Greensview Estates Residential Development

Comprehensive Development Proposal

Final Submission

Prepared by:

WCE design inc.
80 Emerald Ridge East
White City, SK, Canada S4L 0C3
306.540.8312

Project Number:

22-073

Date:

June 19, 2023

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June 21, 2023

Paige Boha, B.A.
Manager of Planning and Development
RM of Edenwold No. 158
306.347.2967

Dear Mrs. Boha:

Project No: **22-073 – Greensview Estates Residential Development**

Regarding: Comprehensive Development Proposal

WCE design inc. is pleased to submit this Comprehensive Development Proposal for the Greensview Estates development located on SE 22-17-18-W2M. This proposal establishes the requirements to develop Blk/Par BB-Plan 102138342 Ext 0 and outlines the objectives and goals of the development as defined in the RM of Edenwold's Official Community Plan and Zoning Bylaws.

Should you have any questions, please contact the undersigned at 306.540.8312.

Sincerely,
WCE Design

Dustin Weiss, P. Eng.
Senior Civil Engineer
WCE Design
dustin.weiss@wcedesign.ca

DW:dw
Encl.
cc: 101270981 SASKATCHEWAN LTD

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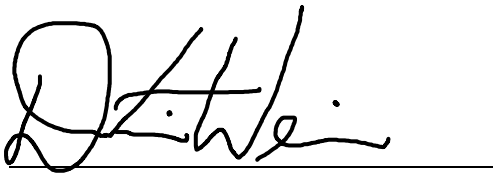
Revision Log

Revision #	Revised By	Date	Issue / Revision Description
0	DAW	22-12-01	Issued for Draft Review
1	DAW	22-12-07	Issued as Draft Submission
2	DAW	23-01-13	Issued as Final Submission
3	DAW	23-02-08	Issued as Final Submission
4	DAW	23-06-21	Re-Issued as Final Submission

WCE Design Signatures

Report Prepared By:



Dustin Weiss, P. Eng.
Civil Engineer
WCE design inc.

Executive Summary

WCE Design (WCE) was commissioned by 102035126 SASKATCHEWAN LTD. (the Developer) to complete a Comprehensive Development Proposal (CDP) for the proposed for development of Blk/Par BB-Plan 102138342 Ext 0 in the SE ¼ Section 22-17-18 W2M in the Rural Municipality of Edenwold No. 158 (the RM).

It is the intent of the Developer is to provide 2 multi-family 3-storey buildings with the potential of a full build out of 7 buildings once there is adequate wastewater treatment capacity from the wastewater authority WCRM 158. This CDP report will explore the requirements for the proposed 2 multi-family 3-storey buildings but will ultimately investigate the capacity for up to 7 multi-family 3-storey buildings in total. Currently, the application is only for re-zoning for 2-multi storey buildings. All additional building phases will require revisions to this CDP and subsequent RM council approval. Each phase will also require separate development agreements.

The RM of Edenwold is currently experiencing a residential housing shortage for the entry level or attainable market. This development is designed to meet this need in the residential market. The region is recognized as a good location to invest in and to raise a family. A need for entry level homes, retirees, or those looking to downsize, but still live in the community or in a rural setting is required in the community. This development does not compete directly with residential development currently within Emerald Park or White City.

Parcel BB is in an area designated as Heritage Sensitive. Heritage Research Branch, Archaeological Resource Management Unit of the Ministry of Parks, Culture, Heritage, and Sport had been contacted and a heritage screening was conducted. The Heritage Resource Branch has no issue with the project proceeding and the parcel has been cleared.

Parcel BB is in an area designated as Extreme Sensitivity to the Aquifer. Section 3.24C.1 of the Zoning Bylaw may require the Developer to provide an Aquifer Protection Plan. A geotechnical investigation was completed on the site in by Ground Engineering Consultants Ltd. Included in this report is an action plan from the geotechnical engineer to construct within the aquifer sensitive area.

Parcel BB is not in an area designated as flood prone, hazardous, or environmentally sensitive.

The development is located on Treaty 4 Territory, the original lands of the Cree, Ojibwe (OJIB-WĒ), Saulteaux (SO-TO), Dakota, Nakota, Lakota, and on the homeland of the Métis Nation. There are no known First Nation lands within 3.5 kilometres of Parcel BB.

The proposed 2 building plan is included in Appendix A. Access to the site will be made from the south service road (Great Plains Road) and McLeod Road. All internal parking and circulation roads will be owned and maintained by the developer.

Site drainage will maintain the existing drainage patterns and incorporate stormwater storage for the 1:100 year storm event. Stormwater will be conveyed with ditches and bioswales to promote water infiltration and other sustainable practices. A detailed Drainage plan can be found within the Appendices.

Water service will be provided by connection to the RM of Edenwold's water distribution system, with a stub located on McLeod Road. Wastewater will be collected and conveyed to the existing sanitary collection system via a manhole on McLeod Road. Currently, the capacity of the wastewater treatment facility will only provide for 2 buildings at this time and this report will speak to these two proposed buildings while addressing the feasibility of multiple units.

Shallow utilities (SaskPower, SaskEnergy, and SaskTel) are in the immediate vicinity of the development. The necessary installation and connection fees will be borne by the developer and servicing will be completed during the development permit phase.

Both a traffic noise noise study and a geotechnical report have been conducted for this site and can be found in the appendices. The noise study found the future noise is within the accepted limits of an outdoor amenity space. The geotechnical report provides the parameters for backfilling, pavement structures, and foundations. The water table is high in this region, which is quite typical with the Emerald Park area. The site is proposed to be built up and this should help mitigate any concerns from ground water.

Fire fighting services are to be provided by the RM. The RM also has standard fire protection agreements with Balgonie, White City, Pilot Butte, City of Regina the Village of Edenwold, and the Hamlet of Kronau. Fire service capacity was confirmed from the RM's Fire Chief, as the current Fire Hall has capacity to deliver services to this development with redundancies from neighbouring detachments.

Police services in the RM are provided by the RCMP's White Butte Detachment.

Residential zones are also required to comply with the landscaping and buffer requirements as outlined in Section 4.44. As part of the Development Agreement process with the RM, the Developer will be required to submit a detailed Landscaping Plan for this entire parcel. A detailed pedestrian access plan will be provided as part of the landscape design. Landscaped areas are shown on the concept plan in Appendix K.

The site requires re-zoning, and a public consultation is to take place by mail-out and comment sheets. No open house is required is required as part of the CDP process. However, the Discretionary Use process may require an open house prior to the public hearing. The mail out portion has been completed, with the questions and responses appended to this report.

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1.0 Introduction

This Comprehensive Development Proposal (CDP) is prepared on behalf of 102035126 SASKATCHEWAN LTD. (the Developer) in support of an application for development of a property located in the Rural Municipality of Edenwold No. 158 (the RM).

The location of the proposed development is shown in Figure 1.1. The development is located within Emerald Park and south of the Highway 1 south service road. The registered owner of Blk/Par BB-Plan 10213842 Ext. 0 in the SE ¼ Section 22-17-18 W2M is 102035126 SASKATCHEWAN LTD. It is the intent of the Developer to develop this parcel into a multi-family development as illustrated in Appendix A for Phase 1 and Appendix G for the full build out. The RM's future zoning map 7A shows the parcel as future mixed use residential/commercial.

This CDP is prepared in accordance with Sections 3.23 of the Zoning Bylaw and provides a framework for the proposed parcel of land for the purpose of developing multi family units on the existing parcel.

Figure 1.1: Location Map

2.0 Existing Conditions

2.1 Existing Land Use

The proposed development site (Parcel BB) is 5.447 hectares (13.46 acres). The site is generally flat terrain and is currently undeveloped. The site is generally grass with some rows of deciduous trees.

In the past, the site has been used as part of the existing golf course and contains an old irrigation pond. The land had been previously disturbed and graded into golf course land. Currently the site has been left undeveloped and not used.

Aerial images for the site from 2020 and 2011 are shown in Figure 2.1[1] and Figure 2.2[2], respectively.

Figure 2.1: Aerial Image from 2021

[1] *Google Earth*
[2] *Google Earth*

Figure 2.2: Aerial Image from 2011

2.2 Adjacent Land Use

Land use in the area is mixed. Parcel BB is currently zoned as Future Development as shown in Figure 2.3. The parcels immediately surrounding Parcel BB are zoned as General Commercial (COM1) and General Industrial (IND1). These parcels include a golf course to the east with some residential bordering the east property line of that golf course parcel. The west property boundary of Parcel BB is bordered by commercial stores, storage units, and Highway No. 1 and the south service road border the north of this property. Development on the north side of the highway is comprised of commercial and industrial developments.

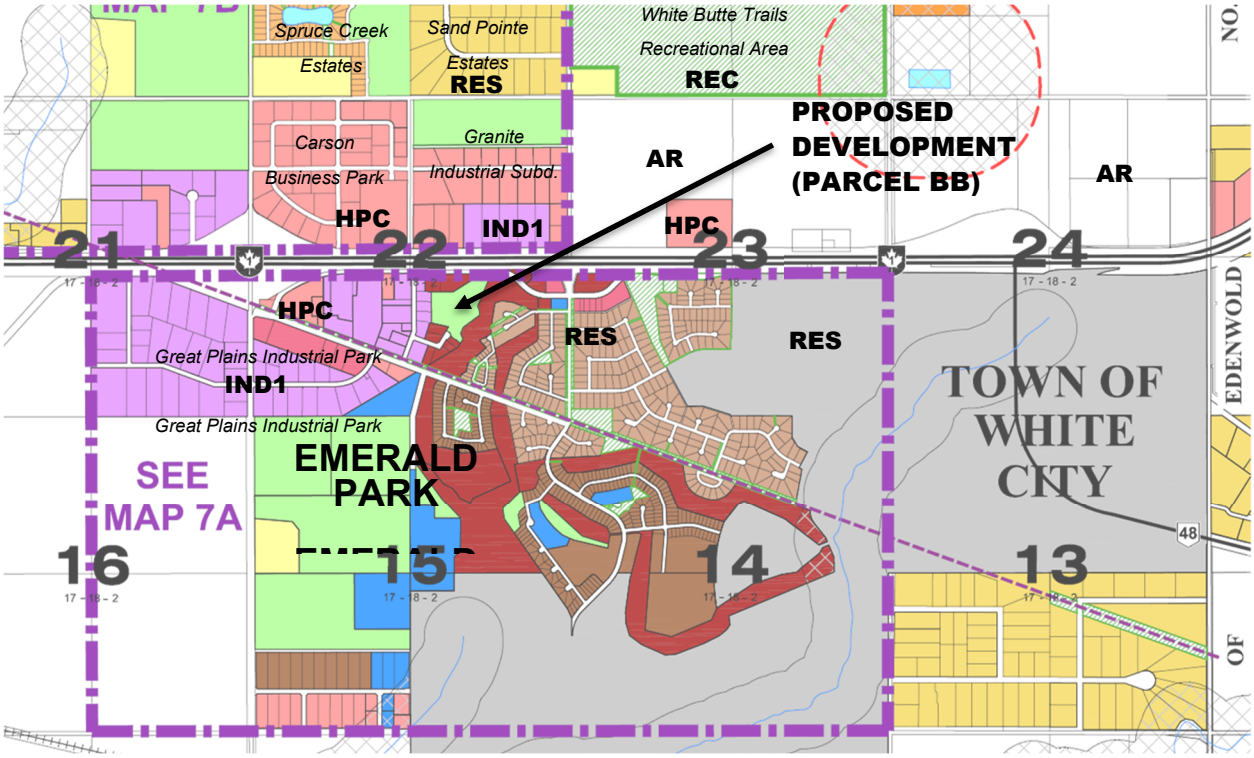


Figure 2.3: Current Land Use Map

2.3 Existing Roadway Network

Existing roadways in the area include:

- Highway No.1 runs east-west along the north side of Parel BB. Service roads are provided on the north and south sides of Highway No. 1 for access to businesses. Access to the proposed development is from the existing two-lane, paved South Service Road known as locally and will be referred to as Great Plains Road, along the north side of the property.

- McLeod Road is a bay on the south side of the development. This road provides a second access to the development and serves multiple industrial/commercial businesses in the area. This road connects to Percival Drive which then leads to either the Great Plains Road or South Plains Road, which are the two major distribution roads in the community.

2.4 Existing Municipal Services and Utilities

Existing Municipal Services in the area include:

- A 200 mm PVC water line is located at McLeod Rd. The water line is stubbed at the end of the bay.
- A manhole serviced by a 200mm PVC sanitary sewer is in the bay of Mcleod Rd.
- There is no minor stormwater system. The Community manages stormwater with above ground drainage.

Existing Utilities in the area include:

- SaskPower also has a high voltage transmission line 100-300 meters east of the site.
- TransGas has a pipeline on the east boundary of the site that runs south to Betteridge Road.

2.5 Topography

The site is relatively flat with drainage trending from northwest to southeast as shown in Figure 2.4[3]. Runoff from the site flows through the Golf Course irrigation ponds and flows south through a defined ditch system through Emerald Park. Eventually the stormwater is conveyed to an unnamed creek south of Highway No. 1 via a series of culverts and ditches. The creek eventually flows into Wascana reek at the east side of Regina.

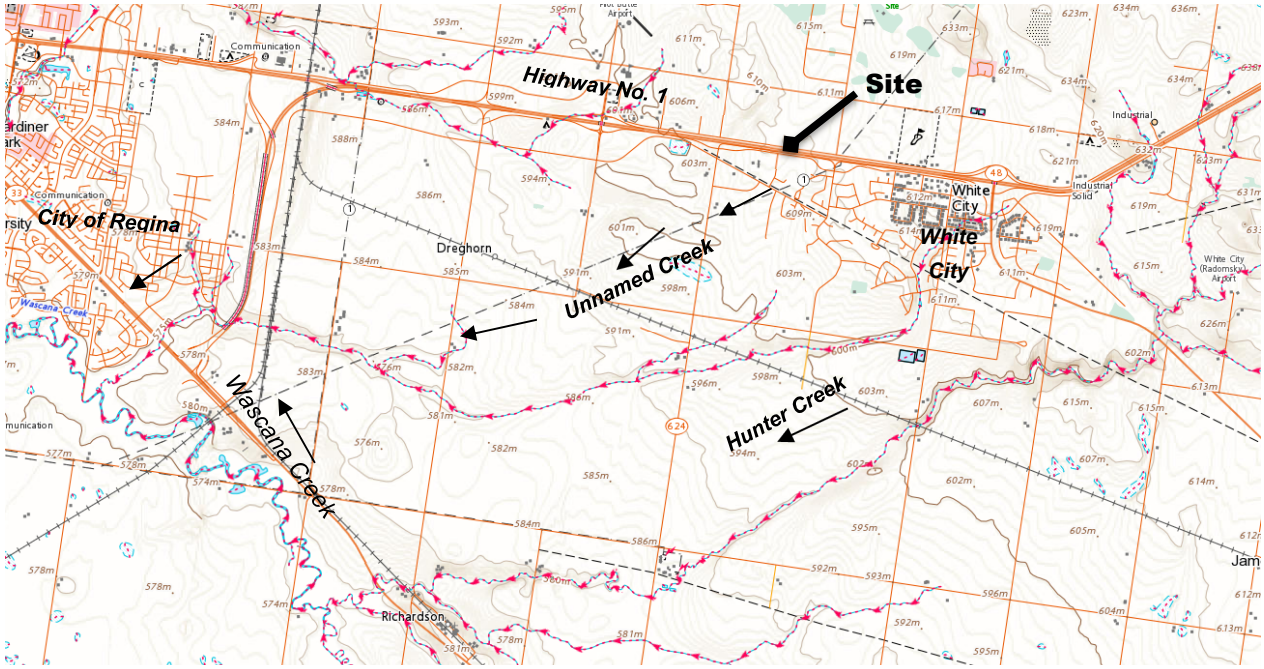


Figure 2.4: Existing Topography

[3] *https://atlas.gc.ca/toporama/en/index.html*

2.6 Regional Surface Geology and Soils

The site is situated on a glacial-fluvial deposit (GFp) as shown in Figure 2.5[4]. GFp deposits generally consist of gravels, sand and silt accumulations transported and deposited by glacial meltwater

Surficial soils in the vicinity or Parcel BB are classified as Class 4 and 5[5]. Class 4 soils have severe limitations that restrict the range of crops that can be planted and require special conservation practices, such as zero-till. Class 5 soils have very severe limitations that restrict their capability to producing perennial forage crops, but improvement practices are feasible.

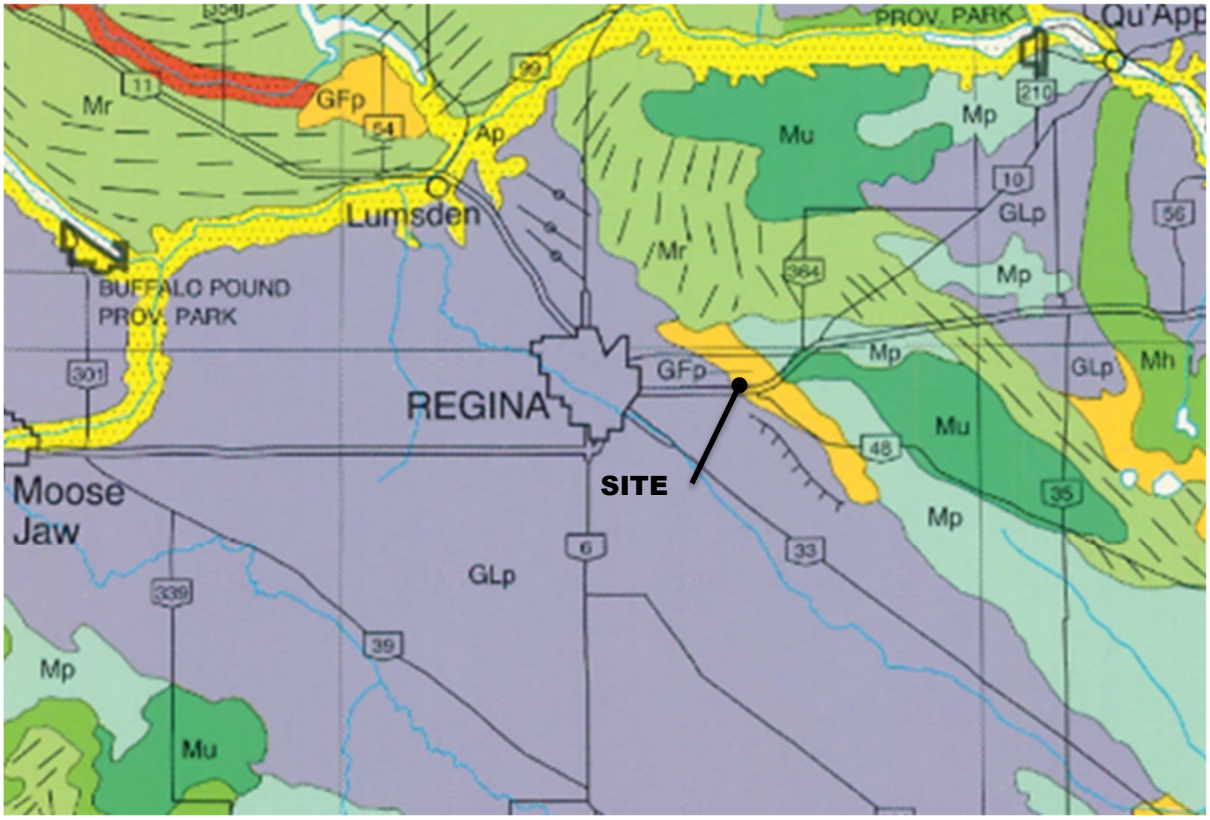


Figure 2.5: Regional Surface Geology

[4] *Surficial Geology Map of Saskatchewan, Saskatchewan Geological Survey*
[5] *RM of Edenwold, Soil Class (Map 8)*

3. Proposed Development

3.1 Policy Context

The development is intended to be a development of multi-storey apartment buildings that back onto the golf course to provide a transition between the industrial/commercial zone and the existing single-family residential. This development is intended to provide a class of home (multi-family), which is currently underserved in this area.

Parcel BB and the proposed development fall within the Urban Residential District 3 (R3). The developer is proposing 2 – 3 storey residential buildings containing 59 units each for a total of 118 units.

The CDP will look at the capacity for the 2 building units along with the potential to add up to 7 buildings. The future concept showing additional phases can be found in the appendix, however the re-zoning request is strictly for the phase 1 - 2 buildings. All additional building phases will require revisions to this CDP and subsequent RM council approval. Each phase will also require separate development agreements.

3.1.1 Land Use and Zoning

The land is currently located within the Emerald Park Business District zoned Future Development and would have to be re-zoned as Urban Residential District 3 (R3) which fits within the RM's Official Community Plan. The OCP designates this area to be a Mixed Use (Res.Com/CS), which the development meets these requirements.

The Proposed development meets the Community Priorities identified in Section 1.6 of the OCP. This parcel provides a buffer or transition between the existing residential lots located on the golf course and the commercial businesses located in the Emerald Park Business District (EPBD). It does not conflict with the adjacent land uses and compliments the existing subdivisions by providing a buffer, improves walkability in the area and completes an undeveloped area within the community.

The proposed development is considered a compatible use with the EPBD as outlined in section 3.9.4 of the RM's OCP and is currently shown as 'Mixed Use (Res/Com/CS)' on the future zoning map 7B and is a proposed future growth area as per Map 15, Growth and Intensification Areas.

The following clauses from the Zoning Bylaw have been addressed:

Clause 3.20 – Additional information is included with this submission.

Clause 3.24C – An aquifer protection plan has been included in section 3.3 and Appendix D.

Clause 3.24D – A public consultation will be conducted and is outlined in Section 3.12.

Clause 3.24E – A transportation plan can be found in Appendix F and is discussed in section 3.7.4.

Clause 3.24G – Noise Impact Study to be completed, where deemed necessary by the municipality. The Noise Impact Study was completed for the site and can be found in Appendix I.

Clause 3.24l – See attached the attached Landscape plan in Appendix G & K, which meets the RM's Zoning Bylaw. Phase 1 detailed landscaping will be confirmed in the detailed design phase under the development agreement.

Clauses 3.33/3.35 – Developer is prepared to pay appropriate Development and Connection Fees.

Clause 4.10 – The proposed grading & drainage plan is located in Appendix C and complies with the General Design Standards to be approved by the Municipal Engineer.

Clause 4.11 – No fencing is anticipated between the units. This will be accomplished with landscaping. A perimeter landscaped buffer will be constructed to separate the development from the existing commercial businesses.

Clause 4.15 – RM standards will be followed for the design of the road connections. All surfacing within the development will be asphalt. The development will meet all requirements of the Saskatchewan Ministry of Highways and Infrastructure.

Clause 4.22 – Development lighting to be designed in accordance with RM of Edenwold Bylaw. The lighting design will be submitted at the development permit stage and will not be directed to adjoining properties, interfere with use/enjoyment of neighbouring lands, or interfere with the effectiveness of any traffic control devices or the vision or safety of motorists.

Clause 4.27 –Parking on site to follow the recommendations of 1.25 stalls per residential unit. Parking stall counts can be found on the concept plan in Appendix A and G.

Clause 4.28 –Bicycle Parking and Facilities will be provided as part of the detailed landscaping plan at the at the time of the Development Agreement.

Clause 4.33 - A geotechnical report has been conducted. The report has been included in Appendix H.

Clause 4.36 – Heritage screening and clearance has been executed for this site and can be found in Appendix E.

Clause 4.44 – Landscape buffers will be provided as per the bylaw and detailed at the development permit stage. The concept plan in Appendix G & K, illustrates the buffer areas adjacent to the neighbouring properties.

Clause 4.45 – A landscape buffer will be provided to reduce noise from the Provincial Highway to the development. This development will create additional noise buffer to adjacent existing residential subdivisions. The developer will obtain the required permits from the Ministry. A traffic noise study has been completed and included in Appendix I.

Clause 4.46 – The proposed concept plan meets the setback requirement for the development to pipelines.

3.1.2 Market Assessment

The RM of Edenwold is currently experiencing a residential housing shortage for the entry level or attainable market. This development is designed to meet this need in the residential market. The region is recognized as a good location to invest in and to raise a family. A need for entry level homes, retirees, or those looking to downsize, but still live in the community or in a rural setting is required in the community. This development does not compete directly with residential development currently within Emerald Park or White City.

3.1.3 Servicing Costs/Levies/Tax Revenue

The developer will be responsible for the construction and maintenance of the infrastructure. The developer is prepared to pay the required Servicing Agreement Fee, Development Agreement Fee and/or connection fees and performance securities to complete this development. As the development will remain private no infrastructure will be turned over to the RM, but instead be managed by the property manager assigned to this development.

When examining the tax revenue for the RM, it is assumed that each unit has tax $3,000 per year. With the 118 unit the tax revenue is approximately $354,000 per year with a total of $7,080,000 in 20 years. As the RM is already providing the services in the area and maintaining all existing roads there is a minimal yearly cost added to the RM. This development would be considered an in-fill or brown field development.

Looking at the potential future build out bringing the unit total to 366 the tax revenue equates to $1,0980,000 per year or a total of $21,960,000 over 20 years.

3.2 Geotechnical Investigation

A geotechnical investigation was completed on the site in 2022 by Ground Engineering Consultants Ltd. The report along with an aquifer protection plan has been appended to this report, both completed by the geotechnical consultant.

3.3 Aquifer Sensitivity

Parcel BB is in an area designated as having Extreme Sensitivity to the Aquifer. An aquifer protection plan will be submitted to the RM as part of the development/building permit process. The plan includes measures for protection of the aquifer during installation of foundations as well as water and sewer services.

Aquifer sensitivity and protection measures have been outlined in the Appendix D a letter from Ground Engineering. The protection plan states:

- The existing water ponds should be pumped out and backfilled with highly plastic clay or clay till obtained from a pre-approved borrow source. Random fill form various sources shall not be permitted. Importing of the fill shall be monitored and the fill shall be placed in lifts which are compacted. Backfilling the ponds in this manner will limit the potential contamination of the underlying aquifer.

- Building foundations will include driven steel pipe/H beams and augercast concrete piles. For lighter loads, screw piles and footings may be an option. Regardless of the foundation type selected, the building foundations will not increase the contaminant risk of the aquifer.

- Installation of the site services(water/sewer) will require excavations which may extend below the water table in some areas. The trenches may be backfilled with the excavated soil which is placed in lifts which are compacted. Backfilling the trenches in this manner will limit the potential contamination of the underlying aquifer.

- Bioswales will be constructed as part of the surface drainage plan. Properly designed and constructed bioswales will limit the potential contamination of the underlying aquifer.

- No fuel shall be stored onsite during and after development.

3.4 Heritage Resources

Parcel BB is in an area designated as Heritage Sensitive. Heritage Research Branch, Archaeological Resource Management Unit of the Ministry of Parks, Culture, Heritage, and Sport had been contacted and a Heritage Screening has been conducted with the response letter appended to this report in Appendix E.

The Heritage Research Branch has no concern with the project proceeding as planned and the potential for the project to impact intact significant heritage sites is low. It should also be noted the heritage review was conducted for the entire external boundary of the parcel and no additional heritage review would be required for changes to the site layout within the Surface Parcel 20284880 boundary.

3.5 Environmental Sensitivity

Parcel BB is not in an area designated by the RM as flood prone, hazardous, or environmentally sensitive.[6]

3.6 First Nations

The development is located on Treaty 4 Territory, the original lands of the Cree, Ojibwe (OJIB-WĒ), Saulteaux (SO-TO), Dakota, Nakota, Lakota, and on the homeland of the Métis Nation.

There are no known First Nation lands within 3.5 kilometres of Parcel A.

[6] *RM of Edenwold, Sensitive Environmental Areas (Map5B)*

3.7 Site Services

A pre-engineering report was conducted for the entire buildout of the development. This would be the largest demand on the infrastructure. This report has been appended to the report. It studied the potential to have 7 buildings on the site footprint and the requirements for water distribution, stormwater management and sanitary sewer collection. The RM's sanitary collection system and the water distribution system both had adequate capacity for all 7 building, totalling 408 units. For the development on the full site a stormwater detention system would be required to store the post development runoff. This storage requirement is 3,410m^3. The existing ponds on site will be utilized to provide this stormwater detention volume. The pre-engineering report has been appended to this report for reference.

Below is the breakdown for servicing the 2 proposed buildings.

3.7.1 Water

The proposed development is proposed to connect to the RM of Edenwold's Emerald Park water distribution system. Water service for this development will be made by a connection to the water stub on McLeod Road. The following summarizes the water system requirements:

- Residential Units = 118 units
- Residential Population = 2.3 c/unit
- Population =272 c
- Water usage per capita =390 L/c/day
- Average Day Demand (ADD) = 106,080 L/day
  =106.08 m^3/day
  =1.23 L/s
- Peak day Demand (ADD x 2.1) =2.58 L/s
- Peak Hour Demand (ADD x 3.2) =3.94 L/s

Based on these demands a 200mm distribution system can be utilized and to make the connection to the RM's infrastructure.

Upon review of the existing water distribution system the RM has determined there is adequate capacity to mee the water demands and this capacity was confirmed with the water model in the pre-engineering report.

The developer will make an application to the WSA upon approval of the CDP with the detailed engineering design.

The figure in Appendix B illustrates the proposed system for Phase 1. Sprinklered buildings only require a 45m hydrant distance to the siamese fire hose connection. The water distribution connects to McLeod Road. The pre-engineering report in Appendix J outlines the full build out servicing.

3.7.2 Wastewater

Wastewater volumes are calculated based on the same population as the water and using 225 L/day. The total volume of wastewater from the proposed development is 61.2 m^3/day or a flow rate of 0.71 L/s as DWF (dry weather flow). Using a I%I (inflow & infiltration) rate of 0.28L/S/ha a WWF (wet weather flow) of Based on this flow rate a 200mm sanitary connection is required to the RM's sanitary sewer collection system. The proposed connection to the sanitary is the manhole on McLeod Road. The RM of Edenwold has confirmed the sanitary collection system has adequate capacity for the additional wastewater flows from this development.

Application will be required to the WCRM 158 for wastewater allocation at the development permit process. Each building requires a separate development/building permit and allocation request to WCRM 158. At this time the development is only requesting capacity for two buildings.

3.7.3 Site Grading and Drainage

The proposed grading plan for Phase 1 is included in Appendix C. The proposed development will consist of overland drainage to drainage swales/ditches, bioswales, infiltration basins, existing irrigation ponds and the existing ditch system in the area.

The proposed drainage pattern will maintain the existing drainage patterns in the are which has stormwater flowing into the existing ponds and drainage system. Upgrades to this system will be made to ensure safe pond overflow elevations and ditch outlets. The site typically drains from north to south. The major stormwater system will include capacity for the existing stormwater that enters the site from the north. The development will be required to hold the post-development1:100-year storm runoff and release the pre-development 1:100-year storm runoff. Based on the developed 1,081m^3 is required to be stored. This storage will be completed within the existing pond and controlled with a transfer structure.

In order to complete the future buildout phase, a Joint Use Agreement/Shared Utility Agreement will be required with the Aspen Village Properties developer to operate the shared pond. This will be submitted at the time of the development permit upon completion of the detailed grading design. The storm water storage requirement for the future build out can be found in the pre-engineering report.

The site will be graded to store the 1:100-year rainfall event to minimize the impact to adjacent properties. All building elevations will be set 0.5m to 1.0m above the stormwater spill point. No building shall be constructed within the 1:500 year flood plain. The proposed development is looking to utilize sustainable stormwater practice such as bioswales and infiltration basins within the storm water management plan and promote stormwater infiltration as well as runoff.

3.7.4 Site Access, Roadways & Transportation

Access to the site will be from the existing Great Plains Road and South Plains Road by way of McLeod Road.

The future buildout portion of the development will generate an additional 2,562 vehicle trips/day with 256 at the peak hour, both am/pm. The volume of vehicles will be a minimal impact on current roadways within the RM and have been considered in the area's growth projections. Both the Great

Plains Road and South Plains Road are major access roads into and out of the existing community. The Pilot Butte interchange is accessible from each road and will be the connection point to Highway 1 for residents travelling west into Regina. Residents wanting to travel east on Highway 1 will either utilize the off ramp at Great Plains Industrial Drive or the off ramp located on Emerald Park Road. Both roads that connect to the Emerald Park Business District would be used for inter-community travel.

The traffic is estimated to be a 60/40 split, with 60% (1,537 AADT) utilizing South Plains Road and 40% using Great Plains Road to access the development.

Internal roadways will remain as part of the development and not be turned over to the RM. These areas are parking lots and general circulation roadways. Parking is to be provided as per section 4.27 of the Zoning Bylaw.

As per clause 3.2.5 of the OCP, it recommends the municipality will continue to expand and upgrade the network of walkways and trail facilities. The proposed development includes pathways, common walkways and pedestrian circulation areas that connect to the existing RM pedestrian infrastructure.

3.7.5 Utilities

Shallow utilities (SaskPower, SaskEnergy, and SaskTel) are in the immediate vicinity of the development. The necessary installation and connection fees will be borne by the developer.

Utility companies will be contacted to confirm servicing requirements after approval of the CDP by the RM and will be submitted within the building/development permit phases.

3.8 Fire and Protective Services

Fire fighting services in the area are provided by the RM. The RM also has standard fire protection agreements with Balgonie, White City, Pilot Butte, the Village of Edenwold, and the Hamlet of Kronau. The RM currently has one ladder truck, while the City of Regina has an additional 3.

Police services in the RM are provided by the RCMP’s White Butte Detachment.

3.9 Phasing & Schedule

The developer will be phasing the construction of the project. A development permit application will be submitted with detailed engineering drawings for the site and services, along with a detailed landscape plan for buildings 1 & 2.

Each additional building in the future buildout will then be phased for construction under separate applications from this CDP. Phase 1 consists of the western buildings (2 buildings) and required road accesses. Future phases have not yet been decided and application will be required to the RM for each building and future phase. Approval of this phase is only for the first 2 buildings as allowed by the wastewater treatment capacity and not the entire 7 buildings. Post construction the landscaping is to be completed during the next planting season after occupancy.

3.10 Landscaping

Commercial Districts are also required to comply with the landscaping and buffer requirements as outlined in Section 3.24I and 4.44. The area between this development and the existing adjacent commercial district will require a landscape buffer.

Landscaping areas, passive park areas and an active playground are illustrated on the site plan in the Appendix K. The playground is planned to be open to all residents within the community and will be deigned for all seasons. A high-level landscape plan for the full buildout has been provided in the Appendix G and a detailed landscape plan for Phase 1 is in Appendix K. A detailed landscape plan is required as part of the development permit phase.

3.11 Pedestrian Access Plan

Pathways will be constructed within the development connecting the internal pedestrian pathways RM public pathways. The pedestrian pathway is a mix of internal sidewalks, and paved pathways connecting the residents and the internal amenities within the development. The site has been designed to promote pedestrian circulation with the area to and from residences, amenities, and pathways.

3.12 Public Consultation

As per our initial meeting with the RM Planning and Engineering staff, an open house is not required. Public consultation will be completed.

A mail out has been distributed to all neighbours within 150m of the proposed development and extended to the residents of St. Andrews Bay and Hogan Place. The RM staff advertised the proposed development via the RM's website/newspaper and provided the developer's contact for comments.

Comments along with responses have been summarized and included in Appendix L.

3.13 Canada Post

Post boxes are to be located within the multi-family buildings, providing additional security to residences.

All post boxes will be coordinated with Canada Post at the time of the Development Agreement.

3.14 Education Services

Education service capacity were discussed with the Prairie Valley School Division (PVSD). From the development an anticipated 10% of total population or 85 school age kids from grades K to 12 may be anticipated from the full buildout.

Grades 9- 12 in the area are serviced from the Greenall High School (GHS) in Balgonie which has a 2024 anticipated capacity of 91%. Grades K-8 in the area are provided by two separate elementary schools in the area Emerald Ridge Elementary (ERES) and Ecole White City School (EWCS). For the 2024 school year these schools are anticipated to be 115% and 103% capacity respectively. Both schools currently have flex space available to convert to classrooms to accommodate

increased capacities. Both schools are also designed for additional mobile classrooms or portables to be added once over-capacity occurs. Funding form these comes provincially and is based on actual enrollment numbers and not anticipated enrollment. EWCS previously had the capacity to house both elementary schools prior to the construction of ERES.

In discussion with the school board the education services will be able to accommodate this development upon full build out as additional classroom units can be added to EWCS and ERES. The GHS school has current additional capacity and can also be fitted with additional portable units if required.

APPENDIX A

Phase 1 Concept Plan

LEGEND
ASPHALT
BUILDING
LANDSCAPE
CONCRETE
WATER

NEW WALKING PATH CONNECT TO EXISTING RM PATH

GREAT PLAINS ROAD

EXISTING POND

EXISTING POND

NEW WALKING PATH

LANDSCAPE BUFFER

LANDSCAPE BUFFER

LIMITS OF CONSTRUCTION

CONCRETE WALK

PLAYGROUND AND AMENITIES SPACE

NEW WALKING PATH

BLK/PAR BB PLAN NO 102138342 EXT 0

CONCRETE SWALE

CONCRETE WALK

CONCRETE WALK

GARBAGE ENCLOSURE SEE BUILDING DESIGN FOR DETAILS

PEDESTRIAN PATHWAY

CONCRETE WALK

CURB AND GUTTER

PROPOSED 3-STOREY PHASE 1 BUILDING B

BARRIER CURB

PHASE 1 LIMITS

CONCRETE SWALE

CONCRETE SWALE

LANDSCAPE BUFFER

McLEOD ROAD

BARRIER CURB

GARBAGE ENCLOSURE SEE BUILDING DESIGN FOR DETAILS

EXISTING POND TO BE BACKFILLED

BARRIER CURB

PROPOSED 3-STOREY PHASE 1 BUILDING A

LANDSCAPE BUFFER

BARRIER CURB

LANDSCAPE BUFFER

LIMITS OF CONSTRUCTION

SITE AREA: 5.447 ha
BUILDING AREA: 0.418 ha
SITE COVERAGE: 7.67%

TOTAL PARKING REQ'D: 148
TOTAL PARKING PROVIDED: 157
PROPOSED PARKING WITHIN ACCORDANCE OF TABLE 5

1 SITE LAYOUT PLAN
SK-1 1:500

LEGEND

SITE
- PROPERTY LINE (℄)
- RIGHT OF WAY (ROW) EASEMENT
- FENCE
- CENTERLINE OF ROAD
- EDGE OF ASPHALT
- EDGE OF GRAVEL
- CENTERLINE OF DITCH

UTILITIES
- NATURAL GAS LINES (GAS)
- TRANSGAS LINES (TRANSGAS)
- TELEPHONE (TEL)
- POWER LINES (OH) (P(OH))
- ACCESS COMMUNICATION (COM)
- POWER LINES (UG) (P(UG))
- POWER POLE

Gilchuk Design & Drafting
130 HANLEY CRESCENT, WHITE CITY, SK
C: 306.535.9197 P: 306.584.3323
jason@gilchukdesign.com

WCE design inc.

REV	DESCRIPTION	DATE
0	ISSUED FOR DEVELOPMENT PERMIT	2023.06.21

SEALS:

GENERAL NOTES

- PRIOR TO PROCEEDING WITH CONSTRUCTION THE OWNER / CONTRACTOR SHALL BE RESPONSIBLE TO CHECK AND VERIFY ALL INFORMATION, DIMENSIONS, AND SPECIFICATIONS OF THIS PLAN AND OBTAIN A BUILDING PERMIT FROM THE AUTHORITY HAVING JURISDICTION. ANY DISCREPANCIES SHALL BE REPORTED TO THE DRAFTSMAN BEFORE CONSTRUCTION COMMENCES.
- BUILDING GRADE ELEVATIONS ARE SUGGESTED ONLY AND MAY HAVE TO BE REVISED TO SUIT EXACT SITE CONDITIONS.
- ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE NATIONAL BUILDING CODE OF CANADA, CURRENT EDITION AND THE AUTHORITY HAVING JURISDICTION.
- WINDOWS SIZES & LOCATIONS SHALL BE CONFIRMED BY THE OWNER.
- UTILITY COMPANIES SHALL BE CONTACTED TO LOCATED ALL UNDER GROUND SERVICES PRIOR TO ANY EXCAVATING COMMENCING.

TALON CAPITAL LTD.
59 UNIT APARTMENT COMPLEX

EMERALD PARK
RM OF EDENWOLD, SASKATCHEWAN

TITLE: PHASE 1 CONCEPT PLAN

DRAWN BY: D. WEISS

DATE: June 21, 2023

FILE NO: 23-010

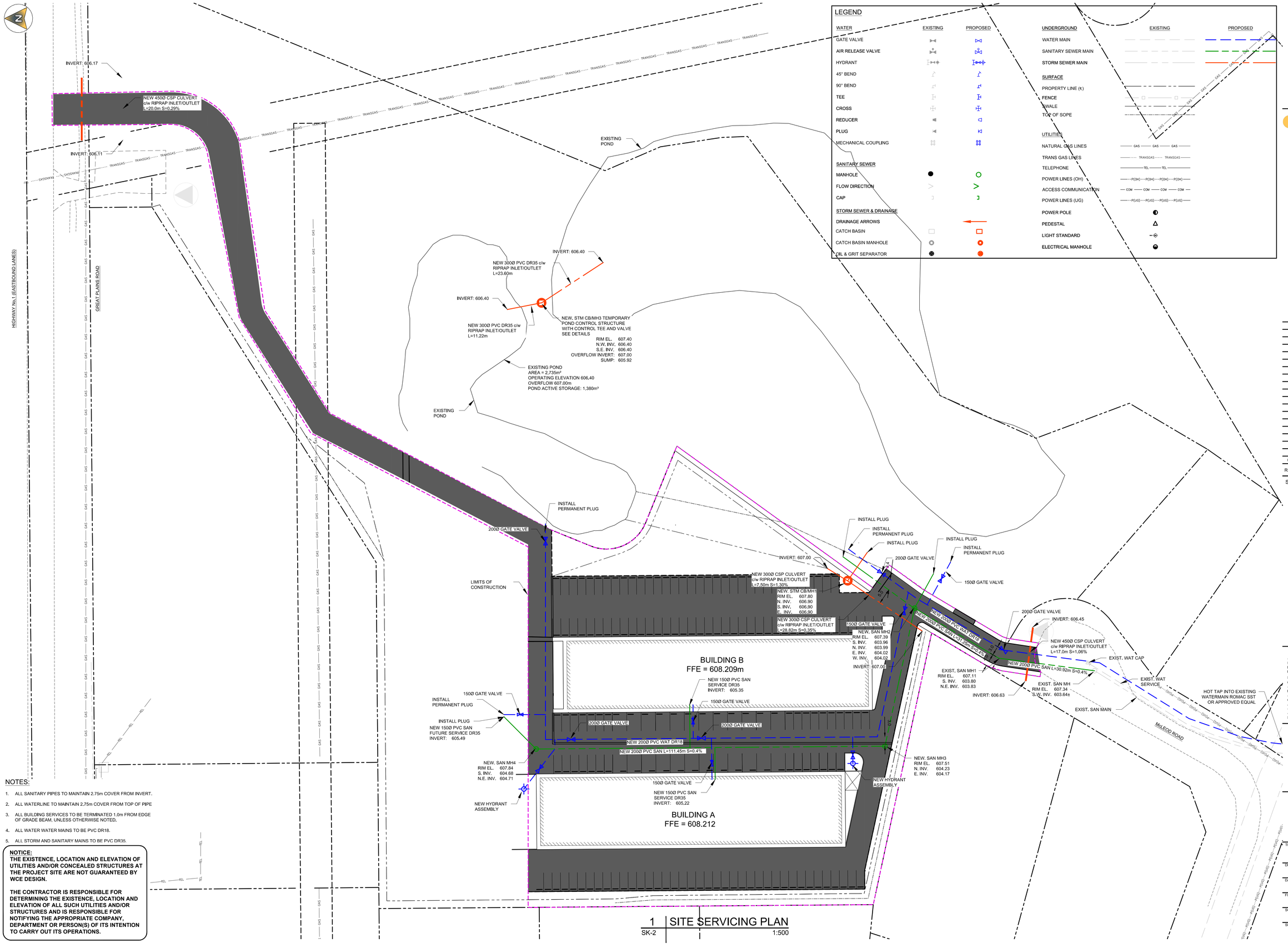
SCALE: AS NOTED

SHEET NO.: SK-1

REVISION: 0

APPENDIX B

Phase 1 Site Servicing Plan



LEGEND

WATER	EXISTING	PROPOSED
GATE VALVE		
AIR RELEASE VALVE		
HYDRANT		
45° BEND		
90° BEND		
TEE		
CROSS		
REDUCER		
PLUG		
MECHANICAL COUPLING		
SANITARY SEWER		
MANHOLE		
FLOW DIRECTION		
CAP		
STORM SEWER & DRAINAGE		
DRAINAGE ARROWS		
CATCH BASIN		
CATCH BASIN MANHOLE		
OIL & GRIT SEPARATOR		

UNDERGROUND	EXISTING	PROPOSED
WATER MAIN		
SANITARY SEWER MAIN		
STORM SEWER MAIN		
SURFACE		
PROPERTY LINE (℄)		
FENCE		
SWALE		
TOP OF SOPE		
UTILITIES		
NATURAL GAS LINES	GAS GAS GAS	
TRANS GAS LINES	TRANSGAS TRANSGAS	
TELEPHONE	TEL TEL	
POWER LINES (OH)	P(OH) P(OH) P(OH)	
ACCESS COMMUNICATION	COM COM COM COM	
POWER LINES (UG)	P(UG) P(UG) P(UG) P(UG)	
POWER POLE		
PEDESTAL		
LIGHT STANDARD		
ELECTRICAL MANHOLE		

NOTES:

1. ALL SANITARY PIPES TO MAINTAIN 2.75m COVER FROM INVERT.
2. ALL WATERLINE TO MAINTAIN 2,75m COVER FROM TOP OF PIPE
3. ALL BUILDING SERVICES TO BE TERMINATED 1.0m FROM EDGE OF GRADE BEAM, UNLESS OTHERWISE NOTED.
4. ALL WATER WATER MAINS TO BE PVC DR18.
5. ALL STORM AND SANITARY MAINS TO BE PVC DR35.

NOTICE:
THE EXISTENCE, LOCATION AND ELEVATION OF UTILITIES AND/OR CONCEALED STRUCTURES AT THE PROJECT SITE ARE NOT GUARANTEED BY WCE DESIGN.

THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE EXISTENCE, LOCATION AND ELEVATION OF ALL SUCH UTILITIES AND/OR STRUCTURES AND IS RESPONSIBLE FOR NOTIFYING THE APPROPRIATE COMPANY, DEPARTMENT OR PERSON(S) OF ITS INTENTION TO CARRY OUT ITS OPERATIONS.

1 SITE SERVICING PLAN
SK-2 1:500

Gilchuk Design & Drafting
130 HANLEY CRESCENT, WHITE CITY, SK
C: 306.535.9197 P: 306.584.3323
jason@gilchukdesign.com

WCE design inc.

REV	DESCRIPTION	DATE
0	ISSUED FOR DEVELOPMENT PERMIT	2023.06.21

SEALS:

GENERAL NOTES

- PRIOR TO PROCEEDING WITH CONSTRUCTION THE OWNER / CONTRACTOR SHALL BE RESPONSIBLE TO CHECK AND VERIFY ALL INFORMATION, DIMENSIONS, AND SPECIFICATIONS OF THIS PLAN AND OBTAIN A BUILDING PERMIT FROM THE AUTHORITY HAVING JURISDICTION. ANY DISCREPANCIES SHALL BE REPORTED TO THE DRAFTSMAN BEFORE CONSTRUCTION COMMENCES.
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- ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE NATIONAL BUILDING CODE OF CANADA, CURRENT EDITION AND THE AUTHORITY HAVING JURISDICTION.
- WINDOWS SIZES & LOCATIONS SHALL BE CONFIRMED BY THE OWNER.
- UTILITY COMPANIES SHALL BE CONTACTED TO LOCATED ALL UNDER GROUND SERVICES PRIOR TO ANY EXCAVATING COMMENCING.

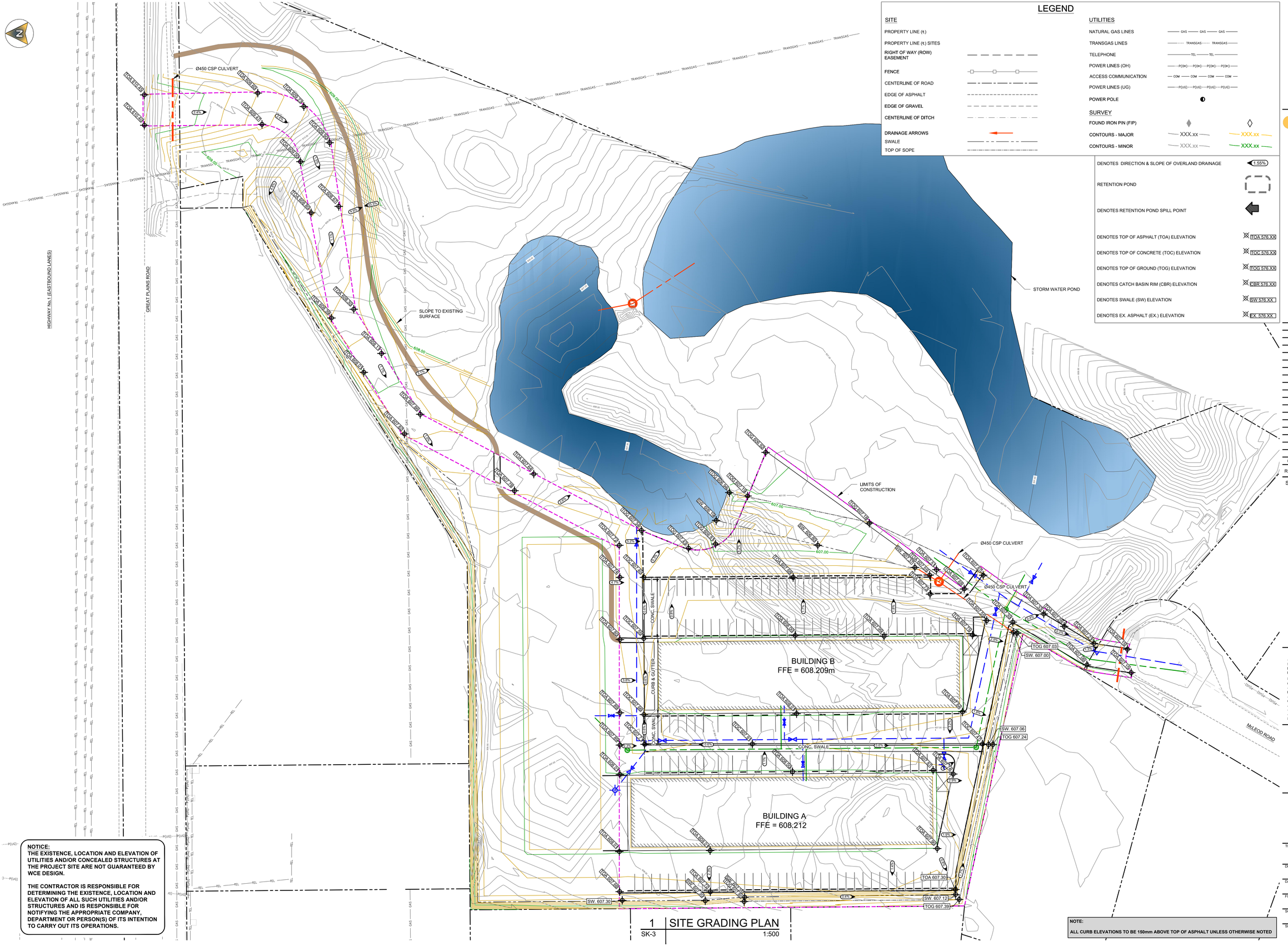
TALON CAPITAL LTD.
59 UNIT APARTMENT COMPLEX

EMERALD PARK
RM OF EDENWOLD, SASKATCHEWAN

TITLE:	SITE SERVICING PLAN PHASE 1
DRAWN BY:	D. WEISS
DATE:	June 21, 2023
FILE NO:	23-010
SCALE:	AS NOTED
SHEET NO.:	SK-2
REVISION:	0

APPENDIX C

Phase 1 Drainage & Grading Plan



1 SITE GRADING PLAN
SK-3 1:500

NOTICE:
THE EXISTENCE, LOCATION AND ELEVATION OF UTILITIES AND/OR CONCEALED STRUCTURES AT THE PROJECT SITE ARE NOT GUARANTEED BY WCE DESIGN.

THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE EXISTENCE, LOCATION AND ELEVATION OF ALL SUCH UTILITIES AND/OR STRUCTURES AND IS RESPONSIBLE FOR NOTIFYING THE APPROPRIATE COMPANY, DEPARTMENT OR PERSON(S) OF ITS INTENTION TO CARRY OUT ITS OPERATIONS.

NOTE:
ALL CURB ELEVATIONS TO BE 150mm ABOVE TOP OF ASPHALT UNLESS OTHERWISE NOTED

GENERAL NOTES

- PRIOR TO PROCEEDING WITH CONSTRUCTION THE OWNER / CONTRACTOR SHALL BE RESPONSIBLE TO CHECK AND VERIFY ALL INFORMATION, DIMENSIONS, AND SPECIFICATIONS OF THIS PLAN AND OBTAIN A BUILDING PERMIT FROM THE AUTHORITY HAVING JURISDICTION. ANY DISCREPANCIES SHALL BE REPORTED TO THE DRAFTSMAN BEFORE CONSTRUCTION COMMENCES.
- BUILDING GRADE ELEVATIONS ARE SUGGESTED ONLY AND MAY HAVE TO BE REVISED TO SUIT EXACT SITE CONDITIONS.
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- WINDOWS SIZES & LOCATIONS SHALL BE CONFIRMED BY THE OWNER.
- UTILITY COMPANIES SHALL BE CONTACTED TO LOCATED ALL UNDER GROUND SERVICES PRIOR TO ANY EXCAVATING COMMENCING.

Gilchuk Design & Drafting
130 HANLEY CRESCENT, WHITE CITY, SK
C: 306.535.9197 P: 306.584.3323
jason@gilchukdesign.com

WCE design inc.

REV	DESCRIPTION	DATE
0	ISSUED FOR DEVELOPMENT PERMIT	2023.06.21

SEALS:

TALON CAPITAL LTD.
59 UNIT APARTMENT COMPLEX

EMERALD PARK
RM OF EDENWOLD, SASKATCHEWAN

TITLE:	SITE GRADING PLAN PHASE 1
DRAWN BY:	D. WEISS
DATE:	June 21, 2023
FILE NO:	23-010
SCALE:	AS NOTED
SHEET NO.:	SK-3
REVISION:	0

APPENDIX D

Geotechnical Investigation
Aquifer Protection Plan

GROUND ENGINEERING CONSULTANTS LTD.
CIVIL & GEOENVIRONMENTAL ENGINEERS
415 – 7TH AVENUE · REGINA · SASKATCHEWAN · S4N 4P1
Tel: (306) 569-9075 FAX: (306) 565-3677 Email: groundeng@myaccess.ca

FILE: GE-1403 December 16, 2022

Talon Capital Ltd.
435 Dewdney Avenue
REGINA, Saskatchewan
S4N 0G1

ATTENTION: MR. TROY METZ

Dear Sir:

SUBJECT: AQUIFER PROTECTION PLAN
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN 102138342
R.M. OF EDENWOLD, SASKATCHEWAN

The proposed development of the above captioned property consists of a residential subdivision which includes construction of 6 apartment buildings and 2 townhouse buildings. The subject property was previously developed as part of the adjacent golf course and is currently vacant. There are 3 water ponds from the former golf course on the property. The 2 ponds which are located entirely on the property will be completely filled in. The 3rd pond which extends onto the adjacent golf course property will be partially filled in. Our Company conducted some preliminary geotechnical work at the subject property in 2014 at which time it was determined that the groundwater table is located at a depth of approximately 1 to 2 metres below grade which corresponds to the water level in the existing ponds. It is expected that the groundwater table has not materially changed since the previous work.

The subject property is located within the Extreme Sensitivity Aquifer zone as identified in the R.M. of Edenwold Official Community Plan (Map 12, Appendix A). The OCP requires that an Aquifer Protection Plan be implemented as part of the development process to limit any potential contamination of the aquifer.

The following recommendations and comments are provided to limit the potential impact the proposed development may have on the underlying aquifer:

.1 The existing water ponds should be pumped out and backfilled with highly plastic clay or clay till obtained from a pre-approved borrow source. Random fill from various sources shall not be permitted. Importing of the fill shall be monitored and the fill shall be placed in lifts which are compacted. Backfilling the ponds in this manner will limit the potential contamination of the underlying aquifer.

.2 Building foundations will include driven steel pipe/H beams and augercast concrete piles. For lighter loads, screw piles and footings may be an option. Regardless of the foundation type selected, the building foundations will not increase the contaminant risk of the aquifer.

.3 Installation of the site services (sewer/water) will require excavations which may extend below the water table in some areas. The trenches may be backfilled with the excavated soil which is placed in lifts which are compacted. Backfilling the trenches in this manner will limit the potential contamination of the underlying aquifer.

.4 Bioswales will be constructed as part of the surface drainage plan. Properly designed and constructed bioswales will limit the potential contamination of the underlying aquifer.

.5 No fuel shall be stored onsite during and after development.

The proposed development consists of a residential subdivision, which by its very nature, is not considered to pose an elevated risk of contamination to the underlying aquifer. Provided the recommendations outlined in this letter are implemented, the potential for contamination of the underlying aquifer will be satisfactorily addressed.

We trust that this letter is satisfactory for your purposes. If you have any questions, please contact this office.

Yours very truly
Ground Engineering Consultants Ltd.

Steve Harty, P. Eng.

SH:cf
Distribution: Talon Capital Ltd. (1 PDF copy)
SH961 Office (1 copy)

APPENDIX E

Heritage Screening

Ministry of Parks, Culture and Sport
Heritage Conservation Branch
2nd Floor, 3211 Albert Street
Regina, Canada S4S 5W6

Phone: 306.787.8157
Fax: 306.787.0069

Email: kim.weinbender@gov.sk.ca

January 13, 2023 Our file: 22-1463

Dustin Weiss
WCE design inc.
Agent for: **Talon Capital Ltd./102035126 SASKATCHEWAN LTD.**
80 Emerald Ridge East
WHITE CITY SK S4L 0C3
Phone: 306.540.8312
Email: dustin.weiss@wcedesign.ca

Dear Dustin Weiss:

RE: RM of Edenwold No. 163 - Multi-building Residential Development
SE 22-17-18-W2M - Blk/Par BB-Plan 102138342 Ext. 0 (5.447 ha)
HERITAGE RESOURCE REVIEW

Thank you for submitting this project 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.

There is one known archaeological site (called EcNc-8) located in direct conflict with the proposed project. The site is over a large area, with notes about locals removing 100s of artifacts dating to all archaeological time periods since the 1930s. The project is also located on sandy soil so there is some potential for deeply buried archaeological sites. However, the parcel has been disturbed by cultivation and various urban development. Recent surveys in the region suggest that the majority of archaeological materials have been removed/extensively disturbed. Therefore, the potential for the project to impact intact, significant heritage sites is low and there are no heritage concerns with the project proceeding as planned.

. . .2

Note: no additional heritage review is required for any revisions to the project layout/plans, provided they occur within the 2023 **external** boundary of Surface Parcel Number 20284880. Please include a copy of this clearance in applications to all other agencies involved in the approval process, to prove heritage clearance has been obtained and that further heritage review of the project is unnecessary.

If you have any questions regarding this review, please do not hesitate to contact me.

Sincerely,

Kim Weinbender
Archaeologist

APPENDIX F

Phase 1 Transportation Plan

LEGEND

- ASPHALT
- BUILDING
- LANDSCAPE
- CONCRETE
- WATER
- TRANSPORTATION PATH
- TRANSPORTATION ROUTE →

ALL WAY DIRECTION INTERSECTION AT GREAT PLAINS ROAD. STOP SIGN CONTROLLED.

GREAT PLAINS ROAD

PROPOSED TRAFFIC ROUTES

BLK/PAR BB PLAN NO 102138342 EXT 0

PROPOSED TRAFFIC ROUTES

ALL WAY DIRECTION INTERSECTION AT MCLEOD ROAD. STOP SIGN CONTROLLED.

PROPOSED 3-STOREY
PHASE 1 BUILDING B

PROPOSED 3-STOREY
PHASE 1 BUILDING A

McLEOD ROAD

SITE AREA: 5.447 ha
BUILDING AREA: 0.418 ha
SITE COVERAGE: 7.67%

TOTAL UNITS REQ'D: 148
TOTAL PARKING: 157
PROPOSED PARKING WITHIN ACCORDANCE OF TABLE 5

1 SITE LAYOUT PLAN
SK-4 1:500

LEGEND

SITE

- PROPERTY LINE (℄)
- RIGHT OF WAY (ROW) EASEMENT
- FENCE
- CENTERLINE OF ROAD
- EDGE OF ASPHALT
- EDGE OF GRAVEL
- CENTERLINE OF DITCH

UTILITIES

- NATURAL GAS LINES (GAS)
- TRANSGAS LINES (TRANSGAS)
- TELEPHONE (TEL)
- POWER LINES (OH) (P(OH))
- ACCESS COMMUNICATION (COM)
- POWER LINES (UG) (P(UG))
- POWER POLE

Gilchuk Design & Drafting
130 HANLEY CRESCENT, WHITE CITY, SK
C: 306.535.9197 P: 306.584.3323
jason@gilchukdesign.com

WCE design inc.

REV	DESCRIPTION	DATE
0	ISSUED FOR DEVELOPMENT PERMIT	2023.06.21

SEALS:

GENERAL NOTES

- PRIOR TO PROCEEDING WITH CONSTRUCTION THE OWNER / CONTRACTOR SHALL BE RESPONSIBLE TO CHECK AND VERIFY ALL INFORMATION, DIMENSIONS, AND SPECIFICATIONS OF THIS PLAN AND OBTAIN A BUILDING PERMIT FROM THE AUTHORITY HAVING JURISDICTION. ANY DISCREPANCIES SHALL BE REPORTED TO THE DRAFTSMAN BEFORE CONSTRUCTION COMMENCES.
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- UTILITY COMPANIES SHALL BE CONTACTED TO LOCATED ALL UNDER GROUND SERVICES PRIOR TO ANY EXCAVATING COMMENCING.

TALON CAPITAL LTD.
59 UNIT APARTMENT COMPLEX

EMERALD PARK
RM OF EDENWOLD, SASKATCHEWAN

TITLE: PHASE 1 TRANSPORTATION PLAN

DRAWN BY: D. WEISS

DATE: June 8, 2023

FILE NO: 23-010

SCALE: AS NOTED

SHEET NO.: SK-4

REVISION: 0

APPENDIX G

Future Buildout & Full Landscape Plan

LEGEND
ASPHALT
BUILDING
LANDSCAPE
CONCRETE
WATER

LEGEND

SITE
PROPERTY LINE (℄)
RIGHT OF WAY (ROW)
EASEMENT
FENCE
CENTERLINE OF ROAD
EDGE OF ASPHALT
EDGE OF GRAVEL
CENTERLINE OF DITCH

UTILITIES
NATURAL GAS LINES
TRANSGAS LINES
TELEPHONE
POWER LINES (OH)
ACCESS COMMUNICATION
POWER LINES (UG)
POWER POLE

Gilchuk Design & Drafting
130 HANLEY CRESCENT, WHITE CITY, SK
C: 306.535.9197 P: 306.584.3323
jason@gilchukdesign.com

WCE design inc.

CONNECTION TO TRANSCANADA TRAIL
NEW PATHWAY
PHASE 1 LIMITS
CONCRETE WALK
LANDSCAPE BUFFER
GARBAGE ENCLOSURE SEE BUILDING DESIGN FOR DETAILS
PROVIDE BIKE RACK
STORM RETENTION POND
PROPOSED 3-STOREY BUILDING E
GREAT PLAINS ROAD
PEDESTRIAN CROSSING
TEMPORARY PHASE 1 ROAD CONNECTION
LANDSCAPE BUFFER c/w CHAIN LINK FENCE
CONCRETE WALK FLUSH WITH ASPHALT
CURB AND GUTTER
PROPOSED 3-STOREY BUILDING F
PROPOSED 3-STOREY BUILDING D
BARRIER CURB
SEDIMENT INFILTRATION POND
PROPOSED 3-STOREY BUILDING G
PLAYGROUND AND AMENITIES SPACE c/w BENCH SEATING
BLK/PAR BB PLAN NO 102138342 EXT 0
CONCRETE SWALE
PROPOSED 3-STOREY PHASE 1 BUILDING B
PROPOSED 3-STOREY BUILDING C
PROPOSED 3-STOREY PHASE 1 BUILDING A
PEDESTRIAN PATHWAY
McLEOD ROAD

SITE AREA: 5.447 ha
BUILDING AREA: 1.374 ha
SITE COVERAGE: 25%

TOTAL UNITS: 413
TOTAL PARKING: 564
PROPOSED PARKING WITHIN ACCORDANCE OF TABLE 5

BIKE RACKS TO BE INSTALLED AT EACH BUILDING. LOCATION TO BE DETERMINED.

1 | SITE LAYOUT PLAN
SK-5 | 1:500

REV	DESCRIPTION	DATE
0	ISSUED FOR REVIEW	2023.05.24

SEALS:

GENERAL NOTES

- PRIOR TO PROCEEDING WITH CONSTRUCTION THE OWNER / CONTRACTOR SHALL BE RESPONSIBLE TO CHECK AND VERIFY ALL INFORMATION, DIMENSIONS, AND SPECIFICATIONS OF THIS PLAN AND OBTAIN A BUILDING PERMIT FROM THE AUTHORITY HAVING JURISDICTION. ANY DISCREPANCIES SHALL BE REPORTED TO THE DRAFTSMAN BEFORE CONSTRUCTION COMMENCES.
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- UTILITY COMPANIES SHALL BE CONTACTED TO LOCATED ALL UNDER GROUND SERVICES PRIOR TO ANY EXCAVATING COMMENCING.

TALON CAPITAL LTD.
59 UNIT APARTMENT COMPLEX

EMERALD PARK
RM OF EDENWOLD, SASKATCHEWAN

TITLE: FUTURE BUILDOUT PLAN
MASTER LANDSCAPE CONCEPT

DRAWN BY: D. WEISS
DATE: MAY 24, 2023
FILE NO: 23-010
SCALE: AS NOTED
SHEET NO.: SK-5
REVISION: 0

APPENDIX H

Geotechnical Report

TITLE: GEOTECHNICAL INVESTIGATION
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN No. 102138342 EXT. 0
EMERALD PARK, SASKATCHEWAN

CLIENT: TALON CAPITAL LTD.

FILE NO: GE-1403 DATE: MARCH 31, 2023

TABLE OF CONTENTS

DRAWINGS

APPENDICES

GROUND ENGINEERING CONSULTANTS LTD.

CIVIL & GEOENVIRONMENTAL ENGINEERS

415 – 7TH AVENUE · REGINA · SASKATCHEWAN · S4N 4P1
Tel: (306) 569-9075 FAX: (306) 565-3677 Email: groundeng@myaccess.ca

FILE: GE-1403 March 31, 2023

Talon Capital Ltd.
c/o Gilchuk Design
PO Box 724
WHITE CITY, Saskatchewan
S4L 5B1

ATTENTION: MR. JASON GILCHUK

Dear Sir:

SUBJECT: GEOTECHNICAL INVESTIGATION
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN No. 102138342 EXT. 0
EMERALD PARK, SASKATCHEWAN

1.0 INTRODUCTION

This report presents the results of a site specific subsurface soils investigation and geotechnical analysis carried out at the above captioned site. It is our understanding that the project includes construction of 6 three-storey, basementless apartment buildings and 2 two-storey townhouses which may have walkout basements. The site was previously developed as part of the existing golf course. Water ponds from the former golf course remain on the property and will be filled in to permit development. Our Company conducted a preliminary geotechnical investigation at the property in 2014. The information obtained during the 2014 investigation is included in this report.

The objectives of this investigation were to provide the following information at the site:

.1 To define the subsurface soil stratigraphy and engineering properties of the foundation soils, including the groundwater regime;

.2 To provide design recommendations for the most suitable and economical type of foundation system to support the proposed buildings;

.3 To provide recommendations with respect to the type of cement to use for concrete in contact with native soils;

.4 To comment on possible excavation and construction problems related to foundation construction with particular reference to groundwater conditions;

.5 To provide recommendations for floor slab design and construction;

.6 To provide recommendations to backfill the existing ponds;

.7 To provide pavement design recommendations for roadways and parking lots;

.8 To provide recommendations on pertinent geotechnical issues identified during the subsurface investigation.

Authorization to proceed with this work was received in your e-mail dated November 23, 2022.

2.0 DESCRIPTION OF THE SITE

The subject property shown in Figure 1 is located at the south side of Great Plains Road, in Emerald Park, Saskatchewan. The legal description of the property is Parcel BB, Plan No. 102138342 Ext. 0. The property was previously developed as a golf course and is currently vacant grassland.

3.0 FIELD AND LABORATORY INVESTIGATION

The subsurface conditions were investigated by drilling 11 test borings at the locations shown on Drawing No. GE-1403-1. The test holes were drilled on February 11, February 12 and March 12, 2014 and March 28, 2023, using truck-mounted diggers equipped with a 150 mm diameter continuous flight auger and a 200 mm diameter hollow stem auger. The test holes were terminated depths ranging from 12.2 to 21.3 metres below existing ground surface. A total of three (3) sandpipe piezometers were installed.

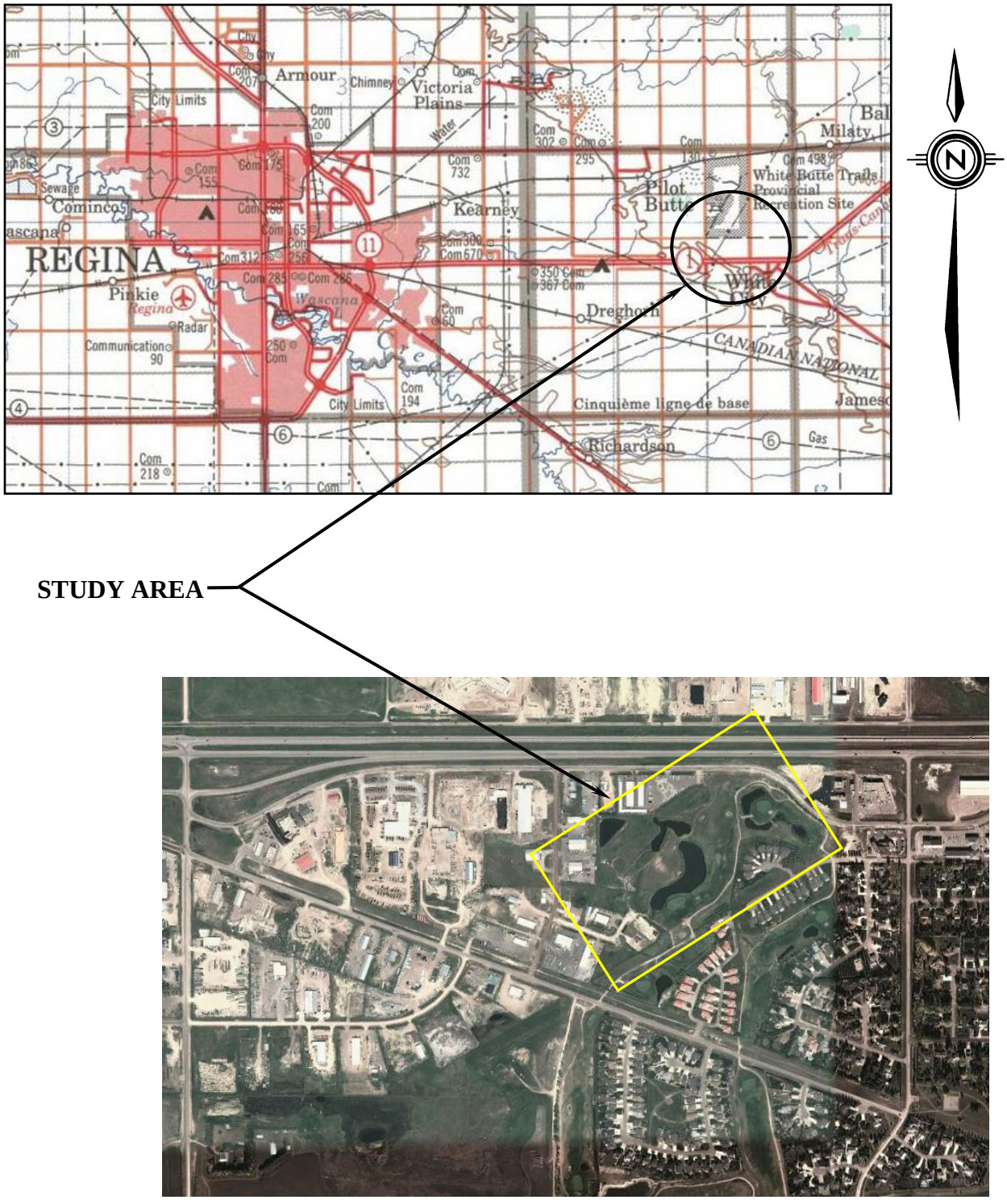

FIGURE 1

LOCATION OF STUDY AREA

Representative disturbed auger samples, split-spoon samples and undisturbed soil samples were recovered from the test borings and taken to our laboratory for analysis. Standard Penetration tests were conducted in select test holes. Each soil sample was visually examined to determine its textural classification and a natural moisture content test was performed on each sample. In addition, Atterberg limits, sulphate content, grain size analysis, unconfined compressive tests were performed on selected representative soil samples. Details of the soil profile, samples taken, laboratory test results, piezometer installations and stratigraphic interpretations of the subsoils are appended to this report on Drawing Nos. GE-1403-5 to -19, inclusive.

The ground surface elevations at the test hole locations were established by representatives of Ground Engineering Consultants Ltd. and are referenced to an assumed datum of 100.00 metres described as the top of the SaskPower transformer base located on McLeod Road as shown on Drawing No. GE-1403-1.

4.0 GEOTECHNICAL ANALYSIS

4.1 Stratigraphy

The drilling information indicates that fill materials have been placed in some areas of the site and extend to depths ranging from 0.5 to 0.9 metres below existing grade. The fill consists predominantly of silty clay with trace quantities of sand, gravel and organics. Fill materials were not encountered in Test Holes 102, 105, 107, 109 and 110, inclusive. In Test Hole 104, the fill materials are underlain by a topsoil layer which extended to a depth of 1.8 metres.

The topsoil and/or surficial fill materials are underlain by a stratified drift unit which extends to a depth of 19.2 metres in Test Hole 110 and to the maximum depth penetrated in the remaining test holes (12.2 metres). The drift unit consists of interbedded layers of clay, silt and sand.

The stratified drift unit is underlain by an unoxidized, glacial till stratigraphic unit which extends to the maximum depth penetrated during the investigation (21.3 metres). The till

material is a heterogeneous mixture of clay, silt, sand and gravel, with occasional cobblestones and boulders.

4.2 Groundwater

The drilling information indicates that there is a shallow water table at this site. Standpipe piezometers were installed in Test Holes 106, 108 and 111 to monitor groundwater levels. Water levels in the piezometers were measured on March 21 and 31, 2023. The data is summarized in Table 1, below.

TABLE 1

PIEZOMETRIC SURFACE MEASUREMENTS

PIEZOMETER NO.	DATE MEASURED	DEPTH OF WELL BELOW GRADE (m)	GROUNDWATER LEVEL FROM TOP OF PIPE (m)	GROUNDWATER LEVEL FROM GROUND SURFACE (m)	GROUNDWATER ELEVATION (ASSUMED)
TH 106	March 21, 2023	5.15	2.44	1.81	98.64
TH 108	March 31, 2023	4.53	2.59	1.59	99.48
TH 111	March 31, 2023	4.74	2.75	1.89	98.92

During periods of heavy rainfall or spring runoff, the water table could be even higher.

5.0 DISCUSSION

5.1 Fill Materials

The surficial fill is moist to very moist with variable amounts of sand and gravel.

5.2 Stratified Drift Unit

The stratified drift unit varies in lithology from clayey, sandy silts to silty clay and silty fine grained sands. These soils are normally consolidated. The clay layers are firm to stiff in consistency with undrained shear strengths ranging from 35 to 80 kPa. The clay layers are highly plastic and have a Plasticity Index ranging from 27 to 46 percent and a Liquid Limit ranging from 48 to 74 percent. The silt and sand layers are loose to medium dense with “N” values ranging from 2 to 15 blows per foot. The silt is dilatent and sensitive to disturbance.

The saturated silts and sands are cohesionless and subject to sloughing. Typical gradations of the sand layers are shown on Drawing Nos. GE-1403-18 to -19, inclusive.

5.3 Till Stratigraphic Unit

The till stratigraphic unit is unoxidized and stiff to hard with undrained shear strengths in the order of 250 kPa. The dry density of the till is in the order of 1.92 tonnes per cubic metre. Standard Penetration "N" values are in the order of 37 blows per foot.

The term till on the borehole logs indicates that the material originates from geological processes associated with glaciation. These processes produce a material that is heterogeneous in composition and, as such, the till may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm) and, therefore, contractors may encounter them during excavation even if they are not evident in the test borings, as is the case at this site. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample descriptions may be applicable to a very limited area; caution is therefore essential when dealing with sensitive excavations in till material.

6.0 FOUNDATION CONSIDERATIONS

Conventional bored concrete piles are not an option at this site due to the shallow water table and sloughing conditions. Spread footings are not considered to be an option due to the highly plastic clay, weak surficial soils and fill materials. We recommend that the proposed structures be supported on driven steel pipe piles or augercast (CFA) bored concrete piles. Helical steel screw piles would be a suitable alternative for the lightly loaded structures. Our specific design recommendations for each type of foundation system are presented as follows:

6.1 Driven Steel Pipe Piles

.1 The structural design of steel pipe piles shall conform to the requirements of Subsection 4.3.4 of the National Building Code of Canada (2015). The steel pipe

piles may be designed as open ended. The piles are to be filled with concrete after driving has been completed.

.2 A minimum embedment length of 7.5 metres is recommended, with a minimum pipe diameter of 273 mm.

.3 The load carrying capacity of a single steel pipe pile is a combination of point resistance and side friction developed between the pile and the surrounding soil. For design purposes, the end bearing component should generally be disregarded. The relationship can be expressed as follows:

$$R = \Phi A_p f$$

Where: R = pile capacity;
Φ = geotechnical resistance factor;
A_p = effective skin friction area;
f = ultimate skin friction

The upper 2.0 metres of pile length or the maximum depth of fill, whichever is greater should discounted insofar as side friction carrying capacity is concerned. The depth of fill within the former ponds must be documented and discounted insofar side friction is concerned. For driven steel piles, an average ultimate skin friction value of 50 kPa may be used for the drift soils at this site. The geotechnical resistance factor that should be applied for Limits State design is 0.4 for piles in compression and 0.3 for piles in tension.

Practical refusal can be calculated in the field on the basis of the pile capacity, pile specifications, pile penetration and the driving energy. Dynamic pile driving formulas should generally not be used for pile design, however, driving beyond the refusal criteria may cause structural damage to the piles which should not be permitted. Practical refusal for steel piles should be defined as a pile penetration of 50 mm for the last 10 blows of a hammer operating at a specified energy (depending on pile size). Typical pile cross sections and recommended energy to achieve

practical refusal are provided in Table 2. Piles driven to refusal should be re-driven after 24 hours to ensure proper set.

TABLE 2
SPECIFIED DRIVING ENERGY FOR
STEEL PIPE PILES DRIVEN TO REFUSAL

PILE DIAMETER*	DRIVING ENERGY (kJ)
273	45
325	52
355	59
406	65
508	85
559	90
610	100

*Section thickness as required for structural integrity and corrosion protection (not less than 11.0 mm).

.5 The materials to be used for steel piles must conform to the requirements of the National Building Code of Canada (2015) and ASTM A252 – Standard Specifications for Welded and Seamless Steel Pipe Piles. Grade 3 steel with a minimum yield strength of 310 MPa is recommended.

.6 Experience indicates that corrosion is not a practical problem for steel piles driven into natural soil. However, in fill at/or above the groundwater table, moderate corrosion may occur. Where these conditions exist, steps should be taken to protect the piles. Among these are the application of coatings such as coal tar epoxy before driving, encasement by cast-in-place concrete jackets, Cathodic protection, inclusion of copper content in the steel, or combinations of these including increasing the wall thickness to provide a margin for corrosion, see National Bureau of Standard Monograph 127 (1972).

.7 The pile driving procedures should be inspected by competent geotechnical personnel and driving records documented for each pile.

.8 A minimum centre to centre spacing of 2.5 times the pile diameter should be maintained between piles.

.9 Additional technical information on structural design and installation of steel pipe piles is included in Appendix A.

6.2 Augercast Bored Concrete Piles

.1 The proposed structures may be supported by augercast (CFA) straight shaft piles designed to develop load carrying capacity on the basis of side friction only. For augercast (CFA) piles, an average ultimate skin friction value of 55 kPa may be used for the drift soils at this site. The geotechnical resistance factor that should be applied for Limits State design is 0.4 for piles in compression and 0.3 for piles in tension.

.2 The upper 2.0 metres of pile length or the maximum depth of fill, whichever is greater, should be discounted insofar as side friction carrying capacity is concerned. The depth of fill within the former ponds must be documented and discounted insofar side friction is concerned. It is recommended that the minimum pile shaft diameter be 400 mm. A minimum pile length of 7.5 metres is also recommended.

.3 The minimum centre to centre pile spacing for CFA piles should be (0.02D + 2.5b) where D is the average depth of the piles and b is the pile diameter.

.4 Pile shafts carrying little or no bending moment should be reinforced with nominal vertical reinforcement in the form of intermediate grade deformed bars, composing about one-half (½) of one (1) percent of the cross-sectional area. The steel reinforcing cage should be projected or dowels set into the top of the caisson to tie into the foundation walls and/or columns.

.5 A minimum of 75 mm of rigid insulation should be placed on the inside of all perimeter grade beams to reduce the heat losses and to prevent drying of the soils.

6.3 Helical Steel Screw Piles

Relatively light loads may be supported on helical steel screw piles. The approximate ultimate vertical capacity Q_u, for a single helix pile installed in cohesionless (sandy) soils may be determined by the following equation:

$$Q_u = (\gamma' H N_q) \frac{\pi (D^2 - d^2)}{4}$$

Where: N_q = bearing capacity factor

$N_q = e^{\pi \, Tan\Phi} [Tan(45 + \Phi/2)]^2$

Φ = the soil angle of internal friction (degrees)

For Drift Soils, $\Phi = 24^o$

H = height of soil above the helix plate

D = diameter of the helix

d = diameter of the shaft

γ' = effective soil unit weight for the saturated silt and sand soils = 8.5 kN/m^3

In the case of a screw pile with multiple helixes, the ultimate vertical compressive load capacity may be determined by:

$$Q_u = \sum_{I=1}^{n} R_{ui} \, Q_{ui}$$

Where: i = helix number, numbered 1 to n, increasing downward

Q_{ui} = ultimate capacity of helix plate "i", from the above equation using the applicable helix diameter and embedment depth.

R_{ui} = interaction factor given in Table 3, to account for the effect of helix spacing.

TABLE 3

INTERACTION FACTOR FOR MULTIPLE HELIX SCREW PILES

Ratio (S/D) of Average Helix Spacings (S) to Average Helix Diameter (D)	Interaction Factor R_u
1	0.3
2	0.5
2.5	0.65
3	0.75
3.5	0.85
4	0.95
5	1.0
Note: For cohesive soils: R_{u1} and R_{un} = 1, for both tension and compressive loads.	

The ultimate capacity calculated using the above recommendations shall be multiplied by the following geotechnical resistance factors (Φ) for Limit States Design purposes: 0.4 for piles in compression; 0.3 for piles in tension, and 1.0 for adfreezing. Assume an adfreeze depth of 2.0 metres.

With a center-to-center spacing of 3 helix diameters or more, the group capacity may be taken as the sum of the capacities of individual piles. At pile spacing between 2 and 3 helix diameters, the sum of the vertical capacities of a group should be reduced by 20 percent. The center-to-center pile spacing should not be less than 2 helix diameters.

A minimum embedment depth of 7.5 metres below grade or 5 times the helix diameter plus 1.5 metres, whichever is greater, is recommended.

Torque measurements are commonly used to predict the vertical capacities of helical piles. However, torque correlations with vertical capacities are unreliable and show significant deviations between the predicted and actual capacities from load tests. The use of torque measurements as a design tool is not acceptable. **Due to the empirical nature of screw pile**

design, load tests are recommended to confirm the screw pile capacities prior to construction.

7.0 EXCAVATION CONSIDERATIONS

Building and trench excavations will be in the surficial fill and stratified drift soils. Conventional excavation procedures should therefore be applicable to the soils at this site. The sand and silt strata are generally saturated and trench instability should be anticipated when excavating in any soils below the water table. Excavations shall comply with minimum requirements of Occupational Health and Safety Regulations.

Occupational Health and Safety Regulations require that any trench or excavation in which people must work must be cut back according to the soil "type" or a temporary shoring system must be used to support the sides of the excavation. The saturated sand and silt below the water table would be classified as a "Type 4 Soils". In the case of a "Type 4 Soil", the walls of excavations which penetrate into the saturated sand and silt layers can be sloped to from the bottom of the excavation at an angle not steeper than three (3) horizontal to one (1) vertical, or 19^{o} measured from the horizontal. If significant vibrations and/or other dynamic loading are near open cuts, shoring or other safety precautions may be required.

Stockpiles and/or surcharge loads should not be placed on the edge of the excavations.

Shoring systems shall protect the worker and prevent instability. All shoring systems shall be designed by a qualified professional engineer.

It is anticipated that in some areas the excavations will extend below the water table, therefore, dewatering will be required during construction. Water may be removed from excavations through the use of sumps. The following points are recommended for dewatering of deep excavations:

.1 The dewatering method must insure the stability of the sides and bottom of the excavation. Extra width of excavation to accommodate ditches and/or sumps may be required;

.2 The lowered water table must be kept under full control to avoid fluctuations which may cause instability in the excavation;

.3 Adequate pumping capacity as well as standby pumping and power capacity should be provided;

.4 Pumped water should be discharged in a manner that will not interfere with the excavation or deposit deleterious materials in waterways;

.5 Loss of ground from around the sump should be prevented;

.6 Observation and maintenance of the excavation should be carried out on a regular basis.

Should changed soil and/or groundwater conditions be encountered as the excavation proceeds, they should be reported immediately to our office in order that we can review our recommendations. Side slopes of deep excavations should be monitored on a daily basis to detect any signs of potential stability problems.

8.0 FLOOR SLAB CONSIDERATIONS

Due to the fill materials, weak surficial soils and highly plastic clay we recommend the buildings have structurally supported floors. The following recommendations are provided for structural floor systems.

8.1 Structurally Supported Floor Systems

We recommend the following items of work for construction of the structural slab.

.1 A minimum 150 mm cardboard void form should be placed beneath the floor slab.

.2 The void form should be covered with a minimum 6 mil polyethylene vapour barrier to deter moisture migration through the floor.

.3 The backfill against the perimeter grade beams should consist of the native soils. The soil should be placed in thin lifts (200 mm) and compacted to 95 percent

Standard Proctor density to minimize infiltration of surface water into the void space beneath the floor.

For buildings designed with deeper crawl spaces, the following recommendations are provided:

.1 The crawl space should be covered with a Permalon X-150 type vapour barrier reduce the humidity in the crawl space and prevent drying of the subgrade soils.

.2 The ground surface in the crawl space should be graded to slope no steeper than 3:1 (horizontal to vertical) towards a positive outlet in order to drain any water that may enter the crawl space area.

.3 Provisions should be made to ventilate the crawl space area to prevent humidity build-up and mold growth.

9.0 FROST HEAVING

In fine-grained soils such as silts and clays, moisture is continuously drawn to the freezing plane where it forms ice lenses. These lenses physically lift the soil above them, thus causing heave at ground surface. The frost heaving risk at this site is high due to the fine-grained soils and shallow groundwater table. The maximum anticipated depth of frost penetration at this site is in the order of 1.8 to 2.2 metres depending on the depth of snow cover.

To minimize frost heaving problems, any paved areas should be sloped to suitably located catch basins or ditches. Regular maintenance of the pavement structure (crack sealing) is critical for satisfactory long-term performance. Rigid insulation is recommended beneath exterior grade supported concrete slabs to minimize the depth of frost penetration and prevent frost heaving adjacent to the buildings.

10.0 PAVEMENT STRUCTURE

It is understood that parking and roadway areas will be surfaced with an asphaltic concrete pavement structure. Our recommendations are provided as follows;

.1 The pavement around the buildings should be designed to slope in order to provide adequate drainage of water away from the perimeter of the building and from the surface of paved areas. The need for adequate drainage cannot be overstressed. To ensure fast runoff, the surface of the pavement should have a slope of at least two (2) percent, either to the outer perimeter of the paved areas, or to suitable located catch basins leading to underground drains. The contour of the finished pavement at all points should prevent water from standing on the surface, and surface water should not be permitted to seep back under the outer edges of the pavement. Subsurface drains should be installed in locations where subsurface water may accumulate within the pavement structure or where its necessary to intercept water that would tend to make its way into the pavement structure.

.2 Pavement structure thicknesses for heavy truck loading and light duty parking areas are as noted in Table 4.

TABLE 4

RECOMMENDED PAVEMENT STRUCTURES

	ASPHALT CONCRETE SURFACE COURSE (mm)	**TYPE 33 BASE COURSE THICKNESS (mm)**	**TYPE 8 SUBBASE THICKNESS (mm)**	**NON-WOVEN GEOTEXTILE (mm)**
Heavy Structure	100	150	350	Geotex 1201
Light Structure	50	150	150	-

.3 The subgrade in the parking and roadway areas should be compacted to a minimum of 95% Standard Proctor density with a heavy sheepsfoot or vibratory padfoot type compactor and any soft or spongy areas should be replaced with granular material before placing the base or subbase. In the roadway areas, a non-woven geotextile (Geotex 1201 or equivalent) is recommended on top of the finished subgrade and in any other wet, soft areas encountered during construction.

.4 The subbase course should be a well graded pit run sand (Type 8) compacted to a minimum of 98% Standard Proctor density. The base course (Type 33) should be a crushed, well graded granular material compacted to 100% Standard Proctor density.

Suggested specifications for asphaltic concrete and base course materials are included in Appendix B.

11.0 BACKFILLING OF EXISTING PONDS

The existing water ponds should be pumped out and backfilled with highly plastic clay or clay till. Ensure all saturated and organic soil is removed from the ponds prior to backfilling. The fill shall be placed in lifts no thicker than 200mm and compacted to 100% Standard Proctor density.

12.0 OTHER

.1 Adequate drainage away from the buildings should be provided and maintained to minimize infiltration of water into the subgrade. This is critical to minimize the potential for frost heaving around the perimeter of the buildings.

.2 Test results on selected samples indicate that the soluble sulphate contents in the soil range from 0.10 to 0.15 percent by dry soil weight. Exposure Class S-3 is considered appropriate for design of concrete in contact with the native soil, as specified in CSA Standard CAN3-A23.1. Minimum requirements for Exposure Class S-3 are as follows:

i) Cement Type: MS, MSb, LH, HS or HSb
ii) Maximum water to cementing materials ratio: 0.50
iii) Air Content: as per CSA CAN-A23.1-09 Tables 2 and 4
iv) Minimum specified Compressive Strength: 30 MPa at 56 days

.3 In the event that changes are made in the design, location or nature of the project, the conclusions and recommendations included in this report would not be deemed valid unless the changes in the project were reviewed by our firm. Modification to this report would then be made if necessary. Furthermore, it is recommended that this firm be allowed an opportunity for a general review of the final design plans and specifications in order to ensure that the recommendations made in this report are properly interpreted and implemented. If this firm is not allowed the opportunity for this review, we assume no responsibility for the misinterpretation of any of the recommendations.

.4 It is recommended that Ground Engineering Consultants Ltd. be retained to provide inspection services during construction of the foundations for this project. This is to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event that the subsurface conditions differ from what was anticipated.

.5 This report has been prepared for Talon Capital Ltd. and is intended for the specific application to the design and construction of the Proposed Greensview Residential Development to be constructed at Parcel BB, Plan No. 102138342 Ext. 0 in Emerald Park, Saskatchewan. The analysis and recommendations are based in part on the data obtained from the test hole logs. The boundaries between soil strata have been established at the bore hole locations. Between the bore holes, the boundaries are assumed from geological evidence and may be subject to considerable error. Contractors bidding on the project works are particularly advised against reviewing the report without realizing the limitations of the subsurface information.

.6 It is recommended that the geotechnical workscope include the following services in addition to subsurface exploration and development of foundation design recommendations. These two services are:

i) geotechnical review of other design professionals' plans relative to their interpretation of geotechnical findings and recommendations, and

ii) construction monitoring to observe construction activities in light of plans and specifications, and to help assure that unforeseen conditions are detected quickly to permit prompt corrective action and thus prevent minor problems from growing to major proportion.

.7 The samples from this site will be retained in our laboratory for 90 days following the date of this report. Should no instructions be received to the contrary, these samples will then be discarded.

13.0 CLOSURE

We trust that this report is satisfactory for your purposes. If you have any questions or require additional information, please contact our office.

Yours very truly
Ground Engineering Consultants Ltd.

PROFESSIONAL ENGINEER
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GROUND ENGINEERING CONSULTANTS LTD.

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This study and report have been prepared in accordance with generally accepted geotechnical and environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. BASIS OF REPORT

This report has been prepared for the specific site, development, design objectives and purpose that were described to Ground Engineering Consultants Ltd. (**GEC**) by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alternation or variation from any of the said descriptions provided to **GEC**, unless **GEC** is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

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4. COMPLETE REPORT

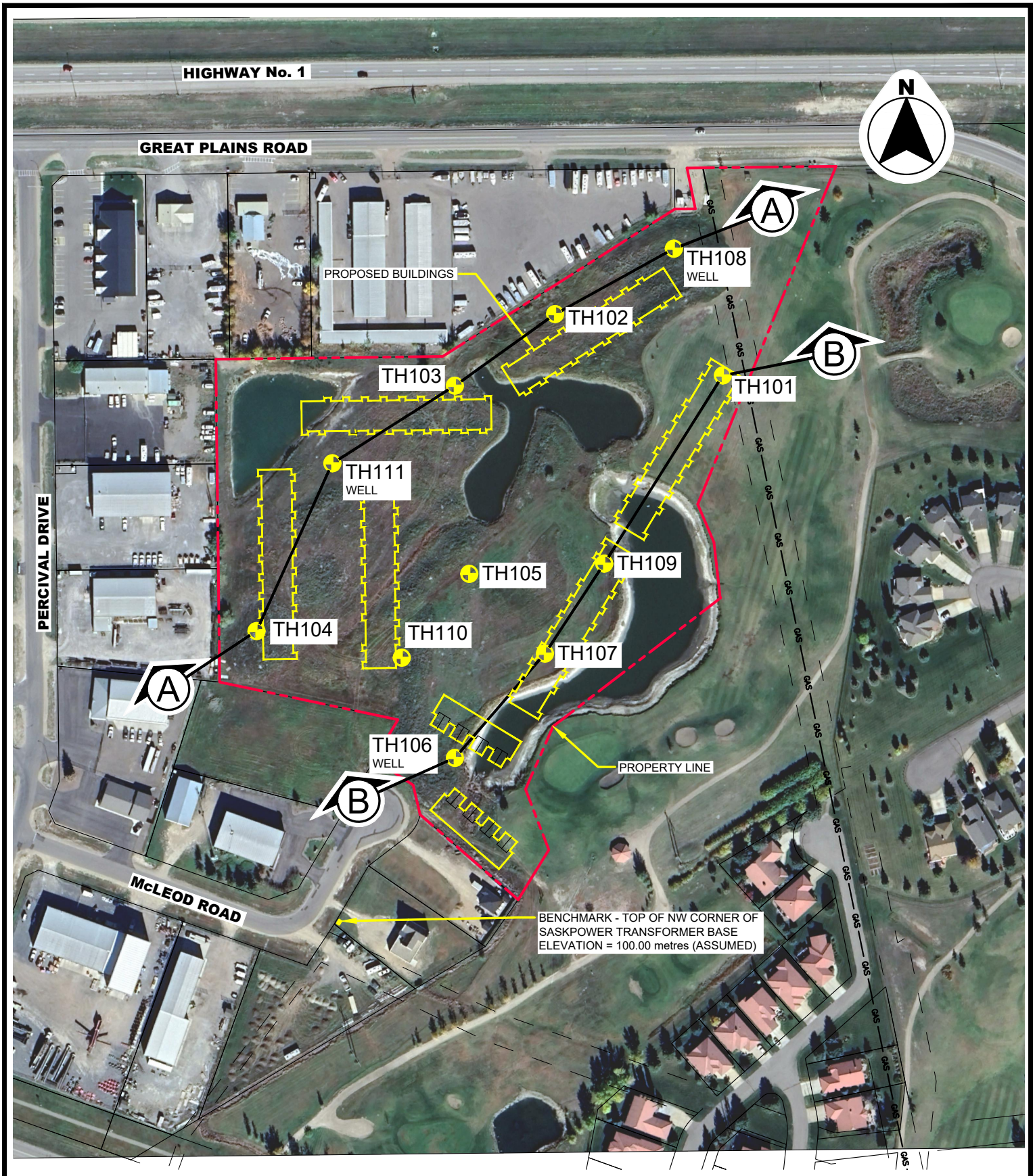
The report is of a summary nature and is not intended to stand alone without reference to the instructions given to **GEC** by the Client, communications between **GEC** and the client, and to any other reports, writings or documents prepared by **GEC** for the Client relative to the specific site described herein, all of which constitute the report. Wherever the word "report" is used herein, it shall refer to any and all of the documents referred to herein

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. **GEC** CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OR PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

5. INTERPRETATION OF THE REPORT

Nature and Exactness of Soil and Contaminant Description. Classification and identification of soils, rocks, geological units, contaminant materials and contaminant quantities have been based on commonly accepted geotechnical and environmental consulting practices in this area. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs implemented with appropriate equipment by experienced personnel, may fail to locate some hidden conditions. All reasonable problems will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such reports should be aware of and accept this risk. Some conditions are subject to change over time and those making use of the report should be aware of this possibility and understand that the report only presents the conditions at the sampled points at the time of sampling.

DRAWINGS



2021 AIR PHOTO

SCALE: 1:2500

GROUND ENGINEERING CONSULTANTS LTD.

CIVIL & GEOENVIRONMENTAL ENGINEERS
415 - 7th AVENUE
REGINA, SASKATCHEWAN, CANADA

SITE PLAN SHOWING LOCATION OF TEST HOLES
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN 102138342, Ext 0
EMERALD PARK, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
TALON CAPITAL LTD.	S. HARTY	MARCH 30, 2023	GE-1403-1

Z:\ PROJECT DIRECTORY \ ENG-FILES \ 2014 FILES \ 1403 GI WALKER ASPEN VILLAGE \ 2022 FILE \ DRAWINGS \ 1403 SITE_GREENSVIEW_TALON CAPITAL.DWG

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

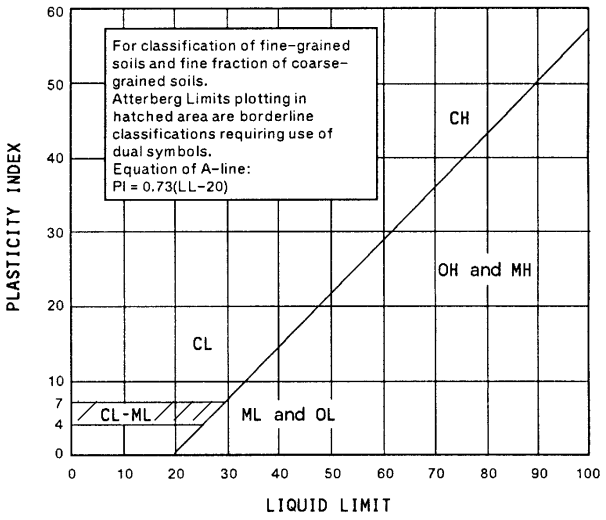
ASTM Designation: D 2487 - 69 AND D 2488 - 69

(Unified Soil Classification System)

Major Divisions			Group Symbols	Typical Names	Classification Criteria
Coarse-grained soils More than 50% retained on No. 200 sieve *	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line with P.I. greater than 7 — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW
		Sands with fines	SM	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line with P.I. greater than 7 — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	
Fine-grained soils 50% or more passes No. 200 sieve *	Silts and clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity	
	Highly organic soils		Pt	Peat, muck and other highly organic soils	

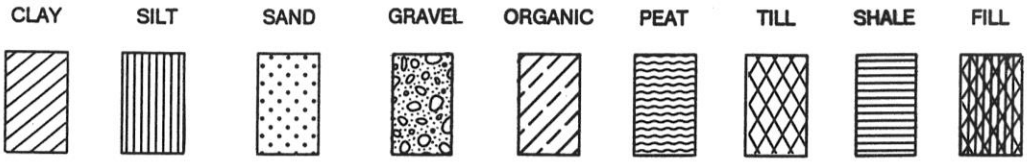
Classification on basis of percentage of fines
Less than 5% pass No. 200 sieve ..... GW, GP, SW, SP
More than 12% pass No. 200 sieve ..... GM, GC, SM, SC
5 to 12% pass No. 200 sieve ..... Borderline classifications requiring use of dual symbols

PLASTICITY CHART



*Based on the material passing the 75mm (3in) sieve.

SYMBOLS AND TERMS USED IN THE REPORT



The symbols may be combined to denote various soil combinations, the predominate soil being heavier.

RELATIVE PROPORTIONS

TERM	RANGE
Trace	0 – 5%
A Little	5 – 15%
Some	15 – 30%
With	30 – 50%

ASTM CLASSIFICATION BY PARTICLE SIZE

Boulder		> 300 mm
Cobble		300 mm – 75 mm
Gravel		75 mm – 4.75 mm
Sand		
	coarse	4.75 mm – 2 mm
	medium	2 mm – 425 um
	fine	425 um – 75 um
Silt		75 um – 5 um
Clay		< 5 um

DENSITY OF SANDS AND GRAVELS

DESCRIPTIVE TERM	RELATIVE DENSITY [1]	N VALUE STANDARD PENETRATION TEST [2]
Very loose	0 – 15%	0 – 4 Blows per 300mm
Loose	15 – 35%	4 – 10 Blows per 300mm
Medium Dense	35 – 65%	10 – 30 Blows per 300mm
Dense	65 – 85%	30 – 50 Blows per 300mm
Very Dense	85 – 100%	> 50 Blows per 300mm

CONSISTENCY OF CLAYS AND SILTS

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa) (CFEM, 2nd Edt., 1985)	N VALUE STANDARD PENETRATION TEST [2]	FIELD IDENTIFICATION (ASTM D 2488–84)
Very Soft	<12	< 2 Blows per 300mm	Thumb will penetrate soil more than 25 mm
Soft	12 – 25	2 – 4 Blows per 300mm	Thumb will penetrate soil about 25 mm
Firm	25 – 50	4 – 8 Blows per 300mm	Thumb will indent soil about 6 mm
Stiff	50 – 100	8 – 15 Blows per 300mm	Thumb will indent, but only with great effort (CFEM)
Very Stiff	100 – 200	15 – 30 Blows per 300mm	Readily indented by thumbnail (CFEM)
Hard	>200	> 30 Blows per 300mm	Thumb will not indent soil but readily indented with thumbnail

NOTES: 1. Relative Density determined by standard laboratory tests.
2. N Value – Blows/300mm of a 620N hammer falling 762mm on a 50mm O.D. Split Spoon.

SYMBOLS AND TERMS USED IN THE REPORT (continued)

GROUNDWATER

▼ Water level measured in the borings at the time and under the conditions indicated. In sand, the indicated levels can be considered reliable groundwater levels. In clay soil, it is not possible to determine the groundwater level within the normal scope of a test boring investigation, except where lenses or layers of more pervious waterbearing soil are present and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed texture soils may not indicate the true level of the groundwater table. The available water level information is given at the bottom of the log sheet.

▽ Water level determined by piezometer installation – In all soils the levels can be considered reliable groundwater levels.

DESCRIPTIVE SOIL TERMS

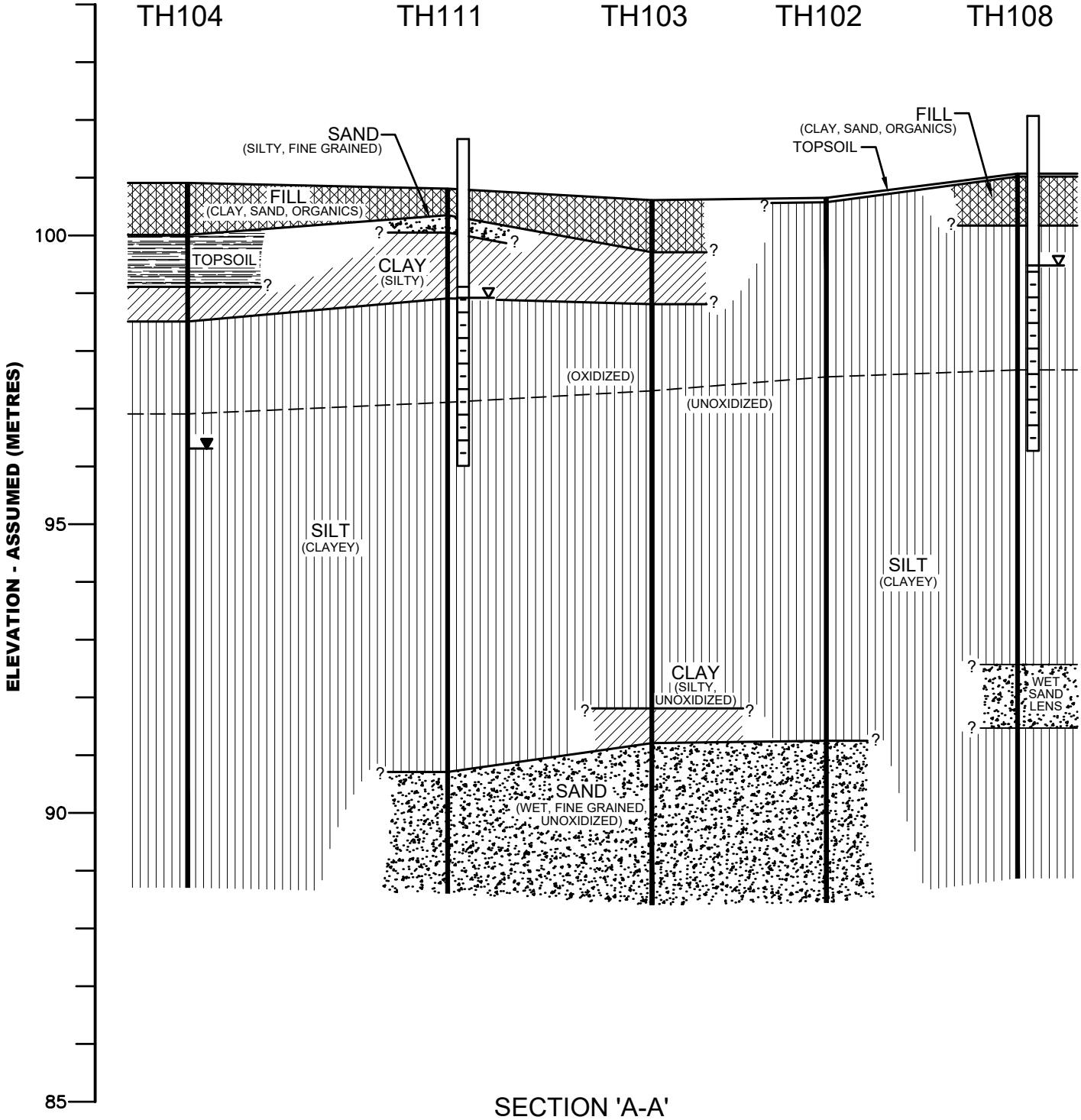
WELL GRADED	Having wide range of grain sizes and substantial amounts of all intermediate sizes.
POORLY GRADED	Predominantly of one grain size.
SLICKENSIDES	Refers to a clay that has planes that are slick and glossy in appearance; slickensides are caused by shear movements.
SENSITIVE	Exhibiting loss of strength on remolding.
FISSURED	Containing cracks, usually attributable to shrinkage. Fissured clays are sometimes described as having a nuggetty structure.
STRATIFIED	Containing layers of different soil types.
ORGANIC	Containing organic matter; may be decomposed or fibrous.
PEAT	A fibrous mass of organic matter in various stages of decomposition. Generally dark brown to black in color and of spongy consistency.
BEDROCK	Preglacial material.
DRIFT	Material deposited directly by glaciers or glacial melt-water.
ALLUVIAL	Soils that have been deposited from suspension from moving water.
LACUSTRINE	Soils that have been deposited from suspension in fresh water lakes.

DRILLING AND SAMPLING TERMS

SYMBOL	DEFINITION
C.S.	Continuous Sampling
Sy	75mm Thin Wall Tube Sample
Sy (2)	50mm Thin Wall Tube Sample
SPT (SS)	50mm O.D. Split Spoon Sample
BLOWS / 300mm	"N" Value – Standard Penetration Test
Bag	Disturbed Bag Sample
No.	Sample Identification Number
⟶	Piezometer Tip
S.I.	Slope Indicator
SPG ⟶	Observed Seepage

LABORATORY TEST SYMBOLS

SYMBOL	DEFINITION
●	Moisture Content – Percent of Dry Weight
⟼	Plastic and Liquid Limit determined in accordance with ASTM D-423 and D-424
◆	Dry Density – t/m^3
■	Shear Strength – As determined by Unconfined Compression Test
▲	Shear Strength – As determined by Field Vane
▲	Shear Strength – As determined by Pocket Penetrometer Test
$\%SO_4$	Water Soluable Sulphates – Percent of Dry Weight
M.A.	Grain Size Analysis



SECTION 'A-A'

SCALE: HOR. 1:2000
VERT. 1:100

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes, the boundaries are interpolated and may be subject to considerable error.

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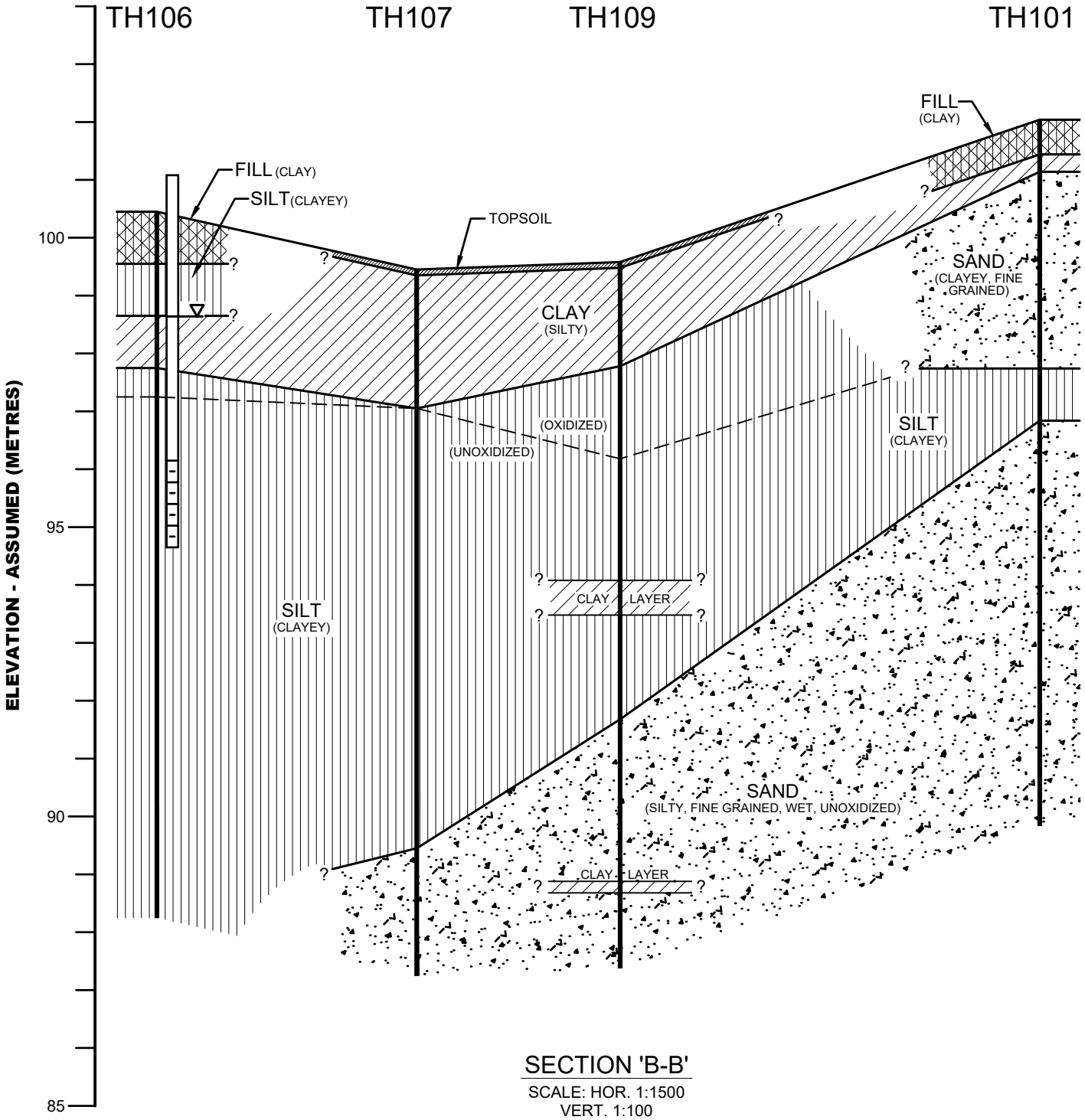
415–7th AVENUE
REGINA, SASKATCHEWAN, CANADA

STRATIGRAPHIC CROSS SECTION 'A-A'
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN 102138342 Ext 0
EMERALD PARK, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
TALON CAPITAL LTD.	S. HARTY	MARCH 30, 2023	GE-1403-5



SECTION 'B-B'

SCALE: HOR. 1:1500
VERT. 1:100

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes, the boundaries are interpolated and may be subject to considerable error.

GROUND ENGINEERING CONSULTANTS LTD.
CIVIL & GEOENVIRONMENTAL ENGINEERS
415–7th AVENUE
REGINA, SASKATCHEWAN, CANADA

STRATIGRAPHIC CROSS SECTION 'B-B'
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN 102138342 Ext 0
EMERALD PARK, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
TALON CAPITAL LTD.	S. HARTY	MARCH 30, 2023	GE-1403-6

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH101
Project No.: GE-1403	Coordinate: 5588419 N; 542936 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 102.04 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6
■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8
Plastic M.C. Liquid 20 40 60 80
● Blow Count ● 20 40 60 80
▲ Vane Shear (kPa) ▲
◆ Pocket Pen (kPa) ◆
■ Unconfined (kPa) ■ 60 120 180 240

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Soil Description	Elevation (m) (Assumed)
					0.00 m 102.04 m FILL - clay - moist - dark grayish brown (2.5Y 4/2)	
1.0	⊠	1				101.0
	▬	2				
2.0					0.60 m 101.44 m CLAY - silty - moist, stiff - oxidized - dark grayish brown (2.5Y 4/2)	100.0
3.0	▬	3				99.0
4.0					0.90 m 101.14 m SAND - clayey, fine grained - moist, wet below 2.4 metres - medium dense - oxidized - olive brown (2.5Y 4/4)	98.0
	⊠	4				
5.0						97.0
6.0	⊠	5				96.0
7.0					4.30 m 97.74 m SILT - sandy, clayey - very moist to wet, loose - unoxidized - dark gray (5Y 4/1)	95.0
8.0	⊠	6				94.0
9.0	⊠	7				93.0
10.0					5.20 m 96.84 m SAND - silty, fine grained - wet, loose - unoxidized - dark gray (5Y 4/1)	92.0
11.0	⊠	8				91.0
12.0	⊠	9				90.0
13.0					Test hole terminated at 12.2 m below grade.	89.0
14.0						88.0
15.0						87.0
16.0						86.0
17.0						85.0
18.0						84.0
19.0						83.0

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 2.3 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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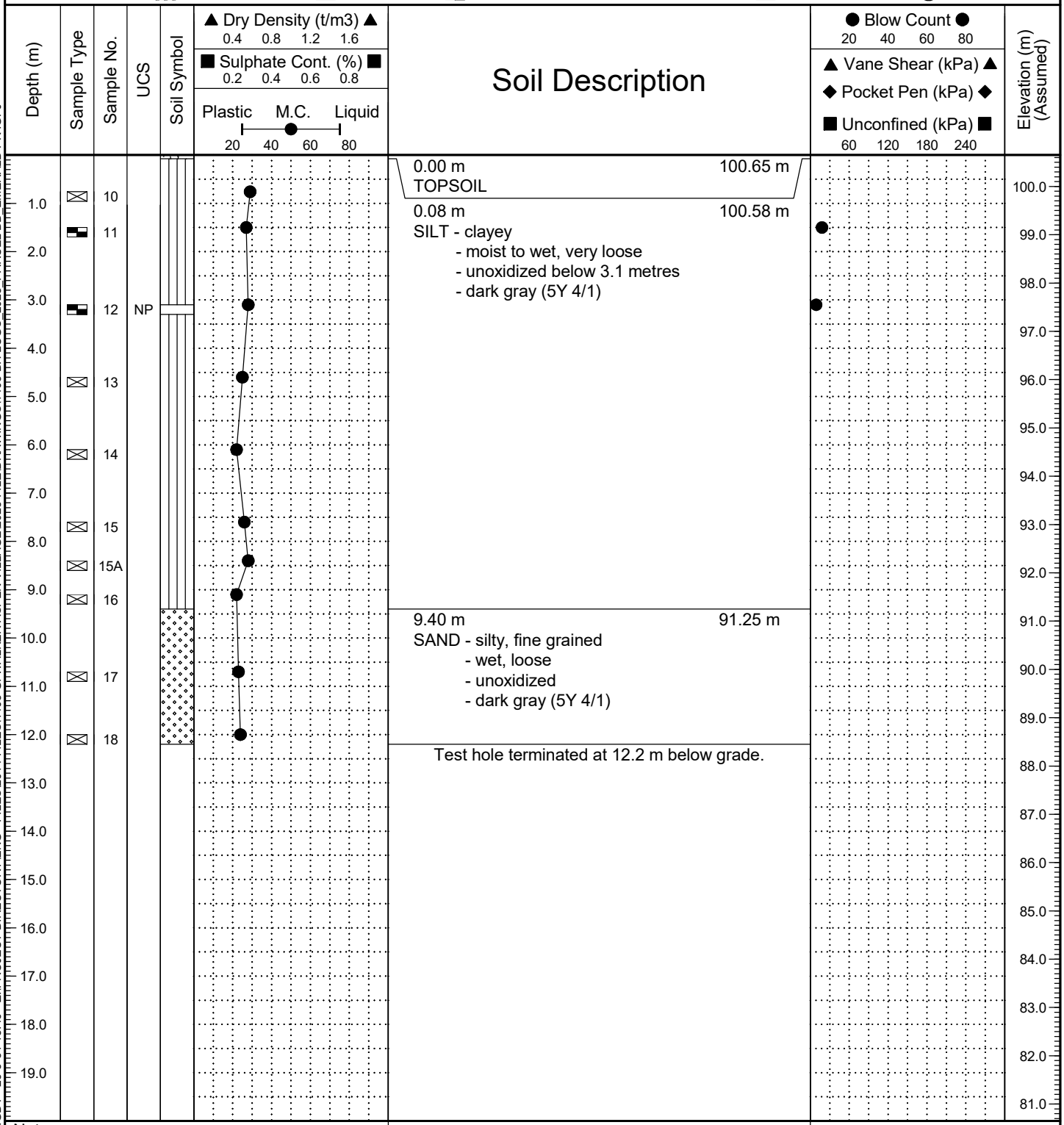
415 - 7th AVENUE, REGINA, SASKATCHEWAN, S4N 4P1

Logged By:	R. Yaremko	Page	1 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-7

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH102
Project No.: GE-1403	Coordinate: 5588449 N; 542854 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.65 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample



Notes:

1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 2.3 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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Logged By:	R. Yaremko	Page	2 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-8

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH103
Project No.: GE-1403	Coordinate: 5588414 N; 542805 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.61 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6
■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8
Plastic M.C. Liquid 20 40 60 80
● Blow Count ● 20 40 60 80
▲ Vane Shear (kPa) ▲
◆ Pocket Pen (kPa) ◆
■ Unconfined (kPa) ■ 60 120 180 240

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Soil Description	Elevation (m) (Assumed)
0.0					0.00 m — 100.61 m FILL - clay - moist - very dark grayish brown (2.5Y 3/2)	100.0
1.0	⊠	19				
1.0	▬	20				
2.0					0.90 m — 99.71 m CLAY - silty - moist, soft to firm - oxidized - dark grayish brown (2.5Y 4/2)	99.0
3.0	▬	21				98.0
4.0						97.0
4.0	⊠	22			1.80 m — 98.81 m SAND - clayey to 3.3 metres - sandy below 3.3 metres - wet, loose - unoxidized below 3.3 metres - dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)	96.0
5.0						95.0
6.0	⊠	23				94.0
7.0						93.0
8.0	⊠	24				92.0
9.0	⊠	25			8.80 m — 91.81 m CLAY - silty - moist, soft - unoxidized - dark gray (5Y 4/1)	91.0
10.0						90.0
11.0	⊠	26				89.0
12.0	⊠	27			9.40 m — 91.21 m SAND - silty, fine grained - wet, loose - unoxidized - dark gray (5Y 4/1)	88.0
13.0						87.0
14.0						86.0
15.0						85.0
16.0						84.0
17.0						83.0
18.0						82.0
19.0						81.0

Test hole terminated at 12.2 m below grade.

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 2.3 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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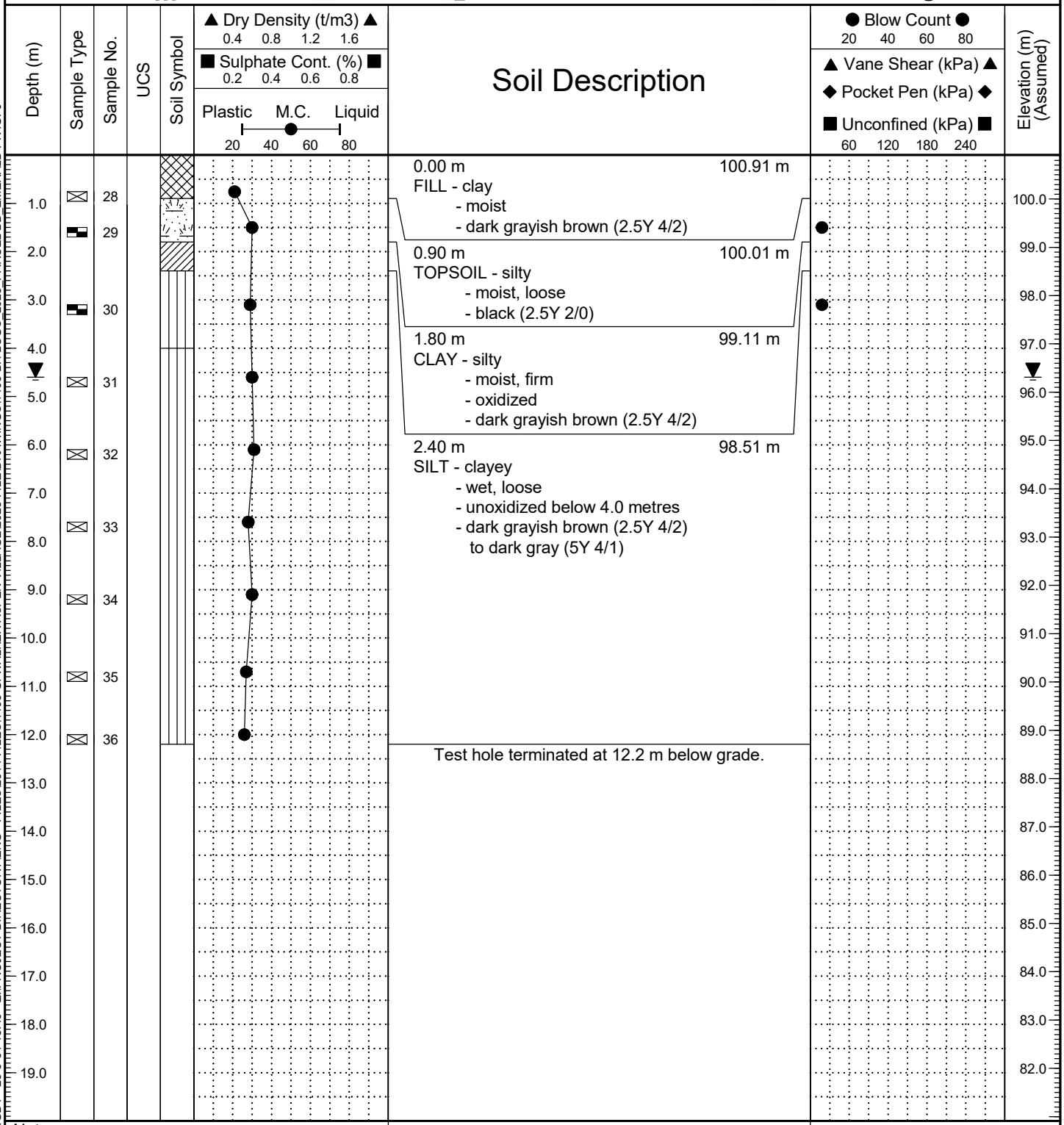
Logged By:	R. Yaremko	Page	3 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-9

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH104
Project No.: GE-1403	Coordinate: 5588294 N; 542708 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.91 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample



Notes:

1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was measured at 4.6 metres immediately after completion of drilling. Test hole sloughed to 5.2 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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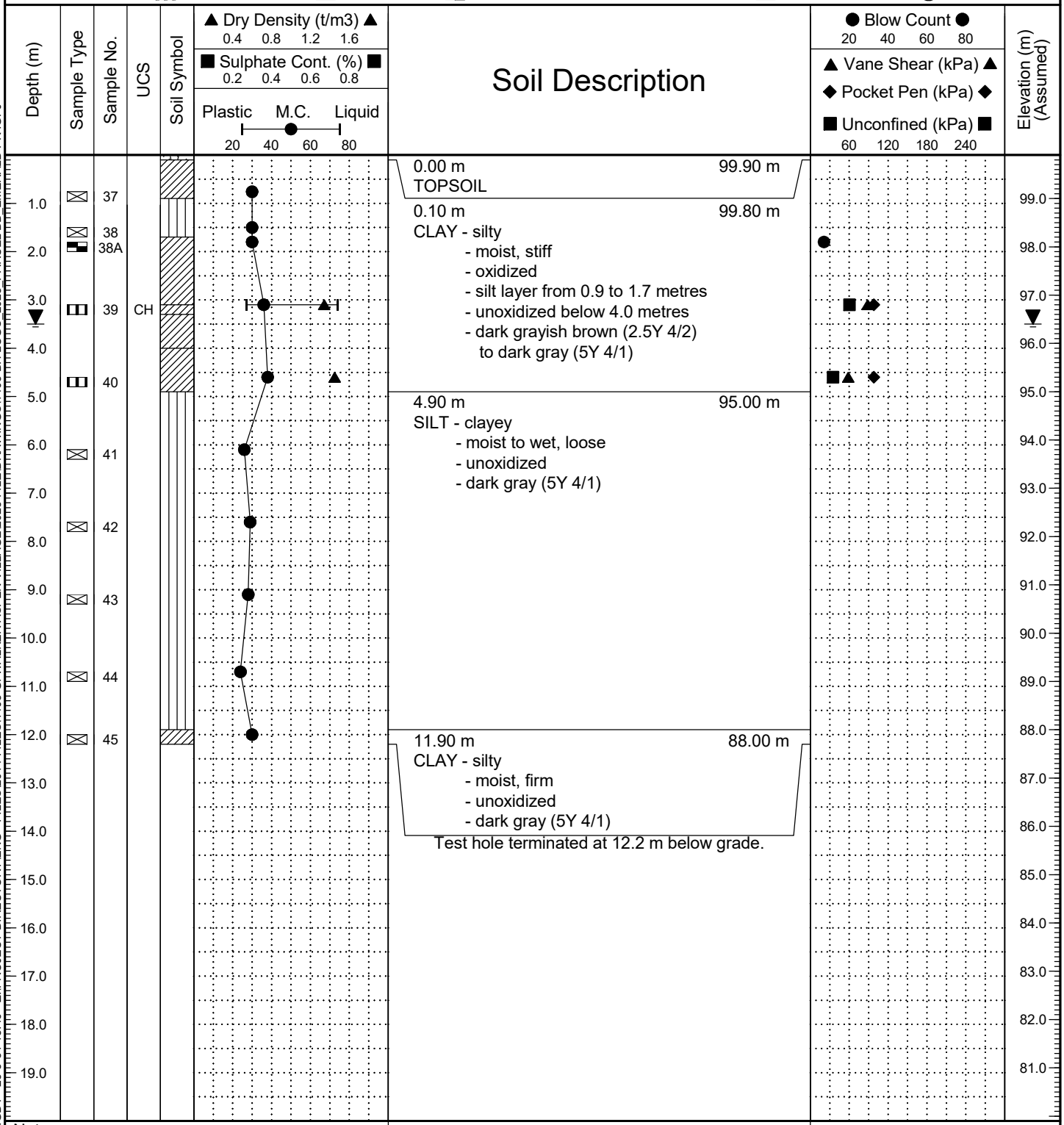
Logged By: R. Yaremko	Page 4 of 11
Drawn By: M. Creary	Date Plotted: 2023-03-31
Reviewed By: S. Harty	Figure No.: GE-1403-10

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH105
Project No.: GE-1403	Coordinate: 5588322 N; 542812 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.90 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample



0.00 m — 99.90 m
TOPSOIL

0.10 m — 99.80 m
CLAY - silty
- moist, stiff
- oxidized
- silt layer from 0.9 to 1.7 metres
- unoxidized below 4.0 metres
- dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)

4.90 m — 95.00 m
SILT - clayey
- moist to wet, loose
- unoxidized
- dark gray (5Y 4/1)

11.90 m — 88.00 m
CLAY - silty
- moist, firm
- unoxidized
- dark gray (5Y 4/1)

Test hole terminated at 12.2 m below grade.

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was measured at 3.5 metres immediately after completion of drilling. Test hole sloughed to 3.7 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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Logged By:	R. Yaremko	Page	5 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-11

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH106
Project No.: GE-1403	Coordinate: 5588232 N; 542805 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.45 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m) | Sample Type | Sample No. | UCS | Soil Symbol

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6

■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8

Plastic M.C. Liquid 20 40 60 80

● Blow Count ● 20 40 60 80

▲ Vane Shear (kPa) ▲

◆ Pocket Pen (kPa) ◆

■ Unconfined (kPa) ■ 60 120 180 240

Well Construction | Elevation (m) (Assumed)

Soil Description

Depth (m)	Sample No.	Elevation (m) (Assumed)
0.00 m		100.5 m
FILL - clay - moist - dark grayish brown (2.5Y 4/2)		
0.90 m		99.6 m
SILT - clayey - moist, loose - oxidized - dark grayish brown (2.5Y 4/2)		
1.80 m		98.7 m
CLAY - silty - moist, stiff - oxidized - dark grayish brown (2.5Y 4/2)		
2.70 m		97.8 m
SILT- clayey - moist, wet below 4.7 metres - loose - unoxidized below 3.2 metres - dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)		
Test hole terminated at 12.2 m below grade.		

Backfill Type: Bentonite | Grout | Sand | Cuttings / Slough

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 4.0 metres.
3. Standpipe piezometr was installed.

Piezo. Details & Water Level Meas.
Top of pipe Elev.: 101.08 m
Ht. of pipe above grade: 0.63 m

Date	Depth (m)	Elev. (m)
21/03/2023	2.44	98.64

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Logged By:	R. Yaremko	Page:	6 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-12

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH107
Project No.: GE-1403	Coordinate: 5588283 N; 542849 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.45 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Dry Density (t/m3) 0.4 0.8 1.2 1.6 / Sulphate Cont. (%) 0.2 0.4 0.6 0.8 / Plastic M.C. Liquid 20 40 60 80	Soil Description	Blow Count 20 40 60 80 / Vane Shear (kPa) / Pocket Pen (kPa) / Unconfined (kPa) 60 120 180 240	Elevation (m) (Assumed)
1.0	⊠	55				0.00 m 99.45 m TOPSOIL		99.0
	⊟	56	CH			0.10 m 99.35 m CLAY - silty - moist, firm to stiff - oxidized - dark grayish brown (2.5Y 4/2)		98.0
2.0								97.0
3.0	▬	57				2.40 m 97.05 m SILT - clayey - moist, wet below 3.2 metres - loose - unoxidized - dark gray (5Y 4/1)		96.0
4.0								95.0
5.0	⊠	58						94.0
6.0	⊠	59						93.0
7.0								92.0
8.0	⊠	60						91.0
9.0	⊠	61						90.0
10.0						10.00 m 89.45 m SAND - silty - wet - unoxidized - dark gray (5Y 4/1)		89.0
11.0	⊠	62						88.0
12.0	⊠	63				Test hole terminated at 12.2 m below grade.		87.0
13.0								86.0
14.0								85.0
15.0								84.0
16.0								83.0
17.0								82.0
18.0								81.0
19.0								80.0

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 6.2 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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415 - 7th AVENUE, REGINA, SASKATCHEWAN, S4N 4P1

Logged By:	R. Yaremko	Page	7 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-13

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH108
Project No.: GE-1403	Coordinate: 5588481 N; 542912 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 101.07 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m) | Sample Type | Sample No. | UCS | Soil Symbol

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6

■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8

Plastic M.C. Liquid 20 40 60 80

Soil Description

● Blow Count ● 20 40 60 80

▲ Vane Shear (kPa) ▲

◆ Pocket Pen (kPa) ◆

■ Unconfined (kPa) ■ 60 120 180 240

Well Construction | Elevation (m) (Assumed)

Depth (m)	Sample No.	Elevation (m) (Assumed)
1.0	64	100.0
2.0	65	99.0
3.0	66	98.0
4.0		97.0
5.0	67	96.0
6.0	68	95.0
7.0		94.0
8.0	69	93.0
9.0	70	92.0
10.0		91.0
11.0	71	90.0
12.0	72	89.0
13.0		88.0
14.0		87.0
15.0		86.0
16.0		85.0
17.0		84.0
18.0		83.0
19.0		82.0

0.00 m — **101.1 m**
TOPSOIL

0.05 m — **101.0 m**
FILL - clay
- trace sand and organics
- moist to very moist
- dark grayish brown (2.5Y 4/2)

0.90 m — **100.2 m**
SILT - sandy
- very moist to wet, firm to soft
- oxidized, iron stains
- unoxidized below 3.4 metres
- wet sand lens from 8.5 to 9.6 metres
- dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)

Test hole terminated at 12.2 m below grade.

Backfill Type: Bentonite | Grout | Sand | Cuttings / Slough

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 4.6 metres.
3. Standpipe piezometer was installed.

Piezo. Details & Water Level Meas.
Top of pipe Elev.: 102.07 m
Ht. of pipe above grade: 1.00 m

Date	Depth (m)	Elev. (m)
31/03/2023	2.59	99.48
28/03/2023	4.48	97.59

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CIVIL & GEOENVIRONMENTAL ENGINEERS
415 - 7th AVENUE, REGINA, SASKATCHEWAN, S4N 4P1

Logged By:	R. Yaremko	Page:	8 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-14

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH109
Project No.: GE-1403	Coordinate: 5588328 N; 542878 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.58 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6
■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8
Plastic M.C. Liquid 20 40 60 80
● Blow Count ● 20 40 60 80
▲ Vane Shear (kPa) ▲
◆ Pocket Pen (kPa) ◆
■ Unconfined (kPa) ■ 60 120 180 240

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Soil Description	Elevation (m) (Assumed)
0.0					0.00 m — 99.58 m TOPSOIL	99.0
1.0	⊠	73			0.10 m — 99.48 m CLAY - silty - moist to very moist, firm - oxidized, iron stains - salt crystals - dark grayish brown (2.5Y 4/2)	98.0
2.0		74				97.0
3.0		75				96.0
4.0					1.80 m — 97.78 m SILT - sandy - very moist to wet, soft - oxidized - unoxidized below 3.4 metres - clay layer from 5.5 to 6.1 metres - dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)	95.0
5.0		76				94.0
6.0		77				93.0
7.0						92.0
8.0		78			7.90 m — 91.68 m SAND - silty, fine grained - wet, very loose to medium dense - unoxidized - clay layer at 10.7 metres - dark gray (5Y 4/1)	91.0
9.0		79				90.0
10.0						89.0
11.0		80				88.0
12.0		81			Test hole terminated at 12.2 m below grade.	87.0
13.0						86.0
14.0						85.0
15.0						84.0
16.0						83.0
17.0						82.0
18.0						81.0
19.0						80.0

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 2.7 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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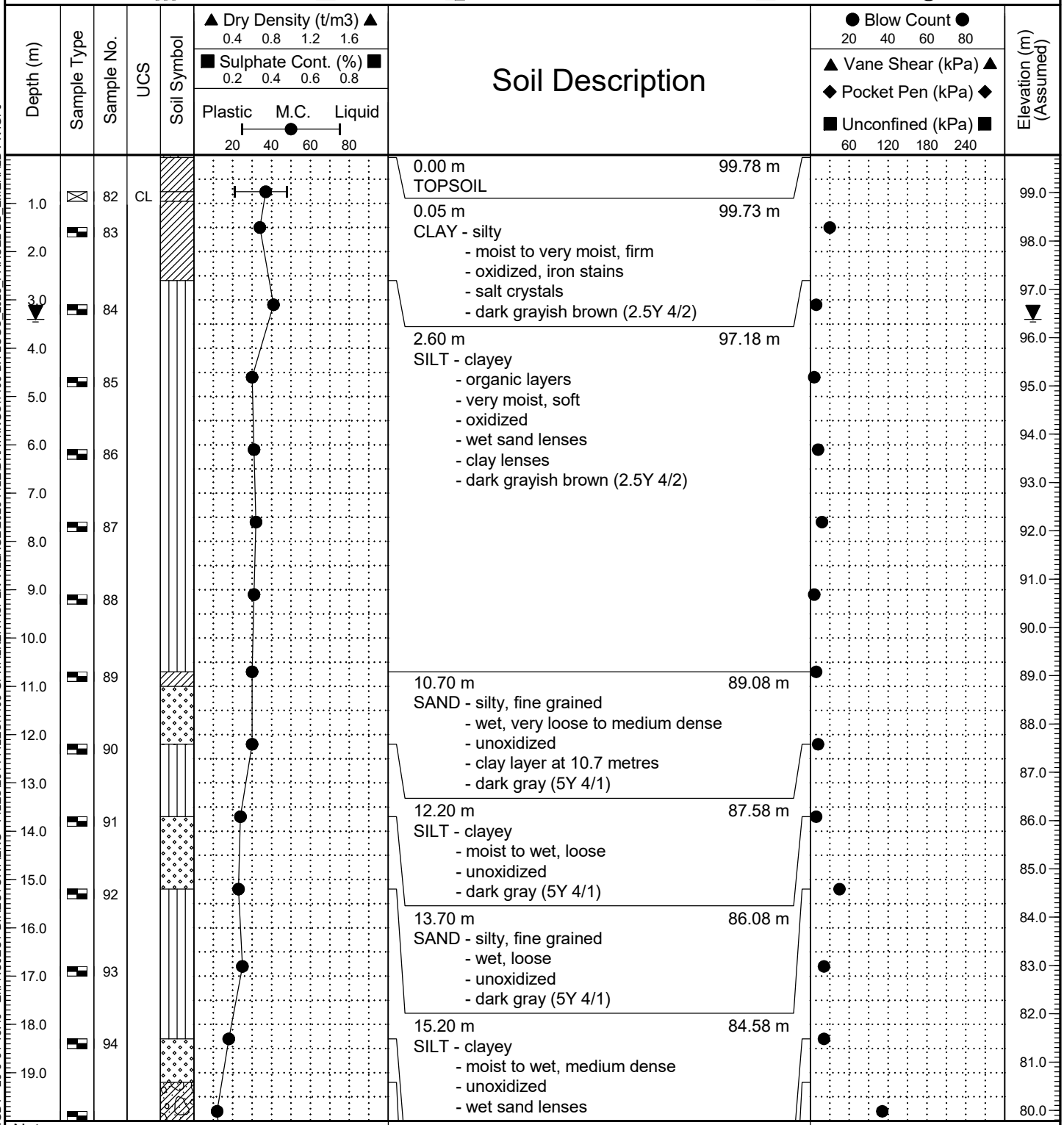
Logged By:	R. Yaremko	Page	9 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-15

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH110
Project No.: GE-1403	Coordinate: 5588281 N; 542779 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.78 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample



Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was measured at 3.4 metres immediately after completion of drilling. Test hole sloughed to 6.7 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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Logged By:	R. Yaremko	Page	10 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-16

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH110
Project No.: GE-1403	Coordinate: 5588281 N; 542779 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.78 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Dry Density (t/m3) 0.4 0.8 1.2 1.6 / Sulphate Cont. (%) 0.2 0.4 0.6 0.8 / Plastic M.C. Liquid 20 40 60 80	Soil Description	Blow Count 20 40 60 80 / Vane Shear (kPa) / Pocket Pen (kPa) / Unconfined (kPa) 60 120 180 240	Elevation (m) (Assumed)
21.0		95				- dark gray (5Y 4/1)		79.0
		96				18.30 m 81.48 m SAND - silty, fine grained - wet, loose - unoxidized - dark gray (5Y 4/1)		
22.0								78.0
23.0						19.20 m 80.58 m TILL - silty, clayey - moist, stiff to hard - unoxidized - dark gray (5Y 4/1)		77.0
24.0								76.0
25.0						Test hole terminated at 21.3 m below grade.		75.0
26.0								74.0
27.0								73.0
28.0								72.0
29.0								71.0
30.0								70.0
31.0								69.0
32.0								68.0
33.0								67.0
34.0								66.0
35.0								65.0
36.0								64.0
37.0								63.0
38.0								62.0
39.0								61.0
								60.0

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was measured at 3.4 metres immediately after completion of drilling. Test hole sloughed to 6.7 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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Logged By: R. Yaremko	Page 10 of 11
Drawn By: M. Creary	Date Plotted: 2023-03-31
Reviewed By: S. Harty	Figure No.: GE-1403-16

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH111
Project No.: GE-1403	Coordinate: 5588376 N; 542745 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.81 m (Assumed)	Date Drilled: 2023-03-28

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m) | Sample Type | Sample No. | UCS | Soil Symbol

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6

■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8

Plastic M.C. Liquid 20 40 60 80

Soil Description

● Blow Count ● 20 40 60 80

▲ Vane Shear (kPa) ▲

◆ Pocket Pen (kPa) ◆

■ Unconfined (kPa) ■ 60 120 180 240

Well Construction | Elevation (m) (Assumed)

Depth (m)	Sample No.	Elevation (m) (Assumed)
0.00	97, 97B	100.8
1.0	98	100.0
2.0		99.0
3.0	99	98.0
4.0		97.0
5.0	100	96.0
6.0	101	95.0
7.0		94.0
8.0	102	93.0
9.0	103	92.0
10.0		91.0
11.0	104	90.0
12.0	105	89.0
13.0		88.0
14.0		87.0
15.0		86.0
16.0		85.0
17.0		84.0
18.0		83.0
19.0		82.0
		81.0

0.00 m — 100.8 m
FILL - silty clay, sandy
- organics
- moist
- dark grayish brown (2.5Y 4/2)

0.46 m — 100.4 m
SAND - silty, fine grained
- moist, medium dense
- oxidized
- olive brown (2.5Y 4/4)

0.76 m — 100.1 m
CLAY - silty, highly plastic
- moist, stiff to firm
- oxidized
- dark grayish brown (2.5Y 4/2)

1.90 m — 98.9 m
SILT - clayey
- moist, wet at 2.4 metres
- soft
- unoxidized below 3.7 metres
- olive brown (2.5Y 4/4) to dark gray (5Y 4/1)

10.10 m — 90.7 m
SAND - silty
- wet, soft
- unoxidized
- dark gray (5Y 4/1)

Test hole terminated at 12.2 m below grade.

Backfill Type: Bentonite | Grout | Sand | Cuttings / Slough

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was meaured at 3.7 metres immediately after completion of drilling. Test hole sloughed to 4.0 metres.
3. Standpipe piezometer was installed.

Piezo. Details & Water Level Meas.
Top of pipe Elev.: 101.67 m
Ht. of pipe above grade: 0.86 m

Date	Depth (m)	Elev. (m)
31/03/2023	2.75	98.92
28/3/2023	3.89	97.78

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Logged By:	J. Stepp	Page:	11 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-17

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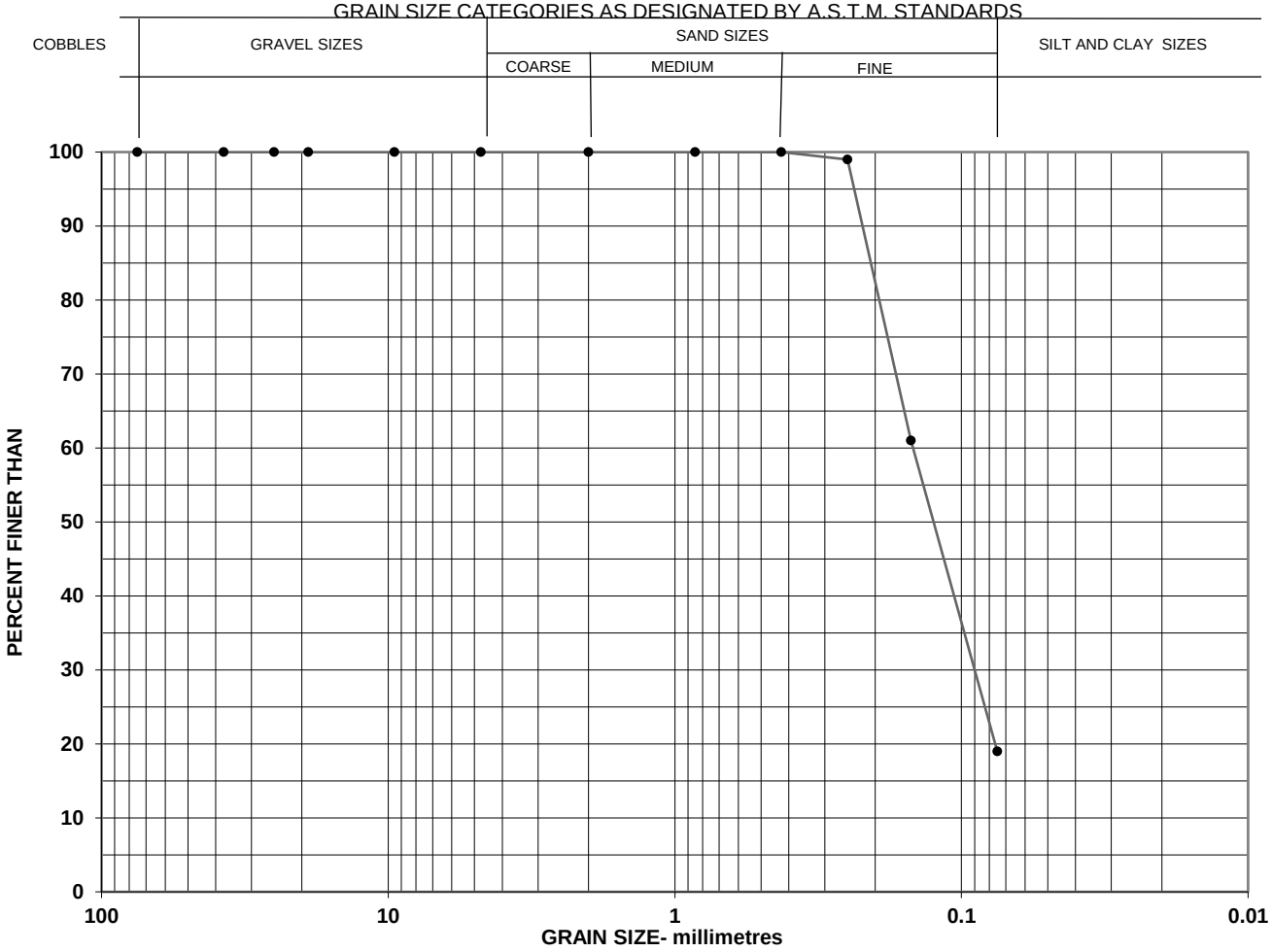
E-MAIL: groundeng@accesscomm.ca

GRAIN SIZE CURVE
(A.S.T.M. C-136, C.S.A. A23.2-2A & 5A)

JOB No: GE-1403 **DATE:** February 17, 2014 **TECH:** S. KHAN
CLIENT: TALON CAPITAL LTD.
PROJECT: PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
LOCATION: EMERALD PARK, SASKATCHEWAN



SIZE OF OPENING (mm)	SPECIFIED % FINER THAN	PERCENT FINER THAN
75.0		100
37.5		100
25.0		100
19.0		100
9.51		100
4.75		100
2.00		100
0.850		100
0.425		100
0.250		99
0.150		61
0.075		19

GRAIN SIZE CATEGORY	PARTICLE SIZE RANGE (mm)	PERCENT RETAINED
GRAVEL	75 to 4.75	0
COARSE SAND	4.75 to 2.0	0
MEDIUM SAND	2.0 to 0.425	0
FINE SAND	0.425 to 0.075	81
SILT & CLAY	< 0.075	19

SAMPLE DESCRIPTION : FINE GRAINED SAND, SOME SILT AND CLAY

MATERIAL SUPPLIED BY: **SAMPLED BY :** R. YAREMKO OF GROUND ENGINEERING CONSULTANTS LTD.

SAMPLE LOCATION: TH 101
SAMPLE NUMBER: 3 AT 10 **DATE SAMPLED :** February 17, 2014

DISTRIBUTION:

WE CERTIFY TESTING PROCEDURES IN ACCORDANCE WITH C.S.A. & A.S.T.M. STANDARDS FOR THAT PORTION OF THE TESTING PERFORMED BY THIS COMPANY GROUND ENGINEERING CONSULTANTS LTD.

Per: _____
KELLY MAUNDER, A.Sc.T.

GE-1403-18

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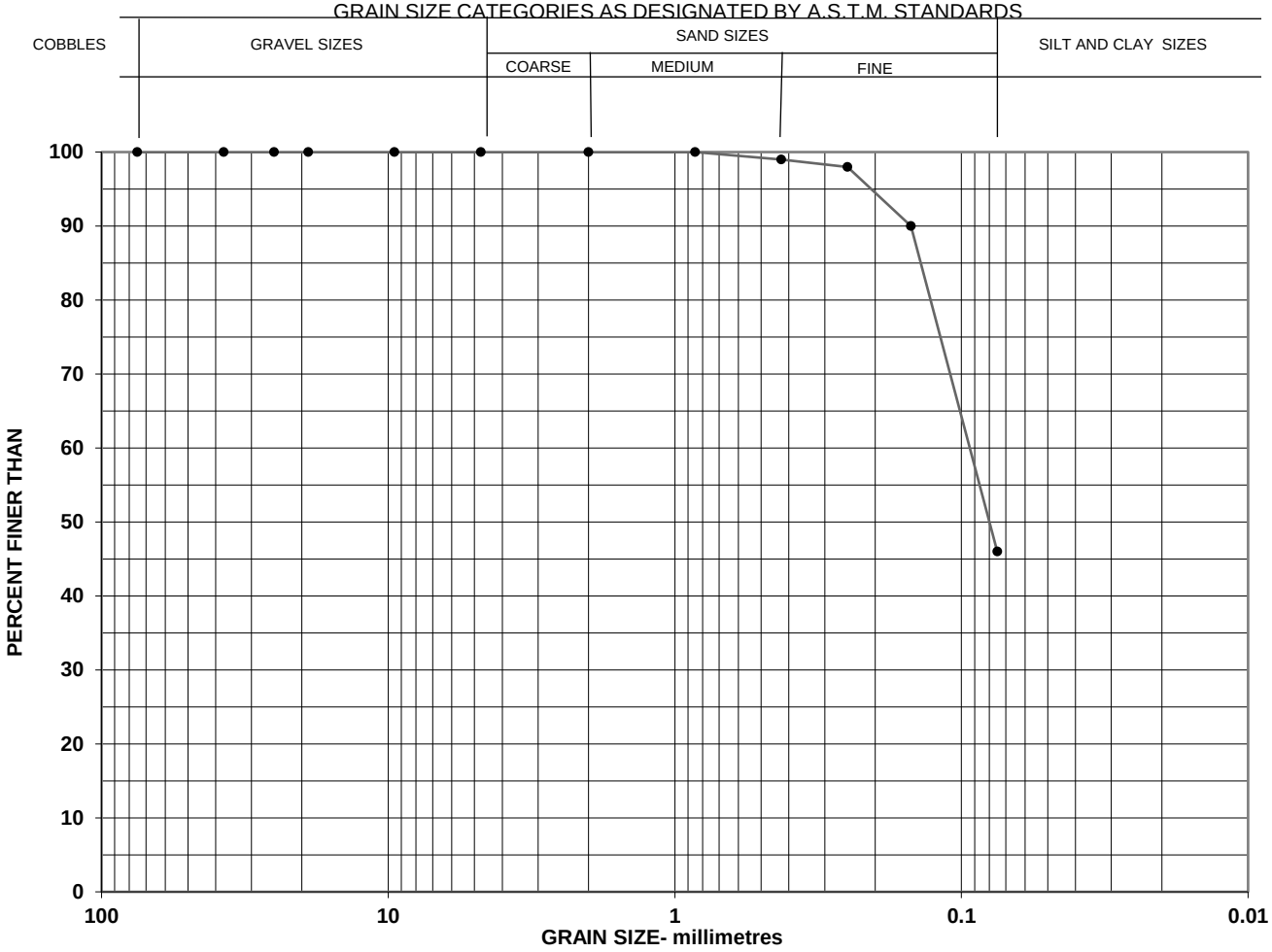
E-MAIL: groundeng@accesscomm.ca

GRAIN SIZE CURVE
(A.S.T.M. C-136, C.S.A. A23.2-2A & 5A)

JOB No: GE-1403 **DATE:** February 17, 2014 **TECH:** S. KHAN
CLIENT: TALON CAPITAL LTD.
PROJECT: PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
LOCATION: EMERALD PARK, SASKATCHEWAN



SIZE OF OPENING (mm)	SPECIFIED % FINER THAN	PERCENT FINER THAN
75.0		100
37.5		100
25.0		100
19.0		100
9.51		100
4.75		100
2.00		100
0.850		100
0.425		99
0.250		98
0.150		90
0.075		46

GRAIN SIZE CATEGORY	PARTICLE SIZE RANGE (mm)	PERCENT RETAINED
GRAVEL	75 to 4.75	0
COARSE SAND	4.75 to 2.0	0
MEDIUM SAND	2.0 to 0.425	1
FINE SAND	0.425 to 0.075	53
SILT & CLAY	< 0.075	46

SAMPLE DESCRIPTION : FINE GRAINED SAND, WITH SILT AND CLAY

MATERIAL SUPPLIED BY: **SAMPLED BY :** R. YAREMKO OF GROUND ENGINEERING CONSULTANTS LTD.

SAMPLE LOCATION: TH 101
SAMPLE NUMBER: 62 AT 35' **DATE SAMPLED :** February 17, 2014

DISTRIBUTION:

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Per: _____
KELLY MAUNDER, A.Sc.T.

GE-1403-19

APPENDIX A

Advantages of concrete filled steel pipe piles

The Steel Pipe Pile represents one of the finest means of providing piled foundations. The individual pipe can be selected in a number of wall thicknesses and diameters to tailor the capacity of the pile to each design load, to the supporting soil capacity and to the ease or difficulty of the driving conditions.

After completion of driving to the required bearing capacity and prior to filling with concrete, each pile can be checked visually for damage in driving, for plumb and for sweep or radius of curvature. In this respect, steel pipe piling is unique. It is subject to full visual observation.

Inspection can be accomplished in very long piles by lowering a safety light on a long drop cord into the steel shaft to inspect for any driving damage. An alternative is the use of a light and mirror to illuminate the interior for inspection. Such inspection methods are not possible with solid piles of steel, concrete, wood or any other structural material. From the time these solid units are driven below the ground surface, nothing is known for certainty of the plumb, curvature or possible damage due to driving or due to obstructions.

After completion of inspection, the steel pipe pile has an added flexibility in its column carrying capacity since the concrete strength can be varied to meet greater or less stringent load demands.

The concrete is placed under controlled conditions to attain the desired results. It is introduced into a thoroughly inspected form which is free of water or any other deleterious substance. This insures a structural integrity which is not possible with any other foundation except a controlled concrete pour in a reinforced pier or caisson.

Other advantages are: high loading capacities; low cost per ton of supported load; ease of driving due to stiffness of the pipe; ease of joining by welding; speed in driving long unspliced lengths, ability of steel to absorb hard driving, reuse of any sections above cut-off elevation, ready availability of pipe; great stability against buckling due to hard driving, high or unusual earth pressures or high loading.

Availability

Stelco Steel Piling Pipe is readily available in many wall thicknesses and diameters. Representative sizes are listed in Table II.

Driving

Steel pipe piling can be driven with or without a plate on the bottom end. Open end piling requires a more expensive cleanout procedure, but does eliminate ground heave in conditions where, in the designer's opinion, ground heave may present a problem.

The closed bottom-end pipe can be driven either with an internal mandrel or by top driving. When driving thin-walled pipe (1/8" to about 3/16" wall), the use of a mandrel ensures damage-free pipe. Mandrel driving requires the driving leads to be approximately double the pile length. Beyond a depth of about 40 feet this method is seldom economic.

Heavier walled pipe can be top driven. This method is particularly applicable when either long piles or hard driving is encountered. The required thickness of the wall is dependent upon the energy of the driving hammer, the ease of driving, the length of pile to be placed, and the imposed design loads.

For any given weight of steel, the pipe pile presents the stiffest shape possible. The radius of gyration of the pipe is the same in all directions. The pile drives straighter than other shapes and keeps drift, out of plumb and sweep to a minimum.

Placing concrete

The requirements of placing concrete in the bottom of a closed bottom-end pipe can be costly if too restrictive. By common practice, in pipes up to 18" in diameter, the pipe is considered to be the chute or spout acting to prevent segregation. If the designer wishes to increase protection against segregation in these smaller diameter pipes (and in any event for diameters of 20 inches or greater) it is recommended that about two feet of strong dry grout be first placed in the bottom of the pile. This grout is placed by free fall regardless of the pile length. The remainder of the pile is filled with a stiff concrete (1 1/2" to 2" slump).

Once again, this concrete is placed without the use of an "elephant trunk" or other special device. It should be noted that some of the larger aggregate in the concrete will penetrate the bottom grout layer to give a pile of uniform high strength.

Piles 12 3/4 x 0.281 wall filled in the above manner have been load tested to greater than 300 tons with no damage to the shaft, and 10 3/4 x 0.250 wall piles have been tested to over 400 tons before failure.

Field splices

Stelco steel piling pipe can be manufactured in any length up to 80'. If pile lengths longer than 80' are required, or if transportation problems dictate shorter pipe lengths than required, field welding is employed. Stelco piling pipe is supplied with bevelled ends to facilitate splicing.

In a bearing pile, it is not essential to have full penetration welds or expensive chill rings and back-up plates. The ends of two adjoining piles are placed in flush contact and then joined with a circumferential fillet weld. In this way, longitudinal compression due to driving and loading is transferred directly across the splice by the end of one pipe bearing on the other. Tensile forces and bending moments induced during driving are easily resisted by the fillet weld.

For any carrying capacity, the splicing of steel piling pipe requires less time and materials than that required for structural shapes. Also, unlike concrete or wood piles, there is little wastage with steel piling pipe since sections cut-off above elevation can be reused.

Load capacity

Soil

The ultimate load capacity of any pile regardless of its column capacity depends upon the surrounding soil in which it is placed. The 1965 National Building Code Section 4.2.2.16 (1), Properties of Soils and Capacities of Foundations is one specification which provides the designer with a number of means for determining the maximum design capacity of a pile. These are: load tests, local experience, or properties of the soil by an appropriate soils investigation.

It is imperative for the designer to remember that the structural column capacity of the pile must be tailored to equal the imposed load which in turn must not exceed the supporting capacity of the soil.

The supporting soil capacity of a friction pile may be taken as the frictional resistance between its surface and the ground with which it is in permanent contact.

Pipe column

The concrete filled steel pipe pile has a very wide range of capacities. The pipe is readily obtained in a number of diameters (5⁹⁄₁₆" to 36"), and wall thicknesses (⅛" to ⅝"). The cast-in-place concrete can be easily varied in strength (3^{KSI} to 5^{KSI} concrete is readily available from most pre-mix plants). The cost of the pile per ton of bearing capacity can be kept to a minimum by adjusting the pipe diameter, the pipe wall thickness, and the concrete strength to suit the driving conditions and bearing capacity of the soil. In this way, the least total cost of the piled foundation is obtained.

From past experience, most concrete filled steel pipe piles in Canada have been driven in the small diameters, i.e., 10¾ and 12¾", with wall thicknesses from 0.219 to 0.281 inches. 3^{KSI} concrete has been used in most cases, although there is presently a trend to higher strength concrete. The larger diameters and thicker walls have generally been used for special conditions.

Lateral support

The 1965 National Building Code presently permits any pile driven into soils other than peat or soft clay to be designed as a short column. Research reported in "Norwegian Experiences with Steel Piles to Rock" by Dr. Lawrence Bjerrum confirms that pipe piling will not undergo column (Euler) buckling provided that

$\frac{I}{A^2} \geq \frac{f^2}{4CE}$ where:

I = Moment of inertia of the transformed cross-section of the concrete filled steel pipe pile,
A = Transformed cross-section area,
f = Yield stress of steel,
E = Young's Modulus of elasticity for steel,
C = Modulus of horizontal compressibility of surrounding soil.

If the yield stress of the pipe (f) is less than or equal to 52,000 psi and "C" is at least 75 psi (a soft clay), the above reduces to:

$\frac{I}{A^2} \geq 0.3$.

In the majority of cases, I/A^2 exceeds 0.3 and the concrete-filled steel pipe pile can be considered as a short column for design purposes. In concrete design, a short column is one in which the unsupported length (h) divided by the outside diameter (d) is 10 or less.

Corrosion of steel pipe piles

The 1965 National Building Code states that steel piles shall have a thickness 1/16" greater than that needed for design requirements unless evidence indicates that corrosion is not a problem. On steel H-piles or sheet steel piles, corrosion can take place on all faces of the member (i.e. two faces of a thickness). On a steel pipe pile, corrosion can take place only on the exterior surface. Hence when making a corrosion allowance in design, the outside diameter is assumed to be reduced by 1/16".

In 1962, the U. S. Department of Commerce released a study on "Corrosion of Steel Piling in Soils", by Melvin Romanoff. This extensive field survey of steel piles located in all types of soil for up to 40 years concluded that:

1. No appreciable corrosion occurs when piles are located in undisturbed soils or below the water table (regardless of the soil types or properties encountered).

2. Above the water table and in fill soils, corrosion is not serious. The areas of pitting in the worst cases are localized and small in area.

3. With the exception of piling exposed to sand erosion, salt water, or tides with high oxygen content in the splash area, *corrosion did not reduce the structural capacity of any pile examined.*

External pressure

The empty steel pipe pile should be strong enough to resist the active earth pressure and the ground water pressure to which it is subjected. The collapse resistance of an empty steel pipe is generally great enough to handle all external earth and any fluid pressures.

For conservative design, particularly in clays, the external earth pressure can be taken as: $p = wh$
where p = External pressure
w = unit weight of soil
h = height of soil at point of calculation

This external pressure should be kept less than the collapse pressure tabulated below.

Table I
External Uniform Collapse Pressure
(33,000 psi minimum yield strength)

Ratio Diameter / Wall Thickness	External Collapse Pressure
10	5300
15	3933
20	2950
25	2360
30	1967
35	1551
40	1012
45	744
50	513
55	389
60	300
65	236
70	189
75	154
80	126
85	105
90	89
95	75
100	65
105	56
110	49
115	43
120	37
125	33

Load tests

The 1965 National Building Code permits a pile to be load tested as a means of verifying its design load capacity (see Section 4.2.2.17 (2)). According to the NBC, the allowable pile load is one-half of the maximum test load applied to the pile. A further stipulation is that the allowable load cannot exceed the load which causes a ½" permanent settlement. As explained in the section "Pipe Column", the above allowable load based on tests need not be reduced when applied to piles which are inspected before the concrete has been poured. When applying test results to uninspected piles, a 25% reduction must be applied to the allowable load determined as above.

Extensive load testing has been carried out on concrete-filled steel pipe piles, both end bearing and friction type. One load test was carried out on two piles at the Steel Company of Canada's Swansea Works in Toronto. The piles were 12.75 O.D. x 0.281 steel tubes filled with 4000 psi high-early strength concrete.

Test pile #1 had a 1" steel plate (13 ½" in diameter) welded across the bottom end to act as a point. The pile was driven 47'8" by a #0 Vulcan Hammer to the surface of a shale layer. Fifteen blows were required for the last inch of penetration.

Testing began two days after driving was completed by applying 20 ton load increments up to a maximum load of 160 tons. The pile was not tested to destruction. The maximum load remained in place for 28 hours and was then removed in 20 ton increments. After unloading was complete, the permanent settlement was 0.474".

Test pile #2 at Swansea was equipped with a 24" x 24" x 1" steel plate point. This pile was driven by the same hammer to the shale layer and refusal was reached at a depth of 35'5". It was also noted that the pile went out of plumb by approximately ½"/foot in driving. Loading of the pile started 9 days after driving was complete and followed the same procedure as pile test #1. After the 160 ton load was removed the pile rebounded to its original elevation for zero permanent settlement. Loading increased the total out of plumbness by ¼".

The Michigan State Highway Department carried out an extensive pile testing program between 1962 and 1965. A twelve inch closed bottom-end pile with a 0.179" wall was top end driven to a depth of 67 feet and loaded to 390 tons. Load test capacity was not available for subjecting the pile to greater loads. At 390 tons, there was failure due to settlement of the pile as a unit into the end supporting glacial till, but no damage to the column shaft capacity was evident.

Western Foundation Corporation (N.Y.) reported that a 10¾ x 0.250 wall pile with 3,000 psi concrete was load tested to over 400 tons in a soil formation prior to failure. This load is equivalent to full tri-axial stressing in accordance with the Richart formula (see section on "Column Strength").

Load tables

Table II lists the section properties of Stelco steel piling pipe and the enclosed concrete core while Table III gives the allowable column strength of concrete filled steel pipe piles.

The tabulated load capacity of a concrete filled steel pipe pile is based upon the 1965 National Building Code, Section 4.5.4A.25 (1) for a "short" column. As explained under "Pipe Column", a short column is one having $h/d \leqq 10$. For this condition, the allowable steel stress is 16.6^{KSI} for steels with a yield of 33^{KSI} or greater and the allowable concrete stress is $0.24\ f'_c$. Three concrete strengths are tabulated—3, 4 and 5^{KSI}. For other strengths, the designer can compute the column capacity of the piles using the above listed stresses.

In some instances, a corrosion allowance may be deemed necessary (see section on "Corrosion"). The corrosion reduction factor in the last column of Table III is based on an assumed loss of 1/16" on the outside pipe diameter. The allowable loads tabulated would be reduced by the corrosion reduction factor.

Table II Properties of Stelco steel pipe and concrete core

Pipe			Area		Moment of inertia		Radius of gyration		Section modulus
outside diameter (in.)	wall (in.)	weight (lbs./ft.)	steel ($in.^2$)	concrete ($in.^2$)	steel ($in.^4$)	concrete ($in.^4$)	steel (in.)	concrete (in.)	steel ($in.^3$)
8.625	0.125	11.35	3.34	55.09	30.15	241.50	3.006	2.094	6.99
8.625	0.134	12.15	3.57	54.85	32.22	239.43	3.002	2.089	7.47
8.625	0.141	12.78	3.76	54.67	33.82	237.83	3.000	2.086	7.84
8.625	0.156	14.11	4.15	54.28	37.22	234.42	2.995	2.078	8.63
8.625	0.164	14.82	4.36	54.07	39.02	232.62	2.992	2.074	9.05
8.625	0.188	16.94	4.98	53.44	44.36	227.29	2.984	2.062	10.29
8.625	0.203	18.26	5.37	53.06	47.65	224.00	2.978	2.055	11.05
8.625	0.219	19.66	5.78	52.64	51.12	220.53	2.973	2.047	11.85
8.625	0.250	22.36	6.58	51.85	57.72	213.93	2.962	2.031	13.38
8.625	0.277	24.70	7.26	51.16	63.35	208.30	2.953	2.018	14.69
8.625	0.312	27.70	8.15	50.28	70.48	201.16	2.941	2.000	16.34
8.625	0.322	28.55	8.40	50.03	72.49	199.16	2.938	1.995	16.81
8.625	0.344	30.42	8.95	49.48	76.84	194.80	2.930	1.984	17.82
8.625	0.406	35.64	10.48	47.94	88.74	182.91	2.909	1.953	20.58
8.625	0.438	38.30	11.27	47.16	94.66	176.99	2.899	1.937	21.95
10.750	0.125	14.18	4.17	86.59	58.89	596.66	3.757	2.625	10.96
10.750	0.134	15.19	4.47	86.29	62.97	592.58	3.754	2.620	11.71
10.750	0.141	15.98	4.70	86.06	66.13	589.42	3.751	2.617	12.30
10.750	0.156	17.65	5.19	85.57	72.85	582.69	3.746	2.609	13.55
10.750	0.164	18.54	5.45	85.31	76.42	579.13	3.743	2.605	14.22
10.750	0.188	21.21	6.24	84.52	87.01	568.53	3.735	2.593	16.19
10.750	0.203	22.87	6.73	84.04	93.56	561.99	3.730	2.586	17.41
10.750	0.219	24.63	7.25	83.52	100.48	555.06	3.724	2.578	18.69
10.750	0.250	28.04	8.25	82.52	113.71	541.83	3.713	2.562	21.16
10.750	0.279	31.20	9.18	81.58	125.87	529.67	3.703	2.548	23.42
10.750	0.307	34.24	10.07	80.69	137.42	518.13	3.694	2.534	25.57
10.750	0.344	38.23	11.25	79.52	152.38	503.16	3.681	2.515	28.35
10.750	0.365	40.48	11.91	78.85	160.73	494.81	3.674	2.505	29.90
10.750	0.438	48.24	14.19	76.57	188.95	466.60	3.649	2.468	35.15
10.750	0.500	54.74	16.10	74.66	211.95	443.60	3.628	2.437	39.43
12.750	0.125	16.85	4.96	122.72	98.79	1198.42	4.464	3.125	15.50
12.750	0.134	18.06	5.31	122.37	105.68	1191.54	4.461	3.120	16.58
12.750	0.141	18.99	5.59	122.09	111.01	1186.20	4.458	3.117	17.41
12.750	0.156	20.98	6.17	121.50	122.39	1174.82	4.453	3.109	19.20
12.750	0.164	22.05	6.48	121.19	128.42	1168.79	4.450	3.105	20.14
12.750	0.188	25.22	7.42	120.26	146.38	1150.83	4.442	3.093	22.96
12.750	0.203	27.20	8.00	119.67	157.50	1139.71	4.437	3.086	24.71
12.750	0.219	29.31	8.62	119.06	169.27	1127.94	4.431	3.078	26.55
12.750	0.250	33.38	9.82	117.86	191.82	1105.39	4.420	3.062	30.09
12.750	0.281	37.42	11.01	116.67	214.03	1083.18	4.410	3.047	33.57
12.750	0.312	41.45	12.19	115.49	235.90	1061.31	4.399	3.031	37.00
12.750	0.330	43.77	12.88	114.80	248.45	1048.76	4.393	3.022	38.97
12.750	0.344	45.58	13.41	114.27	258.13	1039.08	4.388	3.015	40.49
12.750	0.375	49.56	14.58	113.10	279.33	1017.88	4.377	3.000	43.82
12.750	0.406	53.53	15.74	111.93	300.21	997.00	4.367	2.984	47.09
12.750	0.438	57.59	16.94	110.74	321.42	975.80	4.356	2.968	50.42
12.750	0.500	65.42	19.24	108.43	361.54	935.67	4.335	2.937	56.71
14.000	0.188	27.73	8.16	145.78	194.57	1691.18	4.884	3.406	27.80
14.000	0.210	30.93	9.10	144.84	216.31	1669.44	4.876	3.395	30.90
14.000	0.219	32.23	9.48	144.46	225.14	1660.60	4.873	3.390	32.16
14.000	0.250	36.71	10.80	143.14	255.30	1630.44	4.862	3.375	36.47
14.000	0.281	41.17	12.11	141.83	285.04	1600.70	4.851	3.359	40.72
14.000	0.312	45.61	13.42	140.52	314.38	1571.36	4.841	3.344	44.91
14.000	0.344	50.17	14.76	139.18	344.24	1541.50	4.830	3.328	49.18
14.000	0.375	54.57	16.05	137.89	372.76	1512.98	4.819	3.312	53.25
14.000	0.438	63.44	18.66	135.28	429.49	1456.25	4.797	3.281	61.36
14.000	0.500	72.09	21.21	132.73	483.75	1401.99	4.776	3.250	69.11
16.000	0.188	31.75	9.34	191.72	291.90	2925.09	5.591	3.906	36.49
16.000	0.219	36.91	10.86	190.20	338.06	2878.94	5.580	3.890	42.26
16.000	0.250	42.05	12.37	188.69	383.66	2833.33	5.569	3.875	47.96
16.000	0.281	47.17	13.88	187.19	428.72	2788.27	5.558	3.859	53.59
16.000	0.312	52.28	15.38	185.69	473.24	2743.75	5.548	3.844	59.16
16.000	0.344	57.52	16.92	184.14	518.64	2698.35	5.537	3.828	64.83
16.000	0.375	62.58	18.41	182.65	562.08	2654.91	5.526	3.812	70.26
16.000	0.438	72.80	21.41	179.65	648.74	2568.25	5.504	3.781	81.09
16.000	0.500	82.77	24.35	176.71	731.94	2485.05	5.483	3.750	91.49
20.000	0.250	52.73	15.51	298.65	756.43	7097.55	6.983	4.875	75.64
20.000	0.281	59.18	17.41	296.75	846.29	7007.70	6.972	4.859	84.63
20.000	0.312	65.61	19.30	294.86	935.26	6918.73	6.962	4.844	93.53
20.000	0.344	72.22	21.24	292.92	1026.21	6827.77	6.950	4.828	102.62
20.000	0.375	78.60	23.12	291.04	1113.46	6740.52	6.940	4.812	111.35
20.000	0.406	84.96	24.99	289.17	1199.90	6654.08	6.929	4.797	119.99
20.000	0.438	91.51	26.92	287.24	1288.23	6565.76	6.918	4.781	128.82
20.000	0.469	97.83	28.78	285.38	1372.95	6481.03	6.907	4.765	137.30
20.000	0.500	104.13	30.63	283.53	1456.85	6397.12	6.897	4.750	145.69
20.000	0.562	116.67	34.32	279.84	1622.24	6231.74	6.875	4.719	162.22
20.000	0.625	129.33	38.04	276.12	1786.95	6067.02	6.854	4.687	178.70

Table II continued Properties of Stelco steel pipe and concrete core

Pipe			Area		Moment of Inertia		Radius of gyration		Section modulus
outside diameter (in.)	wall (in.)	weight (lbs./ft.)	steel ($in.^2$)	concrete ($in.^2$)	steel ($in.^4$)	concrete ($in.^4$)	steel (in.)	concrete (in.)	steel ($in.^3$)
22.000	0.250	58.07	17.08	363.05	1010.26	10488.76	7.690	5.375	91.84
22.000	0.281	65.18	19.17	360.96	1130.75	10368.27	7.679	5.359	102.80
22.000	0.312	72.27	21.26	358.87	1250.17	10248.86	7.669	5.344	113.65
22.000	0.344	79.56	23.40	356.73	1372.34	10126.67	7.657	5.328	124.76
22.000	0.375	86.61	25.48	354.66	1489.66	10009.36	7.647	5.312	135.42
22.000	0.406	93.64	27.54	352.59	1605.99	9893.03	7.636	5.297	146.00
22.000	0.438	100.87	29.67	350.46	1724.97	9774.05	7.625	5.281	156.82
22.000	0.469	107.85	31.72	348.41	1839.21	9659.81	7.614	5.265	167.20
22.000	0.500	114.81	33.77	346.36	1952.44	9546.57	7.603	5.250	177.49
22.000	0.562	128.68	37.85	342.28	2175.95	9323.07	7.582	5.219	197.81
22.000	0.625	142.68	41.97	338.16	2398.98	9100.03	7.560	5.187	218.09
24.000	0.250	63.41	18.65	433.74	1315.33	14970.69	8.397	5.875	109.61
24.000	0.281	71.19	20.94	431.45	1472.73	14813.30	8.386	5.859	122.73
24.000	0.312	78.94	23.22	429.17	1628.84	14657.19	8.376	5.844	135.74
24.000	0.344	86.91	25.57	426.82	1788.69	14497.34	8.364	5.828	149.06
24.000	0.375	94.62	27.83	424.56	1942.28	14343.74	8.354	5.812	161.86
24.000	0.406	102.31	30.09	422.30	2094.71	14191.31	8.343	5.797	174.56
24.000	0.438	110.22	32.42	419.97	2250.72	14035.30	8.332	5.781	187.56
24.000	0.469	117.87	34.67	417.72	2400.63	13885.39	8.321	5.765	200.05
24.000	0.500	125.49	36.91	415.48	2549.33	13736.68	8.310	5.750	212.44
24.000	0.562	140.68	41.38	411.01	2843.21	13442.81	8.289	5.719	236.93
24.000	0.625	156.03	45.90	406.49	3136.91	13149.11	8.267	5.687	261.41
26.000	0.250	68.75	20.22	510.71	1676.37	20755.41	9.104	6.375	128.95
26.000	0.281	77.19	22.71	508.23	1877.53	20554.25	9.094	6.359	144.43
26.000	0.312	85.60	25.18	505.75	2077.17	20354.61	9.083	6.344	159.78
26.000	0.344	94.26	27.73	503.20	2281.72	20150.05	9.072	6.328	175.52
26.000	0.375	102.63	30.19	500.74	2478.41	19953.36	9.061	6.312	190.65
26.000	0.406	110.98	32.65	498.28	2673.71	19758.06	9.050	6.297	205.67
26.000	0.438	119.58	35.17	495.76	2873.74	19558.03	9.039	6.281	221.06
26.000	0.469	127.89	37.62	493.31	3066.07	19365.70	9.028	6.265	235.85
26.000	0.500	136.17	40.06	490.87	3256.97	19174.79	9.017	6.250	250.54
26.000	0.562	152.69	44.91	486.02	3634.60	18797.16	8.996	6.219	279.58
26.000	0.625	169.38	49.82	481.11	4012.53	18419.23	8.974	6.187	308.66
30.000	0.250	79.43	23.37	683.49	2585.16	37175.67	10.519	7.375	172.34
30.000	0.281	89.19	26.24	680.62	2896.77	36864.06	10.508	7.359	193.12
30.000	0.312	98.93	29.10	677.76	3206.33	36554.50	10.497	7.344	213.76
30.000	0.344	108.96	32.05	674.81	3523.82	36237.00	10.486	7.328	234.92
30.000	0.375	118.65	34.90	671.96	3829.41	35931.40	10.475	7.312	255.29
30.000	0.406	128.33	37.75	669.11	4133.16	35627.66	10.464	7.297	275.54
30.000	0.438	138.29	40.68	666.18	4444.59	35316.22	10.453	7.281	296.31
30.000	0.469	147.92	43.51	663.35	4744.33	35016.48	10.442	7.265	316.29
30.000	0.500	157.53	46.34	660.52	5042.16	34718.64	10.431	7.250	336.14
30.000	0.562	176.70	51.98	654.88	5632.22	34128.59	10.410	7.219	375.48
30.000	0.625	196.08	57.68	649.18	6223.96	33536.83	10.388	7.187	414.93
32.000	0.250	84.77	24.94	779.31	3142.35	48329.57	11.226	7.875	196.40
32.000	0.281	95.20	28.00	776.25	3521.81	47950.12	11.215	7.859	220.11
32.000	0.312	105.59	31.06	773.19	3898.93	47573.00	11.204	7.844	243.68
32.000	0.344	116.30	34.21	770.04	4285.86	47186.06	11.193	7.828	267.87
32.000	0.375	126.66	37.26	766.99	4658.44	46813.47	11.182	7.812	291.15
32.000	0.406	137.00	40.30	763.95	5028.93	46442.98	11.171	7.797	314.31
32.000	0.438	147.65	43.43	760.82	5408.93	46062.98	11.160	7.781	338.06
32.000	0.469	157.94	46.46	757.79	5774.85	45697.05	11.149	7.765	360.93
32.000	0.500	168.21	49.48	754.77	6138.57	45333.33	11.138	7.750	383.66
32.000	0.562	188.70	55.51	748.74	6859.62	44612.28	11.117	7.719	428.73
32.000	0.625	209.43	61.60	742.64	7583.33	43888.54	11.095	7.687	473.96
34.000	0.250	90.11	26.51	881.41	3774.35	61822.96	11.933	8.375	222.02
34.000	0.281	101.20	29.77	878.15	4230.86	61366.50	11.922	8.359	248.87
34.000	0.312	112.26	33.02	874.90	4684.71	60912.64	11.911	8.344	275.57
34.000	0.344	123.65	36.37	871.55	5150.55	60446.81	11.900	8.328	302.97
34.000	0.375	134.67	39.61	868.31	5599.25	59998.05	11.889	8.312	329.37
34.000	0.406	145.67	42.85	865.07	6045.60	59551.74	11.878	8.297	355.62
34.000	0.438	157.00	46.18	861.74	6503.58	59093.73	11.867	8.281	382.56
34.000	0.469	167.96	49.41	858.52	6944.78	58652.57	11.856	8.265	408.52
34.000	0.500	178.89	52.62	855.30	7383.42	58213.84	11.845	8.250	434.32
34.000	0.562	200.71	59.04	848.88	8253.54	57343.76	11.824	8.219	485.50
34.000	0.625	222.78	65.53	842.39	9127.53	56469.73	11.802	8.187	536.91
36.000	0.250	95.45	28.08	989.80	4485.86	77962.12	12.640	8.875	249.21
36.000	0.281	107.20	31.53	986.34	5029.21	77418.88	12.629	8.859	279.40
36.000	0.312	118.92	34.98	982.90	5569.55	76878.50	12.618	8.844	309.42
36.000	0.344	131.00	38.53	979.34	6124.34	76323.75	12.607	8.828	340.24
36.000	0.375	142.68	41.97	975.91	6658.89	75789.12	12.596	8.812	369.94
36.000	0.406	154.34	45.40	972.48	7190.80	75257.25	12.585	8.797	399.49
36.000	0.438	166.36	48.93	968.94	7736.80	74711.25	12.574	8.781	429.82
36.000	0.469	177.98	52.35	965.53	8262.86	74185.12	12.563	8.765	459.05
36.000	0.500	189.57	55.76	962.11	8786.13	73661.81	12.552	8.750	488.12
36.000	0.562	212.71	62.57	955.31	9824.57	72623.37	12.531	8.719	545.81
36.000	0.625	236.13	69.46	948.42	10868.30	71579.69	12.509	8.687	603.79

Table III Allowable column strength of Stelco concrete filled steel pipe piling

Pipe		Area		Allowable column strength (kips)				Corrosion reduction factor (kips)
outside diameter (in.)	wall (in.)	steel ($in.^2$)	concrete ($in.^2$)	steel only	concrete filled steel pipe piling concrete strength $f'_c = 3ksi$	$f'_c = 4ksi$	$f'_c = 5ksi$	
8.625	0.125	3.34	55.09	55.4	95.0	108.2	121.4	14.1
8.625	0.134	3.57	54.85	59.3	98.7	111.9	125.0	14.1
8.625	0.141	3.76	54.67	62.4	101.6	114.7	127.8	14.1
8.625	0.156	4.15	54.28	68.9	107.8	120.8	133.8	14.1
8.625	0.164	4.36	54.07	72.4	111.1	124.1	137.0	14.1
8.625	0.188	4.98	53.44	82.7	121.0	133.8	146.6	14.1
8.625	0.203	5.37	53.06	89.1	127.2	139.8	152.5	14.1
8.625	0.219	5.78	52.64	96.0	133.7	146.3	158.8	14.0
8.625	0.250	6.58	51.85	109.1	146.3	158.6	171.0	14.0
8.625	0.277	7.26	51.16	120.5	157.1	169.3	181.5	14.0
8.625	0.312	8.15	50.28	135.1	171.1	183.1	195.0	14.0
8.625	0.322	8.40	50.03	139.3	175.0	187.0	198.9	14.0
8.625	0.344	8.95	49.48	148.4	183.7	195.5	207.3	14.0
8.625	0.406	10.48	47.94	173.7	208.0	219.4	230.8	14.0
8.625	0.438	11.27	47.16	186.7	220.3	231.5	242.7	14.0
10.750	0.125	4.17	86.59	69.3	131.5	152.2	173.0	17.5
10.750	0.134	4.47	86.29	74.2	136.2	156.9	177.5	17.5
10.750	0.141	4.70	86.06	78.0	139.8	160.5	181.1	17.5
10.750	0.156	5.19	85.57	86.2	147.6	168.1	188.6	17.5
10.750	0.164	5.45	85.31	90.5	151.8	172.2	192.6	17.5
10.750	0.188	6.24	84.52	103.5	164.2	184.4	204.7	17.5
10.750	0.203	6.73	84.04	111.6	171.9	192.0	212.1	17.5
10.750	0.219	7.25	83.52	120.2	180.2	200.1	220.1	17.5
10.750	0.250	8.25	82.52	136.8	196.0	215.7	235.4	17.5
10.750	0.279	9.18	81.58	152.3	210.7	230.2	249.7	17.5
10.750	0.307	10.07	80.69	167.1	224.9	244.1	263.4	17.5
10.750	0.344	11.25	79.52	186.5	243.4	262.4	281.4	17.5
10.750	0.365	11.91	78.85	197.5	253.9	272.7	291.5	17.5
10.750	0.438	14.19	76.57	235.2	290.0	308.2	326.4	17.5
10.750	0.500	16.16	74.66	266.9	320.1	337.9	355.6	17.5
12.750	0.125	4.96	122.72	82.3*	170.5	199.9	229.3	20.8
12.750	0.134	5.31	122.37	88.2	176.1	205.4	234.8	20.8
12.750	0.141	5.59	122.09	92.7	180.5	209.7	239.0	20.8
12.750	0.156	6.17	121.50	102.5	189.8	218.9	248.0	20.8
12.750	0.164	6.48	121.19	107.7	194.7	223.7	252.8	20.8
12.750	0.188	7.42	120.26	123.2	209.5	238.3	267.1	20.8
12.750	0.203	8.00	119.67	132.8	218.8	247.4	276.0	20.8
12.750	0.219	8.62	119.06	143.1	228.6	257.1	285.5	20.8
12.750	0.250	9.82	117.86	162.9	247.5	275.7	303.9	20.8
12.750	0.281	11.01	116.67	182.7	266.3	294.2	322.1	20.8
12.750	0.312	12.19	115.49	202.3	285.1	312.7	340.3	20.8
12.750	0.330	12.88	114.80	213.6	295.9	323.3	350.8	20.8
12.750	0.344	13.41	114.27	222.4	304.3	331.6	358.9	20.8
12.750	0.375	14.58	113.10	241.8	322.8	349.8	376.8	20.8
12.750	0.406	15.74	111.93	261.1	341.3	368.0	394.7	20.8
12.750	0.438	16.94	110.74	281.0	360.2	386.6	413.0	20.8
12.750	0.500	19.24	108.43	319.0	396.5	422.4	448.2	20.8
14.000	0.188	8.16	145.78	135.4	240.1	275.1	310.0	22.8
14.000	0.210	9.10	144.84	151.0	255.0	289.7	324.4	22.8
14.000	0.219	9.48	144.46	157.4	261.1	295.7	330.3	22.8
14.000	0.250	10.80	143.14	179.2	282.0	316.2	350.5	22.8
14.000	0.281	12.11	141.83	201.0	302.7	336.7	370.6	22.8
14.000	0.312	13.42	140.52	222.6	323.4	357.0	390.6	22.8
14.000	0.344	14.76	139.18	244.9	344.6	377.9	411.2	22.8
14.000	0.375	16.05	137.89	266.3	365.1	398.0	431.0	22.8
14.000	0.438	18.66	135.28	309.5	406.4	438.7	470.9	22.8
14.000	0.500	21.21	132.73	351.7	446.6	478.2	509.9	22.8
16.000	0.188	9.34	191.72	155.1	292.8	338.7	384.7	26.1
16.000	0.219	10.86	190.20	180.2	316.9	362.4	408.0	26.1
16.000	0.250	12.37	188.69	205.3	340.8	386.0	431.2	26.1
16.000	0.281	13.88	187.19	230.3	364.7	409.5	454.3	26.1
16.000	0.312	15.38	185.69	255.2	388.4	432.8	477.3	26.1
16.000	0.344	16.92	184.14	280.8	412.9	456.9	500.9	26.1
16.000	0.375	18.41	182.65	305.4	436.4	480.1	523.7	26.1
16.000	0.438	21.41	179.65	355.3	484.0	526.9	569.8	26.1
16.000	0.500	24.35	176.71	403.8	530.4	572.5	614.7	26.1
20.000	0.250	15.51	298.65	257.5	472.1	543.6	615.1	32.6
20.000	0.281	17.41	296.75	289.0	502.1	573.2	644.2	32.6
20.000	0.312	19.30	294.86	320.3	532.1	602.6	673.2	32.6
20.000	0.344	21.24	292.92	352.6	562.9	632.9	703.0	32.6
20.000	0.375	23.12	291.04	383.7	592.6	662.2	731.8	32.6
20.000	0.406	24.99	289.17	414.8	622.2	691.4	760.5	32.6
20.000	0.438	26.92	287.24	446.7	652.7	721.4	790.0	32.6
20.000	0.469	28.78	285.38	477.5	682.1	750.3	818.5	32.6
20.000	0.500	30.63	283.53	508.2	711.4	779.2	846.9	32.6
20.000	0.562	34.32	279.84	569.3	769.8	836.6	903.4	32.6
20.000	0.625	38.04	276.12	631.0	828.7	894.6	960.5	32.6

Table III continued Allowable column strength of Stelco concrete filled steel pipe piling

Pipe		Area		Allowable column strength (kips)				Corrosion reduction factor (kips)
outside diameter (in.)	wall (in.)	steel ($in.^2$)	concrete ($in.^2$)	steel only	concrete filled steel pipe piling concrete strength f'_c = 3ksi	f'_c = 4ksi	f'_c = 5ksi	
22.000	0.250	17.08	363.05	283.6	544.5	631.5	718.4	35.9
22.000	0.281	19.17	360.96	318.3	577.6	664.1	750.5	35.9
22.000	0.312	21.26	358.87	352.9	610.7	696.6	782.5	35.9
22.000	0.344	23.40	356.73	388.5	644.6	730.0	815.4	35.9
22.000	0.375	25.48	354.66	422.9	677.5	762.3	847.2	35.9
22.000	0.406	27.54	352.59	457.1	710.2	794.5	878.9	35.8
22.000	0.438	29.67	350.46	492.4	743.9	827.7	911.5	35.8
22.000	0.469	31.72	348.41	526.5	776.4	859.7	943.0	35.8
22.000	0.500	33.77	346.36	560.4	808.8	891.6	974.4	35.8
22.000	0.562	37.85	342.28	628.0	873.3	955.1	1036.9	35.8
22.000	0.625	41.97	338.16	696.3	938.5	1019.2	1099.9	35.8
24.000	0.250	18.65	433.74	309.7	621.4	725.4	829.3	39.1
24.000	0.281	20.94	431.45	347.7	657.7	761.0	864.3	39.1
24.000	0.312	23.22	429.17	385.5	693.8	796.6	899.3	39.1
24.000	0.344	25.57	426.82	424.4	731.0	833.1	935.3	39.1
24.000	0.375	27.83	424.56	462.0	766.9	868.5	970.1	39.1
24.000	0.406	30.09	422.30	499.5	802.7	903.7	1004.8	39.1
24.000	0.438	32.42	419.97	538.1	839.5	940.0	1040.5	39.1
24.000	0.469	34.67	417.72	575.4	875.1	975.0	1074.9	39.1
24.000	0.500	36.91	415.48	612.6	910.6	1010.0	1109.3	39.1
24.000	0.562	41.38	411.01	686.7	981.4	1079.6	1177.8	39.1
24.000	0.625	45.90	406.49	761.5	1052.8	1149.9	1247.0	39.1
26.000	0.250	20.22	510.71	335.8*	702.9	825.3	947.6	42.4
26.000	0.281	22.71	508.23	377.0	742.2	864.0	985.7	42.4
26.000	0.312	25.18	505.75	418.0	781.4	902.6	1023.7	42.4
26.000	0.344	27.73	503.20	460.3	821.8	942.3	1062.8	42.4
26.000	0.375	30.19	500.74	501.2	860.8	980.7	1100.5	42.4
26.000	0.406	32.65	498.28	541.9	899.7	1019.0	1138.2	42.4
26.000	0.438	35.17	495.76	583.8	939.7	1058.4	1177.0	42.4
26.000	0.469	37.62	493.31	624.4	978.4	1096.4	1214.5	42.4
26.000	0.500	40.06	490.87	664.8	1017.0	1134.4	1251.8	42.4
26.000	0.562	44.91	486.02	745.3	1093.9	1210.1	1326.3	42.4
26.000	0.625	49.82	481.11	826.7	1171.6	1286.6	1401.6	42.4
30.000	0.250	23.37	683.49	388.0*	879.4	1043.2	1207.0	48.9
30.000	0.281	26.24	680.62	435.6*	924.9	1088.0	1251.1	48.9
30.000	0.312	29.10	677.76	483.2	970.3	1132.7	1295.0	48.9
30.000	0.344	32.05	674.81	532.1	1017.0	1178.7	1340.3	48.9
30.000	0.375	34.90	671.96	579.4	1062.2	1223.1	1384.0	48.9
30.000	0.406	37.75	669.11	626.7	1107.3	1267.5	1427.7	48.9
30.000	0.438	40.68	666.18	675.3	1153.7	1313.2	1472.7	48.9
30.000	0.469	43.51	663.35	722.3	1198.6	1357.3	1516.1	48.9
30.000	0.500	46.34	660.52	769.2	1243.4	1401.4	1559.5	48.9
30.000	0.562	51.98	654.88	862.6	1332.6	1489.3	1645.9	48.9
30.000	0.625	57.68	649.18	957.2	1422.9	1578.1	1733.3	48.9
32.000	0.250	24.94	779.31	414.1*	974.4	1161.2	1348.0	52.2
32.000	0.281	28.00	776.25	465.0*	1023.0	1209.1	1395.1	52.2
32.000	0.312	31.06	773.19	515.7*	1071.5	1256.8	1442.0	52.2
32.000	0.344	34.21	770.04	568.0	1121.4	1305.9	1490.4	52.2
32.000	0.375	37.26	766.99	618.6	1169.7	1353.4	1537.1	52.2
32.000	0.406	40.30	763.95	669.0	1217.9	1400.8	1583.8	52.2
32.000	0.438	43.43	760.82	721.0	1267.5	1449.6	1631.8	52.2
32.000	0.469	46.46	757.79	771.2	1315.4	1496.9	1678.3	52.2
32.000	0.500	49.48	754.77	821.4	1363.3	1544.0	1724.6	52.1
32.000	0.562	55.51	748.74	921.3	1458.7	1637.9	1817.0	52.1
32.000	0.625	61.60	742.64	1022.4	1555.3	1732.9	1910.5	52.1
34.000	0.250	26.51	881.41	440.2*	1074.0	1285.3	1496.6	55.4
34.000	0.281	29.77	878.15	494.3*	1125.7	1336.1	1546.6	55.4
34.000	0.312	33.02	874.90	548.3*	1177.2	1386.9	1596.5	55.4
34.000	0.344	36.37	871.55	603.9	1230.4	1439.2	1648.0	55.4
34.000	0.375	39.61	868.31	657.7	1281.7	1489.7	1697.7	55.4
34.000	0.406	42.85	865.07	711.4	1333.0	1540.2	1747.4	55.4
34.000	0.438	46.16	861.74	766.7	1385.8	1592.1	1798.5	55.4
34.000	0.469	49.41	858.52	820.2	1436.8	1642.4	1847.9	55.4
34.000	0.500	52.62	855.30	873.5	1487.8	1692.5	1897.3	55.4
34.000	0.562	59.04	848.88	980.0	1589.4	1792.5	1995.7	55.4
34.000	0.625	65.53	842.39	1087.7	1692.2	1893.7	2095.3	55.4
36.000	0.250	28.08	989.80	466.3*	1178.1	1415.4	1652.6	58.7
36.000	0.281	31.53	986.34	523.6*	1232.9	1469.3	1705.7	58.7
36.000	0.312	34.98	982.90	580.9*	1287.5	1523.1	1758.6	58.7
36.000	0.344	38.53	979.34	639.8*	1343.8	1578.5	1813.1	58.7
36.000	0.375	41.97	975.91	696.9	1398.3	1632.1	1865.8	58.7
36.000	0.406	45.40	972.48	753.8	1452.6	1685.6	1918.5	58.7
36.000	0.438	48.93	968.94	812.4	1508.6	1740.7	1972.7	58.7
36.000	0.469	52.35	965.53	869.1	1562.7	1793.9	2025.1	58.7
36.000	0.500	55.76	962.11	925.7	1616.8	1847.1	2077.5	58.7
36.000	0.562	62.57	955.31	1038.6	1724.6	1953.2	2181.9	58.7
36.000	0.625	69.46	948.42	1152.9	1833.7	2060.6	2287.5	58.7

*These sections have $\frac{O.D.}{t} > \frac{3300}{Fy}$ and by C.S.A. S16-1965 are allowed only with concrete core.

(Concrete Filled)

TABLE OF BASIC LOAD CAPACITIES

For Concrete Strengths of 3000, 4000 and 5000 p.s.i. (28 Days)
Pipe—Minimum Yield Strength of 35000 p.s.i.
(A.S.T.M. Specs. A 252 Grade 2)

Pipe Dia.	Wall In.	Area Concrete	Bearing Capacity Concrete (Kips)			Area of Pipe Less 1/16" Wall	Bearing Capacity Pipe (Kips) fs=14000	Pile or Caisson Bearing Capacity Pipe+Concrete (Kips)		
			f'c—3000	f'c—4000	f'c—5000			f'c—3000	f'c—4000	f'c - 5000
8⅝"	.156	54.272	41.0	54.3	67.7	2.473	34.6	75.6	88.9	102.
	.188	53.456	40.0	53.5	66.6	3.289	46.0	86.0	99.5	112.
	.219	52.651	39.5	52.7	65.6	4.094	57.2	96.7	109.9	122.
	.250	51.849	38.9	51.8	64.9	4.896	68.5	107.4	120.3	133.
10¾"	.156	85.565	64.2	85.6	107	3.099	43.4	107.6	129.0	150.
	.188	84.541	63.4	84.5	106	4.123	57.7	121.1	142.2	163.
	.219	83.528	62.6	83.5	104	5.136	71.8	134.4	155.3	175.
	.250	82.516	61.9	82.5	103	6.146	86.0	147.9	168.5	189.
12¾"	.188	120.28	90.0	120	150	4.91	68.7	158.7	188.7	218.
	.219	119.07	89.3	119	149	6.12	85.6	174.9	204.6	234.
	.250	117.86	88.4	118	147	7.33	103.0	191.4	221.0	250.
	.312	115.47	86.6	115	145	9.72	136.0	222.6	251.0	281.
14"	.188	145.80	109	146	182	5.40	75.5	184.5	221.5	257.
	.219	144.47	108	144	181	6.73	94.2	202.2	238.2	275.
	.250	143.14	107	143	179	8.06	113.0	220.0	256.0	292.
	.312	140.50	105	140	176	10.70	150.0	255.0	290.0	326.
16"	.219	190.20	142	190	237	7.73	108	250	298	
	.250	188.69	141	188	236	9.24	129	270	317	
	.281	187.19	140	187	234	10.75	148	288	335	382
	.312	185.69	139	185	232	12.25	171	310	356	403
20"	.250	298.65	224	298	373	11.60	162	386	460	535
	.281	296.75	223	296	371	13.49	189	412	485	560
	.312	294.80	221	295	368	15.38	215	436	510	583
	.375	291.04	218	291	364	19.20	269	487	560	633
24"	.250	433.74	328	434	547	13.952	195	523	629	742
	.312	429.17	322	429	536	18.517	259	581	688	795
	.375	424.56	318	424	530	23.132	324	642	748	854
	.500	415.48	312	415	520	32.213	451	763	866	971
26"	.250	511.50	384	511	639	15.119	211	595	722	850
	.312	504.85	378	505	630	20.074	281	659	786	911
	.375	501.50	376	501	625	25.085	351	727	852	976
	.500	490.80	369	491	614	34.950	489	858	980	1103
30"	.250	684.70	513	685	855	17.472	244	757	929	1099
	.312	677.60	508	677	846	23.220	325	833	1002	1171
	.375	672.00	504	672	839	29.021	406	910	1078	1245
	.500	660.52	495	660	826	40.459	566	1061	1226	1392
36"	.250	991.50	744	991	1240	21.015	294	1038	1285	1534
	.312	982.90	736	983	1230	27.923	391	1127	1374	1621
	.375	975.91	732	976	1220	34.912	488	1220	1464	1708
	.500	962.12	722	962	1210	48.705	682	1604	1644	1892

APPENDIX B

3300 - 1 DESCRIPTION

1.01 The work shall consist of spreading and compacting screened or crushed aggregate on a prepared surface.

1.02 The following definitions shall apply for this specification:

(a) Mean:

The arithmetic average of a set of 'n' test results constituting the sample.

(b) Moving average:

The arithmetic mean of 3 consecutive test results.

(c) Sub-base aggregate:

The aggregate before mixing, when binder is to be added or the aggregate before spreading and compacting, when no binder is to be added.

(d) Sub-base mix:

The sub-base aggregate after mixing with binder and water but before spreading and compacting.

(e) Sub-base course:

The sub-base aggregate or sub-base mix in place on the road during and after spreading and compacting.

3300 - 2 MATERIALS

Aggregate

2.01 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.

3300 - 3 CONSTRUCTION

General

3.01 (a) Sub-base course shall comply with the requirements listed in Table 1:

TABLE 1

Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series		
	TYPE		
	6	8	10
50.0 mm	100.0	100.0	100.0
2.0 mm	0 - 80.0	0 - 90.0	
400 um	0 - 45.0	0 - 60.0	
160 um	0 - 20.0	0- 25.0	
71 um	0 - 6.0	0 - 15.0	0 - 20.0
Plasticity Index (all types)	0 - 6.0		

(b) 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.

3.02 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

(a) Overburden shall be removed from material deposits in accordance with Specification 2260 For Removal Of Overburden.

(b) Stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

3.03 Binder, filler and blender sand shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

3.04 Sub-base aggregate shall be pushed to a trap or into a stockpile prior to screening.

Processing

3.05 The production of sub-base course shall comply with the following:

(a) The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed in Table 1.

(b) Operations shall not recommence until the specified requirements are met.

(c) Upon recommencement of operations, the specified requirements shall be met on each of the initial 2 tests.

(d) Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

Spreading and Compacting

3.06 The thickness of a compacted lift of sub-base course shall not exceed 120 mm. The lift thickness may be increased if the Contractor can demonstrate that with the use of vibratory compaction equipment and construction procedures, the compaction requirements can be achieved for lifts greater than 120 mm.

3.07 Sub-base courses shall be compacted until no further settlement is apparent and the particles are well keyed into place. The sub-base course shall be free from any rutting or deformations before the placement of the next course.

3.08 If excess moisture originating from external causes including but not limited to precipitation and/or Contractor's operation is present in the sub-base course and/or underlying material prior to the acceptance of the completed surfacing structure; the Contractor shall dry the sub-base course and/or the underlying material to the optimum moisture content and compact the sub-base and/or the underlying material to not less than the specified density or the optimum density in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

Stabilizing

3.09 If the sub-base course proves to be unstable, the Engineer shall require the Contractor to stabilize the sub-base aggregate by one or a combination of the following methods:

(a) By the addition of binder or filler at the aggregate source or at the screening plant. The binder or filler shall be added and thoroughly distributed throughout the aggregate until a homogeneous mixture is obtained.

(b) By the addition of crushed aggregate on the road.

(c) By the addition of emulsified asphalt to the compaction water in the proportions designated by the Engineer. The Department shall supply the asphalt.

(d) Any other method proposed by the Contractor and approved by the Engineer.

Seasonal Shutdown

3.10 If work must be carried over from one construction season to the next, there shall be no exposed sub-base aggregate, mix or sub-base course remaining on the road unless covered by a lift of base course.

3300-4 SAMPLING AND TESTING

General

4.01 Unless otherwise specified, test procedures shall be in accordance with Saskatchewan Highways and Transportation's Standard Test Procedures Manual.

4.02 The test procedures in effect on the closing date of the tenders shall apply.

3300 - 5 MEASUREMENT

5.01 Sub-base course shall be measured in tonnes.

3300 - 6 PAYMENT

6.01 Payment for Sub-base Course shall be at the contract unit price per tonne. The contract unit price shall be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

6.02 If the contract includes a bid item for:

(a) Hauling Sub-base Course and Hauling Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

(b) Watering; payment shall be made in accordance with Specification 2500 For Watering.

(c) Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

(d) Granular Base Course; payment for Granular Base Course used as stabilizing agent shall be at the contract unit price For Granular Base Course.

(e) Prime, Tack or Flush Coat; payment for emulsified asphalt used as stabilizing agent shall be the contract unit price for Prime, Tack and Flush Coat.

3505 - SPECIFICATION FOR GRANULAR BASE COURSE

3505 - 1 DESCRIPTION

1.01 The work shall consist of spreading and compacting crushed and pugmilled aggregate on a prepared surface.

1.02 The following definitions shall apply:

(a) Acceptance limit:

The maximum or minimum value for a test result above or below which the section of roadway shall be rejected.

(b) Acceptance testing:

The testing performed to determine compliance with the specification regarding certain requirements, limits and tolerances for the quality of materials and workmanship to be supplied.

(c) Base aggregate:

The aggregate before pugmilling.

(d) Base mix:

The mix after pugmilling, but before spreading.

(e) Base course:

The mix in place on the road during and after spreading and compacting.

(f) Mean:

The arithmetic average of a set of 'n' test results constituting the sample.

(g) Moving average:

The arithmetic mean of 3 consecutive test results.

(h) Surface defects:

Surface defects that are due to the Contractor’s operation shall include but shall not be limited to the following:

(i) Potholing.

(ii) Surface failures.

(iii) Ravelling.

(iv) Rutting.

(v) Bumps or dips.

(vi) Irregular cross slopes.

(vii) Segregation.

3505 - 2 MATERIALS

Aggregate

2.01 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.

3505 - 3 CONSTRUCTION

General

3.01 (a) Base course shall comply with the requirements listed in Table 1.

TABLE 1

SIEVE DESIGNATION	PERCENT BY WEIGHT PASSING CANADIAN METRIC SIEVE SERIES		
	TYPE		
	31	33	35
31.5 mm	100.0		
18.0 mm	75.0 - 90.0	100.0	100.0
12.5 mm	65.0 - 83.0	75.0 - 100.0	81.0 - 100.0
5.0 mm	40.0 - 69.0	50.0 - 75.0	50.0 - 85.0
2.0 mm	26.0 - 47.0	32.0 - 52.0	32.0 - 65.0
900 um	17.0 - 32.0	20.0 - 35.0	20.0 - 43.0
400 um	12.0 - 22.0	15.0 - 25.0	15.0 - 30.0
160 um	7.0 - 14.0	8.0 - 15.0	8.0 - 18.0
71 um	6.0 - 11.0	6.0 - 11.0	7.0 - 12.0
Plasticity Index	0 - 7.0	0 - 6.0	0 - 5.0
Fractured Face %	50.0 Minimum		
Light Weight Pieces %	5.0 Maximum		

(b) A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 40.0 mm sieve for Type 31 base course and the 22.4 mm sieve for Types 33 and 35 base course.

3.02 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

(a) Overburden shall be removed from material deposits in accordance with Specification 2260 For Removal Of Overburden.

(b) Rock passing a 450 mm square opening screen and larger than the maximum specified size shall be crushed and incorporated simultaneously throughout the crushing operation.

(c) Stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

3.03 Binder, filler, and blender sand shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

3.04 Binder, filler and blender sand shall be added using a separate conveyor system.

3.05 Binder, filler and blender sand feeds shall be accurately controlled and coordinated.

Reject Aggregate

3.06 If the Contractor is required to reject a fraction of the raw aggregate to meet the aggregate requirements in Table 1, the following shall apply:

(a) The raw aggregate shall be screened over a maximum 9.0 mm square opening screen or a 5.0 mm slotted screen prior to crushing.

(b) The Contractor shall be responsible for the rejected material up to a maximum of 10% of the raw aggregate by weight.

(c) The quantity of raw aggregate shall be calculated as follows:

Raw aggregate = (Granular base course less binder, filler and blender sand) x 1.11

Processing

3.07 Base mix production shall comply with the following requirements during the pugmilling stage:

(a) The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed in Table 1.

(b) Operations shall not recommence until the specified requirements are met.

(c) Upon recommencement of operations, the specified requirements shall be met on each of the initial 2 tests.

(d) Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

3.08 Base aggregate shall be stockpiled after the crushing operation and prior to the pugmilling.

3.09 During pugmilling operations, the Contractor shall have sufficient base aggregate in stockpile for at least 24 h of pugmilling operation until crushing is completed.

3.10 Pugmilling shall be performed in a stationary mixing plant. The mixing unit shall be designed to ensure complete mixing of the materials.

3.11 The pugmill shall be equipped with spray bars for the addition of water.

3.12 The moisture content of the base mix shall not be greater than 5 % by weight when it leaves the pugmill.

Spreading And Compacting

3.13 Base mix shall be spread on dry and unfrozen surfaces.

3.14 Base mix shall not be compacted if the atmospheric temperature is less than 2 °C.

3.15 Base course spilled on new asphalt concrete shall be removed immediately.

3.16 The finished surface of the base course shall be true to grade and cross section and free of any surface defects.

3.17 If specified in the Special Provisions or shown on the plans, a prime coat shall be placed on the finished final lift of base course in accordance with Specification 4000 For Bituminous Prime, Tack, And Flush Coat. Prime coat shall be placed within 24 h, weather permitting, after receiving written authorization from the Engineer.

3.18 If a seal coat is specified for shoulder base course, the surface of the final lift of shoulder base course shall be constructed 10 mm below the surface of the final lift of the wearing course.

3.19 If excess moisture originating from external causes including but not limited to precipitation and/or Contractor's operation is present in the subgrade and/or sub-base course and/or base course prior to the acceptance of the completed surfacing structure; the Contractor shall dry the subgrade and/or sub-base course and/or base course to the optimum moisture content and compact the subgrade and/or sub-base course and/or base course to not less than the specified density or the optimum density in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

Seasonal Shutdown

3.20 If work must be carried over from one construction season to the next and the number of working days/completion date have not expired, the following shall apply:

(a) For accepted final lift of base course on which a wearing course has not been placed, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.5 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.5 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Department shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on the 1.5 km limit.

(v) When work resumes, the Contractor shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all other sections outside the 1.5 km limit.

(b) For unaccepted base course and accepted lower lifts of base course, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.5 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.5 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Department shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on the 1.5 km limit.

(v) When work resumes, the Contractor shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all other sections outside the 1.5 km limit.

3.21 If work must be carried over from one construction season to the next and the number of working days/completion date have expired, the following shall apply:

(a) For accepted final lift of base course on which a wearing course has not been placed, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.0 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.0 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Contractor shall bear the costs of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all sections of base course.

(b) For unaccepted base course and accepted lower lifts of base course, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iii) When work resumes, the Contractor shall bear the costs of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all sections of base course.

3.22 The Contractor shall bear the cost of maintenance, except snow and ice removal, on sections of roadway where the road surface has been disturbed by the construction operations.

3505 - 4 SAMPLING AND TESTING

General

4.01 Unless otherwise specified, test procedures shall be in accordance with Saskatchewan Highways and Transportation's Standard Test Procedures Manual.

4.02 The test procedures in effect on the closing date of the tenders shall apply.

Acceptance Testing

4.03 Upon notification from the Contractor that a section of the roadway has been inspected and is ready for acceptance testing, the Engineer shall carry out the required tests for density and surface defects.

Acceptance Testing for Density

4.04 The maximum density value and the corresponding optimum moisture content shall be determined in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

4.05 Densities shall not be taken at locations within 0.5 m of an unsupported edge and 0.1 m of a supported edge.

4.06 Acceptance testing for density of the base course on the road shall be determined in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 205-7).

4.07 Frequency and locations of testing on any section shall be at the discretion of the Engineer.

3505 - 5 ACCEPTANCE OR REJECTION

5.01 The section of base course shall be considered acceptable if it contains no surface defects and if:

(a) The average density meets or exceeds 100 % of maximum density.

(b) All individual test results are greater than 98 % of maximum density.

(c) The moisture content is less than or equal to the optimum moisture content.

5.02 If shoulder base course is placed in a separate operation and shoulder base course is the final wearing course; the section of shoulder base course shall be considered acceptable if it contains no surface defects and if:

(a) The average density meets or exceeds 95.0 % of maximum density.

(b) All individual test results are greater than 93.0 % of maximum density.

(c) The moisture content is less than or equal to the optimum moisture content.

Product Rejection

5.03 If the densities for any section of the roadway are outside the acceptance limits outlined in Sections 5.01 and 5.02, the section shall be rejected as unacceptable work and the following shall apply:

(a) The Contractor shall have the opportunity to remedy existing base course by rerolling or by any other method suggested by the Contractor and approved by the Engineer. The Contractor may request that the section of the roadway be retested during or after the completion of the remedial attempts.

(b) The section shall be tested a total of 3 times free of cost to the Contractor. The Contractor shall pay the cost of any additional testing. The rate for the Department testing shall be as designated in the Special Provisions.

(c) If the base course in the section remains outside the acceptance limits after the remedial attempts, the Contractor shall remove and replace all the base course in that section. The Engineer may approve a base course overlay of equal thickness in lieu of removing and replacing the base course.

5.04 Any section with surface defects shall be rejected as unacceptable work.

Repairs

5.05 Surface defects shall be repaired in a manner acceptable to the Engineer.

3505 - 6 MEASUREMENT

6.01 Granular base course shall be measured in tonnes.

6.02 Reject aggregate shall be measured by the cross section method. The volume of reject shall be multiplied by 1.7 to calculate tonnes.

3505 - 7 PAYMENT

7.01 Payment for Granular Base Course and Granular Shoulder Base Course shall be at the contract unit price per tonne. The unit price shall be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

7.02 The rate that the Department shall pay for rejecting aggregate in excess of 10% shall be as designated in the Special Provisions of the contract.

7.03 If the contract includes a bid item for:

(a) Hauling Granular Base Course, Hauling Granular Shoulder Base Course and/or Hauling Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

(b) Watering; payment shall be made in accordance with Specification 2500 For Watering.

(c) Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

(d) Prime, Tack or Flush Coat; payment shall be made in accordance with Specification 4000 For Bituminous Prime, Tack And Flush Coat.

7.04 All remedial work shall be performed at the Contractor's expense including the cost of materials.

Saskatchewan
Highways and
Transportation

4100 – SPECIFICATION FOR ASPHALT CONCRETE

Table of Contents

TABLES

4100.1 GENERAL

4100.1.1 Description

4100.1.1.1 The work shall consist of mixing crushed aggregates, or a combination of crushed aggregates and reclaimed asphalt concrete, blender sand material as required, additives as required, and asphalt in a hot mix plant; and spreading and compacting the mixture on a prepared surface.

4100.1.2 Definitions

4100.1.2.1 The following definitions shall apply for this specification:

4100.1.2.1.1 Acceptance Limit is the maximum or minimum value for a test result above or below which the block and/or lot will be rejected.

4100.1.2.1.2 Acceptance Testing is the testing performed by the Engineer to determine compliance with the specifications regarding specified requirements, limits and tolerances for the quality of materials and workmanship supplied.

4100.1.2.1.3 Adjusted PrI is the adjusted profile results for smoothness in a block in which individual bumps and dips greater than 12 mm have been removed. The adjusted PrI in a block will be recalculated by removing the individual PrI results corresponding to the location of individual bumps and dips that are greater than 12 mm.

4100.1.2.1.4 Asphalt is the asphalt material being added as bituminous binder.

4100.1.2.1.5 Asphalt Concrete is the asphalt mix in place on the road including levelling and surface courses during and after spreading and compacting.

4100.1.2.1.6 Asphalt Mix is the mix after the asphalt mix aggregate and asphalt have been blended together.

4100.1.2.1.7 Asphalt Mix Aggregate is the aggregate after combining all virgin aggregates, additives and reclaimed asphalt concrete aggregate.

4100.1.2.1.8 Asphalt Mix Design is the laboratory determination of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix.

4100.1.2.1.9 Asphalt Mix Formula is the field determination during the plant calibration process of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix as produced at the plant.

4100.1.2.1.10 Block is the unit of measurement for assessing smoothness and individual bumps and dips. A block is a portion of the final lift of asphalt concrete that is one paver width wide and 100 m long. The first and last block on a construction section may be less than 100 m long.

4100.1.2.1.11 Density

4100.1.2.1.11.1 Asphalt Mix Design Density is the Marshall density for the compacted Asphalt Mix Design specimen (see 4100.1.2.1.8 above).

4100.1.2.1.11.2 Asphalt Mix Formula Density is the Marshall density for the compacted Asphalt Mix Formula specimen (see 4100.1.2.1.9 above).

4100.1.2.1.11.3 Field Density is the density of the Asphalt Concrete as determined by STP 204 – 6, Density-In-Place By Nuclear Gauge.

4100.1.2.1.11.4 Job Mix Formula Density is the Marshall density for the compacted Job Mix Formula specimen (see 4100.1.2.1.13 below).

4100.1.2.1.11.5 Specified Marshall Density is 97% of the 3-point moving average Marshall Density established for the Asphalt Mix Formula or the Job Mix Formula, whichever is in use.

4100.1.2.1.11.6 Target Density is the density established through the rolling pattern strip when the Specified Marshall Density is not achievable.

4100.1.2.1.12 Individual Bump And/Or Dip is a bump or dip measured in the vertical direction that exceeds 12 mm.

4100.1.2.1.13 Job Mix Formula is the field determination of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix as produced at the plant.

4100.1.2.1.14 Lot is approximately 200 tonnes of asphalt concrete which is assessed as a unit for the purpose of payment and selected to represent work produced by essentially the same process and materials. The final lot on a project may vary in mass from 101 t to 300 t.

4100.1.2.1.15 Mean is the arithmetic average of the test results within a lot.

4100.1.2.1.16 Moving Average is the arithmetic mean of 3 consecutive test results.

4100.1.2.1.17 Profile Index (PrI) is the sum of the vertical deviations, in millimetres, outside the 5 mm null band that a roadway deviates from a perfectly flat surface over a horizontal distance of 100 m. The PrI categories are as follows:

4100.1.2.1.17.1 Category I PrI applies to all blocks not identified below as Category II PrI.

4100.1.2.1.17.2 Category II PrI applies to the following circumstances:

4100.1.2.1.17.2.1 Curves with radius less than 600 m;

4100.1.2.1.17.2.2 Blocks within 50 m of a bridge or railway crossing;

4100.1.2.1.17.2.3 Single lift rehabilitation projects where the total thickness of asphalt concrete being placed is 50 mm or less, with the exception of profiled-milled sections;

4100.1.2.1.17.2.4 Areas where there is curb and gutter; and

4100.1.2.1.17.2.5 The block at each construction limit.

4100.1.2.1.18 Reclaimed Asphalt Concrete is asphalt concrete reclaimed from the roadway.

4100.1.2.1.19 Reclaimed Asphalt Concrete Aggregate is the aggregate remaining after the asphalt has been extracted from the Reclaimed Asphalt Concrete.

4100.1.2.1.20 Repair

4100.1.2.1.20.1 Class I Repair is a corrective improvement that removes and replaces, or overlays the defective or damaged block(s) or lot(s) and restores the block(s) or lot(s) to the specified standard.

4100.1.2.1.20.2 Class II Repair is a surface treatment that mends or corrects a structural defect to restore the surface to an acceptable standard (e.g. slurry seal).

4100.1.2.1.20.3 Class III Repair is a surface treatment that mends or corrects a surface defect but does not restore the surface to an acceptable standard (e.g. flush coat).

4100.1.2.1.20.4 Class IV Repair is a corrective improvement to the ride by reducing bump(s) and/or dip(s). An acceptable Class IV repair is one which removes or reduces the bump(s) and/or dip(s) through a smooth transition to the surrounding asphalt concrete without impairing the functionality and/or structural characteristics in the area of the bump(s) and/or dip(s).

4100.1.2.1.21 Segregated Area is an area 0.1 m^2 or greater where the surface texture is either too stony or lacking in continuous matrix of asphalt, fine aggregate and coarse aggregate in relation to the surrounding acceptable asphalt concrete.

4100.1.2.1.22 Segregation Severity

4100.1.2.1.22.1 None means a completely uniform surface texture. The matrix of asphalt and fine aggregate is in place between the coarse aggregate.

4100.1.2.1.22.2 Minor means significantly more stone is visible than in the surrounding acceptable asphalt concrete, usually with a lack of continuous contact with the surrounding matrix.

4100.1.2.1.22.3 Severe means areas that usually appear as very stony mix, with stone against stone, and may be missing matrix.

4100.1.2.1.23 Smoothness means the surface profile of the asphalt concrete with the Profile Index (PrI) as the measured output. Individual bumps and/or dips of 12 mm or less are considered a part of smoothness.

4100.1.2.1.24 Surface Defects that are due to the Contractor's operation shall include, but shall not be limited to the following:

4100.1.2.1.24.1 Areas of segregation less than 0.1 m^2;

4100.1.2.1.24.2 Areas containing excess or insufficient asphalt;

4100.1.2.1.24.3 Areas of open texture;

4100.1.2.1.24.4 Improper matching of longitudinal and transverse joints on final lift of asphalt concrete;

4100.1.2.1.24.5 Roller marks on final lift of asphalt concrete;

4100.1.2.1.24.6 Cracking or tearing;

4100.1.2.1.24.7 Contamination by diesel, hydraulic fluids, detergent or other harmful products;

4100.1.2.1.24.8 Foreign objects or materials that are detrimental to the asphalt concrete; and

4100.1.2.1.24.9 Clay balls or oversized materials.

4100.2 MATERIALS

4100.2.1 Asphalt

4100.2.1.1 The Department will supply and pay for the asphalt.

4100.2.2 Aggregate

4100.2.2.1 Virgin 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, clay, loam, ironstone, coal and organic or other deleterious material.

4100.2.3 Anti-Stripping Agents

4100.2.3.1 The Department will supply and pay for the anti-stripping agents.

4100.3 CONSTRUCTION

4100.3.1 Department Owned or Controlled Aggregate Sources

4100.3.1.1 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

4100.3.1.1.1 Overburden shall be removed from material deposits in accordance with Specification 2260 For The Removal Of Overburden.

4100.3.1.1.2 Rock passing a 610 mm square opening screen and larger than the maximum specified size shall be crushed and incorporated simultaneously throughout the crushing operation.

4100.3.1.1.3 Aggregate stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

4100.3.2 Binder, Filler and Blender Sand

4100.3.2.1 Filler and blender shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

4100.3.3 Anti-Stripping Agents

4100.3.3.1 The Department will determine whether or not anti-stripping agent is required.

4100.3.3.2 When the Department has determined that anti-stripping agent is required, the Engineer will determine if hydrated lime or liquid anti-stripping agent shall be used.

4100.3.3.3 Hydrated Lime

4100.3.3.3.1 When hydrated lime is used, the following shall apply:

4100.3.3.3.1.1 The Contractor shall supply the equipment necessary to add the lime.

4100.3.3.3.1.2 The hydrated lime shall be blended by a pugmill into the cold aggregate feed.

4100.3.3.3.1.3 Sufficient water shall be added at the pugmill to ensure a minimum of 3% moisture content in the aggregate.

4100.3.3.3.1.4 The amount of hydrated lime added shall be approximately 1% of the total dry aggregate by weight, or as designated by the Engineer, for the Job Mix Formula.

4100.3.3.3.1.5 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.

4100.3.3.3.1.6 The Contractor shall maintain records containing bills of lading, estimated quantities on hand, estimated quantities used, and at the completion of the project, the estimated unused quantity. The record of estimated usage shall be provided to the Engineer on a daily basis.

4100.3.3.3.1.7 At the end of the project the bulk measurement of the hydrated lime used on the project shall not deviate by more than 25% from the specified percentage designated by the Job Mix Formula. If the final amount of hydrated lime used on the project exceeds 125% of the specified percentage designated by the Job Mix Formula, the Department will deduct the cost of the hydrated lime used in excess of 125% from the Final Progressive Estimate. If the final amount of hydrated lime used on the project is less than 75% of the specified percentage designated by the Job Mix Formula, the Contractor shall perform at his expense a Class I repair on the asphalt concrete in a manner acceptable to the Engineer.

4100.3.3.4 Liquid Anti-Stripping Agent:

4100.3.3.4.1 When a liquid anti-stripping agent is used, the following shall apply:

4100.3.3.4.1.1 The Contractor shall supply the equipment necessary to add a liquid anti-stripping agent.

4100.3.3.4.1.2 The addition of liquid anti-stripping agent shall be accomplished through the use of a liquid anti-strip injection system containing a positive displacement pump with a variable speed motor, a totalizing flow meter, a sampling valve, a system check valve, a system isolation valve and an inline check valve. The injector pump motor shall be regulated by a signal from the asphalt flow meter.

4100.3.3.4.1.3 Liquid anti-stripping agent will be injected into the plant asphalt line just prior to entry into the drum mixer.

4100.3.3.4.1.4 The system shall be capable of regulating the flow rate resulting in consistent flow rate of liquid anti-stripping agent.

4100.3.3.4.1.5 The system shall be capable of re-circulating the liquid anti-stripping agent to the storage tank until the asphalt plant bypass valve is actuated.

4100.3.3.4.1.6 Liquid anti-stripping agent shall be added at a rate of approximately 1.0% of the weight of liquid asphalt added, or as designated by the Engineer, for the Job Mix Formula.

4100.3.3.4.1.7 The Contractor shall maintain records containing bills of lading, estimated quantities on hand, estimated quantities used, damaged barrels, and at the completion of the project, any estimated quantities of unused anti-stripping agent. The Contractor shall provide the record of estimated usage to the Engineer on a daily basis.

4100.3.3.4.1.8 At the end of the project the bulk measurement of the liquid anti-stripping agent used on the project shall not deviate by more than 10% from the specified percentage designated by the Job Mix Formula. If the final amount of liquid anti-stripping agent used on the project exceeds 110% of the specified percentage designated by the Job Mix Formula, the Department will deduct the cost of the liquid anti-stripping agent used in excess of 110% from the Final Progressive Estimate. If the final amount of liquid anti-stripping agent used on the project is less than 90% of the specified percentage designated by the Job Mix Formula, the Contractor shall perform at his expense a Class I repair on the asphalt concrete.

4100.3.3.4.1.9 The Contractor shall handle all barrels of liquid anti-stripping agent in such a manner that they can be returned to the supplier. The full cost of any barrels damaged such that they cannot be returned to the supplier, or any environmental clean-up required, will be charged back to the Contractor, and deducted from the Final Progressive Estimate. If the Contractor uses liquid anti-stripping in bulk, the full cost of any environmental clean-up required will be charged back to the Contractor and deducted from the Final Progressive Estimate.

4100.3.4 Aggregate

4100.3.4.1 The Contractor shall split the aggregate into 3 separate stockpiles in accordance with the following:

4100.3.4.1.1 The natural fines stockpile shall be produced by screening the raw aggregate over a maximum 9.0 mm square opening screen or 5.0 mm slotted screen prior to crushing.

4100.3.4.1.2 The aggregate retained on the screen shall be crushed and split into crushed coarse and crushed fine stockpiles.

4100.3.4.1.3 The crushed coarse stockpile shall contain no more than 10% of the material passing the 5.0 mm square opening sieve.

4100.3.4.1.4 The crushed fine stockpile shall contain no less than 90% of the material passing the 5.0 mm square opening sieve.

4100.3.4.1.5 The Contractor shall provide accurate measurements of quantities and percentages of aggregate being placed in each stockpile after producing 50% of the aggregate or 10 000 t, whichever is greater; or when all the aggregate is produced if the total quantity is less than 10 000 t. If the splits provided by the Contractor prove to be inaccurate and result in an aggregate shortage, securing additional equivalent aggregate shall be at the Contractor's expense.

4100.3.4.2 The crushed coarse, crushed fines, and natural fines stockpiles shall be mathematically recombined at the percentages provided by the Contractor. If the resulting aggregate does not meet the requirements of Table 4100.3.T1, the Contractor shall be required to reject a fraction of the material in the natural fines stockpile in accordance with General Provision 1500.2.8.

4100.3.4.3 If recycled asphalt concrete is designated in the contract, the following shall apply:

4100.3.4.3.1 The reclaimed asphalt concrete shall not exceed 40 mm when measured in any direction before entering the plant.

4100.3.4.3.2 The crushed coarse, crushed fines, natural fines and reclaimed asphalt concrete stockpiles shall be mathematically recombined at the percentages provided by the Contractor. If the resulting aggregate does not meet the requirements of Table 4100.3.T1, the Contractor shall be required to reject a fraction of the material in the natural fines stockpile in accordance with General Provision 1500.2.8.

4100.3.5 Asphalt Mix Design

4100.3.5.1 The asphalt mix design will be established by the Engineer in accordance with the requirements for Marshall Mix Design (STP 204-10) within 10 calendar days after 50% of the aggregate has been produced or 10 000 t, whichever is greater, and provided that the Contractor has complied with Section 4100.3.4.1.5.

4100.3.5.2 Further to Section 4100.3.4.1.5, if the Department is required to do an additional mix design because the splits provided by the Contractor prove to be inaccurate, the Contractor will be assessed the rate specified in the Special Provisions.

4100.3.5.3 The asphalt mix design type will be specified in the Special Provisions. The asphalt mix characteristics shall meet the requirements in Table 4100.3.T1.

TABLE 4100.3.T1

ASPHALT CONCRETE MIX DESIGN TYPES AND CHARACTERISTICS

Mix Design Type/ Design Factors -Mix Characteristics	**1**	**2**	**3**	**4**	**5**	**6**
Asphalt Type	150-200 A or 200-300 A			150-200 A or 200-300 A		
Marshall Blows	50 blows			75 blows		
Aggregate Type/Sieve Designation*	70 or 70 R	71 or 71 R	72 or 72 R	70 or 70 R	71 or 71 R	72 or 72 R
18.0 mm	100.0			100.0		
16.0 mm	78.0 – 98.0	100.0		78.0-98.0	100.0	
12.5 mm	68.0 – 92.0	78.0 – 98.0	100.0	68.0 – 92.0	78.0 – 98.0	100.0
9.0 mm	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0
5.0 mm	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0
2.0 mm	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0
900 um	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0
400 um	5.0 – 25.0	10.0 -- 27.0	10.0 -- 27.0	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0
160 um	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0
71 um	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0
Air Voids, %	3.0 – 5.0					
Air Voids (Field), %	4.0 – 9.0					
Deleterious Material, Maximum % **	2.0					
Film Thickness, Minimum um	7.5					
Flow, mm	1.5 – 3.5					
Fracture, Minimum % ***	60.0	70.0	80.0	75.0	85.0	95.0
Lightweight Aggregate, Maximum %	1.0					
Retained Stability, Minimum %	70.0					
Sand Equivalent, Minimum	45					
Stability, Minimum N	5500			7000		
Voids Filled, %	65.0 - 78.0					
V. M. A., %	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0

*A tolerance of 3% in the percent by weight retained on the maximum size sieve will be permitted providing 100% of the oversize passes the 22.4 mm sieve for Type 70 and Type 70 R aggregate, the 18.0 mm sieve for Type 71 and 71 R aggregate and the 16 mm sieve for Type 72 and 72 R aggregate.

**Deleterious material includes all other injurious material other than lightweight pieces.

** *The Fractured Face percentage will be calculated on the aggregate after combining all virgin aggregates and additives, excluding reclaim.

TABLE 4100.3.T1 *continued*

ASPHALT CONCRETE MIX DESIGN TYPES AND CHARACTERISTICS

Mix Design Type/ Design Factors - Mix Characteristics	**7**	**8**	**9**	**10**	**11**	**12**
Asphalt Type	300-400 A			300-400 A		
Marshall Blows	50 blows			75 blows		
Aggregate Type/Sieve Designation*	70 or 70 R	71 or 71 R	72 or 72 R	70 or 70 R	71 or 71 R	72 or 72 R
18.0 mm	100.0			100.0		
16.0 mm	78.0 – 98.0	100.0		78.0-98.0	100.0	
12.5 mm	68.0 – 92.0	78.0 – 98.0	100.0	68.0 – 92.0	78.0 – 98.0	100.0
9.0 mm	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0
5.0 mm	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0
2.0 mm	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0
900 um	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0
400 um	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0
160 um	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0
71 um	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0
Air Voids, %	3.0 – 5.0					
Air Voids (Field), %	4.0 – 9.0					
Deleterious Material, Maximum % **	2.0					
Film Thickness, Minimum um	7.5					
Flow, mm	1.5 – 3.5					
Fracture, Minimum % ***	50.0	60.0	70.0	75.0	85.0	95.0
Lightweight Aggregate, Maximum %	1.0					
Retained Stability, Minimum %	70.0					
Sand Equivalent, Minimum	45.0					
Stability, Minimum N	5500			7000		
Voids Filled, %	65.0 - 78.0					
V. M. A., %	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0

*A tolerance of 3% in the percent by weight retained on the maximum size sieve will be permitted providing 100% of the oversize passes the 22.4 mm sieve for Type 70 and Type 70 R aggregate, the 18.0 mm sieve for Type 71 and 71 R aggregate and the 16 mm sieve for Type 72 and 72 R aggregate.

**Deleterious material includes all other injurious material other than lightweight pieces.

** *The Fractured Face percentage will be calculated on the aggregate after combining all virgin aggregates and additives, excluding reclaim.

4100.3.6 Plant Requirements

4100.3.6.1 A uniform mixture shall be produced in which all particles are thoroughly coated. Aggregate particles shall not be coated with residue from fuel combustion. The asphalt mix shall contain no more than 0.5% moisture by weight.

4100.3.6.2 If reclaimed asphalt concrete is added, the following shall apply:

4100.3.6.2.1 The plant shall contain equipment that will prevent the reclaimed asphalt concrete from coming into direct contact with the flame, thus minimizing oxidation of the asphalt in the reclaimed asphalt concrete.

4100.3.6.2.2 The Contractor shall undertake all the necessary adjustments to ensure proper heat transfer and breakdown of the reclaimed asphalt concrete to form a homogeneous end product. The plant shall be capable of heating the reclaimed asphalt concrete particles and blending them with virgin aggregate and any required asphalt to create a homogeneous mix at the plant discharge.

4100.3.7 Plant Calibration and Operation

4100.3.7.1 Plant Calibration:

4100.3.7.1.1 The Contractor shall provide the Engineer with at least three calendar days advance notice of when he plans to do the plant calibration.

4100.3.7.1.2 During plant calibration, the Engineer will assess the property variations of the asphalt mix produced during the calibration process against the asphalt mix design.

4100.3.7.1.3 If the asphalt mix meets the properties and/or characteristics as shown in Table 4100.3.T1, the Contractor may commence hauling to the road upon receiving written approval from the Engineer.

4100.3.7.1.4 The asphalt mix will be rejected if the requirements of Table 4100.3.T1 are not met, and no asphalt mix shall be hauled to the road. The Engineer will provide a modified or new asphalt mix design.

4100.3.7.1.5 After 24 hours of asphalt mix production, if the asphalt mix properties are consistent and meet all specified requirements, the Engineer will approve the Asphalt Mix Formula as the Job Mix Formula.

4100.3.7.2 Plant Operation

4100.3.7.2.1 For the initial 24 hours of plant production at each plant set-up, the asphalt added shall not vary by more than 0.5% from the design asphalt content. Full-scale plant production shall not commence until the percentage of asphalt added to trial batches of asphalt mix complies with the foregoing requirement.

4100.3.7.2.2 After the initial 24 hours of production, the Contractor shall cease operations if the moving average of asphalt added varies by more than 0.3% from the Job Mix Formula.

4100.3.7.2.3 After the Job Mix Formula aggregate gradation has been established, the following shall apply:

4100.3.7.2.3.1 The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed below:

TABLE 4100.3.T2

MAXIMUM PERMISSIBLE SIEVE VARIATION

Maximum Permissible Variation from the Job Mix Formula	
Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series
16.0 mm	±5.0
12.5 mm	±5.0
9.0 mm	±5.0
5.0 mm	±5.0
2.0 mm	±4.0
900 um	±3.0
400 um	±3.0
160 um	±2.0
71 um	±1.5

4100.3.7.2.3.2 Road operations shall not recommence until the specified requirements are met.

4100.3.7.2.3.3 Upon re-commencement of operations, the specified requirements shall be met on each of the initial 2 tests.

4100.3.7.2.3.4 Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

4100.3.7.2.4 The Contractor shall immediately shut down the plant when:

4100.3.7.2.4.1 The stack emissions temperature exceeds the asphalt mix temperature at the mixer discharge by more than 20°C or;

4100.3.7.2.4.2 The temperatures exceed the limits outlined in the following table:

TABLE 4100.3.T3

TEMPERATURE LIMITS

Grade of Asphalt	Degrees Celsius		
	Maximum Temperature of Dry Aggregate	Asphalt Storage Temperature	Asphalt Mix Temperature at Mixer Discharge
150-200A	160	120-175	135-155
200-300A	160	120-175	130-150
300-400A	150	114-175	120-140
400-500A	140	110-175	110-130

4100.3.7.2.5 All material produced subsequent to the occurrence of an event specified in Section 4100.3.7.2.4 will be deemed to be unacceptable material for the purposes of General Provision 1400-7 (Unacceptable And Unauthorized Work).

4100.3.7.2.6 Plant operations shall not recommence until the temperature limits in Section 4100.3.7.2.4 are met.

4100.3.7.2.7 The Contractor shall dispose of any rejected asphalt mix or asphalt concrete in a manner that is acceptable by the Engineer.

4100.3.8 Delivering to the Road

4100.3.8.1 Truck boxes shall be clean and free from accumulations of asphalt mix and foreign materials. Excess truck box lubricants such as light oil, detergent, lime solutions, gasoline, kerosene, diesel or other similar products shall not be allowed to contaminate the asphalt mix, and shall be disposed of in an environmentally acceptable manner.

4100.3.8.2 Every truck used to transport the asphalt mix shall be equipped with a tarpaulin which is waterproof and can be securely fastened, when required, to protect the asphalt mix from precipitation and excessive heat loss.

4100.3.8.3 Prior to unloading into the paver, the temperature at a depth of 40 mm below the surface of the asphalt mix in the truck box shall not be less than 110°C.

4100.3.8.4 Trucks shall be turned around only at approaches.

4100.3.9 Pavers

4100.3.9.1 Pavers shall be self-propelled units capable of spreading and finishing the asphalt concrete to the specified typical cross section and thickness shown on the paving plans. For traffic lanes, pavers shall be operated using the following:

4100.3.9.1.1 Automatic screed controls, for the control of longitudinal and transverse slope and joint matching. The automatic control device shall be capable of being operated from either side of the paver.

4100.3.9.1.2 Vibrating screed

4100.3.10 Spreading

4100.3.10.1 If designated by the Engineer, a tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.3.10.2 Asphalt mix shall be spread on dry, clean, and unfrozen surfaces.

4100.3.10.3 Asphalt concrete shall be placed in accordance with the following temperature limitations:

4100.3.10.3.1 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.

4100.3.10.3.2 The final lift of asphalt concrete shall not be placed if:

4100.3.10.3.2.1 The atmospheric temperature is less than 5°C; or

4100.3.10.3.2.2 The surface temperature is less than 7°C.

4100.3.10.4 The minimum and maximum thickness of a compacted lift of asphalt concrete shall meet the following requirements:

TABLE 4100.3.T4

MINIMUM AND MAXIMUM LIFT THICKNESS

Lift	Type 70 or 70 R Aggregate		Type 71 or 71 R Aggregate		Type 72 or 72 R Aggregate	
	Minimum Thickness	Maximum Thickness	Minimum Thickness	Maximum Thickness	Minimum Thickness	Maximum Thickness
Top	40 mm	60 mm	35 mm	50 mm	30 mm	50 mm
Lower	30 mm	60 mm	30 mm	50 mm	25 mm	50 mm

4100.3.10.5 The following clause shall apply only when shimming and levelling are specified in the Special Provisions as being applicable to the Contract.

4100.3.10.5.1 The Contractor shall shim and level any pavement depressions designated by the Engineer. The use of a motor grader and hand raking will be permitted.

4100.3.10.5.2 All work involved with shimming and levelling will be paid for at the contract unit bid price(s) where applicable.

4100.3.10.5.3 The Contractor shall complete all shimming and levelling operations such that the material has cooled sufficiently before the placement of asphalt concrete.

4100.3.10.6 Longitudinal joints shall not be permitted in the lane. Longitudinal joints shall be vertical butt type, well bonded and sealed, and finished to provide a continuous, smooth profile across the joint.

4100.3.10.7 The asphalt mix temperature in the paver shall not be less than 110°C.

4100.3.10.8 Contact faces of curbs, gutters, manholes, and sidewalks shall be coated with asphalt using a hand applicator before placing the asphalt mix.

4100.3.10.9 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.

4100.3.10.10 Asphalt mix shall not be placed or allowed to fall on previously laid top lift asphalt concrete or the existing asphalt concrete.

4100.3.10.11 Transverse construction joints from one lift to the next shall be separated by at least 2 m.

4100.3.10.12 Road intersections and approaches shall be paved in accordance with the plans or as directed by the Engineer.

4100.3.10.13 If designated by the Engineer, a flush coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.3.11 Compacting

4100.3.11.1 At the beginning of the work, the Contractor shall establish a rolling pattern for achieving the Specified Marshall Density. The rolling pattern strip shall comply with the following:

4100.3.11.1.1 The rolling pattern strip shall have a length of at least 250 m and shall be of the same thickness as the lift it represents.

4100.3.11.1.2 The material used shall conform to the requirements of the asphalt concrete stated in the contract or as specified by the Engineer.

4100.3.11.1.3 The Engineer and/or the Contractor at any time may order the construction of a new rolling pattern strip if there are reasons to indicate that the paving operation, the mix design or lift thickness have been altered.

4100.3.11.1.4 Compaction shall commence immediately and shall be completed before the temperature of the asphalt concrete falls below 55°C for 150-200 A and 200-300 A asphalt concrete mixes, and 40°C for 300-400 A and 400-500 A asphalt concrete mixes.

4100.3.11.1.5 Compaction shall continue until the Specified Marshall Density is achieved or until no appreciable increase in the Field Density can be achieved, even with the use of fully ballasted pneumatic tired rollers with a minimum tire pressure of 620 kPa and having the tire size and wheel load indicated in the table below:

TABLE 4100.3.T5

ROLLER TIRE SIZE AND MINIMUM LOAD

Tire Size (mm)	Minimum Load Per Tire (kg)
190.5 x 381.0	950
228.5 x 508.0	1 300
279.4 x 508.0	1 900

4100.3.11.1.6 The speed of steel rollers shall not exceed 5 km/h and the speed of pneumatic rollers shall not exceed 8 km/h.

4100.3.11.1.7 The rolling pattern strip, if accepted, shall remain in place and shall become part of the completed work.

4100.3.11.2 If the Specified Marshall Density is not achieved, then the value of the Field Density achieved after complying with Section 4100.3.11.1 will be used as the Target Density. Job Mix Formula Densities will continue to be taken, and should change occur in Field Density, lift thickness, or the lane being paved, the Engineer may direct that the Specified Marshall Density control procedure be re-established.

4100.3.11.3 Each lift of asphalt concrete shall be compacted to the Specified Marshall Density established for the lot in accordance with the following:

4100.3.11.3.1 The Specified Marshall Density for the lot will be established using a 3-point moving average.

4100.3.11.3.2 When a new moving average is initiated, it will include the entire lot where the sample is taken and will apply to subsequent lots until the next 3-point moving average is established.

4100.3.11.3.3 A new moving average will be initiated for each new asphalt mix design.

4100.3.11.4 Longitudinal joints shall be rolled directly behind the paver.

4100.3.11.5 All asphalt mix shall be thoroughly compacted, and after final rolling, the finished surface of the mat shall be free from segregation, waves, hairline cracks, and other obvious defects.

4100.3.11.6 Traffic shall not be allowed to travel on the finished surface until the surface has cooled to a temperature as to ensure that no deformation or other defects to the surface will occur.

4100.4 SAMPLING AND TESTING

4100.4.1 General

4100.4.1.1 The failure of the Engineer to provide test results within the time provided in this specification shall not relieve the Contractor of his obligation to remedy any defect, but the Department will be obligated to reimburse the Contractor for any additional costs incurred by the Contractor to remedy the defect, if the additional costs are attributable to the delay in receiving results.

4100.4.2 Acceptance Testing

4100.4.2.1 General

4100.4.2.1.1 Within this specification, certain requirements, limits and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements, where so specified, will be judged by testing as described in this section. These tests cannot be disputed on the grounds of statistical theory or a specified or implied Contractor's risk.

4100.4.2.1.2 The results of acceptance testing for Field Density, smoothness, individual bumps and dips, segregation and surface defects will be used for acceptance, rejection and pay adjustments for the block or lot.

4100.4.2.1.3 Initial acceptance testing will be performed free of cost to the Contractor.

4100.4.2.1.4 If the remedial work by the Contractor on a rejected block or lot involves a repair of the asphalt concrete in the block or lot, all test results from acceptance testing performed on the rejected block or lot prior to the remedial work will be discarded and new sampling and acceptance testing will be performed in accordance with Section 4100.4.2.2.

4100.4.2.2 Sampling and acceptance testing will be in accordance with the following:

4100.4.2.2.1 For **Field Density**:

4100.4.2.2.1.1 The Engineer 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.

4100.4.2.2.1.2 Testing will be conducted prior to the placement of the next lift of asphalt concrete.

4100.4.2.2.1.3 Upon notification from the Contractor that a lot has been inspected and is ready for acceptance testing, the Engineer will locate 3 test sites in the lot in accordance with the requirements for Sampling Location By Random Method (STP 107).

4100.4.2.2.1.4 The Engineer will measure the Field Density at 3 test sites for each lot in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 204-6).

4100.4.2.2.1.5 The Engineer will provide the Contractor with a copy of the results of acceptance tests within 2 calendar days of receiving notification from the Contractor that the lot is ready for acceptance testing.

4100.4.2.2.1.6 If the acceptance test results on a lot indicate a penalty for Field Density, the Contractor will be allowed one opportunity to re-roll the lot. The random sampling procedure for re-testing will exclude areas falling within traffic wheel paths.

4100.4.2.2.2 For **smoothness** and **individual bumps and dips**:

4100.4.2.2.2.1 The surface of the blocks will be profiled by the Engineer in accordance with the standard test procedures.

4100.4.2.2.2.2 If a block is located within a rejected lot, the surface of the block will not be profiled until the lot has been remedied.

4100.4.2.2.2.3 The Engineer will provide the Contractor with a copy of the results of acceptance tests for smoothness and individual bumps and dips within 12 calendar days of the placement of the asphalt concrete.

4100.4.2.2.2.4 When all the acceptance tests for a block are completed, the Engineer will advise the Contractor as to the acceptability of the block with respect to smoothness and individual bumps and dips.

4100.4.2.2.3 For **segregation**:

4100.4.2.2.3.1 Each lane-km, including the shoulder, will be inspected for areas of segregation.

4100.4.2.2.3.2 After receiving notification from the Contractor that the asphalt concrete is ready for acceptance testing, the Engineer will provide the Contractor with the locations of the visually identified segregation in accordance with the following:

4100.4.2.2.3.2.1 Within 12 calendar days during the course of the construction; and

4100.4.2.2.3.2.2 Within 4 calendar days after the completion of all the asphalt concrete.

4100.4.2.2.3.3 A segregated area will be categorized by the worst condition prevalent for 50% or more of the length of the segregated area.

4100.4.2.2.3.4 If the worst condition in a segregated area is not prevalent for at least 50% of the length of the area, then the area will be measured in relation to the length of minor and severe segregation.

4100.4.2.2.4 For **surface defects**:

4100.4.2.2.4.1 Each lane-km, including the shoulder, will be inspected for surface defects.

4100.4.2.2.4.2 After receiving notification from the Contractor that the asphalt concrete is ready for acceptance testing, the Engineer will provide the Contractor with the locations of the visually identified surface defects in accordance with the following:

4100.4.2.2.4.2.1 Within 12 calendar days during the course of the construction; and

4100.4.2.2.4.2.2 Within 4 calendar days after the completion of all the asphalt concrete.

4100.4.3 Exclusions to Random Sampling

4100.4.3.1 Random sampling methods will not apply to the following:

4100.4.3.1.1 Smoothness;

4100.4.3.1.2 Small areas such as approaches, tapers, areas of handwork and gores;

4100.4.3.1.3 Areas of visually identified segregation; and

4100.4.3.1.4 Areas of surface defect repair.

4100.4.4 Appeal of Acceptance Test Results and Appeal Testing

4100.4.4.1 General

4100.4.4.1.1 The Contractor cannot appeal test results that are within the full or bonus payment range.

4100.4.4.1.2 The Engineer will provide the Contractor with a copy of the results of appeal tests within 6 calendar days of delivery of the samples.

4100.4.4.1.3 Appeal testing will be performed by the Department, and the new results shall be binding on the Contractor and the Department.

4100.4.4.1.4 If the appeal testing does not result in a decrease of the pay adjustments, all testing costs incurred during the appeal procedures shall be paid by the Contractor. The rate for Department testing will be as designated in the Special Provisions.

4100.4.4.1.5 If the Engineer determines that certain test results are faulty due to testing equipment malfunction, improper testing procedures or calculations, re-testing will be performed at the expense of the Department.

4100.4.4.1.6 In the case of an appeal, the Department will not be responsible for any delays including but not limited to Contractor's downtime, or other costs as a result of awaiting the receipt of the appeal test results, or due to the nature and values of the appeal test results.

4100.4.4.2 Appeal of the acceptance test results shall be in accordance with the following:

4100.4.4.2.1 For **Field Density**:

4100.4.4.2.1.1 Within 2 calendar days of receipt of the acceptance test results for a lot, the Contractor may appeal the acceptance test results by requesting appeal tests. The following procedures shall apply:

4100.4.4.2.1.1.1 The Engineer will locate 2 appeal test sites in the lot in accordance with the requirements for Sampling Location By Random Method (STP 107).

4100.4.4.2.1.1.2 The Engineer will measure the Field Density at each appeal test site and in the vicinity of the original 3 acceptance test sites in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 204-6).

4100.4.4.2.1.1.3 The mean of the test results from the 5 referee sites will be used for the purpose of acceptance, rejection and determination of pay adjustments.

4100.4.4.2.2 For **smoothness** and **individual bumps and dips**:

4100.4.4.2.2.1 Within 2 calendar days of receipt of the acceptance test results for a block, the Contractor may appeal the test results by requesting appeal tests.

4100.4.4.2.2.2 The Engineer will re-test the entire block for smoothness and individual bumps and dips, if either is under appeal.

4100.4.4.2.3 For **segregation**:

4100.4.4.2.3.1 Within 6 calendar days of receipt of the locations of the visually identified segregation, the Contractor may appeal the acceptance test results by requesting appeal tests.

4100.4.4.2.3.2 The Engineer will obtain a core sample at a location that is representative of the area being considered. The core sample will be obtained in accordance with the requirements for Asphalt Concrete Samples Obtained By Coring (STP 204-5).

4100.4.4.2.3.3 The Engineer will determine the Field Density, asphalt content and the aggregate gradation of the sample.

4100.4.4.2.3.4 The area will be considered non-segregated if the aggregate gradation complies with requirements specified in section 4100.3.7.2.3.

4100.4.4.2.3.5 If the aggregate gradation does not comply with the requirements specified in section 4100.3.7.2.3:

4100.4.4.2.3.5.1 The area will be considered minor segregation if the test results indicate the Field Density of the asphalt concrete meets or exceeds 94% of the Marshall Density established for the Job Mix Formula or Asphalt Mix Formula, and the asphalt content deviates by not more than 0.6% from the asphalt content approved for the Job Mix Formula or Asphalt Mix Formula.

4100.4.4.2.3.5.2 The area will be considered severe segregation if the conditions in section 4100.4.4.2.3.5.1 are not met.

4100.5 ACCEPTANCE, REJECTION AND REPAIRS

4100.5.1 General

4100.5.1.1 The Contractor shall provide a finished product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the specifications and drawings. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice.

4100.5.2 Rejection

4100.5.2.1 The block or lot will be rejected as unacceptable work if:

4100.5.2.1.1 The Field Density for the lot is outside the acceptance limits outlined in section 4100.7.2.1.1.

4100.5.2.1.2 The PrI for the Block is outside the acceptance limits outlined in section 4100.7.2.1.2.

4100.5.2.1.3 Any individual bumps and/or dips exceed 12 mm.

4100.5.2.2 Areas of segregation and surface defects will be considered unacceptable work until the areas are repaired and accepted by the Engineer.

4100.5.3 Repairs

4100.5.3.1 General

4100.5.3.1.1 The Contractor shall not undertake any repair on any defective work prior to notifying the Engineer. Any areas repaired prior to obtaining the Engineer's approval will not be considered for payment.

4100.5.3.1.2 Work on any block or lot which has been rejected shall be remedied within 30 calendar days of receipt of the acceptance test results.

4100.5.3.1.3 All remedial work shall be performed at the Contractor's expense, including the cost of materials.

4100.5.3.1.4 The Contractor shall pay the cost of all re-testing performed following the remedying of work in any block or lot that has been rejected. The rate for Department testing will be as designated in the Special Provisions.

4100.5.3.1.5 Repairs shall be subject to the approval of the Engineer.

4100.5.3.1.6 Alternate repair methods proposed by the Contractor shall be subject to approval of the Engineer. The nature of the deficiencies shall be taken into account in the consideration of the method of repair.

4100.5.3.1.7 Acceptable remedial measures to a rejected block or lot, or areas within a block or lot are as follows:

4100.5.3.1.7.1 A **Class I repair** either overlays or removes and replaces the asphalt concrete.

4100.5.3.1.7.1.1 If an overlay is used as the remedial measure, the following shall apply:

4100.5.3.1.7.1.1.1 A tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat unless otherwise directed by the Engineer.

4100.5.3.1.7.1.1.2 The minimum overlay thickness shall be as specified in Table 4100.3.T4 for top lift.

4100.5.3.1.7.1.1.3 Adjacent lanes and shoulders shall be overlaid to the same thickness and length.

4100.5.3.1.7.1.1.4 On all lifts of asphalt concrete below the final lift, the overlay shall be completed prior to the next lift being placed.

4100.5.3.1.7.1.2 If a removal and replace operation is used as the remedial measure, the following shall apply:

4100.5.3.1.7.1.2.1 The work shall be performed in accordance with Specification 4105 For Reclaiming Asphalt Concrete.

4100.5.3.1.7.1.2.2 The asphalt concrete shall be removed by cold milling to a minimum depth as specified in Table 4100.3.T4 for the lift being removed.

4100.5.3.1.7.1.2.3 A tack coat in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer, shall be applied to the milled surface.

4100.5.3.1.7.1.2.4 The asphalt concrete material removed by the milling operation shall be the property of the Contractor.

4100.5.3.1.7.1.2.5 The asphalt concrete used for back-filling the milled area shall be subject to the same specifications as the original pavement.

4100.5.3.1.7.2 A **Class II repair** is typically either the placing of a slurry seal on the entire block or lot, or the placing of a spot slurry seal patch or patches within the block or lot.

4100.5.3.1.7.2.1 For slurry seals or slurry seal patches, the following shall apply:

4100.5.3.1.7.2.1.1 The seal shall be a mixture of a dry, non- plastic sand, an emulsified asphalt SS-1 (slurry), potable water, and, if needed, acceptable additives such as Portland Cement, and Carbon Black, for colour.

4100.5.3.1.7.2.1.2 The gradation of the sand shall be as follows:

TABLE 4100.3.T6

SLURRY SEAL SAND GRADATION

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
900 um	100.0
400 um	70.0 – 95.0
160 um	60.0 – 80.0
71 um	20.0 – 42.0
Plasticity Index	Non Plastic

4100.5.3.1.7.2.1.3 The mix proportions for a 1 000 litre batch of seal shall be as follows:

4100.5.3.1.7.2.1.3.1 360 litres of SS-1 (slurry);

4100.5.3.1.7.2.1.3.2 270 litres of potable water; and

4100.5.3.1.7.2.1.3.3 850 kg of dry, non-plastic sand.

4100.5.3.1.7.2.1.4 The Contractor shall add the water to the emulsified asphalt followed by the addition of the sand.

4100.5.3.1.7.2.1.5 The Contractor shall thoroughly mix the seal. If a mineral filler is used, it shall be blended into the mixture. A minimum amount of additional water may be added to obtain a fluid, homogeneous mixture.

4100.5.3.1.7.2.1.6 If a tack coat is required, the same asphalt chosen for the seal binder shall be used. The tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack And Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.1.7.2.1.7 The seal shall be neat and square; and uniform and homogeneous with no uncovered areas, ridges or loose aggregate.

4100.5.3.1.7.2.1.8 Hand or mechanical squeegees may be used to spread the seal.

4100.5.3.1.7.2.1.9 The completed seal shall be kept free of all traffic until it has cured sufficiently to prevent pickup of aggregate particles.

4100.5.3.1.7.2.1.10 Any tests performed by the Engineer on the seal will be quality assurance tests and will not be considered as quality control tests.

4100.5.3.1.7.3 A **Class III repair** is typically a flush coat on the entire block or lot, or the placing of a spot flush coat(s) within the block or lot.

4100.5.3.1.7.3.1 A flush coat or spot flush coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.1.7.4 A **Class IV repair** is typically either a re-rolling operation to remove or reduce the bump(s) or a shim operation to remove or reduce dip(s). Other methods of Class IV repairs proposed by the Contractor shall be subject to the approval of the Engineer.

4100.5.3.1.7.4.1 For repairs to a bump(s), the following shall apply:

4100.5.3.1.7.4.1.1 The repair procedure shall not cause damage to the asphalt concrete such as, but not limited to, excessive crushing, pulverizing or displacing the asphalt concrete or its surface.

4100.5.3.1.7.4.1.2 The area repaired shall have a smooth transition to the surrounding pavement without impairing the functionality and/or structural characteristics of the service life of the area.

4100.5.3.1.7.4.2 For repairs to a dip(s), the following shall apply:

4100.5.3.1.7.4.2.1 If shimming is used, the area shimmed shall have a smooth transition to the surrounding pavement. The shim shall have sufficient thickness and be thoroughly compacted to prevent ravel of the shimmed area.

4100.5.3.1.7.4.2.2 If a tack coat is required, the tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.2 Repairs shall be in accordance with the following:

4100.5.3.2.1 For **Field Density**:

4100.5.3.2.1.1 If after re-rolling, the Field Density of a lot remains outside the acceptance limit, the Contractor shall perform a Class I repair.

4100.5.3.2.1.2 If the area(s) requiring repairs appears to be isolated:

4100.5.3.2.1.2.1 The Engineer may identify the area(s) through additional testing.

4100.5.3.2.1.2.2 The Contractor shall perform a Class I repair for only the portion of the lot requiring repairs.

4100.5.3.2.1.2.3 If the isolated repair area continues into an adjacent lot, which is deemed acceptable through acceptance testing, that portion of the adjacent lot shall be repaired along with the portion of the unacceptable lot.

4100.5.3.2.2 For **smoothness**:

4100.5.3.2.2.1 If the acceptance test results on a block indicate a pay adjustment for smoothness, additional work to improve the smoothness will not be allowed except the Contractor will be allowed to perform a Class I or Class IV repair on individual bumps and dips that exceed 12 mm.

4100.5.3.2.2.2 If the smoothness of the final lift of asphalt concrete of a block is outside the acceptance limit outlined in Table 4100.7.T9, the block shall be repaired by a Class I repair.

4100.5.3.2.3 For **individual bumps and dips**:

4100.5.3.2.3.1 Individual bumps and dips that exceed 12 mm in the vertical direction shall be repaired by a Class I or Class IV repair.

4100.5.3.2.3.2 Work to repair individual bumps and dips $\leq$ 12 mm will not be permitted.

4100.5.3.2.4 For **segregation**:

4100.5.3.2.4.1 The Contractor shall repair all segregated areas, except for minor segregation on lower lifts, but including segregated areas with nil pay adjustment. These repairs will not affect the initial pay adjustments assessed in accordance with Tables 4100.7.T10 and 4100.7.T11 with the exception of a Class I repair.

4100.5.3.2.4.2 Severe segregation on lower lifts of asphalt concrete shall be repaired by a Class I repair.

4100.5.3.2.4.3 Segregated areas on the final lift of asphalt concrete shall be repaired in accordance with the following:

4100.5.3.2.4.3.1 Minor segregation on the lane or shoulder shall be repaired by a Class II repair. If the minor segregation is more than one half the lane width or is across the centre of the lane, the full width shall be repaired.

4100.5.3.2.4.3.2 Severe segregation:

4100.5.3.2.4.3.2.1 Individual areas less than 100 m in length shall be repaired with a Class II repair slurry seal patch over the full lane or shoulder width.

4100.5.3.2.4.3.2.2 Individual areas 100 m or greater in length shall be repaired over the full lane or shoulder by a Class II repair slurry seal or by a remove and replace Class I repair.

4100.5.3.2.5 For **surface defects**:

4100.5.3.2.5.1 On all lifts of asphalt concrete, surface defects shall be repaired with a Class I to Class IV repair, in a manner that is acceptable to the Engineer.

4100.5.3.3 Payment options in lieu of repairs:

4100.5.3.3.1 For smoothness and individual bumps and/or dips, the following shall apply, at the discretion of the Engineer, for the final lift of asphalt concrete in a block:

4100.5.3.3.1.1 If the Category I PrI is $\leq$ 23 or the Category II PrI is $\leq$ 28, and individual bumps and/or dips exceed 12 mm, a $2,000 penalty per bump and/or dip plus the adjusted PrI pay adjustment may apply, to a maximum of $6,000.

4100.5.3.3.1.2 If the Category I PrI is > 23 or the Category II PrI is > 28, and no individual bumps and/or dips exceed 12 mm, a $6,000 penalty may apply.

4100.5.3.3.1.3 If the Category I PrI is > 23 or the Category II PrI is > 28, and individual bumps and/or dips exceed 12 mm:

4100.5.3.3.1.3.1 A $6,000 penalty may apply if the adjusted PrI for the Category I PrI is > 23 or the Category II PrI is > 28.

4100.5.3.3.1.3.2 A $2,000 penalty per bump and/or dip plus the adjusted PrI pay adjustment may apply, if the adjusted PrI for the Category I PrI is ≤ 23 or the Category II PrI is ≤ 28.

4100.5.3.3.2 For segregation and surface defects requiring a Class II repair, the Contractor may, subject to the discretion of the Engineer, be charged a fee as shown in the Special Provisions to compensate the Department for having others make the repairs at a later date.

4100.6 MEASUREMENT

4100.6.1 Asphalt Concrete

4100.6.1.1 Asphalt concrete will be measured in tonnes.

4100.7 PAYMENT

4100.7.1 General

4100.7.1.1 Payment for Asphalt Concrete will be at the contract unit price per tonne with pay adjustments for Field Density, smoothness, severity of segregation, segregation frequency and final surface condition.

4100.7.1.2 The contract unit price will be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

4100.7.1.3 If it is stated in the Special Provisions that anti-stripping agent is required, the addition of hydrated lime or liquid anti-stripping agent shall be a subsidiary obligation of the Contractor. If it is determined during the contract that anti-stripping agent is required, the Contractor will be paid at the rate specified in the Special Provisions.

4100.7.1.4 If the shoulder is laid separately from the main lane, the pay adjustments for Field Density for asphalt concrete on the shoulder will be at 50% of the regular rates specified in Tables 4100.7.T7 or 4100.7.T8.

4100.7.1.5 Segregation and surface defects on the shoulder will be excluded from pay adjustments for segregation severity, segregation frequency and final surface condition. The Contractor shall repair segregation and surface defects on the shoulder in accordance with section 4100.5.3.

4100.7.1.6 If the contract includes a bid item for:

4100.7.1.6.1 Hauling Asphalt Concrete, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.2 Reclaimed Asphalt Concrete, payment will be made in accordance with Specification 4105 For Reclaiming Asphalt Concrete.

4100.7.1.6.3 Hauling Reclaimed Asphalt Concrete, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.4 Filler And Blender, payment will be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

4100.7.1.6.5 Hauling Filler And Blender, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.6 Tack Coat And Flush Coat, payment will be made in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.7.1.7 The rate the Department will pay for rejecting aggregate in excess of 10%, or for rejecting aggregate to improve the quality of the asphalt mix design, will be as designated in the Special Provisions of the contract.

4100.7.1.8 The Contractor will be charged at cost for the value of the asphalt and other additives in any asphalt mix that is rejected or wasted, in accordance with the following:

4100.7.1.8.1 The quantity of material rejected or wasted will be determined by the Engineer.

4100.7.1.8.2 The Contractor will not be charged for rejected or wasted material if it has been incorporated back into the work in a manner acceptable to the Engineer.

4100.7.1.8.3 For calculation purposes, the asphalt content will be that of the Job Mix Formula or Asphalt Mix Formula.

4100.7.1.9 When defects in rejected blocks or lots have been remedied, the pay adjustments for Field Density, smoothness, severity of segregation, segregation frequency and final surface condition will be based on testing of the repaired sections where applicable.

4100.7.1.10 The pay adjustments determined through testing of the remedial work will be applied to that quantity of material in the block or lot which was originally rejected.

4100.7.1.11 If any lot or block has been rejected under section 4100.5.2, payment will not be made for the asphalt concrete in the lot or block until the rejected work has been remedied.

4100.7.2 Pay Adjustments

4100.7.2.1 The dollar value of the pay adjustment will be as follows:

4100.7.2.1.1 For **Field Density**:

4100.7.2.1.1.1 The pay adjustment for each lot will be determined from Table 4100.7.T7. If the asphalt mix is a recycled mix with more than 10% reclaimed material, the pay adjustments will be at 50% of the values specified in Table 4100.7.T7.

TABLE 4100.7.T7

PAY ADJUSTMENTS FOR FIELD DENSITY

% of Marshall Density of Job Mix Formula	Pay Adjustment Dollars Per Tonne
≥ 99.0	+1.00
98.9	+0.90
98.8	+0.80
98.7	+0.70
98.6	+0.60
98.5	+0.50
98.4	+0.40
98.3	+0.30
98.2	+0.20
98.1	+0.10
98.0	0.00
97.9	0.00
97.8	0.00
97.7	0.00
97.6	0.00
97.5	0.00
97.4	0.00
97.3	0.00
97.2	0.00
97.1	0.00
97.0	0.00
96.9	-0.05
96.8	-0.10
96.7	-0.20
96.6	-0.30
96.5	-0.40
96.4	-0.50

Table 4100.7.T7 Continued	
% of Marshall Density of Job Mix Formula	Pay Adjustment Dollars Per Tonne
96.3	-0.60
96.2	-0.70
96.1	-0.80
96.0	-0.90
95.9	-1.00
95.8	-1.50
95.7	-2.00
95.6	-2.50
95.5	-3.00
95.4	-3.50
95.3	-4.00
95.2	-4.50
95.1	-5.00
95.0	-5.50
94.9	-6.00
94.8	-7.00
94.7	-8.00
94.6	-9.00
94.5	-10.00
94.4	-11.00
94.3	-12.00
94.2	-13.00
94.1	-14.00
94.0	-15.00
92.5 – ≤ 93.9	No Payment
< 92.5	Reject

4100.7.2.1.1.2 If the Specified Marshall Density is not achieved and the Target Density of Section 4100.3.11.2 must be used, the pay adjustment for each lot will be determined from Table 4100.7.T8. If the asphalt mix is a recycled mix with more than 10% reclaimed material, the pay adjustments will be at 50% of the values specified in Table 4100.7.T8.

TABLE 4100.7.T8

PAY ADJUSTMENTS FOR TARGET DENSITY APPLICATIONS

% of Target Density	Pay Adjustment - Dollars Per Tonne
≥ 99.0	0.00
98.9	-0.10
98.8	-0.20
98.7	-0.30
98.6	-0.40
98.5	-0.50
98.4	-0.60
98.3	-0.70
98.2	-0.80
98.1	-0.90
98.0	-1.00
97.9	-1.10
97.8	-1.20
97.7	-1.30
97.6	-1.40
97.5	-1.50
97.4	-1.60
97.3	-1.70
97.2	-1.80
97.1	-1.90
97.0	-2.00

Table 4100.7.T8 Continued	
% of Target Density	Pay Adjustment - Dollars Per Tonne
96.9	-2.50
96.8	-3.00
96.7	-3.50
96.6	-4.00
96.5	-4.50
96.4	-5.00
96.3	-5.50
96.2	-6.00
96.1	-6.50
96.0	-7.00
95.9	-7.50
95.8	-8.00
95.7	-8.50
95.6	-9.00
95.5	-10.00
95.4	-11.00
95.3	-12.00
95.2	-13.00
95.1	-14.00
95.0	-15.00
≤ 94.9	Reject

4100.7.2.1.2 For **smoothness**:

4100.7.2.1.2.1 The pay adjustment for each block in the final lift of asphalt concrete will be determined in accordance with Table 4100.7.T9:

TABLE 4100.7.T9

PAY ADJUSTMENTS FOR SMOOTHNESS

Category I PrI	Category II PrI	Pay Adjustment for Smoothness of Top Lift - Dollars per Block Lump Sum
0	0 – 1	+200
1 – 2	2 – 3	+150
3 – 4	4 – 6	+100
5 – 6	7 – 9	+50
7 – 10	10 – 15	0
11 – 12	16 – 17	-25
13	18	-50
14	19	-75
15	20	-100
16	21	-150
17	22	-200
18	23	-300
19	24	-400
20	25	-500
21	26	-600
22	27	-800
23	28	-1000
> 23	> 28	Reject

4100.7.2.1.2.2 The pay adjustment for smoothness will be prorated for blocks less than 100 metres in length.

4100.7.2.1.3 For **severity of segregation**:

4100.7.2.1.3.1 The pay adjustment will be determined from Table 4100.7.T10.

TABLE 4100.7.T10

PAY ADJUSTMENTS FOR SEVERITY OF SEGREGATION

Severity of Segregation	Pay Adjustment Dollars per Square Metre
None	0
Minor	- 3.00
Severe	- 6.00

4100.7.2.1.4 For **segregation frequency**:

4100.7.2.1.4.1 The pay adjustment will be determined from Table 4100.7.T11.

TABLE 4100.7.T11

PAY ADJUSTMENTS FOR SEGREGATION FREQUENCY

Segregation Frequency per Lane Kilometre	Pay Adjustment Dollars per Lane Kilometre
0 – 5	0
6 – 15	- 250
16 +	- 500

4100.7.2.1.5 For **final surface condition**:

4100.7.2.1.5.1 For each lane-kilometre of top lift meeting all of the requirements from Table 4100.7.T12, a bonus of $350 will be paid.

TABLE 4100.7.T12

REQUIREMENTS FOR FINAL SURFACE CONDITION BONUS

Number of Blocks with PrI > 10	Number of Individual Bumps/Dips > 8 mm	Number of Segregated Areas	Number of Surface Defects
0	0	0 – 2	0 – 5

4100.7.3 Maximum Pay Adjustment

4100.7.3.1 The sum of the pay adjustments for each lot will not exceed the maximum pay adjustment. The maximum pay adjustment will be calculated as follows:

Maximum Pay Adjustment per Lot	=	Contract Unit Price per Tonne	x	Tonnes of Asphalt Concrete in Lot

APPENDIX I

Traffic Noise Study

HGC ENGINEERING
NOISE | VIBRATION | ACOUSTICS

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DRAFT Road Traffic Noise Study
Proposed Emerald Park Development
Regional Municipality of Edenwold No. 158
Emerald Park, Saskatchewan

Prepared for:

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May 2, 2023

HGC Project No. 02300111

VERSION CONTROL

Version	Date	Version Description
1	May 2, 2023	Draft Report

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1 Introduction & Summary

HGC Engineering was retained by WCE Design Inc. ("WCE") to conduct a road traffic noise study for a proposed multi-storey residential development located in the Regional Municipality ("RM") of Edenwold Park No. 158, Saskatchewan. We understand that the traffic noise study has been requested by the Community Planning administration from the RM of Edenwold, as the developments are located in proximity to the Trans-Canada Highway ("Highway 1"), which is approximately 120 metres beyond the north property line. A total of seven 3-storey buildings are planned to be constructed along Great Plains Road, which acts as a service road for Highway 1. One common outdoor amenity space is included at the center of the development. There are no walkout style residential units proposed to be built and no individual unit amenity areas. The surrounding areas beyond the north and west property lines consist of light industrial land use. Residential areas are located immediately south and east of the proposed development.

The primary noise sources impacting the proposed development is road traffic along Highway 1. The RM has indicated that road traffic noise is required to be assessed, and that other potential noise impacts from adjacent industrial or commercial operations can be omitted. The predicted sound levels were compared to the sound level limits outlined in the City of Saskatoon "Traffic Noise Sound Attenuation Policy", Policy Number C07-028 dated February 27, 2017.

Sound level predictions indicate that future road traffic sound levels in the common outdoor amenity area will be less than the Design Noise Level criteria of 65 dBA. No further sound attenuation is required at the proposed development based on the analysis.

2 Site Description & Noise Sources

The site is located in Emerald Park, Saskatchewan. Figure 1 is a key plan illustrating the location of the proposed site. The site layout plan for the development prepared by WCE Deign Inc., dated April 9, 2023, is shown in Figure 2 along with the noise prediction location. The proposed development will consist of seven multiunit residential buildings, each building features three storeys. Highway 1 is a major truck route and is the dominant source of traffic noise in the area.

3 Noise Level Criteria

Based on our discussion with the RM of Edenwold, the municipality does not have a specific noise policy pertaining to sound level limits and noise attenuation for the assessment of road traffic noise. The RM indicated that standards from other municipalities in the region would be appropriate to use as a guideline. Thresholds and guidelines for acceptable levels of road traffic noise impacting developments is provided in the City of Saskatoon Council Policy "Traffic Noise Sound Attenuation", Policy Number C07-028, dated February 27, 2017. The noise limit threshold is defined by the L_{dn} which is defined as the "logarithmic average conducted over an entire 24-hour period." The acceptable sound levels are indicated as an L_{dn} of 65 dBA for daytime. While the Saskatoon sound attenuation policy does not indicate if noise impact assessments need to be conducted for future traffic levels, it is generally industry practice among other major cities (e.g., Calgary, Toronto) that noise levels are predicted based on forecasted traffic volumes in 20-years (2043).

The policy uses the term 'outdoor rear amenity space', which is used in reference to a receptor located in a backyard, 5 m from the adjacent property line, 1.5 m in elevation and 3 m from any obstructions. Based on industry practice, the outdoor rear amenity space is also applicable to outdoor patios and common amenity areas allocated outside a multi-storey residential building. All outdoor amenity spaces are areas where passive recreation is expected to occur. There are no walkout style or large outdoor patio spaces at any of the proposed buildings, however, one common outdoor amenity space is planned to be constructed at the centre of the development.

4 Traffic Noise Predictions

4.1 Road Traffic Information

Traffic data for eastbound and westbound lanes of Highway 1, east of Emerald Park access, were obtained from the Government of Saskatchewan, Ministry of Highways Department. Road traffic data was provided in the form of hourly traffic counts and Annual Daily Traffic ("ADT") measured from October 17, 2022 to October 19, 2022. The road traffic data used for the analysis of this study is provided in Appendix A. Utilizing the traffic volumes provided, future traffic volumes were projected for 2043 timelines (20-year forecasts) using an annual growth rate of 2.5%. The speed limit of both westbound and eastbound lanes of Highway 1 were confirmed to be 110 km/h.

The detailed traffic data provided is shown in Table 1. The existing traffic volumes and the projected future traffic (2043) are shown in Table 2.

Table 1: Detailed Road Traffic Data Breakdown – October 2022

Road Description		Vehicle Classification – Measured Traffic Volume				
		Motorcycles	Cars	Medium	Heavy	Total
Highway 1	EB	40	16,244	375	2,399	19,058
	WB	38	15,440	467	2,532	18,477

Table 2: Existing and Projected Road Traffic Data

Road Description			Hourly Average Traffic Volume
Highway 1 (Existing, 2022)	EB	Daytime	554
		Nighttime	83
	WB	Daytime	515
		Nighttime	125
Highway 1 (Projected, 2043)	EB	Daytime	931
		Nighttime	139
	WB	Daytime	865
		Nighttime	209

4.2 Road Traffic Noise Prediction

To assess the levels of road traffic noise which will impact the site in the future, predictions were modelled using the computer program CadnaA version 2023 MR1 build: 183.5110. CadnaA includes an implementation of the Traffic Noise Model ("TNM") 2.5, developed by the U.S. Department of Transportation Federal Highway Administration ("FHWA"). It is standard industry practice for major Canadian jurisdictions to use CadnaA with the implementation of TNM 2.5 for road traffic noise assessments. Input tables containing the parameters used for modelling are included in Appendix C.

One prediction location was chosen to represent the future sound levels at the outdoor common amenity space. The receptor location for this amenity space indicated as "R1", is shown in Figure 2. Ground surface topography with a 1 metre resolution for the proposed development, adjacent roadways and surrounding area was obtained from the Government of Canada, CanElevation online database. Aerial photography and the proposed development plans were used in the analysis to determine setbacks to the roadways, and receptor and building locations. Cross sections which indicate the elevations utilized in the predictive modeling for the receptor location are provided in Appendix B. The predicted sound levels at the receptor locations may be subject to modification if the site plan is modified significantly. Table 3 below indicates the predicted future road traffic noise at the common amenity space.

Table 3: Predicted Future Road Traffic Sound Levels [dBA]

Prediction Location	Description	L_{dn} (20-year forecast)	Sound Level Limit, L_{dn}
R1	Common Amenity Space in the Centre of Development	57	65

5 Summary of Recommendations

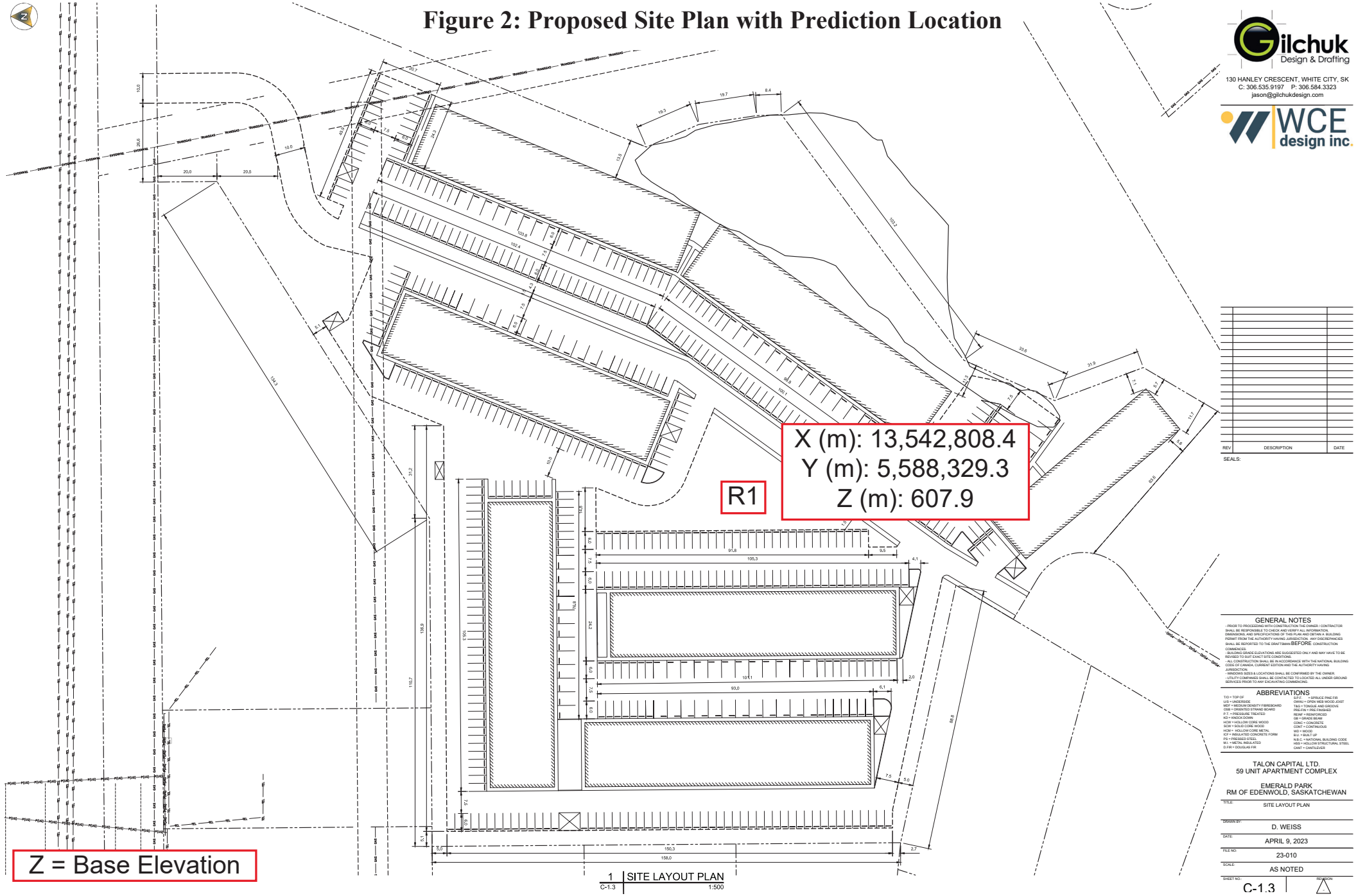
Future road traffic noise levels were assessed at the common outdoor leisure area for a proposed multi-storey residential development located in Emerald Park, Saskatchewan. The sound level predictions indicate that the future traffic sound levels are below the adopted sound level limits and are considered acceptable. No further sound attenuation is required at the proposed development.

References

1. City of Saskatoon, Council Policy, *Surface Transportation Noise Sound Attenuation, Policy Number C07-028*, February 27, 2017.
2. Government of Canada, Natural Resources Canada. High Resolution Digital Elevation Model (HRDEM) – CanElevation Series.
   High Resolution Digital Elevation Model (HRDEM) - CanElevation Series - Open Government Portal (canada.ca)
   [Date Accessed: April 20, 2023]
3. Google Earth Pro V 7.3.6.9285. Emerald Park, Saskatchewan. Aerial Photography.
   https://www.earth.google.com
   [Date Accessed: April 20, 2023]

Figure 1: Key Site Plan and Surrounding Area
Emerald Park, Saskatchewan

Figure 2: Proposed Site Plan with Prediction Location



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WCE design inc.

REV	DESCRIPTION	DATE

SEALS:

GENERAL NOTES

- PRIOR TO PROCEEDING WITH CONSTRUCTION THE OWNER / CONTRACTOR SHALL BE RESPONSIBLE TO CHECK AND VERIFY ALL INFORMATION, DIMENSIONS, AND SPECIFICATIONS OF THIS PLAN AND OBTAIN A BUILDING PERMIT FROM THE AUTHORITY HAVING JURISDICTION. ANY DISCREPANCIES SHALL BE REPORTED TO THE DRAFTSMAN BEFORE CONSTRUCTION COMMENCES.
- BUILDING GRADE ELEVATIONS ARE SUGGESTED ONLY AND MAY HAVE TO BE REVISED TO SUIT EXACT SITE CONDITIONS.
- ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE NATIONAL BUILDING CODE OF CANADA, CURRENT EDITION AND THE AUTHORITY HAVING JURISDICTION.
- WINDOWS SIZES & LOCATIONS SHALL BE CONFIRMED BY THE OWNER.
- UTILITY COMPANIES SHALL BE CONTACTED TO LOCATED ALL UNDER GROUND SERVICES PRIOR TO ANY EXCAVATING COMMENCING.

ABBREVIATIONS

TIO = TOP OF	S.P.F. = SPRUCE PINE FIR
U/S = UNDERSIDE	OWWJ = OPEN WEB WOOD JOIST
MDF = MEDIUM DENSITY FIBREBOARD	T&G = TONGUE AND GROOVE
OSB = ORIENTED STRAND BOARD	PRE-FIN = PRE FINISHED
P.T. = PRESSURE TREATED	REINF = REINFORCED
KD = KNOCK DOWN	GB = GRADE BEAM
HCW = HOLLOW CORE WOOD	CONC = CONCRETE
SCW = SOLID CORE WOOD	CONT = CONTINUOUS
HCM = HOLLOW CORE METAL	WD = WOOD
ICF = INSULATED CONCRETE FORM	B.U. = BUILT UP
PS = PRESSED STEEL	N.B.C. = NATIONAL BUILDING CODE
M.I. = METAL INSULATED	HSS = HOLLOW STRUCTURAL STEEL
D.FIR = DOUGLAS FIR	CANT = CANTILEVER

TALON CAPITAL LTD.
59 UNIT APARTMENT COMPLEX

EMERALD PARK
RM OF EDENWOLD, SASKATCHEWAN

TITLE: SITE LAYOUT PLAN

DRAWN BY: D. WEISS

DATE: APRIL 9, 2023

FILE NO: 23-010

SCALE: AS NOTED

SHEET NO: C-1.3

REVISION:

ACOUSTICS NOISE VIBRATION

www.hgcengineering.com

Appendix A – Road Traffic Data

35 Oct 17-19 1 1500 101722 1500 101922 60 2 2 100 102201

HIGHWAY 1 - EB INNERLANE

0010800MDB0766I

2 15

	Lane		Time Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	0	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	16:00	1	154	72	0	0	0	0	1	4	1	0	0	0	0	0
0	1	0	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	17:00	0	214	75	0	1	0	0	0	1	1	1	1	0	0	1
0	1	0	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	2	0	18:00	0	201	80	0	1	0	0	2	3	0	1	0	1	0	0
0	1	0	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	19:00	0	115	46	0	0	0	0	2	4	1	0	0	4	0	0
0	1	0	20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	2	0	20:00	0	55	21	0	0	0	0	0	2	3	0	0	1	0	0
0	1	0	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	21:00	0	50	20	0	0	0	0	0	0	1	0	0	1	0	0
0	1	0	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	22:00	0	25	7	0	0	0	0	1	3	1	0	0	0	0	0
0	1	0	23:00	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0	2	0	23:00	0	25	10	0	0	0	0	0	0	2	0	0	1	0	0
0	1	0	0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	0:00	0	7	4	0	0	0	0	0	1	0	0	0	0	0	0
0	1	0	1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	1:00	0	5	2	1	0	0	0	0	1	0	0	0	0	0	0
0	1	0	2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	2:00	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	4:00	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	6:00	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	7:00	0	23	13	0	1	0	1	0	1	2	0	0	1	0	0
0	1	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	8:00	0	85	32	0	0	0	0	1	1	0	0	0	0	0	0
0	1	0	9:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
0	2	0	9:00	0	66	40	0	2	0	0	0	2	0	0	0	2	0	0
0	1	0	10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	10:00	0	68	33	0	0	1	0	1	3	2	0	0	0	0	0
0	1	0	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	2	0	11:00	0	52	26	0	2	0	0	0	3	1	0	0	0	0	0
0	1	0	12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	2	0	12:00	0	55	30	0	0	0	0	0	0	0	0	0	0	0	1
0	1	0	13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	13:00	0	81	35	0	0	0	1	4	1	1	0	0	1	0	0
0	1	0	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	14:00	0	70	42	0	0	0	0	1	1	1	1	0	0	0	0
0	1	0	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	2	0	15:00	0	111	57	0	1	0	0	0	3	1	0	0	2	0	0
0	1	0	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	16:00	0	124	45	0	0	0	0	0	2	1	0	0	0	0	0
0	1	0	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
0	2	0	17:00	0	195	68	0	0	0	0	1	4	2	1	0	6	0	0
0	1	0	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	18:00	0	206	85	0	0	0	0	2	7	3	0	0	0	0	0
0	1	0	19:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	2	0	19:00	2	100	47	0	0	0	1	4	0	6	0	0	2	0	1
0	1	0	20:00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	20:00	0	60	27	0	0	0	0	2	4	3	0	0	1	0	2
0	1	0	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	21:00	0	56	22	0	0	0	0	0	4	0	0	1	1	0	0
0	1	0	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
0	2	0	22:00	0	45	16	0	0	0	1	1	1	0	0	0	1	0	0
0	1	0	23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	23:00	0	13	8	0	0	0	0	0	1	0	0	0	0	0	0
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0	1	0	2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	2:00	0	8	0	0	0	0	0	0	0	0	0	0	1	0	0
0	1	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	3:00	0	2	2	0	0	0	0	0	1	1	0	0	0	0	0
0	1	0	4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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0	1	0	6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	6:00	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0
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0	1	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	2	0	8:00	0	73	30	0	1	0	0	0	3	2	0	0	0	3	0
0	1	0	9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	9:00	0	53	42	1	0	0	3	0	4	1	1	0	1	0	0
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0	2	0	10:00	0	55	35	0	1	0	0	2	3	2	0	0	1	0	0
0	1	0	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	11:00	0	58	24	0	0	0	2	1	0	3	1	0	0	2	0
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0	2	0	12:00	0	62	27	0	0	0	1	0	3	3	0	0	0	2	0
0	1	0	13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	2	0	13:00	1	80	27	0	2	0	0	1	0	1	0	0	2	0	1
0	1	0	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	2	0	14:00	1	84	46	0	1	0	1	1	4	4	0	0	0	0	1
0	1	0	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	2	0	15:00	2	138	57	0	3	0	0	7	5	1	0	1	6	0	1

Time Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	Passenger	Trucks
16:00	1	154	72	0	0	0	0	1	4	1	0	0	0	0	0	233	227	6
16:00																		
17:00	0	214	75	0	1	0	0	0	1	1	1	0	0	0	2	296	289	5
17:00																		
18:00	0	201	80	0	1	0	0	2	3	0	1	0	1	0	2	291	281	8
18:00																		
19:00	0	115	46	0	0	0	0	2	4	1	0	0	4	0	0	172	161	11
19:00																		
20:00	0	55	21	0	0	0	0	0	2	3	0	0	1	0	3	85	76	6
20:00																		
21:00	0	50	20	0	0	0	0	0	0	1	0	1	1	0	1	74	70	3
21:00																		
22:00	0	25	7	0	0	0	0	1	3	1	0	0	0	0	0	37	32	5
22:00																		
23:00	0	25	10	0	0	0	0	1	0	0	0	0	1	0	0	39	35	4
23:00																		
0:00	0	7	4	0	0	0	0	0	0	0	0	0	0	0	0	12	11	1
0:00																		
1:00	0	5	2	1	0	0	0	0	1	0	0	0	0	0	1	10	8	1
1:00																		
2:00	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0
2:00																		
3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
3:00																		
4:00	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0
4:00																		
5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00																		
6:00	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	7	7	0
6:00																		
7:00	0	23	13	0	1	0	1	0	1	2	0	0	1	0	0	43	36	6
7:00																		
8:00	0	85	32	0	0	0	0	1	1	1	0	0	0	0	0	120	117	3
8:00																		
9:00	0	66	40	0	2	1	0	0	2	0	0	0	2	0	1	114	106	7
9:00																		
10:00	0	68	33	0	0	1	0	1	3	2	0	0	0	0	1	109	101	7
10:00																		
11:00	0	52	26	0	2	0	0	2	3	1	0	0	1	0	2	89	78	9
11:00																		
12:00	0	55	30	0	0	0	0	0	0	0	0	0	0	0	3	88	85	0
12:00																		
13:00	0	81	35	0	0	0	1	4	1	1	0	0	1	0	0	125	116	8
13:00																		
14:00	0	70	42	0	0	0	0	1	1	1	0	0	0	0	0	117	112	4
14:00																		
15:00	0	111	57	0	1	0	0	0	3	1	0	0	2	0	5	180	168	7
15:00																		
16:00	0	124	45	0	0	0	0	0	2	1	0	0	0	0	3	175	169	3
16:00																		
17:00	0	195	68	0	0	0	0	1	4	2	1	0	6	0	6	283	263	14
17:00																		
18:00	0	206	85	0	0	0	0	2	7	3	0	0	0	0	3	306	291	12
18:00																		
19:00	2	100	47	0	0	1	1	4	0	6	0	0	2	0	1	164	149	14
19:00																		
20:00	1	60	27	0	0	0	0	2	4	3	0	0	1	0	0	100	88	10
20:00																		
21:00	0	56	22	0	0	0	0	4	0	0	0	0	4	0	0	85	78	6
21:00																		
22:00	0	45	16	0	0	1	0	1	1	0	0	0	4	0	0	69	61	4
22:00																		
23:00	0	13	8	0	0	0	0	0	0	0	0	0	1	0	0	23	21	1
23:00																		
0:00	0	9	2	0	0	0	0	0	0	0	0	0	3	0	0	14	11	3
0:00																		
1:00	0	2	2	0	0	0	0	0	0	0	0	0	1	0	0	6	4	1
1:00																		
2:00	0	8	0	0	0	0	0	0	0	0	0	0	0	0	1	10	8	1
2:00																		
3:00	0	2	2	0	0	0	0	0	0	0	0	1	1	0	0	8	4	2
3:00																		
4:00	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	5	4	1
4:00																		
5:00	0	3	0	0	0	0	0	0	1	2	0	0	0	0	0	6	3	3
5:00																		
6:00	0	6	0	0	0	0	0	0	0	0	0	0	1	0	0	8	6	1
6:00																		
7:00	0	21	7	0	0	0	0	1	1	0	0	0	0	0	0	30	28	2
7:00																		
8:00	0	73	30	0	1	0	0	3	2	0	0	0	3	0	3	115	103	9
8:00																		
9:00	0	53	42	1	0	0	3	0	4	1	0	0	1	0	0	106	96	10
9:00																		
10:00	0	55	35	0	1	0	0	2	3	2	0	0	0	0	5	104	90	9
10:00																		
11:00	0	58	24	0	0	0	2	1	0	3	1	0	0	0	1	92	82	9
11:00																		
12:00	0	62	27	0	0	1	0	3	3	0	0	0	2	0	0	98	89	9
12:00																		
13:00	1	80	27	0	2	0	0	1	0	1	0	0	2	0	3	117	108	6
13:00																		
14:00	1	84	46	0	1	0	1	1	4	4	0	0	0	0	3	145	131	11
14:00																		
15:00	2	138	57	0	3	0	0	7	5	1	0	1	6	0	2	222	197	23
15:00																		

Bin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Day 1	1	1471	650	1	8	2	2	16	34	19	3	2	15	0	25	2249
Day 2	7	1457	619	1	9	5	6	29	51	31	2	2	29	0	43	2291
GRAND TOTAL	8	2928	1269	2	17	7	8	45	85	50	5	4	44	0	68	4540
PERCENTS	0.2%	64.5%	28.0%	0.0%	0.4%	0.2%	0.2%	1.0%	1.9%	1.1%	0.1%	0.1%	1.0%	0.0%	1.5%	100.0%

ADT = 2270 CF = 0.95 AADT = 2166

	Straight	Single Trailer	Multi Trailer
Day 1 Trucks	12	69	20
Day 2 Trucks	20	111	33
Total Trucks	32	180	53
Average Trucks	16	90	27

TADT = 133

Start Date	17-Oct-22
End Date	19-Oct-22

Location 0010800MDB-I 7.66

Class Bin Definitions

1	Motorcycles
2	Cars
3	Pickup Trucks
4	Buses
5	2 Axle Single Unit Trucks
6	3 Axle Single Unit Trucks
7	4 or more Axle Single Unit Trucks
8	4 or less Axle Single Trailer Trucks
9	5 Axle Single Trailer Trucks
10	6 or more Axle Single Trailer Trucks
11	5 or less Axle Multi Trailer Trucks
12	6 Axle Multi Trailer Trucks
13	7 or more Axle Multi Trailer Trucks
14	Not used
15	Unclassified vehicles or errors

Truck Types

Straight	Classes 5, 6, 7
Single Trailer	Classes 8, 9, 10
Multi Trailer	Classes 11, 12, 13

Average Hourly Volumes

101	Hour Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	All Vehicles	Passenger	Trucks
164	0:00	0	8	3	0	0	0	0	0	1	2	0	0	0	0	0	13	11	2
265	1:00	0	4	2	1	0	0	0	0	1	1	0	0	0	0	1	8	6	1
	2:00	0	5	1	0	0	0	0	0	0	0	0	0	1	0	1	7	6	1
	3:00	0	1	1	0	0	0	0	0	1	1	0	0	0	0	2	5	2	1
	4:00	0	3	1	0	1	0	0	0	0	0	0	0	0	0	0	5	4	1
	5:00	0	2	0	0	0	0	0	1	1	0	0	0	0	0	0	3	2	2
	6:00	0	6	1	0	0	0	0	0	1	0	0	0	0	0	1	8	7	1
	7:00	0	22	10	0	1	0	1	1	1	1	0	0	1	0	1	37	32	4
	8:00	0	79	31	0	1	0	0	2	2	1	0	0	2	0	2	118	110	6
	9:00	0	60	41	1	1	1	2	0	3	1	1	0	2	0	1	110	101	9
	10:00	0	62	34	0	1	1	0	2	3	2	0	0	1	0	3	107	96	8
	11:00	0	55	25	0	1	1	1	1	3	1	0	0	2	0	2	91	80	9
	12:00	0	59	29	0	0	1	0	2	2	0	0	0	1	0	2	93	87	5
	13:00	1	81	31	0	1	0	1	3	1	1	0	0	2	0	2	121	112	7
	14:00	1	77	44	0	1	0	1	1	3	3	1	0	0	0	2	131	122	8
	15:00	1	125	57	0	2	0	0	4	4	1	0	1	4	0	4	201	183	15
	16:00	1	139	59	0	0	0	0	1	3	1	0	0	0	0	2	204	198	5
	17:00	0	205	72	0	1	0	0	1	3	2	1	1	3	0	4	290	276	10
	18:00	0	204	83	0	1	0	0	2	5	2	1	0	1	0	3	299	286	10
	19:00	1	108	47	0	0	1	1	3	2	4	0	0	3	0	1	168	155	13
	20:00	1	58	24	0	0	0	0	1	3	3	0	0	1	0	3	93	82	8
	21:00	0	53	21	0	0	0	0	0	2	1	0	1	1	0	1	80	74	5
	22:00	0	35	12	0	0	1	0	1	2	1	0	0	1	0	2	53	47	5
	23:00	0	19	9	0	0	0	0	1	0	2	0	0	1	0	1	31	28	3

33 Oct 17-19 1 1500 101722 1500 101922 60 2 2 100 102201

HIGHWAY 1 - EB OUTERLANE

JB0766O

2 15

	Lane		Time Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Time Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	Passenger	Trucks
0	1	0	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16:00	1	338	177	0	10	3	3	14	19	5	0	6	10	0	19	605	516	70
0	2	0	16:00	1	338	177	0	10	3	3	14	19	5	0	6	10	0	19	16:00																		
0	1	0	17:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	17:00	2	450	218	1	3	4	3	12	20	8	2	2	8	0	22	755	671	62
0	2	0	17:00	2	449	218	1	3	4	3	12	20	8	2	2	8	0	22	17:00																		
0	1	0	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18:00	2	510	219	0	2	2	0	11	12	4	4	1	7	0	10	784	731	43
0	2	0	18:00	2	510	219	0	2	2	0	11	12	4	4	1	7	0	10	18:00																		
0	1	0	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19:00	0	290	143	0	1	4	0	7	17	3	0	1	9	0	11	486	433	42
0	2	0	19:00	0	290	143	0	1	4	0	7	17	3	0	1	9	0	11	19:00																		
0	1	0	20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20:00	0	231	117	0	1	0	1	12	19	6	0	0	10	0	9	406	348	49
0	2	0	20:00	0	231	117	0	1	0	1	12	19	6	0	0	10	0	9	20:00																		
0	1	0	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21:00	0	189	71	0	1	0	1	9	18	6	1	1	14	0	3	314	260	51
0	2	0	21:00	0	189	71	0	1	0	1	9	18	6	1	1	14	0	3	21:00																		
0	1	0	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22:00	0	135	46	0	0	2	3	8	16	6	1	3	6	0	2	228	181	45
0	2	0	22:00	0	135	46	0	0	2	3	8	16	6	1	3	6	0	2	22:00																		
0	1	0	23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23:00	0	112	47	1	0	1	2	9	13	1	0	1	9	0	3	199	160	36
0	2	0	23:00	0	112	47	1	0	1	2	9	13	1	0	1	9	0	3	23:00																		
0	1	0	0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0:00	0	44	17	0	0	0	0	2	19	5	0	0	10	0	2	99	61	36
0	2	0	0:00	0	44	17	0	0	0	0	2	19	5	0	0	10	0	2	0:00																		
0	1	0	1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1:00	0	25	12	2	1	1	0	8	12	3	0	0	5	0	2	71	39	30
0	2	0	1:00	0	25	12	2	1	1	0	8	12	3	0	0	5	0	2	1:00																		
0	1	0	2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2:00	0	9	10	0	0	0	0	8	7	4	0	1	0	0	1	40	19	20
0	2	0	2:00	0	9	10	0	0	0	0	8	7	4	0	1	0	0	1	2:00																		
0	1	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3:00	0	2	7	0	1	1	0	4	5	2	1	0	9	0	1	33	9	23
0	2	0	3:00	0	2	7	0	1	1	0	4	5	2	1	0	9	0	1	3:00																		
0	1	0	4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4:00	0	10	4	0	1	0	0	1	7	1	0	0	2	0	0	26	14	12
0	2	0	4:00	0	10	4	0	1	0	0	1	7	1	0	0	2	0	0	4:00																		
0	1	0	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5:00	0	6	9	0	0	0	0	4	8	2	0	2	5	0	0	36	15	21
0	2	0	5:00	0	6	9	0	0	0	0	4	8	2	0	2	5	0	0	5:00																		
0	1	0	6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00	0	25	17	0	5	0	0	1	7	3	0	0	8	0	0	66	42	24
0	2	0	6:00	0	25	17	0	5	0	0	1	7	3	0	0	8	0	0	6:00																		
0	1	0	7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7:00	0	84	70	0	5	2	1	9	17	8	1	0	6	0	1	204	154	49
0	2	0	7:00	0	84	70	0	5	2	1	9	17	8	1	0	6	0	1	7:00																		
0	1	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8:00	0	179	108	0	5	3	3	11	19	6	2	1	6	0	2	345	287	56
0	2	0	8:00	0	179	108	0	5	3	3	11	19	6	2	1	6	0	2	8:00																		
0	1	0	9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00	0	192	115	0	5	5	3	14	17	12	1	3	9	0	4	380	307	69
0	2	0	9:00	0	192	115	0	5	5	3	14	17	12	1	3	9	0	4	9:00																		
0	1	0	10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10:00	1	142	122	0	4	5	6	13	15	6	1	3	18	0	4	340	265	71
0	2	0	10:00	1	142	122	0	4	5	6	13	15	6	1	3	18	0	3	10:00																		
0	1	0	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11:00	0	142	124	1	7	5	2	11	13	7	2	7	18	0	8	347	267	72
0	2	0	11:00	0	142	124	1	7	5	2	11	13	7	2	7	18	0	7	11:00																		
0	1	0	12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12:00	1	168	98	0	3	5	3	30	16	7	4	6	17	0	9	367	267	91
0	2	0	12:00	1	168	98	0	3	5	3	30	16	7	4	6	17	0	9	12:00																		
0	1	0	13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13:00	0	203	130	0	3	5	2	30	17	7	1	2	12	0	17	429	333	79
0	2	0	13:00	0	203	130	0	3	5	2	30	17	7	1	2	12	0	17	13:00																		
0	1	0	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14:00	3	225	118	0	2	3	3	28	17	3	1	4	14	0	16	437	346	75
0	2	0	14:00	3	225	118	0	2	3	3	28	17	3	1	4	14	0	16	14:00																		
0	1	0	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15:00	1	259	147	2	4	3	2	24	22	7	1	5	8	0	21	506	409	76
0	2	0	15:00	1	259	147	2	4	3	2	24	22	7	1	5	8	0	21	15:00																		
0	1	0	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16:00	1	341	136	1	3	2	5	29	7	2	0	4	9	0	21	561	479	61
0	2	0	16:00	1	341	136	1	3	2	5	29	7	2	0	4	9	0	21	16:00																		
0	1	0	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17:00	3	460	173	0	1	1	3	15	14	3	3	5	9	0	37	727	636	54
0	2	0	17:00	3	460	173	0	1	1	3	15	14	3	3	5	9	0	37	17:00																		
0	1	0	18:00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18:00	3	473	237	1	2	1	4	24	12	4	2	4	7	0	45	819	714	60
0	2	0	18:00	2	473	237	1	2	1	4	24	12	4	2	4	7	0	45	18:00																		
0	1	0	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19:00	1	315	128	1	0	0	3	18	22	4	0	2	8	0	20	522	445	57
0	2	0	19:00	1	315	128	1	0	0	3	18	22	4	0	2	8	0	20	19:00																		
0	1	0	20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20:00	1	213	114	0	0	0	3	15	25	10	1	4	11	0	9	406	328	69
0	2	0	20:00	1	213	114	0	0	0	3	15	25	10	1	4	11	0	9	20:00																		
0	1	0	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21:00	0	181	76	0	1	0	0	11	21	3	1	1	11	0	8	314	257	49
0	2	0	21:00	0	181	76	0	1	0	0	11	21	3	1	1	11	0	8	21:00																		
0	1	0	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22:00	0	159	64	0	0	0	0	0	17	24	13	3	0	14	0	3	297	223	71
0	2	0	22:00	0	159	64	0	0	0	0	17	24	13	3	0	14	0	3	22:00																		
0	1	0	23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23:00	0	93	28	0	0	0	0	2	7	23	2	0	2	5	0	2	164	121	41
0	2	0	23:00	0	93	28	0	0	0	2	7	23	2	0	2	5	0	2	23:00																		
0	1	0	0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0:00	0	51	15	0	0	0	0	0	12	15	5	0	1	10	0	1	110	66	43
0	2	0	0:00	0	51	15	0	0	0	0	12	15	5	0	1	10	0	1	0:00																		
0	1	0	1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1:00	0	29	9	0	0	0	0	0	3	17	7	0	0	7	0	5	77	38	34
0	2	0	1:00	0	29	9	0	0	0	0	3	17	7	0	0	7	0	5	1:00																		
0	1	0	2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2:00	0	14	2	0	0	0	0	0	3	12	2	0	1	3	0	1	38	16	21
0	2	0	2:00	0	14	2	0	0	0	0	3	12	2	0	1	3	0	1	2:00																		
0	1	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3:00	0	11	2	0	0	1	0	3	11	3	0	0	3	0	0	34	13	21
0	2	0	3:00	0	11	2	0	0	1	0	3	11	3	0	0	3	0	0	3:00																		
0	1	0	4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4:00	0	9	2	0	2	0	0	2	15	4	0	1	2	0	0	37	11	26
0	2	0	4:00	0	9	2	0	2	0	0	2	15	4	0	1	2	0	0	4:00																		
0	1	0	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5:00	0	12	6	0	0	0	0	4	11	3	0	1	7	0	1	45	18	26
0	2	0	5:00	0	12	6	0	0	0	0	4	11	3	0	1	7	0	1	5:00																		
0	1	0	6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00	0	18	25	0	0	1	0	3	9	5	2	0	4	0	1	68	43	24
0	2	0	6:00	0	18	25	0	0	1	0	3	9	5	2	0	4	0	1	6:00																		
0	1	0	7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7:00	0	71	88	0	4	5	0	5	13	2	0	3	6	0	4	201	159	38
0	2	0	7:00	0	71	88	0	4	5	0	5	13	2	0	3	6	0	4	7:00																		
0	1	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8:00	1	180	105	1	5	7	3	8	19	5	2	0	9	0	8	353	287	58
0	2	0	8:00	1	180	105	1	5	7	3	8	19	5	2	0	9	0	8	8:00																		
0	1	0	9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00	0	184	113	0	16	5	2	16	19	11	0	1	10	0	2	379	297	80
0	2	0	9:00	0	184	113	0	16	5	2	16	19	11	0	1	10	0	2	9:00																		
0	1	0	10:00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10:00	2	163	99	0	10	2	5	11	17	17	0	2	13	0	8	349	264	77
0	2	0	10:00	1	163	99	0	10	2	5	11	17	17	0	2	13	0	8	10:00																		
0	1	0	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11:00	0	149	100	0	7	4	2	26	16	3	1	6	11	0	7	332	249	76
0	2	0	11:00	0	149	100	0	7	4	2	26	16	3	1	6	11	0	7	11:00																		
0	1	0	12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12:00	2	172	112	1	4	5	5	19	17	6	3	4	11	0	8	369	287	74
0	2	0	12:00	2	172	112	1	4	5	5	19	17	6	3	4	11	0	8	12:00																		
0	1	0	13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13:00	2	202	118	0	5	5	5	27	19	2	4	4	11	0	10	414	322	82
0	2	0	13:00	2	202	118	0	5	5	5	27	19	2	4	4	11	0	10	13:00																		
0	1	0	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	14:00	3	250	122	2	7	7	3	22	26	8	2	5	13	0	10	480	377	93
0	2	0	14:00	3	250	122	2	7	7	3	22	26	8	2	5	13	0	9	14:00																		
0	1	0	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15:00	2	210	97	0	6	5	2	14	16	4	0	5	4	0	20	385	309	56
0	2	0	15:00	2	210	97	0	6	5	2	14	16	4	0	5	4	0	20	15:00																		

Bin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Day 1	11	3970	2146	7	64	54	38	280	352	122	23	49	220	0	167	7503
Day 2	21	3960	1971	7	73	51	47	314	400	128	24	56	198	0	231	7481
GRAND TOTAL	32	7930	4117	14	137	105	85	594	752	250	47	105	418	0	398	14984
PERCENTS	0.2%	52.9%	27.5%	0.1%	0.9%	0.7%	0.6%	4.0%	5.0%	1.7%	0.3%	0.7%	2.8%	0.0%	2.7%	100.0%

ADT = 7492 CF = 0.95 AADT = 7150

	Straight	Single Trailer	Multi Trailer
Day 1 Trucks	156	754	292
Day 2 Trucks	171	842	278
Total Trucks	327	1596	570
Average Trucks	164	798	285

TADT = 1247

Start Date 17-Oct-22
End Date 19-Oct-22

Location 0010800MDB-O 7.66

Class Bin Definitions
1 Motorcycles
2 Cars
3 Pickup Trucks
4 Buses
5 2 Axle Single Unit Trucks
6 3 Axle Single Unit Trucks
7 4 or more Axle Single Unit Trucks
8 4 or less Axle Single Trailer Trucks
9 5 Axle Single Trailer Trucks
10 6 or more Axle Single Trailer Trucks
11 5 or less Axle Multi Trailer Trucks
12 6 Axle Multi Trailer Trucks
13 7 or more Axle Multi Trailer Trucks
14 Not used
15 Unclassified vehicles or errors

Truck Types
Straight Classes 5, 6, 7
Single Trailer Classes 8, 9, 10
Multi Trailer Classes 11, 12, 13

Average Hourly Volumes

	Hour Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	All Vehicles	Passenger	Trucks
1202	0:00	0	48	16	0	0	0	0	7	17	5	0	1	10	0	2	105	64	40
1291	1:00	0	27	11	1	1	1	0	6	15	5	0	0	6	0	4	74	39	32
2493	2:00	0	12	6	0	0	0	0	6	10	3	0	1	2	0	1	39	18	21
	3:00	0	7	5	0	1	1	0	4	8	3	1	0	6	0	1	34	11	22
	4:00	0	10	3	0	2	0	0	2	11	3	0	1	2	0	0	32	13	19
	5:00	0	9	8	0	0	0	0	4	10	3	0	2	6	0	1	41	17	24
	6:00	0	22	21	0	3	1	0	2	8	4	1	0	6	0	1	67	43	24
	7:00	0	78	79	0	5	4	1	7	15	5	1	2	6	0	3	203	157	44
	8:00	1	180	107	1	5	5	3	10	19	6	2	1	8	0	5	349	287	57
	9:00	0	188	114	0	11	5	3	15	18	12	1	2	10	0	3	380	302	75
	10:00	2	153	111	0	7	4	6	12	16	12	1	3	16	0	6	345	265	74
	11:00	0	146	112	1	7	5	2	19	15	5	2	7	15	0	8	340	258	74
	12:00	2	170	105	1	4	5	4	25	17	7	4	5	14	0	9	368	277	83
	13:00	1	203	124	0	4	5	4	29	18	5	3	3	12	0	14	422	328	81
	14:00	3	238	120	1	5	5	3	25	22	6	2	5	14	0	13	459	362	84
	15:00	2	235	122	1	5	4	2	19	19	6	1	5	6	0	21	446	359	66
	16:00	1	340	157	1	7	3	4	22	13	4	0	5	10	0	20	583	498	66
	17:00	3	455	196	1	2	3	3	14	17	6	3	4	9	0	30	741	654	58
	18:00	3	492	228	1	2	2	2	18	12	4	3	3	7	0	28	802	723	52
	19:00	1	303	136	1	1	2	2	13	20	4	0	2	9	0	16	504	439	50
	20:00	1	222	116	0	1	0	2	14	22	8	1	2	11	0	9	406	338	59
	21:00	0	185	74	0	1	0	1	10	20	5	1	1	13	0	6	314	259	50
	22:00	0	147	55	0	0	1	2	13	20	10	2	2	10	0	3	263	202	58
	23:00	0	103	38	1	0	1	2	8	18	2	0	2	7	0	3	182	141	39

22 Oct 17-19 1 1500 101722 1500 101922 60 2 2 100 102201

HIGHWAY 1 - WB INNERLANE

DA0767I

2 15

	Lane		Time Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Time Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	Passenger	Trucks
0	1	0	16:00	0	52	65	1	4	0	0	3	6	2	1	0	2	0	19	16:00	0	52	65	1	4	0	0	3	6	2	1	0	2	0	20	156	118	18
0	2	0	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	16:00																		
0	1	0	17:00	2	71	96	0	3	0	1	3	3	1	0	1	3	0	24	17:00	2	71	96	0	3	0	1	3	3	1	0	1	3	0	24	208	169	15
0	2	0	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17:00																		
0	1	0	18:00	0	61	98	0	4	0	1	5	2	1	1	0	0	0	12	18:00	0	61	98	0	4	0	1	5	2	1	1	0	0	0	12	185	159	14
0	2	0	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18:00																		
0	1	0	19:00	0	43	70	0	2	0	0	1	2	1	1	1	2	0	8	19:00	0	43	70	0	2	0	0	1	2	1	1	1	2	0	8	131	113	10
0	2	0	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19:00																		
0	1	0	20:00	0	22	22	0	2	0	0	1	1	0	0	1	0	0	1	20:00	0	22	22	0	2	0	0	1	1	0	0	1	0	0	1	50	44	5
0	2	0	20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20:00																		
0	1	0	21:00	0	17	16	0	0	0	0	0	1	0	0	0	1	0	0	21:00	0	17	16	0	0	0	0	0	1	0	0	0	1	0	1	36	33	2
0	2	0	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	21:00																		
0	1	0	22:00	0	16	5	0	0	0	0	0	0	0	0	0	0	0	0	22:00	0	16	5	0	0	0	0	0	0	0	0	0	0	0	0	21	21	0
0	2	0	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22:00																		
0	1	0	23:00	0	6	2	0	0	0	1	1	1	1	0	0	0	0	0	23:00	0	6	2	0	0	0	1	1	1	1	0	0	0	0	1	13	8	4
0	2	0	23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	23:00																		
0	1	0	0:00	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0:00	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0	4	3	1
0	2	0	0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0:00																		
0	1	0	1:00	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1:00	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
0	2	0	1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1:00																		
0	1	0	2:00	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	2:00	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	4	2	2
0	2	0	2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2:00																		
0	1	0	3:00	0	1	0	0	0	0	0	3	0	1	0	0	0	0	1	3:00	0	1	0	0	0	0	0	3	0	1	0	0	0	0	1	6	1	4
0	2	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3:00																		
0	1	0	4:00	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4:00	1	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	1	1
0	2	0	4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4:00																		
0	1	0	5:00	0	2	1	0	0	0	0	0	0	1	0	1	0	0	0	5:00	0	2	1	0	0	0	0	0	0	1	0	1	0	0	5	3	3	2
0	2	0	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5:00																		
0	1	0	6:00	0	9	11	0	0	0	0	0	0	0	0	0	1	0	1	6:00	0	9	11	0	0	0	0	0	0	0	0	0	1	0	1	22	20	1
0	2	0	6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00																		
0	1	0	7:00	0	59	48	0	0	0	0	0	1	0	0	2	0	0	0	7:00	0	59	48	0	0	0	0	0	1	0	0	2	0	0	0	110	107	3
0	2	0	7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7:00																		
0	1	0	8:00	0	220	134	0	3	1	0	1	1	0	0	1	0	0	5	8:00	0	220	134	0	3	1	0	1	1	0	0	1	0	0	5	366	354	7
0	2	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8:00																		
0	1	0	9:00	0	95	59	1	4	0	0	2	3	1	0	2	2	0	11	9:00	0	95	59	1	4	0	0	2	3	1	0	2	2	0	12	181	155	14
0	2	0	9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9:00																		
0	1	0	10:00	0	83	79	0	6	1	1	1	2	1	0	1	0	0	9	10:00	0	83	79	0	6	1	1	1	2	1	0	1	0	0	12	187	162	13
0	2	0	10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	10:00																		
0	1	0	11:00	0	75	73	0	4	0	0	2	3	0	0	0	1	0	19	11:00	0	75	73	0	4	0	0	2	3	0	0	0	1	0	20	178	148	10
0	2	0	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11:00																		
0	1	0	12:00	0	63	57	0	3	0	0	2	6	0	0	0	1	0	13	12:00	0	63	57	0	3	0	0	2	6	0	0	0	1	0	13	145	120	12
0	2	0	12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12:00																		
0	1	0	13:00	0	69	51	1	3	0	0	0	0	1	0	0	1	0	14	13:00	0	69	51	1	3	0	0	0	0	1	0	0	1	0	14	140	121	5
0	2	0	13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13:00																		
0	1	0	14:00	0	44	43	0	1	0	1	1	1	0	0	0	0	0	10	14:00	0	44	43	0	1	0	1	1	1	0	0	0	0	0	10	101	87	4
0	2	0	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14:00																		
0	1	0	15:00	0	33	50	3	7	0	0	1	3	0	0	0	2	0	13	15:00	0	33	50	3	7	0	0	1	3	0	0	0	2	0	14	113	86	13
0	2	0	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	15:00																		
0	1	0	16:00	0	54	57	1	2	0	1	5	2	1	0	0	3	0	17	16:00	0	54	57	1	2	0	1	5	2	1	0	0	3	0	18	144	112	14
0	2	0	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	16:00																		
0	1	0	17:00	0	53	99	1	3	0	0	1	2	1	0	1	1	0	21	17:00	0	53	99	1	3	0	0	1	2	1	0	1	1	0	23	185	153	9
0	2	0	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	17:00																		
0	1	0	18:00	1	51	65	0	10	1	0	1	3	1	2	0	2	0	18	18:00	1	51	65	0	10	1	0	1	3	1	2	0	2	0	18	155	117	20
0	2	0	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18:00																		
0	1	0	19:00	0	47	57	0	2	0	0	2	0	0	0	1	1	0	16	19:00	0	47	57	0	2	0	0	2	0	0	0	1	1	0	17	127	104	6
0	2	0	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19:00																		
0	1	0	20:00	0	17	20	0	0	0	0	4	1	1	0	1	0	0	5	20:00	0	17	20	0	0	0	0	4	1	1	0	1	0	0	5	49	37	7
0	2	0	20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20:00																		
0	1	0	21:00	0	10	14	0	0	0	0	1	1	0	1	0	0	0	1	21:00	0	10	14	0	0	0	0	1	1	0	1	0	0	0	1	28	24	3
0	2	0	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21:00																		
0	1	0	22:00	0	7	10	0	2	0	0	0	3	1	0	0	0	0	3	22:00	0	7	10	0	2	0	0	0	3	1	0	0	0	0	3	26	17	6
0	2	0	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22:00																		
0	1	0	23:00	0	6	8	0	0	0	1	1	1	1	0	0	0	0	0	23:00	0	6	8	0	0	0	1	1	1	1	0	0	0	0	0	18	14	4
0	2	0	23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23:00																		
0	1	0	0:00	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0:00	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0
0	2	0	0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0:00																		
0	1	0	1:00	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0	1:00	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0	5	1	4
0	2	0	1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1:00																		
0	1	0	2:00	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	2:00	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	3	0	3
0	2	0	2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2:00																		
0	1	0	3:00	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	3:00	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2	0	2
0	2	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3:00																		
0	1	0	4:00	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	4:00	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	2	1	1
0	2	0	4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4:00																		
0	1	0	5:00	0	1	5	0	0	0	0	1	2	1	0	0	0	0	0	5:00	0	1	5	0	0	0	0	1	2	1	0	0	0	0	0	10	6	4
0	2	0	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5:00																		
0	1	0	6:00	0	8	13	0	1	0	0	1	0	0	0	0	0	0	0	6:00	0	8	13	0	1	0	0	1	0	0	0	0	0	0	0	23	21	2
0	2	0	6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00																		
0	1	0	7:00	0	46	62	0	5	0	0	1	1	0	1	0	1	0	5	7:00	0	46	62	0	5	0	0	1	1	0	1	0	1	0	5	122	108	9
0	2	0	7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7:00																		
0	1	0	8:00	0	168	158	0	11	0	0	3	2	0	2	1	1	0	17	8:00	0	168	158	0	11	0	0	3	2	0	2	1	1	0	17	363	326	20
0	2	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8:00																		
0	1	0	9:00	0	87	91	0	11	0	0	4	2	1	0	2	1	0	13	9:00	0	87	91	0	11	0	0	4	2	1	0	2	1	0	13	212	178	21
0	2	0	9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00																		
0	1	0	10:00	2	76	72	0	7	0	1	3	1	1	1	0	1	0	15	10:00	2	76	72	0	7	0	1	3	1	1	1	0	1	0	15	180	150	15
0	2	0	10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10:00																		
0	1	0	11:00	1	64	64	1	3	0	0	3	4	2	0	1	1	0	13	11:00	1	64	64	1	3	0	0	3	4	2	0	1	1	0	13	157	130	14
0	2	0	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11:00																		
0	1	0	12:00	1	64	64	3	6	0	0	6	2	0	1	1	2	0	17	12:00	1	64	64	3	6	0	0	6	2	0	1	1	2	0	17	167	132	18
0	2	0	12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12:00																		
0	1	0	13:00	0	44	48	1	1	0	1	2	2	2	0	0	1	0	18	13:00	0	44	48	1	1	0	1	2	2	2	0	0	1	0	18	120	93	9
0	2	0	13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13:00																		
0	1	0	14:00	0	48	73	0	2	1	0	3	0	0	0	0	0	0	7	14:00	0	48	73	0	2	1	0	3	0	0	0	0	0	0	7	134	121	6
0	2	0	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14:00																		
0	1	0	15:00	0	39	48	0	5	0	0	1	1	1	0	1	0	0	7	15:00	0	39	48	0	5	0	0	1	1	1	0	1	0	0	7	103	87	9
0	2	0	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15:00																		

Bin				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Day 1				3	1046	982	6	46	2	6	27	37	11	3	10	18	0	169	2366
Day 2				5	893	1033	7	71	2	4	47	33	15	8	10	16	0	197	2341
GRAND TOTAL				8	1939	2015	13	117	4	10	74	70	26	11	20	34	0	366	4707
PERCENTS				0.2%	41.2%	42.8%	0.3%	2.5%	0.1%	0.2%	1.6%	1.5%	0.6%	0.2%	0.4%	0.7%	0.0%	7.8%	100.0%

ADT = 2354 CF = 0.95 AADT = 2246

	Straight	Single Trailer	Multi Trailer	
Day 1 Trucks	54	75	31	160
Day 2 Trucks	77	95	34	206
Total Trucks	131	170	65	366
Average Trucks	66	85	33	

TADT = 183

Start Date 17-Oct-22
End Date 19-Oct-22

Location 0010800MDA-I 7.67

Class Bin Definitions
1 Motorcycles
2 Cars
3 Pickup Trucks
4 Buses
5 2 Axle Single Unit Trucks
6 3 Axle Single Unit Trucks
7 4 or more Axle Single Unit Trucks
8 4 or less Axle Single Trailer Trucks
9 5 Axle Single Trailer Trucks
10 6 or more Axle Single Trailer Trucks
11 5 or less Axle Multi Trailer Trucks
12 6 Axle Multi Trailer Trucks
13 7 or more Axle Multi Trailer Trucks
14 Not used
15 Unclassified vehicles or errors

Truck Types
Straight Classes 5, 6, 7
Single Trailer Classes 8, 9, 10
Multi Trailer Classes 11, 12, 13

Average Hourly Volumes

Hour Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	All Vehicles	Passenger	Trucks
0:00	0	3	2	0	0	0	0	0	1	0	0	0	0	0	0	5	5	1
1:00	0	1	1	0	0	0	0	1	1	0	0	1	1	0	0	4	2	2
2:00	0	1	1	0	0	0	1	1	1	1	0	0	1	0	0	4	1	3
3:00	0	1	0	0	0	0	0	2	1	1	0	0	0	0	1	4	1	3
4:00	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	2	1	1
5:00	0	2	3	0	0	0	0	1	1	1	0	1	0	0	0	8	5	3
6:00	0	9	12	0	1	0	0	1	0	0	0	0	1	0	1	23	21	2
7:00	0	53	55	0	3	0	0	1	1	0	1	1	1	0	3	116	108	6
8:00	0	194	146	0	7	1	0	2	2	0	1	1	1	0	11	365	340	14
9:00	0	91	75	1	8	0	0	3	3	1	0	2	2	0	13	197	167	18
10:00	1	80	76	0	7	1	1	2	2	1	1	1	1	0	14	184	156	14
11:00	1	70	69	1	4	0	0	3	4	1	0	1	1	0	17	168	139	12
12:00	1	64	61	2	5	0	0	4	4	0	1	1	2	0	15	156	126	15
13:00	0	57	50	1	2	0	1	1	1	2	0	0	1	0	16	130	107	7
14:00	0	46	58	0	2	1	1	2	1	0	0	0	0	0	9	118	104	5
15:00	0	36	49	2	6	0	0	1	2	1	0	1	1	0	11	108	87	11
16:00	0	53	61	1	3	0	1	4	4	2	1	0	3	0	19	150	115	16
17:00	1	62	98	1	3	0	1	2	3	1	0	1	2	0	24	197	161	12
18:00	1	56	82	0	7	1	1	3	3	1	2	0	1	0	15	170	138	17
19:00	0	45	64	0	2	0	0	2	1	1	1	1	2	0	13	129	109	8
20:00	0	20	21	0	1	0	0	3	1	1	0	1	0	0	3	50	41	6
21:00	0	14	15	0	0	0	0	1	1	0	1	0	1	0	1	32	29	3
22:00	0	12	8	0	1	0	0	0	2	1	0	0	0	0	2	24	19	3
23:00	0	6	5	0	0	0	1	1	1	1	0	0	0	0	1	16	11	4

10 Oct 17-19 1 1500 101722 1500 101922 60 2 2 100 102201

HIGHWAY 1 - WB OUTERLANE

0010800MDA0767O

2 15

01 02 0001 0002

Lane			Time Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Time Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	Passenger	Trucks
0	1	0	16:00	3	220	136	0	8	3	1	7	31	17	1	0	15	0	1	16:00	3	220	136	0	8	3	1	7	31	17	1	0	15	0	1	443	359	83
0	2	0	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16:00																		
0	1	0	17:00	1	257	127	1	3	3	0	8	44	25	2	1	20	0	7	17:00	1	257	127	1	3	3	0	8	44	25	2	1	20	0	7	499	386	106
0	2	0	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17:00																		
0	1	0	18:00	3	241	125	0	10	5	0	7	29	20	0	0	17	0	7	18:00	3	241	125	0	10	5	0	7	29	20	0	0	17	0	7	464	369	88
0	2	0	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18:00																		
0	1	0	19:00	0	196	95	1	2	4	0	5	21	8	0	0	11	0	4	19:00	0	196	95	1	2	4	0	5	21	8	0	0	11	0	4	347	292	51
0	2	0	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19:00																		
0	1	0	20:00	0	131	64	0	2	2	0	5	26	8	0	0	11	0	4	20:00	0	131	64	0	2	2	0	5	26	8	0	0	11	0	4	253	195	54
0	2	0	20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20:00																		
0	1	0	21:00	0	71	42	0	3	1	0	2	24	10	0	0	16	0	1	21:00	0	71	42	0	3	1	0	2	24	10	0	0	16	0	1	170	113	56
0	2	0	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21:00																		
0	1	0	22:00	0	58	27	0	1	2	0	1	16	9	0	0	11	0	0	22:00	0	58	27	0	1	2	0	1	16	9	0	0	11	0	0	125	85	40
0	2	0	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22:00																		
0	1	0	23:00	0	48	19	0	1	1	0	1	21	7	0	0	9	0	0	23:00	0	48	19	0	1	1	0	1	21	7	0	0	9	0	0	107	67	40
0	2	0	23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23:00																		
0	1	0	0:00	0	19	8	0	0	0	0	1	18	3	0	1	12	0	1	0:00	0	19	8	0	0	0	0	1	18	3	0	1	12	0	1	63	27	35
0	2	0	0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0:00																		
0	1	0	1:00	0	15	9	0	1	0	0	0	7	5	0	2	9	0	1	1:00	0	15	9	0	1	0	0	0	7	5	0	2	9	0	1	49	24	24
0	2	0	1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1:00																		
0	1	0	2:00	0	5	3	0	0	0	0	1	11	1	0	0	10	0	0	2:00	0	5	3	0	0	0	0	1	11	1	0	0	10	0	0	31	8	23
0	2	0	2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2:00																		
0	1	0	3:00	0	4	1	0	0	0	0	2	9	1	0	0	11	0	0	3:00	0	4	1	0	0	0	0	2	9	1	0	0	11	0	0	28	5	23
0	2	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3:00																		
0	1	0	4:00	0	6	5	0	1	0	0	0	12	3	1	1	11	0	0	4:00	0	6	5	0	1	0	0	0	12	3	1	1	11	0	0	40	11	29
0	2	0	4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4:00																		
0	1	0	5:00	0	23	8	0	0	0	0	0	13	4	0	2	9	0	0	5:00	0	23	8	0	0	0	0	0	13	4	0	2	9	0	0	59	31	28
0	2	0	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5:00																		
0	1	0	6:00	0	81	56	0	0	0	0	1	8	3	0	1	10	0	3	6:00	0	81	56	0	0	0	0	1	8	3	0	1	10	0	3	163	137	23
0	2	0	6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00																		
0	1	0	7:00	0	238	121	3	2	1	0	3	15	3	0	0	10	0	6	7:00	0	238	121	3	2	1	0	3	15	3	0	0	10	0	6	402	362	34
0	2	0	7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7:00																		
0	1	0	8:00	0	478	215	1	3	1	0	3	19	10	0	0	12	0	10	8:00	0	478	215	1	3	1	0	3	19	10	0	0	12	0	10	752	694	48
0	2	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8:00																		
0	1	0	9:00	0	346	136	0	5	6	1	6	20	15	0	0	18	0	1	9:00	1	346	136	0	5	6	1	6	20	15	0	0	18	0	1	555	483	71
0	2	0	9:00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00																		
0	1	0	10:00	2	319	117	0	4	5	2	6	16	6	0	0	18	0	6	10:00	2	319	117	0	4	5	2	6	16	6	0	0	18	0	6	501	438	57
0	2	0	10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10:00																		
0	1	0	11:00	0	242	149	0	3	8	2	2	22	6	1	0	21	0	6	11:00	0	242	149	0	3	8	2	2	22	6	1	0	21	0	6	462	391	65
0	2	0	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11:00																		
0	1	0	12:00	1	223	123	0	6	5	1	6	29	11	0	1	21	0	4	12:00	1	223	123	0	6	5	1	7	29	11	0	1	21	0	4	432	347	81
0	2	0	12:00	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	12:00																		
0	1	0	13:00	0	201	115	1	5	2	0	9	21	15	0	0	14	0	5	13:00	0	201	115	1	5	2	0	9	21	15	0	0	14	0	6	389	317	66
0	2	0	13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13:00																		
0	1	0	14:00	2	196	106	0	6	7	4	7	15	18	0	1	13	0	3	14:00	2	196	106	0	6	7	4	7	15	18	0	1	13	0	3	378	304	71
0	2	0	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14:00																		
0	1	0	15:00	0	168	116	0	5	6	0	8	32	13	0	0	17	0	6	15:00	0	168	116	0	5	6	0	8	32	13	0	0	17	0	6	371	284	81
0	2	0	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15:00																		
0	1	0	16:00	1	214	136	0	11	8	2	7	19	16	0	0	18	0	5	16:00	1	214	136	0	11	8	2	7	19	16	0	0	18	0	5	437	351	81
0	2	0	16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16:00																		
0	1	0	17:00	1	255	149	0	11	3	1	3	34	15	0	0	16	0	8	17:00	1	255	149	0	11	3	1	3	34	15	0	0	16	0	8	496	405	83
0	2	0	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17:00																		
0	1	0	18:00	3	238	143	0	9	0	1	8	26	9	0	0	16	0	6	18:00	3	238	143	0	9	0	1	8	26	9	0	0	16	0	6	459	384	69
0	2	0	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18:00																		
0	1	0	19:00	2	213	129	0	5	1	1	4	24	9	0	1	17	0	4	19:00	2	213	129	0	5	1	1	4	24	9	0	1	17	0	4	410	344	62
0	2	0	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19:00																		
0	1	0	20:00	0	130	76	0	2	1	0	4	20	9	0	1	7	0	7	20:00	0	130	76	0	2	1	0	4	20	9	0	1	7	0	7	257	206	44
0	2	0	20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20:00																		
0	1	0	21:00	0	107	35	0	1	2	0	3	22	11	0	0	17	0	0	21:00	0	107	35	0	1	2	0	3	22	11	0	0	17	0	0	198	142	56
0	2	0	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21:00																		
0	1	0	22:00	0	61	23	0	1	0	0	4	10	6	0	0	10	0	1	22:00	0	61	23	0	1	0	0	4	10	6	0	0	10	0	1	116	84	31
0	2	0	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22:00																		
0	1	0	23:00	0	33	23	0	0	1	1	2	11	6	0	0	10	0	1	23:00	0	33	23	0	0	1	1	2	11	6	0	0	10	0	1	88	56	31
0	2	0	23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23:00																		
0	1	0	0:00	0	8	8	0	0	0	0	1	11	2	0	1	8	0	0	0:00	0	8	8	0	0	0	0	1	11	2	0	1	8	0	0	39	16	23
0	2	0	0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0:00																		
0	1	0	1:00	0	8	6	0	0	0	0	1	8	1	0	0	12	0	1	1:00	0	8	6	0	0	0	0	1	8	1	0	0	12	0	1	37	14	22
0	2	0	1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1:00																		
0	1	0	2:00	0	9	5	0	0	0	0	1	8	3	0	0	15	0	0	2:00	0	9	5	0	0	0	0	1	8	3	0	0	15	0	0	41	14	27
0	2	0	2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2:00																		
0	1	0	3:00	0	6	3	0	0	1	0	0	5	0	0	0	15	0	0	3:00	0	6	3	0	0	1	0	0	5	0	0	0	15	0	0	30	9	21
0	2	0	3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3:00																		
0	1	0	4:00	0	11	7	0	1	1	0	3	8	4	0	1	9	0	0	4:00	0	11	7	0	1	1	0	3	8	4	0	1	9	0	0	45	18	27
0	2	0	4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4:00																		
0	1	0	5:00	0	22	11	0	0	0	0	1	20	6	1	0	8	0	2	5:00	0	22	11	0	0	0	0	1	20	6	1	0	8	0	2	71	33	36
0	2	0	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5:00																		
0	1	0	6:00	0	72	51	0	1	1	0	3	45	9	0	1	8	0	4	6:00	0	72	51	0	1	1	0	3	45	9	0	1	8	0	4	195	123	68
0	2	0	6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6:00																		
0	1	0	7:00	0	225	128	0	4	0	0	2	24	7	0	0	6	0	6	7:00	0	225	128	0	4	0	0	2	24	7	0	0	6	0	6	402	353	43
0	2	0	7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7:00																		
0	1	0	8:00	1	500	198	0	3	3	0	0	24	15	1	0	6	0	4	8:00	1	500	198	0	3	3	0	0	24	15	1	0	6	0	4	755	699	52
0	2	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8:00																		
0	1	0	9:00	0	298	165	0	7	1	0	4	28	11	1	0	19	0	6	9:00	0	299	165	0	7	1	0	4	28	11	1	0	19	0	6	541	464	71
0	2	0	9:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	9:00																		
0	1	0	10:00	0	301	138	0	7	2	0	9	26	15	0	1	17	0	3	10:00	0	301	138	0	7	2	0	9	26	15	0	1	17	0	3	519	439	77
0	2	0	10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10:00																		
0	1	0	11:00	1	226	135	1	7	5	1	5	28	16	0	0	8	0	2	11:00	1	226	135	1	7	5	1	5	28	16	0	0	8	0	2	435	363	70
0	2	0	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11:00																		
0	1	0	12:00	0	224	118	0	4	6	0	7	25	15	1	3	19	0	7	12:00	0	224	118	0	4	6	0	7	25	15	1	3	19	0	7	429	342	80
0	2	0	12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12:00																		
0	1	0	13:00	2	213	115	0	9	5	0	10	25	9	0	2	23	0	8	13:00	2	213	115	0	9	5	0	10	25	9	0	2	23	0	9	422	330	83
0	2	0	13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13:00																		
0	1	0	14:00	1	198	132	0	13	10	0	10	24	20	0	3	16	0	3	14:00	1	198	132	0	13	10	0	10	24	20	0	3	16	0	3	430	331	96
0	2	0	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14:00																		
0	1	0	15:00	5	182	88	2	10	4	1	8	35	10	0	1	11	0	7	15:00	5	182	88	2	10	4	1	8	35	10	0	1	11	0	7	364	277	80
0	2	0	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15:00																		

Bin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Day 1	13	3786	1923	7	71	62	11	92	479	221	5	10	326	0	77	7083
Day 2	17	3755	2022	3	106	55	8	100	510	224	4	15	311	0	86	7216
GRAND TOTAL	30	7541	3945	10	177	117	19	192	989	445	9	25	637	0	163	14299
PERCENTS	0.2%	52.7%	27.6%	0.1%	1.2%	0.8%	0.1%	1.3%	6.9%	3.1%	0.1%	0.2%	4.5%	0.0%	1.1%	100.0%

ADT = 7150 CF = 0.95 AADT = 6823

	Straight	Single Trailer	Multi Trailer
Day 1 Trucks	144	792	341
Day 2 Trucks	169	834	330
Total Trucks	313	1626	671
Average Trucks	157	813	336

TADT = 1305

Start Date 17-Oct-22
End Date 19-Oct-22

Location 0010800MDA-O 7.67

Class Bin Definitions
1 Motorcycles
2 Cars
3 Pickup Trucks
4 Buses
5 2 Axle Single Unit Trucks
6 3 Axle Single Unit Trucks
7 4 or more Axle Single Unit Trucks
8 4 or less Axle Single Trailer Trucks
9 5 Axle Single Trailer Trucks
10 6 or more Axle Single Trailer Trucks
11 5 or less Axle Multi Trailer Trucks
12 6 Axle Multi Trailer Trucks
13 7 or more Axle Multi Trailer Trucks
14 Not used
15 Unclassified vehicles or errors

Truck Types
Straight Classes 5, 6, 7
Single Trailer Classes 8, 9, 10
Multi Trailer Classes 11, 12, 13

Average Hourly Volumes

1277	Hour Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	All Vehicles	Passenger	Trucks
1333	0:00	0	14	8	0	0	0	0	1	15	3	0	1	10	0	1	51	22	29
2610	1:00	0	12	8	0	1	0	0	1	8	3	0	1	11	0	1	43	19	23
	2:00	0	7	4	0	0	0	0	1	10	2	0	0	13	0	0	36	11	25
	3:00	0	5	2	0	0	1	0	1	7	1	0	0	13	0	0	29	7	22
	4:00	0	9	6	0	1	1	0	2	10	4	1	1	10	0	0	43	15	28
	5:00	0	23	10	0	0	0	0	1	17	5	1	1	9	0	1	65	32	32
	6:00	0	77	54	0	1	1	0	2	27	6	0	1	9	0	4	179	130	46
	7:00	0	232	125	2	3	1	0	3	20	5	0	0	8	0	6	402	358	39
	8:00	1	489	207	1	3	2	0	2	22	13	1	0	9	0	7	754	697	50
	9:00	1	323	151	0	6	4	1	5	24	13	1	0	19	0	4	548	474	71
	10:00	1	310	128	0	6	4	1	8	21	11	0	1	18	0	5	510	439	67
	11:00	1	234	142	1	5	7	2	4	25	11	1	0	15	0	4	449	377	68
	12:00	1	224	121	0	5	6	1	7	27	13	1	2	20	0	6	431	345	81
	13:00	1	207	115	1	7	4	0	10	23	12	0	1	19	0	8	406	324	75
	14:00	2	197	119	0	10	9	2	9	20	19	0	2	15	0	3	404	318	84
	15:00	3	175	102	1	8	5	1	8	34	12	0	1	14	0	7	368	281	81
	16:00	2	217	136	0	10	6	2	7	25	17	1	0	17	0	3	440	355	82
	17:00	1	256	138	1	7	3	1	6	39	20	1	1	18	0	8	498	396	95
	18:00	3	240	134	0	10	3	1	8	28	15	0	0	17	0	7	462	377	79
	19:00	1	205	112	1	4	3	1	5	23	9	0	1	14	0	4	379	318	57
	20:00	0	131	70	0	2	2	0	5	23	9	0	1	9	0	6	255	201	49
	21:00	0	89	39	0	2	2	0	3	23	11	0	0	17	0	1	184	128	56
	22:00	0	60	25	0	1	1	0	3	13	8	0	0	11	0	1	121	85	36
	23:00	0	41	21	0	1	1	1	2	16	7	0	0	10	0	1	98	62	36

Appendix B – Cross Section

Figure B1: Cross Section Location
Emerald Park, Saskatchewan

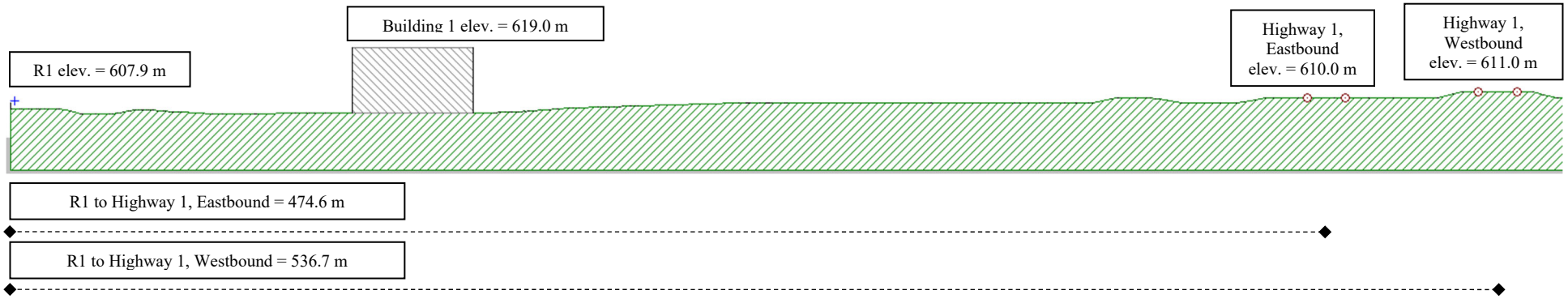

Figure B2: R1 Section View, North to South

Appendix C – Modelling Inputs

Road Segments:

Highway 1 - Eastbound

X (m)	Y (m)	Z (m)	Ground (m)
13542171.5	5588562.8	606.5	606.5
13542184.0	5588562.9	609.0	609.0
13542218.1	5588563.1	610.0	610.0
13542382.8	5588564.0	611.0	611.0
13542829.5	5588566.6	610.0	610.0
13543317.0	5588569.4	612.0	612.0

Highway 1 - Westbound

X (m)	Y (m)	Z (m)	Ground (m)
13542175.7	5588593.8	607.3	607.3
13542182.7	5588593.8	608.9	608.9
13542211.3	5588594.0	610.0	610.0
13542377.0	5588595.1	611.0	611.0
13543308.4	5588601.4	612.0	612.0

Residential Building Coordinates:

Building 1

X (m)	Y (m)	Z (m)	Ground (m)
13542707.6	5588410.6	619.0	607.0
13542804.5	5588412.5	619.0	607.3
13542805.2	5588390.6	619.0	607.3
13542708.2	5588388.6	619.0	607.0

Building 2

X (m)	Y (m)	Z (m)	Ground (m)
13542854.2	5588449.5	620.0	608.0
13542874.6	5588441.4	620.0	608.0
13542840.1	5588350.9	620.0	607.0
13542819.6	5588359.0	620.0	607.0

Building 3

X (m)	Y (m)	Z (m)	Ground (m)
13542918.6	5588440.0	621.0	609.0
13542939.1	5588432.0	621.0	609.0
13542904.5	5588341.4	621.0	606.0
13542884.1	5588349.5	621.0	606.0

Building 4

X (m)	Y (m)	Z (m)	Ground (m)
13542882.6	5588347.2	618.0	606.0
13542900.6	5588334.5	618.0	606.0
13542845.6	5588255.0	618.0	606.0
13542827.6	5588267.7	618.0	606.7

Building 5

X (m)	Y (m)	Z (m)	Ground (m)
13542789.3	5588229.0	619.9	607.9
13542802.5	5588240.9	619.9	607.0
13542848.0	5588188.8	619.9	607.7
13542834.5	5588177.1	619.9	607.0

Building 6

X (m)	Y (m)	Z (m)	Ground (m)
13542752.8	5588370.1	619.8	607.8
13542774.6	5588370.6	619.8	607.5
13542777.6	5588273.3	619.8	607.0
13542755.8	5588272.8	619.8	607.0

Building 7

X (m)	Y (m)	Z (m)	Ground (m)
13542708.6	5588378.2	619.0	607.0
13542730.4	5588378.6	619.0	607.2
13542733.4	5588281.4	619.0	607.0
13542711.6	5588280.9	619.0	607.0

Outdoor Amenity Area – Receptor Coordinates:

R1:

X (m)	13542808.4
Y (m)	5588329.3
Height (m)	1.5
Ground Elev. (m)	607.9

APPENDIX J

Pre-Engineering Report

Greensview Estates Residential Development

Preliminary Engineering Report

Draft Submission

Prepared by:

WCE design inc.
80 Emerald Ridge East
White City, SK, Canada S4L 0C3
306.540.8312

Project Number:

23-010

Date:

June 21, 2023

Statement of Qualifications and Limitations

The attached Report (the “Report”) has been prepared by WCE design inc. (“Consultant”) for the benefit of the client (“Client”) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the “Agreement”).

The information, data, recommendations, and conclusions contained in the Report (collectively, the “Information”):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the “Limitations”)
- represents Consultant’s professional judgement considering the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to the Consultant which has not been independently verified
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made, or issued
- must be read as a whole and sections thereof should not be read out of such context
- was prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental, or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed in writing by Consultant and Client
- as required by law
- for use by governmental reviewing agencies

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This Statement of Qualifications and Limitations is attached to, and forms part of the Report and any use of the Report is subject to the terms hereof.

WCE design inc.
80 Emerald Ridge East
White City, SK. S4L 0C3

tel: 306.540.8312
email: dustin.weiss@wcedesign.ca

June 21, 2023

Clark Gates, P. Eng.
Manager of Engineering and Public Works
RM of Edenwold No. 158
306.347.2974

Dear Mr. Gates:

Project No: **22-073 – Greensview Estates Residential Development**

Regarding: **Preliminary Engineering Report**

WCE Design is pleased to submit this Preliminary Engineering Report for the Greensview Estates residential development located on the SE ¼ 22-17-18-W2M. This proposal establishes the preliminary servicing requirements to develop Blk/Par BB-Plan 102138342 Ext 0 located in Emerald Park in the Rural Municipality of Edenwold.

Should you have any questions, please contact the undersigned at 306.540.8312.

Sincerely,
WCE Design

Dustin Weiss, P. Eng.
Senior Civil Engineer
WCE Design
dustin.weiss@wcedesign.ca

DW:bw
Encl.
cc: Talon Capital Ltd.

Distribution List

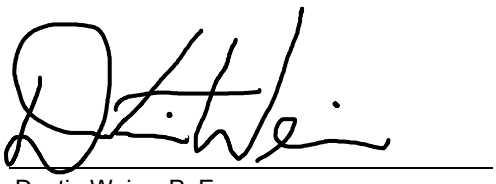
# of Hard Copies	PDF Required	Association / Company Name
0	1	RM of Edenwold
0	1	Talon Capital Ltd

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
0	BW	23-03-03	Issued for Draft Review
0	DW	23-06-21	Issued for Draft Review

WCE Design Signatures

Report Prepared By:



Dustin Weiss, P. Eng.
Civil Engineer
WCE design inc.

Stamp

Executive Summary

WCE Design (WCE) was commissioned by 102035126 SASKATCHEWAN LTD. (the Developer) to complete the Preliminary Engineering Report for the propose Greensview Estates multi-family residential development on Block / Parcel BB, Registered Plan 102138342 in the SE ¼ Section 22-17-18 W2M 10237543 in Emerald Park.

It is the intent of the Developer to develop 7 three storey apartment buildings The proposed development site (Parcel BB) is 5.45 hectares (ha) and is currently undeveloped.

Existing land use north, west and south of the site is comprised of commercial and light industrial businesses. The Aspen Links Golf Course is also located east of the site. The site is currently zoned Future Development (FD).

A previous geotechnical investigation on the site identified groundwater may be present at a depth of approximately one to two metres below existing ground surface. The presence of ground water may impact the installation of services including water and sanitary mains and building foundations. Excavations may require some dewatering to facilitate installation of these services.

Parcel BB is located in an area designated as *Extreme Sensitivity to the Aquifer*. Section 4.38 of the Zoning Bylaw requires the Developer to provide an Aquifer Protection Plan. Recommendations to mitigate any impact to the aquifer from development are included in this report.

Parcel BB is not located in an area designated as environmentally sensitive. A heritage resource screening for the site has been completed. The site has been previously disturbed by cultivation or other development. Therefore, the Heritage Research Branch has no concern with the project proceeding as planned and the potential for the project to impact intact significant heritage sites is low.

The development is located on Treaty 4 Territory, the original lands of the Cree, Ojibwe (OJIB-WĒ), Saulteaux (SO-TO), Dakota, Nakota, Lakota, and on the homeland of the Métis Nation. There are no known First Nation lands within 3.5 kilometres of the site.

Water services for the site will be provided by connecting to the existing 200 mm water main at the north end of McLeod Road. The new water services will consist of 200 PVC water mains. Modeling of the proposed water distribution system has been completed as part of the PER to confirm the system is capable of providing the required flows and pressures including fire flow. The RM has confirmed Emerald Park's existing water distribution system has the capacity to accommodate the additional peak water demands expected from the development.

The required fire flow for the proposed new buildings depends on the floor area, type of construction, occupancy and whether sprinklers are provided. Based on the model, the maximum fire flow the proposed water distribution system can deliver is estimated at 90 L/s. However, the actual available fire flow will depend on the capacity of the RM's existing distribution system and pumps at the water treatment facility.

The wastewater collection system will consist of 200 mm PVC sanitary mains installed at a minimum slope of 0.40%. Wastewater will flow to the existing 200 mm sanitary main on McLeod Road and then south to the existing lift station near the intersection of South Plains Road and Hutchhence Road. The RM has confirmed the existing wastewater system has capacity to accommodate the additional flows from the new development.

The site is relatively flat with drainage trending from northwest to southeast. Runoff from the site flows into an existing pond at the south end of the site. The pond is used for irrigation by the Aspen Links Golf Course and will be retained. The irrigation pond will be utilized as a wet storm detention pond to allow for detention of runoff from the site as well as provide a source for irrigation of the golf course. The proposed temporary detention storage will be sized to detain the 1:100-year, 24 hour rainfall event. Two other ponds on the site will be filled by the proposed site grading.

Outlet from the irrigation pond eventually flows south into Wascana Creek. The pond outlet will be restricted to the pre-development release rate. An orifice plate or inlet control device sized for the pre-development release rate is provided inside the manhole.

Final site grading, pond configuration and pond outlet will be confirmed during detailed design.

Shallow utilities (SaskPower, SaskEnergy, and SaskTel) are located in the immediate vicinity of the development. Services to the site will be coordinated with utility companies during detailed design.

Access to the site will be from McLeod Road to the south of the site. McLeod Road is connected to Percival Drive and provide access to the Great Plains Road to the north and South Plains Road to the south.

The additional traffic volumes expected from the development has been reviewed and is predicted to have minimal impact on existing roadways within the RM.

Internal roadways will remain as part of the development and not be turned over to the RM. These areas are parking lots and general circulation roadways. Parking is to be provided as per section 4.27 of the Zoning Bylaw.

The RM currently maintains pedestrian pathways along the south side of Great Plains Road and the north side of South Plains Road. The proposed development includes pathways, common walkways and pedestrian circulation areas that will connect to the existing RM pedestrian infrastructure.

The developer will be phasing construction of the project. Phase 1 consists of the western buildings (2 buildings) and required road accesses. Subsequent phases consist of the remaining buildings (5 buildings). Each building will be phased for construction under individual building permits and the plan area will be separated into construction phases.

An overall development permit will be submitted to the RM with detailed engineering drawings for the site and services, including a detailed landscape plan.

The area between the proposed development and the existing adjacent commercial district will require a landscape buffer. Landscaping areas will include a passive park area and an active playground. The playground is planned to be open to all residents within the community and will be deigned for all seasons.

Table of Contents

List of Figures

Appendices

1.0 Introduction

This Preliminary Engineering Report (PER) is prepared on behalf of the 102035126 SASKATCHEWAN LTD. (the Developer) in support of an application for development of the Greensview Estates multi-family residential development located in Emerald Park in the Rural Municipality of Edenwold No. 158 (the RM).

The location of the proposed development is shown in Figure 1.1[1]. The development is located in Emerald Park, south of Highway No. 1. It is the intent of the Developer to develop the site into seven three storey apartment buildings.

This PER is prepared in accordance with Sections 3.24 of the Zoning Bylaw and provides a framework for servicing the proposed development.

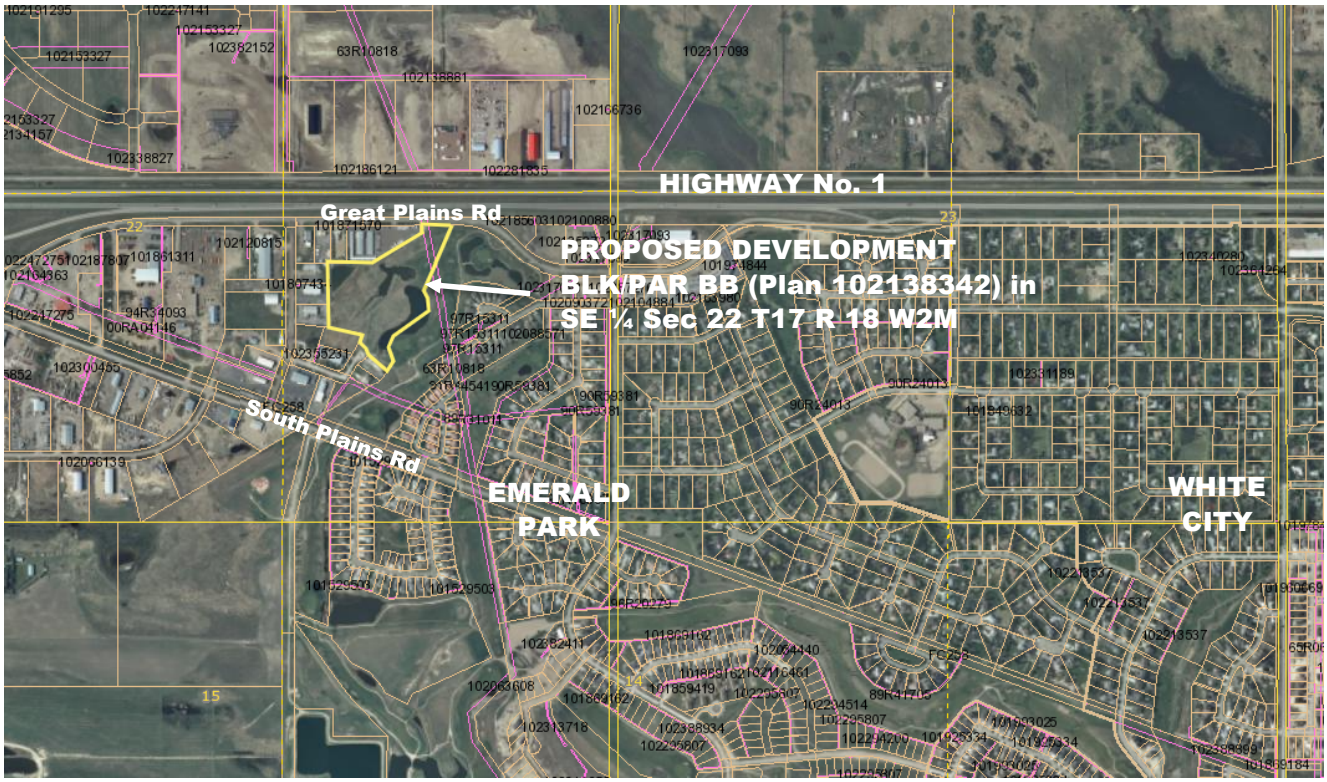


Figure 1.1: Site Location

[1] *Sask Interactive Mapping https://gisappl.saskatchewan.ca/Html5Ext/index.html?viewer=saskinteractive*

2.0 Existing Conditions

2.1 Existing Land Use

The proposed development site is located in the Emerald Park in the RM of Edenwold, in the SE ¼ Section 22-17-18 W2M as shown in Figure 2.1[2]. The site currently undeveloped.

Figure 2.1: Existing Site Plan

The existing land use north, west and south of the site is comprised of commercial and light industrial businesses. The areas east of the site includes the Aspen Links Golf Course and residential developments. The site is currently zoned as Future Development (FD).

2.2 Existing Roadway Network

Existing roadways in the area include:

- Great Plains Road is a service road on the south side of Highway No.1 and runs east-west along the north side of the development.

[2] *Sask Interactive Mapping https://gisappl.saskatchewan.ca/Html5Ext/index.html?viewer=saskinteractive*

- McLeod Road is a two-lane, paved road located at the south limit of the site. McLeod Road connects to Percival Drive which provides access to the Great Plains Road to the north and South Plains Road to the south.

2.3 Existing Municipal Services and Utilities

Existing Municipal Services in the area include:

- An existing 200 mm PVC water main is located at the north end of McLeod Road. The water line is stubbed at the end of the bay.
- An existing 200mm PVC sanitary sewer with manhole is also located at the north end of Mcleod Road.
- There is no minor stormwater system within Emerald Park. The community manages stormwater with overland drainage.

Existing Utilities in the area include:

- SaskPower has a high voltage transmission line 100 to 300 meters east of the site.
- TransGas has a pipeline on the east boundary of the site that runs south to Betteridge Road.

2.4 Existing Topography

The site is relatively flat with drainage trending from northwest to southeast Runoff from the site flows into one of three existing ponds. The southern pond is used by Aspen Links Golf Course for irrigation. The outlet for the pond is located at the south end of the pond. Runoff from the pond eventually flows south through Emerald Park into Wascana Creek.

2.5 Geotechnical

In December 2022, Ground Engineering Consultants Ltd. (GCL) completed a review of the geotechnical conditions of the site based on a previous investigation at the site completed in 2014. The report is included in Appendix A.

The previous geotechnical investigation identified groundwater may be present at a depth of approximately one to two metres below existing ground surface. The presence of ground water may impact the installation of services including water and sanitary mains and building foundations. Excavations may require dewatering to facilitate installation of these services.

2.6 Aquifer Sensitivity

The site is located in an area designated as having *Extreme Sensitivity to the Aquifer*. Section 3.24C of the Zoning requires an *Aquifer Protection Plan* be developed as part of the development to mitigate any potential contamination of the underlying aquifer.

GCL has provided the following recommendations for mitigation of any potential impacts to the aquifer:

- Existing ponds should be pumped out and backfilled with highly plastic clay or clay till obtained from a pre-approved borrow source. Random fill form various sources shall not be permitted. Importing of the fill shall be monitored and the fill shall be placed in lifts which are

compacted. Backfilling the ponds in this manner will limit the potential contamination of the underlying aquifer.

- Building foundations will include driven steel pipe/H beams and auger-cast concrete piles. For lighter loads, screw piles and footings may be an option. Regardless of the foundation type selected, the building foundations will not increase the contaminant risk of the aquifer.

- Installation of the site services (water/sewer) will require excavations which may extend below the water table in some areas. The trenches may be backfilled with the excavated soil which is placed in lifts which are compacted. Backfilling the trenches in this manner will limit the potential contamination of the underlying aquifer.

- Bioswales will be constructed as part of the surface drainage plan. Properly designed and constructed bioswales will limit the potential contamination of the underlying aquifer.

- No fuel shall be stored onsite during and after development.

2.7 Heritage Resources

The site is located in an area designated as *Heritage Sensitive*[3].

Heritage Research Branch, Archaeological Resource Management Unit of the Ministry of Parks, Culture, Heritage, and Sport had been contacted and a Heritage Screening has been completed. The response letter appended in Appendix B.

The site has been previously disturbed by cultivation and various other urban developments. Recent surveys in the region suggest that the majority of archaeological materials may have been removed or extensively disturbed.

Therefore, the Heritage Research Branch has no concern with the project proceeding as planned and the potential for the project to impact intact significant heritage sites is low. The heritage review was conducted for the entire external boundary of the parcel and no additional heritage review would be required for changes to the site layout within the Surface Parcel 20284880 boundary (i.e. including holes 12, 13 and 14 on Aspen Links Golf Course).

2.8 First Nations

The development is located on Treaty 4 Territory, the original lands of the Cree, Ojibwe (OJIB-WĒ), Saulteaux (SO-TO), Dakota, Nakota, Lakota, and on the homeland of the Métis Nation.

There are no First Nation lands located within 3.5 kilometres of Parcel BB.

[3] *RM of Edenwold, OCP Map 6B*

3. Proposed Development

3.1 Site Services

Preliminary plans for the proposed development are included in Appendix C. The proposed concept plan for the new development is shown site services are shown in Figure SK-1. The proposed site services are shown in Figure SK-2.

3.1.1 Water Distribution System

The water distribution system for the proposed development will connect to the existing 200 mm water main at the north end of McLeod Bay. This section outlines the design criteria that will be used during detailed design and summarizes the results of the hydraulic modeling completed for the PER.

3.1.1.1 Design Criteria

The design criteria for the proposed water distribution system are summarized below and is based on Water Security Agency's (WSA's) *EPB 501: Waterworks Design Standard.*

Pressure:

- Normal Operating range: 350 kPa to 480 kPa (50 psi to 70 psi);
- Minimum pressure during peak hour demand: 275 kPa (40 psi);
- Minimum residual pressure during max day demand plus fire flow 140 kPa (20 psi).

Pipe Velocities:

- Maximum 1.5 m/s during Peak Hour Demand;
- Maximum 3.2 m/s during Peak Day Demand plus Fire Flow.

Pipe:

- Minimum 150 diameter water mains, 200mm on dead ends;
- Minimum depth of cover: 2.75m to top of pipe;
- Material: PVC Class 235 (DR 18), CSA B137.3, AWWA C900, ANSI/NSF 61;

Fittings:

- Up to and including 300 mm diameter: Moulded PVC to AWWA C907, ANSI/NSF 61;
- > 300mm diameter: ductile iron to AWWA C110, epoxy coated interior and exterior to AMSI/NSF 61.

Fire hydrants:

- Hydrants to AWWA C502, ANSI/NSF 61, epoxy coated;
- Spacing max 150 m.
- Hose threads to be confirmed by RM.

Valves:

- Resilient seated gate valves to AWWA C509 / C515, ANSI/NSF 61, epoxy coated;
- Spacing max 150 m in commercial/industrial areas, 240 m in residential;
- For HDPE pipe, valves are to be flanged.

Water Service Connections:

- Less than 50 mm diameter Type K copper to AWWA C800, ANSI/NSF 61;
- 50 mm diameter HDPE to AWWA C901, ANSI/NSF 61
- 100 mm and larger HDPE to ASTM F714 and AWWA C906, ANSI'NSF 61, DR 11, PE 4710.

3.1.1.2 Water Demand

The development is proposed to consist of seven, three storey apartment buildings with a total of 408 units.

The estimated water demand for the proposed development at full build out is summarized in Table 3-1. The estimated average day demand (ADD) is based on a water consumption rate of 390 Liters per capita per day.

Table 3-1: Estimated Water Demand

Number of Units	Population Density	Total Population	ADD
408	2.3 persons per unit	938	365,976 L/day (4.24 L/s)

The ADD, Peak Day Demand (PDD) and Peak Hour Demand (PHD) are therefore `estimated as follows based on peaking factors of 2.1 and 3.2 for PDD and PHD, respectively:

- ADD 4.24 L/s
- PDD 8.90 L/s
- PHD 13.55 L/s

3.1.1.3 Fire Flow

Fire fighting services in the area are provided by the RM. The RM also has standard fire protection agreements with Balgonie, White City, Pilot Butte, the Village of Edenwold, Hamlet of Kronau and the City of Regina.

The RM does not currently provide standards for minimum fire flow. There are several methods to determine fire flow based on total floor area, type of construction and occupancy including the Fire Underwriters Survey and the National Fire Protection Agency (MFPA)

The *Fire Underwriters Survey: Water Supply for Public Fire Protection – A Guide to Recommended Practice in Canada* (2020), provides the following method for determining fire flow:

$$F = 220C\sqrt{A}$$

Where:

F = required fire flow in litres per minute (not to be less than 2000 LPM or 33 LPS).

C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.9 for wood frame construction with a minimum of 1-hour fire resistance.
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).
A = total floor area in square metres

For example, fire flow for a three-story multi-family residential building with floor area 1900 m^2 would range from 415 L/s for wood frame construction to 157 L/s for fire resistive construction. If sprinklers are provided, the flow may be reduced by 50%, and residential occupancy has an additional 15% reduction to between 177 L/s and 66 L/s.

Available fire flow will depend on the capacity of the RM's existing distribution system and pumps at the water treatment facility. WCE understands that the RM currently has a pump capable of providing a fire flow of 60 L/s (900 USGPM). The building design will be required to design the sprinkler system to accommodate sprinkler zones to the available water rates.

For reference, the City of Regina requires a minimum fire flow of 90 L/s in residential areas and 150 L/s for multi-family residential buildings.

3.1.1.4 Water Model Results

A model of the proposed water distribution system was developed using *EPANET* (Version 2.2) as shown in Figure 3.1. The model was used to evaluate the performance of the proposed water distribution system for various scenarios. Pressures at the connection point on McLeod Road for the various conditions were provided by the RM as follows:

- Pre- Development PHD Pressure: 450.0 kPa
- PDD at Full Buildout Pressure: 445.9 kPa HGL: 652.57
- PHD at Full Buildout Pressure: 448.9 kPa HGL: 653.99

The following scenarios were evaluated:

- *Scenario 1*: During PHD, pipe velocities should not exceed 1.5 m/s and system pressure should not be less than 275 kPa (40 psi).

  For modeling purposed, all pipes are modeled with 200 mm diameter except building service connections (*) are assumed 100 mm diameter. A Hazen Williams coefficient of 120 was also used.

  The results are summarized in Table 3-2 and Table 3-3. No pressures are below 275 kPa either at ground floor level or on the third floor level during PHD and no velocities exceed 1.5 m/s in any pipes.

- *Scenario 2:* Pipe Velocity during PDD plus Fire Flow should not exceed 3.2 m/s and residual pressure at fire hydrant should not be less than 140 kPa (20 psi).

The fire flow results for selected nodes and pipes are summarized in Table 3-4. Based on the model, the maximum available fire flow that the system can deliver is 90 L/s. The limiting factor that prevents a higher fire flow is the velocity in the pipes supplying the development (i.e. Pipes P3, P4 and P14). Increasing the size of these pipes would allow for a higher fire flow. However, the RM's distribution and pumping system may not be capable of delivering higher fire flows.

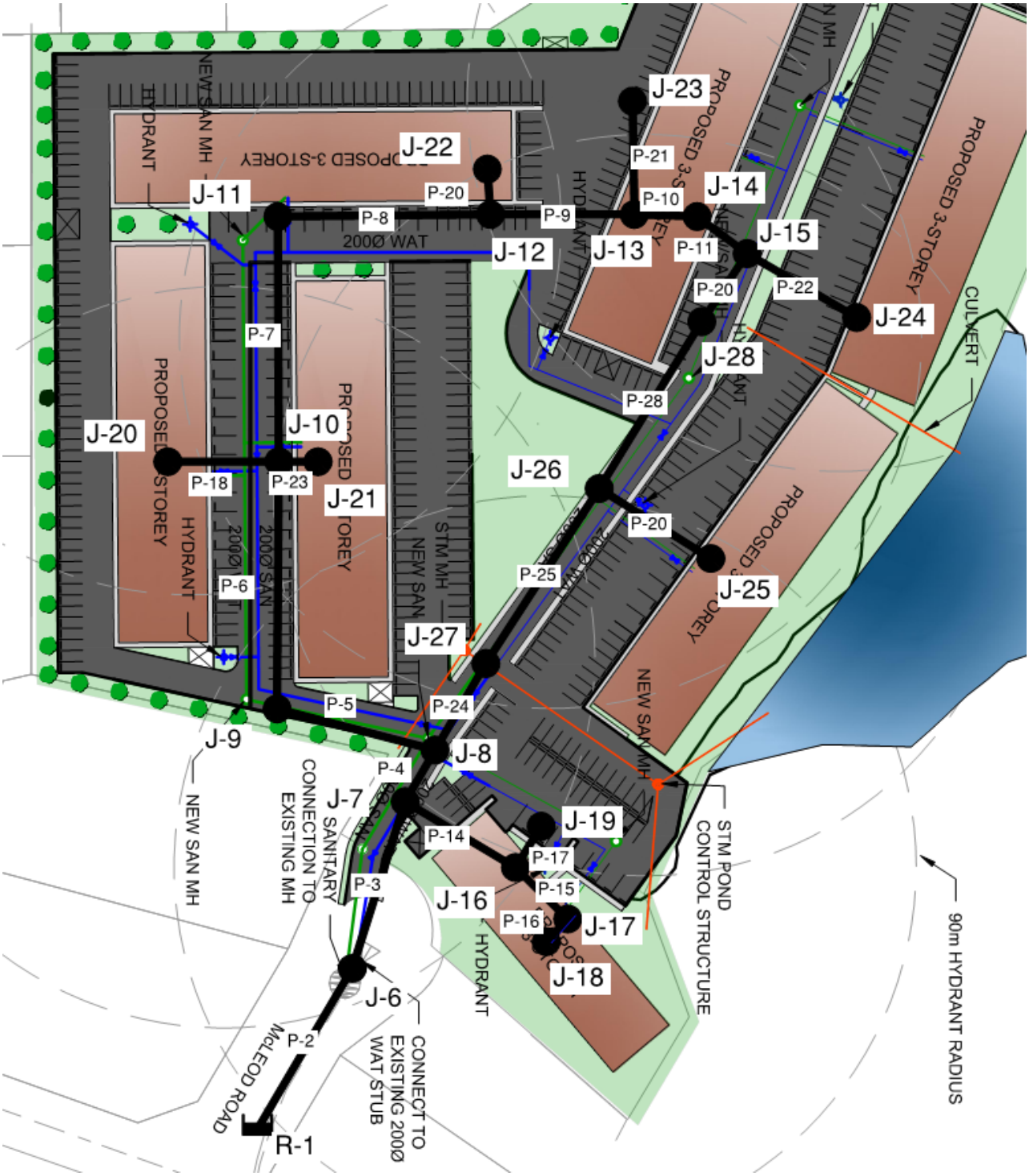


Figure 3.1: Water Model Plan

Table 3-2: PHD Node Pressure

Node	Demand (L/s)	Pressure on Ground Level (kPa)	Pressure on Third Level (kPa)
J-6	0	445.9	-
J-7	0	445.3	-
J-8	0	445.2	-
J-9	0	445.1	-
J-10	0	444.9	-
J-11	0	444.9	-
J-12	0	444.9	-
J-13	0	444.9	-
J-14	0	444.9	-
J-15	0	444.9	-
J-16	0	445.3	-
J-17	0	445.3	-
J-18	0.80	445.3	364.7
J-19	0.80	445.3	364.7
J-20	1.99	444.6	364.0
J-21	1.99	444.8	364.2
J-22	1.99	444.7	364.1
J-23	1.99	444.6	364.0
J-24	1.99	444.5	363.9
J-25	1.99	444.6	364.0
J-26	0	445.0	-
J-27	0	445.1	-
J-28	0	444.9	-

Table 3-3: PHD Pipe Velocities

Pipe	Flow (L/s)	Velocity (m/s)
P-2	13.54	0.19
P-3	13.54	0.43
P-4	11.94	0.38
P-5	5.93	0.19
P-6	5.93	0.19
P-7	1.95	0.06
P-8	1.95	0.06
P-9	-0.04	0.00
P-10	-2.03	0.06
P-11	-2.03	0.06
P-14	1.6	0.05
P-15	0.8	0.03
P-16*	0.8	0.10
P-17*	0.8	0.10
P-18*	1.99	0.25
P-19*	1.99	0.25
P-20*	1.99	0.25
P-21*	1.99	0.25
P-22*	1.99	0.25
P-23*	1.99	0.25
P-24	6.01	0.19
P-25	6.01	0.19
P-26	4.02	0.13
P-27	4.02	0.13

Table 3-4: Fire Flow Summary

Node	Fire Flow (L/s)	Residual Pressure (kPa)	Pipe	Pipe Velocity (m/s)
J-9	90	392.7	P-3, P-4	3.15
J-11	90	378.0	P-3, P-4	3.15
J-13	90	377.2	P-3, P-4	3.15
J-16	90	397.7	P-3, P-4	3.15

3.1.2 Wastewater Collection

The wastewater collection system for the proposed development will be connected to the existing 200 mm sanitary main at the north end of McLeod Bay. This section outlines the design criteria that will be used during detailed design and summarizes the results of the analysis completed for the PER.

3.1.2.1 Design Criteria

The design criteria for the wastewater collection system are summarized below and is based on WSA's *EPB 503: Sewage Works Design Standard.*

- Minimum depth of cover of storm mains: 2.75 m to pipe invert.
- Minimum pipe size: 200 mm.
- Material: PVC SDR 35 to CSA B182.1 and B182.2.
- Minimum pipe slope based on minimum cleansing velocity of 0.6 m/s.
    - For 200 mm mains the minimum slope will be 0.40%.
- Manholes: 1050 diameter pre-cast concrete to ASTM C478 with ductile iron frame and covers.
- Minimum separation from water mains: 2.5 m.

3.1.2.2 Wastewater Generation

The estimated wastewater generation for the proposed development at full build out is summarized in Table 3-4. The estimated dry weather flow (DWF) is based on a wastewater generation rate of 225 Liters per capita per day.

Table 3-2: Estimated Wastewater Generation

Number of Units	Population Density	Total Population	DWF
408	2.3 persons per unit	938	211,140 L/day (2.44 L/s)

EPB 503: Sewage Works Design Standard also suggests an allowance of 0.28 L/s/ha be applied to account for wet weather inflow to manholes and for infiltration into pipes and manholes. An allowance of 0.4 L/s per manhole situated in sag locations.

The estimated DWF and wet weather flow (WWF) are therefore estimated as follows:

- DWF 2.44 L/s
- WWF 5.57 L/s

WWF is based on a total site area of 5.45 ha and assumes 4 manholes are situated in sag locations.

A 200 mm PVC sanitary main installed at a slope of 0.40% would have a capacity of 26 L/s when running 80% full. Therefore, the proposed 200 mm sanitary main has adequate capacity to accommodate the expected WWF from the new development.

During WWF, the 200 mm pipe will flow at a depth of approximately 62 mm or 31% of the pipe diameter. The velocity in the pipe during WWF is estimated to be 0.68 m/s at a pipe slope of 0.40%.

During DWF, the 200 mm pipe will flow at a depth of approximately 41 mm or 21% of the pipe diameter. The velocity in the pipe during DWF is estimated to be 0.54 m/s at a slope of 0.40%. A pipe slope of 0.52% is required to maintain a minimum velocity of 0.60 m/s during DWF.

Wastewater will flow into the existing 200mm sanitary main on McLeod Road and then south to the existing lift station near the intersection of South Plains Road and Hutchhence Road. The RM has confirmed the existing wastewater system has capacity to accommodate the additional flows from the new development.

3.1.3 Storm Water Management

The storm water management system will be designed in accordance with the most current version of WSA's *Stormwater Guidelines (EPB 322)* and other best management practices.

The proposed storm water management system is shown in Figure SK-3 in Appendix C. The existing topography in the area generally slopes from northwest to southeast towards the existing irrigation pond nest to the Aspen Links Golf Course. The existing two northerly ponds will be filled as part of the site grading. Runoff from the site will be directed overland via bio-swales to the existing irrigation pond at the southeast limit of the site.

A storm pond is proposed to be provided to detain a 1:100-year, 24-hour rainfall event. The release rate will be restricted to the pre-development 1:100-year runoff but no shorter than 24 hours after the rainfall event.

Rainfall runoff is based on the *Short Duration Intensity Duration Frequency (IDF)* curves for Regina for the period 1941 to 2017 obtained from *Environment Canada*. Rainfall intensity and rainfall amounts derived from the IDF curves for the 1:100-year, 24-hour duration rainfall event are summarized in Table 3-5.

Table 3-3: Rainfall Data (1:100 Year, 24 Hour Event)

Return Period (Tr)	Rainfall Intensity (mm/hr)	Rainfall Amount (mm)
1:2	1.7	40.1
1:5	2.5	60.0
1:10	3.0	73.1
1:25	3.7	89.7
1:50	4.3	102.0
1:100	4.8	114.2

Based on the site area of 5.45 ha and an assumed post-development runoff coefficient (C) of 0.80, the estimated runoff volume during a 1:100, 24-year rainfall event is estimated as follows:

Runoff Volume = 5.45 ha x 0.80 x 114.2 mm = 4,980 m^3

The release rate for the storm detention pond is typically restricted to the pre-development run-off rate. The pre-development release rate was estimated using the Rational Method as follows:

$$Q = 0.0028\ C\ I\ A$$

Where Q = Peak runoff rate (m^3/s)
C = Runoff coefficient
where C = 0.25 for pre-development conditions and
C = 0.80 for post-development conditions
I = Rainfall Intensity (mm/hr) for the time of concentration (T_c) of the basin.
A = Catchment Area (ha)

The time of concentration was estimated based on the Kirpich formula as follows:

$$Tc = 0.0195\ L^{0.77}\ S^{-0.385}$$

Where L = maximum length of flow (m): estimated at 500 metres
S = Slope of terrain ($^m/_m$): assumed as 0.01 $^m/_m$ or 1.0%

Using a Tc = 14 minutes, the rainfall intensity for the 1:100-year event is approximately 4.8 mm/hr. Assuming a pre-development C = 0.25, the pre-development runoff rate for the 1:100-year rainfall event is estimated at 0.018 m^3/s.

The outlet for the storm detention pond should be also designed to release the volume over a 24-hour period after the 24-hour rainfall event has ended, or at a maximum rate of 4,980 m^3 / 48 hours = 0.030 m^3/s. Since the pre-development release rate is less than the 24-hour release rate, the 1:100-year pre-development release rate (0.018 m^3/s) will be used.

It is assumed the pond will be allowed to release runoff at the pre-development release rate for the duration of the rainfall event. Therefore, the storm detention pond will be sized to deduct the volume released during the 24-hour storm duration as follows:

Runoff Volume during 24-hour rainfall event	4,980 m^3
Less volume released during 24-hour event	1,570 m^3
Volume of temporary detention storage required	3,410 m^3

To maintain a source of water for irrigation of the Aspen Links Golf Course, a wet detention storm pond is proposed. The wet pond concept is shown in Figure 3.2. A wet pond provides for temporary storage above the permanent pool in order to detain the storm water runoff and provide for settling of sediment. The permanent pool can also be used for other purposes such as irrigation.

Pond side slopes are proposed to be 4 horizontals to 1 vertical (4H:1V). A freeboard of between 0.3 m and 0.6 m is also normally provided. The permanent pool typically has a maximum depth of 2.5 m to 3.0 m. The active storage depth would typically be in the range of 1.0 m to 2.0 m.

The proposed pond outlet includes a 450 mm CSP or HDPE pipe with a precast concrete manhole. The pipe would be designed to daylight to natural ground at the south limit of the site (if possible). An orifice plate or inlet control device sized for the release rate of 0.018 m^3/s is provided inside the manhole to control the release of the temporary detention storage. A weir installed inside the manhole is also provided for a high-level overflow.

Final site grading, pond configuration and pond outlet details will be confirmed during detailed design.

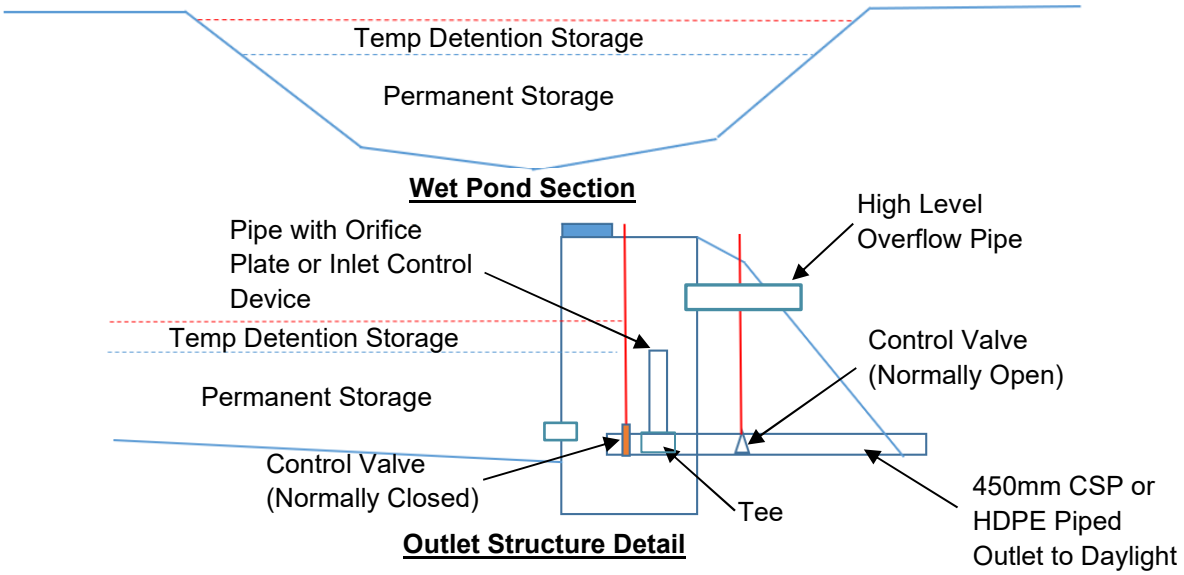


Figure 3.2: Storm Detention Pond Concept

3.2 Traffic Impact Assessment

Access to the site will be from the existing Great Plains Road and South Plains Road by way of Percival Drive and McLeod Road. McLeod Road and Percival Drive are currently a two-lane, paved roadways.

Both the Great Plains Road and South Plains Road are major access roads into and out of the community. The Pilot Butte interchange is accessible from each road and will be the connection point to Highway No. 1 for residents travelling west into Regina. Residents wanting to travel east on Highway No. 1 will either utilize the off ramp at Great Plains Industrial Drive or the off ramp located on Emerald Park Road. Both roads that connect to the Emerald Park Business District would be used for inter-community travel.

The Development will generate an estimated additional 2,562 vehicle trips/day with 256 at the peak hour, both am/pm. The impact on current roadways within the RM due to the additional volume of vehicles is predicted to have minimal impact. The additional traffic has been considered in the area's overall growth projections.

The traffic is estimated to be a 60/40 split, with 60% (1,537 AADT) utilizing South Plains Road and 40% using Great Plains Road to access the development.

Internal roadways will remain as part of the development and not be turned over to the RM. These areas are parking lots and general circulation roadways. Parking is to be provided as per section 4.27 of the Zoning Bylaw.

3.3 Active Transportation Access

The RM currently maintains pedestrian pathways along the south side of Great Plains Road and the north side of South Plains Road.

The proposed development will include pathways, common walkways and pedestrian circulation areas that connect to the existing RM pedestrian infrastructure.

Additional details will be provided with the detailed design drawings.

3.4 Utilities

Shallow utilities (SaskPower, SaskEnergy, and SaskTel) are located in the immediate vicinity of the development. The necessary installation and connection fees will be borne by the individual lot owner.

Utility companies will be contacted to confirm servicing requirements during detailed design.

3.5 Phasing

The developer will be phasing the construction of the project. An overall parcel development permit will be submitted with detailed engineering drawings for the site and services, along with a detailed landscape plan.

Each building will then be phased for construction under individual building permits and the plan area will be separated into construction phases. Phase 1 consists of the western buildings (2 buildings) and required road accesses. Subsequent phases will include the remaining buildings (5 buildings), which has yet to be determined.

APPENDIX A – Geotechnical Review

TITLE: GEOTECHNICAL INVESTIGATION
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN No. 102138342 EXT. 0
EMERALD PARK, SASKATCHEWAN

CLIENT: TALON CAPITAL LTD.

FILE NO: GE-1403 DATE: MARCH 31, 2023

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DRAWINGS

APPENDICES

GROUND ENGINEERING CONSULTANTS LTD.

CIVIL & GEOENVIRONMENTAL ENGINEERS

415 – 7TH AVENUE · REGINA · SASKATCHEWAN · S4N 4P1
Tel: (306) 569-9075 FAX: (306) 565-3677 Email: groundeng@myaccess.ca

FILE: GE-1403 March 31, 2023

Talon Capital Ltd.
c/o Gilchuk Design
PO Box 724
WHITE CITY, Saskatchewan
S4L 5B1

ATTENTION: MR. JASON GILCHUK

Dear Sir:

SUBJECT: GEOTECHNICAL INVESTIGATION
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN No. 102138342 EXT. 0
EMERALD PARK, SASKATCHEWAN

1.0 INTRODUCTION

This report presents the results of a site specific subsurface soils investigation and geotechnical analysis carried out at the above captioned site. It is our understanding that the project includes construction of 6 three-storey, basementless apartment buildings and 2 two-storey townhouses which may have walkout basements. The site was previously developed as part of the existing golf course. Water ponds from the former golf course remain on the property and will be filled in to permit development. Our Company conducted a preliminary geotechnical investigation at the property in 2014. The information obtained during the 2014 investigation is included in this report.

The objectives of this investigation were to provide the following information at the site:

.1 To define the subsurface soil stratigraphy and engineering properties of the foundation soils, including the groundwater regime;

.2 To provide design recommendations for the most suitable and economical type of foundation system to support the proposed buildings;

.3 To provide recommendations with respect to the type of cement to use for concrete in contact with native soils;

.4 To comment on possible excavation and construction problems related to foundation construction with particular reference to groundwater conditions;

.5 To provide recommendations for floor slab design and construction;

.6 To provide recommendations to backfill the existing ponds;

.7 To provide pavement design recommendations for roadways and parking lots;

.8 To provide recommendations on pertinent geotechnical issues identified during the subsurface investigation.

Authorization to proceed with this work was received in your e-mail dated November 23, 2022.

2.0 DESCRIPTION OF THE SITE

The subject property shown in Figure 1 is located at the south side of Great Plains Road, in Emerald Park, Saskatchewan. The legal description of the property is Parcel BB, Plan No. 102138342 Ext. 0. The property was previously developed as a golf course and is currently vacant grassland.

3.0 FIELD AND LABORATORY INVESTIGATION

The subsurface conditions were investigated by drilling 11 test borings at the locations shown on Drawing No. GE-1403-1. The test holes were drilled on February 11, February 12 and March 12, 2014 and March 28, 2023, using truck-mounted diggers equipped with a 150 mm diameter continuous flight auger and a 200 mm diameter hollow stem auger. The test holes were terminated depths ranging from 12.2 to 21.3 metres below existing ground surface. A total of three (3) sandpipe piezometers were installed.

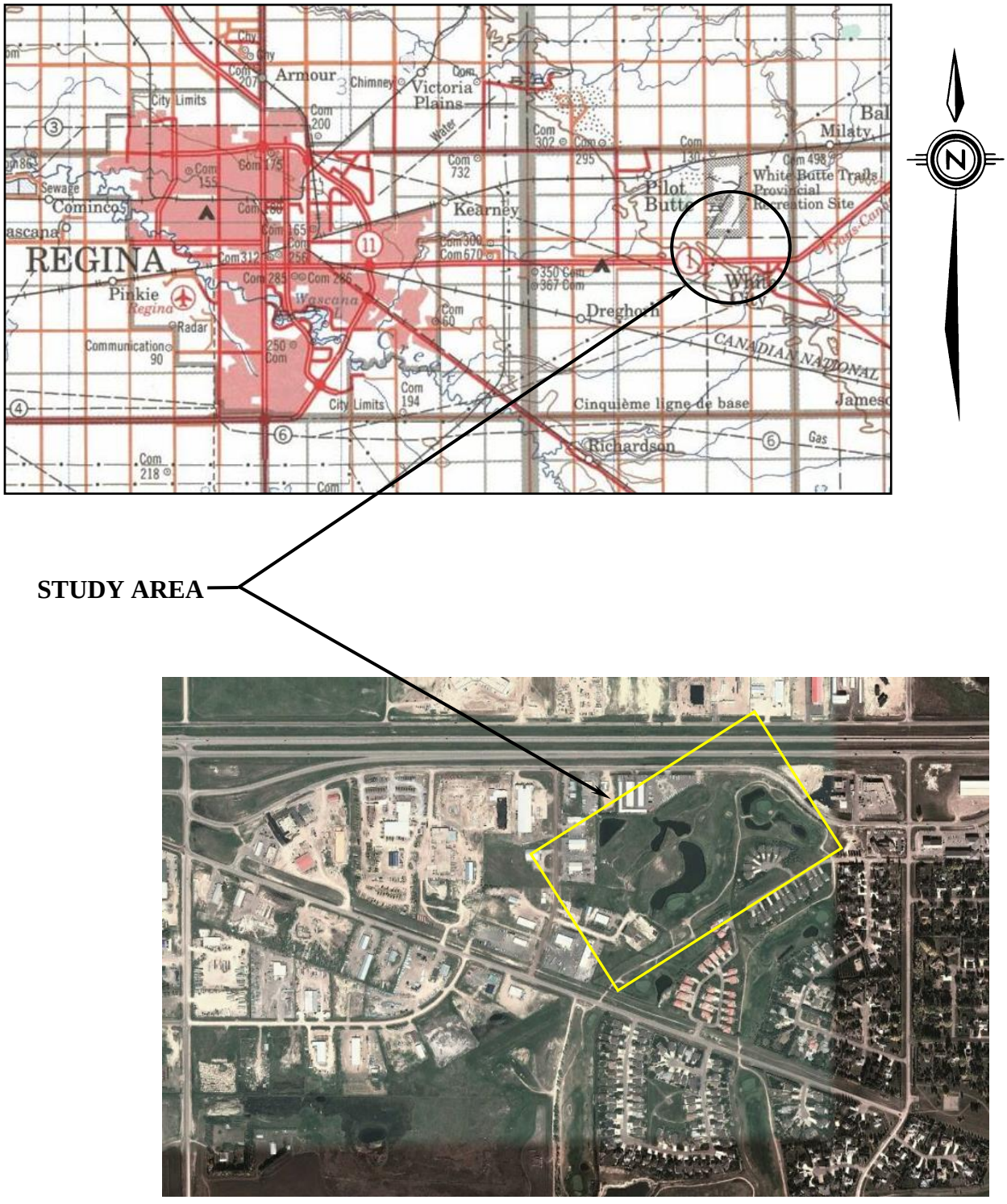

FIGURE 1

LOCATION OF STUDY AREA

Representative disturbed auger samples, split-spoon samples and undisturbed soil samples were recovered from the test borings and taken to our laboratory for analysis. Standard Penetration tests were conducted in select test holes. Each soil sample was visually examined to determine its textural classification and a natural moisture content test was performed on each sample. In addition, Atterberg limits, sulphate content, grain size analysis, unconfined compressive tests were performed on selected representative soil samples. Details of the soil profile, samples taken, laboratory test results, piezometer installations and stratigraphic interpretations of the subsoils are appended to this report on Drawing Nos. GE-1403-5 to -19, inclusive.

The ground surface elevations at the test hole locations were established by representatives of Ground Engineering Consultants Ltd. and are referenced to an assumed datum of 100.00 metres described as the top of the SaskPower transformer base located on McLeod Road as shown on Drawing No. GE-1403-1.

4.0 GEOTECHNICAL ANALYSIS

4.1 Stratigraphy

The drilling information indicates that fill materials have been placed in some areas of the site and extend to depths ranging from 0.5 to 0.9 metres below existing grade. The fill consists predominantly of silty clay with trace quantities of sand, gravel and organics. Fill materials were not encountered in Test Holes 102, 105, 107, 109 and 110, inclusive. In Test Hole 104, the fill materials are underlain by a topsoil layer which extended to a depth of 1.8 metres.

The topsoil and/or surficial fill materials are underlain by a stratified drift unit which extends to a depth of 19.2 metres in Test Hole 110 and to the maximum depth penetrated in the remaining test holes (12.2 metres). The drift unit consists of interbedded layers of clay, silt and sand.

The stratified drift unit is underlain by an unoxidized, glacial till stratigraphic unit which extends to the maximum depth penetrated during the investigation (21.3 metres). The till

material is a heterogeneous mixture of clay, silt, sand and gravel, with occasional cobblestones and boulders.

4.2 Groundwater

The drilling information indicates that there is a shallow water table at this site. Standpipe piezometers were installed in Test Holes 106, 108 and 111 to monitor groundwater levels. Water levels in the piezometers were measured on March 21 and 31, 2023. The data is summarized in Table 1, below.

TABLE 1

PIEZOMETRIC SURFACE MEASUREMENTS

PIEZOMETER NO.	DATE MEASURED	DEPTH OF WELL BELOW GRADE (m)	GROUNDWATER LEVEL FROM TOP OF PIPE (m)	GROUNDWATER LEVEL FROM GROUND SURFACE (m)	GROUNDWATER ELEVATION (ASSUMED)
TH 106	March 21, 2023	5.15	2.44	1.81	98.64
TH 108	March 31, 2023	4.53	2.59	1.59	99.48
TH 111	March 31, 2023	4.74	2.75	1.89	98.92

During periods of heavy rainfall or spring runoff, the water table could be even higher.

5.0 DISCUSSION

5.1 Fill Materials

The surficial fill is moist to very moist with variable amounts of sand and gravel.

5.2 Stratified Drift Unit

The stratified drift unit varies in lithology from clayey, sandy silts to silty clay and silty fine grained sands. These soils are normally consolidated. The clay layers are firm to stiff in consistency with undrained shear strengths ranging from 35 to 80 kPa. The clay layers are highly plastic and have a Plasticity Index ranging from 27 to 46 percent and a Liquid Limit ranging from 48 to 74 percent. The silt and sand layers are loose to medium dense with “N” values ranging from 2 to 15 blows per foot. The silt is dilatent and sensitive to disturbance.

The saturated silts and sands are cohesionless and subject to sloughing. Typical gradations of the sand layers are shown on Drawing Nos. GE-1403-18 to -19, inclusive.

5.3 Till Stratigraphic Unit

The till stratigraphic unit is unoxidized and stiff to hard with undrained shear strengths in the order of 250 kPa. The dry density of the till is in the order of 1.92 tonnes per cubic metre. Standard Penetration "N" values are in the order of 37 blows per foot.

The term till on the borehole logs indicates that the material originates from geological processes associated with glaciation. These processes produce a material that is heterogeneous in composition and, as such, the till may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm) and, therefore, contractors may encounter them during excavation even if they are not evident in the test borings, as is the case at this site. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample descriptions may be applicable to a very limited area; caution is therefore essential when dealing with sensitive excavations in till material.

6.0 FOUNDATION CONSIDERATIONS

Conventional bored concrete piles are not an option at this site due to the shallow water table and sloughing conditions. Spread footings are not considered to be an option due to the highly plastic clay, weak surficial soils and fill materials. We recommend that the proposed structures be supported on driven steel pipe piles or augercast (CFA) bored concrete piles. Helical steel screw piles would be a suitable alternative for the lightly loaded structures. Our specific design recommendations for each type of foundation system are presented as follows:

6.1 Driven Steel Pipe Piles

.1 The structural design of steel pipe piles shall conform to the requirements of Subsection 4.3.4 of the National Building Code of Canada (2015). The steel pipe

piles may be designed as open ended. The piles are to be filled with concrete after driving has been completed.

.2 A minimum embedment length of 7.5 metres is recommended, with a minimum pipe diameter of 273 mm.

.3 The load carrying capacity of a single steel pipe pile is a combination of point resistance and side friction developed between the pile and the surrounding soil. For design purposes, the end bearing component should generally be disregarded. The relationship can be expressed as follows:

$$R = \Phi A_p f$$

Where: R = pile capacity;
Φ = geotechnical resistance factor;
A_p = effective skin friction area;
f = ultimate skin friction

The upper 2.0 metres of pile length or the maximum depth of fill, whichever is greater should discounted insofar as side friction carrying capacity is concerned. The depth of fill within the former ponds must be documented and discounted insofar side friction is concerned. For driven steel piles, an average ultimate skin friction value of 50 kPa may be used for the drift soils at this site. The geotechnical resistance factor that should be applied for Limits State design is 0.4 for piles in compression and 0.3 for piles in tension.

Practical refusal can be calculated in the field on the basis of the pile capacity, pile specifications, pile penetration and the driving energy. Dynamic pile driving formulas should generally not be used for pile design, however, driving beyond the refusal criteria may cause structural damage to the piles which should not be permitted. Practical refusal for steel piles should be defined as a pile penetration of 50 mm for the last 10 blows of a hammer operating at a specified energy (depending on pile size). Typical pile cross sections and recommended energy to achieve

practical refusal are provided in Table 2. Piles driven to refusal should be re-driven after 24 hours to ensure proper set.

TABLE 2
SPECIFIED DRIVING ENERGY FOR
STEEL PIPE PILES DRIVEN TO REFUSAL

PILE DIAMETER*	DRIVING ENERGY (kJ)
273	45
325	52
355	59
406	65
508	85
559	90
610	100

*Section thickness as required for structural integrity and corrosion protection (not less than 11.0 mm).

.5 The materials to be used for steel piles must conform to the requirements of the National Building Code of Canada (2015) and ASTM A252 – Standard Specifications for Welded and Seamless Steel Pipe Piles. Grade 3 steel with a minimum yield strength of 310 MPa is recommended.

.6 Experience indicates that corrosion is not a practical problem for steel piles driven into natural soil. However, in fill at/or above the groundwater table, moderate corrosion may occur. Where these conditions exist, steps should be taken to protect the piles. Among these are the application of coatings such as coal tar epoxy before driving, encasement by cast-in-place concrete jackets, Cathodic protection, inclusion of copper content in the steel, or combinations of these including increasing the wall thickness to provide a margin for corrosion, see National Bureau of Standard Monograph 127 (1972).

.7 The pile driving procedures should be inspected by competent geotechnical personnel and driving records documented for each pile.

.8 A minimum centre to centre spacing of 2.5 times the pile diameter should be maintained between piles.

.9 Additional technical information on structural design and installation of steel pipe piles is included in Appendix A.

6.2 Augercast Bored Concrete Piles

.1 The proposed structures may be supported by augercast (CFA) straight shaft piles designed to develop load carrying capacity on the basis of side friction only. For augercast (CFA) piles, an average ultimate skin friction value of 55 kPa may be used for the drift soils at this site. The geotechnical resistance factor that should be applied for Limits State design is 0.4 for piles in compression and 0.3 for piles in tension.

.2 The upper 2.0 metres of pile length or the maximum depth of fill, whichever is greater, should be discounted insofar as side friction carrying capacity is concerned. The depth of fill within the former ponds must be documented and discounted insofar side friction is concerned. It is recommended that the minimum pile shaft diameter be 400 mm. A minimum pile length of 7.5 metres is also recommended.

.3 The minimum centre to centre pile spacing for CFA piles should be (0.02D + 2.5b) where D is the average depth of the piles and b is the pile diameter.

.4 Pile shafts carrying little or no bending moment should be reinforced with nominal vertical reinforcement in the form of intermediate grade deformed bars, composing about one-half (½) of one (1) percent of the cross-sectional area. The steel reinforcing cage should be projected or dowels set into the top of the caisson to tie into the foundation walls and/or columns.

.5 A minimum of 75 mm of rigid insulation should be placed on the inside of all perimeter grade beams to reduce the heat losses and to prevent drying of the soils.

6.3 Helical Steel Screw Piles

Relatively light loads may be supported on helical steel screw piles. The approximate ultimate vertical capacity Q_u, for a single helix pile installed in cohesionless (sandy) soils may be determined by the following equation:

$$Q_u = (\gamma' H N_q) \frac{\pi (D^2 - d^2)}{4}$$

Where: N_q = bearing capacity factor

$N_q = e^{\pi \, Tan\Phi} [Tan(45 + \Phi/2)]^2$

Φ = the soil angle of internal friction (degrees)

For Drift Soils, $\Phi = 24^o$

H = height of soil above the helix plate

D = diameter of the helix

d = diameter of the shaft

γ' = effective soil unit weight for the saturated silt and sand soils = 8.5 kN/m^3

In the case of a screw pile with multiple helixes, the ultimate vertical compressive load capacity may be determined by:

$$Q_u = \sum_{I=1}^{n} R_{ui} \, Q_{ui}$$

Where: i = helix number, numbered 1 to n, increasing downward

Q_{ui} = ultimate capacity of helix plate "i", from the above equation using the applicable helix diameter and embedment depth.

R_{ui} = interaction factor given in Table 3, to account for the effect of helix spacing.

TABLE 3

INTERACTION FACTOR FOR MULTIPLE HELIX SCREW PILES

Ratio (S/D) of Average Helix Spacings (S) to Average Helix Diameter (D)	Interaction Factor R_u
1	0.3
2	0.5
2.5	0.65
3	0.75
3.5	0.85
4	0.95
5	1.0
Note: For cohesive soils: R_{u1} and R_{un} = 1, for both tension and compressive loads.	

The ultimate capacity calculated using the above recommendations shall be multiplied by the following geotechnical resistance factors (Φ) for Limit States Design purposes: 0.4 for piles in compression; 0.3 for piles in tension, and 1.0 for adfreezing. Assume an adfreeze depth of 2.0 metres.

With a center-to-center spacing of 3 helix diameters or more, the group capacity may be taken as the sum of the capacities of individual piles. At pile spacing between 2 and 3 helix diameters, the sum of the vertical capacities of a group should be reduced by 20 percent. The center-to-center pile spacing should not be less than 2 helix diameters.

A minimum embedment depth of 7.5 metres below grade or 5 times the helix diameter plus 1.5 metres, whichever is greater, is recommended.

Torque measurements are commonly used to predict the vertical capacities of helical piles. However, torque correlations with vertical capacities are unreliable and show significant deviations between the predicted and actual capacities from load tests. The use of torque measurements as a design tool is not acceptable. **Due to the empirical nature of screw pile**

design, load tests are recommended to confirm the screw pile capacities prior to construction.

7.0 EXCAVATION CONSIDERATIONS

Building and trench excavations will be in the surficial fill and stratified drift soils. Conventional excavation procedures should therefore be applicable to the soils at this site. The sand and silt strata are generally saturated and trench instability should be anticipated when excavating in any soils below the water table. Excavations shall comply with minimum requirements of Occupational Health and Safety Regulations.

Occupational Health and Safety Regulations require that any trench or excavation in which people must work must be cut back according to the soil "type" or a temporary shoring system must be used to support the sides of the excavation. The saturated sand and silt below the water table would be classified as a "Type 4 Soils". In the case of a "Type 4 Soil", the walls of excavations which penetrate into the saturated sand and silt layers can be sloped to from the bottom of the excavation at an angle not steeper than three (3) horizontal to one (1) vertical, or 19^{o} measured from the horizontal. If significant vibrations and/or other dynamic loading are near open cuts, shoring or other safety precautions may be required.

Stockpiles and/or surcharge loads should not be placed on the edge of the excavations.

Shoring systems shall protect the worker and prevent instability. All shoring systems shall be designed by a qualified professional engineer.

It is anticipated that in some areas the excavations will extend below the water table, therefore, dewatering will be required during construction. Water may be removed from excavations through the use of sumps. The following points are recommended for dewatering of deep excavations:

.1 The dewatering method must insure the stability of the sides and bottom of the excavation. Extra width of excavation to accommodate ditches and/or sumps may be required;

.2 The lowered water table must be kept under full control to avoid fluctuations which may cause instability in the excavation;

.3 Adequate pumping capacity as well as standby pumping and power capacity should be provided;

.4 Pumped water should be discharged in a manner that will not interfere with the excavation or deposit deleterious materials in waterways;

.5 Loss of ground from around the sump should be prevented;

.6 Observation and maintenance of the excavation should be carried out on a regular basis.

Should changed soil and/or groundwater conditions be encountered as the excavation proceeds, they should be reported immediately to our office in order that we can review our recommendations. Side slopes of deep excavations should be monitored on a daily basis to detect any signs of potential stability problems.

8.0 FLOOR SLAB CONSIDERATIONS

Due to the fill materials, weak surficial soils and highly plastic clay we recommend the buildings have structurally supported floors. The following recommendations are provided for structural floor systems.

8.1 Structurally Supported Floor Systems

We recommend the following items of work for construction of the structural slab.

.1 A minimum 150 mm cardboard void form should be placed beneath the floor slab.

.2 The void form should be covered with a minimum 6 mil polyethylene vapour barrier to deter moisture migration through the floor.

.3 The backfill against the perimeter grade beams should consist of the native soils. The soil should be placed in thin lifts (200 mm) and compacted to 95 percent

Standard Proctor density to minimize infiltration of surface water into the void space beneath the floor.

For buildings designed with deeper crawl spaces, the following recommendations are provided:

.1 The crawl space should be covered with a Permalon X-150 type vapour barrier reduce the humidity in the crawl space and prevent drying of the subgrade soils.

.2 The ground surface in the crawl space should be graded to slope no steeper than 3:1 (horizontal to vertical) towards a positive outlet in order to drain any water that may enter the crawl space area.

.3 Provisions should be made to ventilate the crawl space area to prevent humidity build-up and mold growth.

9.0 FROST HEAVING

In fine-grained soils such as silts and clays, moisture is continuously drawn to the freezing plane where it forms ice lenses. These lenses physically lift the soil above them, thus causing heave at ground surface. The frost heaving risk at this site is high due to the fine-grained soils and shallow groundwater table. The maximum anticipated depth of frost penetration at this site is in the order of 1.8 to 2.2 metres depending on the depth of snow cover.

To minimize frost heaving problems, any paved areas should be sloped to suitably located catch basins or ditches. Regular maintenance of the pavement structure (crack sealing) is critical for satisfactory long-term performance. Rigid insulation is recommended beneath exterior grade supported concrete slabs to minimize the depth of frost penetration and prevent frost heaving adjacent to the buildings.

10.0 PAVEMENT STRUCTURE

It is understood that parking and roadway areas will be surfaced with an asphaltic concrete pavement structure. Our recommendations are provided as follows;

.1 The pavement around the buildings should be designed to slope in order to provide adequate drainage of water away from the perimeter of the building and from the surface of paved areas. The need for adequate drainage cannot be overstressed. To ensure fast runoff, the surface of the pavement should have a slope of at least two (2) percent, either to the outer perimeter of the paved areas, or to suitable located catch basins leading to underground drains. The contour of the finished pavement at all points should prevent water from standing on the surface, and surface water should not be permitted to seep back under the outer edges of the pavement. Subsurface drains should be installed in locations where subsurface water may accumulate within the pavement structure or where its necessary to intercept water that would tend to make its way into the pavement structure.

.2 Pavement structure thicknesses for heavy truck loading and light duty parking areas are as noted in Table 4.

TABLE 4

RECOMMENDED PAVEMENT STRUCTURES

	ASPHALT CONCRETE SURFACE COURSE (mm)	**TYPE 33 BASE COURSE THICKNESS (mm)**	**TYPE 8 SUBBASE THICKNESS (mm)**	**NON-WOVEN GEOTEXTILE (mm)**
Heavy Structure	100	150	350	Geotex 1201
Light Structure	50	150	150	-

.3 The subgrade in the parking and roadway areas should be compacted to a minimum of 95% Standard Proctor density with a heavy sheepsfoot or vibratory padfoot type compactor and any soft or spongy areas should be replaced with granular material before placing the base or subbase. In the roadway areas, a non-woven geotextile (Geotex 1201 or equivalent) is recommended on top of the finished subgrade and in any other wet, soft areas encountered during construction.

.4 The subbase course should be a well graded pit run sand (Type 8) compacted to a minimum of 98% Standard Proctor density. The base course (Type 33) should be a crushed, well graded granular material compacted to 100% Standard Proctor density.

Suggested specifications for asphaltic concrete and base course materials are included in Appendix B.

11.0 BACKFILLING OF EXISTING PONDS

The existing water ponds should be pumped out and backfilled with highly plastic clay or clay till. Ensure all saturated and organic soil is removed from the ponds prior to backfilling. The fill shall be placed in lifts no thicker than 200mm and compacted to 100% Standard Proctor density.

12.0 OTHER

.1 Adequate drainage away from the buildings should be provided and maintained to minimize infiltration of water into the subgrade. This is critical to minimize the potential for frost heaving around the perimeter of the buildings.

.2 Test results on selected samples indicate that the soluble sulphate contents in the soil range from 0.10 to 0.15 percent by dry soil weight. Exposure Class S-3 is considered appropriate for design of concrete in contact with the native soil, as specified in CSA Standard CAN3-A23.1. Minimum requirements for Exposure Class S-3 are as follows:

i) Cement Type: MS, MSb, LH, HS or HSb
ii) Maximum water to cementing materials ratio: 0.50
iii) Air Content: as per CSA CAN-A23.1-09 Tables 2 and 4
iv) Minimum specified Compressive Strength: 30 MPa at 56 days

.3 In the event that changes are made in the design, location or nature of the project, the conclusions and recommendations included in this report would not be deemed valid unless the changes in the project were reviewed by our firm. Modification to this report would then be made if necessary. Furthermore, it is recommended that this firm be allowed an opportunity for a general review of the final design plans and specifications in order to ensure that the recommendations made in this report are properly interpreted and implemented. If this firm is not allowed the opportunity for this review, we assume no responsibility for the misinterpretation of any of the recommendations.

.4 It is recommended that Ground Engineering Consultants Ltd. be retained to provide inspection services during construction of the foundations for this project. This is to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event that the subsurface conditions differ from what was anticipated.

.5 This report has been prepared for Talon Capital Ltd. and is intended for the specific application to the design and construction of the Proposed Greensview Residential Development to be constructed at Parcel BB, Plan No. 102138342 Ext. 0 in Emerald Park, Saskatchewan. The analysis and recommendations are based in part on the data obtained from the test hole logs. The boundaries between soil strata have been established at the bore hole locations. Between the bore holes, the boundaries are assumed from geological evidence and may be subject to considerable error. Contractors bidding on the project works are particularly advised against reviewing the report without realizing the limitations of the subsurface information.

.6 It is recommended that the geotechnical workscope include the following services in addition to subsurface exploration and development of foundation design recommendations. These two services are:

i) geotechnical review of other design professionals' plans relative to their interpretation of geotechnical findings and recommendations, and

ii) construction monitoring to observe construction activities in light of plans and specifications, and to help assure that unforeseen conditions are detected quickly to permit prompt corrective action and thus prevent minor problems from growing to major proportion.

.7 The samples from this site will be retained in our laboratory for 90 days following the date of this report. Should no instructions be received to the contrary, these samples will then be discarded.

13.0 CLOSURE

We trust that this report is satisfactory for your purposes. If you have any questions or require additional information, please contact our office.

Yours very truly
Ground Engineering Consultants Ltd.

PROFESSIONAL ENGINEER
S.J. HARTY
MEMBER 6951
23033
YR. MN. DAY
SASKATCHEWAN

Steve Harty, P. Eng.

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Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
Ground Engineering Consultants Ltd.
Number C0008
Permission to Consult held by:
Discipline Sk. Reg. No. Signature
GEOTECHNICAL

GROUND ENGINEERING CONSULTANTS LTD.

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This study and report have been prepared in accordance with generally accepted geotechnical and environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. BASIS OF REPORT

This report has been prepared for the specific site, development, design objectives and purpose that were described to Ground Engineering Consultants Ltd. (**GEC**) by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alternation or variation from any of the said descriptions provided to **GEC**, unless **GEC** is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

3. USE OF THE REPORT

The information and opinions expressed in this document are for the sole benefit of the Client. No other party may use or rely upon the report or any portion thereof without **GEC**'s expressed written consent. **GEC** will consent to any reasonable request by the Client to approve the use of this report by other parties as approved users. The contents of the report remain the copyright property of **GEC**, who authorizes only the Client and "Approved Users" to make copies of the report only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make available this document or the report or any portion thereof, or any copy of the report or portion thereof, to any party without the expressed written permission of **GEC**.

4. COMPLETE REPORT

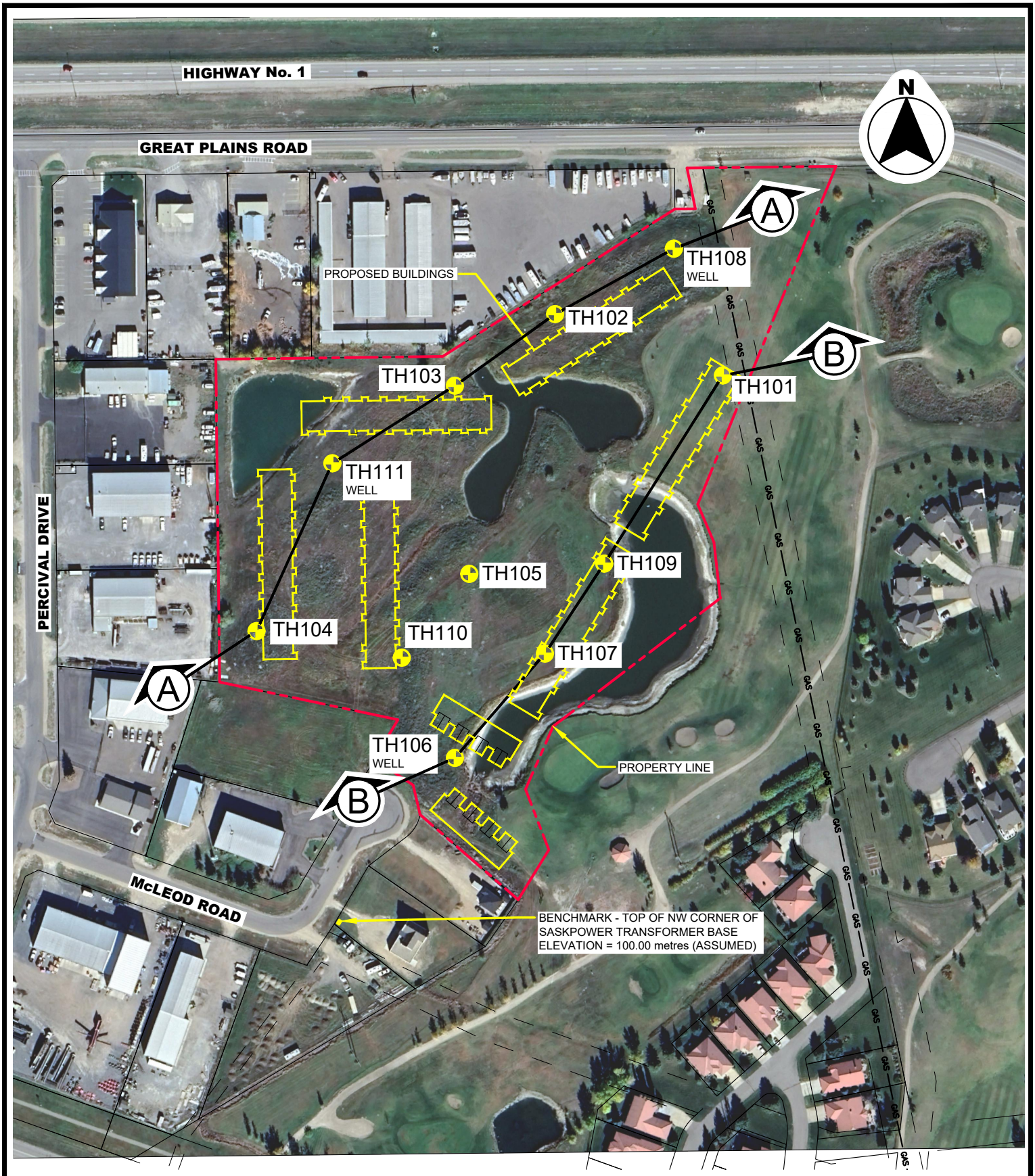
The report is of a summary nature and is not intended to stand alone without reference to the instructions given to **GEC** by the Client, communications between **GEC** and the client, and to any other reports, writings or documents prepared by **GEC** for the Client relative to the specific site described herein, all of which constitute the report. Wherever the word "report" is used herein, it shall refer to any and all of the documents referred to herein

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. **GEC** CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OR PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

5. INTERPRETATION OF THE REPORT

Nature and Exactness of Soil and Contaminant Description. Classification and identification of soils, rocks, geological units, contaminant materials and contaminant quantities have been based on commonly accepted geotechnical and environmental consulting practices in this area. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs implemented with appropriate equipment by experienced personnel, may fail to locate some hidden conditions. All reasonable problems will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such reports should be aware of and accept this risk. Some conditions are subject to change over time and those making use of the report should be aware of this possibility and understand that the report only presents the conditions at the sampled points at the time of sampling.

DRAWINGS



2021 AIR PHOTO

SCALE: 1:2500

GROUND ENGINEERING CONSULTANTS LTD.

CIVIL & GEOENVIRONMENTAL ENGINEERS
415 - 7th AVENUE
REGINA, SASKATCHEWAN, CANADA

SITE PLAN SHOWING LOCATION OF TEST HOLES
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN 102138342, Ext 0
EMERALD PARK, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
TALON CAPITAL LTD.	S. HARTY	MARCH 30, 2023	GE-1403-1

Z:\ PROJECT DIRECTORY \ ENG-FILES \ 2014 FILES \ 1403 GI WALKER ASPEN VILLAGE \ 2022 FILE \ DRAWINGS \ 1403 SITE_GREENSVIEW_TALON CAPITAL.DWG

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

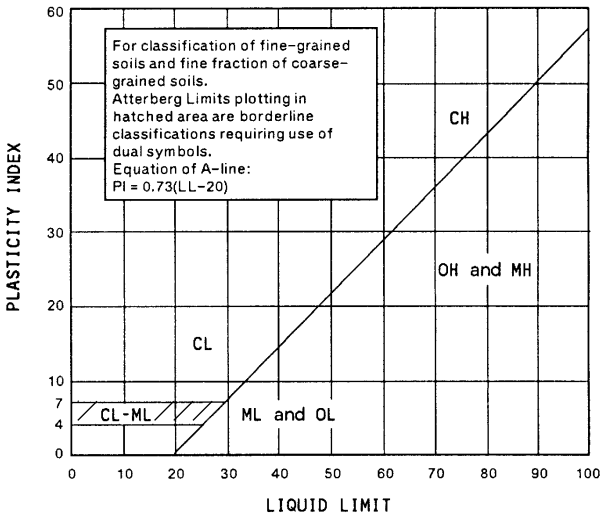
ASTM Designation: D 2487 - 69 AND D 2488 - 69

(Unified Soil Classification System)

Major Divisions			Group Symbols	Typical Names	Classification Criteria
Coarse-grained soils More than 50% retained on No. 200 sieve *	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line with P.I. greater than 7 — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW
		Sands with fines	SM	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line with P.I. greater than 7 — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	
Fine-grained soils 50% or more passes No. 200 sieve *	Silts and clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity	
	Highly organic soils		Pt	Peat, muck and other highly organic soils	

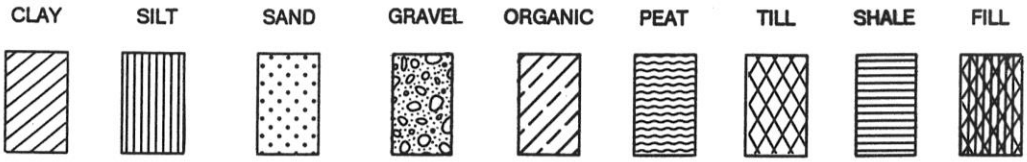
Classification on basis of percentage of fines
Less than 5% pass No. 200 sieve ..... GW, GP, SW, SP
More than 12% pass No. 200 sieve ..... GM, GC, SM, SC
5 to 12% pass No. 200 sieve ..... Borderline classifications requiring use of dual symbols

PLASTICITY CHART



*Based on the material passing the 75mm (3in) sieve.

SYMBOLS AND TERMS USED IN THE REPORT



The symbols may be combined to denote various soil combinations, the predominate soil being heavier.

RELATIVE PROPORTIONS

TERM	RANGE
Trace	0 – 5%
A Little	5 – 15%
Some	15 – 30%
With	30 – 50%

ASTM CLASSIFICATION BY PARTICLE SIZE

Boulder		> 300 mm
Cobble		300 mm – 75 mm
Gravel		75 mm – 4.75 mm
Sand		
	coarse	4.75 mm – 2 mm
	medium	2 mm – 425 um
	fine	425 um – 75 um
Silt		75 um – 5 um
Clay		< 5 um

DENSITY OF SANDS AND GRAVELS

DESCRIPTIVE TERM	RELATIVE DENSITY [1]	N VALUE STANDARD PENETRATION TEST [2]
Very loose	0 – 15%	0 – 4 Blows per 300mm
Loose	15 – 35%	4 – 10 Blows per 300mm
Medium Dense	35 – 65%	10 – 30 Blows per 300mm
Dense	65 – 85%	30 – 50 Blows per 300mm
Very Dense	85 – 100%	> 50 Blows per 300mm

CONSISTENCY OF CLAYS AND SILTS

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa) (CFEM, 2nd Edt., 1985)	N VALUE STANDARD PENETRATION TEST [2]	FIELD IDENTIFICATION (ASTM D 2488–84)
Very Soft	<12	< 2 Blows per 300mm	Thumb will penetrate soil more than 25 mm
Soft	12 – 25	2 – 4 Blows per 300mm	Thumb will penetrate soil about 25 mm
Firm	25 – 50	4 – 8 Blows per 300mm	Thumb will indent soil about 6 mm
Stiff	50 – 100	8 – 15 Blows per 300mm	Thumb will indent, but only with great effort (CFEM)
Very Stiff	100 – 200	15 – 30 Blows per 300mm	Readily indented by thumbnail (CFEM)
Hard	>200	> 30 Blows per 300mm	Thumb will not indent soil but readily indented with thumbnail

NOTES: 1. Relative Density determined by standard laboratory tests.
2. N Value – Blows/300mm of a 620N hammer falling 762mm on a 50mm O.D. Split Spoon.

SYMBOLS AND TERMS USED IN THE REPORT (continued)

GROUNDWATER

▼ Water level measured in the borings at the time and under the conditions indicated. In sand, the indicated levels can be considered reliable groundwater levels. In clay soil, it is not possible to determine the groundwater level within the normal scope of a test boring investigation, except where lenses or layers of more pervious waterbearing soil are present and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed texture soils may not indicate the true level of the groundwater table. The available water level information is given at the bottom of the log sheet.

▽ Water level determined by piezometer installation – In all soils the levels can be considered reliable groundwater levels.

DESCRIPTIVE SOIL TERMS

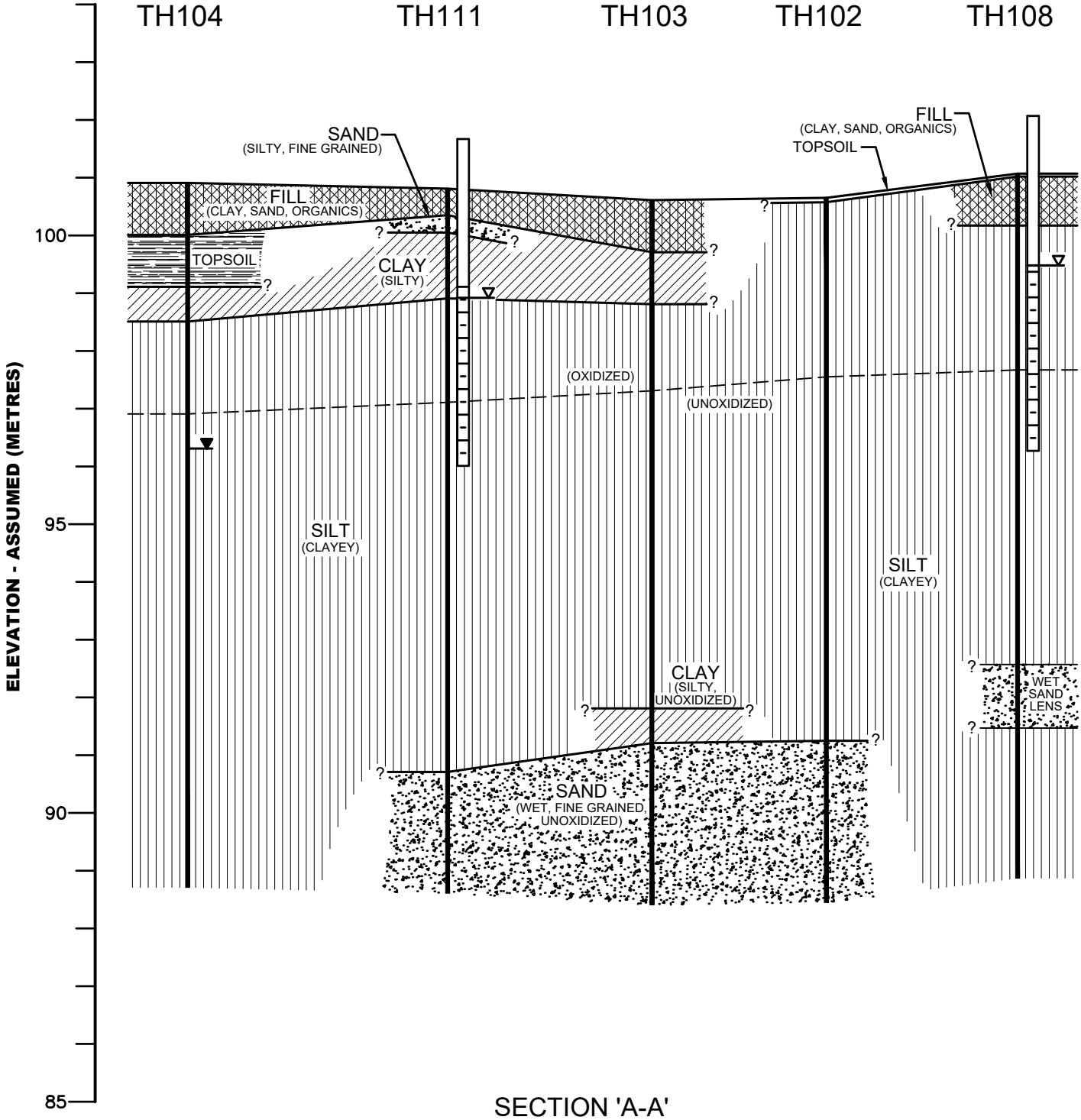
WELL GRADED	Having wide range of grain sizes and substantial amounts of all intermediate sizes.
POORLY GRADED	Predominantly of one grain size.
SLICKENSIDES	Refers to a clay that has planes that are slick and glossy in appearance; slickensides are caused by shear movements.
SENSITIVE	Exhibiting loss of strength on remolding.
FISSURED	Containing cracks, usually attributable to shrinkage. Fissured clays are sometimes described as having a nuggetty structure.
STRATIFIED	Containing layers of different soil types.
ORGANIC	Containing organic matter; may be decomposed or fibrous.
PEAT	A fibrous mass of organic matter in various stages of decomposition. Generally dark brown to black in color and of spongy consistency.
BEDROCK	Preglacial material.
DRIFT	Material deposited directly by glaciers or glacial melt-water.
ALLUVIAL	Soils that have been deposited from suspension from moving water.
LACUSTRINE	Soils that have been deposited from suspension in fresh water lakes.

DRILLING AND SAMPLING TERMS

SYMBOL	DEFINITION
C.S.	Continuous Sampling
Sy	75mm Thin Wall Tube Sample
Sy (2)	50mm Thin Wall Tube Sample
SPT (SS)	50mm O.D. Split Spoon Sample
BLOWS / 300mm	"N" Value – Standard Penetration Test
Bag	Disturbed Bag Sample
No.	Sample Identification Number
⟶	Piezometer Tip
S.I.	Slope Indicator
SPG ⟶	Observed Seepage

LABORATORY TEST SYMBOLS

SYMBOL	DEFINITION
●	Moisture Content – Percent of Dry Weight
⟼	Plastic and Liquid Limit determined in accordance with ASTM D-423 and D-424
◆	Dry Density – t/m^3
■	Shear Strength – As determined by Unconfined Compression Test
▲	Shear Strength – As determined by Field Vane
▲	Shear Strength – As determined by Pocket Penetrometer Test
$\%SO_4$	Water Soluable Sulphates – Percent of Dry Weight
M.A.	Grain Size Analysis



SECTION 'A-A'

SCALE: HOR. 1:2000
VERT. 1:100

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes, the boundaries are interpolated and may be subject to considerable error.

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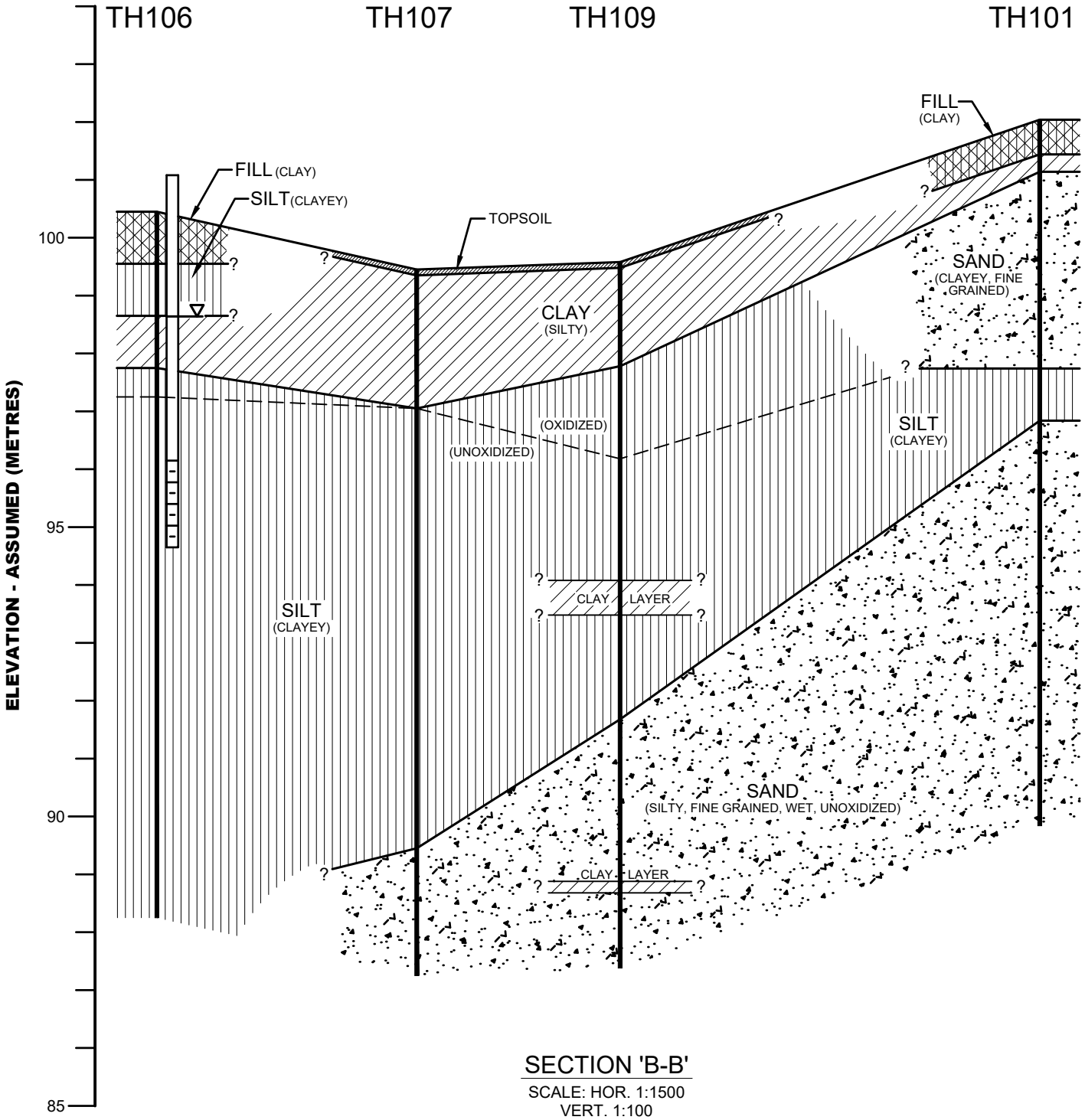
REGINA, SASKATCHEWAN, CANADA

STRATIGRAPHIC CROSS SECTION 'A-A'
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN 102138342 Ext 0
EMERALD PARK, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
TALON CAPITAL LTD.	S. HARTY	MARCH 30, 2023	GE-1403-5



SECTION 'B-B'

SCALE: HOR. 1:1500
VERT. 1:100

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes, the boundaries are interpolated and may be subject to considerable error.

GROUND ENGINEERING CONSULTANTS LTD.
CIVIL & GEOENVIRONMENTAL ENGINEERS
415–7th AVENUE
REGINA, SASKATCHEWAN, CANADA

STRATIGRAPHIC CROSS SECTION 'B-B'
PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
PARCEL BB, PLAN 102138342 Ext 0
EMERALD PARK, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
TALON CAPITAL LTD.	S. HARTY	MARCH 30, 2023	GE-1403-6

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH101
Project No.: GE-1403	Coordinate: 5588419 N; 542936 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 102.04 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6
■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8
Plastic M.C. Liquid 20 40 60 80
● Blow Count ● 20 40 60 80
▲ Vane Shear (kPa) ▲
◆ Pocket Pen (kPa) ◆
■ Unconfined (kPa) ■ 60 120 180 240

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Soil Description	Elevation (m) (Assumed)
					0.00 m 102.04 m FILL - clay - moist - dark grayish brown (2.5Y 4/2)	
1.0	⊠	1				101.0
	▬	2				
2.0					0.60 m 101.44 m CLAY - silty - moist, stiff - oxidized - dark grayish brown (2.5Y 4/2)	100.0
3.0	▬	3				99.0
4.0					0.90 m 101.14 m SAND - clayey, fine grained - moist, wet below 2.4 metres - medium dense - oxidized - olive brown (2.5Y 4/4)	98.0
	⊠	4				
5.0						97.0
6.0	⊠	5				96.0
7.0					4.30 m 97.74 m SILT - sandy, clayey - very moist to wet, loose - unoxidized - dark gray (5Y 4/1)	95.0
8.0	⊠	6				94.0
9.0	⊠	7				93.0
10.0					5.20 m 96.84 m SAND - silty, fine grained - wet, loose - unoxidized - dark gray (5Y 4/1)	92.0
11.0	⊠	8				91.0
12.0	⊠	9				90.0
13.0					Test hole terminated at 12.2 m below grade.	89.0
14.0						88.0
15.0						87.0
16.0						86.0
17.0						85.0
18.0						84.0
19.0						83.0

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 2.3 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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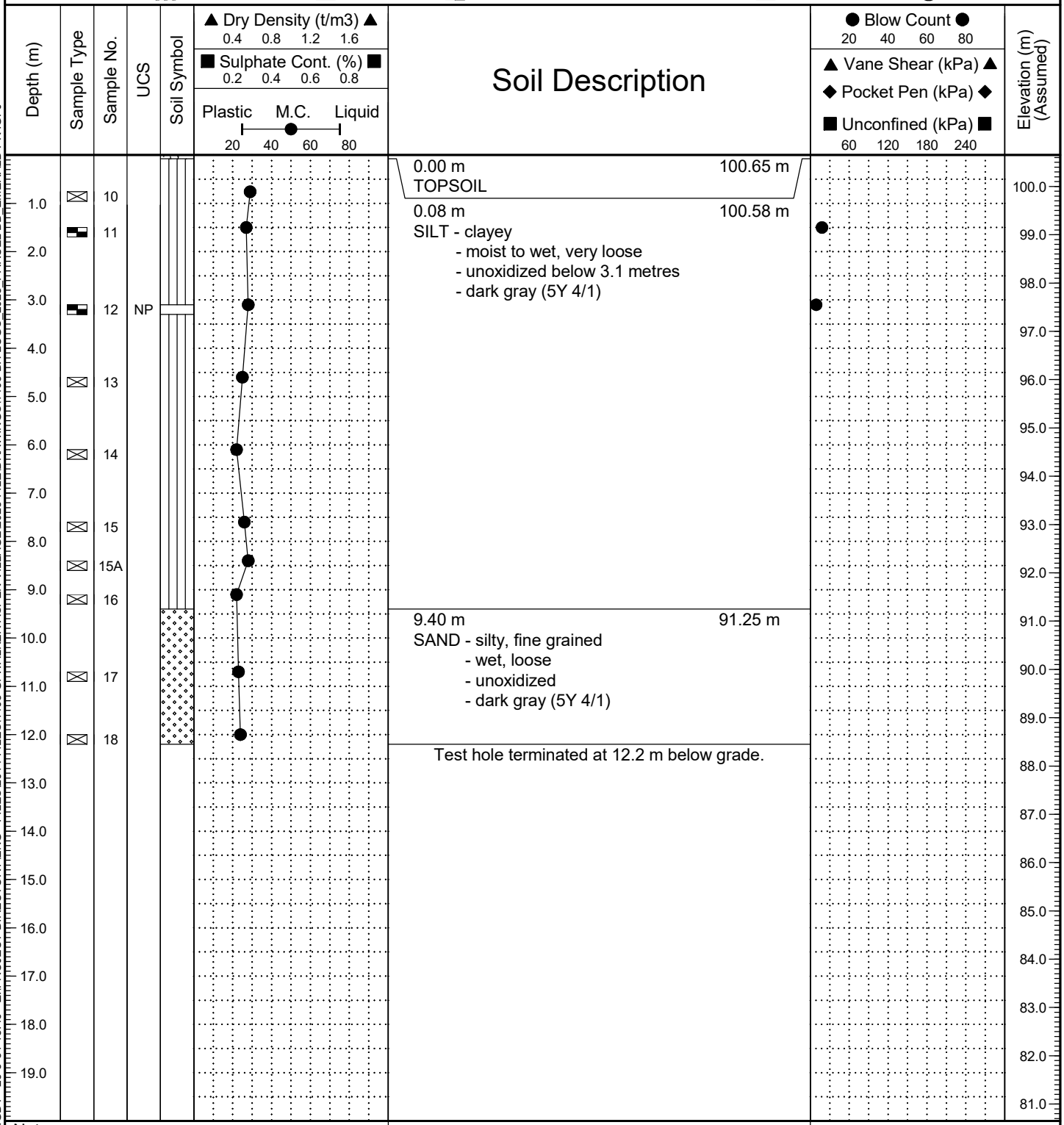
415 - 7th AVENUE, REGINA, SASKATCHEWAN, S4N 4P1

Logged By:	R. Yaremko	Page	1 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-7

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH102
Project No.: GE-1403	Coordinate: 5588449 N; 542854 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.65 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample



Notes:

1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 2.3 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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415 - 7th AVENUE, REGINA, SASKATCHEWAN, S4N 4P1

Logged By:	R. Yaremko	Page	2 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-8

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH103
Project No.: GE-1403	Coordinate: 5588414 N; 542805 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.61 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6
■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8
Plastic M.C. Liquid 20 40 60 80
● Blow Count ● 20 40 60 80
▲ Vane Shear (kPa) ▲
◆ Pocket Pen (kPa) ◆
■ Unconfined (kPa) ■ 60 120 180 240

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Soil Description	Elevation (m) (Assumed)
0.0					0.00 m — 100.61 m FILL - clay - moist - very dark grayish brown (2.5Y 3/2)	100.0
1.0	⊠	19				
1.0	▬	20				
2.0					0.90 m — 99.71 m CLAY - silty - moist, soft to firm - oxidized - dark grayish brown (2.5Y 4/2)	99.0
3.0	▬	21				98.0
4.0						97.0
4.0	⊠	22			1.80 m — 98.81 m SAND - clayey to 3.3 metres - sandy below 3.3 metres - wet, loose - unoxidized below 3.3 metres - dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)	96.0
5.0						95.0
6.0	⊠	23				94.0
7.0						93.0
8.0	⊠	24				92.0
9.0	⊠	25			8.80 m — 91.81 m CLAY - silty - moist, soft - unoxidized - dark gray (5Y 4/1)	91.0
10.0						90.0
11.0	⊠	26				89.0
12.0	⊠	27			9.40 m — 91.21 m SAND - silty, fine grained - wet, loose - unoxidized - dark gray (5Y 4/1)	88.0
13.0						87.0
14.0						86.0
15.0						85.0
16.0						84.0
17.0						83.0
18.0						82.0
19.0						81.0

Test hole terminated at 12.2 m below grade.

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 2.3 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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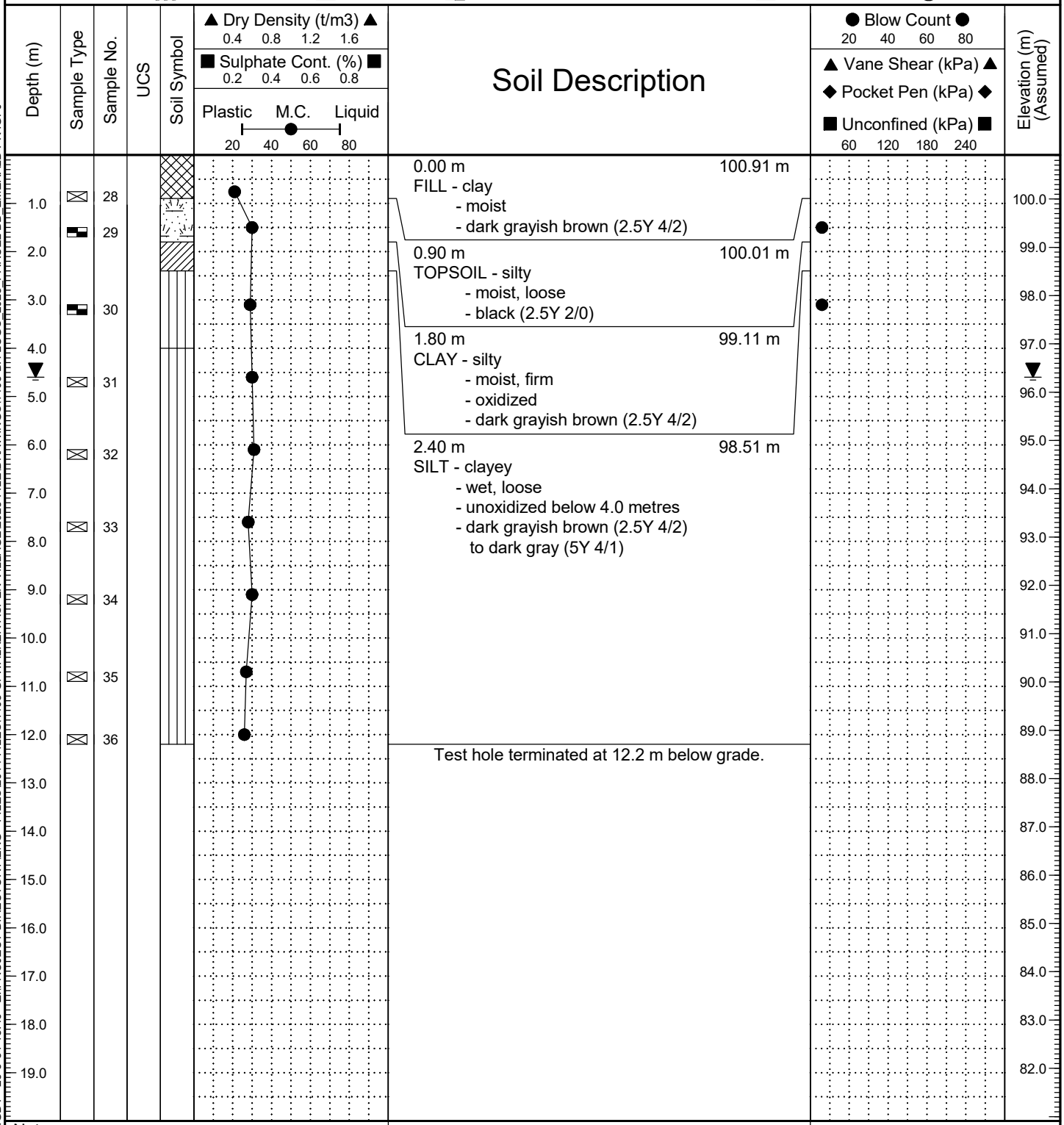
Logged By:	R. Yaremko	Page	3 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-9

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH104
Project No.: GE-1403	Coordinate: 5588294 N; 542708 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.91 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample



Notes:

1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was measured at 4.6 metres immediately after completion of drilling. Test hole sloughed to 5.2 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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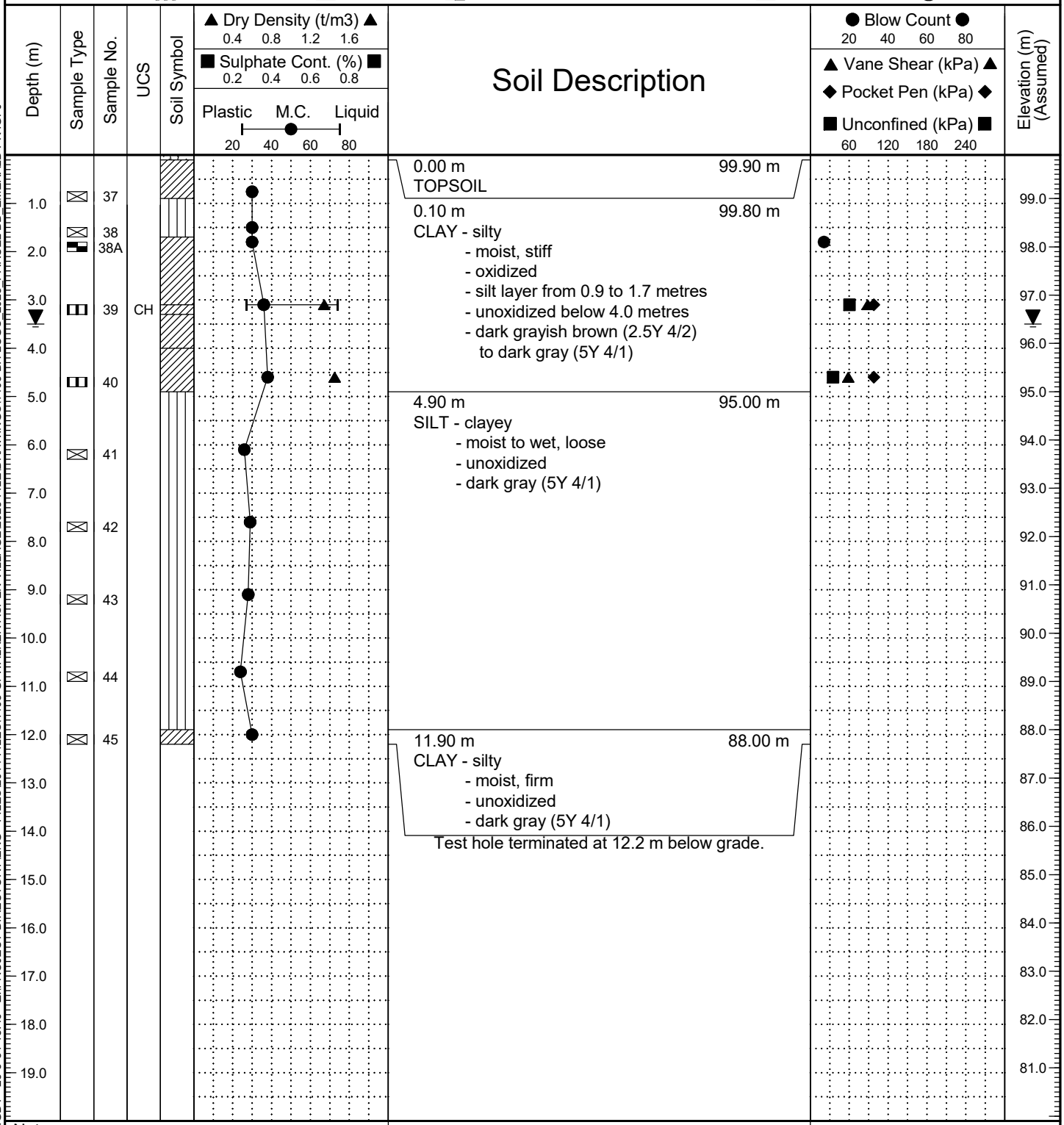
Logged By: R. Yaremko	Page 4 of 11
Drawn By: M. Creary	Date Plotted: 2023-03-31
Reviewed By: S. Harty	Figure No.: GE-1403-10

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH105
Project No.: GE-1403	Coordinate: 5588322 N; 542812 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.90 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample



0.00 m — 99.90 m
TOPSOIL

0.10 m — 99.80 m
CLAY - silty
- moist, stiff
- oxidized
- silt layer from 0.9 to 1.7 metres
- unoxidized below 4.0 metres
- dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)

4.90 m — 95.00 m
SILT - clayey
- moist to wet, loose
- unoxidized
- dark gray (5Y 4/1)

11.90 m — 88.00 m
CLAY - silty
- moist, firm
- unoxidized
- dark gray (5Y 4/1)

Test hole terminated at 12.2 m below grade.

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was measured at 3.5 metres immediately after completion of drilling. Test hole sloughed to 3.7 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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Logged By:	R. Yaremko	Page	5 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-11

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH106
Project No.: GE-1403	Coordinate: 5588232 N; 542805 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.45 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m) | Sample Type | Sample No. | UCS | Soil Symbol

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6

■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8

Plastic M.C. Liquid 20 40 60 80

● Blow Count ● 20 40 60 80

▲ Vane Shear (kPa) ▲

◆ Pocket Pen (kPa) ◆

■ Unconfined (kPa) ■ 60 120 180 240

Well Construction | Elevation (m) (Assumed)

Soil Description

Depth (m)	Sample No.	Elevation (m) (Assumed)
0.00 m		100.5 m
FILL - clay - moist - dark grayish brown (2.5Y 4/2)		
0.90 m		99.6 m
SILT - clayey - moist, loose - oxidized - dark grayish brown (2.5Y 4/2)		
1.80 m		98.7 m
CLAY - silty - moist, stiff - oxidized - dark grayish brown (2.5Y 4/2)		
2.70 m		97.8 m
SILT- clayey - moist, wet below 4.7 metres - loose - unoxidized below 3.2 metres - dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)		
Test hole terminated at 12.2 m below grade.		

Backfill Type: Bentonite | Grout | Sand | Cuttings / Slough

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 4.0 metres.
3. Standpipe piezometr was installed.

Piezo. Details & Water Level Meas.
Top of pipe Elev.: 101.08 m
Ht. of pipe above grade: 0.63 m

Date	Depth (m)	Elev. (m)
21/03/2023	2.44	98.64

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Logged By:	R. Yaremko	Page:	6 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-12

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH107
Project No.: GE-1403	Coordinate: 5588283 N; 542849 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.45 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Dry Density (t/m3) 0.4 0.8 1.2 1.6 / Sulphate Cont. (%) 0.2 0.4 0.6 0.8 / Plastic M.C. Liquid 20 40 60 80	Soil Description	Blow Count 20 40 60 80 / Vane Shear (kPa) / Pocket Pen (kPa) / Unconfined (kPa) 60 120 180 240	Elevation (m) (Assumed)
1.0	⊠	55				0.00 m 99.45 m TOPSOIL		99.0
	⊟	56	CH			0.10 m 99.35 m CLAY - silty - moist, firm to stiff - oxidized - dark grayish brown (2.5Y 4/2)		98.0
2.0								97.0
3.0	▬	57				2.40 m 97.05 m SILT - clayey - moist, wet below 3.2 metres - loose - unoxidized - dark gray (5Y 4/1)		96.0
4.0								95.0
5.0	⊠	58						94.0
6.0	⊠	59						93.0
7.0								92.0
8.0	⊠	60						91.0
9.0	⊠	61						90.0
10.0						10.00 m 89.45 m SAND - silty - wet - unoxidized - dark gray (5Y 4/1)		89.0
11.0	⊠	62						88.0
12.0	⊠	63				Test hole terminated at 12.2 m below grade.		87.0
13.0								86.0
14.0								85.0
15.0								84.0
16.0								83.0
17.0								82.0
18.0								81.0
19.0								80.0

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 6.2 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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Logged By:	R. Yaremko	Page	7 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-13

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH108
Project No.: GE-1403	Coordinate: 5588481 N; 542912 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 101.07 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m) | Sample Type | Sample No. | UCS | Soil Symbol

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6

■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8

Plastic M.C. Liquid 20 40 60 80

Soil Description

● Blow Count ● 20 40 60 80

▲ Vane Shear (kPa) ▲

◆ Pocket Pen (kPa) ◆

■ Unconfined (kPa) ■ 60 120 180 240

Well Construction | Elevation (m) (Assumed)

Depth (m)	Sample No.	Elevation (m) (Assumed)
1.0	64	100.0
2.0	65	99.0
3.0	66	98.0
4.0		97.0
5.0	67	96.0
6.0	68	95.0
7.0		94.0
8.0	69	93.0
9.0	70	92.0
10.0		91.0
11.0	71	90.0
12.0	72	89.0
13.0		88.0
14.0		87.0
15.0		86.0
16.0		85.0
17.0		84.0
18.0		83.0
19.0		82.0

0.00 m — **101.1 m**
TOPSOIL

0.05 m — **101.0 m**
FILL - clay
- trace sand and organics
- moist to very moist
- dark grayish brown (2.5Y 4/2)

0.90 m — **100.2 m**
SILT - sandy
- very moist to wet, firm to soft
- oxidized, iron stains
- unoxidized below 3.4 metres
- wet sand lens from 8.5 to 9.6 metres
- dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)

Test hole terminated at 12.2 m below grade.

Backfill Type: Bentonite | Grout | Sand | Cuttings / Slough

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 4.6 metres.
3. Standpipe piezometer was installed.

Piezo. Details & Water Level Meas.
Top of pipe Elev.: 102.07 m
Ht. of pipe above grade: 1.00 m

Date	Depth (m)	Elev. (m)
31/03/2023	2.59	99.48
28/03/2023	4.48	97.59

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Logged By:	R. Yaremko	Page:	8 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-14

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH109
Project No.: GE-1403	Coordinate: 5588328 N; 542878 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.58 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6
■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8
Plastic M.C. Liquid 20 40 60 80
● Blow Count ● 20 40 60 80
▲ Vane Shear (kPa) ▲
◆ Pocket Pen (kPa) ◆
■ Unconfined (kPa) ■ 60 120 180 240

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Soil Description	Elevation (m) (Assumed)
0.0					0.00 m — 99.58 m TOPSOIL	99.0
1.0	⊠	73			0.10 m — 99.48 m CLAY - silty - moist to very moist, firm - oxidized, iron stains - salt crystals - dark grayish brown (2.5Y 4/2)	98.0
2.0		74				97.0
3.0		75				96.0
4.0					1.80 m — 97.78 m SILT - sandy - very moist to wet, soft - oxidized - unoxidized below 3.4 metres - clay layer from 5.5 to 6.1 metres - dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1)	95.0
5.0		76				94.0
6.0		77				93.0
7.0						92.0
8.0		78			7.90 m — 91.68 m SAND - silty, fine grained - wet, very loose to medium dense - unoxidized - clay layer at 10.7 metres - dark gray (5Y 4/1)	91.0
9.0		79				90.0
10.0						89.0
11.0		80				88.0
12.0		81			Test hole terminated at 12.2 m below grade.	87.0
13.0						86.0
14.0						85.0
15.0						84.0
16.0						83.0
17.0						82.0
18.0						81.0
19.0						80.0

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 2.7 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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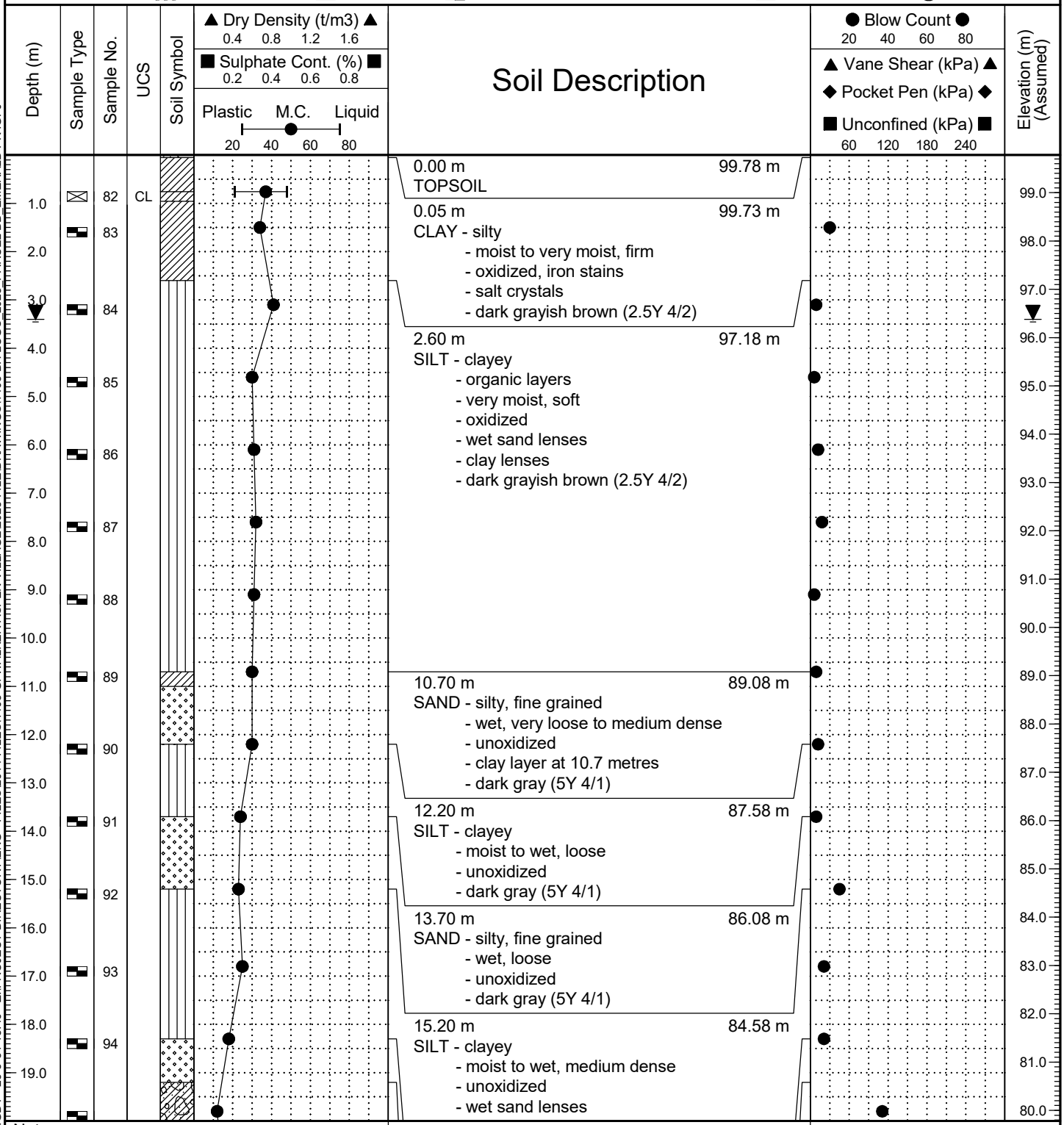
Logged By:	R. Yaremko	Page	9 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-15

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH110
Project No.: GE-1403	Coordinate: 5588281 N; 542779 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.78 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample



Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was measured at 3.4 metres immediately after completion of drilling. Test hole sloughed to 6.7 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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Logged By:	R. Yaremko	Page	10 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-16

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH110
Project No.: GE-1403	Coordinate: 5588281 N; 542779 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 99.78 m (Assumed)	Date Drilled: 2014-02-11

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m)	Sample Type	Sample No.	UCS	Soil Symbol	Dry Density (t/m3) 0.4 0.8 1.2 1.6 / Sulphate Cont. (%) 0.2 0.4 0.6 0.8 / Plastic M.C. Liquid 20 40 60 80	Soil Description	Blow Count 20 40 60 80 / Vane Shear (kPa) / Pocket Pen (kPa) / Unconfined (kPa) 60 120 180 240	Elevation (m) (Assumed)
21.0		95				- dark gray (5Y 4/1)		79.0
		96				18.30 m 81.48 m SAND - silty, fine grained - wet, loose - unoxidized - dark gray (5Y 4/1)		
22.0								78.0
23.0						19.20 m 80.58 m TILL - silty, clayey - moist, stiff to hard - unoxidized - dark gray (5Y 4/1)		77.0
24.0								76.0
25.0						Test hole terminated at 21.3 m below grade.		75.0
26.0								74.0
27.0								73.0
28.0								72.0
29.0								71.0
30.0								70.0
31.0								69.0
32.0								68.0
33.0								67.0
34.0								66.0
35.0								65.0
36.0								64.0
37.0								63.0
38.0								62.0
39.0								61.0
								60.0

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was measured at 3.4 metres immediately after completion of drilling. Test hole sloughed to 6.7 metres.
3. Test hole was backfilled to surface with drill cuttings immediately after completion of drilling.

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Logged By: R. Yaremko	Page 10 of 11
Drawn By: M. Creary	Date Plotted: 2023-03-31
Reviewed By: S. Harty	Figure No.: GE-1403-16

Project: Greensview Residential Development	Location: Parcel BB, Plan 102138342	Test Hole No.: TH111
Project No.: GE-1403	Coordinate: 5588376 N; 542745 E (NAD83)	Drill Rig: Brat 22
Client: Talon Capital Ltd.	Elevation: 100.81 m (Assumed)	Date Drilled: 2023-03-28

Sample Type: Shelby Tube | Disturbed | SPT Sample | Pail Sample | No Recovery | Jar Sample

Depth (m) | Sample Type | Sample No. | UCS | Soil Symbol

▲ Dry Density (t/m3) ▲ 0.4 0.8 1.2 1.6

■ Sulphate Cont. (%) ■ 0.2 0.4 0.6 0.8

Plastic M.C. Liquid 20 40 60 80

Soil Description

● Blow Count ● 20 40 60 80

▲ Vane Shear (kPa) ▲

◆ Pocket Pen (kPa) ◆

■ Unconfined (kPa) ■ 60 120 180 240

Well Construction | Elevation (m) (Assumed)

Depth (m)	Sample No.	Elevation (m) (Assumed)
0.00	97, 97B	100.8
1.0	98	100.0
2.0		99.0
3.0	99	98.0
4.0		97.0
5.0	100	96.0
6.0	101	95.0
7.0		94.0
8.0	102	93.0
9.0	103	92.0
10.0		91.0
11.0	104	90.0
12.0	105	89.0
13.0		88.0
14.0		87.0
15.0		86.0
16.0		85.0
17.0		84.0
18.0		83.0
19.0		82.0
		81.0

0.00 m — 100.8 m
FILL - silty clay, sandy
- organics
- moist
- dark grayish brown (2.5Y 4/2)

0.46 m — 100.4 m
SAND - silty, fine grained
- moist, medium dense
- oxidized
- olive brown (2.5Y 4/4)

0.76 m — 100.1 m
CLAY - silty, highly plastic
- moist, stiff to firm
- oxidized
- dark grayish brown (2.5Y 4/2)

1.90 m — 98.9 m
SILT - clayey
- moist, wet at 2.4 metres
- soft
- unoxidized below 3.7 metres
- olive brown (2.5Y 4/4) to dark gray (5Y 4/1)

10.10 m — 90.7 m
SAND - silty
- wet, soft
- unoxidized
- dark gray (5Y 4/1)

Test hole terminated at 12.2 m below grade.

Backfill Type: Bentonite | Grout | Sand | Cuttings / Slough

Notes:
1. Test hole was excavated using a 150 mm dia. continuous flight auger.
2. Water level was meaured at 3.7 metres immediately after completion of drilling. Test hole sloughed to 4.0 metres.
3. Standpipe piezometer was installed.

Piezo. Details & Water Level Meas.
Top of pipe Elev.: 101.67 m
Ht. of pipe above grade: 0.86 m

Date	Depth (m)	Elev. (m)
31/03/2023	2.75	98.92
28/3/2023	3.89	97.78

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Logged By:	J. Stepp	Page:	11 of 11
Drawn By:	M. Creary	Date Plotted:	2023-03-31
Reviewed By:	S. Harty	Figure No.:	GE-1403-17

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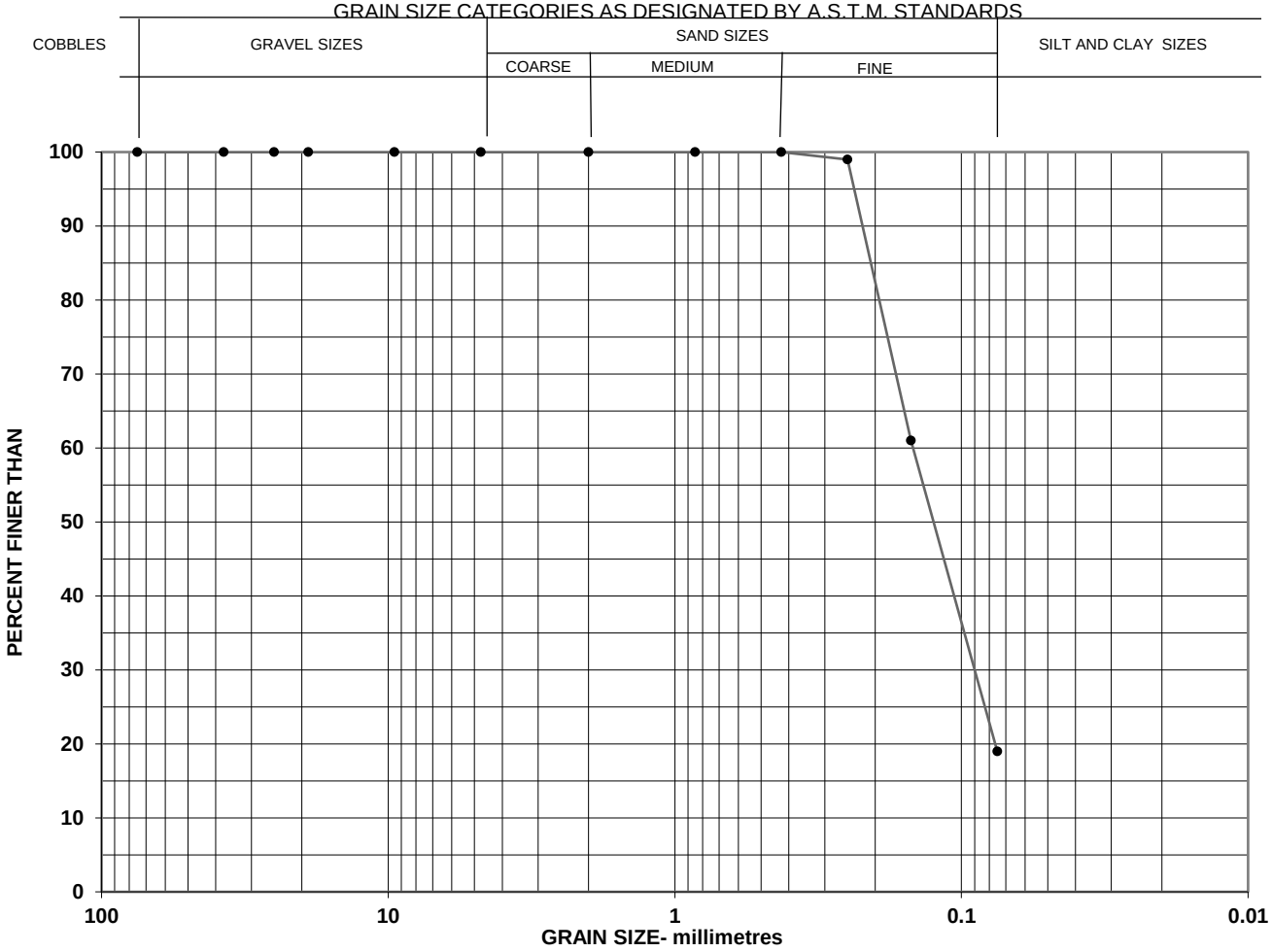
E-MAIL: groundeng@accesscomm.ca

GRAIN SIZE CURVE
(A.S.T.M. C-136, C.S.A. A23.2-2A & 5A)

JOB No: GE-1403 **DATE:** February 17, 2014 **TECH:** S. KHAN
CLIENT: TALON CAPITAL LTD.
PROJECT: PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
LOCATION: EMERALD PARK, SASKATCHEWAN



SIZE OF OPENING (mm)	SPECIFIED % FINER THAN	PERCENT FINER THAN
75.0		100
37.5		100
25.0		100
19.0		100
9.51		100
4.75		100
2.00		100
0.850		100
0.425		100
0.250		99
0.150		61
0.075		19

GRAIN SIZE CATEGORY	PARTICLE SIZE RANGE (mm)	PERCENT RETAINED
GRAVEL	75 to 4.75	0
COARSE SAND	4.75 to 2.0	0
MEDIUM SAND	2.0 to 0.425	0
FINE SAND	0.425 to 0.075	81
SILT & CLAY	< 0.075	19

SAMPLE DESCRIPTION : FINE GRAINED SAND, SOME SILT AND CLAY

MATERIAL SUPPLIED BY: **SAMPLED BY :** R. YAREMKO OF GROUND ENGINEERING CONSULTANTS LTD.

SAMPLE LOCATION: TH 101
SAMPLE NUMBER: 3 AT 10 **DATE SAMPLED :** February 17, 2014

DISTRIBUTION:

WE CERTIFY TESTING PROCEDURES IN ACCORDANCE WITH C.S.A. & A.S.T.M. STANDARDS FOR THAT PORTION OF THE TESTING PERFORMED BY THIS COMPANY GROUND ENGINEERING CONSULTANTS LTD.

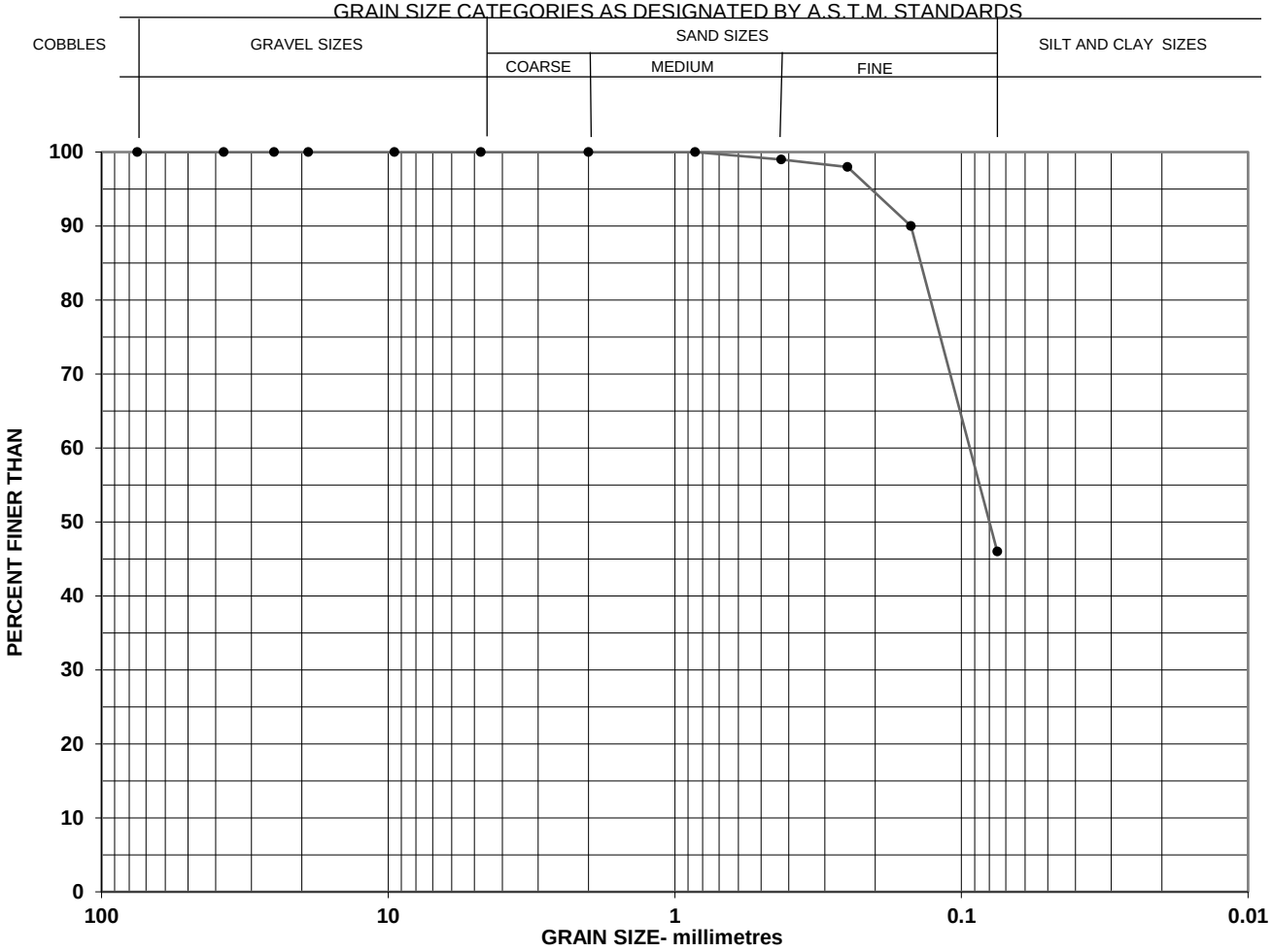
Per: _____
KELLY MAUNDER, A.Sc.T.

GE-1403-18

GROUND ENGINEERING CONSULTANTS LTD.
CIVIL & GEOENVIRONMENTAL ENGINEERS
415 - 7th AVENUE • REGINA • SASKATCHEWAN • CANADA
S4N 4P1 TELEPHONE (306) 569-9075 FAX (306) 565-3877
E-MAIL: groundeng@accesscomm.ca

GRAIN SIZE CURVE
(A.S.T.M. C-136, C.S.A. A23.2-2A & 5A)

JOB No: GE-1403 **DATE:** February 17, 2014 **TECH:** S. KHAN
CLIENT: TALON CAPITAL LTD.
PROJECT: PROPOSED GREENSVIEW RESIDENTIAL DEVELOPMENT
LOCATION: EMERALD PARK, SASKATCHEWAN



SIZE OF OPENING (mm)	SPECIFIED % FINER THAN	PERCENT FINER THAN
75.0		100
37.5		100
25.0		100
19.0		100
9.51		100
4.75		100
2.00		100
0.850		100
0.425		99
0.250		98
0.150		90
0.075		46

GRAIN SIZE CATEGORY	PARTICLE SIZE RANGE (mm)	PERCENT RETAINED
GRAVEL	75 to 4.75	0
COARSE SAND	4.75 to 2.0	0
MEDIUM SAND	2.0 to 0.425	1
FINE SAND	0.425 to 0.075	53
SILT & CLAY	< 0.075	46

SAMPLE DESCRIPTION : FINE GRAINED SAND, WITH SILT AND CLAY

MATERIAL SUPPLIED BY: **SAMPLED BY :** R. YAREMKO OF GROUND ENGINEERING CONSULTANTS LTD.

SAMPLE LOCATION: TH 101
SAMPLE NUMBER: 62 AT 35' **DATE SAMPLED :** February 17, 2014

DISTRIBUTION:

WE CERTIFY TESTING PROCEDURES IN ACCORDANCE WITH C.S.A. & A.S.T.M. STANDARDS FOR THAT PORTION OF THE TESTING PERFORMED BY THIS COMPANY GROUND ENGINEERING CONSULTANTS LTD.

Per: _____
KELLY MAUNDER, A.Sc.T.

GE-1403-19

APPENDIX A

Advantages of concrete filled steel pipe piles

The Steel Pipe Pile represents one of the finest means of providing piled foundations. The individual pipe can be selected in a number of wall thicknesses and diameters to tailor the capacity of the pile to each design load, to the supporting soil capacity and to the ease or difficulty of the driving conditions.

After completion of driving to the required bearing capacity and prior to filling with concrete, each pile can be checked visually for damage in driving, for plumb and for sweep or radius of curvature. In this respect, steel pipe piling is unique. It is subject to full visual observation.

Inspection can be accomplished in very long piles by lowering a safety light on a long drop cord into the steel shaft to inspect for any driving damage. An alternative is the use of a light and mirror to illuminate the interior for inspection. Such inspection methods are not possible with solid piles of steel, concrete, wood or any other structural material. From the time these solid units are driven below the ground surface, nothing is known for certainty of the plumb, curvature or possible damage due to driving or due to obstructions.

After completion of inspection, the steel pipe pile has an added flexibility in its column carrying capacity since the concrete strength can be varied to meet greater or less stringent load demands.

The concrete is placed under controlled conditions to attain the desired results. It is introduced into a thoroughly inspected form which is free of water or any other deleterious substance. This insures a structural integrity which is not possible with any other foundation except a controlled concrete pour in a reinforced pier or caisson.

Other advantages are: high loading capacities; low cost per ton of supported load; ease of driving due to stiffness of the pipe; ease of joining by welding; speed in driving long unspliced lengths, ability of steel to absorb hard driving, reuse of any sections above cut-off elevation, ready availability of pipe; great stability against buckling due to hard driving, high or unusual earth pressures or high loading.

Availability

Stelco Steel Piling Pipe is readily available in many wall thicknesses and diameters. Representative sizes are listed in Table II.

Driving

Steel pipe piling can be driven with or without a plate on the bottom end. Open end piling requires a more expensive cleanout procedure, but does eliminate ground heave in conditions where, in the designer's opinion, ground heave may present a problem.

The closed bottom-end pipe can be driven either with an internal mandrel or by top driving. When driving thin-walled pipe (1/8" to about 3/16" wall), the use of a mandrel ensures damage-free pipe. Mandrel driving requires the driving leads to be approximately double the pile length. Beyond a depth of about 40 feet this method is seldom economic.

Heavier walled pipe can be top driven. This method is particularly applicable when either long piles or hard driving is encountered. The required thickness of the wall is dependent upon the energy of the driving hammer, the ease of driving, the length of pile to be placed, and the imposed design loads.

For any given weight of steel, the pipe pile presents the stiffest shape possible. The radius of gyration of the pipe is the same in all directions. The pile drives straighter than other shapes and keeps drift, out of plumb and sweep to a minimum.

Placing concrete

The requirements of placing concrete in the bottom of a closed bottom-end pipe can be costly if too restrictive. By common practice, in pipes up to 18" in diameter, the pipe is considered to be the chute or spout acting to prevent segregation. If the designer wishes to increase protection against segregation in these smaller diameter pipes (and in any event for diameters of 20 inches or greater) it is recommended that about two feet of strong dry grout be first placed in the bottom of the pile. This grout is placed by free fall regardless of the pile length. The remainder of the pile is filled with a stiff concrete (1 1/2" to 2" slump).

Once again, this concrete is placed without the use of an "elephant trunk" or other special device. It should be noted that some of the larger aggregate in the concrete will penetrate the bottom grout layer to give a pile of uniform high strength.

Piles 12 3/4 x 0.281 wall filled in the above manner have been load tested to greater than 300 tons with no damage to the shaft, and 10 3/4 x 0.250 wall piles have been tested to over 400 tons before failure.

Field splices

Stelco steel piling pipe can be manufactured in any length up to 80'. If pile lengths longer than 80' are required, or if transportation problems dictate shorter pipe lengths than required, field welding is employed. Stelco piling pipe is supplied with bevelled ends to facilitate splicing.

In a bearing pile, it is not essential to have full penetration welds or expensive chill rings and back-up plates. The ends of two adjoining piles are placed in flush contact and then joined with a circumferential fillet weld. In this way, longitudinal compression due to driving and loading is transferred directly across the splice by the end of one pipe bearing on the other. Tensile forces and bending moments induced during driving are easily resisted by the fillet weld.

For any carrying capacity, the splicing of steel piling pipe requires less time and materials than that required for structural shapes. Also, unlike concrete or wood piles, there is little wastage with steel piling pipe since sections cut-off above elevation can be reused.

Load capacity

Soil

The ultimate load capacity of any pile regardless of its column capacity depends upon the surrounding soil in which it is placed. The 1965 National Building Code Section 4.2.2.16 (1), Properties of Soils and Capacities of Foundations is one specification which provides the designer with a number of means for determining the maximum design capacity of a pile. These are: load tests, local experience, or properties of the soil by an appropriate soils investigation.

It is imperative for the designer to remember that the structural column capacity of the pile must be tailored to equal the imposed load which in turn must not exceed the supporting capacity of the soil.

The supporting soil capacity of a friction pile may be taken as the frictional resistance between its surface and the ground with which it is in permanent contact.

Pipe column

The concrete filled steel pipe pile has a very wide range of capacities. The pipe is readily obtained in a number of diameters (5 9/16" to 36"), and wall thicknesses (1/8" to 5/8"). The cast-in-place concrete can be easily varied in strength (3^{KSI} to 5^{KSI} concrete is readily available from most pre-mix plants). The cost of the pile per ton of bearing capacity can be kept to a minimum by adjusting the pipe diameter, the pipe wall thickness, and the concrete strength to suit the driving conditions and bearing capacity of the soil. In this way, the least total cost of the piled foundation is obtained.

From past experience, most concrete filled steel pipe piles in Canada have been driven in the small diameters, i.e., 10 3/4 and 12 3/4", with wall thicknesses from 0.219 to 0.281 inches. 3^{KSI} concrete has been used in most cases, although there is presently a trend to higher strength concrete. The larger diameters and thicker walls have generally been used for special conditions.

Lateral support

The 1965 National Building Code presently permits any pile driven into soils other than peat or soft clay to be designed as a short column. Research reported in "Norwegian Experiences with Steel Piles to Rock" by Dr. Lawrence Bjerrum confirms that pipe piling will not undergo column (Euler) buckling provided that

$\frac{I}{A^2} \geq \frac{f^2}{4CE}$ where:

I = Moment of inertia of the transformed cross-section of the concrete filled steel pipe pile,
A = Transformed cross-section area,
f = Yield stress of steel,
E = Young's Modulus of elasticity for steel,
C = Modulus of horizontal compressibility of surrounding soil.

If the yield stress of the pipe (f) is less than or equal to 52,000 psi and "C" is at least 75 psi (a soft clay), the above reduces to:

$\frac{I}{A^2} \geq 0.3$.

In the majority of cases, I/A^2 exceeds 0.3 and the concrete-filled steel pipe pile can be considered as a short column for design purposes. In concrete design, a short column is one in which the unsupported length (h) divided by the outside diameter (d) is 10 or less.

Corrosion of steel pipe piles

The 1965 National Building Code states that steel piles shall have a thickness 1/16" greater than that needed for design requirements unless evidence indicates that corrosion is not a problem. On steel H-piles or sheet steel piles, corrosion can take place on all faces of the member (i.e. two faces of a thickness). On a steel pipe pile, corrosion can take place only on the exterior surface. Hence when making a corrosion allowance in design, the outside diameter is assumed to be reduced by 1/16".

In 1962, the U. S. Department of Commerce released a study on "Corrosion of Steel Piling in Soils", by Melvin Romanoff. This extensive field survey of steel piles located in all types of soil for up to 40 years concluded that:

1. No appreciable corrosion occurs when piles are located in undisturbed soils or below the water table (regardless of the soil types or properties encountered).

2. Above the water table and in fill soils, corrosion is not serious. The areas of pitting in the worst cases are localized and small in area.

3. With the exception of piling exposed to sand erosion, salt water, or tides with high oxygen content in the splash area, *corrosion did not reduce the structural capacity of any pile examined.*

External pressure

The empty steel pipe pile should be strong enough to resist the active earth pressure and the ground water pressure to which it is subjected. The collapse resistance of an empty steel pipe is generally great enough to handle all external earth and any fluid pressures.

For conservative design, particularly in clays, the external earth pressure can be taken as: $p = wh$
where p = External pressure
w = unit weight of soil
h = height of soil at point of calculation

This external pressure should be kept less than the collapse pressure tabulated below.

Table I
External Uniform Collapse Pressure
(33,000 psi minimum yield strength)

Ratio Diameter / Wall Thickness	External Collapse Pressure
10	5300
15	3933
20	2950
25	2360
30	1967
35	1551
40	1012
45	744
50	513
55	389
60	300
65	236
70	189
75	154
80	126
85	105
90	89
95	75
100	65
105	56
110	49
115	43
120	37
125	33

Load tests

The 1965 National Building Code permits a pile to be load tested as a means of verifying its design load capacity (see Section 4.2.2.17 (2)). According to the NBC, the allowable pile load is one-half of the maximum test load applied to the pile. A further stipulation is that the allowable load cannot exceed the load which causes a ½" permanent settlement. As explained in the section "Pipe Column", the above allowable load based on tests need not be reduced when applied to piles which are inspected before the concrete has been poured. When applying test results to uninspected piles, a 25% reduction must be applied to the allowable load determined as above.

Extensive load testing has been carried out on concrete-filled steel pipe piles, both end bearing and friction type. One load test was carried out on two piles at the Steel Company of Canada's Swansea Works in Toronto. The piles were 12.75 O.D. x 0.281 steel tubes filled with 4000 psi high-early strength concrete.

Test pile #1 had a 1" steel plate (13 ½" in diameter) welded across the bottom end to act as a point. The pile was driven 47'8" by a #0 Vulcan Hammer to the surface of a shale layer. Fifteen blows were required for the last inch of penetration.

Testing began two days after driving was completed by applying 20 ton load increments up to a maximum load of 160 tons. The pile was not tested to destruction. The maximum load remained in place for 28 hours and was then removed in 20 ton increments. After unloading was complete, the permanent settlement was 0.474".

Test pile #2 at Swansea was equipped with a 24" x 24" x 1" steel plate point. This pile was driven by the same hammer to the shale layer and refusal was reached at a depth of 35'5". It was also noted that the pile went out of plumb by approximately ½"/foot in driving. Loading of the pile started 9 days after driving was complete and followed the same procedure as pile test #1. After the 160 ton load was removed the pile rebounded to its original elevation for zero permanent settlement. Loading increased the total out of plumbness by ¼".

The Michigan State Highway Department carried out an extensive pile testing program between 1962 and 1965. A twelve inch closed bottom-end pile with a 0.179" wall was top end driven to a depth of 67 feet and loaded to 390 tons. Load test capacity was not available for subjecting the pile to greater loads. At 390 tons, there was failure due to settlement of the pile as a unit into the end supporting glacial till, but no damage to the column shaft capacity was evident.

Western Foundation Corporation (N.Y.) reported that a 10¾ x 0.250 wall pile with 3,000 psi concrete was load tested to over 400 tons in a soil formation prior to failure. This load is equivalent to full tri-axial stressing in accordance with the Richart formula (see section on "Column Strength").

Load tables

Table II lists the section properties of Stelco steel piling pipe and the enclosed concrete core while Table III gives the allowable column strength of concrete filled steel pipe piles.

The tabulated load capacity of a concrete filled steel pipe pile is based upon the 1965 National Building Code, Section 4.5.4A.25 (1) for a "short" column. As explained under "Pipe Column", a short column is one having $h/d \leqq 10$. For this condition, the allowable steel stress is 16.6^{KSI} for steels with a yield of 33^{KSI} or greater and the allowable concrete stress is $0.24\ f'_c$. Three concrete strengths are tabulated—3, 4 and 5^{KSI}. For other strengths, the designer can compute the column capacity of the piles using the above listed stresses.

In some instances, a corrosion allowance may be deemed necessary (see section on "Corrosion"). The corrosion reduction factor in the last column of Table III is based on an assumed loss of 1/16" on the outside pipe diameter. The allowable loads tabulated would be reduced by the corrosion reduction factor.

Table II Properties of Stelco steel pipe and concrete core

Pipe			Area		Moment of inertia		Radius of gyration		Section modulus
outside diameter (in.)	wall (in.)	weight (lbs./ft.)	steel ($in.^2$)	concrete ($in.^2$)	steel ($in.^4$)	concrete ($in.^4$)	steel (in.)	concrete (in.)	steel ($in.^3$)
8.625	0.125	11.35	3.34	55.09	30.15	241.50	3.006	2.094	6.99
8.625	0.134	12.15	3.57	54.85	32.22	239.43	3.002	2.089	7.47
8.625	0.141	12.78	3.76	54.67	33.82	237.83	3.000	2.086	7.84
8.625	0.156	14.11	4.15	54.28	37.22	234.42	2.995	2.078	8.63
8.625	0.164	14.82	4.36	54.07	39.02	232.62	2.992	2.074	9.05
8.625	0.188	16.94	4.98	53.44	44.36	227.29	2.984	2.062	10.29
8.625	0.203	18.26	5.37	53.06	47.65	224.00	2.978	2.055	11.05
8.625	0.219	19.66	5.78	52.64	51.12	220.53	2.973	2.047	11.85
8.625	0.250	22.36	6.58	51.85	57.72	213.93	2.962	2.031	13.38
8.625	0.277	24.70	7.26	51.16	63.35	208.30	2.953	2.018	14.69
8.625	0.312	27.70	8.15	50.28	70.48	201.16	2.941	2.000	16.34
8.625	0.322	28.55	8.40	50.03	72.49	199.16	2.938	1.995	16.81
8.625	0.344	30.42	8.95	49.48	76.84	194.80	2.930	1.984	17.82
8.625	0.406	35.64	10.48	47.94	88.74	182.91	2.909	1.953	20.58
8.625	0.438	38.30	11.27	47.16	94.66	176.99	2.899	1.937	21.95
10.750	0.125	14.18	4.17	86.59	58.89	596.66	3.757	2.625	10.96
10.750	0.134	15.19	4.47	86.29	62.97	592.58	3.754	2.620	11.71
10.750	0.141	15.98	4.70	86.06	66.13	589.42	3.751	2.617	12.30
10.750	0.156	17.65	5.19	85.57	72.85	582.69	3.746	2.609	13.55
10.750	0.164	18.54	5.45	85.31	76.42	579.13	3.743	2.605	14.22
10.750	0.188	21.21	6.24	84.52	87.01	568.53	3.735	2.593	16.19
10.750	0.203	22.87	6.73	84.04	93.56	561.99	3.730	2.586	17.41
10.750	0.219	24.63	7.25	83.52	100.48	555.06	3.724	2.578	18.69
10.750	0.250	28.04	8.25	82.52	113.71	541.83	3.713	2.562	21.16
10.750	0.279	31.20	9.18	81.58	125.87	529.67	3.703	2.548	23.42
10.750	0.307	34.24	10.07	80.69	137.42	518.13	3.694	2.534	25.57
10.750	0.344	38.23	11.25	79.52	152.38	503.16	3.681	2.515	28.35
10.750	0.365	40.48	11.91	78.85	160.73	494.81	3.674	2.505	29.90
10.750	0.438	48.24	14.19	76.57	188.95	466.60	3.649	2.468	35.15
10.750	0.500	54.74	16.10	74.66	211.95	443.60	3.628	2.437	39.43
12.750	0.125	16.85	4.96	122.72	98.79	1198.42	4.464	3.125	15.50
12.750	0.134	18.06	5.31	122.37	105.68	1191.54	4.461	3.120	16.58
12.750	0.141	18.99	5.59	122.09	111.01	1186.20	4.458	3.117	17.41
12.750	0.156	20.98	6.17	121.50	122.39	1174.82	4.453	3.109	19.20
12.750	0.164	22.05	6.48	121.19	128.42	1168.79	4.450	3.105	20.14
12.750	0.188	25.22	7.42	120.26	146.38	1150.83	4.442	3.093	22.96
12.750	0.203	27.20	8.00	119.67	157.50	1139.71	4.437	3.086	24.71
12.750	0.219	29.31	8.62	119.06	169.27	1127.94	4.431	3.078	26.55
12.750	0.250	33.38	9.82	117.86	191.82	1105.39	4.420	3.062	30.09
12.750	0.281	37.42	11.01	116.67	214.03	1083.18	4.410	3.047	33.57
12.750	0.312	41.45	12.19	115.49	235.90	1061.31	4.399	3.031	37.00
12.750	0.330	43.77	12.88	114.80	248.45	1048.76	4.393	3.022	38.97
12.750	0.344	45.58	13.41	114.27	258.13	1039.08	4.388	3.015	40.49
12.750	0.375	49.56	14.58	113.10	279.33	1017.88	4.377	3.000	43.82
12.750	0.406	53.53	15.74	111.93	300.21	997.00	4.367	2.984	47.09
12.750	0.438	57.59	16.94	110.74	321.42	975.80	4.356	2.968	50.42
12.750	0.500	65.42	19.24	108.43	361.54	935.67	4.335	2.937	56.71
14.000	0.188	27.73	8.16	145.78	194.57	1691.18	4.884	3.406	27.80
14.000	0.210	30.93	9.10	144.84	216.31	1669.44	4.876	3.395	30.90
14.000	0.219	32.23	9.48	144.46	225.14	1660.60	4.873	3.390	32.16
14.000	0.250	36.71	10.80	143.14	255.30	1630.44	4.862	3.375	36.47
14.000	0.281	41.17	12.11	141.83	285.04	1600.70	4.851	3.359	40.72
14.000	0.312	45.61	13.42	140.52	314.38	1571.36	4.841	3.344	44.91
14.000	0.344	50.17	14.76	139.18	344.24	1541.50	4.830	3.328	49.18
14.000	0.375	54.57	16.05	137.89	372.76	1512.98	4.819	3.312	53.25
14.000	0.438	63.44	18.66	135.28	429.49	1456.25	4.797	3.281	61.36
14.000	0.500	72.09	21.21	132.73	483.75	1401.99	4.776	3.250	69.11
16.000	0.188	31.75	9.34	191.72	291.90	2925.09	5.591	3.906	36.49
16.000	0.219	36.91	10.86	190.20	338.06	2878.94	5.580	3.890	42.26
16.000	0.250	42.05	12.37	188.69	383.66	2833.33	5.569	3.875	47.96
16.000	0.281	47.17	13.88	187.19	428.72	2788.27	5.558	3.859	53.59
16.000	0.312	52.28	15.38	185.69	473.24	2743.75	5.548	3.844	59.16
16.000	0.344	57.52	16.92	184.14	518.64	2698.35	5.537	3.828	64.83
16.000	0.375	62.58	18.41	182.65	562.08	2654.91	5.526	3.812	70.26
16.000	0.438	72.80	21.41	179.65	648.74	2568.25	5.504	3.781	81.09
16.000	0.500	82.77	24.35	176.71	731.94	2485.05	5.483	3.750	91.49
20.000	0.250	52.73	15.51	298.65	756.43	7097.55	6.983	4.875	75.64
20.000	0.281	59.18	17.41	296.75	846.29	7007.70	6.972	4.859	84.63
20.000	0.312	65.61	19.30	294.86	935.26	6918.73	6.962	4.844	93.53
20.000	0.344	72.22	21.24	292.92	1026.21	6827.77	6.950	4.828	102.62
20.000	0.375	78.60	23.12	291.04	1113.46	6740.52	6.940	4.812	111.35
20.000	0.406	84.96	24.99	289.17	1199.90	6654.08	6.929	4.797	119.99
20.000	0.438	91.51	26.92	287.24	1288.23	6565.76	6.918	4.781	128.82
20.000	0.469	97.83	28.78	285.38	1372.95	6481.03	6.907	4.765	137.30
20.000	0.500	104.13	30.63	283.53	1456.85	6397.12	6.897	4.750	145.69
20.000	0.562	116.67	34.32	279.84	1622.24	6231.74	6.875	4.719	162.22
20.000	0.625	129.33	38.04	276.12	1786.95	6067.02	6.854	4.687	178.70

Table II continued Properties of Stelco steel pipe and concrete core

Pipe			Area		Moment of Inertia		Radius of gyration		Section modulus
outside diameter (in.)	wall (in.)	weight (lbs./ft.)	steel ($in.^2$)	concrete ($in.^2$)	steel ($in.^4$)	concrete ($in.^4$)	steel (in.)	concrete (in.)	steel ($in.^3$)
22.000	0.250	58.07	17.08	363.05	1010.26	10488.76	7.690	5.375	91.84
22.000	0.281	65.18	19.17	360.96	1130.75	10368.27	7.679	5.359	102.80
22.000	0.312	72.27	21.26	358.87	1250.17	10248.86	7.669	5.344	113.65
22.000	0.344	79.56	23.40	356.73	1372.34	10126.67	7.657	5.328	124.76
22.000	0.375	86.61	25.48	354.66	1489.66	10009.36	7.647	5.312	135.42
22.000	0.406	93.64	27.54	352.59	1605.99	9893.03	7.636	5.297	146.00
22.000	0.438	100.87	29.67	350.46	1724.97	9774.05	7.625	5.281	156.82
22.000	0.469	107.85	31.72	348.41	1839.21	9659.81	7.614	5.265	167.20
22.000	0.500	114.81	33.77	346.36	1952.44	9546.57	7.603	5.250	177.49
22.000	0.562	128.68	37.85	342.28	2175.95	9323.07	7.582	5.219	197.81
22.000	0.625	142.68	41.97	338.16	2398.98	9100.03	7.560	5.187	218.09
24.000	0.250	63.41	18.65	433.74	1315.33	14970.69	8.397	5.875	109.61
24.000	0.281	71.19	20.94	431.45	1472.73	14813.30	8.386	5.859	122.73
24.000	0.312	78.94	23.22	429.17	1628.84	14657.19	8.376	5.844	135.74
24.000	0.344	86.91	25.57	426.82	1788.69	14497.34	8.364	5.828	149.06
24.000	0.375	94.62	27.83	424.56	1942.28	14343.74	8.354	5.812	161.86
24.000	0.406	102.31	30.09	422.30	2094.71	14191.31	8.343	5.797	174.56
24.000	0.438	110.22	32.42	419.97	2250.72	14035.30	8.332	5.781	187.56
24.000	0.469	117.87	34.67	417.72	2400.63	13885.39	8.321	5.765	200.05
24.000	0.500	125.49	36.91	415.48	2549.33	13736.68	8.310	5.750	212.44
24.000	0.562	140.68	41.38	411.01	2843.21	13442.81	8.289	5.719	236.93
24.000	0.625	156.03	45.90	406.49	3136.91	13149.11	8.267	5.687	261.41
26.000	0.250	68.75	20.22	510.71	1676.37	20755.41	9.104	6.375	128.95
26.000	0.281	77.19	22.71	508.23	1877.53	20554.25	9.094	6.359	144.43
26.000	0.312	85.60	25.18	505.75	2077.17	20354.61	9.083	6.344	159.78
26.000	0.344	94.26	27.73	503.20	2281.72	20150.05	9.072	6.328	175.52
26.000	0.375	102.63	30.19	500.74	2478.41	19953.36	9.061	6.312	190.65
26.000	0.406	110.98	32.65	498.28	2673.71	19758.06	9.050	6.297	205.67
26.000	0.438	119.58	35.17	495.76	2873.74	19558.03	9.039	6.281	221.06
26.000	0.469	127.89	37.62	493.31	3066.07	19365.70	9.028	6.265	235.85
26.000	0.500	136.17	40.06	490.87	3256.97	19174.79	9.017	6.250	250.54
26.000	0.562	152.69	44.91	486.02	3634.60	18797.16	8.996	6.219	279.58
26.000	0.625	169.38	49.82	481.11	4012.53	18419.23	8.974	6.187	308.66
30.000	0.250	79.43	23.37	683.49	2585.16	37175.67	10.519	7.375	172.34
30.000	0.281	89.19	26.24	680.62	2896.77	36864.06	10.508	7.359	193.12
30.000	0.312	98.93	29.10	677.76	3206.33	36554.50	10.497	7.344	213.76
30.000	0.344	108.96	32.05	674.81	3523.82	36237.00	10.486	7.328	234.92
30.000	0.375	118.65	34.90	671.96	3829.41	35931.40	10.475	7.312	255.29
30.000	0.406	128.33	37.75	669.11	4133.16	35627.66	10.464	7.297	275.54
30.000	0.438	138.29	40.68	666.18	4444.59	35316.22	10.453	7.281	296.31
30.000	0.469	147.92	43.51	663.35	4744.33	35016.48	10.442	7.265	316.29
30.000	0.500	157.53	46.34	660.52	5042.16	34718.64	10.431	7.250	336.14
30.000	0.562	176.70	51.98	654.88	5632.22	34128.59	10.410	7.219	375.48
30.000	0.625	196.08	57.68	649.18	6223.96	33536.83	10.388	7.187	414.93
32.000	0.250	84.77	24.94	779.31	3142.35	48329.57	11.226	7.875	196.40
32.000	0.281	95.20	28.00	776.25	3521.81	47950.12	11.215	7.859	220.11
32.000	0.312	105.59	31.06	773.19	3898.93	47573.00	11.204	7.844	243.68
32.000	0.344	116.30	34.21	770.04	4285.86	47186.06	11.193	7.828	267.87
32.000	0.375	126.66	37.26	766.99	4658.44	46813.47	11.182	7.812	291.15
32.000	0.406	137.00	40.30	763.95	5028.93	46442.98	11.171	7.797	314.31
32.000	0.438	147.65	43.43	760.82	5408.93	46062.98	11.160	7.781	338.06
32.000	0.469	157.94	46.46	757.79	5774.85	45697.05	11.149	7.765	360.93
32.000	0.500	168.21	49.48	754.77	6138.57	45333.33	11.138	7.750	383.66
32.000	0.562	188.70	55.51	748.74	6859.62	44612.28	11.117	7.719	428.73
32.000	0.625	209.43	61.60	742.64	7583.33	43888.54	11.095	7.687	473.96
34.000	0.250	90.11	26.51	881.41	3774.35	61822.96	11.933	8.375	222.02
34.000	0.281	101.20	29.77	878.15	4230.86	61366.50	11.922	8.359	248.87
34.000	0.312	112.26	33.02	874.90	4684.71	60912.64	11.911	8.344	275.57
34.000	0.344	123.65	36.37	871.55	5150.55	60446.81	11.900	8.328	302.97
34.000	0.375	134.67	39.61	868.31	5599.25	59998.05	11.889	8.312	329.37
34.000	0.406	145.67	42.85	865.07	6045.60	59551.74	11.878	8.297	355.62
34.000	0.438	157.00	46.18	861.74	6503.58	59093.73	11.867	8.281	382.56
34.000	0.469	167.96	49.41	858.52	6944.78	58652.57	11.856	8.265	408.52
34.000	0.500	178.89	52.62	855.30	7383.42	58213.84	11.845	8.250	434.32
34.000	0.562	200.71	59.04	848.88	8253.54	57343.76	11.824	8.219	485.50
34.000	0.625	222.78	65.53	842.39	9127.53	56469.73	11.802	8.187	536.91
36.000	0.250	95.45	28.08	989.80	4485.86	77962.12	12.640	8.875	249.21
36.000	0.281	107.20	31.53	986.34	5029.21	77418.88	12.629	8.859	279.40
36.000	0.312	118.92	34.98	982.90	5569.55	76878.50	12.618	8.844	309.42
36.000	0.344	131.00	38.53	979.34	6124.34	76323.75	12.607	8.828	340.24
36.000	0.375	142.68	41.97	975.91	6658.89	75789.12	12.596	8.812	369.94
36.000	0.406	154.34	45.40	972.48	7190.80	75257.25	12.585	8.797	399.49
36.000	0.438	166.36	48.93	968.94	7736.80	74711.25	12.574	8.781	429.82
36.000	0.469	177.98	52.35	965.53	8262.86	74185.12	12.563	8.765	459.05
36.000	0.500	189.57	55.76	962.11	8786.13	73661.81	12.552	8.750	488.12
36.000	0.562	212.71	62.57	955.31	9824.57	72623.37	12.531	8.719	545.81
36.000	0.625	236.13	69.46	948.42	10868.30	71579.69	12.509	8.687	603.79

Table III Allowable column strength of Stelco concrete filled steel pipe piling

Pipe		Area		Allowable column strength (kips)				Corrosion reduction factor (kips)
outside diameter (in.)	wall (in.)	steel ($in.^2$)	concrete ($in.^2$)	steel only	concrete filled steel pipe piling concrete strength $f'_c = 3ksi$	$f'_c = 4ksi$	$f'_c = 5ksi$	
8.625	0.125	3.34	55.09	55.4	95.0	108.2	121.4	14.1
8.625	0.134	3.57	54.85	59.3	98.7	111.9	125.0	14.1
8.625	0.141	3.76	54.67	62.4	101.6	114.7	127.8	14.1
8.625	0.156	4.15	54.28	68.9	107.8	120.8	133.8	14.1
8.625	0.164	4.36	54.07	72.4	111.1	124.1	137.0	14.1
8.625	0.188	4.98	53.44	82.7	121.0	133.8	146.6	14.1
8.625	0.203	5.37	53.06	89.1	127.2	139.8	152.5	14.1
8.625	0.219	5.78	52.64	96.0	133.7	146.3	158.8	14.0
8.625	0.250	6.58	51.85	109.1	146.3	158.6	171.0	14.0
8.625	0.277	7.26	51.16	120.5	157.1	169.3	181.5	14.0
8.625	0.312	8.15	50.28	135.1	171.1	183.1	195.0	14.0
8.625	0.322	8.40	50.03	139.3	175.0	187.0	198.9	14.0
8.625	0.344	8.95	49.48	148.4	183.7	195.5	207.3	14.0
8.625	0.406	10.48	47.94	173.7	208.0	219.4	230.8	14.0
8.625	0.438	11.27	47.16	186.7	220.3	231.5	242.7	14.0
10.750	0.125	4.17	86.59	69.3	131.5	152.2	173.0	17.5
10.750	0.134	4.47	86.29	74.2	136.2	156.9	177.5	17.5
10.750	0.141	4.70	86.06	78.0	139.8	160.5	181.1	17.5
10.750	0.156	5.19	85.57	86.2	147.6	168.1	188.6	17.5
10.750	0.164	5.45	85.31	90.5	151.8	172.2	192.6	17.5
10.750	0.188	6.24	84.52	103.5	164.2	184.4	204.7	17.5
10.750	0.203	6.73	84.04	111.6	171.9	192.0	212.1	17.5
10.750	0.219	7.25	83.52	120.2	180.2	200.1	220.1	17.5
10.750	0.250	8.25	82.52	136.8	196.0	215.7	235.4	17.5
10.750	0.279	9.18	81.58	152.3	210.7	230.2	249.7	17.5
10.750	0.307	10.07	80.69	167.1	224.9	244.1	263.4	17.5
10.750	0.344	11.25	79.52	186.5	243.4	262.4	281.4	17.5
10.750	0.365	11.91	78.85	197.5	253.9	272.7	291.5	17.5
10.750	0.438	14.19	76.57	235.2	290.0	308.2	326.4	17.5
10.750	0.500	16.16	74.66	266.9	320.1	337.9	355.6	17.5
12.750	0.125	4.96	122.72	82.3*	170.5	199.9	229.3	20.8
12.750	0.134	5.31	122.37	88.2	176.1	205.4	234.8	20.8
12.750	0.141	5.59	122.09	92.7	180.5	209.7	239.0	20.8
12.750	0.156	6.17	121.50	102.5	189.8	218.9	248.0	20.8
12.750	0.164	6.48	121.19	107.7	194.7	223.7	252.8	20.8
12.750	0.188	7.42	120.26	123.2	209.5	238.3	267.1	20.8
12.750	0.203	8.00	119.67	132.8	218.8	247.4	276.0	20.8
12.750	0.219	8.62	119.06	143.1	228.6	257.1	285.5	20.8
12.750	0.250	9.82	117.86	162.9	247.5	275.7	303.9	20.8
12.750	0.281	11.01	116.67	182.7	266.3	294.2	322.1	20.8
12.750	0.312	12.19	115.49	202.3	285.1	312.7	340.3	20.8
12.750	0.330	12.88	114.80	213.6	295.9	323.3	350.8	20.8
12.750	0.344	13.41	114.27	222.4	304.3	331.6	358.9	20.8
12.750	0.375	14.58	113.10	241.8	322.8	349.8	376.8	20.8
12.750	0.406	15.74	111.93	261.1	341.3	368.0	394.7	20.8
12.750	0.438	16.94	110.74	281.0	360.2	386.6	413.0	20.8
12.750	0.500	19.24	108.43	319.0	396.5	422.4	448.2	20.8
14.000	0.188	8.16	145.78	135.4	240.1	275.1	310.0	22.8
14.000	0.210	9.10	144.84	151.0	255.0	289.7	324.4	22.8
14.000	0.219	9.48	144.46	157.4	261.1	295.7	330.3	22.8
14.000	0.250	10.80	143.14	179.2	282.0	316.2	350.5	22.8
14.000	0.281	12.11	141.83	201.0	302.7	336.7	370.6	22.8
14.000	0.312	13.42	140.52	222.6	323.4	357.0	390.6	22.8
14.000	0.344	14.76	139.18	244.9	344.6	377.9	411.2	22.8
14.000	0.375	16.05	137.89	266.3	365.1	398.0	431.0	22.8
14.000	0.438	18.66	135.28	309.5	406.4	438.7	470.9	22.8
14.000	0.500	21.21	132.73	351.7	446.6	478.2	509.9	22.8
16.000	0.188	9.34	191.72	155.1	292.8	338.7	384.7	26.1
16.000	0.219	10.86	190.20	180.2	316.9	362.4	408.0	26.1
16.000	0.250	12.37	188.69	205.3	340.8	386.0	431.2	26.1
16.000	0.281	13.88	187.19	230.3	364.7	409.5	454.3	26.1
16.000	0.312	15.38	185.69	255.2	388.4	432.8	477.3	26.1
16.000	0.344	16.92	184.14	280.8	412.9	456.9	500.9	26.1
16.000	0.375	18.41	182.65	305.4	436.4	480.1	523.7	26.1
16.000	0.438	21.41	179.65	355.3	484.0	526.9	569.8	26.1
16.000	0.500	24.35	176.71	403.8	530.4	572.5	614.7	26.1
20.000	0.250	15.51	298.65	257.5	472.1	543.6	615.1	32.6
20.000	0.281	17.41	296.75	289.0	502.1	573.2	644.2	32.6
20.000	0.312	19.30	294.86	320.3	532.1	602.6	673.2	32.6
20.000	0.344	21.24	292.92	352.6	562.9	632.9	703.0	32.6
20.000	0.375	23.12	291.04	383.7	592.6	662.2	731.8	32.6
20.000	0.406	24.99	289.17	414.8	622.2	691.4	760.5	32.6
20.000	0.438	26.92	287.24	446.7	652.7	721.4	790.0	32.6
20.000	0.469	28.78	285.38	477.5	682.1	750.3	818.5	32.6
20.000	0.500	30.63	283.53	508.2	711.4	779.2	846.9	32.6
20.000	0.562	34.32	279.84	569.3	769.8	836.6	903.4	32.6
20.000	0.625	38.04	276.12	631.0	828.7	894.6	960.5	32.6

Table III continued Allowable column strength of Stelco concrete filled steel pipe piling

Pipe		Area		Allowable column strength (kips)				Corrosion reduction factor (kips)
outside diameter (in.)	wall (in.)	steel ($in.^2$)	concrete ($in.^2$)	steel only	concrete filled steel pipe piling concrete strength f'_c = 3ksi	f'_c = 4ksi	f'_c = 5ksi	
22.000	0.250	17.08	363.05	283.6	544.5	631.5	718.4	35.9
22.000	0.281	19.17	360.96	318.3	577.6	664.1	750.5	35.9
22.000	0.312	21.26	358.87	352.9	610.7	696.6	782.5	35.9
22.000	0.344	23.40	356.73	388.5	644.6	730.0	815.4	35.9
22.000	0.375	25.48	354.66	422.9	677.5	762.3	847.2	35.9
22.000	0.406	27.54	352.59	457.1	710.2	794.5	878.9	35.8
22.000	0.438	29.67	350.46	492.4	743.9	827.7	911.5	35.8
22.000	0.469	31.72	348.41	526.5	776.4	859.7	943.0	35.8
22.000	0.500	33.77	346.36	560.4	808.8	891.6	974.4	35.8
22.000	0.562	37.85	342.28	628.0	873.3	955.1	1036.9	35.8
22.000	0.625	41.97	338.16	696.3	938.5	1019.2	1099.9	35.8
24.000	0.250	18.65	433.74	309.7	621.4	725.4	829.3	39.1
24.000	0.281	20.94	431.45	347.7	657.7	761.0	864.3	39.1
24.000	0.312	23.22	429.17	385.5	693.8	796.6	899.3	39.1
24.000	0.344	25.57	426.82	424.4	731.0	833.1	935.3	39.1
24.000	0.375	27.83	424.56	462.0	766.9	868.5	970.1	39.1
24.000	0.406	30.09	422.30	499.5	802.7	903.7	1004.8	39.1
24.000	0.438	32.42	419.97	538.1	839.5	940.0	1040.5	39.1
24.000	0.469	34.67	417.72	575.4	875.1	975.0	1074.9	39.1
24.000	0.500	36.91	415.48	612.6	910.6	1010.0	1109.3	39.1
24.000	0.562	41.38	411.01	686.7	981.4	1079.6	1177.8	39.1
24.000	0.625	45.90	406.49	761.5	1052.8	1149.9	1247.0	39.1
26.000	0.250	20.22	510.71	335.8*	702.9	825.3	947.6	42.4
26.000	0.281	22.71	508.23	377.0	742.2	864.0	985.7	42.4
26.000	0.312	25.18	505.75	418.0	781.4	902.6	1023.7	42.4
26.000	0.344	27.73	503.20	460.3	821.8	942.3	1062.8	42.4
26.000	0.375	30.19	500.74	501.2	860.8	980.7	1100.5	42.4
26.000	0.406	32.65	498.28	541.9	899.7	1019.0	1138.2	42.4
26.000	0.438	35.17	495.76	583.8	939.7	1058.4	1177.0	42.4
26.000	0.469	37.62	493.31	624.4	978.4	1096.4	1214.5	42.4
26.000	0.500	40.06	490.87	664.8	1017.0	1134.4	1251.8	42.4
26.000	0.562	44.91	486.02	745.3	1093.9	1210.1	1326.3	42.4
26.000	0.625	49.82	481.11	826.7	1171.6	1286.6	1401.6	42.4
30.000	0.250	23.37	683.49	388.0*	879.4	1043.2	1207.0	48.9
30.000	0.281	26.24	680.62	435.6*	924.9	1088.0	1251.1	48.9
30.000	0.312	29.10	677.76	483.2	970.3	1132.7	1295.0	48.9
30.000	0.344	32.05	674.81	532.1	1017.0	1178.7	1340.3	48.9
30.000	0.375	34.90	671.96	579.4	1062.2	1223.1	1384.0	48.9
30.000	0.406	37.75	669.11	626.7	1107.3	1267.5	1427.7	48.9
30.000	0.438	40.68	666.18	675.3	1153.7	1313.2	1472.7	48.9
30.000	0.469	43.51	663.35	722.3	1198.6	1357.3	1516.1	48.9
30.000	0.500	46.34	660.52	769.2	1243.4	1401.4	1559.5	48.9
30.000	0.562	51.98	654.88	862.6	1332.6	1489.3	1645.9	48.9
30.000	0.625	57.68	649.18	957.2	1422.9	1578.1	1733.3	48.9
32.000	0.250	24.94	779.31	414.1*	974.4	1161.2	1348.0	52.2
32.000	0.281	28.00	776.25	465.0*	1023.0	1209.1	1395.1	52.2
32.000	0.312	31.06	773.19	515.7*	1071.5	1256.8	1442.0	52.2
32.000	0.344	34.21	770.04	568.0	1121.4	1305.9	1490.4	52.2
32.000	0.375	37.26	766.99	618.6	1169.7	1353.4	1537.1	52.2
32.000	0.406	40.30	763.95	669.0	1217.9	1400.8	1583.8	52.2
32.000	0.438	43.43	760.82	721.0	1267.5	1449.6	1631.8	52.2
32.000	0.469	46.46	757.79	771.2	1315.4	1496.9	1678.3	52.2
32.000	0.500	49.48	754.77	821.4	1363.3	1544.0	1724.6	52.1
32.000	0.562	55.51	748.74	921.3	1458.7	1637.9	1817.0	52.1
32.000	0.625	61.60	742.64	1022.4	1555.3	1732.9	1910.5	52.1
34.000	0.250	26.51	881.41	440.2*	1074.0	1285.3	1496.6	55.4
34.000	0.281	29.77	878.15	494.3*	1125.7	1336.1	1546.6	55.4
34.000	0.312	33.02	874.90	548.3*	1177.2	1386.9	1596.5	55.4
34.000	0.344	36.37	871.55	603.9	1230.4	1439.2	1648.0	55.4
34.000	0.375	39.61	868.31	657.7	1281.7	1489.7	1697.7	55.4
34.000	0.406	42.85	865.07	711.4	1333.0	1540.2	1747.4	55.4
34.000	0.438	46.16	861.74	766.7	1385.8	1592.1	1798.5	55.4
34.000	0.469	49.41	858.52	820.2	1436.8	1642.4	1847.9	55.4
34.000	0.500	52.62	855.30	873.5	1487.8	1692.5	1897.3	55.4
34.000	0.562	59.04	848.88	980.0	1589.4	1792.5	1995.7	55.4
34.000	0.625	65.53	842.39	1087.7	1692.2	1893.7	2095.3	55.4
36.000	0.250	28.08	989.80	466.3*	1178.1	1415.4	1652.6	58.7
36.000	0.281	31.53	986.34	523.6*	1232.9	1469.3	1705.7	58.7
36.000	0.312	34.98	982.90	580.9*	1287.5	1523.1	1758.6	58.7
36.000	0.344	38.53	979.34	639.8*	1343.8	1578.5	1813.1	58.7
36.000	0.375	41.97	975.91	696.9	1398.3	1632.1	1865.8	58.7
36.000	0.406	45.40	972.48	753.8	1452.6	1685.6	1918.5	58.7
36.000	0.438	48.93	968.94	812.4	1508.6	1740.7	1972.7	58.7
36.000	0.469	52.35	965.53	869.1	1562.7	1793.9	2025.1	58.7
36.000	0.500	55.76	962.11	925.7	1616.8	1847.1	2077.5	58.7
36.000	0.562	62.57	955.31	1038.6	1724.6	1953.2	2181.9	58.7
36.000	0.625	69.46	948.42	1152.9	1833.7	2060.6	2287.5	58.7

*These sections have $\frac{O.D.}{t} > \frac{3300}{Fy}$ and by C.S.A. S16-1965 are allowed only with concrete core.

(Concrete Filled)

TABLE OF BASIC LOAD CAPACITIES

For Concrete Strengths of 3000, 4000 and 5000 p.s.i. (28 Days)
Pipe—Minimum Yield Strength of 35000 p.s.i.
(A.S.T.M. Specs. A 252 Grade 2)

Pipe Dia.	Wall In.	Area Concrete	Bearing Capacity Concrete (Kips)			Area of Pipe Less 1/16" Wall	Bearing Capacity Pipe (Kips) fs=14000	Pile or Caisson Bearing Capacity Pipe+Concrete (Kips)		
			f'c—3000	f'c—4000	f'c—5000			f'c—3000	f'c—4000	f'c - 5000
8⅝"	.156	54.272	41.0	54.3	67.7	2.473	34.6	75.6	88.9	102.
	.188	53.456	40.0	53.5	66.6	3.289	46.0	86.0	99.5	112.
	.219	52.651	39.5	52.7	65.6	4.094	57.2	96.7	109.9	122.
	.250	51.849	38.9	51.8	64.9	4.896	68.5	107.4	120.3	133.
10¾"	.156	85.565	64.2	85.6	107	3.099	43.4	107.6	129.0	150.
	.188	84.541	63.4	84.5	106	4.123	57.7	121.1	142.2	163.
	.219	83.528	62.6	83.5	104	5.136	71.8	134.4	155.3	175.
	.250	82.516	61.9	82.5	103	6.146	86.0	147.9	168.5	189.
12¾"	.188	120.28	90.0	120	150	4.91	68.7	158.7	188.7	218.
	.219	119.07	89.3	119	149	6.12	85.6	174.9	204.6	234.
	.250	117.86	88.4	118	147	7.33	103.0	191.4	221.0	250.
	.312	115.47	86.6	115	145	9.72	136.0	222.6	251.0	281.
14"	.188	145.80	109	146	182	5.40	75.5	184.5	221.5	257.
	.219	144.47	108	144	181	6.73	94.2	202.2	238.2	275.
	.250	143.14	107	143	179	8.06	113.0	220.0	256.0	292.
	.312	140.50	105	140	176	10.70	150.0	255.0	290.0	326.
16"	.219	190.20	142	190	237	7.73	108	250	298	
	.250	188.69	141	188	236	9.24	129	270	317	
	.281	187.19	140	187	234	10.75	148	288	335	382
	.312	185.69	139	185	232	12.25	171	310	356	403
20"	.250	298.65	224	298	373	11.60	162	386	460	535
	.281	296.75	223	296	371	13.49	189	412	485	560
	.312	294.80	221	295	368	15.38	215	436	510	583
	.375	291.04	218	291	364	19.20	269	487	560	633
24"	.250	433.74	328	434	547	13.952	195	523	629	742
	.312	429.17	322	429	536	18.517	259	581	688	795
	.375	424.56	318	424	530	23.132	324	642	748	854
	.500	415.48	312	415	520	32.213	451	763	866	971
26"	.250	511.50	384	511	639	15.119	211	595	722	850
	.312	504.85	378	505	630	20.074	281	659	786	911
	.375	501.50	376	501	625	25.085	351	727	852	976
	.500	490.80	369	491	614	34.950	489	858	980	1103
30"	.250	684.70	513	685	855	17.472	244	757	929	1099
	.312	677.60	508	677	846	23.220	325	833	1002	1171
	.375	672.00	504	672	839	29.021	406	910	1078	1245
	.500	660.52	495	660	826	40.459	566	1061	1226	1392
36"	.250	991.50	744	991	1240	21.015	294	1038	1285	1534
	.312	982.90	736	983	1230	27.923	391	1127	1374	1621
	.375	975.91	732	976	1220	34.912	488	1220	1464	1708
	.500	962.12	722	962	1210	48.705	682	1604	1644	1892

APPENDIX B

3300 - 1 DESCRIPTION

1.01 The work shall consist of spreading and compacting screened or crushed aggregate on a prepared surface.

1.02 The following definitions shall apply for this specification:

(a) Mean:

The arithmetic average of a set of 'n' test results constituting the sample.

(b) Moving average:

The arithmetic mean of 3 consecutive test results.

(c) Sub-base aggregate:

The aggregate before mixing, when binder is to be added or the aggregate before spreading and compacting, when no binder is to be added.

(d) Sub-base mix:

The sub-base aggregate after mixing with binder and water but before spreading and compacting.

(e) Sub-base course:

The sub-base aggregate or sub-base mix in place on the road during and after spreading and compacting.

3300 - 2 MATERIALS

Aggregate

2.01 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.

3300 - 3 CONSTRUCTION

General

3.01 (a) Sub-base course shall comply with the requirements listed in Table 1:

TABLE 1

Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series		
	TYPE		
	6	8	10
50.0 mm	100.0	100.0	100.0
2.0 mm	0 - 80.0	0 - 90.0	
400 um	0 - 45.0	0 - 60.0	
160 um	0 - 20.0	0- 25.0	
71 um	0 - 6.0	0 - 15.0	0 - 20.0
Plasticity Index (all types)	0 - 6.0		

(b) 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.

3.02 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

(a) Overburden shall be removed from material deposits in accordance with Specification 2260 For Removal Of Overburden.

(b) Stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

3.03 Binder, filler and blender sand shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

3.04 Sub-base aggregate shall be pushed to a trap or into a stockpile prior to screening.

Processing

3.05 The production of sub-base course shall comply with the following:

(a) The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed in Table 1.

(b) Operations shall not recommence until the specified requirements are met.

(c) Upon recommencement of operations, the specified requirements shall be met on each of the initial 2 tests.

(d) Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

Spreading and Compacting

3.06 The thickness of a compacted lift of sub-base course shall not exceed 120 mm. The lift thickness may be increased if the Contractor can demonstrate that with the use of vibratory compaction equipment and construction procedures, the compaction requirements can be achieved for lifts greater than 120 mm.

3.07 Sub-base courses shall be compacted until no further settlement is apparent and the particles are well keyed into place. The sub-base course shall be free from any rutting or deformations before the placement of the next course.

3.08 If excess moisture originating from external causes including but not limited to precipitation and/or Contractor's operation is present in the sub-base course and/or underlying material prior to the acceptance of the completed surfacing structure; the Contractor shall dry the sub-base course and/or the underlying material to the optimum moisture content and compact the sub-base and/or the underlying material to not less than the specified density or the optimum density in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

Stabilizing

3.09 If the sub-base course proves to be unstable, the Engineer shall require the Contractor to stabilize the sub-base aggregate by one or a combination of the following methods:

(a) By the addition of binder or filler at the aggregate source or at the screening plant. The binder or filler shall be added and thoroughly distributed throughout the aggregate until a homogeneous mixture is obtained.

(b) By the addition of crushed aggregate on the road.

(c) By the addition of emulsified asphalt to the compaction water in the proportions designated by the Engineer. The Department shall supply the asphalt.

(d) Any other method proposed by the Contractor and approved by the Engineer.

Seasonal Shutdown

3.10 If work must be carried over from one construction season to the next, there shall be no exposed sub-base aggregate, mix or sub-base course remaining on the road unless covered by a lift of base course.

3300-4 SAMPLING AND TESTING

General

4.01 Unless otherwise specified, test procedures shall be in accordance with Saskatchewan Highways and Transportation's Standard Test Procedures Manual.

4.02 The test procedures in effect on the closing date of the tenders shall apply.

3300 - 5 MEASUREMENT

5.01 Sub-base course shall be measured in tonnes.

3300 - 6 PAYMENT

6.01 Payment for Sub-base Course shall be at the contract unit price per tonne. The contract unit price shall be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

6.02 If the contract includes a bid item for:

(a) Hauling Sub-base Course and Hauling Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

(b) Watering; payment shall be made in accordance with Specification 2500 For Watering.

(c) Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

(d) Granular Base Course; payment for Granular Base Course used as stabilizing agent shall be at the contract unit price For Granular Base Course.

(e) Prime, Tack or Flush Coat; payment for emulsified asphalt used as stabilizing agent shall be the contract unit price for Prime, Tack and Flush Coat.

3505 - SPECIFICATION FOR GRANULAR BASE COURSE

3505 - 1 DESCRIPTION

1.01 The work shall consist of spreading and compacting crushed and pugmilled aggregate on a prepared surface.

1.02 The following definitions shall apply:

(a) Acceptance limit:

The maximum or minimum value for a test result above or below which the section of roadway shall be rejected.

(b) Acceptance testing:

The testing performed to determine compliance with the specification regarding certain requirements, limits and tolerances for the quality of materials and workmanship to be supplied.

(c) Base aggregate:

The aggregate before pugmilling.

(d) Base mix:

The mix after pugmilling, but before spreading.

(e) Base course:

The mix in place on the road during and after spreading and compacting.

(f) Mean:

The arithmetic average of a set of 'n' test results constituting the sample.

(g) Moving average:

The arithmetic mean of 3 consecutive test results.

(h) Surface defects:

Surface defects that are due to the Contractor’s operation shall include but shall not be limited to the following:

(i) Potholing.

(ii) Surface failures.

(iii) Ravelling.

(iv) Rutting.

(v) Bumps or dips.

(vi) Irregular cross slopes.

(vii) Segregation.

3505 - 2 MATERIALS

Aggregate

2.01 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.

3505 - 3 CONSTRUCTION

General

3.01 (a) Base course shall comply with the requirements listed in Table 1.

TABLE 1

SIEVE DESIGNATION	PERCENT BY WEIGHT PASSING CANADIAN METRIC SIEVE SERIES		
	TYPE		
	31	33	35
31.5 mm	100.0		
18.0 mm	75.0 - 90.0	100.0	100.0
12.5 mm	65.0 - 83.0	75.0 - 100.0	81.0 - 100.0
5.0 mm	40.0 - 69.0	50.0 - 75.0	50.0 - 85.0
2.0 mm	26.0 - 47.0	32.0 - 52.0	32.0 - 65.0
900 um	17.0 - 32.0	20.0 - 35.0	20.0 - 43.0
400 um	12.0 - 22.0	15.0 - 25.0	15.0 - 30.0
160 um	7.0 - 14.0	8.0 - 15.0	8.0 - 18.0
71 um	6.0 - 11.0	6.0 - 11.0	7.0 - 12.0
Plasticity Index	0 - 7.0	0 - 6.0	0 - 5.0
Fractured Face %	50.0 Minimum		
Light Weight Pieces %	5.0 Maximum		

(b) A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 40.0 mm sieve for Type 31 base course and the 22.4 mm sieve for Types 33 and 35 base course.

3.02 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

(a) Overburden shall be removed from material deposits in accordance with Specification 2260 For Removal Of Overburden.

(b) Rock passing a 450 mm square opening screen and larger than the maximum specified size shall be crushed and incorporated simultaneously throughout the crushing operation.

(c) Stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

3.03 Binder, filler, and blender sand shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

3.04 Binder, filler and blender sand shall be added using a separate conveyor system.

3.05 Binder, filler and blender sand feeds shall be accurately controlled and coordinated.

Reject Aggregate

3.06 If the Contractor is required to reject a fraction of the raw aggregate to meet the aggregate requirements in Table 1, the following shall apply:

(a) The raw aggregate shall be screened over a maximum 9.0 mm square opening screen or a 5.0 mm slotted screen prior to crushing.

(b) The Contractor shall be responsible for the rejected material up to a maximum of 10% of the raw aggregate by weight.

(c) The quantity of raw aggregate shall be calculated as follows:

Raw aggregate = (Granular base course less binder, filler and blender sand) x 1.11

Processing

3.07 Base mix production shall comply with the following requirements during the pugmilling stage:

(a) The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed in Table 1.

(b) Operations shall not recommence until the specified requirements are met.

(c) Upon recommencement of operations, the specified requirements shall be met on each of the initial 2 tests.

(d) Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

3.08 Base aggregate shall be stockpiled after the crushing operation and prior to the pugmilling.

3.09 During pugmilling operations, the Contractor shall have sufficient base aggregate in stockpile for at least 24 h of pugmilling operation until crushing is completed.

3.10 Pugmilling shall be performed in a stationary mixing plant. The mixing unit shall be designed to ensure complete mixing of the materials.

3.11 The pugmill shall be equipped with spray bars for the addition of water.

3.12 The moisture content of the base mix shall not be greater than 5 % by weight when it leaves the pugmill.

Spreading And Compacting

3.13 Base mix shall be spread on dry and unfrozen surfaces.

3.14 Base mix shall not be compacted if the atmospheric temperature is less than 2 °C.

3.15 Base course spilled on new asphalt concrete shall be removed immediately.

3.16 The finished surface of the base course shall be true to grade and cross section and free of any surface defects.

3.17 If specified in the Special Provisions or shown on the plans, a prime coat shall be placed on the finished final lift of base course in accordance with Specification 4000 For Bituminous Prime, Tack, And Flush Coat. Prime coat shall be placed within 24 h, weather permitting, after receiving written authorization from the Engineer.

3.18 If a seal coat is specified for shoulder base course, the surface of the final lift of shoulder base course shall be constructed 10 mm below the surface of the final lift of the wearing course.

3.19 If excess moisture originating from external causes including but not limited to precipitation and/or Contractor's operation is present in the subgrade and/or sub-base course and/or base course prior to the acceptance of the completed surfacing structure; the Contractor shall dry the subgrade and/or sub-base course and/or base course to the optimum moisture content and compact the subgrade and/or sub-base course and/or base course to not less than the specified density or the optimum density in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

Seasonal Shutdown

3.20 If work must be carried over from one construction season to the next and the number of working days/completion date have not expired, the following shall apply:

(a) For accepted final lift of base course on which a wearing course has not been placed, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.5 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.5 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Department shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on the 1.5 km limit.

(v) When work resumes, the Contractor shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all other sections outside the 1.5 km limit.

(b) For unaccepted base course and accepted lower lifts of base course, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.5 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.5 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Department shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on the 1.5 km limit.

(v) When work resumes, the Contractor shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all other sections outside the 1.5 km limit.

3.21 If work must be carried over from one construction season to the next and the number of working days/completion date have expired, the following shall apply:

(a) For accepted final lift of base course on which a wearing course has not been placed, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.0 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.0 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Contractor shall bear the costs of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all sections of base course.

(b) For unaccepted base course and accepted lower lifts of base course, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iii) When work resumes, the Contractor shall bear the costs of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all sections of base course.

3.22 The Contractor shall bear the cost of maintenance, except snow and ice removal, on sections of roadway where the road surface has been disturbed by the construction operations.

3505 - 4 SAMPLING AND TESTING

General

4.01 Unless otherwise specified, test procedures shall be in accordance with Saskatchewan Highways and Transportation's Standard Test Procedures Manual.

4.02 The test procedures in effect on the closing date of the tenders shall apply.

Acceptance Testing

4.03 Upon notification from the Contractor that a section of the roadway has been inspected and is ready for acceptance testing, the Engineer shall carry out the required tests for density and surface defects.

Acceptance Testing for Density

4.04 The maximum density value and the corresponding optimum moisture content shall be determined in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

4.05 Densities shall not be taken at locations within 0.5 m of an unsupported edge and 0.1 m of a supported edge.

4.06 Acceptance testing for density of the base course on the road shall be determined in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 205-7).

4.07 Frequency and locations of testing on any section shall be at the discretion of the Engineer.

3505 - 5 ACCEPTANCE OR REJECTION

5.01 The section of base course shall be considered acceptable if it contains no surface defects and if:

(a) The average density meets or exceeds 100 % of maximum density.

(b) All individual test results are greater than 98 % of maximum density.

(c) The moisture content is less than or equal to the optimum moisture content.

5.02 If shoulder base course is placed in a separate operation and shoulder base course is the final wearing course; the section of shoulder base course shall be considered acceptable if it contains no surface defects and if:

(a) The average density meets or exceeds 95.0 % of maximum density.

(b) All individual test results are greater than 93.0 % of maximum density.

(c) The moisture content is less than or equal to the optimum moisture content.

Product Rejection

5.03 If the densities for any section of the roadway are outside the acceptance limits outlined in Sections 5.01 and 5.02, the section shall be rejected as unacceptable work and the following shall apply:

(a) The Contractor shall have the opportunity to remedy existing base course by rerolling or by any other method suggested by the Contractor and approved by the Engineer. The Contractor may request that the section of the roadway be retested during or after the completion of the remedial attempts.

(b) The section shall be tested a total of 3 times free of cost to the Contractor. The Contractor shall pay the cost of any additional testing. The rate for the Department testing shall be as designated in the Special Provisions.

(c) If the base course in the section remains outside the acceptance limits after the remedial attempts, the Contractor shall remove and replace all the base course in that section. The Engineer may approve a base course overlay of equal thickness in lieu of removing and replacing the base course.

5.04 Any section with surface defects shall be rejected as unacceptable work.

Repairs

5.05 Surface defects shall be repaired in a manner acceptable to the Engineer.

3505 - 6 MEASUREMENT

6.01 Granular base course shall be measured in tonnes.

6.02 Reject aggregate shall be measured by the cross section method. The volume of reject shall be multiplied by 1.7 to calculate tonnes.

3505 - 7 PAYMENT

7.01 Payment for Granular Base Course and Granular Shoulder Base Course shall be at the contract unit price per tonne. The unit price shall be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

7.02 The rate that the Department shall pay for rejecting aggregate in excess of 10% shall be as designated in the Special Provisions of the contract.

7.03 If the contract includes a bid item for:

(a) Hauling Granular Base Course, Hauling Granular Shoulder Base Course and/or Hauling Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

(b) Watering; payment shall be made in accordance with Specification 2500 For Watering.

(c) Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

(d) Prime, Tack or Flush Coat; payment shall be made in accordance with Specification 4000 For Bituminous Prime, Tack And Flush Coat.

7.04 All remedial work shall be performed at the Contractor's expense including the cost of materials.

Saskatchewan
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Transportation

4100 – SPECIFICATION FOR ASPHALT CONCRETE

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4100.1 GENERAL

4100.1.1 Description

4100.1.1.1 The work shall consist of mixing crushed aggregates, or a combination of crushed aggregates and reclaimed asphalt concrete, blender sand material as required, additives as required, and asphalt in a hot mix plant; and spreading and compacting the mixture on a prepared surface.

4100.1.2 Definitions

4100.1.2.1 The following definitions shall apply for this specification:

4100.1.2.1.1 Acceptance Limit is the maximum or minimum value for a test result above or below which the block and/or lot will be rejected.

4100.1.2.1.2 Acceptance Testing is the testing performed by the Engineer to determine compliance with the specifications regarding specified requirements, limits and tolerances for the quality of materials and workmanship supplied.

4100.1.2.1.3 Adjusted PrI is the adjusted profile results for smoothness in a block in which individual bumps and dips greater than 12 mm have been removed. The adjusted PrI in a block will be recalculated by removing the individual PrI results corresponding to the location of individual bumps and dips that are greater than 12 mm.

4100.1.2.1.4 Asphalt is the asphalt material being added as bituminous binder.

4100.1.2.1.5 Asphalt Concrete is the asphalt mix in place on the road including levelling and surface courses during and after spreading and compacting.

4100.1.2.1.6 Asphalt Mix is the mix after the asphalt mix aggregate and asphalt have been blended together.

4100.1.2.1.7 Asphalt Mix Aggregate is the aggregate after combining all virgin aggregates, additives and reclaimed asphalt concrete aggregate.

4100.1.2.1.8 Asphalt Mix Design is the laboratory determination of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix.

4100.1.2.1.9 Asphalt Mix Formula is the field determination during the plant calibration process of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix as produced at the plant.

4100.1.2.1.10 Block is the unit of measurement for assessing smoothness and individual bumps and dips. A block is a portion of the final lift of asphalt concrete that is one paver width wide and 100 m long. The first and last block on a construction section may be less than 100 m long.

4100.1.2.1.11 Density

4100.1.2.1.11.1 Asphalt Mix Design Density is the Marshall density for the compacted Asphalt Mix Design specimen (see 4100.1.2.1.8 above).

4100.1.2.1.11.2 Asphalt Mix Formula Density is the Marshall density for the compacted Asphalt Mix Formula specimen (see 4100.1.2.1.9 above).

4100.1.2.1.11.3 Field Density is the density of the Asphalt Concrete as determined by STP 204 – 6, Density-In-Place By Nuclear Gauge.

4100.1.2.1.11.4 Job Mix Formula Density is the Marshall density for the compacted Job Mix Formula specimen (see 4100.1.2.1.13 below).

4100.1.2.1.11.5 Specified Marshall Density is 97% of the 3-point moving average Marshall Density established for the Asphalt Mix Formula or the Job Mix Formula, whichever is in use.

4100.1.2.1.11.6 Target Density is the density established through the rolling pattern strip when the Specified Marshall Density is not achievable.

4100.1.2.1.12 Individual Bump And/Or Dip is a bump or dip measured in the vertical direction that exceeds 12 mm.

4100.1.2.1.13 Job Mix Formula is the field determination of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix as produced at the plant.

4100.1.2.1.14 Lot is approximately 200 tonnes of asphalt concrete which is assessed as a unit for the purpose of payment and selected to represent work produced by essentially the same process and materials. The final lot on a project may vary in mass from 101 t to 300 t.

4100.1.2.1.15 Mean is the arithmetic average of the test results within a lot.

4100.1.2.1.16 Moving Average is the arithmetic mean of 3 consecutive test results.

4100.1.2.1.17 Profile Index (PrI) is the sum of the vertical deviations, in millimetres, outside the 5 mm null band that a roadway deviates from a perfectly flat surface over a horizontal distance of 100 m. The PrI categories are as follows:

4100.1.2.1.17.1 Category I PrI applies to all blocks not identified below as Category II PrI.

4100.1.2.1.17.2 Category II PrI applies to the following circumstances:

4100.1.2.1.17.2.1 Curves with radius less than 600 m;

4100.1.2.1.17.2.2 Blocks within 50 m of a bridge or railway crossing;

4100.1.2.1.17.2.3 Single lift rehabilitation projects where the total thickness of asphalt concrete being placed is 50 mm or less, with the exception of profiled-milled sections;

4100.1.2.1.17.2.4 Areas where there is curb and gutter; and

4100.1.2.1.17.2.5 The block at each construction limit.

4100.1.2.1.18 Reclaimed Asphalt Concrete is asphalt concrete reclaimed from the roadway.

4100.1.2.1.19 Reclaimed Asphalt Concrete Aggregate is the aggregate remaining after the asphalt has been extracted from the Reclaimed Asphalt Concrete.

4100.1.2.1.20 Repair

4100.1.2.1.20.1 Class I Repair is a corrective improvement that removes and replaces, or overlays the defective or damaged block(s) or lot(s) and restores the block(s) or lot(s) to the specified standard.

4100.1.2.1.20.2 Class II Repair is a surface treatment that mends or corrects a structural defect to restore the surface to an acceptable standard (e.g. slurry seal).

4100.1.2.1.20.3 Class III Repair is a surface treatment that mends or corrects a surface defect but does not restore the surface to an acceptable standard (e.g. flush coat).

4100.1.2.1.20.4 Class IV Repair is a corrective improvement to the ride by reducing bump(s) and/or dip(s). An acceptable Class IV repair is one which removes or reduces the bump(s) and/or dip(s) through a smooth transition to the surrounding asphalt concrete without impairing the functionality and/or structural characteristics in the area of the bump(s) and/or dip(s).

4100.1.2.1.21 Segregated Area is an area 0.1 m^2 or greater where the surface texture is either too stony or lacking in continuous matrix of asphalt, fine aggregate and coarse aggregate in relation to the surrounding acceptable asphalt concrete.

4100.1.2.1.22 Segregation Severity

4100.1.2.1.22.1 None means a completely uniform surface texture. The matrix of asphalt and fine aggregate is in place between the coarse aggregate.

4100.1.2.1.22.2 Minor means significantly more stone is visible than in the surrounding acceptable asphalt concrete, usually with a lack of continuous contact with the surrounding matrix.

4100.1.2.1.22.3 Severe means areas that usually appear as very stony mix, with stone against stone, and may be missing matrix.

4100.1.2.1.23 Smoothness means the surface profile of the asphalt concrete with the Profile Index (PrI) as the measured output. Individual bumps and/or dips of 12 mm or less are considered a part of smoothness.

4100.1.2.1.24 Surface Defects that are due to the Contractor's operation shall include, but shall not be limited to the following:

4100.1.2.1.24.1 Areas of segregation less than 0.1 m^2;

4100.1.2.1.24.2 Areas containing excess or insufficient asphalt;

4100.1.2.1.24.3 Areas of open texture;

4100.1.2.1.24.4 Improper matching of longitudinal and transverse joints on final lift of asphalt concrete;

4100.1.2.1.24.5 Roller marks on final lift of asphalt concrete;

4100.1.2.1.24.6 Cracking or tearing;

4100.1.2.1.24.7 Contamination by diesel, hydraulic fluids, detergent or other harmful products;

4100.1.2.1.24.8 Foreign objects or materials that are detrimental to the asphalt concrete; and

4100.1.2.1.24.9 Clay balls or oversized materials.

4100.2 MATERIALS

4100.2.1 Asphalt

4100.2.1.1 The Department will supply and pay for the asphalt.

4100.2.2 Aggregate

4100.2.2.1 Virgin 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, clay, loam, ironstone, coal and organic or other deleterious material.

4100.2.3 Anti-Stripping Agents

4100.2.3.1 The Department will supply and pay for the anti-stripping agents.

4100.3 CONSTRUCTION

4100.3.1 Department Owned or Controlled Aggregate Sources

4100.3.1.1 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

4100.3.1.1.1 Overburden shall be removed from material deposits in accordance with Specification 2260 For The Removal Of Overburden.

4100.3.1.1.2 Rock passing a 610 mm square opening screen and larger than the maximum specified size shall be crushed and incorporated simultaneously throughout the crushing operation.

4100.3.1.1.3 Aggregate stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

4100.3.2 Binder, Filler and Blender Sand

4100.3.2.1 Filler and blender shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

4100.3.3 Anti-Stripping Agents

4100.3.3.1 The Department will determine whether or not anti-stripping agent is required.

4100.3.3.2 When the Department has determined that anti-stripping agent is required, the Engineer will determine if hydrated lime or liquid anti-stripping agent shall be used.

4100.3.3.3 Hydrated Lime

4100.3.3.3.1 When hydrated lime is used, the following shall apply:

4100.3.3.3.1.1 The Contractor shall supply the equipment necessary to add the lime.

4100.3.3.3.1.2 The hydrated lime shall be blended by a pugmill into the cold aggregate feed.

4100.3.3.3.1.3 Sufficient water shall be added at the pugmill to ensure a minimum of 3% moisture content in the aggregate.

4100.3.3.3.1.4 The amount of hydrated lime added shall be approximately 1% of the total dry aggregate by weight, or as designated by the Engineer, for the Job Mix Formula.

4100.3.3.3.1.5 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.

4100.3.3.3.1.6 The Contractor shall maintain records containing bills of lading, estimated quantities on hand, estimated quantities used, and at the completion of the project, the estimated unused quantity. The record of estimated usage shall be provided to the Engineer on a daily basis.

4100.3.3.3.1.7 At the end of the project the bulk measurement of the hydrated lime used on the project shall not deviate by more than 25% from the specified percentage designated by the Job Mix Formula. If the final amount of hydrated lime used on the project exceeds 125% of the specified percentage designated by the Job Mix Formula, the Department will deduct the cost of the hydrated lime used in excess of 125% from the Final Progressive Estimate. If the final amount of hydrated lime used on the project is less than 75% of the specified percentage designated by the Job Mix Formula, the Contractor shall perform at his expense a Class I repair on the asphalt concrete in a manner acceptable to the Engineer.

4100.3.3.4 Liquid Anti-Stripping Agent:

4100.3.3.4.1 When a liquid anti-stripping agent is used, the following shall apply:

4100.3.3.4.1.1 The Contractor shall supply the equipment necessary to add a liquid anti-stripping agent.

4100.3.3.4.1.2 The addition of liquid anti-stripping agent shall be accomplished through the use of a liquid anti-strip injection system containing a positive displacement pump with a variable speed motor, a totalizing flow meter, a sampling valve, a system check valve, a system isolation valve and an inline check valve. The injector pump motor shall be regulated by a signal from the asphalt flow meter.

4100.3.3.4.1.3 Liquid anti-stripping agent will be injected into the plant asphalt line just prior to entry into the drum mixer.

4100.3.3.4.1.4 The system shall be capable of regulating the flow rate resulting in consistent flow rate of liquid anti-stripping agent.

4100.3.3.4.1.5 The system shall be capable of re-circulating the liquid anti-stripping agent to the storage tank until the asphalt plant bypass valve is actuated.

4100.3.3.4.1.6 Liquid anti-stripping agent shall be added at a rate of approximately 1.0% of the weight of liquid asphalt added, or as designated by the Engineer, for the Job Mix Formula.

4100.3.3.4.1.7 The Contractor shall maintain records containing bills of lading, estimated quantities on hand, estimated quantities used, damaged barrels, and at the completion of the project, any estimated quantities of unused anti-stripping agent. The Contractor shall provide the record of estimated usage to the Engineer on a daily basis.

4100.3.3.4.1.8 At the end of the project the bulk measurement of the liquid anti-stripping agent used on the project shall not deviate by more than 10% from the specified percentage designated by the Job Mix Formula. If the final amount of liquid anti-stripping agent used on the project exceeds 110% of the specified percentage designated by the Job Mix Formula, the Department will deduct the cost of the liquid anti-stripping agent used in excess of 110% from the Final Progressive Estimate. If the final amount of liquid anti-stripping agent used on the project is less than 90% of the specified percentage designated by the Job Mix Formula, the Contractor shall perform at his expense a Class I repair on the asphalt concrete.

4100.3.3.4.1.9 The Contractor shall handle all barrels of liquid anti-stripping agent in such a manner that they can be returned to the supplier. The full cost of any barrels damaged such that they cannot be returned to the supplier, or any environmental clean-up required, will be charged back to the Contractor, and deducted from the Final Progressive Estimate. If the Contractor uses liquid anti-stripping in bulk, the full cost of any environmental clean-up required will be charged back to the Contractor and deducted from the Final Progressive Estimate.

4100.3.4 Aggregate

4100.3.4.1 The Contractor shall split the aggregate into 3 separate stockpiles in accordance with the following:

4100.3.4.1.1 The natural fines stockpile shall be produced by screening the raw aggregate over a maximum 9.0 mm square opening screen or 5.0 mm slotted screen prior to crushing.

4100.3.4.1.2 The aggregate retained on the screen shall be crushed and split into crushed coarse and crushed fine stockpiles.

4100.3.4.1.3 The crushed coarse stockpile shall contain no more than 10% of the material passing the 5.0 mm square opening sieve.

4100.3.4.1.4 The crushed fine stockpile shall contain no less than 90% of the material passing the 5.0 mm square opening sieve.

4100.3.4.1.5 The Contractor shall provide accurate measurements of quantities and percentages of aggregate being placed in each stockpile after producing 50% of the aggregate or 10 000 t, whichever is greater; or when all the aggregate is produced if the total quantity is less than 10 000 t. If the splits provided by the Contractor prove to be inaccurate and result in an aggregate shortage, securing additional equivalent aggregate shall be at the Contractor's expense.

4100.3.4.2 The crushed coarse, crushed fines, and natural fines stockpiles shall be mathematically recombined at the percentages provided by the Contractor. If the resulting aggregate does not meet the requirements of Table 4100.3.T1, the Contractor shall be required to reject a fraction of the material in the natural fines stockpile in accordance with General Provision 1500.2.8.

4100.3.4.3 If recycled asphalt concrete is designated in the contract, the following shall apply:

4100.3.4.3.1 The reclaimed asphalt concrete shall not exceed 40 mm when measured in any direction before entering the plant.

4100.3.4.3.2 The crushed coarse, crushed fines, natural fines and reclaimed asphalt concrete stockpiles shall be mathematically recombined at the percentages provided by the Contractor. If the resulting aggregate does not meet the requirements of Table 4100.3.T1, the Contractor shall be required to reject a fraction of the material in the natural fines stockpile in accordance with General Provision 1500.2.8.

4100.3.5 Asphalt Mix Design

4100.3.5.1 The asphalt mix design will be established by the Engineer in accordance with the requirements for Marshall Mix Design (STP 204-10) within 10 calendar days after 50% of the aggregate has been produced or 10 000 t, whichever is greater, and provided that the Contractor has complied with Section 4100.3.4.1.5.

4100.3.5.2 Further to Section 4100.3.4.1.5, if the Department is required to do an additional mix design because the splits provided by the Contractor prove to be inaccurate, the Contractor will be assessed the rate specified in the Special Provisions.

4100.3.5.3 The asphalt mix design type will be specified in the Special Provisions. The asphalt mix characteristics shall meet the requirements in Table 4100.3.T1.

TABLE 4100.3.T1

ASPHALT CONCRETE MIX DESIGN TYPES AND CHARACTERISTICS

Mix Design Type/ Design Factors -Mix Characteristics	**1**	**2**	**3**	**4**	**5**	**6**
Asphalt Type	150-200 A or 200-300 A			150-200 A or 200-300 A		
Marshall Blows	50 blows			75 blows		
Aggregate Type/Sieve Designation*	70 or 70 R	71 or 71 R	72 or 72 R	70 or 70 R	71 or 71 R	72 or 72 R
18.0 mm	100.0			100.0		
16.0 mm	78.0 – 98.0	100.0		78.0-98.0	100.0	
12.5 mm	68.0 – 92.0	78.0 – 98.0	100.0	68.0 – 92.0	78.0 – 98.0	100.0
9.0 mm	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0
5.0 mm	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0
2.0 mm	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0
900 um	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0
400 um	5.0 – 25.0	10.0 -- 27.0	10.0 -- 27.0	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0
160 um	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0
71 um	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0
Air Voids, %	3.0 – 5.0					
Air Voids (Field), %	4.0 – 9.0					
Deleterious Material, Maximum % **	2.0					
Film Thickness, Minimum um	7.5					
Flow, mm	1.5 – 3.5					
Fracture, Minimum % ***	60.0	70.0	80.0	75.0	85.0	95.0
Lightweight Aggregate, Maximum %	1.0					
Retained Stability, Minimum %	70.0					
Sand Equivalent, Minimum	45					
Stability, Minimum N	5500			7000		
Voids Filled, %	65.0 - 78.0					
V. M. A., %	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0

*A tolerance of 3% in the percent by weight retained on the maximum size sieve will be permitted providing 100% of the oversize passes the 22.4 mm sieve for Type 70 and Type 70 R aggregate, the 18.0 mm sieve for Type 71 and 71 R aggregate and the 16 mm sieve for Type 72 and 72 R aggregate.

**Deleterious material includes all other injurious material other than lightweight pieces.

** *The Fractured Face percentage will be calculated on the aggregate after combining all virgin aggregates and additives, excluding reclaim.

TABLE 4100.3.T1 *continued*

ASPHALT CONCRETE MIX DESIGN TYPES AND CHARACTERISTICS

Mix Design Type/ Design Factors - Mix Characteristics	**7**	**8**	**9**	**10**	**11**	**12**
Asphalt Type	300-400 A			300-400 A		
Marshall Blows	50 blows			75 blows		
Aggregate Type/Sieve Designation*	70 or 70 R	71 or 71 R	72 or 72 R	70 or 70 R	71 or 71 R	72 or 72 R
18.0 mm	100.0			100.0		
16.0 mm	78.0 – 98.0	100.0		78.0-98.0	100.0	
12.5 mm	68.0 – 92.0	78.0 – 98.0	100.0	68.0 – 92.0	78.0 – 98.0	100.0
9.0 mm	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0
5.0 mm	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0
2.0 mm	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0
900 um	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0
400 um	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0
160 um	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0
71 um	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0
Air Voids, %	3.0 – 5.0					
Air Voids (Field), %	4.0 – 9.0					
Deleterious Material, Maximum % **	2.0					
Film Thickness, Minimum um	7.5					
Flow, mm	1.5 – 3.5					
Fracture, Minimum % ***	50.0	60.0	70.0	75.0	85.0	95.0
Lightweight Aggregate, Maximum %	1.0					
Retained Stability, Minimum %	70.0					
Sand Equivalent, Minimum	45.0					
Stability, Minimum N	5500			7000		
Voids Filled, %	65.0 - 78.0					
V. M. A., %	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0

*A tolerance of 3% in the percent by weight retained on the maximum size sieve will be permitted providing 100% of the oversize passes the 22.4 mm sieve for Type 70 and Type 70 R aggregate, the 18.0 mm sieve for Type 71 and 71 R aggregate and the 16 mm sieve for Type 72 and 72 R aggregate.

**Deleterious material includes all other injurious material other than lightweight pieces.

** *The Fractured Face percentage will be calculated on the aggregate after combining all virgin aggregates and additives, excluding reclaim.

4100.3.6 Plant Requirements

4100.3.6.1 A uniform mixture shall be produced in which all particles are thoroughly coated. Aggregate particles shall not be coated with residue from fuel combustion. The asphalt mix shall contain no more than 0.5% moisture by weight.

4100.3.6.2 If reclaimed asphalt concrete is added, the following shall apply:

4100.3.6.2.1 The plant shall contain equipment that will prevent the reclaimed asphalt concrete from coming into direct contact with the flame, thus minimizing oxidation of the asphalt in the reclaimed asphalt concrete.

4100.3.6.2.2 The Contractor shall undertake all the necessary adjustments to ensure proper heat transfer and breakdown of the reclaimed asphalt concrete to form a homogeneous end product. The plant shall be capable of heating the reclaimed asphalt concrete particles and blending them with virgin aggregate and any required asphalt to create a homogeneous mix at the plant discharge.

4100.3.7 Plant Calibration and Operation

4100.3.7.1 Plant Calibration:

4100.3.7.1.1 The Contractor shall provide the Engineer with at least three calendar days advance notice of when he plans to do the plant calibration.

4100.3.7.1.2 During plant calibration, the Engineer will assess the property variations of the asphalt mix produced during the calibration process against the asphalt mix design.

4100.3.7.1.3 If the asphalt mix meets the properties and/or characteristics as shown in Table 4100.3.T1, the Contractor may commence hauling to the road upon receiving written approval from the Engineer.

4100.3.7.1.4 The asphalt mix will be rejected if the requirements of Table 4100.3.T1 are not met, and no asphalt mix shall be hauled to the road. The Engineer will provide a modified or new asphalt mix design.

4100.3.7.1.5 After 24 hours of asphalt mix production, if the asphalt mix properties are consistent and meet all specified requirements, the Engineer will approve the Asphalt Mix Formula as the Job Mix Formula.

4100.3.7.2 Plant Operation

4100.3.7.2.1 For the initial 24 hours of plant production at each plant set-up, the asphalt added shall not vary by more than 0.5% from the design asphalt content. Full-scale plant production shall not commence until the percentage of asphalt added to trial batches of asphalt mix complies with the foregoing requirement.

4100.3.7.2.2 After the initial 24 hours of production, the Contractor shall cease operations if the moving average of asphalt added varies by more than 0.3% from the Job Mix Formula.

4100.3.7.2.3 After the Job Mix Formula aggregate gradation has been established, the following shall apply:

4100.3.7.2.3.1 The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed below:

TABLE 4100.3.T2

MAXIMUM PERMISSIBLE SIEVE VARIATION

Maximum Permissible Variation from the Job Mix Formula	
Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series
16.0 mm	±5.0
12.5 mm	±5.0
9.0 mm	±5.0
5.0 mm	±5.0
2.0 mm	±4.0
900 um	±3.0
400 um	±3.0
160 um	±2.0
71 um	±1.5

4100.3.7.2.3.2 Road operations shall not recommence until the specified requirements are met.

4100.3.7.2.3.3 Upon re-commencement of operations, the specified requirements shall be met on each of the initial 2 tests.

4100.3.7.2.3.4 Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

4100.3.7.2.4 The Contractor shall immediately shut down the plant when:

4100.3.7.2.4.1 The stack emissions temperature exceeds the asphalt mix temperature at the mixer discharge by more than 20°C or;

4100.3.7.2.4.2 The temperatures exceed the limits outlined in the following table:

TABLE 4100.3.T3

TEMPERATURE LIMITS

Grade of Asphalt	Degrees Celsius		
	Maximum Temperature of Dry Aggregate	Asphalt Storage Temperature	Asphalt Mix Temperature at Mixer Discharge
150-200A	160	120-175	135-155
200-300A	160	120-175	130-150
300-400A	150	114-175	120-140
400-500A	140	110-175	110-130

4100.3.7.2.5 All material produced subsequent to the occurrence of an event specified in Section 4100.3.7.2.4 will be deemed to be unacceptable material for the purposes of General Provision 1400-7 (Unacceptable And Unauthorized Work).

4100.3.7.2.6 Plant operations shall not recommence until the temperature limits in Section 4100.3.7.2.4 are met.

4100.3.7.2.7 The Contractor shall dispose of any rejected asphalt mix or asphalt concrete in a manner that is acceptable by the Engineer.

4100.3.8 Delivering to the Road

4100.3.8.1 Truck boxes shall be clean and free from accumulations of asphalt mix and foreign materials. Excess truck box lubricants such as light oil, detergent, lime solutions, gasoline, kerosene, diesel or other similar products shall not be allowed to contaminate the asphalt mix, and shall be disposed of in an environmentally acceptable manner.

4100.3.8.2 Every truck used to transport the asphalt mix shall be equipped with a tarpaulin which is waterproof and can be securely fastened, when required, to protect the asphalt mix from precipitation and excessive heat loss.

4100.3.8.3 Prior to unloading into the paver, the temperature at a depth of 40 mm below the surface of the asphalt mix in the truck box shall not be less than 110°C.

4100.3.8.4 Trucks shall be turned around only at approaches.

4100.3.9 Pavers

4100.3.9.1 Pavers shall be self-propelled units capable of spreading and finishing the asphalt concrete to the specified typical cross section and thickness shown on the paving plans. For traffic lanes, pavers shall be operated using the following:

4100.3.9.1.1 Automatic screed controls, for the control of longitudinal and transverse slope and joint matching. The automatic control device shall be capable of being operated from either side of the paver.

4100.3.9.1.2 Vibrating screed

4100.3.10 Spreading

4100.3.10.1 If designated by the Engineer, a tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.3.10.2 Asphalt mix shall be spread on dry, clean, and unfrozen surfaces.

4100.3.10.3 Asphalt concrete shall be placed in accordance with the following temperature limitations:

4100.3.10.3.1 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.

4100.3.10.3.2 The final lift of asphalt concrete shall not be placed if:

4100.3.10.3.2.1 The atmospheric temperature is less than 5°C; or

4100.3.10.3.2.2 The surface temperature is less than 7°C.

4100.3.10.4 The minimum and maximum thickness of a compacted lift of asphalt concrete shall meet the following requirements:

TABLE 4100.3.T4

MINIMUM AND MAXIMUM LIFT THICKNESS

Lift	Type 70 or 70 R Aggregate		Type 71 or 71 R Aggregate		Type 72 or 72 R Aggregate	
	Minimum Thickness	Maximum Thickness	Minimum Thickness	Maximum Thickness	Minimum Thickness	Maximum Thickness
Top	40 mm	60 mm	35 mm	50 mm	30 mm	50 mm
Lower	30 mm	60 mm	30 mm	50 mm	25 mm	50 mm

4100.3.10.5 The following clause shall apply only when shimming and levelling are specified in the Special Provisions as being applicable to the Contract.

4100.3.10.5.1 The Contractor shall shim and level any pavement depressions designated by the Engineer. The use of a motor grader and hand raking will be permitted.

4100.3.10.5.2 All work involved with shimming and levelling will be paid for at the contract unit bid price(s) where applicable.

4100.3.10.5.3 The Contractor shall complete all shimming and levelling operations such that the material has cooled sufficiently before the placement of asphalt concrete.

4100.3.10.6 Longitudinal joints shall not be permitted in the lane. Longitudinal joints shall be vertical butt type, well bonded and sealed, and finished to provide a continuous, smooth profile across the joint.

4100.3.10.7 The asphalt mix temperature in the paver shall not be less than 110°C.

4100.3.10.8 Contact faces of curbs, gutters, manholes, and sidewalks shall be coated with asphalt using a hand applicator before placing the asphalt mix.

4100.3.10.9 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.

4100.3.10.10 Asphalt mix shall not be placed or allowed to fall on previously laid top lift asphalt concrete or the existing asphalt concrete.

4100.3.10.11 Transverse construction joints from one lift to the next shall be separated by at least 2 m.

4100.3.10.12 Road intersections and approaches shall be paved in accordance with the plans or as directed by the Engineer.

4100.3.10.13 If designated by the Engineer, a flush coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.3.11 Compacting

4100.3.11.1 At the beginning of the work, the Contractor shall establish a rolling pattern for achieving the Specified Marshall Density. The rolling pattern strip shall comply with the following:

4100.3.11.1.1 The rolling pattern strip shall have a length of at least 250 m and shall be of the same thickness as the lift it represents.

4100.3.11.1.2 The material used shall conform to the requirements of the asphalt concrete stated in the contract or as specified by the Engineer.

4100.3.11.1.3 The Engineer and/or the Contractor at any time may order the construction of a new rolling pattern strip if there are reasons to indicate that the paving operation, the mix design or lift thickness have been altered.

4100.3.11.1.4 Compaction shall commence immediately and shall be completed before the temperature of the asphalt concrete falls below 55°C for 150-200 A and 200-300 A asphalt concrete mixes, and 40°C for 300-400 A and 400-500 A asphalt concrete mixes.

4100.3.11.1.5 Compaction shall continue until the Specified Marshall Density is achieved or until no appreciable increase in the Field Density can be achieved, even with the use of fully ballasted pneumatic tired rollers with a minimum tire pressure of 620 kPa and having the tire size and wheel load indicated in the table below:

TABLE 4100.3.T5

ROLLER TIRE SIZE AND MINIMUM LOAD

Tire Size (mm)	Minimum Load Per Tire (kg)
190.5 x 381.0	950
228.5 x 508.0	1 300
279.4 x 508.0	1 900

4100.3.11.1.6 The speed of steel rollers shall not exceed 5 km/h and the speed of pneumatic rollers shall not exceed 8 km/h.

4100.3.11.1.7 The rolling pattern strip, if accepted, shall remain in place and shall become part of the completed work.

4100.3.11.2 If the Specified Marshall Density is not achieved, then the value of the Field Density achieved after complying with Section 4100.3.11.1 will be used as the Target Density. Job Mix Formula Densities will continue to be taken, and should change occur in Field Density, lift thickness, or the lane being paved, the Engineer may direct that the Specified Marshall Density control procedure be re-established.

4100.3.11.3 Each lift of asphalt concrete shall be compacted to the Specified Marshall Density established for the lot in accordance with the following:

4100.3.11.3.1 The Specified Marshall Density for the lot will be established using a 3-point moving average.

4100.3.11.3.2 When a new moving average is initiated, it will include the entire lot where the sample is taken and will apply to subsequent lots until the next 3-point moving average is established.

4100.3.11.3.3 A new moving average will be initiated for each new asphalt mix design.

4100.3.11.4 Longitudinal joints shall be rolled directly behind the paver.

4100.3.11.5 All asphalt mix shall be thoroughly compacted, and after final rolling, the finished surface of the mat shall be free from segregation, waves, hairline cracks, and other obvious defects.

4100.3.11.6 Traffic shall not be allowed to travel on the finished surface until the surface has cooled to a temperature as to ensure that no deformation or other defects to the surface will occur.

4100.4 SAMPLING AND TESTING

4100.4.1 General

4100.4.1.1 The failure of the Engineer to provide test results within the time provided in this specification shall not relieve the Contractor of his obligation to remedy any defect, but the Department will be obligated to reimburse the Contractor for any additional costs incurred by the Contractor to remedy the defect, if the additional costs are attributable to the delay in receiving results.

4100.4.2 Acceptance Testing

4100.4.2.1 General

4100.4.2.1.1 Within this specification, certain requirements, limits and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements, where so specified, will be judged by testing as described in this section. These tests cannot be disputed on the grounds of statistical theory or a specified or implied Contractor's risk.

4100.4.2.1.2 The results of acceptance testing for Field Density, smoothness, individual bumps and dips, segregation and surface defects will be used for acceptance, rejection and pay adjustments for the block or lot.

4100.4.2.1.3 Initial acceptance testing will be performed free of cost to the Contractor.

4100.4.2.1.4 If the remedial work by the Contractor on a rejected block or lot involves a repair of the asphalt concrete in the block or lot, all test results from acceptance testing performed on the rejected block or lot prior to the remedial work will be discarded and new sampling and acceptance testing will be performed in accordance with Section 4100.4.2.2.

4100.4.2.2 Sampling and acceptance testing will be in accordance with the following:

4100.4.2.2.1 For **Field Density**:

4100.4.2.2.1.1 The Engineer 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.

4100.4.2.2.1.2 Testing will be conducted prior to the placement of the next lift of asphalt concrete.

4100.4.2.2.1.3 Upon notification from the Contractor that a lot has been inspected and is ready for acceptance testing, the Engineer will locate 3 test sites in the lot in accordance with the requirements for Sampling Location By Random Method (STP 107).

4100.4.2.2.1.4 The Engineer will measure the Field Density at 3 test sites for each lot in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 204-6).

4100.4.2.2.1.5 The Engineer will provide the Contractor with a copy of the results of acceptance tests within 2 calendar days of receiving notification from the Contractor that the lot is ready for acceptance testing.

4100.4.2.2.1.6 If the acceptance test results on a lot indicate a penalty for Field Density, the Contractor will be allowed one opportunity to re-roll the lot. The random sampling procedure for re-testing will exclude areas falling within traffic wheel paths.

4100.4.2.2.2 For **smoothness** and **individual bumps and dips**:

4100.4.2.2.2.1 The surface of the blocks will be profiled by the Engineer in accordance with the standard test procedures.

4100.4.2.2.2.2 If a block is located within a rejected lot, the surface of the block will not be profiled until the lot has been remedied.

4100.4.2.2.2.3 The Engineer will provide the Contractor with a copy of the results of acceptance tests for smoothness and individual bumps and dips within 12 calendar days of the placement of the asphalt concrete.

4100.4.2.2.2.4 When all the acceptance tests for a block are completed, the Engineer will advise the Contractor as to the acceptability of the block with respect to smoothness and individual bumps and dips.

4100.4.2.2.3 For **segregation**:

4100.4.2.2.3.1 Each lane-km, including the shoulder, will be inspected for areas of segregation.

4100.4.2.2.3.2 After receiving notification from the Contractor that the asphalt concrete is ready for acceptance testing, the Engineer will provide the Contractor with the locations of the visually identified segregation in accordance with the following:

4100.4.2.2.3.2.1 Within 12 calendar days during the course of the construction; and

4100.4.2.2.3.2.2 Within 4 calendar days after the completion of all the asphalt concrete.

4100.4.2.2.3.3 A segregated area will be categorized by the worst condition prevalent for 50% or more of the length of the segregated area.

4100.4.2.2.3.4 If the worst condition in a segregated area is not prevalent for at least 50% of the length of the area, then the area will be measured in relation to the length of minor and severe segregation.

4100.4.2.2.4 For **surface defects**:

4100.4.2.2.4.1 Each lane-km, including the shoulder, will be inspected for surface defects.

4100.4.2.2.4.2 After receiving notification from the Contractor that the asphalt concrete is ready for acceptance testing, the Engineer will provide the Contractor with the locations of the visually identified surface defects in accordance with the following:

4100.4.2.2.4.2.1 Within 12 calendar days during the course of the construction; and

4100.4.2.2.4.2.2 Within 4 calendar days after the completion of all the asphalt concrete.

4100.4.3 Exclusions to Random Sampling

4100.4.3.1 Random sampling methods will not apply to the following:

4100.4.3.1.1 Smoothness;

4100.4.3.1.2 Small areas such as approaches, tapers, areas of handwork and gores;

4100.4.3.1.3 Areas of visually identified segregation; and

4100.4.3.1.4 Areas of surface defect repair.

4100.4.4 Appeal of Acceptance Test Results and Appeal Testing

4100.4.4.1 General

4100.4.4.1.1 The Contractor cannot appeal test results that are within the full or bonus payment range.

4100.4.4.1.2 The Engineer will provide the Contractor with a copy of the results of appeal tests within 6 calendar days of delivery of the samples.

4100.4.4.1.3 Appeal testing will be performed by the Department, and the new results shall be binding on the Contractor and the Department.

4100.4.4.1.4 If the appeal testing does not result in a decrease of the pay adjustments, all testing costs incurred during the appeal procedures shall be paid by the Contractor. The rate for Department testing will be as designated in the Special Provisions.

4100.4.4.1.5 If the Engineer determines that certain test results are faulty due to testing equipment malfunction, improper testing procedures or calculations, re-testing will be performed at the expense of the Department.

4100.4.4.1.6 In the case of an appeal, the Department will not be responsible for any delays including but not limited to Contractor's downtime, or other costs as a result of awaiting the receipt of the appeal test results, or due to the nature and values of the appeal test results.

4100.4.4.2 Appeal of the acceptance test results shall be in accordance with the following:

4100.4.4.2.1 For **Field Density**:

4100.4.4.2.1.1 Within 2 calendar days of receipt of the acceptance test results for a lot, the Contractor may appeal the acceptance test results by requesting appeal tests. The following procedures shall apply:

4100.4.4.2.1.1.1 The Engineer will locate 2 appeal test sites in the lot in accordance with the requirements for Sampling Location By Random Method (STP 107).

4100.4.4.2.1.1.2 The Engineer will measure the Field Density at each appeal test site and in the vicinity of the original 3 acceptance test sites in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 204-6).

4100.4.4.2.1.1.3 The mean of the test results from the 5 referee sites will be used for the purpose of acceptance, rejection and determination of pay adjustments.

4100.4.4.2.2 For **smoothness** and **individual bumps and dips**:

4100.4.4.2.2.1 Within 2 calendar days of receipt of the acceptance test results for a block, the Contractor may appeal the test results by requesting appeal tests.

4100.4.4.2.2.2 The Engineer will re-test the entire block for smoothness and individual bumps and dips, if either is under appeal.

4100.4.4.2.3 For **segregation**:

4100.4.4.2.3.1 Within 6 calendar days of receipt of the locations of the visually identified segregation, the Contractor may appeal the acceptance test results by requesting appeal tests.

4100.4.4.2.3.2 The Engineer will obtain a core sample at a location that is representative of the area being considered. The core sample will be obtained in accordance with the requirements for Asphalt Concrete Samples Obtained By Coring (STP 204-5).

4100.4.4.2.3.3 The Engineer will determine the Field Density, asphalt content and the aggregate gradation of the sample.

4100.4.4.2.3.4 The area will be considered non-segregated if the aggregate gradation complies with requirements specified in section 4100.3.7.2.3.

4100.4.4.2.3.5 If the aggregate gradation does not comply with the requirements specified in section 4100.3.7.2.3:

4100.4.4.2.3.5.1 The area will be considered minor segregation if the test results indicate the Field Density of the asphalt concrete meets or exceeds 94% of the Marshall Density established for the Job Mix Formula or Asphalt Mix Formula, and the asphalt content deviates by not more than 0.6% from the asphalt content approved for the Job Mix Formula or Asphalt Mix Formula.

4100.4.4.2.3.5.2 The area will be considered severe segregation if the conditions in section 4100.4.4.2.3.5.1 are not met.

4100.5 ACCEPTANCE, REJECTION AND REPAIRS

4100.5.1 General

4100.5.1.1 The Contractor shall provide a finished product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the specifications and drawings. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice.

4100.5.2 Rejection

4100.5.2.1 The block or lot will be rejected as unacceptable work if:

4100.5.2.1.1 The Field Density for the lot is outside the acceptance limits outlined in section 4100.7.2.1.1.

4100.5.2.1.2 The PrI for the Block is outside the acceptance limits outlined in section 4100.7.2.1.2.

4100.5.2.1.3 Any individual bumps and/or dips exceed 12 mm.

4100.5.2.2 Areas of segregation and surface defects will be considered unacceptable work until the areas are repaired and accepted by the Engineer.

4100.5.3 Repairs

4100.5.3.1 General

4100.5.3.1.1 The Contractor shall not undertake any repair on any defective work prior to notifying the Engineer. Any areas repaired prior to obtaining the Engineer's approval will not be considered for payment.

4100.5.3.1.2 Work on any block or lot which has been rejected shall be remedied within 30 calendar days of receipt of the acceptance test results.

4100.5.3.1.3 All remedial work shall be performed at the Contractor's expense, including the cost of materials.

4100.5.3.1.4 The Contractor shall pay the cost of all re-testing performed following the remedying of work in any block or lot that has been rejected. The rate for Department testing will be as designated in the Special Provisions.

4100.5.3.1.5 Repairs shall be subject to the approval of the Engineer.

4100.5.3.1.6 Alternate repair methods proposed by the Contractor shall be subject to approval of the Engineer. The nature of the deficiencies shall be taken into account in the consideration of the method of repair.

4100.5.3.1.7 Acceptable remedial measures to a rejected block or lot, or areas within a block or lot are as follows:

4100.5.3.1.7.1 A **Class I repair** either overlays or removes and replaces the asphalt concrete.

4100.5.3.1.7.1.1 If an overlay is used as the remedial measure, the following shall apply:

4100.5.3.1.7.1.1.1 A tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat unless otherwise directed by the Engineer.

4100.5.3.1.7.1.1.2 The minimum overlay thickness shall be as specified in Table 4100.3.T4 for top lift.

4100.5.3.1.7.1.1.3 Adjacent lanes and shoulders shall be overlaid to the same thickness and length.

4100.5.3.1.7.1.1.4 On all lifts of asphalt concrete below the final lift, the overlay shall be completed prior to the next lift being placed.

4100.5.3.1.7.1.2 If a removal and replace operation is used as the remedial measure, the following shall apply:

4100.5.3.1.7.1.2.1 The work shall be performed in accordance with Specification 4105 For Reclaiming Asphalt Concrete.

4100.5.3.1.7.1.2.2 The asphalt concrete shall be removed by cold milling to a minimum depth as specified in Table 4100.3.T4 for the lift being removed.

4100.5.3.1.7.1.2.3 A tack coat in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer, shall be applied to the milled surface.

4100.5.3.1.7.1.2.4 The asphalt concrete material removed by the milling operation shall be the property of the Contractor.

4100.5.3.1.7.1.2.5 The asphalt concrete used for back-filling the milled area shall be subject to the same specifications as the original pavement.

4100.5.3.1.7.2 A **Class II repair** is typically either the placing of a slurry seal on the entire block or lot, or the placing of a spot slurry seal patch or patches within the block or lot.

4100.5.3.1.7.2.1 For slurry seals or slurry seal patches, the following shall apply:

4100.5.3.1.7.2.1.1 The seal shall be a mixture of a dry, non- plastic sand, an emulsified asphalt SS-1 (slurry), potable water, and, if needed, acceptable additives such as Portland Cement, and Carbon Black, for colour.

4100.5.3.1.7.2.1.2 The gradation of the sand shall be as follows:

TABLE 4100.3.T6

SLURRY SEAL SAND GRADATION

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
900 um	100.0
400 um	70.0 – 95.0
160 um	60.0 – 80.0
71 um	20.0 – 42.0
Plasticity Index	Non Plastic

4100.5.3.1.7.2.1.3 The mix proportions for a 1 000 litre batch of seal shall be as follows:

4100.5.3.1.7.2.1.3.1 360 litres of SS-1 (slurry);

4100.5.3.1.7.2.1.3.2 270 litres of potable water; and

4100.5.3.1.7.2.1.3.3 850 kg of dry, non-plastic sand.

4100.5.3.1.7.2.1.4 The Contractor shall add the water to the emulsified asphalt followed by the addition of the sand.

4100.5.3.1.7.2.1.5 The Contractor shall thoroughly mix the seal. If a mineral filler is used, it shall be blended into the mixture. A minimum amount of additional water may be added to obtain a fluid, homogeneous mixture.

4100.5.3.1.7.2.1.6 If a tack coat is required, the same asphalt chosen for the seal binder shall be used. The tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack And Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.1.7.2.1.7 The seal shall be neat and square; and uniform and homogeneous with no uncovered areas, ridges or loose aggregate.

4100.5.3.1.7.2.1.8 Hand or mechanical squeegees may be used to spread the seal.

4100.5.3.1.7.2.1.9 The completed seal shall be kept free of all traffic until it has cured sufficiently to prevent pickup of aggregate particles.

4100.5.3.1.7.2.1.10 Any tests performed by the Engineer on the seal will be quality assurance tests and will not be considered as quality control tests.

4100.5.3.1.7.3 A **Class III repair** is typically a flush coat on the entire block or lot, or the placing of a spot flush coat(s) within the block or lot.

4100.5.3.1.7.3.1 A flush coat or spot flush coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.1.7.4 A **Class IV repair** is typically either a re-rolling operation to remove or reduce the bump(s) or a shim operation to remove or reduce dip(s). Other methods of Class IV repairs proposed by the Contractor shall be subject to the approval of the Engineer.

4100.5.3.1.7.4.1 For repairs to a bump(s), the following shall apply:

4100.5.3.1.7.4.1.1 The repair procedure shall not cause damage to the asphalt concrete such as, but not limited to, excessive crushing, pulverizing or displacing the asphalt concrete or its surface.

4100.5.3.1.7.4.1.2 The area repaired shall have a smooth transition to the surrounding pavement without impairing the functionality and/or structural characteristics of the service life of the area.

4100.5.3.1.7.4.2 For repairs to a dip(s), the following shall apply:

4100.5.3.1.7.4.2.1 If shimming is used, the area shimmed shall have a smooth transition to the surrounding pavement. The shim shall have sufficient thickness and be thoroughly compacted to prevent ravel of the shimmed area.

4100.5.3.1.7.4.2.2 If a tack coat is required, the tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.2 Repairs shall be in accordance with the following:

4100.5.3.2.1 For **Field Density**:

4100.5.3.2.1.1 If after re-rolling, the Field Density of a lot remains outside the acceptance limit, the Contractor shall perform a Class I repair.

4100.5.3.2.1.2 If the area(s) requiring repairs appears to be isolated:

4100.5.3.2.1.2.1 The Engineer may identify the area(s) through additional testing.

4100.5.3.2.1.2.2 The Contractor shall perform a Class I repair for only the portion of the lot requiring repairs.

4100.5.3.2.1.2.3 If the isolated repair area continues into an adjacent lot, which is deemed acceptable through acceptance testing, that portion of the adjacent lot shall be repaired along with the portion of the unacceptable lot.

4100.5.3.2.2 For **smoothness**:

4100.5.3.2.2.1 If the acceptance test results on a block indicate a pay adjustment for smoothness, additional work to improve the smoothness will not be allowed except the Contractor will be allowed to perform a Class I or Class IV repair on individual bumps and dips that exceed 12 mm.

4100.5.3.2.2.2 If the smoothness of the final lift of asphalt concrete of a block is outside the acceptance limit outlined in Table 4100.7.T9, the block shall be repaired by a Class I repair.

4100.5.3.2.3 For **individual bumps and dips**:

4100.5.3.2.3.1 Individual bumps and dips that exceed 12 mm in the vertical direction shall be repaired by a Class I or Class IV repair.

4100.5.3.2.3.2 Work to repair individual bumps and dips $\leq$ 12 mm will not be permitted.

4100.5.3.2.4 For **segregation**:

4100.5.3.2.4.1 The Contractor shall repair all segregated areas, except for minor segregation on lower lifts, but including segregated areas with nil pay adjustment. These repairs will not affect the initial pay adjustments assessed in accordance with Tables 4100.7.T10 and 4100.7.T11 with the exception of a Class I repair.

4100.5.3.2.4.2 Severe segregation on lower lifts of asphalt concrete shall be repaired by a Class I repair.

4100.5.3.2.4.3 Segregated areas on the final lift of asphalt concrete shall be repaired in accordance with the following:

4100.5.3.2.4.3.1 Minor segregation on the lane or shoulder shall be repaired by a Class II repair. If the minor segregation is more than one half the lane width or is across the centre of the lane, the full width shall be repaired.

4100.5.3.2.4.3.2 Severe segregation:

4100.5.3.2.4.3.2.1 Individual areas less than 100 m in length shall be repaired with a Class II repair slurry seal patch over the full lane or shoulder width.

4100.5.3.2.4.3.2.2 Individual areas 100 m or greater in length shall be repaired over the full lane or shoulder by a Class II repair slurry seal or by a remove and replace Class I repair.

4100.5.3.2.5 For **surface defects**:

4100.5.3.2.5.1 On all lifts of asphalt concrete, surface defects shall be repaired with a Class I to Class IV repair, in a manner that is acceptable to the Engineer.

4100.5.3.3 Payment options in lieu of repairs:

4100.5.3.3.1 For smoothness and individual bumps and/or dips, the following shall apply, at the discretion of the Engineer, for the final lift of asphalt concrete in a block:

4100.5.3.3.1.1 If the Category I PrI is $\leq$ 23 or the Category II PrI is $\leq$ 28, and individual bumps and/or dips exceed 12 mm, a $2,000 penalty per bump and/or dip plus the adjusted PrI pay adjustment may apply, to a maximum of $6,000.

4100.5.3.3.1.2 If the Category I PrI is > 23 or the Category II PrI is > 28, and no individual bumps and/or dips exceed 12 mm, a $6,000 penalty may apply.

4100.5.3.3.1.3 If the Category I PrI is > 23 or the Category II PrI is > 28, and individual bumps and/or dips exceed 12 mm:

4100.5.3.3.1.3.1 A $6,000 penalty may apply if the adjusted PrI for the Category I PrI is > 23 or the Category II PrI is > 28.

4100.5.3.3.1.3.2 A $2,000 penalty per bump and/or dip plus the adjusted PrI pay adjustment may apply, if the adjusted PrI for the Category I PrI is ≤ 23 or the Category II PrI is ≤ 28.

4100.5.3.3.2 For segregation and surface defects requiring a Class II repair, the Contractor may, subject to the discretion of the Engineer, be charged a fee as shown in the Special Provisions to compensate the Department for having others make the repairs at a later date.

4100.6 MEASUREMENT

4100.6.1 Asphalt Concrete

4100.6.1.1 Asphalt concrete will be measured in tonnes.

4100.7 PAYMENT

4100.7.1 General

4100.7.1.1 Payment for Asphalt Concrete will be at the contract unit price per tonne with pay adjustments for Field Density, smoothness, severity of segregation, segregation frequency and final surface condition.

4100.7.1.2 The contract unit price will be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

4100.7.1.3 If it is stated in the Special Provisions that anti-stripping agent is required, the addition of hydrated lime or liquid anti-stripping agent shall be a subsidiary obligation of the Contractor. If it is determined during the contract that anti-stripping agent is required, the Contractor will be paid at the rate specified in the Special Provisions.

4100.7.1.4 If the shoulder is laid separately from the main lane, the pay adjustments for Field Density for asphalt concrete on the shoulder will be at 50% of the regular rates specified in Tables 4100.7.T7 or 4100.7.T8.

4100.7.1.5 Segregation and surface defects on the shoulder will be excluded from pay adjustments for segregation severity, segregation frequency and final surface condition. The Contractor shall repair segregation and surface defects on the shoulder in accordance with section 4100.5.3.

4100.7.1.6 If the contract includes a bid item for:

4100.7.1.6.1 Hauling Asphalt Concrete, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.2 Reclaimed Asphalt Concrete, payment will be made in accordance with Specification 4105 For Reclaiming Asphalt Concrete.

4100.7.1.6.3 Hauling Reclaimed Asphalt Concrete, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.4 Filler And Blender, payment will be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

4100.7.1.6.5 Hauling Filler And Blender, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.6 Tack Coat And Flush Coat, payment will be made in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.7.1.7 The rate the Department will pay for rejecting aggregate in excess of 10%, or for rejecting aggregate to improve the quality of the asphalt mix design, will be as designated in the Special Provisions of the contract.

4100.7.1.8 The Contractor will be charged at cost for the value of the asphalt and other additives in any asphalt mix that is rejected or wasted, in accordance with the following:

4100.7.1.8.1 The quantity of material rejected or wasted will be determined by the Engineer.

4100.7.1.8.2 The Contractor will not be charged for rejected or wasted material if it has been incorporated back into the work in a manner acceptable to the Engineer.

4100.7.1.8.3 For calculation purposes, the asphalt content will be that of the Job Mix Formula or Asphalt Mix Formula.

4100.7.1.9 When defects in rejected blocks or lots have been remedied, the pay adjustments for Field Density, smoothness, severity of segregation, segregation frequency and final surface condition will be based on testing of the repaired sections where applicable.

4100.7.1.10 The pay adjustments determined through testing of the remedial work will be applied to that quantity of material in the block or lot which was originally rejected.

4100.7.1.11 If any lot or block has been rejected under section 4100.5.2, payment will not be made for the asphalt concrete in the lot or block until the rejected work has been remedied.

4100.7.2 Pay Adjustments

4100.7.2.1 The dollar value of the pay adjustment will be as follows:

4100.7.2.1.1 For **Field Density**:

4100.7.2.1.1.1 The pay adjustment for each lot will be determined from Table 4100.7.T7. If the asphalt mix is a recycled mix with more than 10% reclaimed material, the pay adjustments will be at 50% of the values specified in Table 4100.7.T7.

TABLE 4100.7.T7

PAY ADJUSTMENTS FOR FIELD DENSITY

% of Marshall Density of Job Mix Formula	Pay Adjustment Dollars Per Tonne
≥ 99.0	+1.00
98.9	+0.90
98.8	+0.80
98.7	+0.70
98.6	+0.60
98.5	+0.50
98.4	+0.40
98.3	+0.30
98.2	+0.20
98.1	+0.10
98.0	0.00
97.9	0.00
97.8	0.00
97.7	0.00
97.6	0.00
97.5	0.00
97.4	0.00
97.3	0.00
97.2	0.00
97.1	0.00
97.0	0.00
96.9	-0.05
96.8	-0.10
96.7	-0.20
96.6	-0.30
96.5	-0.40
96.4	-0.50

Table 4100.7.T7 Continued	
% of Marshall Density of Job Mix Formula	Pay Adjustment Dollars Per Tonne
96.3	-0.60
96.2	-0.70
96.1	-0.80
96.0	-0.90
95.9	-1.00
95.8	-1.50
95.7	-2.00
95.6	-2.50
95.5	-3.00
95.4	-3.50
95.3	-4.00
95.2	-4.50
95.1	-5.00
95.0	-5.50
94.9	-6.00
94.8	-7.00
94.7	-8.00
94.6	-9.00
94.5	-10.00
94.4	-11.00
94.3	-12.00
94.2	-13.00
94.1	-14.00
94.0	-15.00
92.5 – ≤ 93.9	No Payment
< 92.5	Reject

4100.7.2.1.1.2 If the Specified Marshall Density is not achieved and the Target Density of Section 4100.3.11.2 must be used, the pay adjustment for each lot will be determined from Table 4100.7.T8. If the asphalt mix is a recycled mix with more than 10% reclaimed material, the pay adjustments will be at 50% of the values specified in Table 4100.7.T8.

TABLE 4100.7.T8

PAY ADJUSTMENTS FOR TARGET DENSITY APPLICATIONS

% of Target Density	Pay Adjustment - Dollars Per Tonne
≥ 99.0	0.00
98.9	-0.10
98.8	-0.20
98.7	-0.30
98.6	-0.40
98.5	-0.50
98.4	-0.60
98.3	-0.70
98.2	-0.80
98.1	-0.90
98.0	-1.00
97.9	-1.10
97.8	-1.20
97.7	-1.30
97.6	-1.40
97.5	-1.50
97.4	-1.60
97.3	-1.70
97.2	-1.80
97.1	-1.90
97.0	-2.00

Table 4100.7.T8 Continued	
% of Target Density	Pay Adjustment - Dollars Per Tonne
96.9	-2.50
96.8	-3.00
96.7	-3.50
96.6	-4.00
96.5	-4.50
96.4	-5.00
96.3	-5.50
96.2	-6.00
96.1	-6.50
96.0	-7.00
95.9	-7.50
95.8	-8.00
95.7	-8.50
95.6	-9.00
95.5	-10.00
95.4	-11.00
95.3	-12.00
95.2	-13.00
95.1	-14.00
95.0	-15.00
≤ 94.9	Reject

4100.7.2.1.2 For **smoothness**:

4100.7.2.1.2.1 The pay adjustment for each block in the final lift of asphalt concrete will be determined in accordance with Table 4100.7.T9:

TABLE 4100.7.T9

PAY ADJUSTMENTS FOR SMOOTHNESS

Category I PrI	Category II PrI	Pay Adjustment for Smoothness of Top Lift - Dollars per Block Lump Sum
0	0 – 1	+200
1 – 2	2 – 3	+150
3 – 4	4 – 6	+100
5 – 6	7 – 9	+50
7 – 10	10 – 15	0
11 – 12	16 – 17	-25
13	18	-50
14	19	-75
15	20	-100
16	21	-150
17	22	-200
18	23	-300
19	24	-400
20	25	-500
21	26	-600
22	27	-800
23	28	-1000
> 23	> 28	Reject

4100.7.2.1.2.2 The pay adjustment for smoothness will be prorated for blocks less than 100 metres in length.

4100.7.2.1.3 For **severity of segregation**:

4100.7.2.1.3.1 The pay adjustment will be determined from Table 4100.7.T10.

TABLE 4100.7.T10

PAY ADJUSTMENTS FOR SEVERITY OF SEGREGATION

Severity of Segregation	Pay Adjustment Dollars per Square Metre
None	0
Minor	- 3.00
Severe	- 6.00

4100.7.2.1.4 For **segregation frequency**:

4100.7.2.1.4.1 The pay adjustment will be determined from Table 4100.7.T11.

TABLE 4100.7.T11

PAY ADJUSTMENTS FOR SEGREGATION FREQUENCY

Segregation Frequency per Lane Kilometre	Pay Adjustment Dollars per Lane Kilometre
0 – 5	0
6 – 15	- 250
16 +	- 500

4100.7.2.1.5 For **final surface condition**:

4100.7.2.1.5.1 For each lane-kilometre of top lift meeting all of the requirements from Table 4100.7.T12, a bonus of $350 will be paid.

TABLE 4100.7.T12

REQUIREMENTS FOR FINAL SURFACE CONDITION BONUS

Number of Blocks with PrI > 10	Number of Individual Bumps/Dips > 8 mm	Number of Segregated Areas	Number of Surface Defects
0	0	0 – 2	0 – 5

4100.7.3 Maximum Pay Adjustment

4100.7.3.1 The sum of the pay adjustments for each lot will not exceed the maximum pay adjustment. The maximum pay adjustment will be calculated as follows:

Maximum Pay Adjustment per Lot	=	Contract Unit Price per Tonne	x	Tonnes of Asphalt Concrete in Lot

APPENDIX B – Heritage Resource Screening

Ministry of Parks, Culture and Sport
Heritage Conservation Branch
2nd Floor, 3211 Albert Street
Regina, Canada S4S 5W6

Phone: 306.787.8157
Fax: 306.787.0069

Email: kim.weinbender@gov.sk.ca

January 13, 2023 Our file: 22-1463

Dustin Weiss
WCE design inc.
Agent for: **Talon Capital Ltd./102035126 SASKATCHEWAN LTD.**
80 Emerald Ridge East
WHITE CITY SK S4L 0C3
Phone: 306.540.8312
Email: dustin.weiss@wcedesign.ca

Dear Dustin Weiss:

RE: RM of Edenwold No. 163 - Multi-building Residential Development
SE 22-17-18-W2M - Blk/Par BB-Plan 102138342 Ext. 0 (5.447 ha)
HERITAGE RESOURCE REVIEW

Thank you for submitting this project 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.

There is one known archaeological site (called EcNc-8) located in direct conflict with the proposed project. The site is over a large area, with notes about locals removing 100s of artifacts dating to all archaeological time periods since the 1930s. The project is also located on sandy soil so there is some potential for deeply buried archaeological sites. However, the parcel has been disturbed by cultivation and various urban development. Recent surveys in the region suggest that the majority of archaeological materials have been removed/extensively disturbed. Therefore, the potential for the project to impact intact, significant heritage sites is low and there are no heritage concerns with the project proceeding as planned.

. . .2

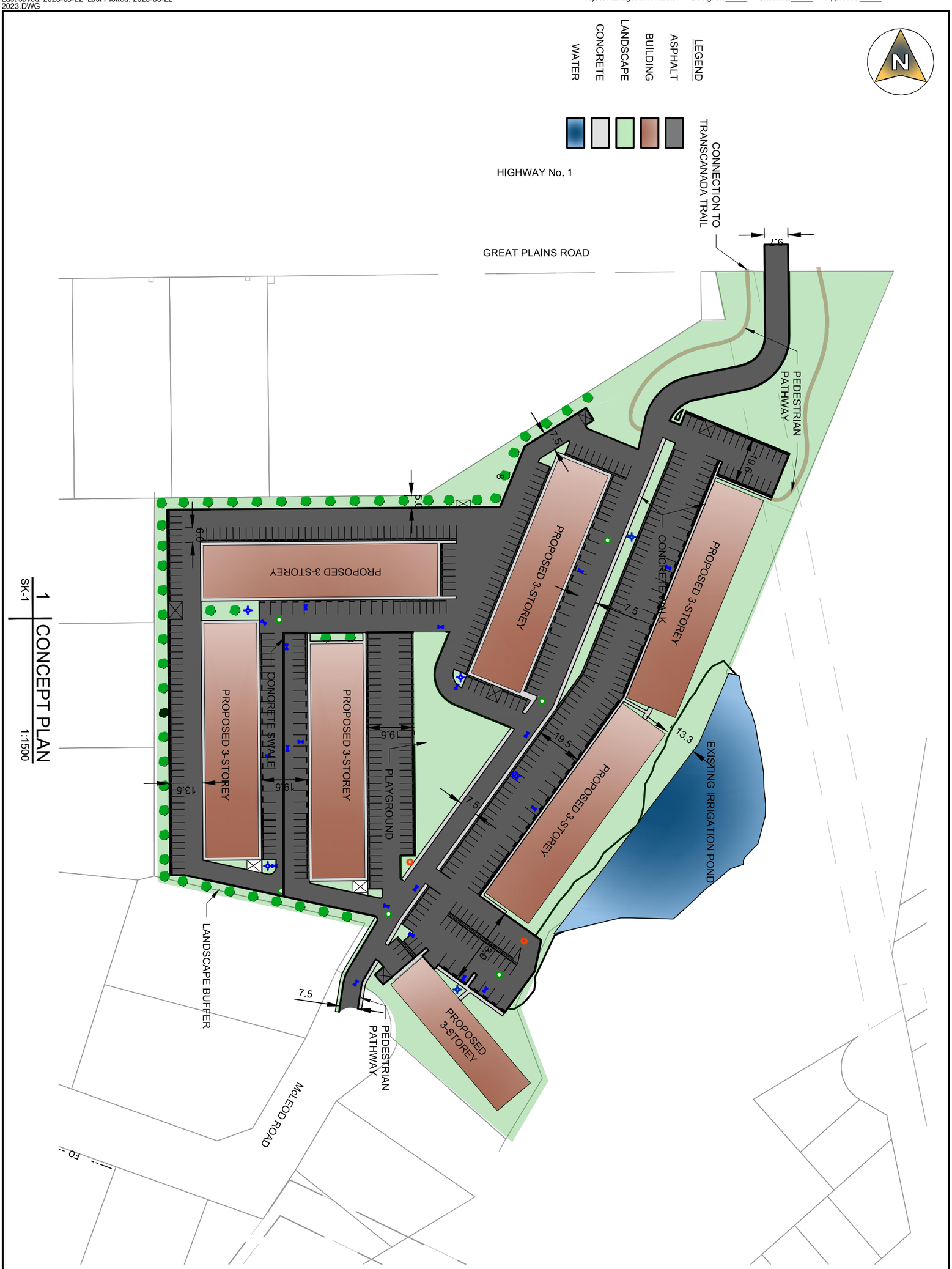
Note: no additional heritage review is required for any revisions to the project layout/plans, provided they occur within the 2023 **external** boundary of Surface Parcel Number 20284880. Please include a copy of this clearance in applications to all other agencies involved in the approval process, to prove heritage clearance has been obtained and that further heritage review of the project is unnecessary.

If you have any questions regarding this review, please do not hesitate to contact me.

Sincerely,

Kim Weinbender
Archaeologist

APPENDIX C – Proposed Servicing Plans



1 CONCEPT PLAN
SK-1
1:1500

TOTAL UNITS: 413
TOTAL PARKING: 564

TALON CAPITAL LTD.
GREENSVIEW
CONCEPT PLAN
Project No.: 22-073 Date: 2023-06-21

WCE design inc.

SK-1

LEGEND

UNDERGROUND	EXISTING	PROPOSED
WATER MAIN		
SANITARY SEWER MAIN		
STORM SEWER MAIN		
WATER		
HYDRANT		
SANITARY SEWER		
MANHOLE		
UTILITIES		
NATURAL GAS LINES	GAS GAS GAS	
TRANSGAS LINES	TRANSGAS	
TELEPHONE	T T	
POWER LINES (OH)	P(OH) P(OH) P(OH)	
ACCESS COMMUNICATION	COM COM COM COM COM COM	

1 | SERVICE PLAN

WC design

ON CAPITAL LTD.
ENSVIEW
VICE PLAN
ect No.: 22-073 Date: 2023-06-21

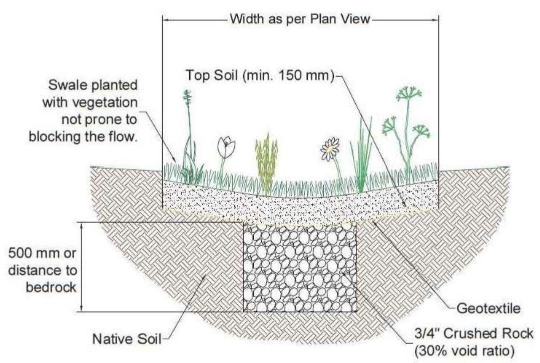
Project Management Initials: Designer: Checked: Approved: ANSI B 1

G:\Shared Drives\WC Design 2022\2022-073 METZ CDP\900 - CAD\920 - C3D\EDENWOLD 2 BUILDINGS JUNE 21

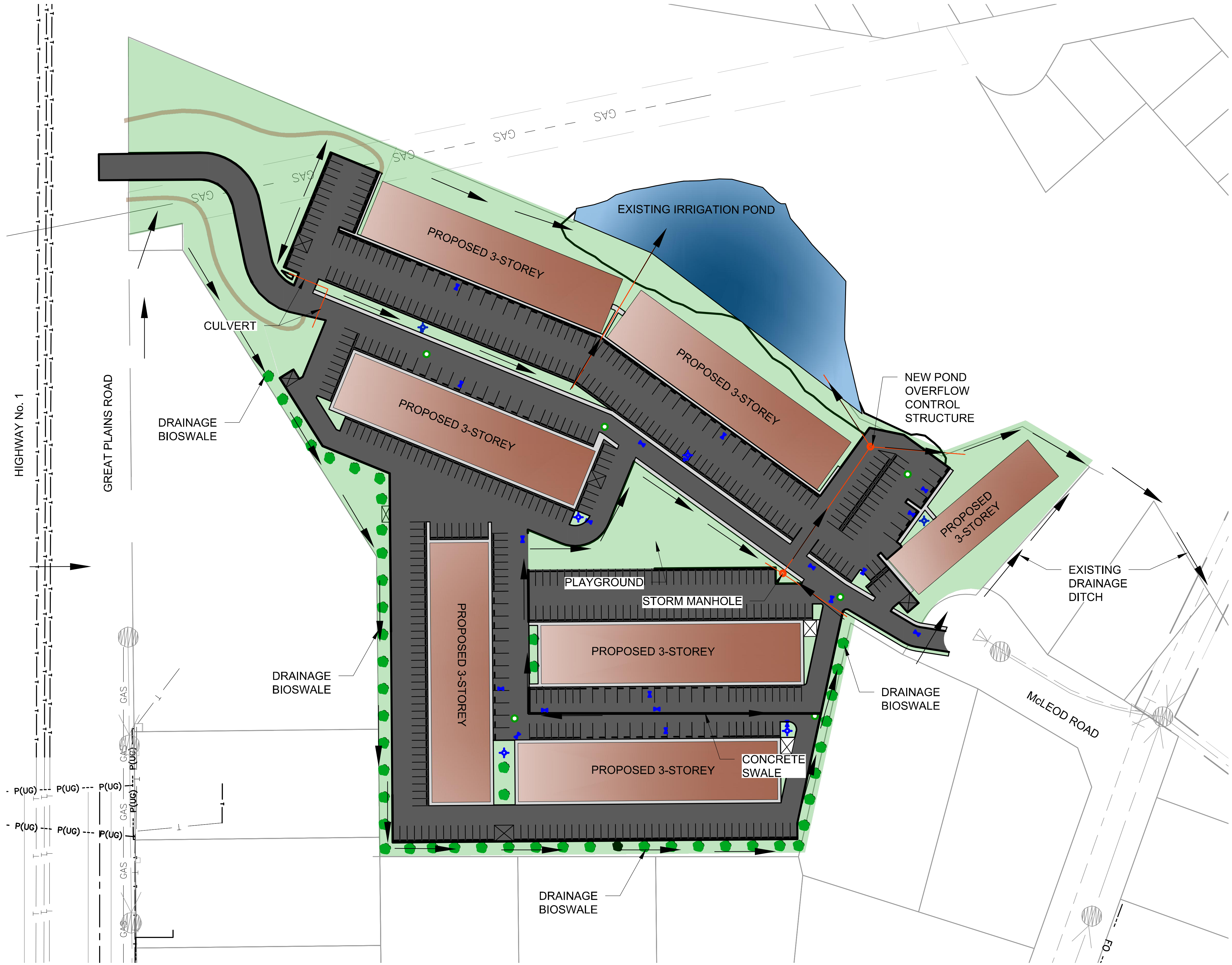
LEGEND

STORM SEWER & DRAINAGE

DRAINAGE ARROWS



2 | BIOSWALE
SK-3 | N.T.S.



1 | DRAINAGE CONCEPT PLAN

Project Management Initials: Designer: Checked: Approved: ANSI B 1

...C3D\EDENWOLD 2 BUILDINGS JUNE 21

WC design

...ON CAPITAL LTD.
...ENSVIEW
...INAGE CONCEPT PLAN
...ect No.: 22-073 Date: 2023-06-21

APPENDIX K

Phase 1 Landscape Plan

LEGEND

ASPHALT

BUILDING

LANDSCAPE

CONCRETE

NEW WALKING PATH CONNECT TO EXISTING RM PATH

SEEDED TURF

GREAT PLAINS ROAD

1:5

EXISTING CHAIN LINK FENCE ALONG PROPERTY

EXISTING POND

EXISTING POND

DL - 4

NEW WALKING PATH

BLK/PAR BB PLAN NO 102138342 EXT 0

PEDESTRIAN CROSSING

SEEDED TURF

EXISTING CHAIN LINK FENCE ALONG PROPERTY

LIMITS OF CONSTRUCTION

CONCRETE WALK

SOD TURF c/w IRRIGATION

PLAYGROUND TO BE DESIGN BUILD

PP - 5

BE - 36

STREET LAMP

NEW WALKING PATH

PT - 1

STREET LAMP

KF - 3

PEDESTRIAN CROSSING

CONCRETE WALK

PEDESTRIAN CROSSING

CONCRETE WALK

PEDESTRIAN PATHWAY

BICYCLE PARKING PROVIDE BIKE RACK

ROCK MULCH

KF - 2

STREET LAMP

DL - 2

ROCK MULCH

GARBAGE ENCLOSURE SEE BUILDING DESIGN FOR DETAILS

PROPOSED 3-STOREY PHASE 1 BUILDING B

PT - 2

LANDSCAPE BUFFER NEW CHAIN LINK FENCE ALONG PROPERTY

STREET LAMP

KF - 3

STREET LAMP

PHASE 1 LIMITS

CONCRETE SWALE

CONCRETE SWALE

McLEOD ROAD

BICYCLE PARKING PROVIDE BIKE RACK

BICYCLE PARKING PROVIDE BIKE RACK

ROCK MULCH

BARRIER CURB

GARBAGE ENCLOSURE SEE BUILDING DESIGN FOR DETAILS

PT - 1

STREET LAMP

DL - 2

PROPOSED 3-STOREY PHASE 1 BUILDING A

LANDSCAPE BUFFER NEW CHAIN LINK FENCE ALONG PROPERTY

ROCK MULCH

ROCK MULCH

KF - 2

BARRIER CURB

16.5

LANDSCAPE BUFFER

SEEDED TURF

STREET LAMP

STREET LAMP

STREET LAMP

EXISTING CHAIN LINK FENCE ALONG PROPERTY

EXISTING CHAIN LINK FENCE ALONG PROPERTY

LIMITS OF CONSTRUCTION

1 LANDSCAPE PLAN

SK-6 1:500

PROPOSED PLANTING SCHEDULE

TREES

QTY	SYM	BOTANICAL NAME	COMMON NAME	SIZE	COND.	HT.	WIDTH
8	DL	*TILIA X FLAVESCENS 'DROPMORE'*	DROPMORE LINDEN	50mm CAL	B & B	10m	7m
5	PP	*PICEA PUNGEONS*	COLORADO BLUE SPRUCE	1800mm	B & B	14m	5m
36	BE	*ULMUS AMERICANA 'BRANDON ELM'*	BRANDON ELM	50mm CAL	B & B	10m	7m

SHRUBS

QTY	SYM	BOTANICAL NAME	COMMON NAME	SIZE	COND.	HT.	WIDTH
11	PT	*CORNUS ALBA 'KESSELRINGII'*	PURPLE TWIG DOGWOOD	450mm	B & B	0.90m	0.90m
28	KF	*CALAMAGROSTIS ACUTIFLORA 'KARL FOERSTER'*	KARL FOERSTER REED GRASS	450mm	B & B	0.90m	0.60m

LEGEND

SITE

- PROPERTY LINE (℄)
- RIGHT OF WAY (ROW)
- EASEMENT
- FENCE
- CENTERLINE OF ROAD
- EDGE OF ASPHALT
- EDGE OF GRAVEL
- CENTERLINE OF DITCH

UTILITIES

- NATURAL GAS LINES (GAS)
- TRANSGAS LINES (TRANSGAS)
- TELEPHONE (TEL)
- POWER LINES (OH) (P(OH))
- ACCESS COMMUNICATION (COM)
- POWER LINES (UG) (P(UG))
- POWER POLE

Gilchuk Design & Drafting

130 HANLEY CRESCENT, WHITE CITY, SK
C: 306.535.9197 P: 306.584.3323
jason@gilchukdesign.com

WCE design inc.

REV	DESCRIPTION	DATE
0	ISSUED FOR DEVELOPMENT PERMIT	2023.06.08

SEALS:

GENERAL NOTES

- PRIOR TO PROCEEDING WITH CONSTRUCTION THE OWNER / CONTRACTOR SHALL BE RESPONSIBLE TO CHECK AND VERIFY ALL INFORMATION, DIMENSIONS, AND SPECIFICATIONS OF THIS PLAN AND OBTAIN A BUILDING PERMIT FROM THE AUTHORITY HAVING JURISDICTION. ANY DISCREPANCIES SHALL BE REPORTED TO THE DRAFTSMAN BEFORE CONSTRUCTION COMMENCES.
- BUILDING GRADE ELEVATIONS ARE SUGGESTED ONLY AND MAY HAVE TO BE REVISED TO SUIT EXACT SITE CONDITIONS.
- ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE NATIONAL BUILDING CODE OF CANADA, CURRENT EDITION AND THE AUTHORITY HAVING JURISDICTION.
- WINDOWS SIZES & LOCATIONS SHALL BE CONFIRMED BY THE OWNER.
- UTILITY COMPANIES SHALL BE CONTACTED TO LOCATED ALL UNDER GROUND SERVICES PRIOR TO ANY EXCAVATING COMMENCING.

TALON CAPITAL LTD.
59 UNIT APARTMENT COMPLEX

EMERALD PARK
RM OF EDENWOLD, SASKATCHEWAN

TITLE: Phase 1 Landscape Plan

DRAWN BY: D. WEISS

DATE: June 8, 2023

FILE NO: 23-010

SCALE: AS NOTED

SHEET NO.: SK-6

REVISION: 0

APPENDIX L

Public Engagement Summary

Public Engagement Summary.

Phone Calls (Inquiry requested a return call).

1. Resident/Business Owner left a return call number and discussed how this development will bring people to the area and clean up an undeveloped parcel. She was for the development and was happy to hear of the potential to multiple housing options for the community.

2. Landowner in the community left a return call back number. Discussed the development with him. He discussed the positives this development would bring to the community and was glad to see something happing with the vacant land.

Email Questions and Responses.

1. *How many individual units are in each building?*

   Response: There is as many as 60 units and the entire buildout is around 366 units.

2. *Are they rental units or privately owned units?*

   Response: There will be a mix of both within the development. Phase 1 is to be rentals.

3. *Will the parking be ground level or underground? Would the families have two cars?*

   Response: Parking is to be surface only. The RM requires 1.25 stalls per unit. Based on our preliminary parking plan we have more than this providing ample parking.

4. *Can you provide greater detail as to the road access, the walking paths in and out of the development?*

   Response: Currently, the path shown on the concept plan is the detail we have. The plan is to have paved walking paths connecting both north and south of the development including internal walk paths within the development.

5. *Is there a time frame for completion of phase 1 and phase 2?*

   Response: Phase 1 is to start construction this calendar year.

6. *Can you provide more detail on the 'noise buffers'?*

   Response: The RM requested a Noise Impact Study be provided due to the proximity to the Provincial Highway. This study is required at the permitting stage as opposed to the rezoning (current). Landscape buffers are required to mitigate noise and are described in section 4.44 of the Zoning Bylaw. The noise buffers will be accomplished be creating tree screening. Perimeter landscaping will be provided around the development and will utilize various tree types to help cut down the noise from adjacent uses and as well the highway.

7. *Do you have conceptual elevation drawings of the buildings and development including finalized landscaping?*

   Response: We are currently in the design stage and don't have detailed elevations yet. The landscaping has only been detailed as much as the provided concept plan. Currently, we are awaiting the re-zoning prior to moving forward. Elevations will be provided during the permitting stages of the development.

8. *Will the RM require a performance bond from the developer on the installation of the water, sewer, and any additional roads?*

   Response: Yes, performance securities will be taken for water and sewer connections. The roadways are internal and therefore, no performance securities can be taken.

9. *Will light pollution be considered in this dense development?*

   Response: All outdoor lighting must be in compliance with section 4.22 of the Zoning Bylaw to mitigate impacts on adjacent residents/landowners. The lighting design for the site will be completed by a professional engineer and dark sky principals will be implemented.

10. *What about the potential for increased volumes of traffic, is that a consideration?*

    Response: Yes, the increased traffic has been considered. Internal traffic control will be included in the design along with any required traffic control in/out of the development. All jurisdictions will be engaged for review of the accesses and in the design phase to ensure negative impacts are mitigated.

11. *Will there be provision for controlling dust/dirt during construction when strong prevailing west and northwest winds occur?*

    Response: The Development Agreement that is to be entered into between the developer and the RM at the permitting stage will outline the responsibilities of the Developer, which include limiting the disruption to adjacent residents and landowners. We will work with the RM to ensure the construction has as little impact as possible to the community. Dust control is one consideration as will erosion control be important.

12. *Who are the owners/principals of Greensview? The only name on any of the documentation sent out by the RM is "Greensview" which is obviously a tradename. The "legal" name would probably be the same as the name on title and the name of the applicant for the zoning change. Can you please elaborate.*

    Response: The owners are local individuals and are listed on ISC. The land is registered to the numbered company 102035126 SASKATCHEWAN LTD, which is the same as the ownership group. They consist of local investors.

13. *What traffic control measures (traffic signals, stop signs?) are proposed for Macleod Road/South Plains Road and Great Plains Road.?*

    Response: McLeod Road is to have a stop sign for traffic control exiting the development. Currently, this project is for rezoning the land and the detailed design has not yet been completed. At minimum there will be a stop sign at each location. The requirements for each connection will be determined in conjunction with the Ministry of Highways for the service road and the RM for McLeod Rd.

14. *Eight multi-family 3-storey units. How many suites are in each unit? How many people in total would be occupying that site when fully developed.?*

    Response: Currently, we are ranging from 20-60 units per building. As this is a re-zoning and not a development/building application nothing has yet to be finalized. The estimated population for the development could be 400-800 residents.

15. *Are the drainage ponds being closed? Where does the water go if the drainage ponds are closed? There will be a lot of pavement and buildings. Is there a drainage plan for this project? I so where can I find the details of same?*

    Response: As we are currently in the re-zoning phase of the parcel an engineered grading plan has not yet been completed. A pre-engineering report and an engineered drainage plan for the development must be completed and approved by the RM prior to receiving a development permit. These are currently ground fed water features from the golf course previously utilized for irrigation. The two on this development will be filled in and the pond within both properties will be altered for the development. The stormwater management plan will be developed in the detailed design stage. Stormwater storage will still be required for the site, but it will need to be in separate locations from the existing ones.

16. *Who develops the storm management plan?*

    Response: The stormwater management plan and detailed design will be produced by a professional engineer and approved by the RM of Edenwold within the development permit stage of the development.

17. *If these are primarily rental suits. I'm concerned about the increase in crime as a more transient population would be living there.*

    Response: It is a common misconception that multi-family units increase crime. This development will provide a missing level of residential offerings to the Emerald Park area. There currently are no offerings for young families entering the housing market, young professionals, or homeowners that wish to downsize but remain in the community. This development would be giving those an opportunity to stay in this community and provide economic support to local businesses and either raise their families here or remain close to their families that already live in Emerald Park.

18. *You're taking away our view of the sunset.*

    Response: Please note the golf course will remain between these two developments and provide additional landscaping and a buffer from the existing industrial area.