICPMS (Diss.)							
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	LAB	SFP				01-NOV-17	R3872832
Iron (Fe)-Dissolved	<0.010		0.010	mg/L		02-NOV-17	R3873502
Miscellaneous Parameters							
Ammonia, Total (as N)	0.511		0.050	mg/L	02-NOV-17	02-NOV-17	R3874267
Ferric Iron, Dissolved	<0.030		0.030	mg/L		31-OCT-17	
Phosphorus (P)-Total	1.34	DLR	0.90	mg/L	27-OCT-17	27-OCT-17	R3869361
Total Coliform, E. Coli - Quanti-Tray							
Total Coliforms	>200.5		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Escherichia Coli	0		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Diss. Ferrous Iron in Water by Colour							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2012694-4 MW17-06							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Diss. Ferrous Iron in Water by Colour							
Ferrous Iron, Dissolved	<0.020		0.020	mg/L	31-OCT-17	31-OCT-17	R3871051
Dissolved Fe2 Filtration Location	FIELD					31-OCT-17	R3870866
Total Nitrogen							
Nitrate, Nitrite and Nitrate+Nitrite-N							
Nitrate-N	1.71		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrite-N	0.060		0.050	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrate+Nitrite-N	1.77		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
TKN in Water by Colour							
Total Kjeldahl Nitrogen	3.21		0.20	mg/L	30-OCT-17	31-OCT-17	R3871346
Total Nitrogen (Calculation)							
Total Nitrogen	4.98		0.54	mg/L		01-NOV-17	
Routine Water Analysis (no Fluoride)							
Alkalinity by Auto. Titration							
Bicarbonate (HCO3)	452.		20	mg/L		26-OCT-17	R3866566
Hydroxide (OH)	<10.		10	mg/L		26-OCT-17	R3866566
Carbonate (CO3)	<10.		10	mg/L		26-OCT-17	R3866566
Alkalinity, Total (as CaCO3)	370		20	mg/L		26-OCT-17	R3866566
Chloride (Cl)							
Chloride (Cl)	16.5		1.0	mg/L	30-OCT-17	30-OCT-17	R3869677
Conductivity (Automated)							
Conductivity	1590		10	uS/cm		26-OCT-17	R3866566
ICP Cations							
Calcium (Ca)	234	DLDS	2.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Potassium (K)	5.7	DLDS	2.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Magnesium (Mg)	77.2	DLDS	2.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Sodium (Na)	26.6	DLDS	4.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Sulfur (as SO4)	567	DLDS	6.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Ion Balance Calculation							
Cation - Anion Balance	-1.2			%		30-OCT-17	
TDS (Calculated)	1160			mg/L		30-OCT-17	
Hardness (as CaCO3)	902			mg/L		30-OCT-17	
pH by Meter (Automated)							
pH	7.57		0.10	pH		26-OCT-17	R3866566
L2012694-5 MW17-06D							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Single Metal in Water by ICPMS (Diss.)							
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	LAB	SFP				01-NOV-17	R3872832
Iron (Fe)-Dissolved	<0.010		0.010	mg/L		02-NOV-17	R3873502
Miscellaneous Parameters							
Ammonia, Total (as N)	0.277		0.050	mg/L	02-NOV-17	02-NOV-17	R3874267
Ferric Iron, Dissolved	<0.030		0.030	mg/L		31-OCT-17	
Phosphorus (P)-Total	0.47		0.30	mg/L	27-OCT-17	27-OCT-17	R3869361
Total Coliform, E. Coli - Quanti-Tray							
Total Coliforms	50		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Escherichia Coli	0		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Diss. Ferrous Iron in Water by Colour							
Ferrous Iron, Dissolved	<0.020		0.020	mg/L	31-OCT-17	31-OCT-17	R3871051
Dissolved Fe2 Filtration Location	FIELD					31-OCT-17	R3870866
Total Nitrogen							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2012694-5 MW17-06D							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Nitrate, Nitrite and Nitrate+Nitrite-N							
Nitrate-N	1.18		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrite-N	0.059		0.050	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrate+Nitrite-N	1.24		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
TKN in Water by Colour							
Total Kjeldahl Nitrogen	0.46		0.20	mg/L	30-OCT-17	31-OCT-17	R3871346
Total Nitrogen (Calculation)							
Total Nitrogen	1.71		0.54	mg/L		01-NOV-17	
Routine Water Analysis (no Fluoride)							
Alkalinity by Auto. Titration							
Bicarbonate (HCO3)	411.		20	mg/L		26-OCT-17	R3866566
Hydroxide (OH)	<10.		10	mg/L		26-OCT-17	R3866566
Carbonate (CO3)	<10.		10	mg/L		26-OCT-17	R3866566
Alkalinity, Total (as CaCO3)	337		20	mg/L		26-OCT-17	R3866566
Chloride (Cl)							
Chloride (Cl)	16.1		1.0	mg/L	30-OCT-17	30-OCT-17	R3869677
Conductivity (Automated)							
Conductivity	824		10	uS/cm		26-OCT-17	R3866566
ICP Cations							
Calcium (Ca)	104		1.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Potassium (K)	7.2		1.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Magnesium (Mg)	35.6		1.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Sodium (Na)	26.1		2.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Sulfur (as SO4)	109		3.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Ion Balance Calculation							
Cation - Anion Balance	-0.6			%		30-OCT-17	
TDS (Calculated)	506			mg/L		30-OCT-17	
Hardness (as CaCO3)	406			mg/L		30-OCT-17	
pH by Meter (Automated)							
pH	7.86		0.10	pH		26-OCT-17	R3866566
L2012694-6 MW17-07							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
Single Metal in Water by ICPMS (Diss.)							
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	LAB	SFP				01-NOV-17	R3872832
Iron (Fe)-Dissolved	<0.050	DLDS	0.050	mg/L		02-NOV-17	R3873502
Miscellaneous Parameters							
Ammonia, Total (as N)	0.920		0.050	mg/L	02-NOV-17	02-NOV-17	R3874267
Ferric Iron, Dissolved	<0.050		0.050	mg/L		31-OCT-17	
Phosphorus (P)-Total	1.54	DLR	0.90	mg/L	27-OCT-17	27-OCT-17	R3869361
Total Coliform, E. Coli - Quanti-Tray							
Total Coliforms	>200.5		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Escherichia Coli	0		0	MPN/100mL	25-OCT-17	26-OCT-17	R3866975
Diss. Ferrous Iron in Water by Colour							
Ferrous Iron, Dissolved	0.029		0.020	mg/L	31-OCT-17	31-OCT-17	R3871051
Dissolved Fe2 Filtration Location	FIELD					31-OCT-17	R3870866
Total Nitrogen							
Nitrate, Nitrite and Nitrate+Nitrite-N							
Nitrate-N	18.1		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrite-N	0.061		0.050	mg/L	25-OCT-17	25-OCT-17	R3866688
Nitrate+Nitrite-N	18.1		0.50	mg/L	25-OCT-17	25-OCT-17	R3866688

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2012694-6 MW17-07							
Sampled By: DMC on 24-OCT-17 @ 12:00							
Matrix: WATER							
TKN in Water by Colour							
Total Kjeldahl Nitrogen	6.39		0.20	mg/L	30-OCT-17	31-OCT-17	R3871346
Total Nitrogen (Calculation)							
Total Nitrogen	24.5		0.54	mg/L		01-NOV-17	
Routine Water Analysis (no Fluoride)							
Alkalinity by Auto. Titration							
Bicarbonate (HCO3)	499.		20	mg/L		26-OCT-17	R3866566
Hydroxide (OH)	<10.		10	mg/L		26-OCT-17	R3866566
Carbonate (CO3)	<10.		10	mg/L		26-OCT-17	R3866566
Alkalinity, Total (as CaCO3)	409		20	mg/L		26-OCT-17	R3866566
Chloride (Cl)							
Chloride (Cl)	45.2	DLDS	2.0	mg/L	30-OCT-17	30-OCT-17	R3869677
Conductivity (Automated)							
Conductivity	4910		10	uS/cm		26-OCT-17	R3866566
ICP Cations							
Calcium (Ca)	478	DLDS	5.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Potassium (K)	9.7	DLDS	5.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Magnesium (Mg)	574	DLDS	5.0	mg/L	27-OCT-17	27-OCT-17	R3869618
Sodium (Na)	210	DLDS	10	mg/L	27-OCT-17	27-OCT-17	R3869618
Sulfur (as SO4)	3230	DLDS	15	mg/L	27-OCT-17	27-OCT-17	R3869618
Ion Balance Calculation							
Cation - Anion Balance	1.6			%		30-OCT-17	
TDS (Calculated)	4870			mg/L		30-OCT-17	
Hardness (as CaCO3)	3560			mg/L		30-OCT-17	
pH by Meter (Automated)							
pH	7.59		0.10	pH		26-OCT-17	R3866566

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLR	Detection Limit Raised due to required dilution, limited sample amount, and/or high moisture content (soil samples)
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
SFP	Sample was Filtered and Preserved at the laboratory
TKNI	TKN result may be biased low due to Nitrate interference. Nitrate-N is > 10x TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-SK	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALS Test Code	Matrix	Test Description	Method Reference**
CL-COL-SK	Water	Chloride (Cl)	APHA 4500-CL E

Thiocyanate ion (SCN) is liberated from mercuric thiocyanate by chloride ion to form un-ionized mercuric chloride. In the presence of ferric ion, the liberated SCN forms a colored ferric thiocyanate complex proportional to the original chloride concentration. Absorbance of the colored complex is measured using a Gallery discrete analyzer.

ALS Test Code	Matrix	Test Description	Method Reference**
EC-PCT-SK	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

ALS Test Code	Matrix	Test Description	Method Reference**
ETL-ROUTINE-ICP-SK	Water	ICP Cations	APHA 3120 B-ICP-OES-ROU

These ions are determined directly y ICP-OES.

Reference
Greenberg, Arnold E., Cleseri, Lenore S., Eaton, Andrew D., Standard Methods For The Examination of Water and Wastewater, 18th Edition, 1992, Method 3120B.

ALS Test Code	Matrix	Test Description	Method Reference**
FE2-D-COL-VA	Water	Diss. Ferrous Iron in Water by Colour	APHA 3500-Fe B/James Ball et al (1999)

This analysis is carried out using procedures adapted from APHA 3500-Fe B and "A New Method for the Direct Determination of Dissolved Iron Concentration in Acid Mine Waters" published by James W. Ball et al (1999). The procedure involves preliminary sample filtration, and ferrous iron is determined using the "FerroZine" colourimetric method.

ALS Test Code	Matrix	Test Description	Method Reference**
FE3-D-CALC-VA	Water	Ferric Iron - Calculated	APHA 3500 Fe

Dissolved Ferric Iron is determined by calculating the difference between Dissolved Iron and Dissolved Ferrous Iron.

ALS Test Code	Matrix	Test Description	Method Reference**
IONBALANCE-OP03-SK	Water	Ion Balance Calculation	APHA 1030-E
MET-D-CCMS-SK	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B / EPA 6020A

This procedure involves preliminary filtration through a 0.45 um filter followed by instrumental analysis using collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

ALS Test Code	Matrix	Test Description	Method Reference**
N-T-CALC-SK	Water	Total Nitrogen (Calculation)	APHA 4500 N-Calculated

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

ALS Test Code	Matrix	Test Description	Method Reference**
N2/N3-SK	Water	Nitrate, Nitrite and Nitrate+Nitrite-N	APHA 4500 NO3F

Nitrate is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl)ethylenediamine dihydrochloride. The resulting water-soluble dye has a magenta color, which is measured at 520nm. Original nitrite can also be determined by removing the cadmium column and following the same procedure. Nitrate-N, Nitrite-N and NO3+NO2-N are reported.

ALS Test Code	Matrix	Test Description	Method Reference**
NH4-SK	Water	Ammonia-N	APHA 4500 NH3-NITROGEN (AMMONIA)

Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.

ALS Test Code	Matrix	Test Description	Method Reference**
P-T-COL-SK	Water	Total P in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
PH-PCT-SK	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

ALS Test Code	Matrix	Test Description	Method Reference**
TC,EC-QT51-SK	Water	Total Coliform, E. Coli - Quanti-Tray	APHA 9223B 2B

The analysis of Total Coliform (TC) & Escherichia coli (EC) is processed by Quanti-tray (QT): Two substrates, ONPG for TC detection and MUG for EC detection are used. The substrates are added to the 100 ml sample dispensed into the 51 well tray. The tray is incubated at 35 Celcius for 24 hours. A colour reaction develops to indicate a positve reaction (presence of TC, EC). The number of positive wells are counted and converted to Most Probable Number Units (MPNU) per 100 ml.

ALS Test Code	Matrix	Test Description	Method Reference**
TKN-CFA-ED	Water	TKN in Water by Colour	APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total Kjeldahl Nitrogen is determined by sample digestion at 380 celcius with analysis using an automated colourimetric finish.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-540861

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2012694 Report Date: 07-NOV-17

Client: Associated Environmental Consultants Inc.
1 - 2225 Northridge Drive
Saskatoon SK S7L 6X6
Contact: Dan McCrank

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-PCT-SK	**Water**							
Batch R3866566								
WG2648495-1 DUP		**L2012694-3**						
Alkalinity, Total (as CaCO3)		286	284		mg/L	0.7	20	26-OCT-17
WG2648495-2 LCS		**PCT**						
Alkalinity, Total (as CaCO3)			98.6		%		85-115	26-OCT-17
WG2648495-5 LCS		**PCT**						
Alkalinity, Total (as CaCO3)			98.4		%		85-115	26-OCT-17
WG2648495-3 MB								
Alkalinity, Total (as CaCO3)			<20		mg/L		20	26-OCT-17
WG2648495-6 MB								
Alkalinity, Total (as CaCO3)			<20		mg/L		20	26-OCT-17
CL-COL-SK	**Water**							
Batch R3869677								
WG2649236-4 LCS		**50PPM-CL**						
Chloride (Cl)			95.1		%		90-110	30-OCT-17
WG2649236-1 MB								
Chloride (Cl)			<1.0		mg/L		1	30-OCT-17
WG2649236-5 MS		**L2012694-2**						
Chloride (Cl)			N/A	MS-B	%		-	30-OCT-17
EC-PCT-SK	**Water**							
Batch R3866566								
WG2648495-1 DUP		**L2012694-3**						
Conductivity		1480	1470		uS/cm	0.3	10	26-OCT-17
WG2648495-2 LCS		**PCT**						
Conductivity			97.9		%		90-110	26-OCT-17
WG2648495-5 LCS		**PCT**						
Conductivity			97.6		%		90-110	26-OCT-17
WG2648495-3 MB								
Conductivity			<10		uS/cm		10	26-OCT-17
WG2648495-6 MB								
Conductivity			<10		uS/cm		10	26-OCT-17
ETL-ROUTINE-ICP-SK	**Water**							
Batch R3869618								
WG2648279-3 LCS								
Calcium (Ca)			92.2		%		80-120	27-OCT-17
Potassium (K)			90.4		%		80-120	27-OCT-17
Magnesium (Mg)			92.2		%		80-120	27-OCT-17
Sodium (Na)			91.8		%		80-120	27-OCT-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ETL-ROUTINE-ICP-SK	**Water**							
Batch R3869618								
WG2648279-3 LCS								
Sulfur (as SO4)			93.4		%		90-110	27-OCT-17
WG2648279-1 MB								
Calcium (Ca)			<1.0		mg/L		1	27-OCT-17
Potassium (K)			<1.0		mg/L		1	27-OCT-17
Magnesium (Mg)			<1.0		mg/L		1	27-OCT-17
Sodium (Na)			<2.0		mg/L		2	27-OCT-17
Sulfur (as SO4)			<3.0		mg/L		3	27-OCT-17
FE2-D-COL-VA	**Water**							
Batch R3871051								
WG2652994-3 DUP		**L2012694-1**						
Ferrous Iron, Dissolved		<0.020	<0.020	RPD-NA	mg/L	N/A	20	31-OCT-17
WG2652994-2 LCS								
Ferrous Iron, Dissolved			98.3		%		80-120	31-OCT-17
WG2652994-1 MB								
Ferrous Iron, Dissolved			<0.020		mg/L		0.02	31-OCT-17
WG2652994-4 MS		**L2012694-2**						
Ferrous Iron, Dissolved			100.6		%		70-130	31-OCT-17
MET-D-CCMS-SK	**Water**							
Batch R3873502								
WG2654621-3 CRM		**TMRM_20**						
Iron (Fe)-Dissolved			106.0		%		80-120	02-NOV-17
WG2654621-2 DUP		**L2012694-5**						
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	02-NOV-17
WG2654621-1 MB								
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	02-NOV-17
N2/N3-SK	**Water**							
Batch R3866688								
WG2648285-3 LCS								
Nitrate-N			104.3		%		90-110	25-OCT-17
Nitrite-N			95.4		%		90-110	25-OCT-17
Nitrate+Nitrite-N			103.1		%		90-110	25-OCT-17
WG2648285-2 MB								
Nitrate-N			<0.50		mg/L		0.5	25-OCT-17
Nitrite-N			<0.050		mg/L		0.05	25-OCT-17
Nitrate+Nitrite-N			<0.50		mg/L		0.5	25-OCT-17
NH4-SK	**Water**							

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH4-SK	**Water**							
Batch R3874267								
WG2648225-1 DUP		**L2012694-5**						
Ammonia, Total (as N)		0.277	0.265		mg/L	4.4	20	02-NOV-17
WG2648225-4 LCS		**0.75PPM-NH4-N**						
Ammonia, Total (as N)			98.8		%		85-115	02-NOV-17
WG2648225-3 MB								
Ammonia, Total (as N)			<0.050		mg/L		0.05	02-NOV-17
P-T-COL-SK	**Water**							
Batch R3869361								
WG2648735-1 DUP		**L2012694-4**						
Phosphorus (P)-Total		1.34	1.40		mg/L	4.4	20	27-OCT-17
WG2648735-3 LCS								
Phosphorus (P)-Total			93.2		%		80-120	27-OCT-17
WG2648735-2 MB								
Phosphorus (P)-Total			<0.30		mg/L		0.3	27-OCT-17
WG2648735-4 MS		**L2012694-6**						
Phosphorus (P)-Total			82.0		%		70-130	27-OCT-17
PH-PCT-SK	**Water**							
Batch R3866566								
WG2648495-1 DUP		**L2012694-3**						
pH		7.75	7.72	J	pH	0.03	0.2	26-OCT-17
WG2648495-2 LCS		**PCT**						
pH			6.86		pH		6.76-6.96	26-OCT-17
WG2648495-5 LCS		**PCT**						
pH			6.89		pH		6.76-6.96	26-OCT-17
TC,EC-QT51-SK	**Water**							
Batch R3866975								
WG2648340-1 DUP		**L2012694-2**						
Total Coliforms		145	130		MPN/100mL	11	65	26-OCT-17
Escherichia Coli		0	0		MPN/100mL	0.0	65	26-OCT-17
WG2648340-2 MB								
Total Coliforms			0		MPN/100mL		1	26-OCT-17
Escherichia Coli			0		MPN/100mL		1	26-OCT-17
TKN-CFA-ED	**Water**							
Batch R3871346								
WG2652493-34 LCS								
Total Kjeldahl Nitrogen			108		%		75-125	31-OCT-17
WG2652493-35 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TKN-CFA-ED	**Water**							
Batch R3871346								
WG2652493-35 MB								
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	31-OCT-17

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated)							
	1	24-OCT-17 12:00	26-OCT-17 01:00	0.25	37	hours	EHTR-FM
	2	24-OCT-17 12:00	26-OCT-17 01:00	0.25	37	hours	EHTR-FM
	3	24-OCT-17 12:00	26-OCT-17 01:00	0.25	37	hours	EHTR-FM
	4	24-OCT-17 12:00	26-OCT-17 01:00	0.25	37	hours	EHTR-FM
	5	24-OCT-17 12:00	26-OCT-17 01:00	0.25	37	hours	EHTR-FM
	6	24-OCT-17 12:00	26-OCT-17 01:00	0.25	37	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2012694 were received on 24-OCT-17 16:45.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2012694-COFC

COC Number: 15 - 540861

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Associated Engineering
Contact:	Dan McCrank
Phone:	306 715 3581
	Company address below will appear on the final report
Street:	1-2225 Northridge Dr.
City/Province:	Saskatoon SK
Postal Code:	

Invoice To		
	Same as Report To	☒ YES ☐ NO
	Copy of Invoice with Report	☒ YES ☐ NO
Company:		
Contact:		

Project Information

ALS Account # / Quote #: 23570
Job #: 2017-4165
PO / AFE:
LSD:

ALS Lab Work Order # (lab use only)

Report Format / Distribution

Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☒ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: mccrankd@ae.ca
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax
Email 2

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Contact: B. Morgan | Sampler: DMC

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Bacteriological (P)	Ferric Iron (F/P)	Routine Parameters	NH_4 Total P (P)	TKN - Total N (P)	Number of Containers
	MW17-02	24-OCT-17	PM	Water	X	X	X	X	X	
	MW17-03	↓	↓	↓	X	X	X	X	X	
	MW17-05	↓	↓	↓	X	X	X	X	X	
	MW17-06	↓	↓	↓	X	X	X	X	X	
	MW17-06D	↓	↓	↓	X	X	X	X	X	
	MW17-07	↓	↓	↓	X	X	X	X	X	

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☒ NO
Are samples for human drinking water use? ☐ YES ☒ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☒ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C: 1°
FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Dan McCrank	Date: Oct 24, 2017	Time:	Received by: ADM	Date: Oct 24/17	Time: 4:55	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1 If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Bill Delainey

From: Dukart, Shawn GR <shawn.dukart@gov.sk.ca>
Sent: Wednesday, August 22, 2018 9:24 AM
To: Mike Pawluski; Bill Delainey
Subject: FW: R0640-14S Eagle Heights, Hydrogeotech Review, Acceptable
Attachments: FW: OWTS Approval Process; Eagle Heights Subdivision - OWTS Options Review

Hi guys,

Please find comments from Brent attached below.

Regards,

Shawn Dukart
Government of Saskatchewan
Planning Consultant
Community Planning Branch, Ministry of Government Relations
Room 978, 122 - 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6
Bus: (306) 933-7883
Fax: (306) 933-7720

From: Latimer, Brent SHA <Brent.Latimer@saskhealthauthority.ca>
Sent: Wednesday, August 22, 2018 8:38 AM
To: Dukart, Shawn GR <shawn.dukart@gov.sk.ca>
Subject: R0640-14S Eagle Heights, Hydrogeotech Review, Acceptable

We have reviewed the Hydrogeological investigation by Associated Engineering (Sask.) Ltd for R0640-14S at RM 373, W ½ 11-37-04 W3M.

Originally concerns were raised than an abbreviated hydrogeotech report was submitted. Our office contacted Associated Engineering on May 8th and 22nd to discuss these concerns. In follow up to these conversations on May 25, 2018 Gordon Will (P.Eng) of Associated Engineering provided a written amendment (see attached document) which stated that appropriate isolations from a supply aquifer will be met. As such section 3.3.1 of the provincial "Guidance Document for Developments and Subdivisions where Onsite Wastewater Treatment Systems are Proposed (July 2012)" allows for an abbreviated report to be submitted.

Based on the review of the submitted hydrogeotechnical report and additional information provided, we would advise that community planning accept the report as submitted provided that the findings and recommendations of the hydrogeological study are adhered either by:
a) Community Planning Branch discusses the need for a servicing agreement between the municipality and the developer that will incorporate the findings of the report. This servicing agreement should be registered on the individual parcels.

b) The RM registers the report to Information Services Corporation (ISC) for all proposed parcels. This information must be available to any purchaser though ISC.

The installation of any new plumbing and sewage systems shall be permitted, inspected and approved by our department. Permit applications and related information can be found on our website at www.saskatoonhealthregion.ca (search: sewage).

Brent Latimer, B.Sc, B.EH, CIPHI(C)
Supervisor – Environmental Public Health Department
Idylwyld Centre - Saskatoon
Saskatchewan Health Authority | 306-655-4655 |Facsimile: (306) 655-4699

From: Dukart, Shawn GR [mailto:shawn.dukart@gov.sk.ca]
Sent: August 16, 2018 3:11 PM
To: Latimer, Brent SHA <Brent.Latimer@saskhealthauthority.ca>
Subject: RE: Eagle Heights, Hydrogeotech Review

Sure for reference it is R0640-14S.

On timing, not a problem at all.

Thanks!

Regards,

Shawn Dukart
Government of Saskatchewan
Planning Consultant
Community Planning Branch, Ministry of Government Relations
Room 978, 122 - 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6
Bus: (306) 933-7883
Fax: (306) 933-7720

From: Latimer, Brent SHA <Brent.Latimer@saskhealthauthority.ca>
Sent: Thursday, August 16, 2018 3:04 PM
To: Dukart, Shawn GR <shawn.dukart@gov.sk.ca>
Subject: RE: Eagle Heights, Hydrogeotech Review

Can you give me a tracking number? I need that to complete the forms.

As I am away tomorrow would having the response by this Wednesday or Thursday be acceptable?

Brent Latimer, B.Sc, B.EH, CIPHI(C)
Supervisor – Environmental Public Health Department
Idylwyld Centre - Saskatoon
Saskatchewan Health Authority | 306-655-4655 |Facsimile: (306) 655-4699

From: Dukart, Shawn GR [mailto:shawn.dukart@gov.sk.ca]
Sent: August 16, 2018 2:42 PM
To: Latimer, Brent SHA <Brent.Latimer@saskhealthauthority.ca>
Subject: RE: Eagle Heights, Hydrogeotech Review

Great thanks, if you don't mind finalizing it that would be appreciated! J

Regards,

Shawn Dukart
Government of Saskatchewan
Planning Consultant
Community Planning Branch, Ministry of Government Relations
Room 978, 122 - 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6
Bus: (306) 933-7883
Fax: (306) 933-7720

From: Latimer, Brent SHA <Brent.Latimer@saskhealthauthority.ca>
Sent: Thursday, August 16, 2018 1:24 PM
To: Dukart, Shawn GR <shawn.dukart@gov.sk.ca>
Subject: RE: Eagle Heights, Hydrogeotech Review

It is effectively done. The comments will be the same as the last report that was submitted by this particular engineering firm. If we are asked for comment I would need to find the email and comments and finish the formal documentation process I could have that competed within two business days.

Brent Latimer, B.Sc, B.EH, CIPHI(C)
Supervisor – Environmental Public Health Department
Idylwyld Centre - Saskatoon
Saskatchewan Health Authority | 306-655-4655 |Facsimile: (306) 655-4699

From: Dukart, Shawn GR [mailto:shawn.dukart@gov.sk.ca]
Sent: August 14, 2018 11:25 AM
To: Latimer, Brent SHA <Brent.Latimer@saskhealthauthority.ca>
Subject: Eagle Heights, Hydrogeotech Review

Hey Brent,

I believe you have the hydrogeological for the proposed Eagle Heights subdivision. You may recall that we don't have a formal application in yet but I did indicate that you may go ahead and review the report in the meantime. The developer is just asking if you may have begun your review. If you could let me know the status that would be appreciated.

Thanks!

Regards,

Shawn Dukart
Government of Saskatchewan
Planning Consultant
Community Planning Branch, Ministry of Government Relations
Room 978, 122 - 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6
Bus: (306) 933-7883
Fax: (306) 933-7720

From: Dukart, Shawn GR
Sent: Tuesday, July 17, 2018 9:09 AM
To: Latimer, Brent SHA <brent.latimer@saskhealthauthority.ca>
Subject: RE: R0647-14S, Pinnacle Ridge, Hydrogeotech Review, Acceptable

Okay thanks. Of course, this is not my call but if you wish to begin the review that is fine with me.

Regards,

Shawn Dukart
Government of Saskatchewan
Planning Consultant
Community Planning Branch, Ministry of Government Relations
Room 978, 122 - 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6
Bus: (306) 933-7883
Fax: (306) 933-7720

From: Latimer, Brent SHA [mailto:Brent.Latimer@saskhealthauthority.ca]
Sent: Tuesday, July 17, 2018 8:59 AM
To: Dukart, Shawn GR
Subject: RE: R0647-14S, Pinnacle Ridge, Hydrogeotech Review, Acceptable

Correct. I am waiting for a formal request from community planning before I proceed to do work on the file. I am aware of the proposal because it is the same engineering firm that worked on Pinnacle Ridge and both files were discussed.

Brent Latimer, B.Sc, B.EH, CIPHI(C)
Supervisor – Environmental Public Health Department
Idylwyld Centre - Saskatoon
Saskatchewan Health Authority | 306-655-4655 |Facsimile: (306) 655-4699

From: Dukart, Shawn GR [mailto:shawn.dukart@gov.sk.ca]
Sent: July 13, 2018 3:53 PM
To: Latimer, Brent SHA <Brent.Latimer@saskhealthauthority.ca>
Subject: RE: R0647-14S, Pinnacle Ridge, Hydrogeotech Review, Acceptable

Hi Brent,

With regard to Eagle Heights. I believe you mentioned you were close the recommendation. Recall there is no file number currently.

Regards,

Shawn Dukart
Government of Saskatchewan
Planning Consultant
Community Planning Branch, Ministry of Government Relations
Room 978, 122 - 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6
Bus: (306) 933-7883
Fax: (306) 933-7720

From: Dukart, Shawn GR
Sent: Wednesday, July 11, 2018 10:57 AM
To: Latimer, Brent SHA
Subject: RE: R0647-14S, Pinnacle Ridge, Hydrogeotech Review, Acceptable

Hi Brent,

With regard to Eagle Heights, as I noted we don't have a file number handy but if you have completed your review feel free to send it to me.

Regards,

Shawn Dukart
Government of Saskatchewan
Planning Consultant
Community Planning Branch, Ministry of Government Relations
Room 978, 122 - 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6
Bus: (306) 933-7883
Fax: (306) 933-7720

From: Dukart, Shawn GR
Sent: Thursday, July 05, 2018 8:19 AM
To: Latimer, Brent SHA
Subject: RE: R0647-14S, Pinnacle Ridge, Hydrogeotech Review, Acceptable

Hi Brent,

Thank you very much, I really appreciate your expertise!

I received your message and with regard to Eagle Heights, we don't have a file number just yet. We are waiting on the paper work. Once I get a number I will send it your way.

Thanks again!

Regards,

Shawn Dukart
Government of Saskatchewan
Planning Consultant
Community Planning Branch, Ministry of Government Relations
Room 978, 122 - 3rd Avenue North
Saskatoon, Saskatchewan S7K 2H6
Bus: (306) 933-7883
Fax: (306) 933-7720

Appendix G: Conceptual Drainage Plan

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

TECHNICAL MEMORANDUM

Issue Date:	August 31, 2020	File No.:	E.03.00
To:	RM of Corman Park	Previous Issue Date:	N/A
From:	Alicia Masserey, P.Eng.	Project No.:	2012-4165.00
Client:	101120614 Saskatchewan Ltd.		
Project Name:	Eagle Heights Subdivision		
Subject:	CDR Revision Summary		

1 INTRODUCTION

Associated Engineering (Sask.) Ltd. (AE) has been retained by 101120614 Saskatchewan Ltd. to complete a drainage analysis as part of a Comprehensive Development Review (CDR) for a proposed country residential development located 5.5 km northeast of Saskatoon in the Rural Municipality of Corman Park (RM). The development which is located within NW 11-37-4-W3M and SW 11-37-4-W3M east of Highway 41, as depicted in Figure 4165-FG-101, attached, is intended to be comprised of 84 lots ranging in size from 0.65 to 2.05 ha and will be developed in four phases.

AE has previously been in contact with the Water Security Agency (WSA) and the RM regarding this project. The project has gone through various revisions for the phasing and design intent. Discussions with the RM in January 2020 highlighted concerns due to a lack of detail around the drainage plan for the subdivision. The following technical memo and figures are meant to provide clarification.

2 LOCAL TOPOGRAPHY AND EXISTING LAND FEATURES

The development site consists of rolling hills with local drainage trending toward several natural low-lying areas. The site is separated into four natural catchment areas, which can be seen in Figure 4165-FG-102. Catchment Area 1 drains northeast into Catchment Area 4, which is a terminal basin for water. By terminal basin, we are referring to a location where significant runoff storage occurs (+4 meters deep) before water tips out of the natural slough/pond. Catchment Area 2 is also a terminal basin for water that potentially drains into Catchment 1 if runoff volumes are significant enough. Catchment Area 3 is the only typical catchment in that it has a defined outlet; a culvert across Range Road 3042.

3 DRAINAGE PLAN

The proposed country residential development is intended to be an acreage style development with little to no lot grading other than what is required to build an access and house. Some grading will be required to direct natural surface runoff along property lines through easements, as well as filling some of the natural depressions to allow for positive drainage away from houses.

Surface runoff is intended to be conveyed overland via ditches to adjacent roads, using culverts at driveways and intersections, as well as at locations of natural drainage paths which have been defined with swale easements. The conceptual plan for site drainage is to continue to collect the runoff water in the four natural storage ponds located within each catchment area. The lands surrounding the natural storage ponds will be designated as Municipal Utility Parcels.

The concept plan has been developed to work with the natural drainage. Consideration has been given to ensure that private properties are not located below tipping points or within potential storage basins. Figure 1 illustrates the post development drainage and corresponding 1:100-year 24-hour storm event flood extents. Existing topography of the ponds generally allows for adequate post development storage, with the exception of Pond 3 which will need to be deepened to allow for storm water storage without flooding adjacent lots.

Due to a lack of survey information underwater and in heavily treed areas, some aspects of this conceptual drainage plan, such as existing pond depths, were estimated using the available survey.

The following section details the characteristics of each catchment.

3.1 Catchment Area 1 Drainage Design

3.1.1 Permanent Storage

Catchment Area 1 has only one major depression on site, which we have referred to as Pond 1, that has a natural spill point into Pond 4. Pond 1 will continue to be used as the natural storage area for Catchment Area 1. The available storage within Pond 1 below the natural tipping point was estimated to be 34,000 m^3. The required permanent storage for Catchment Area 1 due to the increase of runoff from the development was calculated using the 1:100 year 24-hour storm event, which was calculated to be 2,600 m^3

Based on recommendations received from WSA, the permanent storage in Pond 1will be increased from the calculated 2,600 m3 to accommodate storing the calculated active storage of Catchment Area 1 and Catchment Area 2. This has been done in order to offer additional permanent storage in this catchment which will limit the burden placed on Pond 4. This will add an additional 13,600 m^3 of permanent storage for a total of 16,200 m^3 in this pond.

The minimal change in runoff volume (due to the development), would be stored within the ponds existing storage area with negligible difference in normal water elevation. Due to the surface area of the existing pond, the additional permanent storage of 16,200 m^3 would increase the elevation by 330 mm. Comparing this to the evaporation potential of this pond, which for this area is approximately 500 mm/year (WSA Mean Annual Net Evaporation Phase), and the average rainfall of 350 mm/year, the increase in permanent storage is within the average evaporation potential and offers an additional level of protection to the downstream users in this area.

3.1.2 Active Storage

The active storage within a pond is needed to temporarily store runoff during a storm event due to the restricted release rate that is designed to the average 100-year 24-hour post-development flow rate. This ensures that the peak outflow from the pond is, at most, the average 100-year 24-hour pre-development flow rate.

The active storage is calculated using the modified rational method to determine the difference between the average 100-year 24-hour pre-development rate, and the simulated design storm using a peak 100-year 24-hour post-development rate.

The active storage is located above the permanent storage volume, while allowing for a minimum of 0.5 m freeboard between the 100-year 24-hour storm highwater level and the lowest back of lot elevation around the pond. For this phase of the design we wanted to locate the active storage and the discharge culvert at a higher elevation than the natural tipping point, to decrease the frequency of Pond 4 backflowing into Pond 1 during extremely wet conditions. Pond 1 is designed to discharge at a maximum rate of 0.12 m^3/s through a 600 mm CSP pipe across the road to Pond 4, which was sized using Culvert Master modelling. As one of the main roads into the development will need to be used as a berm between Pond 1 and 4, the section of road should be constructed with armoring on either side to protect the road embankment.

The necessary active storage required to decrease the flow rate out of the pond to the average 100-year 24-hour pre-development flow rate of 0.12 m^3/s was calculated to be 8,500 m^3. This temporary increase in pond elevation is 0.15 m above the discharge culvert invert which is shown in Figure 1 as the 100-year high-water level flood extents.

3.1.3 Estimated 500-year Level

WSA requires all permanent structures to be located above the 1:500-year flood level, which is known as the Safe Building Elevation (SBE). For our analysis, the SBE will be 0.50 m above the 1:500-year flood level. To estimate the 500-year level within Catchment Area 1, a frequency analysis on the IDF data for Saskatoon was completed using the Gumbel Distribution method to obtain the 500-year 24-hour rainfall total, which was estimated to be 113.2 mm in 24 hours.

To estimate the 500-year level on Pond 1, the post-development runoff volume for the 500-year 24-hour storm event was calculated to be 16,800 m^3 which results in a temporary water level increase of 0.32 m above the discharge culvert invert elevation. This gives an approximate 500-year elevation for Catchment Area 1 of 549.85 m, which can also be seen in Figure 1.

As stated previously, Pond 1 discharges into Pond 4, which is a terminal basin. AE has reached out to WSA to ask for their determination of the 500-year level on Pond 4. This level is not known at this time, but the ultimate tipping elevation point on Pond 4 is approximately 552.60 m (shown in Figure 4165-FG-101). The statistical analysis of the water level in Pond 4 is not known, so it is unclear if the ultimate tipping point of 552.60 m would be the 500-year flood level for Pond 4, or if would represent a much higher, more extreme statistical level.

To be conservative, the elevation of 553.1 m should be used as the SBE for Catchment Area 1.

3.2 Catchment Area 2 Drainage Design

3.2.1 Permanent Storage

Catchment Area 2 has one large pond, which we have referred to as Pond 2, as well as smaller depressions which have not been considered to hold additional storage for the increase in runoff due to development. Pond 2 will continue to be used as the main natural storage area for Catchment Area 2. Available storage between the existing water level at the time of survey and the design tipping point is 23,100 m^3. The total available permanent storage could be even more when considering the volume of water that exists in the pond below the surveyed water level.

Due to increase of runoff from the development, the required permanent storage for Catchment Area 2 was calculated using the 1:100 year 24-hour storm event, which was calculated to be 1,500 m^3.

The minimal change in runoff volume (due to the development) would be stored within the pond's existing storage area with negligible difference in normal water elevation. Due to the surface area of the existing pond, the additional permanent storage of 1,500 m^3 would increase the elevation by 40 mm. Comparing this to the evaporation potential of this pond, as was done for Catchment Area 1, the increase in permanent storage is well within the average evaporation potential.

3.2.2 Active Storage

Active storage for Pond 2 was calculated using the same modified rational method as Pond 1, which gives the difference in runoff volume between the average 100-year 24-hour pre-development rate and the simulated design storm using a peak 100-year 24-hour post-development rate. The tipping point chosen for Pond 2 allows for a minimum 1 m of freeboard between the 100-year 24-hour storm highwater level and the lowest back of lot elevation around the pond. This is lower than the natural tipping point, which if used, would result in flood extents covering a portion of the adjacent lots. The pond is designed to discharge at a maximum rate of 0.08 m^3/s through a 600 mm CSP pipe, sized using Culvert Master modelling, through a berm meant to hold back active storage during a storm event. Due to a large pond surface area and storage volume, the headwater above the culvert invert is small, which means that the discharge rate is normally less than the pre-development rate.

The necessary active storage required to decrease the flow rate out of the pond to the average 100-year 24-hour pre-development flow rate of 0.08 m^3/s was calculated to be 5,100 m^3. This temporary increase in pond elevation is 0.15 m, which is shown in Figure 1 as the 100-year high-water level flood extents.

Pond 2 will be designed to discharge its active storage into Pond 1, and as noted earlier Pond 1 will be designed to have permanent storage for this volume of water which increases the 100-year high-water level within Pond 1 by 0.10 m.

3.2.3 Estimated 500-year Level

The SBE for Pond 2 was calculated in the same way as Pond 1, as per WSA requirements. To estimate the 500-year level on Pond 2, the post-development runoff volume for the 500-year 24-hour storm event was calculated to be 13,700 m^3 which results in a temporary water level increase of 0.38 m above the Pond 2 tipping point culvert elevation. This gives the approximate 500-year level for Catchment Area 2 as 553.6 m, which can also be seen in Figure 1.

The SBE for Catchment 2 is then estimated to be 554.1 m. However, given the potential for the stormwater to temporarily achieve an elevation of 554.0 due to the cover over the discharge culvert as noted on Figure 1, we would recommend an SBE for Catchment 2 to be 554.5.

3.3 Catchment Area 3 Drainage Design

3.3.1 Permanent Storage

Catchment Area 3 has one large pond, which we have referred to as Pond 3, and will be used as the main natural storage area for Catchment Area 3. Four small existing water bodies are to be filled-in or graded such that they no longer hold standing water. The total volume of natural storage that would need to be compensated for due to the four water bodies being filled in is approximately 7000 m^3, assuming an average storage depth of 0.5 m. The required permanent storage for Catchment Area 3 due to the increase of runoff from the development was calculated using the 1:100 year 24-hour storm event, which was calculated to be 3,800 m^3. This would result in a total permanent storage requirement of 10,800 m^3.

Catchment Area 3 has a defined outlet in the existing 400 mm CSP culvert crossing on Range Road 3042. The available permanent storage within Pond 3 below the existing culvert was estimated to be 4,300 m^3 which is less than the total storage required. This pond will need to be deepened to accommodate all permanent storage below the tipping point culvert elevation.

The change in runoff volume due to the development would be stored within the pond's enlarged storage area which will have a slightly larger surface area than the existing pond. Using the larger proposed surface area of the pond, the additional permanent storage of 10,800 m^3 would increase the water level elevation by 434 mm. Comparing this to the evaporation potential of this pond, as was done for previous catchments, the increase in permanent storage is slightly more than the average annual rainfall for this area and below the average evaporation potential.

3.3.2 Active Storage

Active storage for Pond 3 was calculated using the same modified rational method as previous ponds, which gives the difference in runoff volume between the average 100-year 24-hour pre-development rate and the simulated design storm using a peak 100-year 24-hour post-development rate. The existing culvert outlet for Pond 3 allows for a release rate of 0.18 m^3/s which is higher than the pre-development flow rate of Catchment 3 which is 0.13 m^3/s and will need to be altered with a flow restrictor on the existing culvert so that the release rate is lowered to pre-development rate. The necessary active storage required to decrease the flow rate out of the pond to the average 100-year 24-hour pre-development flow rate of 0.13 m^3/s was calculated to be 10,100 m^3. This temporary increase in pond elevation is 0.60 m which will result in flood extents covering portions of adjacent lots. To avoid this, an increase in storage area for active storage should be accommodated when the pond is deepened to ensure that 100-year high-water level flood extents stay at or below the lowest back of lot elevation. This would result in almost the entire Municipal Utility Parcels being altered by steepening the existing slopes and deepening the existing pond. The approximate pond size is shown in Figure 1.

3.3.3 Estimated 500-Year Level

The SBE for Pond 3 was calculated in the same way as previous ponds, as per WSA requirements. To estimate the 500-year level on Pond 3, the post-development runoff volume for the 500-year 24-hour storm event was calculated to be 19,000 m^3 which results in a temporary water level increase of 0.76 m above the outlet culvert invert elevation. This gives an approximate 500-year level for Catchment Area 3 as 551.4 m, which can also be seen in Figure 1.

The SBE for Catchment 3 is estimated to be 551.9 m.

3.4 Catchment 4

While the development of Eagle Heights would contribute very little additional flow directly to Pond 4, we have compared the total active storage increase in Catchments 1 and 2 to the existing surface area of Pond 4. The total active storage required due to development is 13,600 m^3 which would result in a water level increase in Pond 4 of approximately 35 mm. Comparing this to the average annual rainfall and evaporation potential of this pond, the increase in water level is well within the average evaporation potential and should not have any significant impacts on adjacent lands.

4 DEVELOPMENT GRADING

As mentioned previously, the development is intended to be an acreage style development with little to no lot grading other than what is required to build an access and house. Some grading will be required to direct natural surface runoff along property lines through easements, as well as filling some of the natural depressions to allow for positive drainage away from houses.

A grading map (see Figure 2), was created to highlight areas such as roadways, ditches, and swales that would need to be constructed, as well as locations of necessary swales along property lines, which would be locations where drainage easements would be required. It also highlights the location of lots that would need to be developed to allow for positive drainage through the development and to the ponds.

Figure 2 does not show any internal lot grading that would be required for house building and access road construction, as the location of those would be determined by the lot owner and could vary.

5 CLOSURE

This technical memorandum was prepared for the RM of Corman Park to summarize further details of the drainage design for the Eagle Heights Subdivision.

Should you have any questions, please feel free to contact our office.

Prepared by:

Alicia Masserey, P.Eng.
Water Resources Engineer

Reviewed by:

Darrell Rinas, P.Eng.
Division Manager - Infrastructure

KP/AM/ib/np

Attachments:

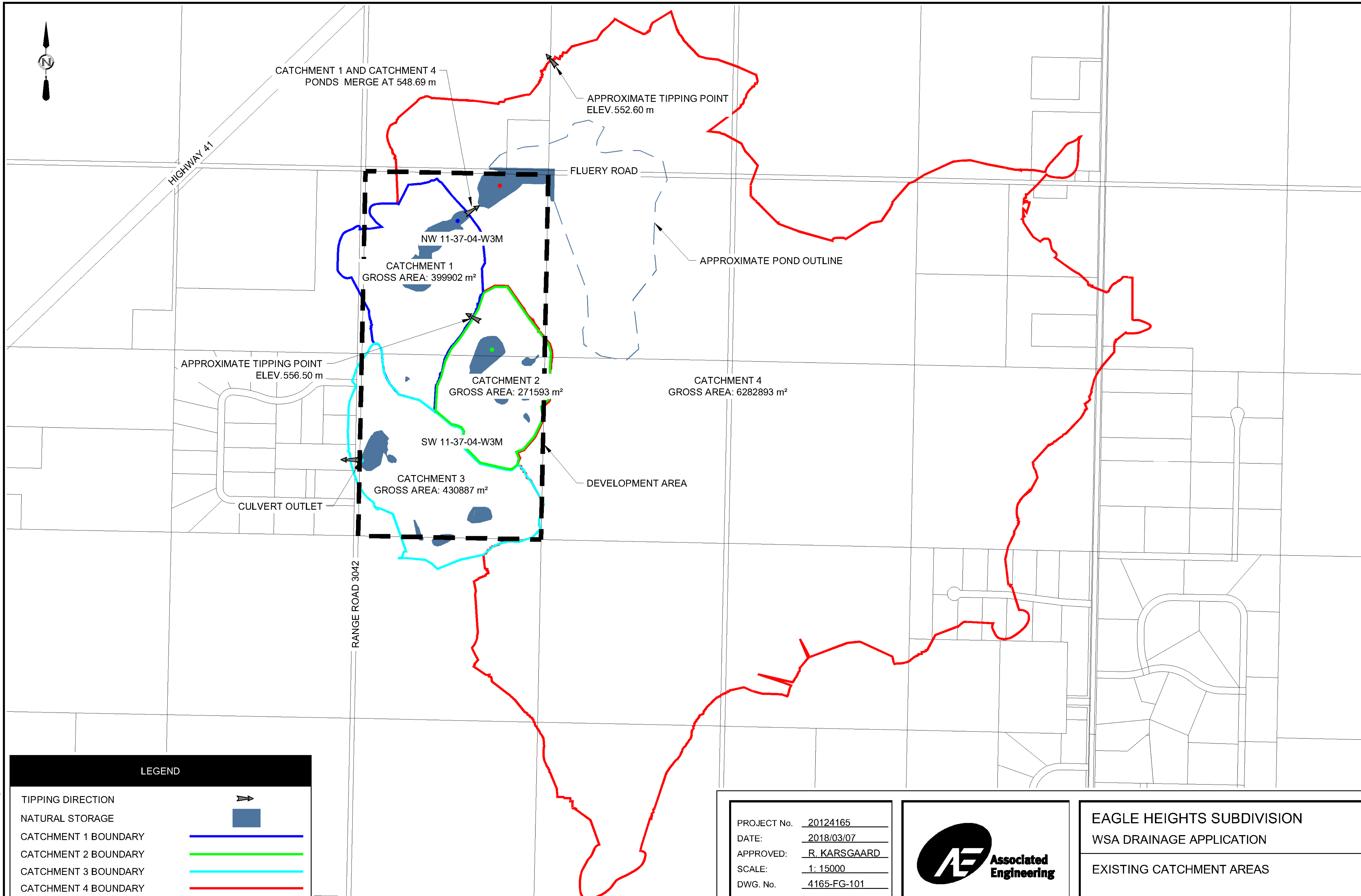
- Figure 4165-FG-101 (2018)
- Figure 4165-FG-102 (2018)
- Figure 1 (2020)
- Figure 2 (2020)

ASSOCIATION OF PROFESSIONAL ENGINEERS
AND GEOSCIENTISTS OF SASKATCHEWAN
CERTIFICATE OF AUTHORIZATION
ASSOCIATED ENGINEERING (SASK.) LTD.
NUMBER
C116
Permission to Consult Held By:

Discipline	Sask. Reg. No.	Signature
Municipal	12894	

PROFESSIONAL ENGINEER
A.M. MASSEREY
MEMBER 22608
2020-08-30
YR. MN. DAY
SASKATCHEWAN

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature:
Date: August 31, 2020



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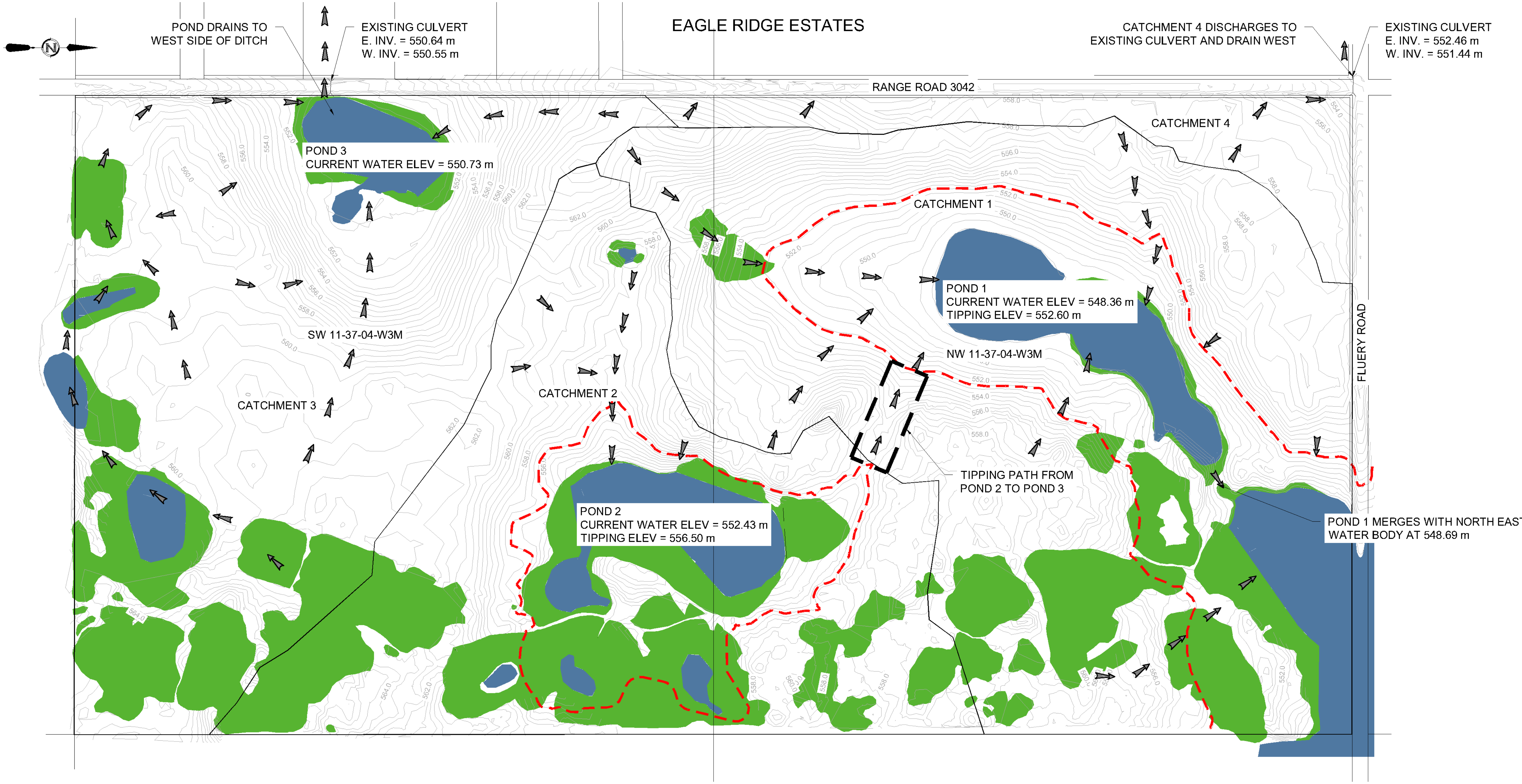
DATE: 2018-03-07, Reid Styranko

PROJECT No. 20124165
DATE: 2018/03/07
APPROVED: R. KARSGAARD
SCALE: 1: 15000
DWG. No. 4165-FG-101

Associated Engineering

EAGLE HEIGHTS SUBDIVISION
WSA DRAINAGE APPLICATION

EXISTING CATCHMENT AREAS



LEGEND	
DRAINAGE RUN	
EXISTING PONDING AREAS	
EXISTING TREE AREAS	
WATER LEVEL AT NATURAL TIPPING ELEVATION	
CATCHMENT BOUNDARY	

PROJECT No.	20124165
DATE:	2018/03/07
APPROVED:	R. KARSGAARD
SCALE:	1:5000
DWG. No.	4165-FG-102

Associated Engineering

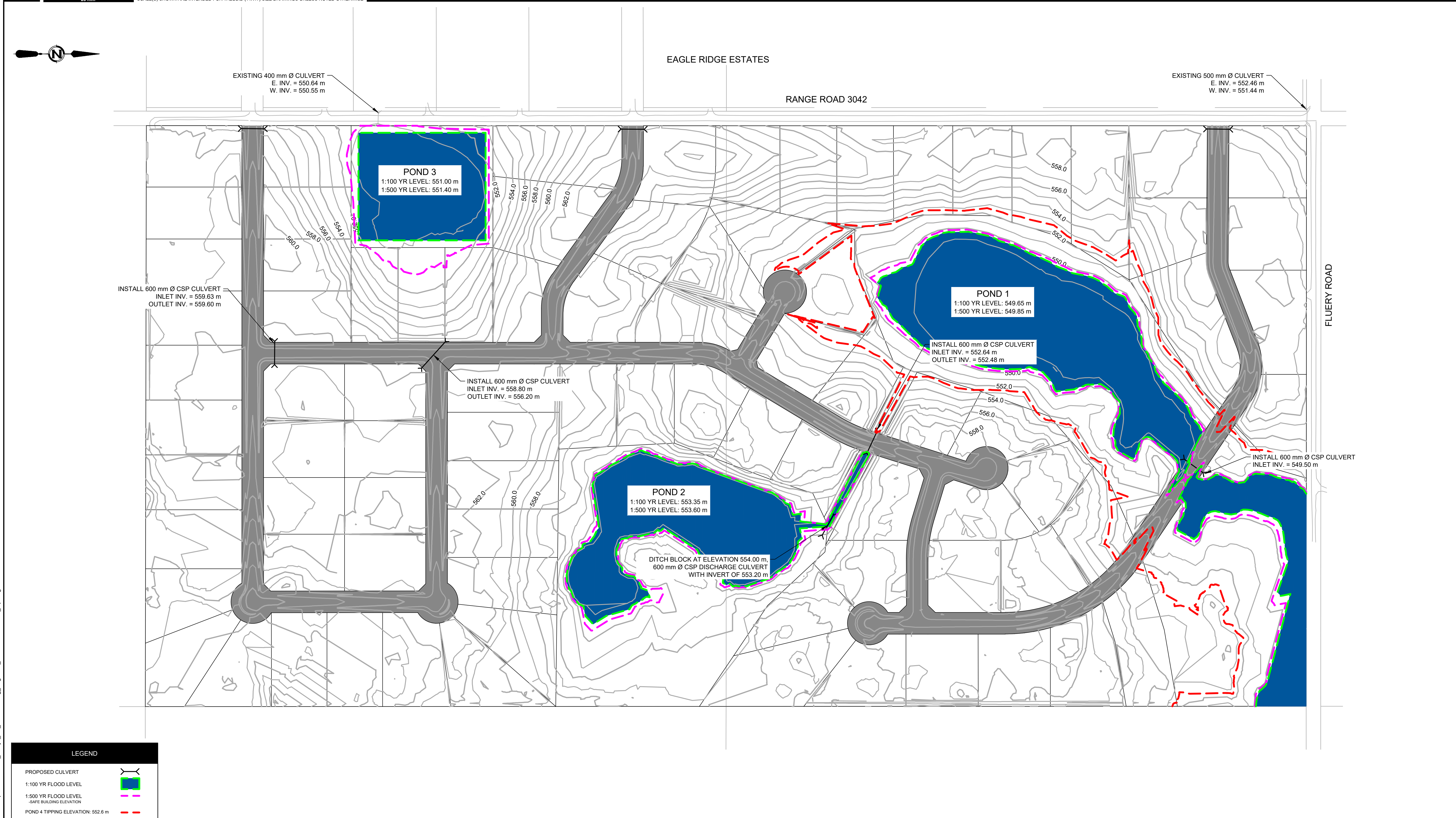
EAGLE HEIGHTS SUBDIVISION

WSA DRAINAGE APPLICATION

EXISTING DRAINAGE

P:\20124165\00_Cebryk_Res_Devl\Working_Dwgs\100_Civil\4165-FG-1022.dwg
DATE: 2018-03-07, Reid Styranko

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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Associated Engineering

CANADA BEST MANAGED COMPANIES
Platinum member

AE PROJECT No.	20124165-00
SCALE	1:5000
APPROVED	A. MASSEREY
DATE	2020AUG04
REV	1
DESCRIPTION	ISSUED FOR CDR SUBMISSION

FIGURE 1

EAGLE HEIGHTS SUBDIVISION

CIVIL
SITE PLAN
1:100 YEAR FLOOD EXTENTS

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

LEGEND

- DIRECTION OF DRAINAGE
- DRAINAGE SWALE
- PROPOSED CULVERT

CUT/FILL ANALYSIS

RANGE NUMBER	COLOUR	MIN ELEVATION (m)	MAX ELEVATION (m)
1		-5.5 m	-5.0 m
2		-5.0 m	-4.0 m
3		-4.0 m	-3.0 m
4		-3.0 m	-2.0 m
5		-2.0 m	-1.0 m
6		-1.0 m	-0.1 m
7		-0.1 m	0.1 m
8		0.1 m	1.0 m
9		1.0 m	2.0 m
10		2.0 m	3.0 m
11		3.0 m	3.5 m

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Associated Engineering

CANADA BEST MANAGED COMPANIES
Platinum member

AE PROJECT No.	20124165-00
SCALE	1:5000
APPROVED	A. MASSEREY
DATE	2020AUG04
REV	1
DESCRIPTION	ISSUED FOR CDR SUBMISSION

FIGURE 2

EAGLE HEIGHTS SUBDIVISION

CIVIL
SITE PLAN
EARTHWORKS CUT/FILL MAP

From:	Bill Delainey
To:	Adam Antoine
Cc:	Adam Toth; [redacted] cebrykc@outlook.com; Darrell Rinas; Dukart, Shawn MA (shawn.dukart@gov.sk.ca); Cory Zubrowski
Subject:	Re: Eagle Heights Preliminary Drainage Plan - Request for Comments
Date:	Thursday, July 30, 2020 5:16:18 AM
Attachments:	image002.png image007.png

Thanks Adam, we will make this minor revision to our drainage plan and resubmit to the RM. We will also provide the MBE elevations to the surveyor for inclusion on the PPS for Phase 1.

Bill Delainey
Sent from my iPhone

On Jul 29, 2020, at 2:20 PM, Adam Antoine <Adam.Antoine@wsask.ca> wrote:

Afternoon Bill,

Just to clarify, as Catchment 1 and Catchment 2 both contribute to Pond 4, the conversion of active to permanent would be for a total of 13,600 m^3.

Other than that, you have captured my comments accurately.

<image002.png>

From: Bill Delainey <delaineyb@ae.ca>
Sent: Wednesday, July 29, 2020 12:48 PM
To: Adam Antoine <Adam.Antoine@wsask.ca>
Cc: Adam Toth <atoth@rmcormanpark.ca>; Tim Makahoniuk (tim.makahoniuk@woodplc.com) <tim.makahoniuk@woodplc.com>; cebrykc@outlook.com; Darrell Rinas <rinasd@ae.ca>; Dukart, Shawn MA (shawn.dukart@gov.sk.ca) <shawn.dukart@gov.sk.ca>; Cory Zubrowski <c.zubrowski@machibroda.com>
Subject: RE: Eagle Heights Preliminary Drainage Plan - Request for Comments

Good afternoon Adam and thank you so much for taking the time to review and respond to our request for comments. It appears you were burning the midnight oil last night.

We have reviewed your communication and it is our understanding the WSA is:

- discouraging the establishment of a MBE based upon ground water elevations due to the high level of unpredictability in estimating changes in elevations consistently and accurately;
- recommending that the MBE should be established through an assessment of surface water elevations as there are proven approaches to this which create more consistent

and accurate results;

- suggesting that if infiltration is an issue, waterproofing basements would be an acceptable response; and
- recommending the conversion of the active storage of 8,500 m^3 within Pond 1 to permanent storage and adjusting the 1:100 and 1:500 yr elevations accordingly to offer additional permanent storage and to limit the burden placed on Pond 4 which extends into the adjacent ¼ section.

We would propose to increase the invert elevation of the culvert located between Ponds 1 and 4 by 0.15 m to 549.40 m which would subsequently increase the 1:100 year and 1:500 year levels in Pond 1 to 549.55 m and 549.75 m respectively which would increase the permanent storage and maintain an additional 8,500 m^3 of active storage as well. We note that this has no impact on the current MBE for this pond and both of these events are able to be fully contained within the existing Municipal Utility parcel containing Pond 1.

Have I misrepresented your communication in anyway? If not, we will make the appropriate updates to the technical memo to reflect this.

Regards,

Bill Delainey, RPP
Group Manager, Urban Planning
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK S7L 6X6
Tel: 306.653.4969 | Cel: 306.261-.9612 | Dir: 306.653.2137 Ext. 5489

<image003.gif>
<image004.gif>

<image005.gif>
<image006.gif>

From: Adam Antoine <Adam.Antoine@wsask.ca>
Sent: Wednesday, July 29, 2020 12:00 AM
To: Bill Delainey <delaineyb@ae.ca>
Cc: Adam Toth <atoth@rmcormanpark.ca>; Tim Makahoniuk (tim.makahoniuk@woodplc.com) <tim.makahoniuk@woodplc.com>; cebrykc@outlook.com; Darrell Rinas <rinasd@ae.ca>; Dukart, Shawn MA (shawn.dukart@gov.sk.ca) <shawn.dukart@gov.sk.ca>; Cory Zubrowski <c.zubrowski@machibroda.com>
Subject: RE: Eagle Heights Preliminary Drainage Plan - Request for Comments

Evening Bill,

An MBE requirement at the basement slab level is unusual and should likely be supported technically by a detailed geotechnical analysis and/or a lack of ability to “flood proof” basement foundations. As you are aware, there are several techniques for waterproofing basements if groundwater infiltration is a concern. If this approach was adopted throughout the municipality, several less pronounced topographic areas would require extensively infilled build sites to accommodate this requirement. As you know, groundwater dynamics are complex and extremely challenging to predict, and therefore would be difficult to develop a consistent approach to MBE establishment throughout the municipality. Though complicated, surface water hydrology is far more predictable and can be fairly consistently replicated across several experts in the field.

In regard to the April 23, 2020 Eagle Heights Subdivision Technical Memo, I have concerns regarding Ponds 1 & 4. As you are aware, a property outside of the proposed subdivision has experienced flooding in recent years, with WSA's Emergency Flood Damage Reduction Program providing support in the construction of protection dykes. Though it is not the responsibility of this development to ensure the property does not flood, it must account for all artificial/unnatural (pre to post) increases to volumes and flows. I have concerns regarding the implementation of active storage facilities into a semi-closed/terminal basin area. As the report suggests, in "normal" years, the evaporation will outweigh the precipitation. However, the previous 13 years have detailed that prairie hydrology is extremely complex, and the very small data set we have available is often inadequate in design and forecasting. Given known sensitivities and terminal basin constraints, WSA recommends the calculated active storage for which eventually contributes to Pond 4 be converted into permanent storage. This can be done with the construction of a new retention facility, or what is likely more practical, the expansion of an existing natural pond area.

Besides that, I have no other issues with the proposal at this stage.

<image007.png>

From: Bill Delainey <delaineyb@ae.ca>
Sent: Thursday, July 16, 2020 7:10 AM
To: Adam Antoine <Adam.Antoine@wsask.ca>
Cc: Adam Toth <atoth@rmcormanpark.ca>; Tim Makahoniuk (tim.makahoniuk@woodplc.com) <tim.makahoniuk@woodplc.com>; cebrykc@outlook.com; Darrell Rinas <rinasd@ae.ca>; Dukart, Shawn MA (shawn.dukart@gov.sk.ca) <shawn.dukart@gov.sk.ca>; Cory Zubrowski <c.zubrowski@machibroda.com>
Subject: Eagle Heights Preliminary Drainage Plan - Request for Comments

Good morning Adam. As you are aware, we have been pursuing approval to rezone land within the NW-11-37-4-W3M and the SW 11-37-4-W3M for the purpose of enabling the subdivision and development of the initial phase of the Eagle Heights Country Residential Estates development in Corman Park. The RM has requested that we supply you with the attached, more detailed drainage plan for your review and comments. The RM has indicated a preference to apply the Safe Building Elevation (SBE) now referred to as the Minimum Building Elevation (MBE) to the basement slab rather than the lowest opening in the building foundation as an increased safety factor. We note that our SBEs include a 0.5 metre freeboard. The desired outcome of this consultation is to gain support from your office for the attached plan and to get your opinion on the appropriateness of the basis for measurement of the SBE (slab elevation) and the application of a 0.5 m freeboard. Once we have verified this aspect of the plan with your office, I anticipate we are in a position to submit the updated CDR report to the RM Council for a decision.

We appreciate your assistance in progressing this application to its completion.

Regards,

Bill Delainey, RPP
Group Manager, Urban Planning
Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive, Saskatoon, SK   S7L 6X6
Tel: 306.653.4969 | Cel: 306.261-.9612 | Dir: 306.653.2137 Ext. 5489

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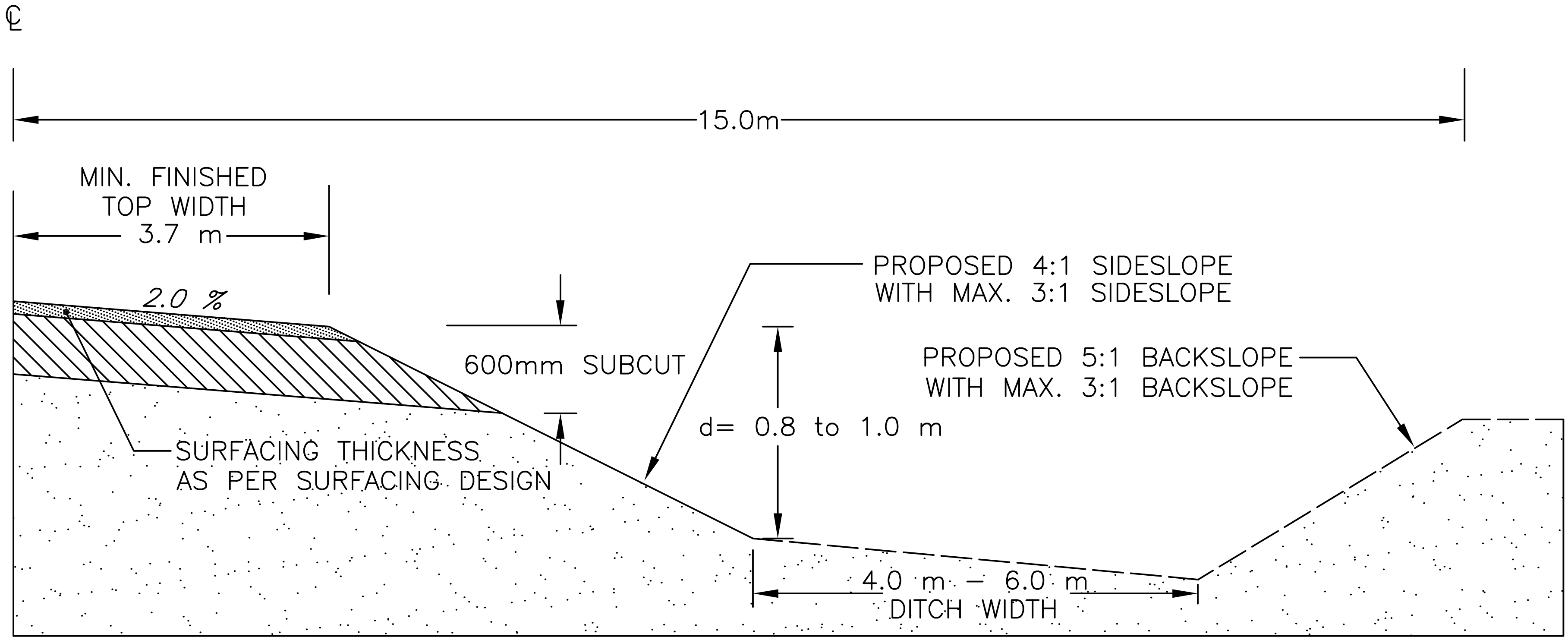
You may unsubscribe from Associated's electronic communications at any time.

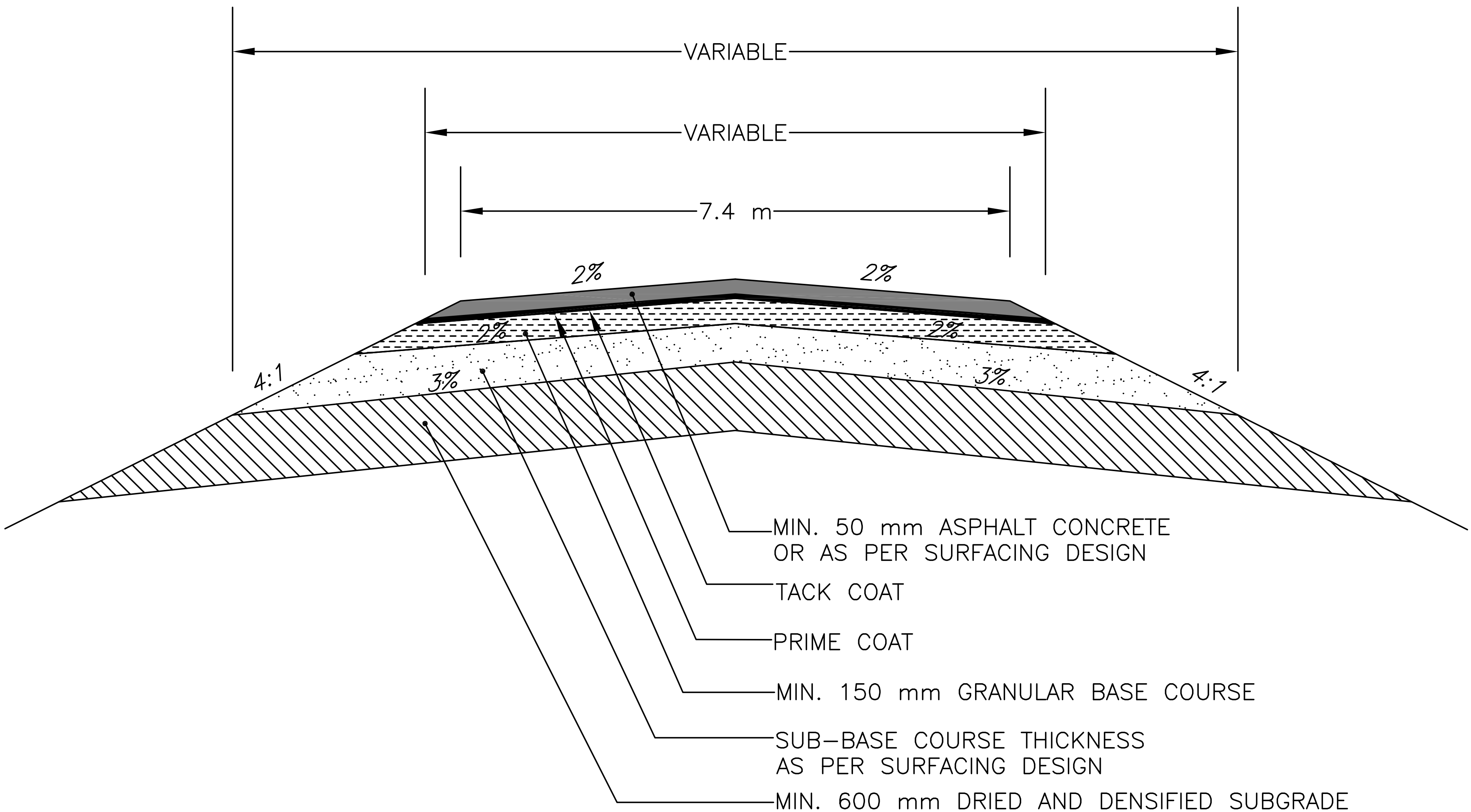
Appendix H: Internal Road Standard and Surfacing Design



Rural Municipality of Corman Park

PUBLIC WORKS
COUNTRY RESIDENTIAL - TYPICAL CROSS SECTION
SUBGRADE

DATE: 2017	SCALE: NTS	DRAWN BY: WOOD E&I



Rural Municipality of Corman Park

PUBLIC WORKS
COUNTRY RESIDENTIAL - TYP. SURFACING
ASPHALT CONCRETE

DATE: 2017	SCALE: NTS	DRAWN BY: WOOD E&I

1. Description

- Road design and construction standards for paved (asphalt concrete) subdivisions and special roads as designed within the Rural Municipality of Corman Park, No. 344 (Municipality).

2. Miscellaneous

- For the purposes of this document, the term "proponent" shall be used to address duties that shall be undertaken by the owner, developer, contractor and engineer interchangeable.
- During construction, the proponent shall be responsible for all traffic accommodation measures. This shall include but not limited to:
  - Proper signing of all access roads whereby traffic (construction or local) may access existing Municipality roads.
  - Traffic gravel shall be applied, if or as necessary for local traffic.
  - Proper measures shall be taken to ensure that local traffic can safely interact with construction equipment.
- The proponent shall ensure that all necessary Haul Road Agreements are in place including any provisions for dust control prior to the hauling of materials.
- Dust control to be applied on any approved detour routes.

3. Required Right-Of-Way Standards

- Minimum allowable Right-of-Way (ROW) purchased shall be 30.0 meters (m).
- The proponent shall be responsible for the purchase of all ROW.
- The minimum allowable ROW for cul-de-sacs and turnabouts purchased shall be 60.0 m with a minimum of 15.0 m radius for the driving surface.
- The road shall be designed and constructed in the center of the Right-Of-Way unless with special permission of the Municipality.

4. Road Widths and Geometric Standards

4.1. Finished Road Width and Height

- The finished asphalt driving surface (paved width before the start of the asphalt slope) shall be as follows:
  - For fill heights of 3.0 m or less (where the road surface is from 0.0 m to 3.0 m in height), a 7.4 m finished road top width (asphalt) shall be required.
  - For fill heights greater than 3.0 m (where the road surface is from 3.1 metres in height or more), a 8.0 m finished road top width (asphalt) shall be required.
- The road cross-fall (slope) shall be constructed to 2.0% with any curves must be constructed with the proper super-elevation.

- The average shoulder elevation of the road surface should be approximately 0.8 m to 1.0 m above the adjacent ground except in cut areas.
- The subgrade surface shall not be less than 1.5 m above high water level on the ground water table. (ie: level to which free water would rise in a hole sunk in the ground).

4.2. Surfacing and Hydraulic Design
- A grading, surfacing and hydraulic design shall be completed, signed and stamped by a Professional Engineer registered with the Association Of Professional Engineers and Geoscientists of Saskatchewan (APEGS) and licensed to practice (Permission to Consult in this field of expertise) within the Province of Saskatchewan.
- The surfacing structure shall be based upon the Saskatchewan Ministry of Highways and Infrastructure's Shell Curve method and shall be based on a 15 year design life (N_{15}).
- Soils testing shall be in accordance with the Saskatchewan Ministry of Highways and Infrastructure's Standard Test Procedures manual.
- Hydraulic structures (culverts) with significant flows shall be designed (sized) in accordance with the Saskatchewan Ministry of Highways and Infrastructures Hydraulic Manual and shall be based on a Q^{25} flow (1 in 25 year (1:25)) frequency.
  - The Municipality may request that the design be based on a Q^{50} flow (1 in 50 year (1:50)) frequency based on the location (proximity) of any residences upstream of the crossing.
  - The proponent shall apply for, and shall meet all of the listed requirements, an Aquatic Habitat Protection Permit (AHPP) from SaskWatershed Authority for hydraulic passages requiring such.

4.3. Sideslopes
- Sideslopes shall range from 3:1 to 4:1 depending upon situation and with approval from the Municipality.
  - The standard required sideslope shall be 4:1.
    - For road fills ranging from 0.0 to 3.0 m in height, the sideslope shall be 4:1.
    - For road fills ranging in height from 3.0 m to 4.0 m, the toe of slope shall be 12.0 m from shoulder of the road.
    - For road fills greater than 4 m the sideslope shall be 3:1.
  - If upon review by the Municipality, a sideslope of 3:1 may be allowed only with special permission from the Municipality.

4.4. Ditch Bottom Widths
- Ditch bottom widths shall be range from 4.0 to 6.0 m depending upon grade height and backslope requirements.
  - The desirable is 6.0 m for snow storage.

4.5. Backslopes

- Sideslopes shall range from 5:1 to 3:1 depending upon the situation and with approval from the Municipality.
  - o The standard required back slope shall be 5:1.
    - ▪ A backslope of ranging from a minimum of 3:1 to the standard backslope of 5:1 will be allowed in conjunction with maximizing the ditch bottom width.

4.6. Maximum Road Gradient

- The maximum road gradient allowed shall be 5.0%.
- With special approval by the Municipality, a 6.0% gradient may be allowed.

4.7. Stopping Sight and Intersection Distances

- The stopping sight distance for intersections with any road shall be a minimum of 140 m. This is based upon the SARM guidelines for an 80 km/h road design.
  - o For urban (low speed internal roads), reduced stopping sight distances will be utilized and approved based on design and operating speeds.
- The minimum length of road (constructed past an approach) shall be 100 m.
  - o This is done in order to meet Stopping Sight Distances, snow and ice removal and road maintenance.
- For intersecting roads, the sight triangles shall be clear of any obstructions.
  - o The sight triangle shall be a minimum of 85.0 m from the point of intersection on municipal roads and grid intersections and to a maximum of 140.0 m on primary grid roads using 80 km/h design speed.
    - ▪ For urban (low speed internal roads), the sight triangles will be utilized and approved based on design, operating speeds and applicable signing.

4.8. Existing Roads

- Consideration may be given within existing multi-parcel subdivisions for reduced finished road widths to a maximum of 7.4 m.

5. Snow Clearance Standards

- When shoulder grade elevation is 0.3 m or less above natural surface at 15.0 m to 20.0 m from center line then the backslope must be flattened using a variable slope of 5:1 to a maximum of 3:1.

6. Road Construction

6.1. Clearing and Grubbing

- Timber, brush, duff (vegetation), roots, logs and stumps shall be completely cleared from the surface of the Right-of-Way.
- Debris from clearing and grubbing operations shall not be used in the construction of embankments (any portion of the road structure).

- Debris from clearing and grubbing operations shall not be buried within the Right-Of-Way.

6.2. Removal and Replacement of Topsoil

- All topsoil within the Construction Footprint shall be removed and stockpiled.
  - The Construction Footprint is defined as the area within the cut or fill stakes.
- The Contractor shall install appropriate sediment control to ensure no sedimentation from topsoil stockpiles enters into adjacent water bodies.
- Upon completion of the construction, topsoil shall be replaced to a uniform depth over the Construction Footprint excluding the road surface.
  - The maximum compacted depth of topsoil replaced will be 100 mm.
- Stones (rocks) 75 mm or more in diameter shall be removed and disposed of from the topsoil replaced.

6.3. Drainage (culvert) Installations

- If the foundation is unsuitable, the bottom of the bed shall be sub-cut to a minimum of 0.3 m below the granular backfill layer.
- A geotextile fabric shall be installed to separate the ground surface from the granular materials.
  - A minimum 8 ounce (Geotex 801 or equivalent) nonwoven geotextile shall be used.
- The bedding line shall be shaped to fit the culvert.
- Corrugated metal pipe culverts (CSP) shall be placed with the inside circumferential laps pointing downgrade and with the longitudinal laps at the sides or quarter points. The sections of the culvert shall be firmly joined with coupling bands. Joints shall be as tight as possible.
- Culverts shall be to the following minimum sizes unless larger sizes are required to meet flow requirements:
  - Approach culverts shall be a minimum of 400 mm in diameter.
  - Through grade culverts shall be a minimum of 600 mm in diameter.
- CSP culverts shall have a minimum thickness of 2.0 mm (12 gauge).
- Granular material shall be composed of sand or gravel free from undesirable quantities of soft or flaky particles, loam, and organic or other deleterious material. Granular material shall comply with the following requirements:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series		
	TYPE		
	115	116	10
50 mm	100	-	100
9.0 mm	-	100	-
900 µm	-	30 - 100	-
400 µm	-	15 - 75	-
160 µm	-	0 - 10	-
71 µm	0 - 15	-	0 - 20
Plasticity Index	0 - 6	0 - 6	0 - 6

- For backfilling all types of culverts and bridge abutments, Type 115 shall be used.
- For backfilling subsurface drain pipes, Type 116 shall be used as a filter Material.
- For backfilling curbs, curbs and gutters, sidewalks, driveways, storm sewers, and manholes, catch basins, and other ancillary structures, Type 10 shall be used.
- Earth backfill under the haunches of culverts, except those in approaches not to be paved shall be compacted with mechanical impact tampers.
- After the earth backfill and granular backfill has been placed and compacted around the culvert, the remainder of the embankment shall be constructed by drying the earth material to at least the optimum moisture content and compacted to an average of not less than one-hundred (100) percent of the maximum density as determined by a Saskatchewan Ministry of Highways and Infrastructure Standard Proctor test.
- The earth material above the bedding line shall be placed, simultaneously and uniformly, in lifts on each side of the culvert. In subcut sections, the lift shall extend to the limits of the sub-cut; otherwise the lifts shall extend not less than 15 m from each side of the culvert.
- No objectionable material shall be used within that portion of the embankment above or below the bedding line on culverts through the roadbed.
- The embankment, within three diameters or three span; of the culvert barrel, shall be free from rocks having a dimension of 80 mm or greater when measured in any direction.
- Random riprap shall be installed at all culvert locations where the culvert diameter is greater than 800 mm.
  - A nonwoven geotextile shall be placed prior to the placement of the riprap material.

6.4. <u>Subgrade Embankments</u>

- Earth embankments shall consist of acceptable earth material and rock material free from objectionable quantities of organic matter, frozen soil, stumps, trees, moss, and other unsuitable materials.
- The embankment shall be constructed by placing the material in successive layers.
- The depth of each layer shall not be more than fifteen (15) centimetres (cm) uncompacted. The full width of each segment of each layer shall be bladed with a motor grader at least twice prior to being compacted.
- The slopes and surface of the embankment shall be shaped and trimmed to a uniform smooth surface conforming to the cross-sections shown on the plans, or as staked.
- Stones having a dimension of eight (8) cm or more when measured in any direction shall be removed from the top fifteen (15) cm of the subgrade.
- The following requirements will apply for all embankments:
  - When unsuitable material is encountered below the natural ground surface in embankment areas, the material shall be excavated and removed.
  - The embankment layer (other than at culverts including the sub-cut backfill layer) from 750 mm to 600 mm below the top of the subgrade shall be dried to within 3% of the optimum moisture content.

  - Each layer of the top 600 mm of the subgrade shall be dried to at least the optimum moisture content and compacted to an average of not less than one-hundred (100) percent of the maximum density as determined by the Saskatchewan Ministry of Highways and Infrastructure Standard Proctor test. The moisture and densities will be considered satisfactory when:
    - All individual moisture test results are equal to or less than the optimum moisture content.
    - Density test results average not less than one hundred (100) percent of the maximum density.
    - All individual density tests are greater than ninety-eight (98) percent of the maximum density.
  - If the moisture existing in the soil is insufficient for compacting to the specified density and for finishing, the proponent may elect to add water.
  - The foregoing requirements will also apply to backfill of subcuts and the embankment required to prepare the beds and backfill drainage structures.
- Approaches to be constructed as per Municipalities Approach Construction policy.

6.5. Traffic Gravel

- Traffic gravel shall comply with Type 106.

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
	TYPE
	106
40.0 mm	-
31.5 mm	-
22.4 mm	100
18.0 mm	63 – 92
5.0 mm	0 – 50
2.0 mm	0 – 35
400 µm	
Fractured Faces	40% Minimum

- A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted.

6.6. Traffic Gravel Behind Construction

- Type 106 Traffic Gravel shall be placed and spread on a newly constructed subgrade surface.
- Traffic gravel Type 106 shall not be deposited until the subgrade surface has been compacted (to the required density) and trimmed.
- Traffic gravel shall be dumped and spread uniformly on the subgrade surface as required.
- Traffic gravel shall be applied to the finished surface of all approaches.

6.7. Sub-Base Course

- Sub-base aggregate shall be composed of sound, hard, and durable particles of sand, gravel and rock free from injurious quantities of soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
- Sub-base course shall comply with the requirements listed in following table:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
50 mm	100
2.0 mm	0 – 80.0
400 μm	0 – 45.0
160 μm	0 – 20.0
71 μm	0 – 8.0
Plasticity Index	0 – 6

A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 63.0 mm sieve.

- The thickness of any one compacted lift of sub-base course shall not exceed 120 mm.
- Sub-base courses shall be compacted until no further settlement is apparent and the particles are well keyed into place.
- The finished surface of the sub-base course shall be true to grade and cross section and free of any surface defects, rutting or deformations the placement of the next course.

6.8. Granular Base Course

- Base aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock free from injurious quantities of elongated, soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
- Base Course Mix (Type 33) shall comply with the requirements listed in following table:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
18.0 mm	100
12.5 mm	75.0 – 100.0
5.0 mm	50.0 – 75.0
2.0 mm	32.0 – 52.0
900 μm	20.0 – 35.0
400 μm	15.0 – 25.0
160 μm	8.0 – 15.0
71 μm	6.0 – 11.0
Plasticity Index	0 – 6
Fractured Faces (%)	50.0% Minimum
Lightweight Pieces	5.0% Maximum

- A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 22.4 mm sieve.
- Granular Base Mix shall be spread on dry and unfrozen surfaces and shall not be compacted if the atmospheric temperature is less than 2° Celsius.
- The finished surface of the Granular Base Course shall be true to grade and cross section and free of any surface defects.
- The Granular Base Course shall be considered satisfactory when:
  - It contains no surface defects.
  - The average density meets or exceeds 100% of maximum density.
  - All individual test results are greater than 98% of maximum density.
  - The moisture content is less than or equal to the optimum moisture content.
- A prime coat shall be placed on the finished final lift of Granular Base Course
  - Prime coat shall be placed within 24 hours, weather permitting.

6.9. <u>Asphalt Prime and Tack Coat</u>

- The proponent may elect to use MC-30, an emulsified asphalt primer, road-mixed SS-1, road-mixed SS-1H for the prime coat.
  - If using SS-1 or SS-1H, the SS-1 must be incorporated into the top 25 mm to 50 mm of the Granular Base Course.
- SS-1 or SS-1H emulsified asphalt shall be used as a tack coat.
- The tack coat shall be applied in accordance with the application rates outlined in the following table:

Surface Type	Application Rate (L/m^2)		
	Residual	Undiluted	Diluted (one part water to one part emulsified asphalt)
New Asphalt Concrete	0.14 – 0.18	0.23 – 0.32	0.45 – 0.60

- Potable water shall be used to dilute the emulsified asphalt.
- The tack coat shall be applied in a single application and uniformly across the prepared surface.
- Asphalt for prime coat and tack coat shall not be applied to a prepared surface when:
  - The surface temperature is less than 2° C.
  - The weather is misty, rainy, or if rain is impending.
- Traffic will not be permitted to travel on prime coat until 6 hours after application. After 6 hours, excess asphalt remaining on the surface shall be blotted by sand before traffic is permitted to travel on the surface.

6.10. <u>Asphalt Concrete</u>

- Virgin aggregate used for Asphalt Concrete shall be composed of sound, hard and durable particles of sand, gravel and rock, free from injurious quantities of elongated, soft or flaky particles, shale, clay, loam, ironstone, coal and organic or other deleterious materials.

- Type 150 – 200A asphalt shall be used as bituminous binder.
  - This material shall meet the requirements of Saskatchewan Ministry of Highways and Infrastructure's Specifications for Manufactured Materials (SMM) For Asphalt Cements.
- Hydrated-lime or liquid anti-strip shall be used as an anti-stripping agent.
  - The stripping potential shall not exceed 5% as determined by SMHI Standard Test Procedure (STP 204-15).
  - Liquid anti-stripping agent shall be added at a rate of approximately 1.0% of the weight of liquid asphalt added.
  - The amount of hydrated lime added shall be approximately 1% of the total dry aggregate by weight.
  - The Contractor shall ensure the procedures and equipment used for the addition of hydrated lime anti-stripping agent are adequate to ensure that the hydrated lime is added at a uniform consistent rate.
- Only the following Mix Design Type will be permitted:

Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series
12.5 mm	100
9.0 mm	76-89
5.0 mm	50-60
2.0 mm	30-48
900 um	19-38
400 um	10-26
160 um	3-10
71 um	2-5
Fracture Minimum %	70 (1 face)
Sand Equivalent Minimum %	45
Los Angeles Abrasion (% loss)	35 (max)
Organic Content (% passing 5 mm)	1.0
Marshal Blows	50
Marshal Stability (kN) at 60ºC min	8
Retained Stability (min %)	75
Marshal Flow Index (mm)	2-4
Air Voids in Mixture	3-5
Voids Filled With Asphalt %	70-80
Min Film Thickness	8.0

- A tack coat shall be applied and allowed to fully cure prior to the placement of the asphalt mix (paving operations).
- Asphalt concrete shall be spread on dry, clean, and unfrozen surfaces.
- Asphalt concrete shall be placed in accordance with the following temperature limitations:

  - Paving may begin, for other than the final lift, when the temperature is 0° C provided the temperature is forecast, by Environment Canada, for the closest location to the project, to reach at least 5° C that day.
  - The final lift of asphalt concrete shall not be placed if:
    - The atmospheric temperature is less than 5° C;
    - The surface temperature is less than 7° C.
- The asphalt concrete mat shall be constructed to a field density range of 97% to 98% of the Marshall Density based on readings from a correlated Nuclear Densometer gauge.
  - The proponent will develop a correlation between the results of the nuclear gauge and the results of the asphalt concrete cores obtained from the compacted lift of asphalt concrete. The density results obtained from the cores will be used to correct the Field Density results obtained from the nuclear gauge.
- The asphalt mat shall be constructed so that:
  - There are no pavement depressions.
  - Longitudinal construction joints from one lift to the next shall be separated by at least 100 mm.
- The minimum and maximum thickness of a compacted lift of asphalt concrete shall meet the following requirements:
  - Minimum asphalt mat thickness shall be 30 mm.
  - Maximum asphalt mat thickness shall be 50 mm.
- The asphalt mix temperature in the paver shall not be less than 110° C.
- Contact faces of curbs, gutters, manholes, and sidewalks shall be coated with asphalt using a hand applicator before placing the asphalt mix.
- When paving is discontinued on the roadway, the asphalt concrete shall be temporarily feathered to a slope of 10 horizontal to 1 vertical. When paving is resumed, the transverse joint shall be straight and have a vertical face when the taper is removed.
- Asphalt mix shall not be placed or allowed to fall on previously laid top lift asphalt concrete or the existing asphalt concrete.
- Transverse construction joints from one lift to the next shall be separated by at least 2.0 m.
- The proponent shall construct the asphalt mat so that there are no areas of:
  - Segregation.
  - Surface defects which may consist of:
    - Roller marks.
    - Open texture.
    - Improper matching of longitudinal and/or transverse joints.
    - Cracking or tearing.
    - Contamination by diesel, hydraulic fluids, detergent or other harmful products.
    - Foreign objects or materials that are detrimental to the asphalt concrete.
    - Clay balls or oversized materials.
  - Any repairs required shall be to the satisfaction and approval by the Municipality.

6.11. Seeding

- Prior to seeding, the area to be seeded shall be true to grade and cross section and free from irregularities.
- The proponent shall harrow the seeded areas immediately after the seeding is completed.
- The seed material shall contain the following blend of seeds:

Seed Mix Common Name	% of Mix
Sheep's Fescue	15
Canada Blue Grass	15
Blue Fescue	15
Hard Fescue	15
Chewings Fescue	15
Creeping Red Fescue	15
Perennial Rye Grass	10

- The seed application rate shall be 14 kg per hectare (31 lbs per acre).
- The Municipality may approve other grass seed mixtures having similar grass seeds or slight changes in mixture percentages.

7. Design and Construction Certification

- The Municipality reserves the right to request any and/or all test result(s) or other associated documentation at any stage of the project.
- Upon completion of the project and prior to the start of the warranty period, the proponent's Engineer and/or engineering firm shall complete and submit a signed and sealed Statutory Declaration stating that all design and construction criteria/specifications in accordance with the parameters aforementioned have been met.
    - The Engineer of Record shall be a Professional Engineer registered with the Association Of Professional Engineers and Geoscientists of Saskatchewan (APEGS) and licensed to practice (Permission to Consult) within the Province of Saskatchewan.
    - The Engineer(s) of Record shall have reviewed and/or been involved with the design and/or construction of the project and shall have firsthand knowledge of the work completed.

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May 20, 2020

Associated Engineering (Sask.) Ltd.
1 – 2225 Northridge Drive
Saskatoon, SK S7L 6X6

Attention: Mr. Bill Delainey, Group Manager – Urban Planning

**RE: GEOTECHNICAL ADDENDUM TO
SNC-LAVALIN REPORT 163596
SUBDIVISION ROADS
PROPOSED RESIDENTIAL SUBDIVISION
W½-11-37-04-W3M
EAST OF SASKATOON, SASKATCHEWAN
PMEL PROJECT NO. 16265**

1 INTRODUCTION

While employed by SNC-Lavalin, I (Cory Zubrowski) prepared a geotechnical report for the above-mentioned site (refer to SNC-Lavalin Project No. 613596, dated August 2013). It is understood that a geotechnical addendum is now required to address some questions posed by the RM of Corman Park. Specifically, additional information is required with respect to roadway design and basement construction as relevant to flooding.

This letter addresses the subdivision roads; an additional letter will be provided for the basement construction as relevant to flooding. The information presented in this letter supercedes the recommendations presented in the 613596 geotechnical report.

2 SUBDIVISION ROADS

At the time of preparation of the 613596 geotechnical report, the intent was to use gravel-surfaced roads. It is now understood that paved roads are required as per the RM of Corman Park Country Residential Paved Roads standard. Based on the RM standards, the following road structure recommendations have been provided.

2.1 DESIGN CBR

The near-surface subgrade soils consisted of silt/clay. The group index and correlated soaked California Bearing Ratio (CBR) values have been summarized in Table I.

TABLE I - SOAKED CBR VALUES (GI CORRELATED).

Test Hole No.	Depth (metres)	Soil Type	Group Index	Correlated Soaked CBR	Corrected Soaked CBR[1]
613596-1	1.0	Silt	6.6	6.8	4.8
613596-12	1.0	Silt/Clay	9.2	5.3	4.3
613596-17	1.0	Silt	6.4	7	5.0
613596-31	1.0	Sandy Silt	2.5	11.3	10.3
				Average (All Samples)	**6.1**
				Average (Sandy Silt Removed)	**4.7**

[1] The MHI Surfacing Design Manual recommends reducing the soaked CBR of silt soil by 1 to 2.

Upon review of Table I, the average group index correlated soaked CBR value was 6.1 for all samples assessed and 4.7 with the sandy silt sample removed. Based on a review of the test hole drill logs, the majority of the roadways within the development will likely be constructed on silt. As such, the pavement design has been based on a soaked CBR value of 4 to 5 for silt subgrade soil.

2.2 DESIGN TRAFFIC LOADING

It is understood that the subdivision will be divided into approximately 83 lots with an assumed average of 680 vehicle trips per day at full build out (i.e., 20 years). It is assumed that each trip will consist of 2 vehicle passes (i.e., 1,360 vehicle passes per day at year 20). The traffic loading assumptions have been summarized in Table II. Based on the assumed traffic loading, a design N_{15} of 325,021 ESALs was calculated for the proposed roadways. A detailed breakdown of the design traffic loading (ESALs) has been attached for reference.

TABLE II - TRAFFIC INFORMATION

Item	Value	Note
Design Life	15 years	As per the RM of Corman Park Country Residential Paved Roads specification.
Design AADT (Year 20)	1,360	680 trips/day as provided by Associated Engineering (Sask.) Ltd. 680 trips/day x 2 traffic passes/trip = 1,360 AADT.
Percent Growth Rate	5% - Year 0 to 20	Year 20 build out of the development as provided by Associated Engineering.
Design AADT (Year 1)	513	Based on assumed and provided parameters (back calculated using 5% growth rate and AADT at 20 year).
Number of Lanes per Direction	1	Assumed (2-way traffic - 1 lane per direction).
Directional Split	50%	Assumed (traffic will travel equally in each direction).
Percent Commercial Truck Traffic	4%	Assumed (construction trucks, garbage/recycling trucks and septic trucks anticipated).

TABLE III - TRAFFIC INFORMATION (CONTINUED)...

Item	Value	Note
Truck Traffic Distribution	90%/10%	Assumed (single unit trucks/tractor semi-trailer combinations).
Bus Passes/Design Life	6,000	Assumed (1 bus trip per day x 2 passes per trip x 5 days/school week x 40 school weeks/year x 15 years).
ESALs per Unit (Trucks)	3.0/6.3	Single unit trucks/tractor semi-trailer combinations.
ESALs per Unit (Buses)	5	

2.3 RECOMMENDED PAVEMENT STRUCTURE

The R.M. of Corman Park Country Residential Paved Road Construction Standard requires the roadway to be designed in accordance with the Saskatchewan Ministry of Highways and Infrastructure's Shell curve method.

As discussed in Section 2.1, a soaked CBR in the order of 4 to 5 was utilized for the design of the proposed Roadways. As such, the CBR 4.0 and 5.0 shell curves were utilized for the design (curves have been attached for reference).

Based on the CBR rating and design traffic loading (as summarized in Sections 2.1 and 2.2, respectively), the recommended asphalt concrete pavement structure has been presented in Table IV.

TABLE IV - THICKNESS DESIGN FOR PAVEMENT STRUCTURES.

Pavement Structure	Thickness (mm)
Asphalt Concrete (150-200A) [1]	75
Granular Base (Min CBR = 65)	175
Granular Sub-Base (Min CBR = 20)	235
Geotextile / Geogrid [2]	As Required
Prepared Subgrade	(600)
Total Thickness (mm)	**485**

[1] Asphalt Concrete type as per the R.M. of Corman Park Residential Paved Road Construction Standard.
[2] Geogrid/geotextile may be required where soft/wet/loose subgrade soil conditions are encountered.

2.4 PAVEMENT CONSTRUCTION RECOMMENDATIONS

It should be noted that the R.M. of Corman Park has roadway construction standards. Detailed construction specifications (subgrade preparation, material type and compaction specifications, etc.) have been outlined in the R.M. of Corman Park Country Residential Paved Road Construction Standard (https://www.rmcormanpark.ca/DocumentCenter/View/1812/Country-Residential-Paved-Road?bidId=). The pavement should be designed/constructed in accordance with the construction specifications provided in the R.M. Paved Road Construction Standard.

3 CLOSURE

We trust that this meets your requirements at this time. If you have any questions or require additional information, please contact our office.

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Number 172
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
Geotechnical	12138	

2020-05-20

Enclosures:
Detailed Breakdown of Design Traffic Loading, Shell Curves

APPENDIX A

DETAILED BREAKDOWN OF
DESIGN TRAFFIC LOADING, AND,
SHELL CURVES

DETAILED BREAKDOWN OF DESIGN TRAFFIC LOADING

1) Design Traffic Loading (ESALs)

Associated Engineering (Sask.) Ltd. has reported that the subdivision will be divided into approximately 83 lots and it can be assumed that there will be an average of 680 vehicle trips per day at full build out (i.e., 20 years). It is assumed that each trip will consist of 2 vehicle passes (i.e., 1,360 vehicle passes per day).

The roadway design has been based off the following design traffic loading assumptions.

TABLE A1 Traffic Volume

Item	Value	Note
Design Life	15 years	As per the RM of Corman Park Country Residential Paved Roads specification.
Design AADT - Year 20	1,360	680 trips/day as provided by Associated Engineering (Sask.) Ltd. (680 trips/day*2 traffic passes/trip = 1,360 AADT).
Percent Growth Rate	5% - Year 0 to 20	Year 20 build out of the development was provided by Associated Engineering (Sask.) Ltd.
Design AADT - Year 1	513	Based on assumed and provided parameters (back calculated using 5% growth rate and AADT at 20 year).
Number of Lanes per direction	1	Assumed (2 way traffic - 1 lane per direction).
Directional Split	50%	Assumed (traffic will travel equally in each direction).
Percent Commercial Truck Traffic	4%	Assumed (construction trucks, garbage/recycling and septic trucks anticipated).
Truck Traffic Distribution	90%/10%	Assumed (single unit trucks/tractor semi-trailer combinations).
Bus Passes/Design Life	6,000	Assumed (1 bus trip per day x 2 passes per trip x 5 days/school week x 40 school weeks/year x 15 years).
ESALs per Unit – Trucks	3.0/6.3	Single unit trucks/tractor semi-trailer combinations.
ESALs per Unit – Buses	5	

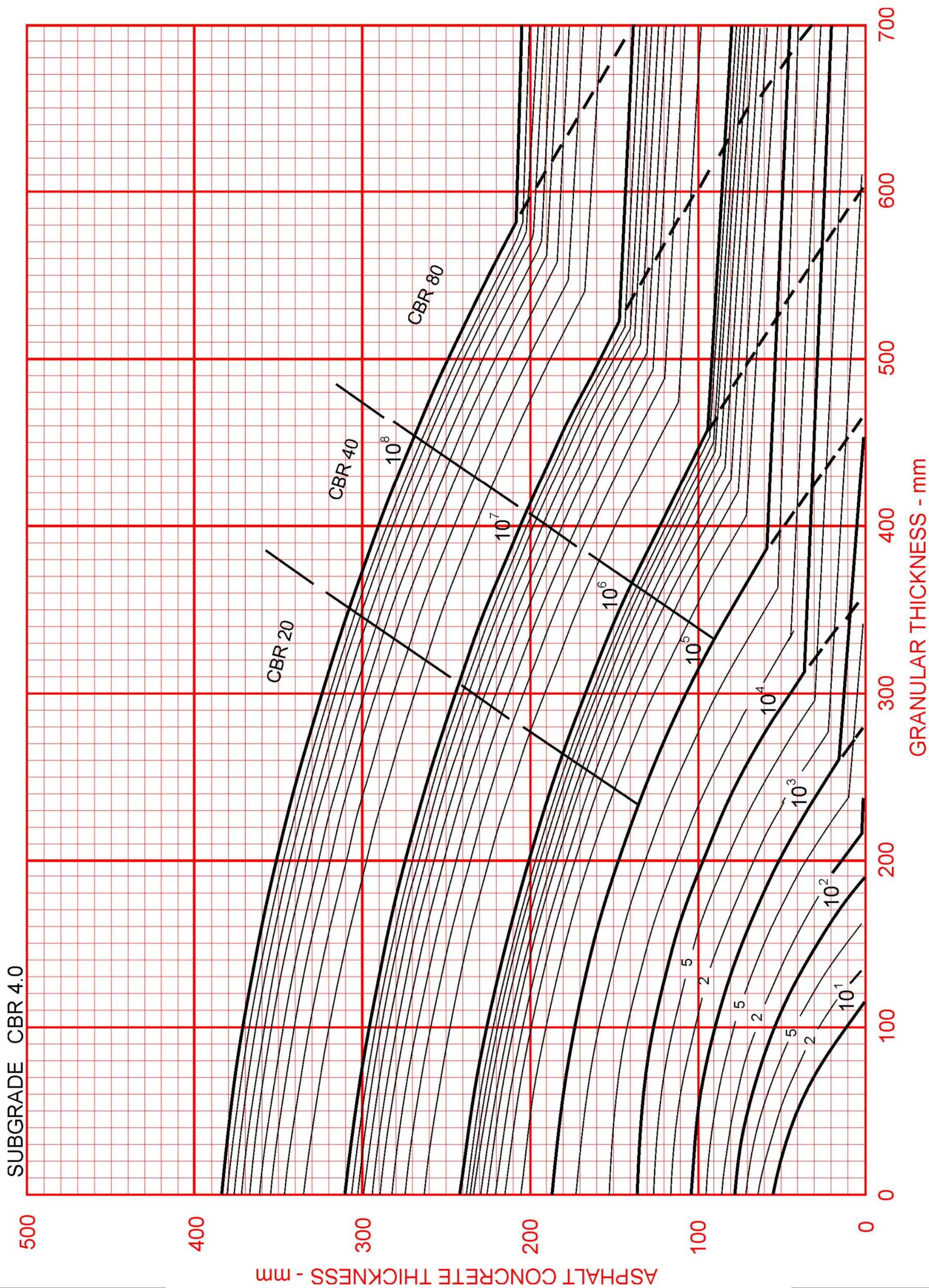
Based on the above assumption, the following truck traffic volume is assumed to use the roadway over the design life:

TABLE A2 Cumulative Truck Traffic

Year	Growth Rate (per year)	AADT	AADT - Design Lane[2]	Percent Commercial Traffic	Total Trucks - Design Lane (per day)[3]	Total Trucks - Design Lane (per year)[4]	Cumulative Truck Traffic
0	5%	513.0	256.5	4%	10.3	3,744.9	3,744.9
1	5%	538.7	269.3	4%	10.8	3,932.1	7,677.0
2	5%	565.6	282.8	4%	11.3	4,128.8	11,805.8
3	5%	593.9	296.9	4%	11.9	4,335.2	16,141.0
4	5%	623.6	311.8	4%	12.5	4,551.9	20,692.9
5	5%	654.7	327.4	4%	13.1	4,779.5	25,472.5
6	5%	687.5	343.7	4%	13.7	5,018.5	30,491.0
7	5%	721.8	360.9	4%	14.4	5,269.5	35,760.5
8	5%	757.9	379.0	4%	15.2	5,532.9	41,293.4
9	5%	795.8	397.9	4%	15.9	5,809.6	47,102.9
10	5%	835.6	417.8	4%	16.7	6,100.0	53,203.0
11	5%	877.4	438.7	4%	17.5	6,405.0	59,608.0
12	5%	921.3	460.6	4%	18.4	6,725.3	66,333.3
13	5%	967.3	483.7	4%	19.3	7,061.6	73,394.9
14	5%	1,015.7	507.9	4%	20.3	7,414.6	80,809.6
15	5%	1,066.5	533.2	4%	21.3	7,785.4	88,594.9
16	5%	1,119.8	559.9	4%	22.4	8,174.6	96,769.6
17	5%	1,175.8	587.9	4%	23.5	8,583.4	105,353.0
18	5%	1,234.6	617.3	4%	24.7	9,012.5	114,365.5
19	5%	1,296.3	648.2	4%	25.9	9,463.2	123,828.7
20	5%	1,361.1	680.6	4%	27.2	9,936.3	133,765.0

Where:

[1] AADT = AADT(20XX) x (1+Growth Rate)
[2] AADT-Design Lane = AADT x Directional Split x Load Distribution Factor (Truck)
[3] Total Trucks - Design Lane (per day) = AADT - Design Lane x Percent Commercial Traffic
[4] Total Trucks - Design Lane (per year) = Total Trucks - Design Lane x 365


SUBGRADE CBR 4.0
CBR 80
CBR 40
CBR 20
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10^1
5
2
GRANULAR THICKNESS - mm
0
100
200
300
400
500
600
700
ASPHALT CONCRETE THICKNESS - mm
500
400
300
200
100
0


SUBGRADE CBR 5.0
CBR 20
CBR 40
CBR 80
10^8
10^7
10^6
10^5
10^4
10^3
10^2
5
2
GRANULAR THICKNESS - mm
ASPHALT CONCRETE THICKNESS - mm
0
100
200
300
400
500
600
700

Load Equivalency Factor, LEF

TABLE A3 Weight ESALs, Commercial

Vehicle Type	Assumed Percent Vehicle Type	Corresponding ESALs per Unit (primary weights) - Based on DDSM
Single unit Trucks	90.0	3
Tractor Semi-Trailer Cominations	10.0	6.3
	Weighted ESALs =	3.33

Bus Traffic

It was assumed that there will be 2 bus passes per day per week day during the school year. It is estimated that there is approximately 40 weeks in the school year. Each bus trip will have 2 passes. As such, the following number of buses are assumed over the design life:

6000 buses/design life (1 bus trip per day x 2 passes per trip x 5 days/school week x 40 school weeks/year x 15 years)

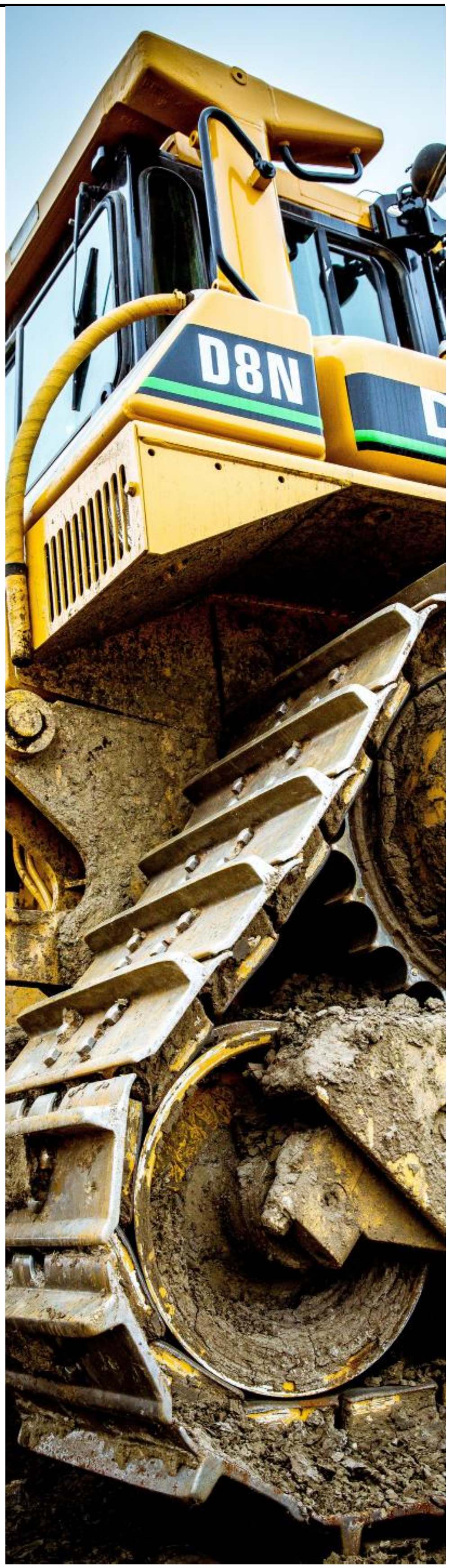
Design ESALS/lane

Commercial =	295,021	(Weighted ESALs x 15 Year Cumulative Truck Traffic from Table A2)
Buses =	30,000	(Bus ESAL from Table AI x buses/design life)
Design ESALs/Lane =	**325,021**	

Appendix I: Cost of Servicing Summary Estimate

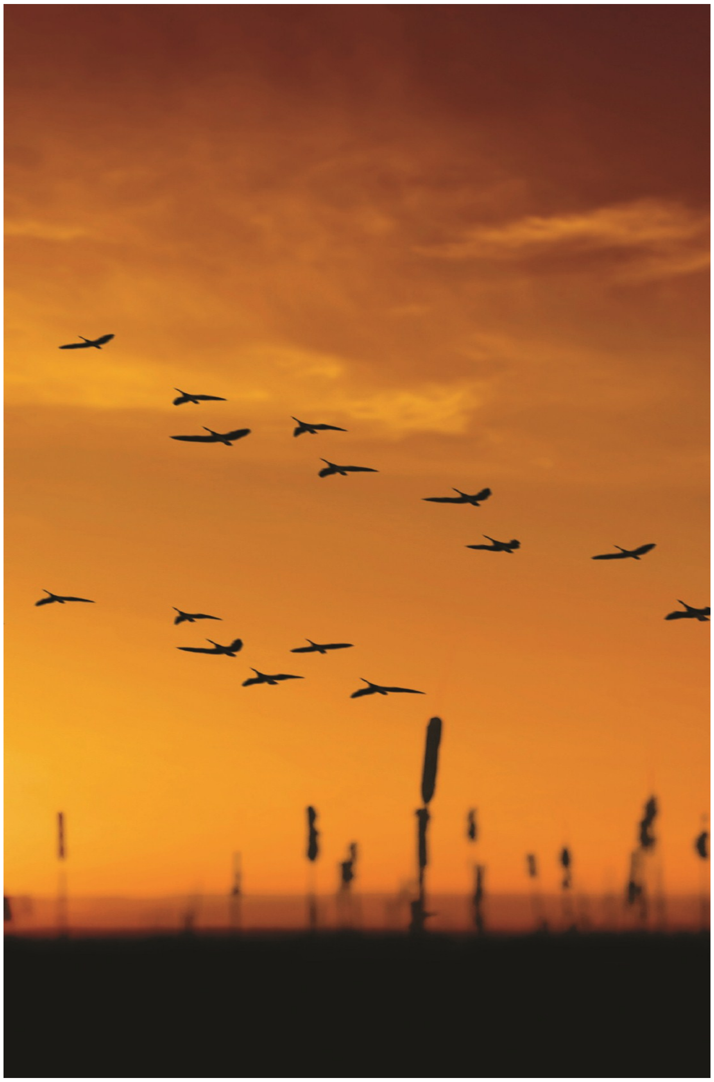
SERVICING SUMMARY

SITE GRADING AND DRAINAGE WORKS	**$ 1,500,000**
ROADWAYS AND RELATED WORKS	**$ 4,500,000**
WATER DISTRIBUTION	**$ 1,400,000**
SHALLOW UTILITIES	**$ 450,000**
OTHER AMENITIES	**$ 950,000**
ENGINEERING & CONTIGENCY	**$ 1,400,000**
TOTAL ESTIMATED COST OF SERVICING	**$ 10,200,000**



Appendix J: Record of Consultation

Eagle Heights Country Estates



Applicant:	101120614 Saskatchewan Ltd., c/o Chris Cebryk
Address:	103 Baldwin Crescent Saskatoon, SK S7H 3M5
Phone:	(306) 717-7457
Email:	ccebryk@shaw.ca
Planning Consultant:	Associated Engineering Ltd. 1-2225 Northridge Drive Saskatoon, SK Project Manager: Bill Delainey RPP, MCIP
Legal Land Location:	SW of Section 11-37-4-W3 and NW of Section 11-37-4-W3
Proposed Number of Lots	95 (in three phases)
Average Lot Size	1.0 hectares (2.47 acres)
Proposed Lot Density:	0.32 units/acre

Development Summary

101120614 Saskatchewan Limited is applying to rezone and subdivide land located in the W½ of Section 11-37-4-W3M within the RM of Corman Park No. 344 for the purpose of developing a 95-lot country residential development. The proposed development comprises 129.5 hectares (320 acres) of land and is known as Eagle Heights Country Estates. The proposed development is located approximately 1.5 km northeast of the City of Saskatoon along Highway 41 directly east of Eagle Ridge Estates. The development site is strategically situated in the Strawberry Hills to take full advantage of the vista views provided from the land to the west and the varied topography combined with the natural vegetation contained on the property lends itself to the accommodation of a variety of housing styles and residential options. The development is intended to exclusively host single detached dwellings on various sized properties maintaining a minimum average of 1 hectare (2.47 acres) within the three planned phases of development. The proposed residential subdivision has been specifically designed to positively integrate with and complement Eagle Ridge Estates which is located directly west of the development site.

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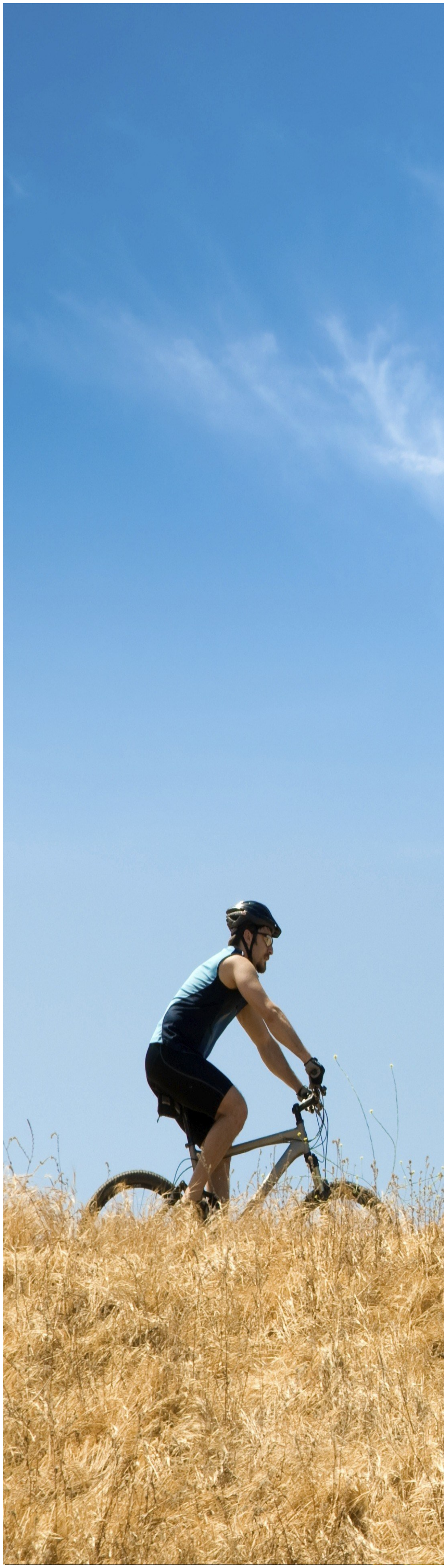

Local Topography and Existing Features

The development site is located at the plateau of the Strawberry Hills and the local topography of the area ranges from near level in the southeast corner to gently sloping across the site to the north, as shown on the attached Site Plan. The site consists primarily of farmland with significant uncultivated natural vegetation and bluffs located along the eastern portion of the site.

The development site contains four natural ponding areas with the natural drainage of the property generally flowing west through Eagle Ridge Estates and north across Fleury Road. An engineered conceptual drainage plan has been prepared by Associated Engineering for the site, confirming the ability to manage a 1:100 year storm event by utilizing and enhancing the site's natural drainage systems. It is anticipated that a certain amount of additional land surrounding these ponding areas will be set aside as public land to further insulate the development from increasingly frequent storm events and to enable public access to these areas as a four season recreational amenity.

In addition to utilizing the existing topography to naturally manage any incremental increase in runoff due to the development of the lands, the proposed design promotes the retention of significant natural vegetation along the eastern boundary of the site through the implementation of larger sites within these areas of the development. By incorporating larger sites in these areas, the likelihood of a property owner clearing significant tracts of vegetation in advance of housing construction on the lot is significantly decreased. Alternatively, this expands the opportunities provided to home owners to site a dwelling on high, dry land while maximizing the retention of the natural forested areas. The gentle slopes will enable the construction of a wide variety of housing types including walk-outs to taking full advantage of the natural vistas to the west.

The public lands surrounding the natural ponding areas and dedicated internal trail system designed to follow the internal roadways and access the ponding areas provides recreational opportunities for local residents to utilize these areas for pedestrian and bicycle trails and other seasonal recreational uses. Utilizing the existing topography and natural conditions of the land for these recreational uses will help to keep the development unique through the creation of natural linkages within the development.

A preliminary geotechnical investigation has been completed for the site by SNC Lavelin confirming its suitability for the proposed development. The investigation concluded that the site offers no issues with slope stability, high ground water tables or propensity for flooding making the site ideal for the proposed development.

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Land Use Integration

Eagle Heights Country Estates is located approximately 5.5 kilometres northeast of Saskatoon and east of Highway No. 41. The Strawberry Hills has historically been an area in high demand for this form of development with several significant existing residential communities located within the vicinity of the subject site including Eagle Ridge Country and Discovery Ridge Estates in Corman Park along with Mission Ridge and Strawberry Hills Estates which are located north and east of the subject property in the RM of Aberdeen.

The location is ideal for hosting country residential development due to its close proximity to the City of Saskatoon and its associated amenities via Highway No. 41. The height of land not only promotes positive site drainage but it also offers great views of the surrounding rural countryside. Residents will be able to enjoy the rural lifestyle of Corman Park while still being in close proximity to the City and its amenities.

The development site is fully accessible along an existing chip sealed municipal roadway currently accessing Eagle Ridge Country Estates, which is adjacent to the development. Clustering country residential developments along an existing improved roadway in the direct vicinity of a provincial highway provides immediate amenity to future residents, enables a focused municipal investment in the area and expands the source of funding for maintaining improved municipal roadways.

The proposed development concept acknowledges and seeks to positively integrate with the existing natural and built conditions in the area while successfully offering a diverse range of lot sizes and housing opportunities to satisfy a broad demand for country residency. For example, the concept design employs complementary lot sizes in the direct vicinity of Eagle Ridge Estates transitioning to smaller acreages within more interior locations as a means of positively integrating the new development with existing residential development.

The following existing land uses are located within 1.6 kilometres of the development site and are illustrated on the attached Location Plan:

Land Use	Distance from Development Site	
Intensive Livestock Operation	None	
Single Residences or Farmsteads	North	SW 14-37-4-W3 (160 m) SE 15-37-4-W3 (201 m) SW 13-37-4-W3 (900 m)
	East	None
	South	SW 2-37-4-W3 (1270 m)
	West	NE 10-37-4-W3 (345 m) SW 10-37-4-W3 (1550 m)
Existing Multi-parcel Country Residential Development	Eagle Ridge Country Estates (50 m)	
Landfill or Waste Disposal Site	None	
Urban Municipality	None	
Airport	None	
Lagoon	None	
Existing Commercial or Industrial Development	None	
Mineral Extraction Operations	None	

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The Canada Land Inventory Soil Capability rating for the development site is Class 3, which is considered to have moderately severe limitations that restrict the range of crops or require special conservation practices. Generally, Class 3 agricultural lands in Saskatchewan are considered moderate agricultural land. The natural depressions and significant swaths of natural vegetation along the eastern boundary of the development site have limited the agricultural productivity of the site and make the site better suited to country residential usage. The development of the site is not expected to impact the continued but limited agricultural production in the area. Agricultural activity in the areas surrounding the development site are limited to some cultivated farmland, scrub areas and pasture lands. There are no intensive livestock operations in the vicinity and the main property access road is not currently used to transport agricultural products or machinery.

Development Phasing and Servicing

Development of Eagle Heights Country Estates will occur in three equal phases as summarized below and illustrated on the attached Concept Plan:

Phase	Number of Lots
1	35
2	32
3	28
TOTAL	95

The internal roads within the development will be constructed to an RM standard within a 30 metre right of way and are intended to be chip sealed to match the existing municipal access road and to minimize traffic disturbance on existing and future residents of the area.

SaskEnergy, SaskPower, and SaskTel will provide shallow utilities for the development, which currently service adjacent developments, and there are no foreseen issues in accommodating the development. A low-pressure rural water utility line is proposed to service the development and would be supplied by the Highway 41 Water Corporation. A water service line and connection will be provided to the property line and each individual owner will be responsible to manage their own services with the water utility.

Wastewater and sewage disposal will be the responsibility of each lot owner. Solid waste generated by landowners will be hauled off-site and individual lot owners will be required to contract for this service. There are companies in the Saskatoon area that provide solid waste removal for a fee.

The proposed site has knob and kettle topography and there are four natural low areas which will contain any runoff water from the development. The site drainage is intended to be conveyed overland via ditches adjacent to roads, culverts at driveways and intersections, and grassed drainage swales. The drainage pattern moves in two directions, with the southeast corner flowing west and merging with the natural drainage in Eagle Ridge Country Estates. The remainder of the development flows through the ponding areas following a north easterly direction to a larger collection area along the north road allowance in an existing slough. An engineered storm water management plan has been prepared for the development confirming the management of surficial water discharges within the property and will be submitted within the final Comprehensive Development Review Report.

Developer Experience

Eagle Heights Country Estates is being developed by a family who has owned the land for over 75 years. The development group includes:

◊ A local real estate agent who specializes in residential real estate in the Saskatoon area and has a degree in economics. He brings a keen awareness of market trends relating to residential development in the Saskatoon area and has substantial development knowledge obtained through his experience as a licensed realtor.

◊ A senior economist with over 25 years of experience in economic research and market analysis in both the private and public sectors.

◊ An active investor in the residential real estate market with over 50 years experience buying, selling, developing, and marketing numerous residential and commercial properties.

This knowledge is supplemented by the experienced professional planners and engineers of Associated Engineering who bring a wealth of experience and professional expertise to the project as well as a strong understanding of the policies and procedures associated with this form of development within the RM of Corman Park. The developers have spent the last year planning this development in collaboration with Associated Engineering to ensure they have met the criteria required to move forward with such a development. They have proceeded with conceptual engineering to confirm the site services and have completed a preliminary geotechnical investigation to confirm the suitability of the site for the proposed development.

Bylaw Compliance

The proposed development site is currently zoned Agricultural District (AG) pursuant to the RM of Corman Park Zoning Bylaw. An amendment to the Zoning Map to rezone the development site to a Country Residential 1 District (CR1) will be required to accommodate the proposed subdivision. It is anticipated that a holding provision would be applied to phases 2 and 3 of the subdivision to reflect the development staging. The phased development brings the overall development area into compliance with the RM of Corman Park Official Community Plan and individual site areas comply with the minimum and average size requirement defined within the bylaws for the CR1 zone.

Associated Engineering GLOBAL PERSPECTIVE. LOCAL FOCUS.

RM of Corman Park Evaluation Criteria

Proximity to amenities		
<3 km to school	1	The development is located in the Prairie Spirit School Division (PSSD), however the nearest schools will be the future Willowgrove Schools (Approximately 13 km, Estimated Date of Completion 2014). The closest schools in the PSSD are approximately 25 km away in the Town of Aberdeen or Village of Clavet.
Along school bus route	1	The development is served by the PSSD along an existing bus route.
<3 km to community hall	1	The Bergheim School is located approximately 3.8 km northeast from the development.
<3 km to park/beach	1	There is park space intended to be provided within the development along the periphery of the storm water retention facilities.
<3km to convenience shopping	1	There is an existing convenience store/gas bar located at the junction of Highway Nos. 5 and 41, which is just over 3.5 km from the development site.
Access to existing waterline	1	Highway 41 Water Utility has confirmed that they will provide potable water to the development site.

Road implications		
<3 km to paved roadway	3	The development is adjacent to an existing chip sealed road which was constructed to provide dust-free access to Eagle Ridge Estates which leads to an existing intersection at Highway No. 41. The Ministry of Highways and Infrastructure has been contacted regarding the existing access point and has indicated that it can continue to be used at this location for Eagle Heights Country Estates. It is expected that a Traffic Impact Study will be prepared to confirm the suitability of the alignments and traffic management systems at this location.
Adjacent to primary grid	2	The development is adjacent to two primary grids running both north south and east west. The north-south road allowance is an upgraded all weather roadway.
Off-site upgrading beneficial	2	The development proposes to upgrade a small section of Fleury Road adjacent to the northern boundary of the development site.
Minimize provision of internal roads	2	The area proposed for roadways represents 8.7% of the total development area.

Use of natural resources (i.e. conservation)		
Wetlands/natural drainage retained	2	Eagle Heights Country Estates has been designed to utilize the natural topography to facilitate overland drainage to existing ponding areas contained through the development.
Stormwater management / drainage concept	3	An engineered stormwater management plan has been prepared for the development and will be submitted within the final Comprehensive Development Review. Stormwater is intended to be managed overland via drainage channels and swales, internal roadways and culverts.
Natural vegetation and topography retained	2	The design of the development takes advantage of the natural vegetation contained within the development and the topography of the area to manage drainage and provide building sites with excellent vistas. The lot sizes along the eastern portion of the development are larger to allow minimal disturbance of the natural vegetation during site preparations.

Wildlife habitat links retained	2	As the natural topography and vegetation is intended to be as minimally disturbed as possible, the impact on the current wildlife habitat links will be minimal.
Habitat conservation/ enhancement	2	The Conservation Data Centre online database indicates that there are no at risk wildlife or vegetation located on the development site.
Not located on hazard lands (flood prone, slope instability)	3	The preliminary geotechnical report prepared for the development confirms that the site is not flood prone or susceptible to slope instabilities and is suitable for the type of development proposed. A copy of the geotechnical will be submitted with the final Comprehensive Development Review.

Community concept		
Demographics provided	2	The development is intended to be marketed for single detached dwellings to those people who want to live the country lifestyle but remain very close to the amenities of a larger urban centre. Based upon available census data, it is expected that development of all three phases will result in an estimated increase in local population 285 people.
Pedestrian/bicycle trails planned	2	A dedicated pathway is planned to be incorporated within the 30-metre right-of-ways within the development providing for a separation of vehicular and non vehicular movements within the subdivision and to enable a circulation of a variety of forms of traffic within the subdivision. Additionally, the walking trails will also extend into the areas identified as storm water management ponds.
Purposeful public open/park space amenity	2	The ponding areas feature undeveloped park space around them, which will be available to the public for recreational use throughout all four seasons with minimal maintenance required.
Provision of public facility (school, art/cultural/community centre)	2	N/A

Neighbourhood fit		
Shows integration/buffering with adjacent areas	2	Recognizing the impacts of introducing additional development into an area already hosting this form of development, the subdivision has been intentionally designed to positively integrate with Eagle Ridge Estates by providing properties of a similar acreage along the interface of the two developments and gradually transitioning to smaller site areas within the internal lots.
Unlikely conflict with agriculture	2	The surrounding land uses include existing country residential development, some cultivated farmland , scrub areas and some pasture lands. Further country residential development in this location is not likely to negatively impact the limited agricultural production in this area. No intensive livestock operations are located in the vicinity of this development.
Located on non-prime agricultural land (class 4-7)	2	The development is located on Class 3 agricultural lands, which according to the Canadian Land Inventory, have moderately severe limitations for agricultural development. These lands are a prime candidate for conversion to country residential use, as it will cluster similar land uses in one area making conflicts with other land uses even more unlikely and allowing for greater assistance with municipal servicing.
Adds social/cultural diversity	1	The wide range of lot sizes promotes diversity as they will appeal to different segments of the market.

Supports local businesses	2	Increased population in the area means there are more people who will support local businesses, including people who provide services directly to the development (such as sewage hauling).
Assist municipal servicing	2	Development clustering provides an increasingly focused tax base in the area to assist with the costs of municipal servicing. In addition, new services required to support the development will be provided through the further private investment of the developer.

Design features		
Significant landscaping/buffering considerations	2	The subdivision design accommodates smaller lots within the central area of the development transitioning to larger sites along the outer peripheral areas of the development to enable the retention of large tracts of existing vegetation and to encourage positive integration with adjacent country residential development in Eagle Ridge Estates. The development does not utilize , nor is it deemed to be necessary to utilize any additional formal landscaping to buffer the development from adjacent lands. The property's higher elevation along the ridge also eliminates any degradation of the view to the west within the existing Eagle Ridge Estates.
Deliberate building siting considerations (location & orientation)	2	The topography of the area and natural drainage patterns influenced the location and orientation of the lots. The size of the individual lots allows the lot owners flexibility in determining the optimal placement of the building on the parcel.
Energy conservation	2	The intention of the development is to retain as much natural vegetation as possible, which provide shelter to the homes within the development.
Incorporates solid waste management (reduction, recycling)	3	This will be left up to individual lot purchasers to manage their own waste. There are options for recycling within the City of Saskatoon, which allow residents to manage their own recycling.
Uses new/innovative technology in liquid waste management	3	The development is planned to utilize private onsite waste disposal systems designed and constructed to meet the requirements of the Saskatoon District Health Region. The installation and management of these systems will be left up to individual lot owners.
Inclusion of public art	1	N/A
Building and site design guidelines	2	The location and orientation of the lots are developed to utilize the topography of the development and the lots comply with the minimum standards set out in the RM zoning bylaw.
Uniqueness		
New subdivision design	3	The subdivision features an organic curvilinear design, which honours the natural topography and drainage of the site.
New housing or land use mix	2	The wide range of lot sizes will help to provide a mix of housing options within the development
Social equity (non-market housing, special needs, etc)	2	There are grants available to encourage individual lot owners to provide socially equitable housing options, such as secondary suites, subject to conformance with the RM zoning bylaw.
New public amenity and/or facility	1	There will be public lands provided around the ponding areas, which provide a recreational amenity to the area that were not previously available.

<table>
<tr><th colspan="3">Developer’s qualifications</th></tr>
<tr><td>Experienced in residential development</td><td>3</td><td>The development group includes three individuals comprising of a residential real estate agent, economist, and residential land developer. Planning and engineering services are supplied by Associated Engineering.</td></tr>
<tr><td>Has significant related experience</td><td>3</td><td rowspan="2">The development group consists of:
◊ A local real estate agent who specializes in residential real estate in the Saskatoon area and has a degree in economics. He brings a keen awareness of market trends relating to residential development in the Saskatoon area and has substantial development knowledge obtained through his experience as a licensed realtor.
◊ A senior economist with over 25 years of experience in economic research and market analysis in both the private and public sectors.
◊ An active investor in the residential real estate market with over 50 years of experience buying, selling, developing, and marketing numerous residential and commercial properties.
The development group is supported by Associated Engineering, which is a firm which has over 60 years of experience providing professional engineering and planning services throughout Saskatchewan and Canada.</td></tr>
<tr><td>Shows clear development knowledge</td><td>3</td></tr>
</table>

Market analysis		
Analysis of current information	2	The Strawberry Hills has historically been an area in high demand for this form of development with several significant existing residential communities located within vicinity of the subject site including Eagle Ridge Country Estates, Discovery Ridge, Mission Ridge Estates and Strawberry Hills Estates. Market analysis has been undertaken by the developers for this project and this analysis has been ongoing since 2007. With economic projections for the city of Saskatoon and the province continuing to be favorable for development and point to steady population growth and gains in personal income, the developers began the initial steps towards developing Eagle Heights Country Estates. With 25 years of experience in economic research and market analysis, a partner in the development corporation, worked as a leading economic researcher and consultant where they undertook many large-scale projects that included detailed demographic analysis, industrial analysis and studies on the benefits and costs of large major construction projects across the country. Many of these projects included a detailed analysis of the impact on the municipalities in which they were located.
Experienced in residential marketing	2	The development group includes a licensed Realtor specializing in residential real estate, who holds a degree in economics and is skilled in providing research, analysis and marketing for residential developments.
Target/known market demographics	2	The development group studied the market demographics to determine which demographic group to target through the sale of the lots within the development. The development will target residents who wish to enjoy the rural lifestyle of Corman Park while still being in close proximity to the City and its amenities.
Phasing strategy	2	The development is intended to be completed in 3 phases

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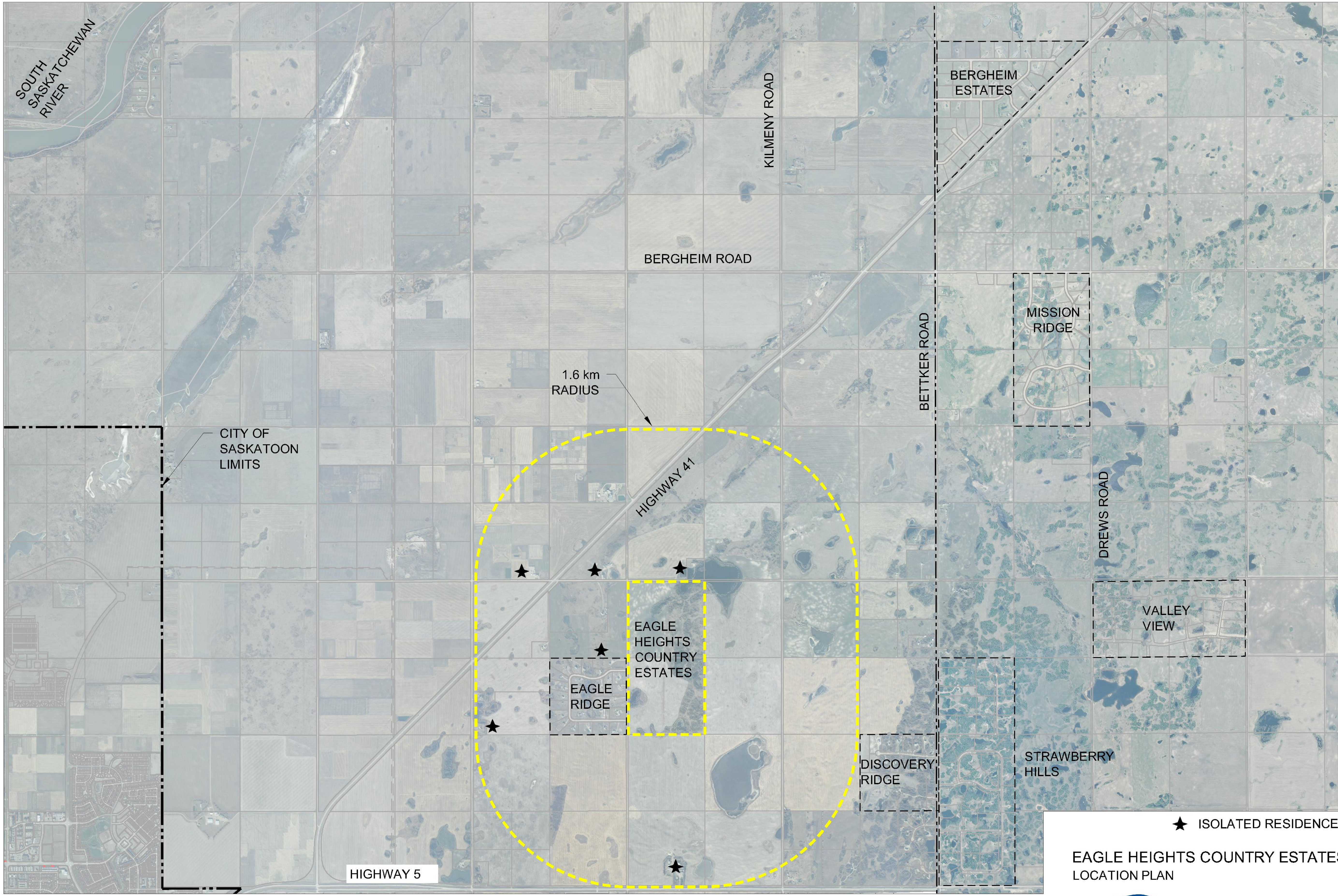
Contribution to area		
New business and employment onsite	1	There is a possibility that home owners may want to pursue a home based business as allowed for under the RM of Corman Park bylaws. The development does not anticipate the generation of any commercial activity within site. The incremental increase in local populations will help to support existing convenience commercial developments within the City and surrounding areas including within Sunset Estates to the southeast.
New public amenities or services	2	There will be public lands provided around the ponding areas, which provide a recreational amenity to the area that were not previously available. The formalized trials within the development will also provide amenity to residents within Eagle Ridge Estates.
Integrated lifestyle diversity	1	Eagle Heights Country Estates provides an excellent opportunity for people to live in a community and experience the rural country lifestyle and expanded recreational opportunities that are associated with the country life while enjoying easy access to urban amenities and services.
Clear environmental benefits	3	The development seeks to retain the natural vegetation and ponding areas, which have environmental benefits relating to carbon sinks and footprint, air quality, and wildlife habitat areas.
OCP/Zoning Bylaw		
Meets current Zoning Districts policies (density, lot size, etc)	3	The development has been designed to comply to all requirements of the Country Residential 1 District.



★ ISOLATED RESIDENCE

EAGLE HEIGHTS COUNTRY ESTATES
LOCATION PLAN

Associated Engineering
GLOBAL PERSPECTIVE. LOCAL FOCUS.

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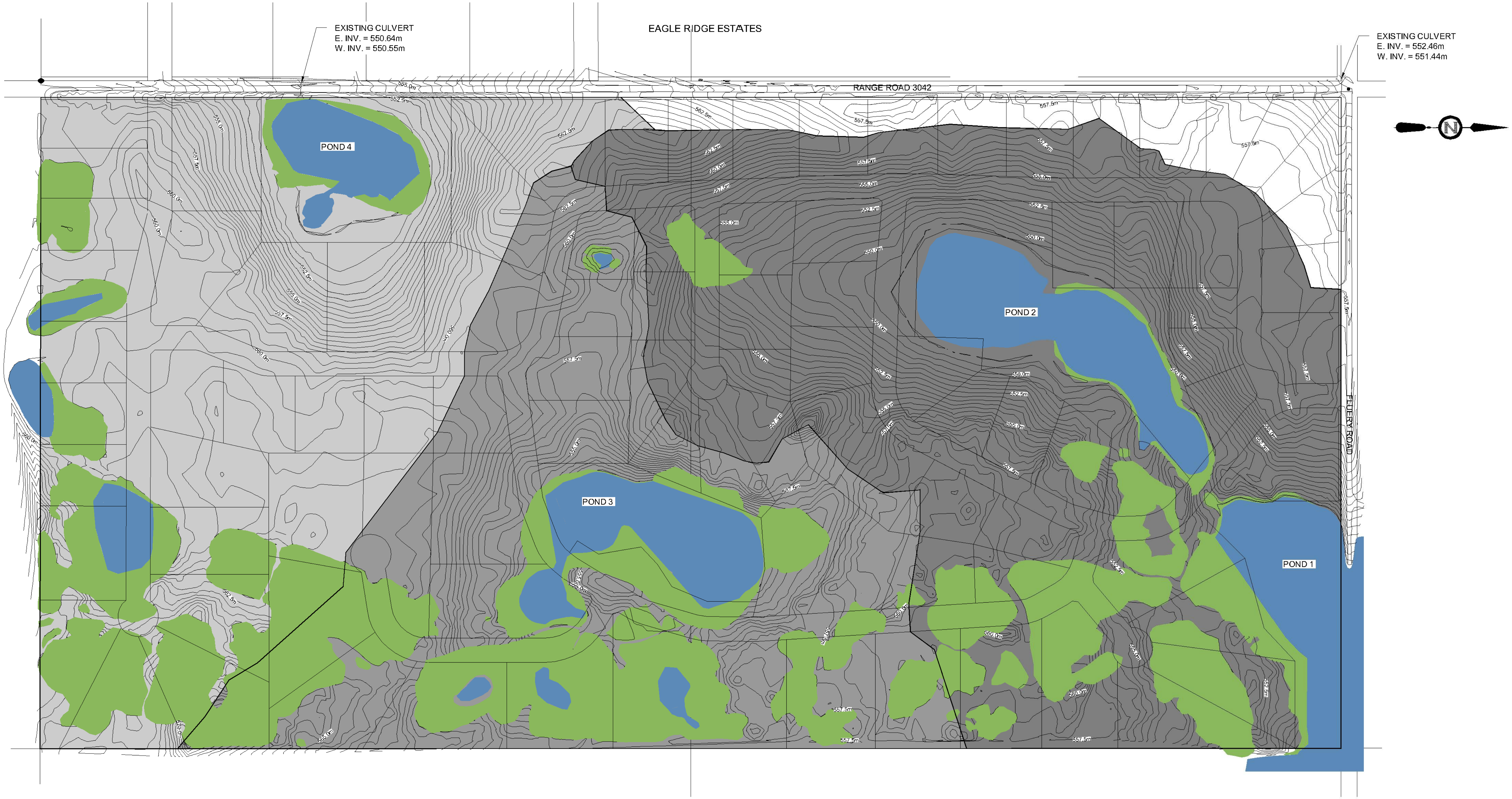

LEGEND:

EXISTING PONDINIG AREAS

EXISTING TREE AREAS

NOTE:
ALL SOIL IS CLAS S 3

EAGLE HEIGHTS COUNTRY ESTATES

SITE PLAN

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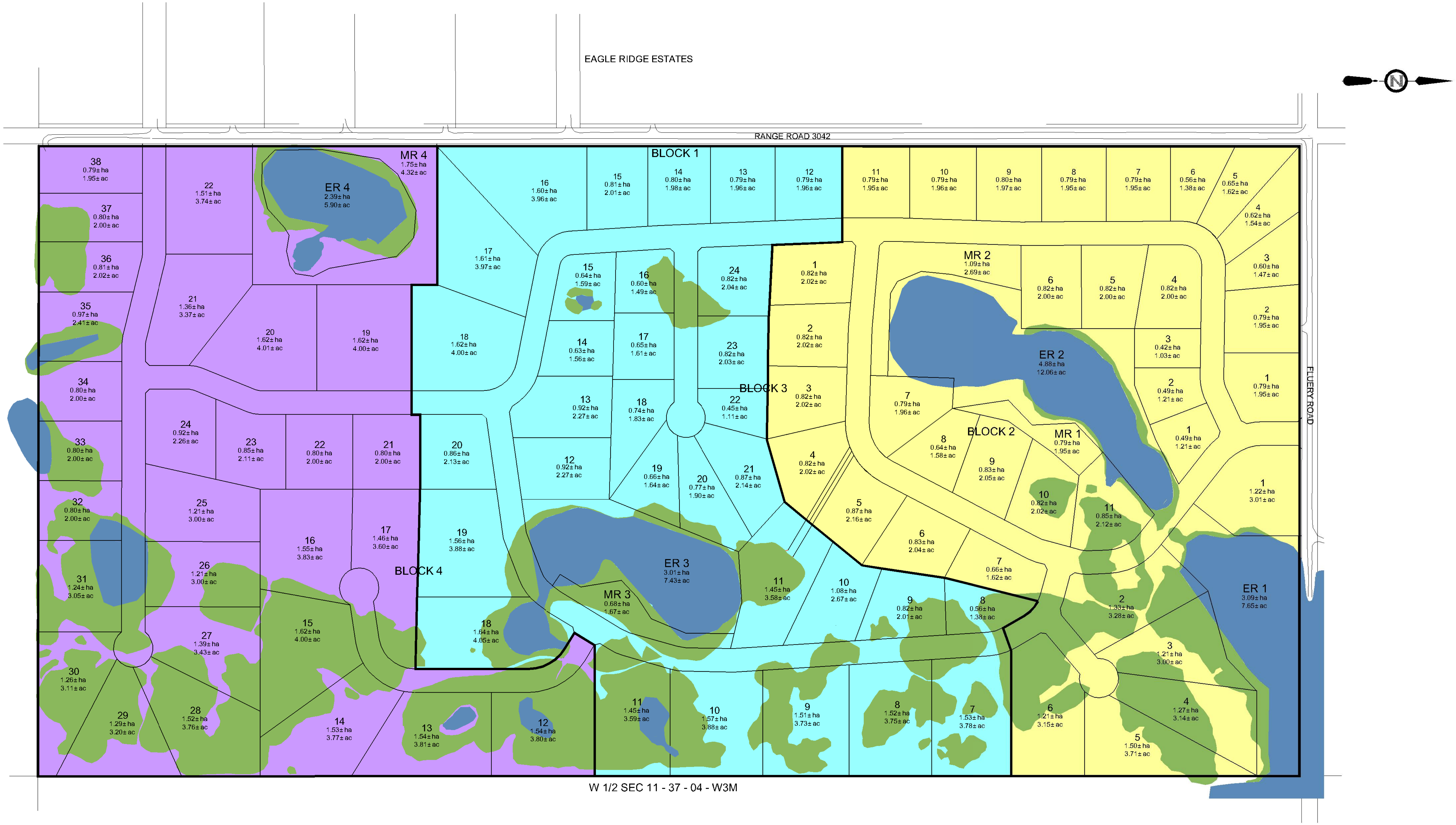

LEGEND:

PHASE 1

PHASE 2

PHASE 3

EXISTING PONDING AREAS

EXISTING TREE AREAS

EAGLE HEIGHTS COUNTRY ESTATES

CONCEPT PLAN

Associated Engineering
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Eagle Heights Country Estates

Development Summary

Eagle Heights Country Estates is a proposed 95 lot multi-parcel development located in the Rural Municipality of Corman Park No. 344 within the W 1/2 11-37-4-W3M near Highway 41.

The proposed development comprises 129.5 ha (320 acres) of land and is proposed to be subdivided and developed in three phases:

- Phase 1 includes 35 lots
- Phase 2 includes 32 lots
- Phase 3 includes 28 lots

The developer is seeking approval for the rezoning of the entire development area and the subdivision of Phase 1 as part of the current application.

Consultation Methods

A mail out containing a project newsletter was provided to the landowners within 1.6 km of the proposed multi-parcel subdivision. The newsletter introduced the development as well as provided information on the proposed property services, the planned amenities and introduced a proposed concept design. The newsletter included contact information for Associated Engineering as well as a reference to the project website which provides additional information on the development. The website, PlaceSpeak, is an interactive site where landowners are able to acquire additional information and provide their comments as well as post questions. The project website provides a link to local stakeholders interested in monitoring the progress of the development enabling continuous interactions.

Record of Consultation

Responses to the mailing comprised a single phone call accompanied by a follow-up email, a single post on the project website as well as a number of emails. A summary of the written comments received are provided verbatim below:

	COMMENTS RECEIVED	DEVELOPER RESPONSE
	One of the first statements in this proposal contravenes Corman Park Bylaws: "The maximum size for the development area for an individual multi-parcel country residential development shall be 64.8 (160 acres)." The proposed development is 320 acres.	The proposed development is planned to be subdivided and developed in 3 phases across the 320 acre development area, requiring 3 separate municipal approvals. This application is for phase 1 only, encompassing approximately 110 acres of land.

	COMMENTS RECEIVED	DEVELOPER RESPONSE
Lot Sizing ,Layouts & Density	• *Also, the average of lots in Phase 1 is 2.059 acres per lot which does not meet the 2.47 acres criteria for a subdivision at the 160 acre size.* • *The proposal states that the concept seeks to positively integrate with existing natural and built conditions. This is obviously incorrect and the proposal overplays the concept of lot size variation. Lot sizes are significantly below those of Eagle Ridge and houses would be able to be built closer to Range Road 3042 as they would back onto it rather than face it, which would completely destroy the atmosphere of Eagle Ridge.*	The concept design was intentional and strategic. The lot layout within the development was designed to locate larger lots in the areas adjacent to Eagle Ridge and in areas where the developer is seeking to retain the natural vegetation of the area. The majority of the smaller lots are located in phase 1, on previously cultivated land outside of the area adjacent to and impacting neighboring properties in Eagle Ridge. The average site area within phase 1 is slightly below the 2.47 minimum, but the overall average site area for the entire development site is 2.49 acres, exceeding the 2.47 acre minimum. All, but one of the lots, backing onto Range Road 3042 are north of Eagle Ridge. The municipal road is included in a 20m road right-of-way, which provides separation along with a municipal buffer along Range Road 3042, located within the proposed development. It is anticipated lot owners will want to insulate themselves from the municipal road and set their houses away from the road.
	An estimated population increase of 295 for 95 new homes we feel is an underestimate. The development would make a huge change to the population density of the area making it more of a suburb rather than a country residential area. We would expect the same minimum requirements for construction as those in the Eagle Ridge bylaws e.g. minimum house size, limitation of out buildings etc. We have concerns over discussion of "suites".	The population calculation was based on published Statistics Canada data for the RM of Corman Park. An average of 3 people per private household, was used to calculate the population estimate of 285. There are numerous other existing development areas in the RM which have seen the successful integration of new country residential development within existing developed areas. The regulation of construction will be managed through the RM's building bylaw and land use will be regulated through the RM's zoning bylaw.
	Traffic - Increased traffic will decrease safety for pedestrians, children and pets in the neighbourhood.	There are dedicated pedestrian walkways and bicycle paths planned within Eagle Heights that will be available to the surrounding residents to facilitate active leisure, potentially eliminating reliance on local roadways to accommodate pedestrian and bicycle traffic.

	COMMENTS RECEIVED	DEVELOPER RESPONSE
Roadways and Traffic	• *There have already been several accidents at the intersection of Fleury Road and Highway 41. Highway 41 is becoming increasingly busy, we have a poor angle for turning onto the highway and there is no right turn lane to exit the highway into the area. All of these will increase the risk of accidents.* • *There will be a higher risk of accidents in the area as well with the expected increase in traffic - with no public transit; we would expect a minimum of 2 cars per new home.*	A Traffic Impact Assessment will be required at the request of the Ministry of Highways and Infrastructure which will address the safety concerns and define any functional improvements required at the intersection of Highway 41 and Fleury Road. Any improvements made will improve the existing situation. The developer will work with the RM to complete an assessment of the physical and functional capacity of the local municipal roadways in order to define whether improvements will be necessary.
	There is some discussion of expanding Range Rd. 3042 to meet highway 5. If this were to occur, this road would become very heavily used as it would be a short cut from Highway 5 to Highway 41.	The developer has no plans to extend a new municipal roadway south to Highway 5 as a means of facilitating this development.
	The traffic affects not only our area but the entire east side of Saskatoon. It is already a bottle neck getting into Saskatoon as the only reasonable approach from the east is Highway 5/College Drive.	This is a concern that may be addressed by the RM, the City and Ministry of Highways.
	How will all of these new houses affect snow build up especially on range road 3042, which has been an issue in the past? Last winter there was a 24 hour period where there was no access to the neighbourhood because of snow drifts – what if there was a medical emergency?	This condition exists regardless of the new development proposed. This is a larger maintenance issue to be discussed further with the RM. The additional development in this area will increase the local voice at Council and will expand the tax revenues in the area potentially funding an expansion of the level of service for the area.

	COMMENTS RECEIVED	DEVELOPER RESPONSE
Roadways and Traffic	• *The Construction phase means more trucks, garbage and gravel on the roads which will increase damage to cars such as stone chips and cracked windshield. It will also lead to increased traffic volume and delays on our only access road for an extensive period of time. In fact, an accident involving a construction vehicle could completely block all access to the neighbourhood.* • *The chip sealing and asphalt on the roads of Eagle Ridge were (and are still being) paid for directly by the residents of Eagle Ridge through a significant levy on our taxes. Would the developer reimburse us for the use of the road? The roads will be subjected to increase use both from construction equipment and increased traffic with new homes. There needs to be a guarantee from the developer that the roads will be upgraded and maintained at no extra cost to the residents of Eagle Ridge.*	Upon receiving municipal approval for the subdivision of phase 1, it is expected that a servicing agreement will be executed with the RM prescribing the developer's obligation for roadway improvements and for the ongoing and continued maintenance during the construction phase of the development. There will be no construction traffic on Range Road 3042 for phase 1.
Lot Servicing	*Is there adequate access to police and fire services for that increase in housing density? With the winds in the area, a fire could easily spread from house to house and what capability do fire services have in such an area? There are no fire hydrants in the area.*	Police and Fire Services have both been contacted and have identified no concerns with responding to new development in the area. Building construction will need to comply with the fire codes per the RM's building bylaw and future home owners will be expected to carry an appropriate level of insurance coverage recognizing the rural location.

	COMMENTS RECEIVED	DEVELOPER RESPONSE
	We have had issues over the last number of years with our water pressure and supply. Does the Highway 41 Water Corporation have the capacity to supply water to this new area while still maintaining uninterrupted service to us? We have actually heard there was a moratorium on further water developments in this area.	Highway 41 Water Utility has been contacted and indicated a temporary shortfall with their water capacity based upon a limitations sourced with the SaskWater supply. They have accepted a deposit from the developer and have indicated that they are working with SaskWater to expand the local supply.
	We are concerned with 95 new septic systems in the area and waste water safety - where is all of the effluent from 95 new dwellings and 295+ people expected to be absorbed? We have several wells in the neighbourhood as well as animals including horses - will the water be safe for humans and animals?	Private onsite systems will be constructed and installed to Saskatchewan Health Regulations. The developer undertook a preliminary geotechnical and hydro-geotechnical investigation of the site to confirm the suitability of the site to accommodate private onsite systems.

	COMMENTS RECEIVED	DEVELOPER RESPONSE
Lot Servicing	*The increased runoff due to rooftops, driveways, roadways and landscaped (possibly irrigated) lots as well as increased household water usage, would further aggravate problems with erosion, flooding and high groundwater levels in Eagle Ridge and areas further downstream.* *Several years ago a ditch was constructed to facilitate overflow from the slough beside Range Road 3042, however, the Water Security Agency would not allow the ditch and it had to be filled in. We have had issues in recent years with flooding. We have had damage to our roads because of water levels and are still waiting to hear about our PDAP application to help cover the cost of road repairs. Many people in the area have already had to replace septic mounds because of water issues. Water levels have been very high, particularly in the north west corner of the area, and houses in this area may come at risk of further flooding. How can the developer guarantee this will not get worse?*	A preliminary engineered storm water management plan has been completed and submitted to the RM and the Water Security Agency (WSA) for their comments. The plan will continue to be developed through further consultations with the approving agencies. Provincial subdivision approval will ultimately be contingent upon receipt of WSA approval.
Natural Conditions	*With the diagrams as presented, there is no way this construction can occur without disruption of natural habitat. Is there actually any constraint on individual land owners to not entirely clear their land? How much will be damaged with just the construction phase? We have seen a great horned owl, but have also seen antelope, fox, moose, mule and white tailed deer, coyote, snow geese, Canadian geese, prairie chickens, plover, killdeer, kingfishers and thirteen lined ground squirrel.* *How can these not be affected by the change in habitat?*	The area will be affected by construction the same way Eagle Ridge was affected when it was constructed. As stated earlier, the lot layout was designed to incorporate the natural areas of the site. As well, where natural treed vegetation exists, larger lots have been incorporated, so as to minimize disturbance to these natural areas and encourage retention of vegetation. There is no constraint on a landowner clearing their land however; the developer is open to exploring opportunities for employing formal development standards in vegetated areas. It is unlikely a landowner would clear their lot as people tend to insulate their development through tree planting.

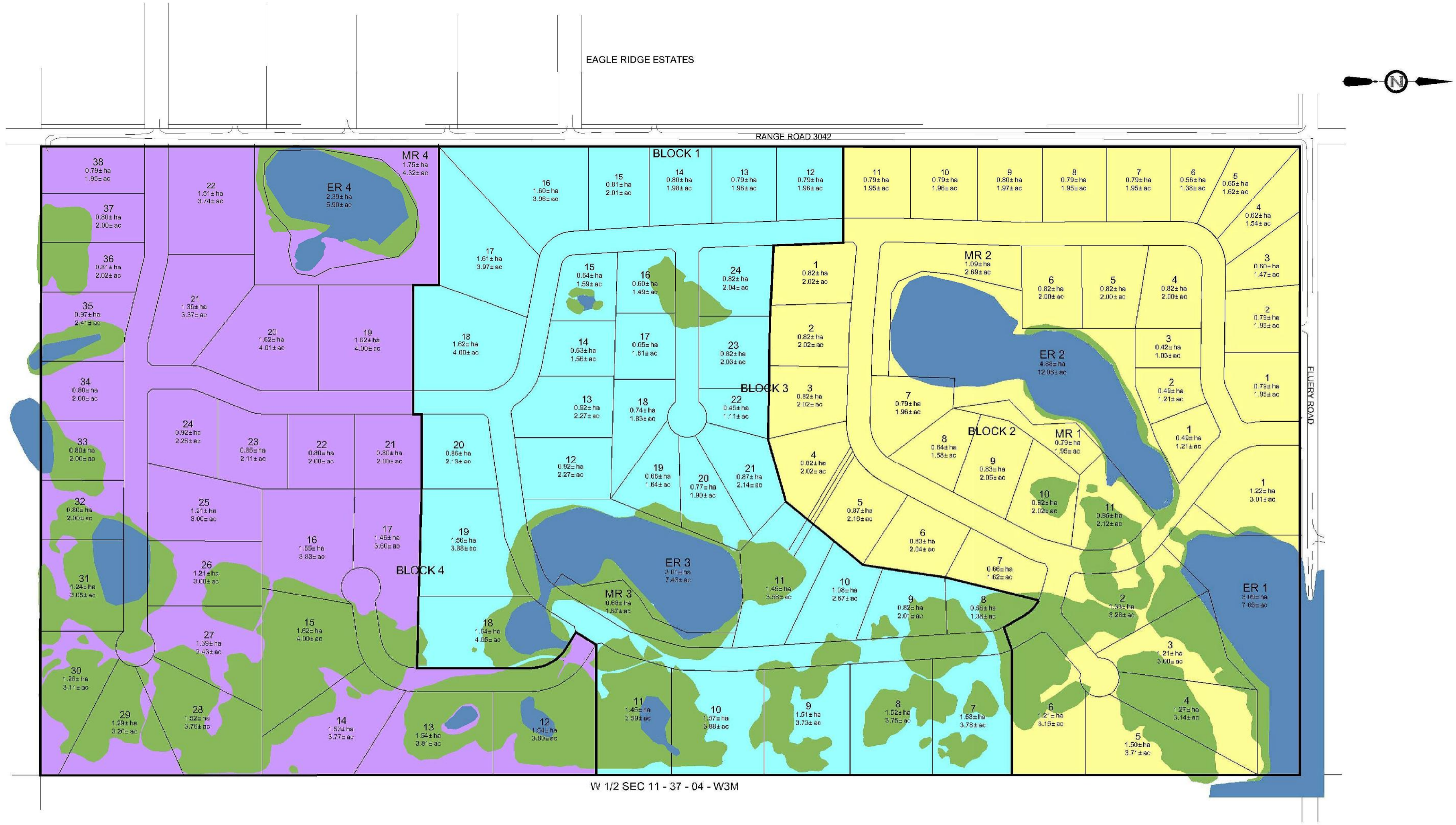
	COMMENTS RECEIVED	DEVELOPER RESPONSE
Social Integration	*Crime - one of the benefits of the area and the single entrance has been the low incidence of crime in the area. With more houses and more knowledge of the area, we are concerned that our crime rate will increase.*	The Corman Park Police have been contacted and are aware of the development. The population moving into the development are expected to be of similar backgrounds and interests to the existing residents which provide more local "eyes" in the area.
	A big concern is also the depreciation in property value and quality. For the years of construction it would likely be difficult to sell a house in Eagle Ridge because of the construction of 95 more houses. After completion, houses will have decreased in value because there will be similar houses available which are 15 years newer.	There is no empirical evidence to support this statement. Property values are generally affected by the amenities and overall desirability of an area.
	We feel it is worthwhile pointing out that Eagle Ridge is populated by highly qualified people who are paying a significant amount of taxes. The people in Eagle Ridge are not a group that a city/municipality would want to move away.	We have chosen not to respond to this statement.
	Esthetics –on a more personal note, the residents of Eagle Ridge moved here to get out of the city. A development of this type will increase general pollution as well as light and noise pollution. We will lose our view to the east and our beautiful sunrises.	Development within Eagle Heights will be required to adhere to the RM's light and noise regulations. The proposed development is located above Eagle Ridge along the slope of the valley where views to the east are very limited. One of the key amenities of the area, making this a desirable location is the views to the east.

	COMMENTS RECEIVED	DEVELOPER RESPONSE
	In conclusion, we were told by our councillor that buy in from the community affected would play a large part in the decision to proceed with a new development. While we acknowledge that growth is inevitable, we feel this proposal is not an appropriate one. We hope that the lure of more tax dollars does not influence a decision that will affect long time Corman Park tax payers. We hope you will take this input seriously and not proceed as planned with the new Eagle Heights development.	The RM of Corman Park Council received the developer's preliminary application and rated it high based on their published evaluation criteria. It is the developer's expectation that the initial and ongoing consultations will result in obtaining constructive input on how the development can be designed to positively integrate itself within its surroundings rather than being construed as a public vote.
	We are discouraged that the old bylaw of having a one mile buffer zone between developments was overturned as this would alleviate many of our concerns. The fact that there is no buffer zone at all is completely unacceptable.	This bylaw no longer exists and therefore cannot be addressed.

Continued Work – Follow up

The proposed development is in the preliminary stages and the developer is committed to working with the surrounding residents, the RM, and the regulatory agencies to create a development plan which positively integrates itself within its surroundings. The developer recognizes there is still work to be done prior to approval of this development.

- The developer is committed to ongoing personal and online consultations with landowners to receive and consider their input. The project website (PlaceSpeak) will remain active throughout the application process.
- The developer realizes that roadways and traffic management in the area is an issue which will require further review and consideration. The developer will conduct a Traffic Impact Assessment to the satisfaction of the Ministry of Highways and Infrastructure for the existing highway intersection and will continue to work with the RM to determine what improvements might be required along the municipal access roads.
- The conceptual storm water management will continue to be refined through further consultations with the RM and the Water Security Agency.
- The developer will continue to work with the Highway 41 Water Utility to obtain access to a sufficient potable water supply.



LEGEND:

- PHASE 1
- PHASE 2
- PHASE 3
- EXISTING PONDING AREAS
- EXISTING TREE AREAS

EAGLE HEIGHTS COUNTRY ESTATES
CONCEPT PLAN

Associated Engineering
GLOBAL PERSPECTIVE.
LOCAL FOCUS.

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DATE: 2013-06-20, Ryan Seabrook

You Are Cordially Invited to Join Us at:

The Eagle Heights Country Estates Open House

The Developers of Eagle Heights Country Estates have engaged Associated Engineering (AE) to prepare a Comprehensive Development Review (CDR) report to support an application to rezone and subdivide 129.3 hectares for the purposes of accommodating a future multi-lot country residential development on the W½ 11-37-04-W3M in the RM of Corman Park.

The subject property is currently zoned Agricultural District pursuant to the RM of Corman Park Zoning Bylaw. An amendment to the zoning map to rezone the subject property to a Country Residential 1 District (CR1) will be required to accommodate the proposed subdivision.

The proposed development includes 84 single family country residential lots ranging in size between 0.65 and 2.05 hectares, with an average lot size of 1.01 hectares. The presented lot sizes establish an opportunity to accommodate a variety of housing types and orientations.

You are invited to attend a come and go public open house event intended to provide information pertaining to the proposed multi-lot country residential development, and allow attendees an opportunity to share their perspective on the subdivision.

Date: Wednesday July 11th, 2018

Time: 6:00 p.m. - 8:00 p.m.

Location: Sunset Estates Community Hall –
Along Highway 5 in Sunset Estates

Please note that there will not be a formal presentation, AE staff will be present throughout the evening to answer any questions that you may have concerning the proposed multi-lot country residential development as it relates to the CDR report.

Associated Engineering

The Eagle Heights Country Estates
Land Use Concept Plan

LEGEND

- COUNTRY RESIDENTIAL
- STORM PONDS
- DRAINAGE CHANNEL
- ROADS
- TRAIL

RECORD OF TELEPHONE CONVERSATION

Date:	November 29, 2013	Time:	12:00 PM	Project No.:	20124165	File No:	20124165

Call to *or* Call from: Call From Name: Paul Deason

Company: Phone Number:

Associated Engineering Representative Making or Receiving Call: Kylie McLean

Project: Eagle Heights

Contract:

Subject: Proposed Development

Summary of Discussions:

A landowner adjacent to the development contacted me in regards to the proposed multi-parcel development. A list of their concerns were:

- They were unhappy they were not contacted directly and earlier in the process.
- They were concerned about the additional traffic the development would generate at the Highway 41 access.
- Concerned about the density and the septic tanks on the smaller lots and the amount of wastewater produced, identified they would like to see bigger lots
- Would like buffer zones surrounding the development

Conclusions/Decisions/Actions to be taken:

AE is following a 3-step process and a call for proposals that was released by the RM of Corman Park. We are following the steps identified within the call and there was not an earlier time to contact the public. If the development proceeds to the next step, there will be ample opportunity for public engagement.
Traffic will be dealt with at the next stage of the call, if the development is approved to proceed to the next level. A TIA would most likely be required by MHI where the access off Highway 41 will be assessed.
The density and lot sizing adheres to the RM's standards and the wastewater will be engineered, managed and approved by the proper health authorities on this matter.
The final concept has not been approved yet and there may be potential opportunity to make some adjustments if required and necessary.

Distribution:						
	[X]	Client:	Cebryk	[X]	File:	20124165
	[ ]	Contractor:		[ ]		
	[X]	Project Manager:	Bill Delainey	[ ]		

Feedback from Carisa Polischuk
#19 Eagle Ridge Road,
Eagle Ridge, SK S7K 2L6

Hi, I attended the Eagle Heights Open House on July 11, 2018 at Sunset Estates Community Hall. I am taking the opportunity to provide strong feedback in opposition of the proposed Eagle Heights development. I am aware that you have already received comprehensive feedback in opposition of the development from Alexander Moewes and Jan Rayburn dated July 31, 2018 (copied below).

I am a newer resident of Eagle Ridge so I was not fully aware of all of the issues dating back to when the Eagle Heights development was first proposed. However, I am aware of what has happened more recently and taken together it is deeply disturbing to comprehend how such a development could possibly move forward given all of the issues that have been identified and outlined.

For my own feedback, I have added my comments to the document provided by Alexander Moewes and Jan Rayburn, which I fully support. My feedback is highlighted in blue with grey background beginning with "*CP Feedback*" throughout the document copied below. I also fully support the petition (as illustrated by my signature) in opposition of the new Eagle Heights development as currently proposed.

Feedback provided by Alexander Moewes and Jan Rayburn, July 31, 2018

Re.: Comments on Eagle Heights proposal next to Eagle Ridge community

Dear Sir or Madam, with this letter we express that we are strongly opposed to the idea of placing a new proposed Eagle Heights development with now 84 houses directly next to our Eagle Ridge hamlet. This is for the following reasons:

(1) The proposal is in violation of the Corman Park Bylaws [1], the Corman Park Official Community Plan [2] and the Corman Park rezoning document [3]:

(a) The Bylaw states: "*4.3. The maximum size of the development area for an individual multi-parcel country residential development shall be 64.8 ha (160 acres). (Bylaw 25/08, Approved July 3, 2008).*" [1]

The proposed development in its final form will be 320 acres and therefore larger than the Bylaws allow.

CP Feedback: How is it possible that this development can proceed when it is double the allowable acres according to the bylaw? Moving forward with this development as currently proposed would be a disturbing precedent to set and a complete violation of the current bylaw.

(b) Community plan section 5.1.5 states [2]: "*To ensure that country residential development provides a high quality living environment through appropriate design, density and location.*" [2]

The proposed development has currently a density that is at least a factor 2 higher than at Eagle Ridge. Eagle Ridge lot size are between 5 and 6 acres (except for one smaller lot and some that are larger). Eagle Heights has an average size of 2.5 acres with lots between 1.6 and 5.1 acres. The Eagle Ridge community also has strict bylaws that should be matched by any nearby development.

CP Feedback: Our acreage is 6.8 acres, which is more than two and a half times the average lot size for Eagle Heights. In general, the proposed lot sizes for Eagle Heights are much smaller and more dense resulting in an inappropriate 'density' in relation to Eagle Ridge. It is also an inappropriate 'location' given the "one-mile buffer zone" of neighbouring acreage developments that used to exist but I understand that this buffer was recently removed which puts into question trust over how this new development is proceeding.

An argument made by one of the AE representatives at the Open House was that the density is similar to Eagle Ridge since the "across the street" density at the top of the hill was recently changed to more closely match the number of acreages in Eagle Ridge. This argument is weak, at best, since the concern is not about "across the street" density but rather the density for the area as a whole which is clearly much higher than Eagle Ridge. There is no hiding behind this fact or attempting to disguise it. The number of properties for the new development compared to the number of properties for Eagle Ridge are not compatible and are a major concern.

(c) Community plan section 5.2.3.2 states [2]: "*Council shall consider* <u>*the current demand*</u> *for and existing inventory of undeveloped multi-parcel country residential lots when reviewing multi- parcel country residential subdivision proposals.*" [2]

As I will demonstrate below, it is unreasonable to expect to sell 84 homes in about 5 years in this area. The current market is slow specifically for acreages. Eagle Ridge #18 is on the market for sale since July 2017 and has not sold. The fact that families that rely on schoolbus transportation Page 2 of 10 for their children have to enrol their children in Clavet is a hurdle that further suppresses the demand for the proposed lots.

CP Feedback: If Council is truly to consider the current demand and existing inventory, this new development would not be proceeding as currently proposed with 84 lots. Perhaps when this development was first considered several years ago, the market was hot and developers were looking to cash in but the market has changed substantially in the last few years.

I closely followed the acreage market for 3 years before purchasing our acreage at Eagle Ridge. During this search, acreages were hard to come by but now there is an abundance of acreages on the market; several which have been on the market for months and in some cases years that have yet to sell. If the plan is to sell 84 properties in 5 years, I agree that this is a completely unreasonable expectation especially since the developer will likely attempt to get top dollar for each property making it even more difficult to sell all 84 proposed lots in a 5-year period.

(d) Community plan section 5.2.3.15 states [2]: "*Where a multi-parcel country residential development is proposed on lands near or abutting an existing multi-parcel country residential development, the proposed development* <u>*shall be designed to complement the existing development and respond to the reasonable concerns and interests of the residents of the existing development and where required by Council, shall provide visual buffering*</u>*, house site separation, complementary lot sizing or any other measures necessary to achieve compatible land use and development.*"

Again this indicates that the style of the existing and proposed communities should mesh and similar bylaws should be adopted.

CP Feedback: I would argue that all of the issues raised in this comprehensive document are very reasonable concerns and interests of the residents of Eagle Ridge. They are not outrageous attempts to stop the development but rather very logical concerns outlining the major issues with how the development has proceeded to this point, how it currently violates many of the processes Corman Park has in place for such developments, and how it will affect the lives of current residents in Eagle Ridge.

If the process requires opportunities for existing residents to provide feedback, then all feedback (including the feedback I am currently providing) must be taken into consideration and not simply collected and stored. This is my understanding of what was done with previous feedback provided based on information shared by an AE representative at the Open House. This development just seems to keep moving forward jumping over proper processes and procedures that Corman Park has in place. It is very difficult to understand how the development could be this far along without considering feedback from the very residents who will be directly impacted by the development.

Furthermore, an AE representative indicated at the Open House that the developer could still proceed with the development as proposed with the only risk being that of angering Eagle Ridge residents. Somehow, I think the monetary gain the developer is looking to make will make it easy to overlook the anger of Eagle Ridge residents even though this anger is warranted given how many violations to the process that have occurred to date.

(e) The rezoning section of the Corman Park website [3] states: "*A* ***Comprehensive Development Review (CDR)*** *is required in support of any application to rezone and/or* ***subdivide land*** *for multi-parcel country residential, or any size of commercial, industrial, or intensive recreational purposes.*"

According to the information we received at the open house on July 11th, 2018, the CDR is being produced currently and we have not seen it. As of today, July 31st, 2018, the CDR has not been received by Corman Park. How is it possible that the CDR is produced after the rezoning process? The decision on a possible rezoning is based on the information provided in the CDR.

CP Feedback: This completely backwards process is deeply disturbing to the official processes in place and erodes trust in how the development is proceeding. It demands a response in how the land could have possibly been re-zoned prior to a CDR being completed when the CDR is required in support of an application to rezone and/or subdivide land. Further, the vague responses as to when the CDR will be complete is unacceptable and makes it appear that yet again another step in the process will be skipped to allow this development to move forward regardless of official processes.

(2) **Green Network Study Area:** According to the Draft Regional Land use map (Jan. 2017), the proposed development is in a zone that is marked as "Green Network Study Area" and additional review is required. We have inquired to no effect whether this additional study is being produced.

CP Feedback: Again, another step in the process that doesn't appear like it is being followed. All parts of the process for such a major development need to be followed otherwise it begs the question as to what is driving the process (e.g. personal, political, monetary gain) and further erodes trust. Green Network Study Areas cannot just magically disappear. There needs to be clear communication and explanation for steps that are taken in favour of the new development while disregarding the concerns of existing residents of Eagle Ridge.

(3) **Water situation:** The incoming city water has been problematic at times and it is not clear how the new development would affect our current situation. Adding 84 new septic fields on the hill will increase the water problems severely that we have experienced over the last years due to the heavy clay in the soil. With the high water table, our residents have seen increased septic issues during the last years. To our surprise the previous documents reflect that there are no water issues while this area has been flooded severely. In fact Agra Road (Township Road #372) is since over 10 years interrupted by a lake that did previously not exist. A printout of a map is attached as well. At least two additional lakes came into existence since then. We further note that since 2000, especially the acreages at the bottom of the hill have encountered problems with their septic fields. Some houses are into their third septic field since then. There have been also flooding issues, which is why we would like to see a guarantee that all the additional water will not dramatically increase our current problems.

CP Feedback: It is inconceivable how previous documents state that there are no water issues when this land has undergone severe water changes over the last few years. As surprises like these continue to arise, it is hard to make sense of how this development is proceeding other than that of personal, political, and monetary gain being the major drivers.

AE presented its findings and a plan to handle the water issue so it would not affect Eagle Ridge residents. However, if mother nature can change the landscape as drastically as it did over the last few years and with these new lakes forming considered to be a non-issue, it is hard to believe that digging the lakes deeper will solve the additional water that 84 new properties will produce. This is a major concern as our property is one of the low-lying properties in Eagle Ridge. What is the recourse for us when (not if) our property experiences major flooding issues in the future as a result of the Eagle Heights development?

(4) <u>Nearby schools & Schoolbus traffic:</u> The current zoning of school districts is such that school busses would deliver children only to Clavet. No family wants their small children on a bus for an hour each way to and from school. school buses turning on Hway 41 is extremely dangerous! The developer needs to rebuild the grid road going East so the school buses can go East and then directly across Hwy 5 toward Clavet.

CP Feedback: I agree 100% with rebuilding the grid road to Hwy 5 not only for school access but to handle the additional traffic and safety issues that will result from vehicle traffic to 84 additional properties. This cannot wait to be done after the development is complete. It must be handled upfront to alleviate traffic and safety concerns before they arise.

(5) <u>Demand for houses:</u> The above school bus transportation to Clavet poses a serious constraint to families with children. It is therefore quite unrealistic to assume that 84 houses can be sold in the next five years with this constraint. There is currently one home for sale since July 2017 (Eagle Ridge #18) and the real estate agent has encountered difficulties selling the house for exactly this reason. The house is still for sale.

CP Feedback: Assuming 84 properties will be easy to sell in 5 years without changing school and access roads to Eagle Ridge is unreasonable especially in the current housing market. Also, the AE representatives indicated that they didn't think there was a deadline to build after property was purchased. This is hugely problematic as it could potentially lead up to years and years of dealing with construction of this new development completely changing the way we currently live at Eagle Ridge. Nobody in our shoes would ever wish for that. This is a very reasonable concern that has not been yet been addressed.

(6) <u>Traffic concerns:</u> The proposed development means at least *<u>four-fold increase in traffic</u>* with increased accidents. Roads and intersections would have to see major upgrades and these should be realized *<u>before</u>* the development shall break ground. This is a major concern for our community. 116 total houses with minimum of two cars each plus several school buses coming and going on to Hwy 41. This is at least 240 vehicles coming and going each day. There is currently only one access road in and out. This is an impossible scenario – traffic- and safety-wise.

CP Feedback: An argument the AE representative made at the Open House is that extra lanes will be created on Highway 41. This will certainly make it easier to enter Eagle Ridge from Hwy 41 but it does not address the safety issues of crossing Hwy 41 to go to work every day. An extra lane does not help when traffic heading North on Hwy 41 is busy in the morning and it does not address the drastic increase in traffic heading into the city each morning with 84 new properties. A line up waiting to cross Hwy 41 is a nightmare scenario and a major accident waiting to happen. This is why re-building the grid road to Hwy 5 is also imperative. There needs to be more than one major access point in and out of Eagle Ridge if such a high density development like Eagle Heights moves forward.

(7) <u>Many other Safety concerns:</u> We do have many safety concerns that all relate to the dramatic increase in housing density – ranging from possible firefighting, and a terribly long construction phase with drastically increased noise, heavy traffic, garbage, dust and dirt, to name a few.

CP Feedback: 100% agree on all points. Another major concern is the road around Eagle Ridge, which is the responsibility of current residents to maintain. The road is in need of repairs but we are hesitant to move forward without knowing the impact that the Eagle Heights development will have on our roads. Will we have to live with chewed up roads until the development is complete? There needs to be a clear plan in place that keeps our roads in good condition throughout the duration of construction even if that construction takes decades which is a very reasonable outcome given the current housing market.

(8) <u>Procedural issues:</u> Since Nov. 2013, when we first received the advertisement to purchase lots in our mail, the process of the Eagle Heights development has been seriously flawed. The proposal has moved from originally low priority with Corman Park to higher priority. In the July 18, 2016 meeting of Corman Park, councillor John Germs withdrew his motion to move Eagle Height to the CDR stage (the minutes state due to strong opposition of the Eagle Ridge Residents). At that time, the P4G was against this development but in a recent surprising development, we learned at the P4G open house in Jan. 2017, that now P4G seems in favour of the Eagle Heights development.

CP Feedback: Sounds a bit suspect. Difficult to understand what is going on behind the scenes other than motivations that are clearly a higher priority than the concerns of existing residents in Eagle Ridge.

(9) <u>Rezoning:</u> There was still one problem in order to move the development to the CDR stage and that is the rezoning of the area to Country Residential. To our surprise we learned recently in January 2017, that now the pertinent area has undergone rezoning from Urban Residential to now Country Residential to accommodate moving the development to the next stage. One look at your Jan. 2017 Regional Land Use map (attached with red box added) shows that this is at best strange and goes against all logic. Previously, there was a green network study area (in green on the map) that according to your own documents presents a natural border between Country and Urban Page 4 of 10 residential. Now P4G singled out the three sectors East of Eagle ridge (14, 11, 02 in Twp. 37) for rezoning. This in fact is done only to accommodate the developer. Planning should be guided by fair and informed justification with the goal to develop the greater Saskatoon area which we all live in in a suitable way. Instead a mixture of political and personal reasons are driving the processes.

CP Feedback: I would like to emphasize one line in the argument above which I 100% support. "*Planning should be guided by fair and informed justification with the goal to develop the greater Saskatoon area which we all live in a suitable way."* The fact that this new development isn't proceeding this way leads me to believe other factors are driving the process such as personal, political, and monetary gain.

(10) <u>Misinformation:</u> At no time and stage, were we ever properly informed let alone that a dialogue was in place. Attempts include hiding of information, deadlines and rewriting of minutes that were posted first online and then changed to reflect events differently. Our hamlet had to constantly inquire for information with Corman Park, attend meetings to get the minimum information.

CP Feedback: Some funny business that clearly needs to be addressed with Eagle Ridge residents.

(11) <u>Corman Park & Councillor Germs:</u> The role of councillor Germs has been particularly troublesome. Instead of exchanging information with our hamlet – the hamlet in his portfolio – he has single handedly pushed the Eagle Heights project forward. In the only in-person meeting with councillor Germs – a meeting I might add we had to request – councillor Germs misrepresented the facts and tried to downplay that this development would every move to the CDR stage.

CP Feedback: More funny business that clearly needs to be addressed with Eagle Ridge residents.

(12) <u>Complete transformation of the character of Eagle Ridge:</u> Most importantly this new development would completely change the current character of our community. We would basically transform into a city suburb with a total of 26 + 84 + 3 (additional homes that formally do not belong to Eagle Ridge) + 3 houses on Fleury Road = 116 houses. Living on an acreage reflects a certain concept and lifestyle – one happily compromises extra time in more and longer driving, septic fields, more difficult winter road conditions etc. – all for remoteness and privacy of an acreage. In fact when I purchased our lot in 2000, I specifically asked the builder whether there would be any chance of having another acreage development nearby. At that time, he of course eased my concerns by pointing to the one-mile buffer zone that was conveniently removed recently as well.

CP Feedback: We too purchased our acreage in Eagle Ridge for the lifestyle it provided and agree that the Eagle Heights development will completely change the lifestyle we currently have. This is in violation of the Community

Plan where "*the proposed development shall be designed to complement the existing development and respond to the reasonable concerns and interests of the residents of the existing development*". The current proposal for Eagle Heights will have a drastic negative impact on the character of the Eagle Ridge community, which leads me to believe other motivations are involved which will continue to push this development forward bypassing official processes.

(13) There is absolutely no reason for the Eagle Heights development: If the proposed development would for example go 1.6 km further East, our community could stay intact. We also have no problem if the land would be developed by the city because this means that it is done right and with additional infrastructure. It is impossible to see why such narrow spacing would be pursued with such different composition of homes (in density and lot size). The only reason this is moving forward is to accommodate a developer. Looking at your map (or Google Earth) makes clear that Eagle Heights is an area that is singled out for development of unnatural density. It goes against all natural borders and a natural city development.

CP Feedback: Agree 100% with all points made above. Something else is clearly driving this process and its sets a disturbing precedent for all future developments if official processes and bylaws can be bypassed or changed willy-nilly to allow a new development to proceed in order to ensure personal, political, and monetary gain.

When we all purchased our lots, we did so feeling comfortable with the rules in place for neighbouring developments. The impact of the current Eagle Heights development is equivalent to Eagle Ridge being a nice quiet crescent in Saskatoon suddenly finding out the houses across the street will be demolished to put in condominiums drastically affecting the density, character, roadways, and safety of what is currently a nice quiet crescent.

It is hard to comprehend why the Eagle Heights development has been allowed to break so many rules in the process including keeping Eagle Ridge residents in the dark. This is no way to move new developments forward. Processes are in place for a purpose and they need to be followed to ensure that everything is on the up and up with regard to new developments.

SUMMARY:

A series of issues and concerns have been raised in opposition to the Eagle Heights development. I fully support all of them and I have added my own feedback as outlined above. The issues and concerns that have been raised are very reasonable from very reasonable residents who simply don't want to see our lives and lifestyles at Eagle Ridge negatively impacted and the character of our community permanently changed for the worse.

The Eagle Heights development has not proceeded through the appropriate processes or channels and leads me to believe it is intentional because everyone involved knows the negative impact this development will have on existing residents of Eagle Ridge. It is imperative that the issues raised by Eagle Ridge residents be addressed, in particular those which are in violation of current Corman Park processes.

Sincerely,

Carisa Polischuk, Eagle Ridge Resident

Carisa Polischuk

Dr. Alexander Moewes & Jan Rayburn
#20 Eagle Ridge Road
Eagle Ridge, SK S7K 2L6, Canada
[redacted]

July 31, 2018

To **AE Engineering**
Submitted by email on July 31st, 2018
to pawluskim@ae.ca

Re.: Comments on Eagle Heights proposal next to Eagle Ridge community

Dear Sir or Madam,
with this letter we express that we are strongly opposed to the idea of placing a new proposed Eagle Heights development with now 84 houses directly next to our Eagle Ridge hamlet. This is for the following reasons:

(1) The proposal is in violation of the Corman Park Bylaws [1], the Corman Park Official Community Plan [2] and the Corman Park rezoning document [3]:

(a) The Bylaw states: "*4.3. The maximum size of the development area for an individual multi-parcel country residential development shall be 64.8 ha (160 acres). (Bylaw 25/08, Approved July 3, 2008).*" [1]

The proposed development in its final form will be 320 acres and therefore larger than the Bylaws allow.

(b) Community plan section 5.1.5 states [2]: *"To ensure that country residential development provides a high quality living environment through appropriate design, density and location.*" [2]

The proposed development has currently a density that is at least a factor 2 higher than at Eagle Ridge. Eagle Ridge lot size are between 5 and 6 acres (except for one smaller lot and some that are larger). Eagle Heights has an average size of 2.5 acres with lots between 1.6 and 5.1 acres. The Eagle Ridge community also has strict bylaws that should be matched by any nearby development.

(c) Community plan section 5.2.3.2 states [2]: *"Council shall consider the current demand for and existing inventory of undeveloped multi-parcel country residential lots when reviewing multi- parcel country residential subdivision proposals.*" [2]

As I will demonstrate below, it is unreasonable to expect to sell 84 homes in about 5 years in this area. The current market is slow specifically for acreages. Eagle Ridge #18 is on the market for sale since July 2017 and has not sold. The fact that families that rely on schoolbus transportation for their children have to enrol their children in Clavet is a hurdle that further suppresses the demand for the proposed lots.

(d) Community plan section 5.2.3.15 states [2]: *"Where a multi-parcel country residential development is proposed on lands near or abutting an existing multi-parcel country residential development, the proposed development shall be designed to complement the existing development and respond to the reasonable concerns and interests of the residents of the existing development and where required by Council, shall provide visual buffering, house site separation, complementary lot sizing or any other measures necessary to achieve compatible land use and development*."

Again this indicates that the style of the existing and proposed communities should mesh and similar bylaws should be adopted.

(e) The rezoning section of the Corman Park website [3] states: *"A Comprehensive Development Review (CDR) is required in support of any application to rezone and/or subdivide land for multi-parcel country residential, or any size of commercial, industrial, or intensive recreational purposes."*
According to the information we received at the open house on July 11th, 2018, the CDR is being produced currently and we have not seen it. As of today, July 31st, 2018, the CDR has not been received by Corman Park. How is it possible that the CDR is produced after the rezoning process? The decision on a possible rezoning is based on the information provided in the CDR.

(2) **Green Network Study Area:** According to the Draft Regional Land use map (Jan. 2017), the proposed development is in a zone that is marked as "Green Network Study Area" and additional review is required. We have inquired to no effect whether this additional study is being produced.

(3) **Water situation:** The incoming city water has been problematic at times and it is not clear how the new development would affect our current situation. Adding 84 new septic fields on the hill will increase the water problems severely that we have experienced over the last years due to the heavy clay in the soil. With the high water table, our residents have seen increased septic issues during the last years. To our surprise the previous documents reflect that there are no water issues while this area has been flooded severely. In fact Agra Road (Township Road #372) is since over 10 years interrupted by a lake that did previously not exist. A printout of a map is attached as well. At least two additional lakes came into existence since then. We further note that since 2000, especially the acreages at the bottom of the hill have encountered problems with their septic fields. Some houses are into their third septic field since then. There have been also flooding issues, which is why we would like to see a guarantee that all the additional water will not dramatically increase our current problems.

(4) **<u>Nearby schools & Schoolbus traffic:</u>** The current zoning of school districts is such that school busses would deliver children only to Clavet. No family wants their small children on a bus for an hour each way to and from school. school buses turning on Hway 41 is extremely dangerous! The developer needs to rebuild the grid road going East so the school buses can go East and then directly across Hwy 5 toward Clavet.

(5) **<u>Demand for houses:</u>** The above school bus transportation to Clavet poses a serious constraint to families with children. It is therefore quite unrealistic to assume that 84 houses can be sold in the next five years with this constraint. There is currently one home for sale since July 2017 (Eagle Ridge #18) and the real estate agent has encountered difficulties selling the house for exactly this reason. The house is still for sale.

(6) **<u>Traffic concerns:</u>** The proposed development means at least *<u>four-fold increase in traffic</u>* with increased accidents. Roads and intersections would have to see major upgrades and these should be realized *<u>before</u>* the development shall break ground. This is a major concern for our community. 116 total houses with minimum of two cars each plus several school buses coming and going on to Hwy 41. This is at least 240 vehicles coming and going each day. There is currently only one access road in and out. This is an impossible scenario – traffic- and safety-wise.

(7) **<u>Many other Safety concerns:</u>** We do have many safety concerns that all relate to the dramatic increase in housing density – ranging from possible firefighting, and a terribly long construction phase with drastically increased noise, heavy traffic, garbage, dust and dirt, to name a few.

(8) **<u>Procedural issues:</u>** Since Nov. 2013, when we first received the advertisement to purchase lots in our mail, the process of the Eagle Heights development has been seriously flawed. The proposal has moved from originally low priority with Corman Park to higher priority. In the July 18, 2016 meeting of Corman Park, councillor John Germs withdrew his motion to move Eagle Height to the CDR stage (the minutes state due to strong opposition of the Eagle Ridge Residents). At that time, the P4G was against this development but in a recent surprising development, we learned at the P4G open house in Jan. 2017, that now P4G seems in favour of the Eagle Heights development.

(9) **<u>Rezoning:</u>** There was still one problem in order to move the development to the CDR stage and that is the rezoning of the area to Country Residential. To our surprise we learned recently in January 2017, that now the pertinent area has undergone rezoning from Urban Residential to now Country Residential to accommodate moving the development to the next stage. One look at your Jan. 2017 Regional Land Use map (attached with red box added) shows that this is at best strange and goes against all logic. Previously, there was a green network study area (in green on the map) that according to your own documents presents a natural border between Country and Urban

residential. Now P4G singled out the three sectors East of Eagle ridge (14, 11, 02 in Twp. 37) for rezoning. This in fact is done only to accommodate the developer. Planning should be guided by fair and informed justification with the goal to develop the greater Saskatoon area which we all live in in a suitable way. Instead a mixture of political and personal reasons are driving the processes.

(10) **Misinformation:** At no time and stage, were we ever properly informed let alone that a dialogue was in place. Attempts include hiding of information, deadlines and rewriting of minutes that were posted first online and then changed to reflect events differently. Our hamlet had to constantly inquire for information with Corman Park, attend meetings to get the minimum information.

(11) **Corman Park & Councillor Germs:** The role of councillor Germs has been particularly troublesome. Instead of exchanging information with our hamlet – the hamlet in his portfolio – he has single handedly pushed the Eagle Heights project forward. In the only in-person meeting with councillor Germs – a meeting I might add we had to request – councillor Germs misrepresented the facts and tried to downplay that this development would every move to the CDR stage.

(12) **Complete transformation of the character of Eagle Ridge:** Most importantly this new development would completely change the current character of our community. We would basically transform into a city suburb with a total of 26 + 84 + 3 (additional homes that formally do not belong to Eagle Ridge) + 3 houses on Fleury Road = 116 houses. Living on an acreage reflects a certain concept and lifestyle – one happily compromises extra time in more and longer driving, septic fields, more difficult winter road conditions etc. – all for remoteness and privacy of an acreage. In fact when I purchased our lot in 2000, I specifically asked the builder whether there would be any chance of having another acreage development nearby. At that time, he of course eased my concerns by pointing to the one-mile buffer zone that was conveniently removed recently as well.

(13) **There is absolutely no reason for the Eagle Heights development:** If the proposed development would for example go 1.6 km further East, our community could stay intact. We also have no problem if the land would be developed by the city because this means that it is done right and with additional infrastructure. It is impossible to see why such narrow spacing would be pursued with such different composition of homes (in density and lot size). The only reason this is moving forward is to accommodate a developer. Looking at your map (or Google Earth) makes clear that Eagle Heights is an area that is singled out for development of unnatural density. It goes against all natural borders and a natural city development.

On a side note, I was surprised to find out from AE engineering at the open house on July 11th, 2018, that none of our concerns have been noted so far. I am including a list of letters that I sent to various sources some of which were sent to AE.

Finally, I would like to stress that our community presented a list of signatures (see attachment) to AE at the open house that showed that the Eagle Ridge community is unanimously against the Eagle Heights development in its current form.

We hope to be informed when the CDR is received by Corman Park.

Sincerely,

[Dr. Alexander Moewes] [Jan Rayburn]

References

[1] Corman Park Bylaws October 2017
https://www.rmcormanpark.ca/DocumentCenter/View/183/RM-Zoning-Bylaw---Bylaw-No-0994-PDF page 82, section 4.3.
[2] Corman Park Official Community plan March 2018
https://www.rmcormanpark.ca/DocumentCenter/View/180/RM-Official-Community-Plan---Bylaw-No-0894-PDF
[3] Corman Park website for rezoning as of July 31st, 2018
https://www.rmcormanpark.ca/206/Rezoning-Land

Enclosures:

(a) List of Letters sent previously.
(b) Print out of Google maps with new water.
(c) List of signatures of Eagle Ridge households opposing the development.

(a) Letters send previously

Dec. 2nd, 2013
Letter to Kylie McLean, project planner
Letter to RM of Corman Park
Minister Morgan (Gordon Rutton replied)
Mayor Atkinson
Rob Norris
City council members

July 18th, 2016
Letter to council

November 14th, 2016
Letters to Rebecca Row
Letter to all members of P4G

February 24th, 2017
Alex Fallon, Chair Regional Oversight Committee

July 31st, 2018
By email to AE Engineering

July 31st, 2018
By Email to Corman Park

(b) Printout from Google Maps showing new water (since 2004) in the aread of the proposed Eagle Heights development:

(c) Signature list of Eagle Ridge members opposing the Eagle Heights development (originals were handed out to AE at the open house)

We the undersigned, residents of the Hamlet of Eagle Ridge,

oppose the proposed development of the Eagle Heights Country Estates.

The proposed development of Eagle Heights Country Estates is unreasonable and not compatible with Eagle Ridge Country Estates. The proposed development will completely change the character of our community for no good reason other than profit.

	EXISTING: Eagle Ridge	**PROPOSED:** Eagle Heights
# of lots / houses	26	84
approx. lot sizes	5 to 10 acre	1.6 to 5.1 acre

June, 2018

Eagle Ridge #	Date	PRINTED NAME	Signature
22	24/6/2018	Pia Wennek	[illegible]
22	24/6/2018	Jens Mueller	[illegible]
20	24/6/18	ALEX MOEWES	[illegible]
20	30/6/18	Jan Rayburn	[illegible]
14	24/6/18	Chantel Jarrett	[illegible]
14	24/6/18	Kevin Jarrett	Kevin Jarrett
24	24/6/18	D Locke	Don Locke
24	24/6/18	Janet Locke	J Locke
21	24/6/18	CANDACE FRANKE	Candace Franke
23	29/6/18	Michele Conn	Michele Conn
23	05/7/18	KEN CONN	[illegible]
25	25/6/18	Darcie Wells	[illegible]
25	25/6/18	Calvin Wells	[illegible]

1 of 3

Eagle Ridge #	Date	PRINTED NAME	Signature
12	JUNE 25/18	S. FOX	S. Fox
12	June 25/18	P. FOX	P Fox
11	June 25/18	Tony Balezantis	A J Balezantis
11	June 25/18	Marcella Balezantis	M Balez antis
19	JUNE 25/18	CARISA POLISCNUK	[illegible]
19	JUNE 25/18	DENNIS THOMPSON	[illegible]
18	June 28/18	Brynn MacLachlan	CB MacLachlan
18	[illegible] 28/18	JeFF Charlebois	[illegible]
15	June 28/18	C Arnold	[illegible]
15	July 4/18	V Arnold	VArnold
08	June 29/18	Josiah Wade	[illegible]
08	July 4 2018	Alicia Megaw	Alicia Megaw
05	JUNE 29/18	PETER ECKSTEIN	[illegible]
21	[illegible] 30/18	Gordon Franke	[illegible]
26	June 30/18	Helen Semaganis	[illegible]
26	" "	Donald Worme	[illegible]
37126	JUNE 30/18	ROXANE ROMMEL	[illegible]
37118	July 5/18	Jo-Anne Couture	J. Couture.

37118 JULY 5/18 LES COUTURE [illegible]

2 of 3

Eagle Ridge #	Date	PRINTED NAME	Signature
10	July 1, 2018	Keith Martell	Keith Martell
10	July 1, 2018	Cathy Martell	Cathy Martell
7.	July 1/18	WILMA JORDEN	W Jordan
7	July 1	ED JORDAN	Jordan
2	July 4	Dennis Pilipiak	[illegible]
2.	July 5, 2018	Annette Pilipiak	A Pilipiak
9	✓	Greg Lindgren	[illegible]
9	18/07/05	Claudia Lindgren	Claudia Lindgren
5	July 6/18	Jo-Anne Relf-Eckstein	Jo-Anne Relf-Eckstein
16	9 JULY 18	Rod Bowes	[illegible]
16	9 July/18	Shannon Bowes	Shannon Bowes
4	9 July 18	Nanci Chouinard	NANCI CHOUINARD
4	9 July 18	Guy CHOUINARD	Guy Chouinard
13	9 July 18	Shawn Wimpney	[illegible]
13	10 July 18	Shanna Wimpney	Shanna Wimpney

3 of 3

Pia Wennek and Jens Mueller
22 Eagle Ridge Road
Eagle Ridge, SK, S7k 2L6

Forward to
Associate Engineering
Re: Comments to the open house on Eagle Heights Estates (July 11, 2018)

My wife Pia and I live in the Hamlet of Eagle Ridge and are concerned about the proposed Eagle Height Estates. I attended the open house on July 11th, and instead of providing feedback on your "Comment Sheets", my wife and I provide comments and feedback with this letter.

The proposed Eagle Heights Estates are not compatible with the existing Hamlet of Eagle Ridge.
1) Lot sizes
The proposed average lot size is not even half of that in Eagle Ridge. Most of our lots are 5 to 6 acres; some are even larger. The proposed average lot size in Eagle Heights is 2.5 acres, with lot between 1.6 and 5.1 acres. Based on the building density alone, the proposed development will have a very different character from our hamlet. Not even the proposed lots directly adjacent to Eagle Ridge have a comparable size. We like to cite paragraph 5.2.3.15 from the "Official Community Plan" of Corman Park:
"Where a multi-parcel country residential development is proposed on lands near or abutting an existing multi-parcel country residential development, the proposed development shall be designed to complement the existing development and respond to the reasonable concerns and interests of the residents of the existing development and where required by Council, shall provide visual buffering, house site separation, complementary lot sizing or any other measures necessary to achieve compatible land use and development."
As the developer already obtained significant feedback from our hamlet in 2013-2014, we were expecting that concerns raised would resulted in an improved proposal. Unfortunately, this has not happened.
2) Building standards (requirements)
The Hamlet of Eagle Ridge had been developed using strict standards so that a new community of a certain style and standard evolved. If one would take a tour through our hamlet, one would see that this concept was very successful. As Eagle Heights Estates are proposed to be directly attached to our hamlet, the same or stricter requirements (standards) need to be put in place. As paragraph 5.2.3.15 says the "proposed development shall be designed to complement the existing development". Eagle Ridge should be the blueprint for any expansion or new development that is directly adjacent to it. This is currently not the case.
3) Traffic
It is proposed to add 84 houses to the existing 26 houses of Eagle Ridge, meaning an increase from 26 to 110 households. It is proposed to use the same single road in the future to deal with the tremendous increase in traffic. It is difficult to imagine that this will work effectively and safely.

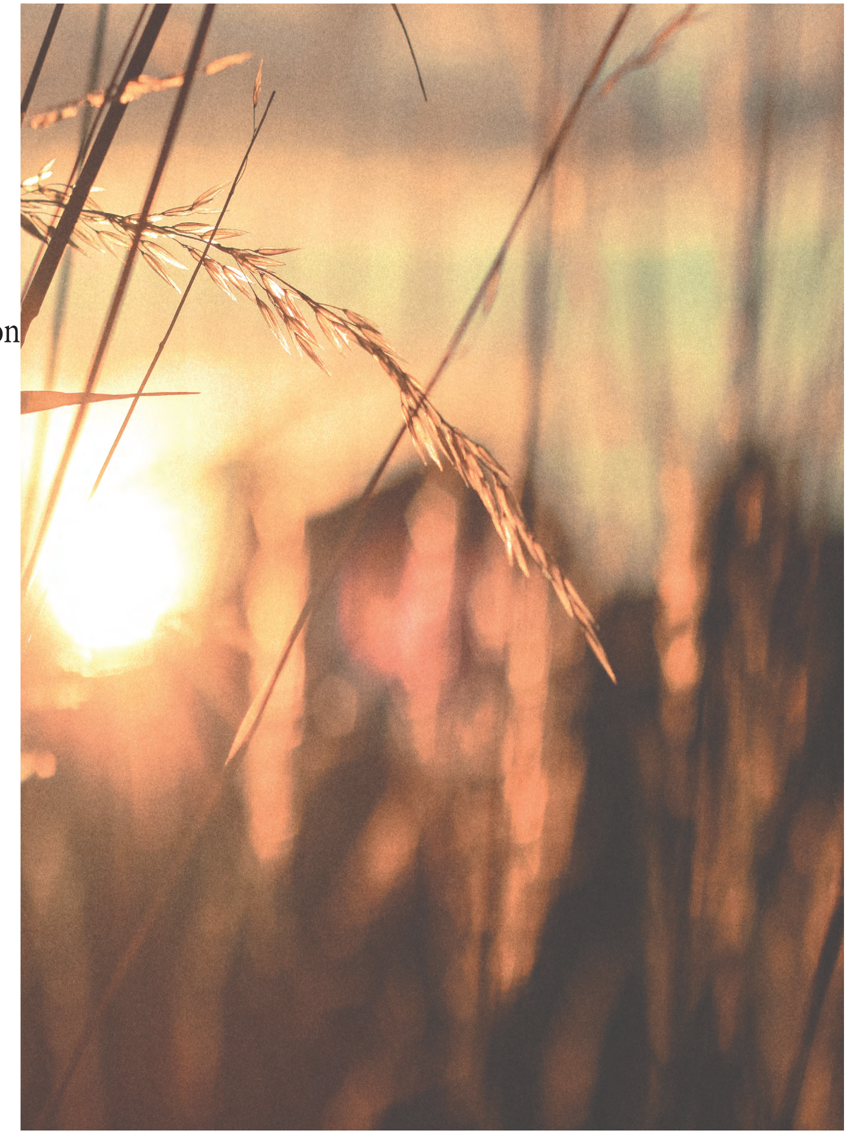
In summary, it is surprising that after significant feedback had been provided to the developer and Corman Park many years ago, the current proposal is not significantly different from the original proposal. Still, the proposal is unreasonable as it is not compatible with Eagle Ridge.

Yours sincerely,

Pia Wennek and Jens Mueller (July 20, 2018)

WELCOME

Welcome, please take an opportunity to browse through the display boards for the proposed Eagle Heights Country Estates development. Tonight's event is intended to provide the public with an overview of the proposed multi-lot country residential development in the W½ 11-37-04-W3M. Members of the Associated Engineering project team are present to answer any questions you may have regarding the proposed development.



The information gathered from this evening will be used to contribute to the preparation and submission of a Comprehensive Development Review (CDR) report to support the rezoning and phased subdivision of the proposed Eagle Heights Country Estates development.

Following your review of the information provided on the display boards, we ask that you please take a moment to provide us with your written feedback on one of the comment sheets provided.

For more information or to provide additional comments regarding the proposed development, please contact Mike Pawluski by email at pawluskim@ae.ca or by telephone at (306)653-4969.

Associated Engineering

DEVELOPMENT OVERVIEW

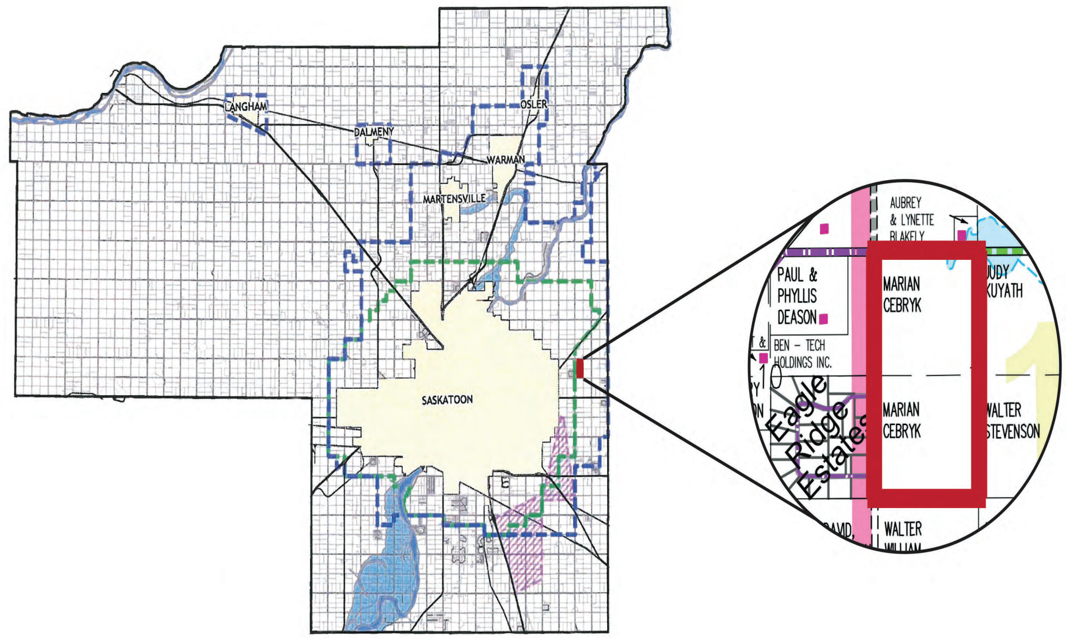
Eagle Heights Country Estates is located ~5.5 kilometres northeast of Saskatoon and ~800 metres east of Highway 41 along Fleury Road and Range Road 3042. The development is located in the Strawberry Hills which has historically been in high demand for this form of development with several existing country residential communities located within the direct vicinity including Eagle Ridge Estates, Discovery Ridge, Mission Ridges Estates, and Strawberry Hills Estates.

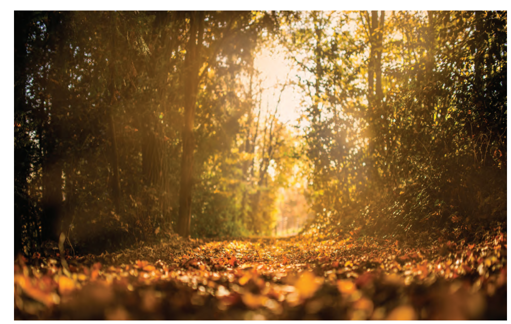
The plan area is located at the plateau of Strawberry Hills and its local topography ranges from flat in the southeast corner to gently sloping across the site to the north. It consists primarily of farmland with significant uncultivated natural vegetation and tree bluffs located along the eastern boundary of the site. The plan area contains three natural ponding areas which relate to a larger wetland complex in the area. The development of the site intends to retain, enhance and integrate these ponding areas as a functional amenity within the community.

The plan area comprises 129.3 hectares (319.5 acres) and is intended to be subdivided in four phases to create 84 country residential lots. Lots within the development range in size between 0.4 ha (1.03 acres) and 1.6 ha (4.05 acres); maintaining an average size of 1.0 ha (2.47 acres) within each phase as per the RM of Corman Park zoning regulations.

The lots have been sized to provide property owners with sufficient area to meet their own outdoor recreational needs and as such no public recreational open space is intended to be dedicated.

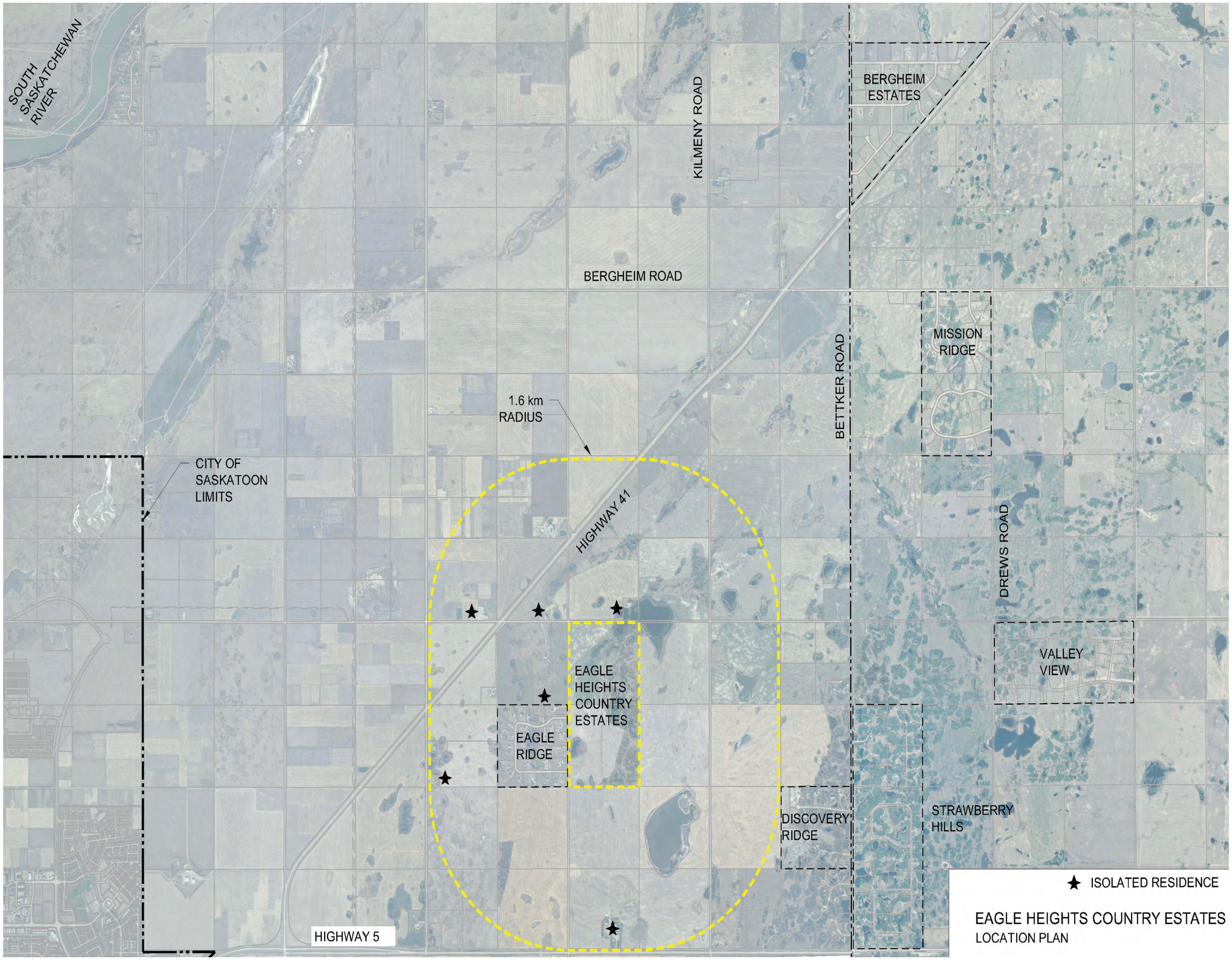
The proposed development is intended to include an integrated trail system within the internal road right-of-way to provide an alternate means of navigating the area.





Associated Engineering

LOCATION & ADJACENT LAND USES



Associated Engineering

MUNICIPAL & HIGHWAY ACCESS

Municipal & Highway Access

Primary access to the site is provided from Fleury Road along the northern boundary and Range Road 3042 along the western boundary of the plan area. These roads are under the jurisdiction of the RM of Corman Park.

Fleury Road connects directly to Highway No. 41 at an existing intersection west of the plan area. A Traffic Impact Assessment (TIA) was prepared by Associated Engineering for the Eagle Heights Country Estates. The purpose of the TIA included forecasting anticipated traffic volumes generated as a result of the development, confirming the location for permanent highway access along Highway 41 and making recommendations concerning necessary highway intersection upgrades to ensure efficient and safe vehicle movements following full development of the lands. The TIA was submitted to the Ministry of Highways and Infrastructure (MHI) for their review and approval. The TIA recommended the following improvements to the Highway 41 and Fleury Road intersection:

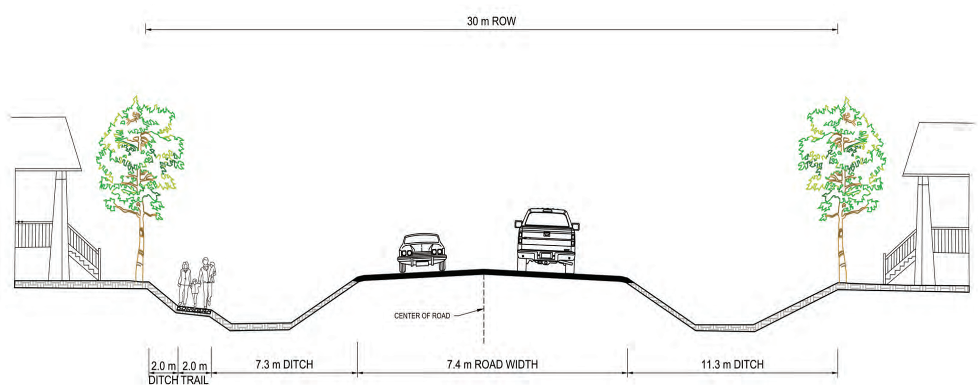
1. Installation of intersection delineation lighting on east side of Highway 41.
2. Installation of a right turn lane for northeast-bound traffic on Highway 41.
3. Realignment of the existing intersection to meet with Highway 41 at a right-angle.

The MHI agreed with the analysis and recommendations included in the TIA report. A second TIA was prepared by another property owner to support a proposed commercial development situated along the west side of Highway 41. The MHI intends to use the recommendations from both reports to inform the preparation of a design for the highway improvements. Construction of the improvements are expected to be completed by MHI as part of their Safety Improvement Program (SIP).

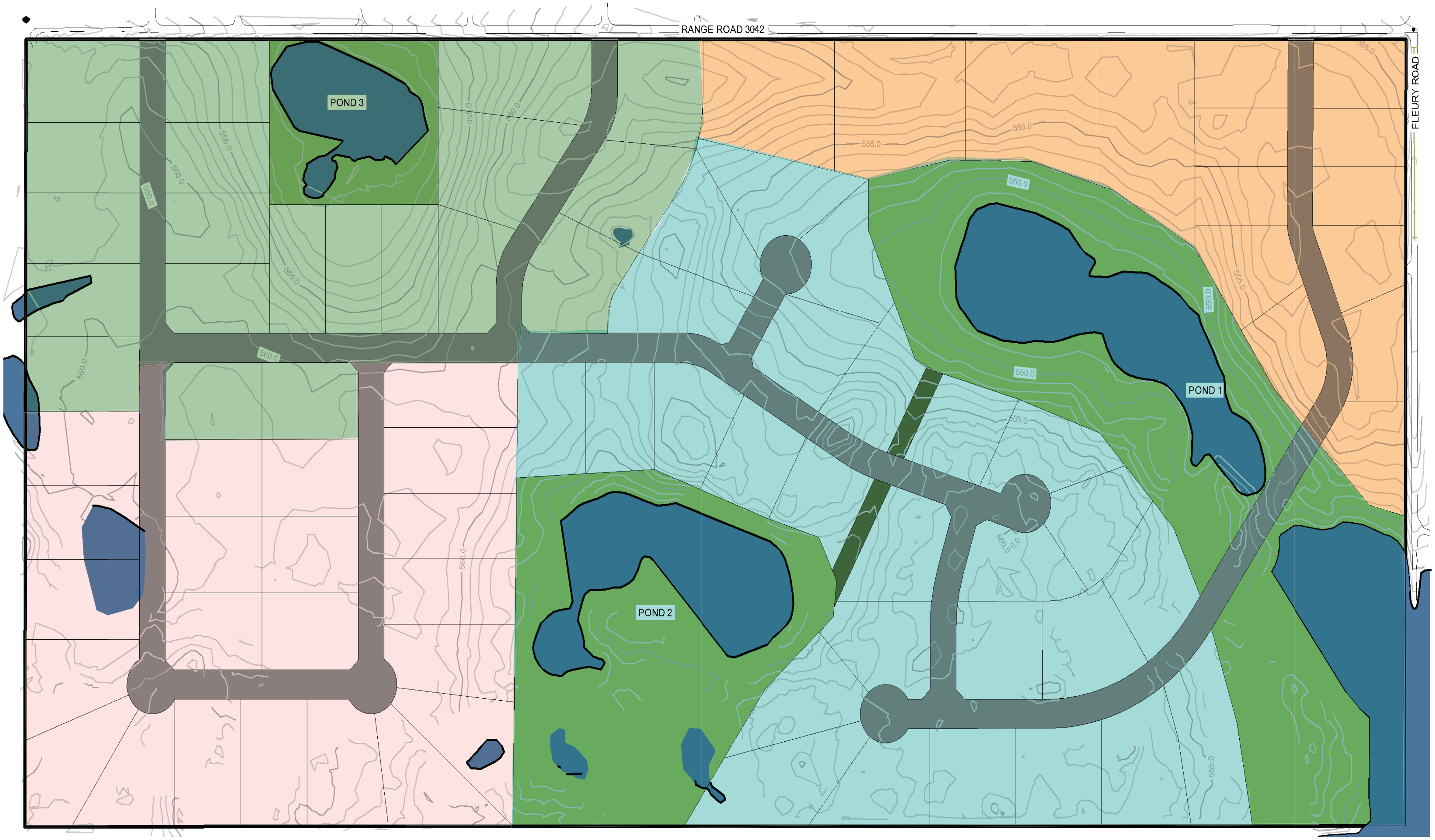
The timing for these improvements will be determined by MHI.

Internal Roadways

Internal roadways will be constructed in conformance with the RM of Corman Park Country Residential Road Standard on a 30 metre right-of-way. Internal roads will be paved with a minimum driving surface of 7.4 metres. A trail system is planned to be constructed along the internal road network. This trail will be separated from the roadway by a grassed boulevard to maintain a separation between vehicles and pedestrians. The gravel surfaced trail system is intended to be unlit with the exception of locations at internal roadway intersections as a means of balancing the need for traffic safety and avoiding unnecessary glare and light pollution.



LAND USE CONCEPT & PROPOSED PHASING



LEGEND

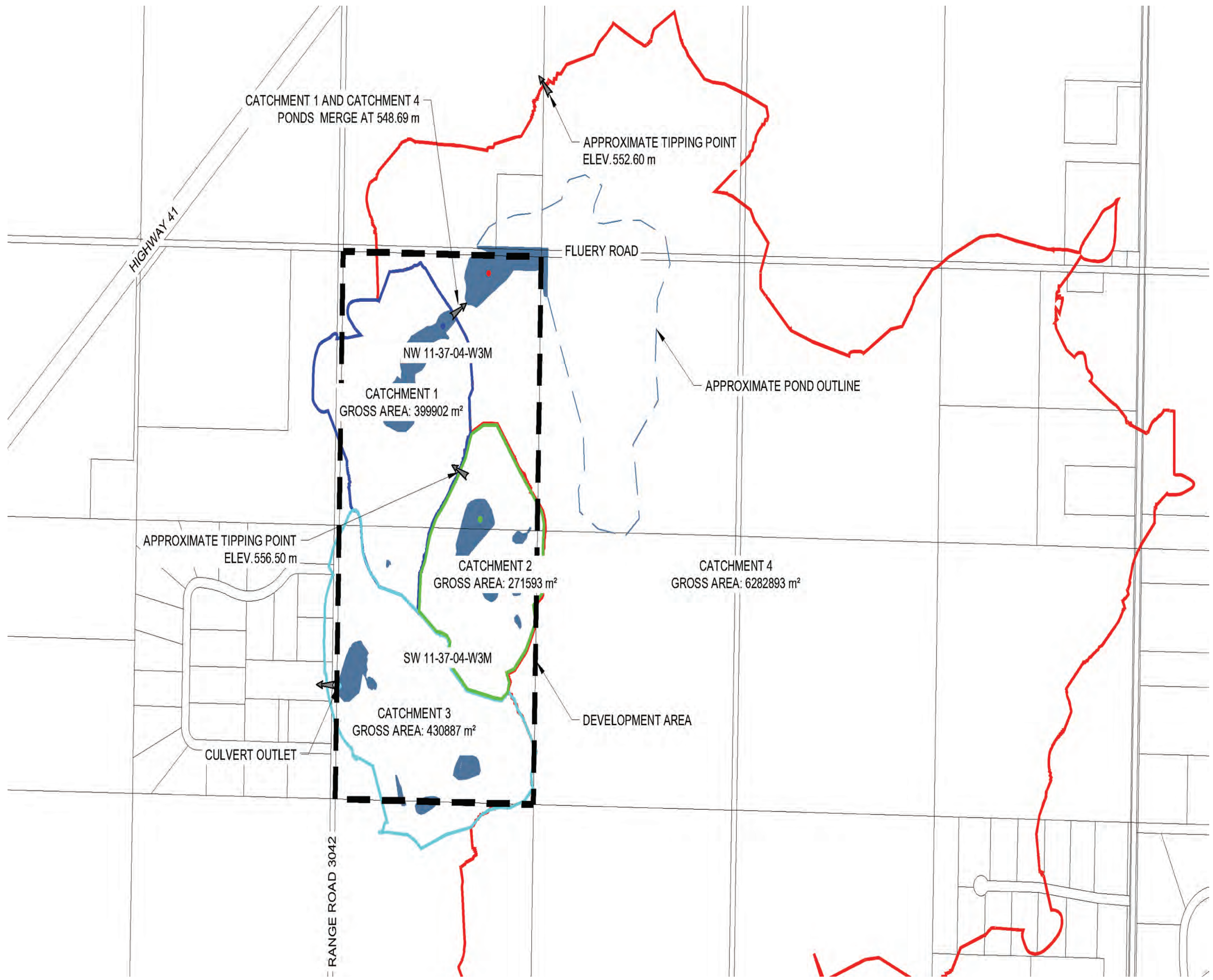
		AREA (HA)	# OF LOTS
PHASE 1		15.97	15
PHASE 2		20.02	20
PHASE 3		21.70	22
PHASE 4		26.77	27

Associated Engineering

STORMWATER MANAGEMENT

Topography within the plan area consists of rolling hills with local drainage trending toward several natural low-lying areas. The land is separated into four distinct drainage catchments corresponding to existing wetland areas on and surrounding the property. A conceptual drainage plan has been prepared for the site in direct consultation with the Saskatchewan Water Security Agency. With the exception of Catchment Area 3, the lands surrounding the proposed development are considered a terminal basin where run-off accumulates within low lying areas discharging from the point of lowest elevation within the basin when maximum pond storage elevations have been exceeded.

A field survey was completed for the development site and surrounding area to determine the local drainage characteristics including estimation of the total permanent storage capacity of the existing low lying areas within the terminal basin. Current provincial regulations require that sufficient land area is set aside within a proposed subdivision to retain its natural water storage capacity as well as to safely accommodate the storage of any incremental increase in run-off associated with the development of the land.



Associated Engineering

STORMWATER MANAGEMENT

The conceptual drainage plan has been developed to mimic the natural drainage for the site. Run-off generated within the development will be directed to the existing ponds which will be enhanced in conjunction with site development to provide sufficient storage capacity to detain the run-off associated with a 1:100 year 24-hour storm event. The green shaded areas are intended to be dedicated as municipal utility parcels to accommodate the potential expansion of the ponds during extended periods of high precipitation and during spring run-off. An additional 15 metre easement is proposed to surround this area to provide additional security to properties abutting the utility parcels.

A safe building elevation has been established for the lots located adjacent to the ponds. Grading of the pond areas and the back of these lots will seek to formalize and distinguish water storage areas from residential building areas.

Run-off from Pond 3 is designed to be released through an existing culvert situated along Range Road 3042 at the current release rate which is less than the calculated pre-development rate. As terminal basins, Ponds 1 and 2 will continue to collect run-off until the maximum water elevation has been achieved within the larger pond system which extends beyond the project site. Once the system has reached its maximum capacity, the water will tip out of the basin at its lowest elevation which is located at its northern point situated in Section 14-37-4-W3M. As with any terminal basin, water storage capacity is regenerated primarily by evaporation.

Associated Engineering

WATER & WASTEWATER

Water

The Highway No. 41 Water Utility has confirmed its ability to supply potable water to the development from an existing line located along Highway 41. This utility currently provides treated water to a number of developments in the area including Valley View Estates, Mission Ridge and Bergheim Estates.

The Highway 41 Water Utility will design, construct and operate waterworks within the subdivision. Lot owners will be responsible for connecting buildings to the internal distribution network. The delivery flow rate to each residential lot is estimated to be 0.33 imperial gallons per minute which is considered a low pressure trickle system.

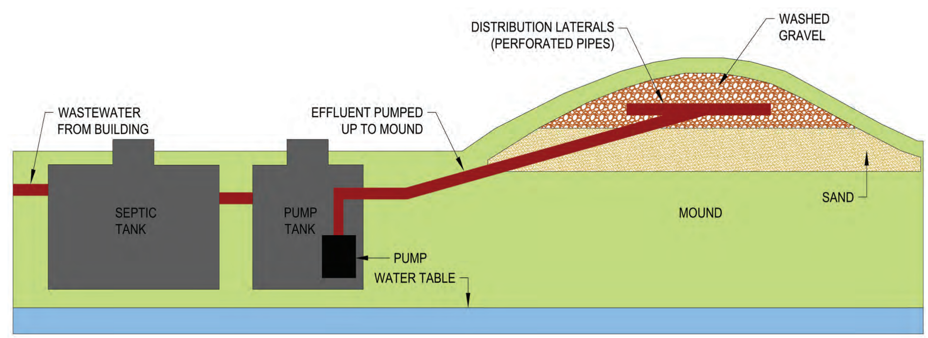
As with all low pressure rural water systems, a cistern and privately owned pressure system will need to be installed by each homeowner to provide sufficient water storage and pressure to meet daily household needs. The size of cistern required depends upon the size of the dwelling and its occupancy. The proposed water line will not have sufficient volume or pressure to provide firefighting support within the development.

Based upon an estimated three persons per household, this development will likely host a population of approximately 250 people and daily water consumption is estimated to range between 225 and 300 litres per day per capita.

Wastewater

The development has been planned to employ private on-site wastewater disposal systems to manage domestic sewage. Each property owner will be responsible for the installation, operation, and ongoing maintenance of their private system as defined by the Saskatoon District Health Region (SHR).

A hydrogeological investigation has been completed for the site and submitted to the SHR to confirm that the local soil and groundwater conditions are conducive for the use of private on-site disposal systems. The type of system required will be determined by the SHR on an application basis. Below is an image of a Type II Mound system which was considered a suitable type of private on-site wastewater disposal system as per this investigation.



Associated Engineering

OTHER SERVICES

Solid Waste Disposal

Management of domestic solid waste will be the responsibility of each property owner. The developer has contacted a local licensed hauler to confirm their ability to manage this aspect of the development. There are a number of companies offering this service that could be contracted. Alternatively, the RM of Corman Park operates a transfer station south of Saskatoon and landowners are also provided access to the Northern Landfill situated south of Martensville.

Fire and Protective Services

Fire protective services are contracted by the RM of Corman Park to fire departments situated in surrounding urban communities through agreements for service. Eagle Heights Country Estates is situated within the service area of the Saskatoon Fire Department. It is anticipated that additional support will be provided by the Town of Aberdeen and Sunset Estates volunteer fire departments on an as needed basis.

Policing for this development is to be provided by the Saskatoon RCMP detachment and the RM of Corman Park police service.

Schools

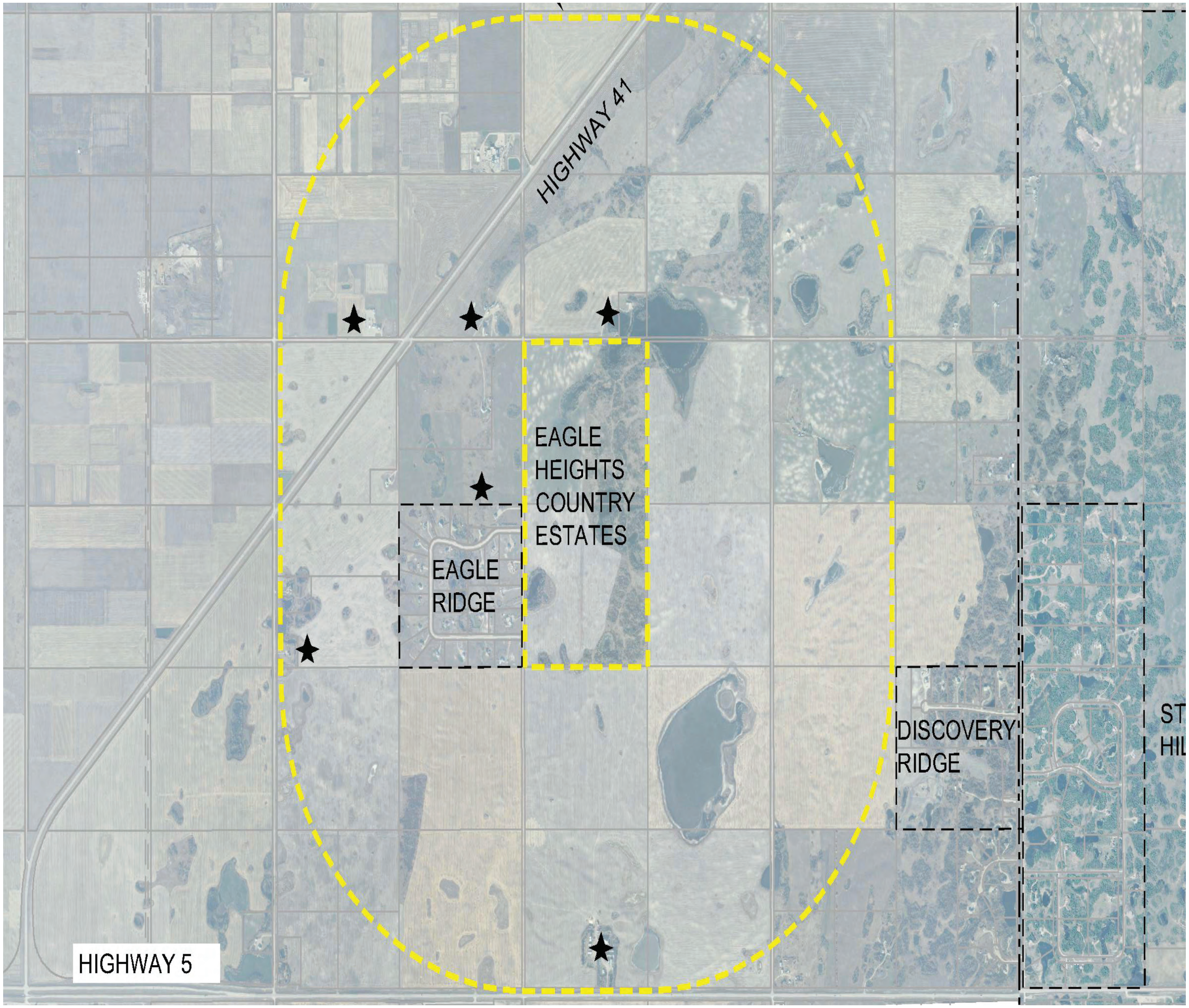
Eagle Heights Country Estates is situated within the Prairie Spirit School Division which operates schools within nearby Aberdeen and Clavet. Bus service is available to school-aged children to attend either of these schools. The school division was contacted and confirmed their ability to accommodate the additional enrollments associated with this development.

An additional option available for residents would be to register their children in the Saskatoon Public or Greater Saskatoon Catholic school systems and include this destination within their daily commute into the City of Saskatoon for work.

Associated Engineering

IDENTIFY WHERE YOU LIVE

Using a sticker, please locate where you live and/or have land holdings on the map below. Also, sticky notes are available for you to provide comments regarding any additional conditions you think the developer should be aware of.



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Eagle Ridge Concerns and Requests Regarding Eagle Heights Development

Introduction

In July 2018, a petition was unanimously signed by all residents of Eagle Ridge opposing the proposed Eagle Heights development in its current state (with the exception of 1 residence that abstained due to a conflict of interest with the new development). The petition stated - *"We the undersigned, residents of the Hamlet of Eagle Ridge, oppose the proposed development of the Eagle Heights Country Estates. The proposed development of Eagle Heights Country Estates is unreasonable and not compatible with Eagle Ridge Country Estates. The proposed development will completely change the character of our community for no good reason other than profit."*

On October 2nd, a draft copy of the Eagle Heights Country Residential Estates Comprehensive Development Review (CDR) was provided to the Hamlet of Eagle Ridge Board of Directors. The Board reviewed the CDR in detail and met with Corman Park representatives (Adam Tittemore, Administrator and Rebecca Row, Director of Planning and Development) on November 23rd and separately with Bill Delainey, Group Manager, Urban Planning with Associated Engineering on December 10th, to ask questions and provide feedback.

The following summary, prepared by the Eagle Ridge Board, details outstanding concerns including the impact to Eagle Ridge residents regarding the proposed Eagle Heights development and outlines 10 requests that would help alleviate these concerns.

Roadways and Highway Intersection Improvements

Background/Concerns:

There is currently only one way to access Eagle Ridge properties off of Highway 41 via Township Road 372 (to be referred to as "Fleury Road") and Range Road 3042. These two roadways would be shared with the proposed Eagle Heights development therefore becoming the only access roads for both developments.

A major concern is the impact that several years of construction traffic will have on current roadway infrastructure representing the only access for Eagle Ridge residents. In addition, a more than 3-fold increase in residential traffic, resulting from such a large development, would further impact the integrity of these roads.

Eagle Ridge Requests:

1. Pave Fleury Road (from Highway 41 to Range Road 3042) and Range Road 3042 (from Fleury Road to Eagle Ridge Road south access) prior to initiating Eagle Heights site development.
2. Ensure implementation of CDR recommendations for improvements to the intersection at Highway 41 and Fleury Road prior to initiating Eagle Heights site development[1]:
   - Installation of intersection delineation lighting on the east side of Highway 41
   - Installation of a right turn lane for northeast bound traffic along Highway 41
   - Reconfiguration of Fleury Road to meet Highway 41 at a right angle
3. Require a construction access road off of Fleury Road (east of Range Road 3042), as a condition of approval for the Eagle Heights development, to limit the impact of construction on the main access roadway to Eagle Ridge.

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[1] To occur in conjunction with intersection improvements at Highway 41 and Agra Road for site development west of Highway 41

Minimum Lot Size Requirements

BACKGROUND/CONCERNS:

Eagle Ridge acknowledges that the proposed Eagle Heights development complies with Corman Park Zoning Bylaw[2] 3.1. *The minimum site area shall be 0.4 ha (1 acre) and the maximum site area shall be 4.05 ha (10 acres). (Bylaw 25/08, Approved July 3, 2008)* and 4.1. *The maximum residential density for multi-parcel residential development shall be one residential lot per acre, maintaining an overall average minimum lot size of 2.47 acres throughout the proposed subdivision.*

Compliance with these bylaws would be sufficient if the proposed Eagle Heights development was to be located on its own (i.e. not adjacent to any existing developments such as Eagle Ridge). However, the proposed development is located directly adjacent to the existing Eagle Ridge development (including shared road access off of Highway 41). Therefore, consideration must be given to the multi-parcel country residential subdivision policies in the Corman Park Official Community Plan[3] including 5.2.3.15. *Where a multi-parcel country residential development is proposed on lands near or abutting an existing multi-parcel country residential development, the proposed development shall be designed to complement the existing development and respond to the reasonable concerns and interests of the residents of the existing development and where required by Council, shall provide visual buffering, house site separation, complementary lot sizing or any other measures necessary to achieve compatible land use and development.*

In accordance with policy 5.2.3.15 noted above, the following requests represent *"the reasonable concerns and interests of the residents of the existing development"* by better addressing *"complementary lot sizing"* along the common site line with the average lot size in Eagle Ridge and *"visual buffering"* between the two developments. Also requested is a very reasonable compromise for lot size, behind the common site line, resulting in slightly fewer lots for the remainder of Eagle Heights, while still being half the size of Eagle Ridge lots on average.

EAGLE RIDGE REQUESTS:

4. Apply a <u>minimum lot size of 5.0 acres</u> for all acreages <u>along the common site line</u> (i.e. entire length of Range Road 3042) to be more compatible with the average lot size in Eagle Ridge.
5. Apply a <u>minimum lot size of 2.5 acres</u> for all acreages <u>behind the common site line</u> to better transition from the common site line and reduce the number of lots to be more compatible with Eagle Ridge.

Architectural Controls/Time Limit on Construction

BACKGROUND/CONCERNS:

In keeping with the policies around multi-parcel country residential subdivision policies in the Corman Park Official Community Plan, page 22 of the CDR states: *"The developer intends to prepare and adopt lot controls which will ensure a high level of development is maintained which is consistent with current development in the area. These lot controls will reflect and build upon the architectural controls currently enforced within Eagle Ridge."* Eagle Ridge fully supports the adoption of architectural controls as per Schedule A of the Bylaws of Eagle Ridge Community Association Inc. (see Appendix A).

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[2] Rural Municipality of Corman Park No. 344 Zoning Bylaw (Consolidated October, 2018). Retrieved from https://www.rmcormanpark.ca/DocumentCenter/View/183/RM-Zoning-Bylaw---Bylaw-No-0994-PDF?bidId

[3] Rural Municipality of Corman Park No. 344 Official Community Plan (Consolidated October, 2018). Retrieved from https://www.rmcormanpark.ca/DocumentCenter/View/180/RM-Official-Community-Plan---Bylaw-No-0894-PDF?bidId

Related to architectural controls, a major concern is the length of time it will take for such a large development (occurring over 4 phases) to be completed given that Corman Park does not currently have bylaws related to construction timelines. Page 16 of the CDR states: *"Generally speaking compatible development should not unreasonably impact the use and enjoyment of your property. Factors impacting the use and enjoyment of property are typically nuisance related including noise, dust, and traffic but can also include more significant concerns related to drainage and source water contamination."* Without time limits placed on construction, there is strong potential for Eagle Ridge to experience several years, if not decades, of construction noise, dust, and traffic before the development is completed which will have a major impact on the quality of life of current residents.

EAGLE RIDGE REQUESTS:

6. Ensure architectural controls that are intended to be prepared and adopted for Eagle Heights are consistent with Eagle Ridge as per Schedule A of the Bylaws of Eagle Ridge Community Association Inc. (see Appendix A).
7. Implement time limits for construction of all houses in Eagle Heights as follows:
   - House construction must being within 1 year of purchasing lot
   - Exterior of all houses must be completed within 1 year of beginning construction (in accordance with Eagle Ridge architectural controls)

Market Demand

BACKGROUND/CONCERNS:

Bylaw 5.2.3.2, in the Corman Park Official Community Plan[4], states *"Council shall consider the current demand for and existing inventory of undeveloped multi-parcel country residential lots when reviewing multi- parcel country residential subdivision proposals"*. Page 31 of the CDR under "compliance notes" suggests that the planned density of the proposed Eagle Heights development *"reflects the current market demands"*.

There is concern with the lack of evidence provided regarding the current market demand for the proposed Eagle Heights development noting that the overall housing market in and around the Saskatoon area has changed significantly since this development was first proposed in 2012. These market demand concerns also correlate to concerns previously expressed around the time it will take for the development to be fully constructed (taking into consideration the length of time to sell all 84 lots as currently proposed over 4 phases).

Another major concern is that the proposed Eagle Heights development will affect the re-sale and depreciate the value of existing properties in Eagle Ridge during the many years of construction and following completion with newer homes in direct competition with Eagle Ridge. During the public consultation on July 11, 2018 with Eagle Ridge residents and a recent meeting between Corman Park representatives and the Eagle Ridge Board on November 23, 2018, it was stated that there is a reduced market demand for larger acreages based on a couple of recent acreage developments. Although the developer noted that *"There is no empirical evidence to support this statement"* on page 428 of the CDR, it stands to reason that if smaller lots are preferred, newer and smaller Eagle Heights properties could disadvantage older and larger Eagle Ridge properties based on direct competition in the area.

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[4] Rural Municipality of Corman Park No. 344 Official Community Plan (Consolidated October, 2018). Retrieved from https://www.rmcormanpark.ca/DocumentCenter/View/180/RM-Official-Community-Plan---Bylaw-No-0894-PDF?bidId

EAGLE RIDGE REQUESTS:

8. Provide evidence of *"current demand for and existing inventory of undeveloped multi-parcel country residential lots"* in the area (in accordance with bylaw 5.2.3.2 of the Corman Park Official Community Plan) to support the Eagle Heights development as proposed.
9. Provide evidence that the overall size and lot size/density of the proposed development will not disadvantage existing Eagle Ridge properties in terms of re-sale and depreciation in property value.

Studies/Reports

BACKGROUND/CONCERNS:

The CDR includes the findings of a series of major studies and reports undertaken by the developer including a preliminary geotechnical investigation, heritage & environmental screening, traffic impact assessment, and hydrogeological report. Eagle Ridge is not in the financial position to confirm or dispute the results of these major studies/reports but is looking to Corman Park to ensure that due diligence is followed in verifying the accuracy of report findings.

EAGLE RIDGE REQUESTS:

10. Ensure that due diligence is followed to verify the accuracy of findings in the major studies and reports included in the CDR.

Appendix A

BYLAWS OF EAGLE RIDGE COMMUNITY ASSOCIATION INC.

TABLE OF CONTENTS

1. DEFINITIONS

In these and all other bylaws of the Corporation, unless the context otherwise requires or specifies:

(a) "Act" means *The Non-profit Corporations Act, 1995*, as amended or replaced from time to time, and in the case of such amendment, any references in the bylaws of the Corporation shall be read as referring to the amended provisions;

(b) "the Corporation" means Eagle Ridge Community Association Inc.

(c) "the directors", "board" and "board of directors" means the directors of the Corporation for the time being;

(d) the headings used in the bylaws are inserted for reference only and are not to be considered in constructing the terms thereof or to be deemed in any way to clarify, modify, or explain the effect of any such terms;

(e) all terms contained in the bylaws and which are defined in the Act shall have the meanings given to such terms in the Act;

(f) words importing the masculine gender shall include the feminine, and words importing the singular shall include the plural and vice versa;

(g) "regular member" means a resident of Eagle Ridge Estates or a resident of a household connected to and utilizing the Eagle Ridge central water system.

(h) "voting member" means one representative from a residence of Eagle Ridge Estates or from a residence connected to and utilizing the Eagle Ridge central water system.

(i) "Eagle Ridge Estates" shall include the area encompassed by the southeast quarter of section ten, township thirty-seven, range four, west of the third meridian.

2. OBJECTS

The objects of the Corporation are:

(a) to operate the central water system for the use of all members;

(b) to provide facilities, recreation, social and other like services to members;

(c) to promote better acquaintance, understanding and co-operation among members;

(d) to provide a forum for the discussion and distribution of information on matters of interest to members.

3. FISCAL YEAR

The fiscal year of the Corporation shall end on the 31st day of March in each year.

4. **MEMBERSHIP**
   (a) The membership of the Corporation shall consist of regular members who are entitled to all privileges of membership. The voting member's privileges also include the right to vote at meetings of members.
   (b) Voting members will pay an annual fee to the association of $75.00/year.
   (c) Any person who is eligible for admission as a voting member may, upon payment of the prescribed fee, be admitted as a voting member by resolution of the directors.
   (d) Membership fees are not refundable.

5. **MEETINGS OF MEMBERS**
   (a) An annual meeting of members shall be held in the month of June in each year at a time and place to be fixed by the previous annual meeting or by the directors.
   (b) At least one other meeting of members shall be held in each calendar year at a time and place to be fixed by the directors.
   (c) (i) The president may call a special meeting of members at any time but shall do so upon the written request of at least 10% of the voting members.
   (ii) All business transacted at a special meeting of members or at an annual meeting of members, other than consideration of financial statements and an auditors report, election of directors and reappointment of an incumbent auditor, is deemed to be special business.
   (iii) No special business may be transacted at a meeting of members unless the notice of meeting stated the nature of the business in sufficient detail to permit members to form a reasoned judgement thereon.
   (d) Notice of the time and place of a meeting of members shall be sent, not less than 15 days or more than 50 days before the meeting, to each member entitled to attend the meeting and to the auditor.
   (e) (i) No voting member is entitled to more than one vote on any questions.
   (ii) Voting members shall vote by a show of hands except where a ballot is demanded by a voting member either before or after a vote by show of hands.
   (f) One-half of all voting members of the Corporation personally present at the opening of a meeting shall constitute a quorum.
   (g) The latest revised edition of Roberts Rules of Order shall govern the conduct of meetings.

6. **DIRECTORS**
   (a) The directors shall manage the activities and affairs of the Corporation.
   (b) The directors of the Corporation shall consist of a president, vice president, secretary, treasurer and a minimum of three or a maximum of five other members.
   (c) Directors shall be elected at the annual meeting.
   (d) Directors hold office until the conclusion of the meeting at which their successors are elected.
   (e) Subject to (d), the term of office of a director shall be 1 year.
   (f) The voting members may, by ordinary resolution at a meeting called for that purpose, remove any director(s) from office.
   (g) Where there is a vacancy on the board of directors and;
      (i) where there is a quorum of directors, the remaining directors;
         a) may exercise all the powers of the directors; or
         b) may fill the vacancy until the next annual meeting;
      (ii) where there is not a quorum of directors, the remaining directors shall call a general meeting for the purpose of electing regular members to fill any vacancies.

(h) Any remmeration paid to directors must be approved by the regular membership.
(j) Every director shall be given, by letter, telephone or otherwise, at least 5 days notice of every meeting of directors.
(k) Attendance of a director at a meeting of directors is deemed to be a waiver of notice of the meeting, unless the director attends the meeting for the express purpose of objecting to the transaction of any business on the grounds that the meeting was not lawfully called.
(l) The quorum at board meetings shall be a majority of the board.

7. OFFICERS

The board of directors shall designate the offices of the Corporation, appoint persons as officers, specify the duties and delegate powers to manage the business affairs of the Corporation to them.

8. FINANCIAL DISCLOSURE

(a) The directors shall place before the members at every annual meeting:
- (i) financial statements for the year ended not more than 4 months before the annual meeting;
- (ii) the report of the auditor, if any; and
- (iii) any further information respecting the financial affairs of the association.

(b) The directors shall approve the financial statements and shall evidence their approval by the signature of one or more directors.
(b) No financial statement shall be released or circulated unless it has been approved by the directors and is accompanied by the report of the auditor.
(c) The Corporation shall, not less than 15 days before each annual meeting, send a copy of its financial statements and report of the auditor to each voting member and to the Director, Corporations Branch, Saskatchewan Justice.

9. AMENDMENTS TO BYLAWS

(a) The directors may, by resolution, make, amend, or repeal any bylaws that regulate the activities and affairs of the Corporation.
(b) The directors shall submit a bylaw, or an amendment or repeal of a bylaw to the next meeting of voting members and the voting members may, by ordinary resolution, confirm, reject or amend the bylaw, amendment or repeal.
(c) A bylaw, or an amendment or repeal of a bylaw is effective from the day of the resolution of directors until confirmed, confirmed as amended, or rejected by the voting members.
(d) If a bylaw, or any amendment or repeal of a bylaw is rejected by the voting members or is not submitted to the next meeting of members, the bylaw, amendment or repeal thereof, ceases to be effective and no subsequent bylaw, amendment or repeal having substantially the same purpose or effect shall be effective until confirmed or confirmed as amended by the voting members.

10. ARCHITECTURAL CONTROLS

Architectural controls as listed in the attached Schedule "A" shall apply to all residents of Eagle Ridge Estates.

11. LIQUIDATION AND DISSOLUTION

The remaining property of the Corporation shall, in the course of liquidation and dissolution, be transferred equally to the voting members.

SCHEDULE "A"

Whereas the Corporation wishes to maintain the general character of the said lands and to that end to declare, establish, impose and annex to the said lands as conditions or covenants running with the said lands the stipulations, restrictions, conditions and provisions hereinafter mentioned, the same to be in force and run with the said lands and be binding on the owners of the said lands and all persons claiming under them as follows:

1. The said lands shall be used for residential purposes only with not more than one detached dwelling house erected on the said lands and no attached or semi-detached house, duplex or apartment, or any house or building designed for more than one family shall be erected on the said lands.

2. No residence shall be erected on the said lands exceeding two stories in addition to a basement, if any.

3. Buildings of any kind for private use other than dwellings may be erected upon the said lands, but not to exceed a height of 18 feet or a combined total area of no more than 1000 square feet of all outbuildings on the said property.

4. No poultry, birds, livestock or animals of any kind shall be kept on the said lands except the Owner may keep horses, dogs, cats, rabbits, or other family or household pets but in each instance no more than two (2) in number or in accordance with R.M. bylaws, if numbers differ with this agreement, the R.M. Bylaws shall prevail. No Owner shall have swine of any kind on the development.

5. No house shall be erected which shall have an area of less than:

    1,500 square feet for the main floor of a one-story house.
    2,000 square feet for the both levels of a two-story house

    1,500 square feet for the total of the top two levels of a split-level house.

    1,500 square feet for the main floor of a bi-level house.

    The measurements shall be taken from the exterior walls but shall exclude any attached garage, patio or porch.

    Each residence shall have a minimum double attached garage

    The exterior must be completed within one year of beginning construction and must be stucco, or combination brick, stone, stucco. An exemption may be allowed in the case of a Victorian style house.
    Roof material must be asphalt shingles, minimum requirement skyline, renaissance, or equivalent style.
    All buildings will have a minimum roof pitch of 5/12.

6. No trailer, mobile home or unit used for the purpose of living accommodation shall be used or left upon the said lands for a total period of more than six (6) months during

construction, however, this shall not restrict the Owner from maintaining a "recreational vehicle" or "holiday trailer" on the said lands.

7. No excavation shall be made in or to the said lands and no soil, sand or gravel shall be removed from the said lands except for the purpose of building or for the improvement of the grounds or natural terrain of the said lands and no soil, sand or gravel shall be removed from the said lands.

8. No inoperative vehicle or large commercial type vehicles such as but not limited to dump trucks, cement mixer, oil or gas trucks, tractor trailer, or farm machinery and no unsightly objects, materials or debris shall be stored, moved onto or left upon the said lands and the entire site and all improvements thereon including but no restricted to landscaping, buildings, fences and other structures shall at all times be made from new materials and maintained in a neat and tidy manner and kept clean and, where applicable, repainted so often as may be reasonably required so not to give a "run down" or "worn" appearance.

9. No used building or structures may be moved upon the said lands.

10. Fencing - All fencing rails and posts shall be painted or stained white. Standard fence shall be a three (3) rail wood fence consisting of 5" to 6" x 7ft treated round posts spaced at 8 ft and rough 2 x 6 x 16 ft slabs.

11. Wires and electrical lines - No wires or electrical lines shall be strung on the said lot above ground level or attached to the exterior of any residence, clotheslines shall be permitted.

12. This development is governed by a zoning agreement with the R.M. of Corman Park. All residents shall abide by and be aware of this agreement.

13. It is highly recommended by the Corporation, that persons owning lots immediately adjacent to surrounding farm lands refrain from planting trees, shrubs or gardens within fifty (50) feet of those said farm lands. Anyone doing so, does so at their own risk and may not hold the adjacent farmer or landowner liable for any damages caused by drift, inversion or overspray during normal spraying operations.

14. It is also understood that any persons owning lots in the subdivision may not hold any farmers or land owners in the surrounding area liable for any noises or smells that may occur in the operation of normal farming practices or in the raising of animals.

15. The Corporation may not be held liable for any persons and or lot owner in the development that breaks or does not conform with the above restrictions.