

Burns Maendel Consulting Engineers Ltd.

Crystal Springs Colony Community Development Geotechnical Report

Prepared for: Mr. Andrew Lepp, P. Eng. Burns Maendel Consulting Engineers Ltd. 1331 Princess Avenue Brandon, MB R7A 0R4

Project Number: 0105 035 00

Date: November 8, 2021



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November 8, 2021

Our File No. 0105 035 00

Mr. Andrew Lepp, P. Eng. Burns Maendel Consulting Engineers Ltd. 1331 Princess Avenue Brandon, MB R7A 0R4

RE: Crystal Springs Colony Community Development – Geotechnical Report (Revised)

TREK Geotechnical Inc. is pleased to submit our revised final geotechnical investigation report for the above noted project.

Please contact the undersigned should you have any questions.

Sincerely,

TREK Geotechnical Inc. Per:



Ryan Belbas M.Sc., P.Eng. Senior Geotechnical Engineer

Encl.



Revision History

Revision No.	Author	Issue Date	Description			
0 RB		October 21, 2021	Final Report			
1 RB		November 8, 2021	Revised Final Report			

Authorization Signatures



Ryan Belbas M.Sc., P.Eng. Senior Geotechnical Engineer

Reviewed By:



Kent Bannister, M.Sc., P.Eng. Senior Geotechnical Engineer





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I.0 Introduction

This report summarizes the results of a geotechnical investigation completed by TREK Geotechnical Inc. (TREK) for the proposed Crystal Springs Colony community development located approximately 12 km southwest of Gimli, MB. The terms of reference for the investigation are included in our proposal to Mr. Parasdeep Kanda of Burns Maendel Consulting Engineers Ltd. (BMCE), dated July 5, 2021. The scope of work includes a sub-surface investigation, laboratory testing and provision of geotechnical recommendations for the development.

2.0 Background and Site Conditions

The property is vacant, undeveloped land measuring approximately 640 acres in area and is bounded by Road 106 N to the south, Road 15 E to the east, Road 107 N to the north and vacant, undeveloped land to the west. The property is comprised of a mixture of dense forest and open boggy areas with scattered bushes and grass. The community development will include residential, industrial, and agricultural structures, as well as a school and gymnasium, kitchen, dining room, church, orchard, cemetery, sports field, ice rink, wastewater lagoon, parking areas, and access roads. A layout of the proposed development is shown on Figure 01 (Test Hole Location Plan).

3.0 Existing Information

A conceptual layout of the community development and topographic survey information were provided by BMCE. This information was used by TREK to select the test hole/pit locations for the sub-surface investigation.

4.0 Field Program

4.1 Sub-surface Investigation

A sub-surface investigation was completed May 3 to 6, 2021 under the supervision of TREK personnel to assess soil stratigraphy and groundwater conditions at the site. A total of 23 tests holes (TH21-01 to 23) and six test pits (TP21-01 to 06) were drilled/excavated and sampled at the locations shown on Figure 01. The test holes were drilled to depths ranging from 1.5 to 15.7 m below grade and the test pits were excavated to a depth of approximately 4.0 m. The test holes were drilled by Paddock Drilling Ltd. using a CME-850 track-mounted geotechnical drill rig equipped with 125 mm diameter solid stem augers. The test pits were excavated by Graboweski Concrete using a track mounted Hitachi Zaxis 135 US excavator. The test holes were backfilled with auger cuttings and/or bentonite chips and the test pits were backfilled with excavated material and track packed.

Sub-surface soils observed during drilling were visually classified based on the Unified Soil Classification System (USCS). Samples retrieved during drilling included disturbed (auger cutting, split spoon, bulk) samples, and relatively undisturbed (Shelby tube) samples. All samples retrieved during drilling were transported to TREK's testing laboratory in Winnipeg, Manitoba. Laboratory testing consisted of moisture content determination on all samples, and undrained shear strength testing (pocket



penetrometer, torvane and unconfined compression), grain size analysis (hydrometer method), Atterberg limits, remolded permeability (flexible wall), and Standard Proctor testing on select samples. Laboratory test results are included in Appendix A.

Test hole/pit locations were recorded using a handheld GPS. Test hole/pit elevations (geodetic) were estimated based on the topographic survey information provided by BMCE. The UTM coordinates of each test hole/pit are provided on the attached test hole/pit logs. Laboratory test results are included in Appendix A. The test hole/pit logs also include a description of the soil units encountered and other pertinent information such as groundwater and sloughing conditions, and a summary of the laboratory testing results.

4.2 Soil Stratigraphy

A brief description of the units encountered at the test hole/pit locations are provided below. All interpretations of soil stratigraphy for the purposes of design should refer to the detailed information provided on the attached test hole/pit logs.

The soil stratigraphy encountered at the test hole/pit locations generally consists of organic clay or silt (topsoil) or peat (approximately 0.2 m thick) overlying layers of sand, silt and clay, and/or silty clay which are underlain by silt till. The sand, silt and clay, and silty clay layers are variable in thickness. These layers were not encountered in test holes in TH21-04, 14, 18, 20, or 23 as well as TP21-06 and vary in thickness from 0.2 to 2.8 m in the remaining test holes/pits. The sand is generally poorly graded, fine to coarse grained, dry to moist, and loose. The silt and clay is typically dry to moist, stiff to hard, and of intermediate plasticity. The silty clay is moist, stiff, and of high plasticity. The silt till is generally sandy, with trace to some clay, trace gravel, and trace cobbles. It is dry to moist and compact to very dense.

4.3 Groundwater Conditions

Groundwater seepage and sloughing were observed in several of the test holes/pits as noted in Table 1. Seepage and sloughing conditions were not observed in any other test holes/pits.



Test Hole / Test Pit	Depth Below Grade (m)	Depth Groundwater Seepage Encountered Below Grade (m)	Water Level Below Grade Upon Completion of Drilling/Excavation (m)	Depth Sloughing Encountered Below Grade (m)	Depth Below Grade Test Hole/Pit Open to Upon Completion of Drilling (m)
TH21-01	3.0	Not observed	dry	0.1 to 0.5	2.3
TH21-02	1.7	Not observed	dry	0.1 to 0.3	1.5
TH21-04	2.0	Not observed	dry	Below 1.5	1.5
TH21-05	2.0	Not observed	dry	0.3 to 0.5	1.4
TH21-08	2.0	Not observed	dry	Below 1.5	1.5
TH21-09	2.0	Not observed	dry	Below 1.5	1.5
TH21-10	2.0	Not observed	dry	Below 1.5	1.5
TH21-13	6.5	Not observed	dry	Below 6.0	6.1
TH21-14	6.6	4.6	dry	Not observed	5.8
TH21-15	6.6	2.1 to 2.4	5.6	0.1 to 1.5	5.6
TH21-16	6.5	Not observed	dry	Below 5.0	5.9
TH21-17	6.5	Not observed	dry	Below 6.0	6.1
TH21-19	6.5	Not observed	dry	Below 6.0	6.1
TH21-20	7.6	Not observed	dry	Below 7.0	7.5
TH21-21	15.7	Not observed	dry	Below 6.0	6.1
TH21-22	15.7	Not observed	dry	1.2 to 1.5	15.2
TH21-23	15.7	9.1 to 10.7	2.6	9.1 to 10.7	10.7
TP21-01	4.1	Not observed	dry	0.1 to 1.4	4.1
TP21-02	4.1	Not observed	dry	0.3 to 0.9	4.1
TP21-03	4.0	Not observed	dry	0.1 to 1.2	3.8
TP21-05	4.0	Not observed	dry	0.3 to 1.2	4.0

Table 1. Groundwater Seepage and Sloughing Conditions

The groundwater observations made during drilling are short-term and should not be considered reflective of (static) groundwater levels at the site which would require monitoring over an extended period to determine. It is important to recognize that groundwater conditions may vary seasonally, annually, or as a result of construction activities.

5.0 Site Development

Site development is anticipated to require levelling of the ground surface to achieve design grades. Ground levelling is expected to consist of cut and fill methods. In areas where fill is required to raise grades, organics (topsoil, peat), silt, and any other deleterious materials should be stripped such that the sub-grade consists of sand, silt and clay, silty clay, or silt till. The fill may also consist of the local silt and clay, silty clay, sand, and silt till materials. Fill should be placed in lifts no greater than 150 mm



and compacted to at least 95% of the Standard Proctor Maximum Dry Density (SPMDD). At this level of compaction, settlement ranging from 1 to 2% of the fill thickness for soils such as the natural silt and clays and silty clays, silt tills, and sands and 0.5 to 1% of the fill thickness for imported granular fills should be expected.

6.0 Foundation Recommendations

The most suitable foundation options for the proposed development include cast-in-place concrete (CIPC) footings and thickened-edge slabs based on the observed sub-surface and loading conditions. Deep foundations such as CIPC friction piles are also suitable for heavy foundation loads but are not anticipated to be required. Recommendations according to the National Building Code of Canada (NBCC, 2010) are provided in the following sections. Driven pile options such as precast concrete piles and steel piles were not evaluated as part of our current scope of work and may not be suitable due to the potential for boulders within the till.

6.1 Limit States Design

Limit States Design recommendations for shallow and deep foundations in accordance with the NBCC (2010) are provided below. Limit states design requires consideration of distinct loading scenarios comparing the structural loads to the foundation bearing capacity using resistance and load factors that are based on reliability criteria. Two general design scenarios are evaluated corresponding to the serviceability and ultimate capacity requirements.

The Ultimate Limit State (ULS) is concerned with ensuring that the maximum structural loads do not exceed the nominal (ultimate) capacity of the foundation units. The ULS foundation bearing capacity is obtained by multiplying the nominal (ultimate) bearing capacity by a resistance factor (reduction factor), which is then compared to the factored (increased) structural loads. The ULS bearing capacity must be greater or equal to the maximum factored load to provide an adequate margin of safety. Table 2 summarizes the resistance factors that can be used for the design of deep foundations as per the NBCC (2010) depending upon the method of analysis and verification testing completed during construction.

The Service Limit State (SLS) is concerned with limiting deformation or settlement of the foundation under service loading conditions such that the integrity of the structure will not be impacted. The Service Limit State should generally be analysed by calculating the settlement resulting from applied service loads and comparing this to the settlement tolerance of the structure. However, the settlement tolerance of the structure is typically not yet defined at the preliminary design stage. As such, SLS bearing capacities are often provided that are developed on the basis of limiting settlement to 25 mm or less. A more detailed settlement analysis should be conducted to refine the estimated settlement and/or adjust the SLS capacity if a more stringent settlement tolerance is required or if large groups of piles are used.



Resistance to Vertical Loads for Shallow Foundations (Analysis Methods)	Resistance Factor
Semi-empirical analysis using laboratory and in-situ test data	0.5
Resistance to Axial Load for Deep Foundations (Analysis Methods)	Resistance Factor
Semi-empirical analysis using laboratory and in-situ test data	0.4
Analysis using static loading test results	0.6
Uplift resistance by semi-empirical analysis.	0.3
Uplift resistance using loading test results.	0.4

Table 2. ULS Resistance Factors for Shallow and Deep Foundations (NBCC, 2010)

6.2 Shallow Foundations

Footings and thickened-edge slabs bearing on compact to dense silt till can be designed using an SLS unit bearing resistance of 220 kPa and an ULS unit bearing resistance of 330 kPa. Footings and thickened-edge slabs bearing on compact to dense sand, stiff to hard silt and clay, or stiff to very stiff silty clay can be designed using an SLS unit bearing resistance of 100 kPa and an ULS unit bearing resistance of 150 kPa. For thickened-edge slabs the bearing resistances should only be applied to the base of the thickened-edges. The SLS values are based on a limiting settlement to 25 mm or less and the ULS values were determined using a resistance factor of 0.5.

Shallow foundations are subject to vertical movements associated with moisture and volume changes of the underlying silt and clay and silty clay soils. Although difficult to predict, these movements could be in the order of 25 mm or more. Shallow foundations in unheated areas will be subject to further movements due to freeze/thaw of the bearing soils. It may be desirable to provide control joints in the slabs to reduce random cracking and isolation joints to separate the foundations from other structural elements and accommodate these movements. If these movements are considered unacceptable, a piled foundation will be required to support the proposed buildings. It should be understood that seasonal movements are independent of displacement required to mobilize bearing capacity.

The foundation soils at the site (*i.e.* till) are frost susceptible, which refers to the propensity of the soil to grow ice lenses and heave during freezing. Methods to reduce frost-related movements include placement of the footings and thickened edges below the depth of frost penetration (2.4 m below final grade) or incorporating insulation such as Styrofoam Highload into the foundation design to provide frost protection to an equivalent depth of 2.4 m.

Additional Design Recommendations:

1. Footings and thickened edges should be placed on comact to compact to dense silt till, compact to dense sand, stiff to hard silt and clay, or stiff to very stiff silty clay to develop the recommended bearing resistances.



- 2. Minimum footing and thickened edge widths should be verified with the applicable building code (e.g. Manitoba Building Code, NBCC).
- 3. A filter-protected drainage system (weeping tile) should be installed around the perimeter of the buildings and connected to a collection (sump) pit and pumped away from the structure to reduce water infiltration into the bearing soils and minimize footing and slab movements.
- 4. Footings and thickened-edge slabs should be designed to resist all design loads (overturning, sliding, vertical) and forces induced from seasonal movements (swelling, shrinkage, freeze, thaw). Resistance to overturning and uplift forces due to lateral and/or eccentric loads will be provided from the weight of the backfill and structural dead loads. A unit weight of 20 kN/m³ may be used for the backfill provided it consists of granular fill compacted to 98% of the SPMDD in lifts no greater than 150 mm.

Additional Construction Recommendations:

- 1. All organics, loose sands, fills and any other deleterious material should be completely removed such that the bearing surface consists of undisturbed, compact to dense silt till, compact to dense sand, stiff to hard silt and clay, or stiff to very stiff silty clay.
- 2. Excavations for footings and thickened-edges should be completed by an excavator equipped with a smooth-bladed bucket operating from the edge of the excavation. The till is excpected to be highly sensitive to disturbance during construction, the contractor should work carefully to prevent disturbance to the bearing surface at all times.
- 3. The contractor should be prepared to manage seepage through the use of temporary sumps and pumping within the excavations where encountered.
- 4. The bearing surfaces should be protected from freezing, drying, or inundation with water at all times. If any of these conditions occur, the disturbed soil should be reomoved in its entirety such that the bearing surface consists of undisturbed, compact to dense till. Measures to prevent freezing of the foundation soils could include construction of the footings and thickened-edge slabs during the summer and fall seasons when frost is absent at or below the footing depth, or heating and hoarding the site in late fall or early winter before frost has penetrated to the foundation level.

6.3 Cast-in-Place Concrete Friction Piles

Cast-in-place concrete piles friction Piles bearing in till will derive a majority of their resistance in shaft friction (adhesion) with a relatively small contribution from end bearing. Table 2 provides the recommended axial (compressive and uplift) unit resistances for shaft adhesion and end bearing. Piles designed based on the SLS resistances provided in Table 3 are expected to exhibit less than 10 mm of settlement at the pile toe. Elastic shortening of the pile should be added to the tip displacement to calculate the pile head settlement.



		Factored ULS Unit Resistance (kPa)							
Approximate Pile Depth Below Existing Site Grade	SLS Shaft Adhesion	Compre Φ = 0	Uplift $\mathbf{\Phi} = 0.3$						
(m)	(kPa)	Shaft Adhesion	End Bearing (Note 2)	Shaft Adhesion					
0 to X (Note 1)	-	-	-	-					
X (Note 1) to 3	12	14	-	10.5					
3 to 9	20	24	1,000	18					
9 to 15	15	18	700	13.5					

Table 3. ULS and SLS Bearing Resistances for CIPC Piles

 X=1.5 m for piles that will not be subjected to freezing conditions. For piles subject to freezing conditions X=2.5 m

2. For piles with a diameter of less than 0.5 m. If larger pile diameters are required TREK should be contacted to provide revised end bearing values.

Additional Design Recommendations:

- 1. The weight of the embedded portion of the pile may be neglected.
- 2. Piles should be designed with a maximum depth of 15 m below existing site grade.
- 3. For piles supporting heated structures (excluding perimeter piles), shaft adhesion in compression and uplift within the upper 1.5 m below final grade should be neglected. For piles subjected to freezing conditions or perimeter piles in heated structures, shaft adhesion in compression and uplift within the upper 2.5 m below final grade should be neglected.
- 4. Piles should have a minimum spacing of 3 pile diameters measured centre to centre. If a closer spacing or large group of piles are required, TREK should be contacted to provide an efficiency (reduction) factor to account for potential group effects.
- 5. Piles require steel reinforcement designed for the anticipated axial (compression and tension), lateral and bending loads induced from the structure as well as forces induced from seasonal movements (i.e. shrinkage/swelling and frost-related movements) of the bearing soils.

Additional Construction Recommendations:

- 1. Temporary steel casings (sleeves) should be available and used if sloughing of the pile hole occurs and/or to control groundwater seepage which is likely to occur. Care should be taken in removing sleeves to prevent sloughing (necking) of the shaft walls and a reduction in the cross-sectional area of the pile.
- 2. Boulders may be encountered within the till and the contractor should be prepared to encounter boulders during piling operations.
- 3. Concrete should be placed in one continuous operation immediately after the completion of drilling the pile hole to avoid potential construction problems such as sloughing or caving of the pile hole and groundwater seepage. Concrete placed by free-fall methods should be poured under dry conditions. If groundwater is encountered, it should be controlled or removed. If water cannot be controlled or removed, the concrete should be placed using tremie methods.



4. Concrete placed by free-fall methods should be directed through the middle of the pile shaft and steel reinforcing cage to prevent striking of the drilled shaft walls to protect against soil contamination of the concrete.

6.4 Lateral Pile Analysis

The soil response (sub-grade reaction) to lateral loads can be modeled in a simplified manner that assumes the soil around a pile can be simulated by a series of horizontal springs for preliminary design of pile foundations. The soil behaviour can be estimated using an equivalent spring constant referred to as the lateral sub-grade reaction modulus (K_s) as provided in Table 4. The majority of lateral resistance will typically be offered by the upper 5 to 10 m of soil, depending on the relative stiffness of the pile and soil units.

Depth Below Existing Site Grade (m)	Site Grade Soil type (k							
0 to 1.5	-	-						
15 to 2.0	Clay and Silt / Silty Clay	3,500/d (Note 1)						
1.5 to 3.0	Sand	2,200z/d (Note 1 and 2)						
3.0 to 15.0	Till	4,400z/d (Note 1 and 2)						
N	Note 1: d = pile diameter							

Table 4. Recommended Values for Lateral Sub-grade Reaction Modulus (Ks)

Note 2: z = depth below grade

It should be understood that using the lateral sub-grade reaction modulus assumes a linear response to lateral loading and therefore is only appropriate under the following conditions:

- maximum pile deflections are small (less than 1% of the pile diameter),
- loading is static (no cycling), and
- pile material behaves linear elastically (does not reach yield conditions).

If one or more of these conditions are not met, a more rigorous analysis that includes non-linear behavior of the piles and surrounding soil is required. In this regard, as part of preliminary design, a lateral pile analysis that incorporates the material and section properties of the piles, final lateral deflection criteria and a more realistic elastic-plastic model of the soil response to loading should be carried out by TREK to confirm the lateral load capacity of the piles.

6.5 Pile Caps and Grade Beams

A minimum void of 100 mm should be provided underneath all grade beams and pile caps to accommodate volumetric changes in the underlying sub-grade soils (i.e. swelling, shrinkage, and thermal expansion and contraction in unheated areas). The void can consist of a compressible layer such as low-density polystyrene void form. Void forms should be selected such that they can deform a minimum of 150 mm with minimal stress transfer to the structure. Excavations for grade beams and



pile caps should be backfilled with non-frost susceptible soils (clean, granular fill) in lifts no greater than 150 mm and compacted to 98% of the SPMDD.

6.6 Ad-freezing Effects

Concrete piles, footings, thickened edges, pile caps, grade beams, and buried walls subjected to freezing conditions should be designed to resist ad-freeze and uplift forces related to frost action acting along the vertical face of the member within the depth of frost penetration (2.4 m). In this regard, concrete piles, footings, thickened edges, pile caps, grade beams, and walls may be subject to an ad-freeze bond stress of 65 kPa within the depth of frost penetration. For piles, ad-freeze forces will be resisted by structural dead loads and uplift resistance provided by the length of the pile below the depth of frost penetration. For footings, ad-freeze forces will be resisted by structural dead loads and the weight of the backfill.

Additional Design Recommendations:

- 1. An ad-freeze bond stress of 65 kPa within the depth of frost penetration (2.4 m).
- 2. A load factor (α) of 1.2 may be used in the calculation of ad-freezing forces.
- 3. A reduction factor of 0.8 may be used in calculation of the geotechnical resistance for the factored ULS condition with ultimate (nominal) uplift resistances as follows:
 - a. 43 kPa for piles.
 - b. For footings, unit weight of 20 kN/m³ for granular fill compacted to 98% of the SPMDD.
- 4. Resistance to ad-freezing within the depth of frost penetration should be neglected.
- 5. Structural dead loads should be added to the resistance.
- 6. The calculated geotechnical resistance plus the structural dead loads must be greater than the factored ad-freezing forces.
- 7. Piles subject to ad-freezing forces should be a minimum of 8.0 m or as calculated by the method above, whichever is greater.
- 8. Measures such as flat lying rigid polystyrene insulation could be considered to reduce frost penetration depths and thereby ad-freezing and uplift forces.

6.7 Foundation Concrete

All foundation concrete should be designed by a qualified structural engineer for the anticipated axial (compression and uplift), lateral, and bending loads from the structure. Two soil samples (G87 and G88 from TH21-22) were tested (by ALS Environmental) for total sulphate ion content to assess the degree of exposure for concrete subjected to sulphate attack. The samples had a total sulphate ion content less than 0.2% indicating a negligible total sulphate ion content. It should be noted that sulphate concentrations within in the soils likely vary across the site.

6.8 Foundation Inspection Requirements

In accordance with Section 4.2.2.3 Field Review of the NBCC (2010), the designer or other suitably qualified person shall carry out a field review on:



- 1. a continuous basis during:
 - i. the construction of all deep foundation units,
 - ii. the installation and removal of retaining structures and related backfilling operations, and
 - iii. during the placement of engineered fills.
- 2. on an as-required basis for the construction of shallow foundation units and in excavating, dewatering and other related works.

TREK, as the geotechnical engineer of record, must be retained to observe the installation of all foundation elements. TREK is familiar with the geotechnical conditions and the basis for the foundation recommendations and can provide geotechnical design modifications deemed to be necessary should altered sub-surface conditions be encountered.

7.0 Concrete Slabs

7.1 Grade Supported Floor Slabs

If some movement can be tolerated, grade supported concrete floor slabs can be used. Vertical deformation of grade supported slabs should be expected due to volumetric changes in the underlying sub-grade soils (i.e. swelling and shrinkage). Although difficult to predict these movements could be in the order of 50 mm or more. Slabs in unheated areas or near the perimeter of the structure will be subject to additional movements from freeze/thaw of the sub-grade soils. If these movements cannot be tolerated, a structural floor slab will be required.

Additional Design and Construction Recommendations:

- 1. Organics, loose sand, silt, and any other deleterious material should be stripped such that the subgrade consists of compact to dense silt till, compact to dense sand, stiff to hard silt and clay, or stiff to very stiff silty clay.
- 2. Excavation should be completed with an excavator equipped with a smooth bucket operating from the edge of the excavation. Care should be taken to minimize the sub-grade disturbance at all times.
- 3. After excavation, the sub-grade should be inspected by TREK personnel. Silt and/or soft areas should be repaired as per directions provided by TREK. This will likely consist of excavating an additional 150 to 300 mm and placing a non-woven geotextile on the sub-grade and backfilling with granular fill in lifts no greater than 150 mm and compacted to a minimum of 98% of the SPMDD.
- 4. The exposed sub-grade surface should be protected from freezing, inundation, drying, or disturbance. If any of these conditions occur, the disturbed zone can either be over-excavated and such that the bearing surface consists of undisturbed soil consistent with the design bearing surface material, or the sub-grade could be scarified, moisture conditioned, and re-compacted to a minimum of 95% of the SPMDD.
- 5. In heated areas, the floor slab should be placed on a 150 mm thick layer of 37.5 mm down granular fill sub-base underlying a 150 mm thick base consisting of 20 mm down granular fill. In unheated areas (e.g. exterior slabs) the thickness of 37.5 mm down granular fill should be increased to



250 mm. The granular fill should be placed in lifts no greater than 150 mm and compacted to 98% of the SPMDD.

- 6. The granular fill should consist of a well graded, sand and gravel or durable crushed rock in accordance with the Manitoba Infrastructure Standard Specification No. 900.
- 7. A vapour barrier should be placed above the granular base and beneath the floor slab.
- 8. Floor slabs should be designed to resist all design loads and to minimize slab cracking associated with movements as a result of swelling, shrinkage, and thermal expansion and contraction of the sub-grade soils. To accommodate slab movements, it may be desirable to provide control joints to reduce random cracking and isolation joints to separate the slab from other structural elements. Allowances should be made to accommodate vertical movements of light weight structures (e.g. partitions) bearing on the slab.
- 9. A filter-protected drainage system (weeping tile) should be installed around the perimeter of all grade supported slabs and connected to a collection pit complete with a sump pump.

7.2 Structural Slabs

In areas where movement of floor slabs is not tolerable, a structural floor slab should be used. A minimum void of 150 mm beneath structural floor slabs is recommended to accommodate volumetric changes in the underlying sub-grade soils (i.e. freeze-thaw volume changes and thermal expansion and contraction in unheated areas). The void should consist of a compressible layer (e.g. void form) to permit sub-grade soil movements without causing intolerable stress on the floor slab or, alternatively, a crawl space may be used. A vapour barrier should be placed between the floor slab and the void form (if present).

8.0 Lateral Earth Pressures

The magnitude of lateral earth pressures from retained soil acting against the below grade walls will depend on the retained material type, method of placing and compacting the backfill, and the magnitude of rotation of the walls. TREK anticipates that basement and other retaining walls will be backfilled with granular fill and that the walls will be fixed and not free to rotate. Table 5 below provides K_o values for calculation of lateral earth pressures developed from backfill acting on below grade walls.

Design Parameter	Backfill
At-Rest Earth Pressure Coefficient (K₀)	0.5
Estimated Bulk Unit Weight, Y (kN/m ³)	21
Estimated Effective Unit Weight, Y' (kN/m ³)	11.2

Table 5. Lateral Earth Pressure Parameters for Below Grade Wall Design

Where backfill drainage is expected, such as a sub-drainage system at the base of the wall to prevent the build-up of hydrostatic pressures, the total lateral earth pressure force is the area of the triangular



pressure distribution acting on a below grade wall which can be derived based on the following equation:

 $P = K \gamma D$

Where,

P = lateral earth pressure at depth D (kPa)

K = earth pressure coefficient (unitless)

 γ = bulk unit weight of retained soil (kN/m³)

D = depth below finished grade to where earth pressure is being calculated (m)

If drainage is not expected, the following equation should be used:

$$P = K_0 \gamma' D + \gamma_w D$$

Where,

P = lateral earth pressure at depth D (kPa)

K = earth pressure coefficient (unitless)

 γ' = effective unit weight of retained soil (kN/m³)

D = depth below finished grade to where earth pressure is being calculated (m)

 γ_w = unit weight of water (9.81 kN/m³)

Backfill (retained fill) should not be placed and compacted until the walls can support lateral earth pressures. Over-compaction of the retained fill may result in earth pressures that are considerably higher than those predicted in design. Compaction of granular fill within about 1.5 m of the walls should be conducted with a light hand-operated vibrating plate compactor and the number of compaction passes should be limited. A maximum compacted density of 92% of the Standard Proctor Maximum Dry Density should be specified for fill placed directly adjacent to the walls.

9.0 Wastewater Lagoon

The proposed development includes a wastewater lagoon. Lagoon geometry is unknown but is anticipated to have berms in the order of 1 to 2 m above prairie level and a base at 1 to 2 m below prairie level for a total berm height of 2 to 4 m. A water depth of 1 to 2 m is anticipated under operating conditions. Lagoon berms are assumed to be designed with a 3 m wide crest and 1 m freeboard. According to provincial guidelines, the berms must have inside and outside slopes of 3H:1V and 4H:1V, respectively, or flatter. Flatter slopes are not anticipated to be required based on the soils encountered during drilling. However, TREK should be engaged during detailed design to review the proposed design and verify the factor of safety of the berm slopes based once berm design materials (i.e. site soils vs. imported soils) and geometry have been determined.



9.1 Design and Construction of Liners

The province of Manitoba requires that soil liners have a minimum hydraulic conductivity of 1×10^{-7} cm/s. An in-situ soil liner is not anticipated to achieve the minimum hydraulic conductivity requirements due to the type, structure, and variability of the near surface soils and, therefore, the permeability of compacted site soils were assessed. Flexible wall permeability testing, Standard Proctor testing, Atterberg limits, and grain size analyses were completed on a compacted bulk sample of the silt and clay layer obtained from within the proposed wasterwater lagoon area. Atterberg limits and grain size analyses were also completed on a select auger cutting sample of the same material. Table 6 summarizes the results of the testing.

Test Hole	• "	Sample	Remoulded	Atter	berg Li	mits	Grai	n Size I	Distribut	tion (%)
and Sample Number	Soil Description	Depth Below Grade (m)	Hydraulic Conductivity (cm/s)	PL ¹	LL1	PI ¹	Clay	Silt	Sand	Gravel
TH21-17 G216	Silt and Clay	0.2 to 1.5	1.78x10 ⁻⁸	14	40	26	32	46	22	0
TH21-16 G189	Silt and Clay	0.9 to 1.1	Not Measured	13	44	31	39	34	23	4

Table 6. Soil Permeability Properties

Note 1. PL- Plastic Limit, LL – Liquid Limit, PI- Plasticity Index

The silt and clay sample (G216) compacted to 96.5% of the SPMDD exceeded the provincial hydraulic conductivity requirements for use as a soil liner with a measured hydraulic conductivity of 1.78×10^{-8} cm/s indicating that this material will be suitable for use in a compacted liner. The permeability test results are representative of compacted silt and clay properties at a specific point and do not necessarily apply to the final properties of the silt and clay following bulk excavation, placement, and compaction. Variations in the silt and clay composition, moisture content, and compacted density can alter hydraulic conductivity properties and further testing may be required by regulatory authorities to confirm the hydraulic conductivity of the silt and clay.

The high plastic, silty clay soils present within the lagoon area, are also anticipated to meet the hydraulic conductivity requirements provided proper construction and compaction techniques are followed. Sand and silt till within the lagoon area are not suitable for lagoon construction and will have to be removed prior to placement of silt and clay and silty clay soils for a compacted soil liner.

The lagoon is anticipated to be constructed using cut and fill methods. However, sufficient volumes of silt and clay and/or silty clay are likely not present within the proposed lagoon area and additional liner material may need to be obtained from other areas of the site or imported from an off-site borrow source. TREK recommends an that an additional sub-surface investigation be undertaken to locate a suitable on-site borrow source if it is preferred to use local materials for the liner. TREK can provide a scope of work and cost estimate to perform the investigation upon request. Alternatively a synthetic liner can be used.

Placement and compaction of silt and clay, sitly clay, or imported fill for a compacted soil liner will likely be required within 1 m of the liner surface with additional sampling and Standard Proctor and



permeability testing to verify the level of compaction required to achieve a hydraulic conductivity of 1×10^{-7} cm/s or less. Organics and sands must be removed from the subgrade prior to placement of the liner soils. This may however not be practical from a cost perspective and a synthetic liner may be preferred. In this regard, the in-situ soils at the site are sufficient for a synthetic liner sub-grade. Preparation of a synthetic liner sub-grade should consist of removal of topsoil, silt, and any other deleterious materials such that the sub-grade consists of sand, silt and clay, silty clay and/or silt till. Berms can be constructed of silt and clay, silty clay, silt till, or suitable imported fill (e.g. high plastic silty clay) in lifts of 150 mm compacted to 95% of the SPMDD. Removal of topsoil, silt, and any other deleterious materials must also be performed prior to berm construction.

10.0 Pavements

The following section on pavement structure should be used for gravel surfaced pavements. The recommended pavement structure is provided in Table 7 for parking areas and areas subject to heavier vehicular loads such as access roads. Crushed granular base course base consistent with the Manitoba Infrastructure Standard Specification No. 900 (or equivalent as approved by TREK) are recommended for the base and sub-base layers.

	Layer T	hickness	Compaction/Installation
Material	Car Parking Heavy Vehicular Areas Loads		Requirements
20 mm down gravel / limestone (Base)	150 mm	150 mm	98% of the SPMDD
37.5 mm down gravel / limestone (Sub-base)	250 mm	350 mm	98% of the SPMDD
Non-Woven Geotextile (Geotex 801 or equivalent)	Required	Required	Install as per manufacturer's recommendations

Table 7. Recommended Gravel Surfaced Pavement Sections for Roads and Parking Areas

Additional Pavement Recommendations:

- 1. Organics, loose sand, fills, and any other deleterious material should be stripped such that the subgrade consists of compact to dense silt till, compact to dense sand, stiff to hard silt and clay, or stiff to very stiff silty clay.
- 2. Excavation should be completed with an excavator equipped with a smooth-bladed bucket and operating from the edge of the excavation in order to minimize disturbance to the exposed sub-grade.
- 3. After excavation, the sub-grade should be inspected by TREK personnel. The sub-grade should be proof-rolled with a fully loaded tandem axle truck to detect silt or soft areas. Silt or soft areas should be repaired as per directions provided by TREK. This will likely consist of excavating an



additional 150 to 300 mm, placing a non-woven geotextile on the sub-grade, and backfilling with a 37.5 mm down crushed granular fill. The granular fill should be placed in lifts no greater than 150 mm and compacted to a minimum of 95% of the SPMDD.

- 4. The sub-grade should be protected from freezing, drying, inundation with water or disturbance at all times. If any of these conditions occur the sub-grade should be scarified, moisture conditioned as appropriate, and re-compacted to a minimum of 95% of the SPMDD.
- 5. A non-woven geotextile should be placed in accordance with the manufacturer's recommendations on the prepared sub-grade prior to placement of granular fill.
- 6. The granular sub-base and base materials should be placed in lifts not exceeding 150 mm and compacted as per the recommendations in Table 7.

II.0 Temporary Excavations

Excavations must be carried out in compliance with the appropriate regulations under the Manitoba Workplace Safety and Health Act. Any open-cut excavation greater than 3 m deep must be designed and sealed by a professional engineer and reviewed by the geotechnical engineer of record (TREK). If space is limited or the stability of adjacent structures may be endangered by an excavation, a shoring system may be required to prevent damage to, or movement of, any part of adjacent structures, and the creation of a hazard to workers and the public.

Excavation stability is the responsibility of the Contractor for the duration of construction. Excavations should be monitored regularly and flattened as necessary to maintain stability recognizing that excavation stability is time and weather dependent. Excavated slopes should be covered with polyethylene sheets to prevent wetting and drying.

Stockpiles of excavated material and heavy equipment should be kept away from the edge of any excavation by a distance equal to or greater than the depth of excavation. Dewatering measures should be completed as necessary to maintain a dry excavation and permit proper completion of the work. If seepage is encountered, it should be collected and pumped out of the excavation. If saturated silts or sands are encountered, shoring or slope flattening may be required. To prevent wet silts and sands from entering the excavation, gravel buttressing could be used in conjunction with sump pits for dewatering. Surface water should be diverted away from the excavation and the excavation should be backfilled as soon as possible following construction.



12.0 Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be highly variable across a site. If subsurface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

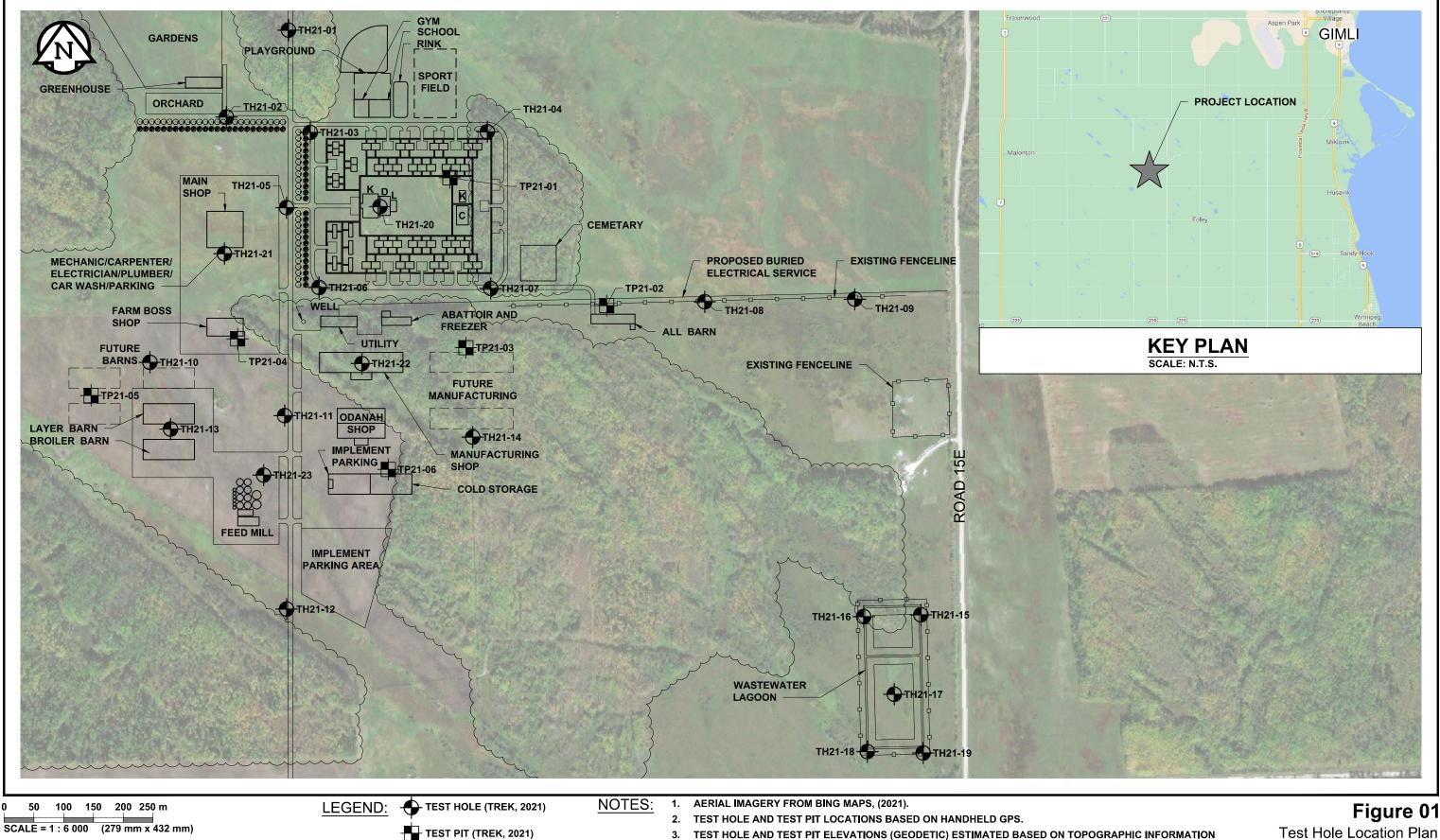
All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work or standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of Burns Maendel Consulting Engineers Ltd. (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be used or relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.



Figure





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4. SITE LAYOUT PROVIDED BY BMCE.

PROVIDED BY BMCE.

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Burns Maendel Consulting Engineers Ltd. Crystal Spring Colony Community Development



Test Hole Logs

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.

2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.

3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Ma	ajor Div	isions	USCS Classi- fication	Symbols	Typical Names	Laboratory Classification Criteria		riteria		ş							
	raction	gravel no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines		$C_{U} = \frac{D_{60}}{D_{10}}$ greater than	^{n 4;} C _c = _	$(D_{30})^2$ between 1 and 3 $D_{10} \times D_{60}$		ieve sizes	#10 to #4	#40 to #10	#200 to #40	< #200		
sieve size)	Gravels than half of coarse fraction alarder than 4.75 mm)	Clean (Little or	GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines	grain size curve, er than No. 200 sieve) g dual symbols*	Not meeting all gradatic	on requirer	nents for GW	e	ASTM Sieve	#10	#401	#200	¥ V		
ained soils larger than No. 200 sieve	Gra than half o	Gravel with fines (Appreciable amount of fines)	GM		Silty gravels, gravel-sand-silt mixtures	rain size curve r than No. 200 dual symbols*	Atterberg limits below " line or P.I. less than 4	"A"	Above "A" line with P.I. between 4 and 7 are border-	Particle Size	٩			+			
ained soils larger than	lore	Gravel w (Appre amount	GC		Clayey gravels, gravel-sand-silt mixtures		Atterberg limits above " line or P.I. greater than	"A" 7	line cases requiring use of dual symbols	Par		Ľ	, g	25			
Coarse-Grained (More than half the material is larger	e fraction mm)	sands no fines)	SW	\$****	Well-graded sands, gravelly sands, little or no fines	Determine percentages of sand and gravel from g depending on percentage of fines (fraction smaller coarse-grained soils are classified as follows: Less than 5 percent GM, GP, SW, SP More than 12 percent Borderline cases requiring 6 to 12 percent	$C_{U} = \frac{D_{60}}{D_{10}}$ greater than	^{n 6;} C _c =	$\frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3		шш	2 00 to 4 75	0.425 to 2.00	0.075 to 0.425	c/0.0 >		
n half the r	Sands alf of coarse fi r than 4 75 mi	Clean (Little or	SP		Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SV			ments for SW		ments for SW				. 0	0	
(More thai	Sands than half of coarse smaller than 4 75 n	Sands with fines (Appreciable amount of fines)	SM		Silty sands, sand-silt mixtures	lemine percentages of s; pending on percentage of arse-grained soils are clas arse than 5 percent More than 12 percent 6 to 12 percentBord	Atterberg limits below " line or P.I. less than 4	"A"	Above "A" line with P.I. between 4 and 7 are border-	lai	5				Clay		
	(More t	Sands w (Appre amount	SC		Clayey sands, sand-clay mixtures	Determir dependir coarse-g Less More 6 to 1	Atterberg limits above " line or P.I. greater than	"A" 7	line cases requiring use of dual symbols	Material	ואומר	Sand	Medium	Fine	SIIT OF CIAY		
e size)	, sk		ML		Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart			r unte		e Sizes		-	Ë i			
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Cla	(Liquid limit less than 50)	CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	70 - 60 -	an 0.425 mm		"U LII ALLINE	e	S	> 12 in. 3 in to 12 in	2	3/4 in. to 3 in. #4 to 3/4 in	15 2 14		
soils er than No	Si	<u> </u>	OL	==	Organic silts and organic silty clays of low plasticity	- 00 (%)		/ CH		Particle Size	ASTM:	+	_		_		
e-Grained al is small	ski	t 50)	MH		Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts	- 40 - L 40 - L 40 - S30 -				Pa	mm	> 300 75 to 300	222	19 to 75 4 75 to 19	P 10		
Fine the materi	ts and Cla	(Liquid limit greater than 50)	СН		Inorganic clays of high plasticity, fat clays	20-			MH OR OH		L	75 1	· ·	191) F		
than half	N		OH		Organic clays of medium to high plasticity, organic silts		ML & OL 16 20 30 40 50 LIQUID L	60 70 LIMIT (%)	80 90 100 110		5	ers	3_		-		
(More	Highly	Organic Soils	Pt	<u>6 76 76</u> <u>72 77 7</u>	Peat and other highly organic soils	Von Post Classification Limit Strong colour or odour, and often fibrous texture			Material	ואומוכ	Boulders	Gravel	Coarse				

Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

Asphalt	Bedrock (undifferentiated)	62	Cobbles
Concrete	Limestone Bedrock		Boulders and Cobbles
Fill	Cemented Shale		Silt Till
	Non-Cemented Shale		Clay Till



EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

- LL Liquid Limit (%)
- PL Plastic Limit (%)
- PI Plasticity Index (%)
- MC Moisture Content (%)
- SPT Standard Penetration Test
- RQD- Rock Quality Designation
- Qu Unconfined Compression
- Su Undrained Shear Strength
- VW Vibrating Wire Piezometer
- SI Slope Inclinometer

- ☑ Water Level at Time of Drilling
- ▼ Water Level at End of Drilling
- ☑ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	<u>SPT (N) (Blows/300 mm)</u>
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50
The Standard Penetration Test blow count (N) of a c	cohesive soil can be related to its consistency as follows:

Descriptive TermsSPT (N) (Blows/300 mm)Very soft< 2</td>Soft2 to 4Firm4 to 8Stiff8 to 15Very stiff15 to 30Hard> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear <u>Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

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Project Name:	Crystal Spring Colony Community Development	Location:	UTM N-5604394.56, E-632271.68
Contractor:	Paddock Drilling Ltd.	Ground Elevation	on: _247.95 m (local datum)
Method:	125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig	Date Drilled:	August 19, 2021
Sample [®]	Type: Grab (G) Shelby Tube (T)	Split Spoon	(SS) / SPT 🔀 Split Barrel (SB) / LPT 🚺 Core (C)
Particle	Size Legend: Fines Clay Silt	Sand	Gravel 🚰 Cobbles 🔛 Boulders
Elevation (m) Depth (m)	MATERIAL DESCRIPTION		Jang C □ Bulk Unit Wt (kN/m³) Undrained Shear Strength (kPa) 0 0 16 17 18 19 20 21 0 0 0 20 40 60 80 100 Test Type △ Torvane △ 0 20 40 60 80 100 ♥ Pocket Pen. ♥ 0 20 40 60 80 100 ♡ Field Vane ○ 0 20 40 60 80 100 0 50 100 150 200255
247.8 247.5 246.7 246.2	 ORGANIC SILT (TOPSOIL) - some sand, trace rootlets, training mm diam.), black, dry, loose, low plasticity SAND - silty, trace clay, trace gravel (<20 mm diam.), light poorly graded, fine to coarse grained SILT AND CLAY - laminated (<5 mm thick), some sand, trace (<20 mm diam.), light grey and dark grey, dry to moist, very plasticity SILT (TILL) - sandy, trace clay, trace gravel (<30 mm diam) Compact to dense, low plasticity END OF TEST HOLE AT 1.7 m IN SILT (TILL) Notes: Sloughing observed. Sloughing observed between 0.1 m and 0.3 m depth. Test hole dry and open to 1.5 m depth immediately after 4) Test hole backfilled with cuttings. 	brown, dry, loose, ace silt inclusions y stiff, intermediate .), light brown, dry,	G127 G128 G129 SSS130 37 / 24mm

Burns Maendel Consulting Engineers Ltd. rroject Name: Crystal Spring Colony Community Development contractor: Paddock Drilling Ltd. lethod: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Sample Type: Grab (G) Shelby Tube (T)						Project Number Location: Ground Elevatio Date Drilled:	on:	UTM 247.6 Augus	035-00 N-5604368.65, E-632412.32 0 m (local datum) st 19, 2021 PT Split Barrel (SB) / LPT Core (C)								
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Proje	ct Name	: <u>Cr</u>	ystal Sprin	ng Colony Comm	unity Developme	nt	Location:		UTM	N-56	60424	42.49, E	-632372.45						
Contr	actor:	Pa	ddock Dril	lling Ltd.			Ground Elevati	on:	248.0	248.00 m (local datum)									
Metho	od:	125	mm Solid S	Stem Auger / HQ Cori	ng, CME-850 Track N	Nounted Rig	Date Drilled:		Augu	st 19,	202	1							
	Sample	Туре	:	Grab (G	i) S	Shelby Tube (T)	Split Spoor	n (S	S) / SF	т 🕨		Split Ba	rrel (SB) / L	PT	C	ore	(C)		
	Particle	Size	Legend:	Fines	Clay	Silt	Sand			Gra	avel	5	-		Boul	ders			
Elevation (m)	Depth (m)	Soil Symbol	ORGANI		/IATERIAL DESC		ce gravel (<10	Sample Type	Sample Number	SPT (N)		17 18 Particle 20 40	Unit Wt 19 20 2' Size (%) 60 80 100 1C LL 60 80 100		∆ Tor Pocke ⊠ C O Field	th (kF Type /ane et Per 0u ⊠ Vane	²a) ≙ ∆ 1. ₱		
			mm diam	.), black, dry, loos	se, low plasticity											_			
247.5			SAND - tr	race silt, trace gra	avel (<20 mm dia ined	ım.), light brown,	dry, loose, poorly		G123							_			
			SILT AND	CLAY - laminat	ed (<5 mm thick) mediate plasticit	, some sand, ligl v	ht grey and dark		G124						Δ				
246.8			· ·	-		-	\ \												
			- ligh	nt brown	clay, trace grave	r (<20 mm ulam.)		G125										
				ist, compact to do plasticity	ense			X	SS126	48	•								
246.0	: :,	M.M	END OF	TEST HOLE AT 2	2.0 m IN SILT (TI	ILL)													
			4) Test no	ole backfilled with	i culungs.														
Logge	ed By:	Rusla	an Amara	singhe	Reviewed	i By: <u>Kent Ban</u>	nister		_ F	Projec	ct En	ngineer:	Ryan Bell	bas					

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GEUTECHNICHL Client: Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00														
Clier	nt:	Bu	Burns Maendel Consulting Engineers Ltd. Project Nu	umber:	0105	5-035-	00							_
Proje	ect Nam	ne: <u>Cr</u>	Crystal Spring Colony Community Development Location:		UTM	I N-56	6041	08.5, E-	63242	27.22				_
Cont	ractor:	Pa	Paddock Drilling Ltd. Ground El	evation	: <u>247.</u>	99 m	(loca	al datum)					_
Meth	nod:	12	25 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drille	ed:	Aug	ust 19	, 202	21						_
	Sampl	е Туре	be: Grab (G) Shelby Tube (T) Split S	Spoon (SS)/S	РТ		Split Ba	arrel (S	SB) / LPT] Cor	e (C)	
	Particl	e Size	e Legend: 🗰 Fines 🚧 Clay 🛄 Silt 👯	Sand		Gra	avel	50] Col	bbles	K	Boulde	rs	
Elevation (m)		Soil Symbol	MATERIAL DESCRIPTION ORGANIC SILT (TOPSOIL) - some sand, trace rootlets, trace gravel (<1 mm diam.), black, dry, friable, hard, intermediate plasticity SILT AND CLAY - laminated (<5 mm thick), some sand, trace gravel (<2	0	Sample Number	SPT (N)		(k) 17 18 Particle 20 40 PL I	60	20 21	Str A P O F	Irained ength (<u>Test Ty</u> Torvar ocket F ⊠ Qu I Field Va 100 1:	(kPa) ne ∆ Pen. ● ⊠ ane O	
247. ⁻ 246.			mm diam.), light brown, dry to moist, hard, intermediate plasticity CLAY - silty, trace sand, trace silt inclusions (< 40 mm diam.), light grey dark grey, moist, very stiff, high plasticity SILT (TILL) - sandy, trace clay, trace gravel (< 40 mm diam.), light browr moist, compact to dense, low plasticity		G119 G120 SS12 ⁷	-		•					-	
246.0	oE i	DJ TK	END OF TEST HOLE AT 2.0 m IN SILT (TILL) Notes:	/	V									

Seepage and sloughing not observed.
 Test hole dry and open to 2.0 m depth immediately after drilling.
 Test hole backfilled with cuttings.

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1 of 1	

Client:		Bu	rns Maen	del Con	sulting Eng	gineers l	_td.			Proj	ect Nur	nber:	010	5-035-	00										
Project	t Name	e: <u>Cr</u>	ystal Sprir	ng Color	ny Commu	nity Dev	elopme	ent		Loc	ation:		UTN	/ N-50	6041	06.79,	E-63	2715.09)						
Contra	ctor:									Gro	und Ele	evation: _100.00 m (local datum)													
Method	d:	125	mm Solid S	Stem Auge	er / HQ Coring	HQ Coring, CME-850 Track Mounted Rig				Date Drilled:		:	_August 20, 2021												
S	Sample	Туре	:		Grab (G)			Shelby 7	ube (T)	\bowtie	Split S	poon (SS)/S	SPT		Split E	arrel	(SB) / L	.PT		Core	e (C)			
Р	Particle	Size	Legend:		Fines		Clay		Silt	 •	ះះ	and		Gra	avel	50		obbles	•		oulder				
866 Elevation (m)	Depth (m)	Soil Symbol	ORGANI	<u>C SILT (</u>	M/ TOPSOIL)					gravel	(< 10 m		Sample Number	SPT (N)		17 18 Partic 20 40 PL	Ik Unit (N/m ³) 3 19 e Size) 60 MC → 60	20 2 (%) 80 10	0	<u>⊺e</u> ∆T ●Poo ∑ OFie	ngth (l est Typ orvan cket P Q Qu D eld Va	kPa) <u>⊳e</u> e ∆ en. Ф ⊠			
98.9	*****		diam.), tra SILT ANI mm diam	ace root D CLAY .), light l	lets, black, - laminate prown, dry	dry, hai d (<5 mr to moist	rd, inter n thick) t, hard,	mediate , some interme	e plasticit sand, tra diate pla	y, friab ce grav sticity	le /el (< 2	0	G17		•										
98.5	المسلية المسلمية المسلم		grey, moi SILT (TIL - bro - mo	sť, very L) - san		olasticity			, -		nd darł		G175												
96.5	ل ا ا			теот ц	OLE AT 3.	5 m IN 9							SS18	0 20											
			Notes: 1) Seepa 2) Test he	ge and s ole dry a	sloughing i ind open to filled with	not obse o 3.5 m o	erved. depth ir		ely after	drilling															

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GE	OT	EC	HNIC	AL																
Clien	t:	Bu	urns Maenc	lel Con	sulting Eng	gineers Ltd.		Project N	lumber	: _0)105-(035-0	0							
Proje	ct Nam	e: _Cr	ystal Sprin	g Color	iy Commu	nity Developn	Location	:	L	JTM	N-560	04084	4.5, E-6	3307	4.4					
Conti	actor:	Pa	addock Dril	ling Ltd			Ground Elevation: 246.65 m (local datum)													
Meth	od:	_125	5 mm Solid St	em Auge	r / HQ Coring	g, CME-850 Trac	k Mounted Rig	Date Drilled: _August 20, 2021												
	Sample	е Туре	: :		Grab (G)		Split	t Spoon	i (SS)) / SP	т 🕨	(s	Split Bar	rel (S	B) / LP	т[Core	(C)	
	Particle	e Size	Legend:		Fines	Clay	Silt	•••••	Sand			Grav	vel	67	Cob			Βοι	ulder	3
Elevation (m)	Depth (m)	Soil Symbol				ATERIAL DES					Sample Number	S	0 20	Particle S 0 40 PL MC	m ³) 19 Size (% 60 C L	20 21	4	∆ To Pocł ⊠ O Fiel	gth (k st Type rvane ket Pe Qu ⊠ d Van	Pa) ≙ ∆ n. ₽
246.3		<u>x1 / </u>	ORGANIC	CLAY	(TOPSOII	L) - silty, trace	sand, black, dry,	hard, friable			G181									
245.3	بىلىرىلىرىلىر		- ligh - dry	t brown to mois	and dark	grey	k), some sand				<u>3182</u>			•						
240.0					dy, trace c	lay, trace grav	/el (<20 mm diam)												
244.7				<i>w</i> n st, com plastici						Xs	S183	18		•	_					
			Notes: 1) Seepag 2) Sloughi	je not o ing obs le dry a	bserved. erved belo ind open to	.0 m IN SILT (ov 1.5 m depti o 1.5 m depth cuttings.	, ,	drilling.												

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246.4 246.4 246.4 246.4 246.2 Image: Silong and the second	hity Development Location: Ground Elevation: Ground Elevation: , CME-850 Track Mounted Rig Date Drilled: Image: Shelby Tube (T) Split Spoon (Simple Clay) Clay Silt Clay Sand ATERIAL DESCRIPTION Sand Image: Clay Silt Status Sand ATERIAL DESCRIPTION Sand Image: Clay Sand Image: Clay	UTM N-5604 n: 246.55 m (loc August 20, 2 (SS) / SPT Grave	4088.62, E-633325.96 cal datum) 021 Split Barrel (SB) / LPT el Cobbles Bulk Unit Wt 6 17 18 19 20 21 Particle Size (%) 20 40 60 80 100 PL MC LL	Boulders Undrained Shear Strength (kPa) <u>Test Type</u> △ Torvane △ ♥ Pocket Pen. ♥ ⊠ Qu ⊠ ○ Field Vane ○
Contractor: Paddock Drilling Ltd. Method: 125 mm Solid Stem Auger / HQ Coring Sample Type: Grab (G) Particle Size Legend: Fines Image: Stem Solid Stem Auger / HQ Coring Fines Image: Stem Solid Stem Auger / HQ Coring Grab (G) Particle Size Legend: Image: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Grab (G) Particle Size Legend: Image: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Image: Stem Solid Stem Auger / HQ Coring Mage: Stem Solid Stem Auger / HQ Coring Ima	Ground Elevation: <u>CME-850 Track Mounted Rig</u> Date Drilled: Shelby Tube (T) Split Spoon (S Clay Silt Solt Sold ATERIAL DESCRIPTION) - silty, trace rootlets, trace sand, black, damp, d (<5 mm thick), some sand, light brown and dark intermediate plasticity ay, trace gravel (<30 mm diam.) 0 m IN SILT (TILL) w 1.5 m depth. 1.5 m depth.	n: 246.55 m (lor August 20, 2 (SS) / SPT (SS) / SPT	cal datum) 021 Split Barrel (SB) / LPT el Cobbles Bulk Unit Wt 6 17 18 19 20 Particle Size (%) 20 40 60 80 100 PL MC LL 20 40 60 80 100	Boulders Undrained Shear Strength (kPa) <u>Test Type</u> △ Torvane △ ♥ Pocket Pen. ♥ ⊠ Qu ⊠ ○ Field Vane ○
Method: 125 mm Solid Stem Auger / HQ Coring Sample Type: Grab (G) Particle Size Legend: Fines Image: State Sta	CME-850 Track Mounted Rig Date Drilled: Shelby Tube (T) Split Spoon (S Clay Silt Clay Silt ATERIAL DESCRIPTION Sand ATERIAL DESCRIPTION Attack (<5 mm thick), some sand, light brown and dark intermediate plasticity	August 20, 2 (SS) / SPT (SS) / SPT (ST)	021 Split Barrel (SB) / LPT el Cobbles Bulk Unit Wt (kN/m ³) 20 21 Particle Size (%) 20 40 60 80 100 PL MC LL 20 40 60 80 100 0 0	Boulders Undrained Shear Strength (kPa) <u>Test Type</u> △ Torvane △ ♥ Pocket Pen. ♥ ⊠ Qu ⊠ ○ Field Vane ○
Sample Type: Grab (G) Particle Size Legend: Fines Image: State Size Legend: Image: Size Legend: Image: State Size Legend: Image: Size Legend: Image: Size Legend: Size Size Size Legend: Image: Size Legend: Size Size Size Size Size Size Size Size	Shelby Tube (T) Split Spoon (S Clay Silt Soon (S Clay Silt Soon (S ATERIAL DESCRIPTION) - silty, trace rootlets, trace sand, black, damp, (<5 mm thick), some sand, light brown and dark intermediate plasticity ay, trace gravel (<30 mm diam.) 0 m IN SILT (TILL) w 1.5 m depth. 1.5 m depth.	(SS) / SPT Grave Sample Numper Sample Numper G184 G185 G186	Split Barrel (SB) / LPT el Cobbles Bulk Unit Wt 6 17 18 19 20 Particle Size (%) 20 40 60 80 20 40 60 80 100	Boulders Undrained Shear Strength (kPa) <u>Test Type</u> △ Torvane △ ♥ Pocket Pen. ♥ ⊠ Qu ⊠ ○ Field Vane ○
Particle Size Legend: Fines Fines Fines Fines Fines Fines Fines Fines Fines Fines Fines Fines Fines M. Content of the final	Clay Silt Sand ATERIAL DESCRIPTION (<5 mm thick), some sand, light brown and dark intermediate plasticity ay, trace gravel (<30 mm diam.) 0 m IN SILT (TILL) w 1.5 m depth. 1.5 m depth immediately after drilling.	Cample Type Sample Number 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	el Cobbles obbles Cobbles Cobbles Cobbles Cobbles Cobbles Cobbles Cobbles Cobbles Cobbles Cobbles Cobbles Cobbles Cobbles C	Boulders Undrained Shear Strength (kPa) <u>Test Type</u> △ Torvane △ ♥ Pocket Pen. ♥ ⊠ Qu ⊠ ○ Field Vane ○
Image: Second	ATERIAL DESCRIPTION) - silty, trace rootlets, trace sand, black, damp, d (<5 mm thick), some sand, light brown and dark intermediate plasticity ay, trace gravel (<30 mm diam.) 0 m IN SILT (TILL) w 1.5 m depth. o 1.5 m depth immediately after drilling.	Cample Type Sample Type Cample Number 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Bulk Unit Wt 6 17 18 19 20 21 Particle Size (%) 20 40 60 80 100 PL MC LL 1 20 40 60 80 100 PL MC LL 1 20 40 60 80 100 0	Undrained Shear Strength (kPa) <u>Test Type</u> △ Torvane △ ♥ Pocket Pen. ● ⊠ Qu ⊠ ○ Field Vane ○
246.4 3 1/2 · · · · · · · · · · · · · · · · · · ·	 a) - silty, trace rootlets, trace sand, black, damp, b) - silty, trace rootlets, trace sand, light brown and dark intermediate plasticity ay, trace gravel (<30 mm diam.) b) 0 m IN SILT (TILL) b) 1.5 m depth. b) 1.5 m depth immediately after drilling. 	G184 G185 G186	6 17 (kN/m ³) 20 21 Particle Size (%) 20 40 60 80 100 PL MC LL 20 40 60 80 100 0 0 20 40 60 80 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Strength (kPa) <u>Test Type</u> △ Torvane △ ● Pocket Pen. ● ⊠ Qu ⊠ ○ Field Vane ○
244.6 SILT AND CLAY - laminate grey, dry to moist, very stiff, silt (TILL) - sandy, trace of - light brown 244.6	o m IN SILT (TILL) w 1.5 m depth. 0 1.5 m depth immediately after drilling.	G186	• · · · · • · · · · · • · · · · · • · · · · · • · · · · ·	
RING COLO	cuttings.			
Logged By: _Ruslan Amarasinghe				5

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GE	UT	EC	HNI	<u>Cal</u>																				
										Project N	lumber:		0105-	035-0	00									
Proje	ct Nam	I	Location	:		UTM	N-56	0398	2.92, E	E-632 ⁻	43.4	7				_								
Conti	actor:	Pa	addock Dri	illing Ltd					(Ground I	Elevatio	ation: _248.77 m (local datum)												
Meth	od:	12	5 mm Solid S	Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig							led:	August 19, 2021												
	Sample	е Туре	ə:		Grab (G	i)	S	Shelby Tube	(T)		Spoon	(SS	6) / SF	т 🕨		Split Ba	arrel (SB) / I	_PT	Core (C)				
	Particle Size Legend: Image: Clay Image: Clay													Gra	vel	57		obles		В	oulde	rs		
Elevation (m)	Depth (m)	Soil Symbol	OPCANI						(c10 m	m diam)		Sample Type	62 64 62 84 84 84 84 84 84 84 84 84 84 84 84 84	SI		(ki 7 18 Particle		20 2	00	Stre <u>T</u> <u>A</u> Pro I O Fi	ained ength (est Ty forvar cket F ⊠ Qu [eld Va 00 1	kPa) <u>pe</u> ne ∆ Pen. Ф ⊠ ne ⊖	•	
<u>248.6</u> 247.7	بلسراسراب		SILT ANI 5 mm dia diam.), bi	black, dr D CLAY Im.), trac rown and	y, loose, - laminat e gravel d light bro e sand to	lów plasti ed (<5 mr (< 20 mm own, mois	city m thick) n diam.), st, firm to	, some sand , trace silt in o stiff, interm y, trace grav	l, trace clusion nediate	precipita s (< 30 n plasticity	tes (< nm		G79 G80 G81		•									
246.8			- mc - low - dry, der	oist, com v plastici use belov	pact to d ty w 1.5 m	ense 2.0 m IN S							SS82	49	•									
			3) Test h drilling.	ning obso ole dry a	erved be nd open	low 1.5 m	depth ap	oproximately	y 5 minu	utes after														

		RE	K	S	ub-Su	face Lo	DQ	3				-	Test	Hole	TH	21-1 1 of	
Client: Project Na Contractor Method: Sam	me:	Crystal Sprin Paddock Dril 125 mm Solid S	del Consulting E g Colony Comm ling Ltd.	iunity Developmer		Project Number Location: Ground Elevation Date Drilled: Split Spoor	on: _	UTM 248.7 Augu	7 <u>6 m (</u> ist 19, PT []	0389 local 202	· · · ·	rrel (S] Co	re (C)	
Elevation (m) (m)				MATERIAL DESC			Sample Type	Sample Number	SPT (N)	16 0 2	☐ Bulk (kN 17 18 Particle 20 40	Unit W /m ³) 19 Size (%	/t 2021		drainec trength <u>Test T</u> ∆ Torva Pocket ⊠ Qu Field V 100	I Shear (kPa) y <u>pe</u> ne ∆ Pen. Φ ⊠ ane ⊖	•
248.6		trace root SILT AND mm diam. CLAY - sil 30 mm dia	lets, black, dry, l CLAY - laminat), brown and gre lty, trace sand, ti	grey, moist, stiff,	mediate plasticit some sand, tra f to hard, intermo mm diam.), trace	y ce gravel (< 20		G83 G84 G85							Δ	•	

Seepage and sloughing not observed.
 Test hole dry and open to 1.5 m depth approximately 5 minutes after drilling.
 Test hole backfilled with cuttings.

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	Bu	urns Maendel Co	nsulting Er	ngineers Ltd.		Project Number	: _(0105-	035-0	00								_
t Nam	e: _Cr	rystal Spring Cold	ony Comm	unity Developr	nent	Location:	l	JTM	N-56	035	68.65, E-	6323	72.71					_
ctor:	Pa	addock Drilling Lt	d.			Ground Elevation	on: _2	248.0	4 m (loca	l datum)							_
:	_12	5 mm Solid Stem Aug	ger / HQ Cori	ng, CME-850 Trac	k Mounted Rig	Date Drilled:	4	Augu	st 19,	202	21							_
ample	е Туре	e:	Grab (G)	Shelby Tube (T)	Split Spoor	n (SS) / SF	т р		Split Bar	rel (S	B) / LF	т [Core	(C)	
article	e Size	Legend:	Fines	Clay	Silt	Sand			Gra	vel	52	Cob	bles		Βοι	ulder	S	
Depth (m)	Soil Symbol		Ν	IATERIAL DE	SCRIPTION		Sample Type	Sample Number	SPT (N)	0	(kN/ 17 18 Particle \$ 20 40	m ³) 19 Size (%	20 21 5) 80 100 L		Stren <u>Tes</u> △ To Pocl Ø Pocl Ø O Fiel	igth (kl st Type orvane ket Pe Qu ⊠ Id Van	Pa) △ ∩. ● e ○	0 250
		friable CLAY - silty, trac - grey - moist, sof - high plast - trace silt inclus	ce sand it to firm icity sions (<20	mm diam.) bel	ow 1.2 m	ack, damp, hard,		G46										
	Nam ctor: : ampld article	Bit Name: Citor: Particle 12 ample Type article Size article Size article Size article Size article Size article Size	Burns Maendel Co Name: Crystal Spring Colo Ctor: Paddock Drilling Lt 125 mm Solid Stem Aug ample Type: Aug article Size Legend: Aug Type: Aug article Size Legend: Aug Type: Aug article Size Legend: Aug Type: Aug article Size Legend: Aug Type: Aug Aug Aug Aug Aug Aug Aug Aug	Name: Crystal Spring Colony Comm Ctor: Paddock Drilling Ltd. 125 mm Solid Stem Auger / HQ Corri ample Type: Grab (G article Size Legend: Fines Grading M Grading M Comparison Comparison	Burns Maendel Consulting Engineers Ltd. Name: Crystal Spring Colony Community Development Ctor: Paddock Drilling Ltd. 125 mm Solid Stem Auger / HQ Coring, CME-850 Trace ample Type: Grab (G) article Size Legend: Fines Color Clay article Size Legend: MATERIAL DE	Burns Maendel Consulting Engineers Ltd. Name: Crystal Spring Colony Community Development Ctor: Paddock Drilling Ltd. I: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig ample Type: Image: Grab (G) article Size Legend: Fines Image: Grap Grap Grap Grap Grap Grap Grap Grap	Burns Maendel Consulting Engineers Ltd. Project Number Name: Crystal Spring Colony Community Development Location: ctor: Paddock Drilling Ltd. Ground Elevation it: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: ample Type: Image: Grab (G) Shelby Tube (T) Split Spoor article Size Legend: Fines Clay Silt Sand Image: Grag Image: Grag (G) NATERIAL DESCRIPTION Sand Image: Grage ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, friable CLAY - silty, trace sand - grey - moist, soft to firm - high plasticity - trace silt inclusions (<20 mm diam.) below 1.2 m	Burns Maendel Consulting Engineers Ltd. Project Number: Q Name: Crystal Spring Colony Community Development Location: Q ctor: Paddock Drilling Ltd. Ground Elevation: Q it: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: Q ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS article Size Legend: Fines Clay Silt Sand MATERIAL DESCRIPTION MATERIAL DESCRIPTION MATERIAL DESCRIPTION M Image: ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, friable Grey Grey Finosit, soft to firm Finity, trace sand Finity,	Burns Maendel Consulting Engineers Ltd. Project Number: 0105- Name: Crystal Spring Colony Community Development Location: UTM. ctor: Paddock Drilling Ltd. Ground Elevation: 248.0 It: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: Augustion: ample Type: Image: Grab (G) Image: Shelby Tube (T) Split Spoon (SS) / SF article Size Legend: Fines Clay Image: Sand Image: Sand Image: Grag Grag Grab (G) MATERIAL DESCRIPTION MATERIAL DESCRIPTION Image: Grap Grap Grap Grap Grap Grap Grap Grap	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-4 Name: Crystal Spring Colony Community Development Location: UTM N-56 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (It: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, ample Type: Image: Grab (G) Image: Shelby Tube (T) Split Spoon (SS) / SPT Image: Grab Grab Grab Grab Grab Grab Grab Grab	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-56035 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (location: it: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 202 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Image: Split Spoon (SS) / SPT article Size Legend: Fines Clay Silt Sand Gravel Image: Split Spoon (SS) / SPT MATERIAL DESCRIPTION Split Spoon (SS) / SPT Image: Split Spoon (SS) / SPT Image: Split Spoon (SS) / SPT Image: Split Spoon (SS) / SPT Image: Split Spoon (SS) Split Spoon (SS) / SPT Image: Split	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E- Ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Bar article Size Legend: Fines Clay Silt Sand Gravel Burls MATERIAL DESCRIPTION MATERIAL DESCRIPTION ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, grey G45 G45 G45 ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, grey G45 G45 G46 G46 ULX G46 G47 G47 G47 G47	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-6323 Stor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (S article Size Legend: Fines Clay Silt Gravel Color (C) MATERIAL DESCRIPTION MATERIAL DESCRIPTION In trace silt inclusions (<20 mm diam.) below 1.2 m	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-632372.71 Stor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LF article Size Legend: Fines Clay Silt Gravel Cobles MATERIAL DESCRIPTION MATERIAL DESCRIPTION If 17 18 If 17 18 If 10	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-632372.71 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Image: Grab (G) Image: Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT article Size Legend: Image: Fines Clay Image: Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Image: Gravel Image: Gravel	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-632372.71 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT article Size Legend: Fines Clay Silt Silt Gravel Cobles Boo 00000 Fines Clay Silt Sand Gravel Cobles Boo 00001 MATERIAL DESCRIPTION MATERIAL DESCRIPTION Image: Stem Gravel CLAY - Silty, trace sand, trace rootlets, black, damp, hard, friable Gravel Gravel Gravel CLAY - Silty, trace sand Gravel Gravel <td>Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-632372.71 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core article Size Legend: Fines Clay Silt Sand Gravel Gravel OC Dobles Bulk Unit Wt Undrained S 0 0 20 40 60 80 100 Strength (kt 0 20 40 60 80 100<!--</td--><td>Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-632372.71 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) it: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C) article Size Legend: Fines Clay Silt Strength (kPa) Particle Size (%) Date Drilled: Oroyana CA model MATERIAL DESCRIPTION MATERIAL DESCRIPTION Gravel Cold 40 60 80 100 50 100 150 201 MATERIAL DESCRIPTION MATERIAL DESCRIPTION Gravel Gravel Cold 40 Cold 40 OR 80 100 50 100 150 201 Project Number: ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, riable Gravel Gravel Gravel Or 40 S0 100 150 201 ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, riable Gravel Gravel Gravel Gravel Gravel Gravel Gravel <</td></td>	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-632372.71 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core article Size Legend: Fines Clay Silt Sand Gravel Gravel OC Dobles Bulk Unit Wt Undrained S 0 0 20 40 60 80 100 Strength (kt 0 20 40 60 80 100 </td <td>Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-632372.71 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) it: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C) article Size Legend: Fines Clay Silt Strength (kPa) Particle Size (%) Date Drilled: Oroyana CA model MATERIAL DESCRIPTION MATERIAL DESCRIPTION Gravel Cold 40 60 80 100 50 100 150 201 MATERIAL DESCRIPTION MATERIAL DESCRIPTION Gravel Gravel Cold 40 Cold 40 OR 80 100 50 100 150 201 Project Number: ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, riable Gravel Gravel Gravel Or 40 S0 100 150 201 ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, riable Gravel Gravel Gravel Gravel Gravel Gravel Gravel <</td>	Burns Maendel Consulting Engineers Ltd. Project Number: 0105-035-00 Name: Crystal Spring Colony Community Development Location: UTM N-5603568.65, E-632372.71 ctor: Paddock Drilling Ltd. Ground Elevation: 248.04 m (local datum) it: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled: August 19, 2021 ample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C) article Size Legend: Fines Clay Silt Strength (kPa) Particle Size (%) Date Drilled: Oroyana CA model MATERIAL DESCRIPTION MATERIAL DESCRIPTION Gravel Cold 40 60 80 100 50 100 150 201 MATERIAL DESCRIPTION MATERIAL DESCRIPTION Gravel Gravel Cold 40 Cold 40 OR 80 100 50 100 150 201 Project Number: ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, riable Gravel Gravel Gravel Or 40 S0 100 150 201 ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, damp, hard, riable Gravel Gravel Gravel Gravel Gravel Gravel Gravel <

Notes:

Seepage and sloughing not observed.
 Test hole dry and open to 1.5 m depth immediately after drilling.
 Test hole backfilled with cuttings.

			RE	K			Sub-S	Surf	ace Lo	ວດ	J				٦	[est	Hol	e T		-13 1 of 1	
Clien					ting En	gineers Ltd.			roject Number		0105-	035 (0								
						nity Develop	oment		ocation:	-				0.85, E-	-63217	78					-
-	ractor		Paddock Dr			<u></u>			Ground Elevation	-						•					-
Meth	od:	_		-	HQ Corin	g, CME-850 Tra	ack Mounted Rig		ate Drilled:		Augu										_
	Samp	le Typ	be:	G	rab (G)		Shelby Tub	e (T) >	Split Spoor	n (S	S) / SF	т 🕨		Split Bar	rrel (S	B) / LP	тΓ		Core	(C)	
	Partic	le Siz	e Legend:	Fi	nes	Cla	у	Silt	 Sand			Gra	vel	67	Cob	oles		Βοι	ulders		
<i>c</i>		0								be	Ther		16 1 [°]	□ Bulk (kN/ 7 18		20 21		Stren	ned Sl gth (kl	Pa)	
Elevation (m)	(m)	Symbol			М	ATERIAL DI	ESCRIPTION			Sample Type	Sample Number	SPT (N)		Particle	Size (%	·		∆Tc	<u>st Type</u> prvane ket Pe	Δ	
Ē		Soil								Samp	ample	SP	0 2	0 40 PL M		80 100 L		\boxtimes	Qu 🛛 d Van		
			105000	<u> </u>						07			02	0 40	60	80 100 () 50) 100	0 150	200	J 250
248.6	f -		black, dr	y, hard, fria	ble		otlets, trace gra		,	\square	_G69_										
			SILT ANI		aminate	d (<5 mm th	ick), some san	id, trace g	gravel (<20												
			- bro - mo	own and lig bist, firm to	stiff						G70		•	•					¢		
247.4	- -			ermediate p L) - some o	clay, tra	-	ce gravel (<20	mm dian	ı.)		0.71									_	
				own and gre bist, firm	еу						G71										
	Ē		ି - hig	h plasticity						Й	SS72	21	•								
	Ę.																				
											G73										
	L .																_				
		50								\square											
			sandy, t	trace clay, l	ight bro	wn, compac	t to dense, low	/ plasticity	/ below 3.4 m	М	SS74	25	•								
	Ę.,																				
	E -										G75								_	_	
										\square	SS76	19									
										Д	5570	13								_	
			\leq																		
											G77										
	E.		\leq																		
	È .									\square	SS78	13	•								
242.1	È :	2010		TEST HOL	FAT6	.5 m IN SILT				\mathbb{N}	0010	10									
			Notes: 1) Seepa 2) Slougl 3) Test h drilling.	ige not obs ning observ	erved. ved belo I open t	ow 6.0 m dej o 6.1 m dep		ly 5 minu	tes after												

Clie Proj					ulting En y Commu			nt		Project Numl Location:	ber:	0105 UTM			57.2, E	-632	684.88					_
	tractor: hod:		ddock Dr		/ HQ Corin		50 Trook M	lounted	Dia	Ground Eleva	ation:		· · ·			n)						-
Wet		le Type			Grab (G)				Tube (T)	Split Spl	oon (S	Augu		_		arrel	(SB) / LI	эт		Core	e (C)	
	-		Legend:		Fines		Clay		∏ Silt	Sar			Gra		57		obbles		Во	oulder	. ,	
Elevation	(m) Depth (m)	Soil Symbol			М	ATERIA	L DESC	RIPTIC	NC		Sample Type	Sample Number	SPT (N)		17 18	MC	20 21 (%) 80 100 LL	1	Stre △ T ● Po ○ Fie	ained S ngth (k est Typ orvane cket Pe d Qu Ø eld Var 00 15	kPa) e ∆ en. ● ⊠ ne ⊖	I
99.	.8		ORGANI hard, fria		(TOPSOI	L) - silty	, trace sa	and, tra	ace rootlets	s, black, dry,		G109										
	-0.5-	10////	SILT (TIL		ly, trace c	lay, trac	ce gravel	l (<20 r	mm diam.)													
	1.0-			∕, loose ∕ plasticit	у							G110		•								
	-1.5-		- compac	t to dens	e below 1	l.5 m					X	SS111	31									
	-2.5-											G112										
	-3.0-										X	SS113	33	•								
	4.0-											G114										
	-4.5-		- trace gr	avel (<3() mm diar	n.) belo	w 4.6 m				X	SS115	26									
	-5.5-											G116										
93.	-6.0 			TEST U		E m IN					X	SS117	27	•								
<u>93</u> .			Notes: 1) Seepa 2) Slougl 3) Test h	ge obser ning obse ole dry a	OLE AT 6 rved at 4.6 prved belo nd open t filled with	6 m dep w 5.0 n o 5.8 m	th. n depth. depth im		itely after c	trilling.												

			REK Sub-Surface	Lo	DC	J				Test	Ho	ole T	י -1 נל 1 נ	15 of 1
			HNICAL											
Client			Irns Maendel Consulting Engineers Ltd. Project Nu			0105-								
-			ystal Spring Colony Community Development Location:		-				9, E-633	3437				
	actor:		ddock Drilling Ltd. Ground E		_									
Metho	od:	_125	5 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drille	ed:	-	Augu	st 20,	202						
	Sampl	е Туре	e: Grab (G) Shelby Tube (T) Split	Spoon	(SS	S) / SF	т Ъ		Split Bar	rel (SB) / LF	ΡŢ		Core (C	C)
	Particl	e Size	Legend: Fines Clay Silt	Sand			Gra	vel	67	Cobbles		Во	ulders	
						er			Bulk U				ined She igth (kPa	
uo	-C	Symbol			Type	qmn	2	16 1					st Type	,
Elevation (m)	Depth (m)	Syn	MATERIAL DESCRIPTION		ble	e N	SPT (0 2	Particle S	60 80 100			orvane ∆ ket Pen.⊧	
Ě		Soil			Sample Type	Sample Number	S		PL MC				IQu⊠ Id Vane (S
								0 2	0 40	60 80 100	0	50 10	0 150	200 250
247.5			PEAT - Amorphous, trace rootlets, trace sand, damp, black, loose SAND - some silt, trace clay, trace gravel (<30 mm diam.)	/	A	G224								
	-0.5-		- brown											
			- dry, loose - poorly graded, fine to coarse grained											
	-1.0-					G225		•						
	-1.5-		- moist below 1.5 m											
					0	SS226								
	-2.0-													
245.2			- wet below 2.1 m		4	G227								
	-2.5-		CLAY - silty, trace silt inclusions (<40 mm diam.), trace sand, trace grav	el		G228			•			∆©		
244.8			(<20 mm diam.), light brown and light grey, moist, stiff, high plasticity			9220								
	-3.0-		SILT (TILL) - sandy, trace clay, trace gravel (<30 mm diam.) - light brown		\mathbf{H}									
	_		- moist, dense - low plasticity		M	SS229	30	•						
	-3.5-		- low plasticity		Ħ									
	4.0													
	4.0				A	G230								
	-4 5-													
					M	SS231	40							
	-5.0-				Д	33231	40							
	-5.5-					G232								
	-6.0-				Ц									
			- compact below 6.1 m		M	SS233	18	•						
241.1	_6.5_		END OF TEST HOLE AT 6.5 m IN SILT (TILL)											
			 Notes: 1) Seepage observed from 2.1 m to 2.4 m depth. 2) Sloughing observed from 0.1 m to 1.5 m depth. 3) Water level at 5.6 m depth approximately 5 minutes after drilling. 4) Test hole open to 5.6 m depth approximately 5 minutes after drilling. 5) Test hole backfilled with bentonite. 											

Sub-Surface Lo	Test Hole TH21-16 1 of 1
GEOTECHNICAL Project Number: Client: Burns Maendel Consulting Engineers Ltd. Project Number: Project Name: Crystal Spring Colony Community Development Location: Contractor: Paddock Drilling Ltd. Ground Elevation Method: 125 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date Drilled:	0105-035-00 UTM N-5603556, E-633341 n: 100.00 m (local datum) August 20, 2021
Sample Type: Grab (G) Shelby Tube (T) Split Spon Particle Size Legend: Fines Clay Silt Sand	(SS) / SPT Split Barrel (SB) / LPT Core (C)
	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $
99.8 99.8 97.4 PEAT - Amorphous, trace rootlets, trace sand, damp, black, loose 99.8 SILT AND CLAY - laminated (<5 mm thick), some sand, trace gravel (<20 mm diam.)	G188 G190 G189
SILT (TILL) - sandy, trace clay, trace gravel (<20 mm diam.) Iight brown - noist, compact to dense -2.0 → C, - low plasticity -2.5 → C, - low plasticity -3.0 → C,	SS191 23 •
-3.5-2 -3	G194 G194
- 5.5 - 0 () - 5.5 - 0 () - 5.5 - 0 () - 5.5 - 0 () - 6.0 - 0 () () - 6.0 - 0 () () - 6.0 - 0 () ()	SS195 39 • · · · · · · · · · · · · · · · · · ·
 <u>93.4 6.5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6</u>	SS197 41

	REK Sub-Surfac	ce Lo	og		Test H	Hole TH21-17 1 of 1
GEOTE	CHNICAL					
Client:	Burns Maendel Consulting Engineers Ltd. Proj	ect Number:	0105	-035-0	00	
Project Name:	Crystal Spring Colony Community Development Loca	ation:	UTM	N-56	03425.66, E-633392.34	
Contractor:	Paddock Drilling Ltd. Grou	und Elevatio	n: <u>100.0</u>	0 m (local datum)	
Method: _1	25 mm Solid Stem Auger / HQ Coring, CME-850 Track Mounted Rig Date	Drilled:	Augu	st 20,	2021	
Sample Ty	be: Grab (G) Shelby Tube (T)	Split Spoon	(SS) / SI	т р	Split Barrel (SB) / LP1	Core (C)
Particle Siz	e Legend: 🗰 Fines 🚧 Clay 🛄 Silt 🕻	Sand		Gra	vel Cobbles	Boulders
_			ber		□ Bulk Unit Wt (kN/m ³) 16 17 18 19 20 21	Undrained Shear Strength (kPa)
evation (m) Depth (m) Symbol			Sample Type Sample Number	ź	Particle Size (%)	Test Type
Elevation (m) Depth (m) oil Symbo	MATERIAL DESCRIPTION		nple ole N	SPT (N)	0 20 40 60 80 100	∆ Torvane ∆ ∳ Pocket Pen. ∳ ⊠ Qu ⊠
Soil D Soil			San	0)	PL MC LL	○ Field Vane ○
99.8E	실 안 PEAT - Amorphous, trace rootlets, trace sand, damp, black, loose		G215		0 20 40 60 80 100 0	50 100 150 200 250
	SILT AND CLAY - laminated (<5 mm thick), some sand, trace grav	/ſ	GZIJ			
-0.5-	mm diam.) - light grey and dark grey	,				
	- moist, very stiff		G216			
-1.0-	- intermediate plasticity					
-1.5-						
			T217			
97.9 - 2.0 -						
	SILT (TILL) - sandy, trace clay, trace gravel (<20 mm diam.)					
	- moist, compact		G218			
	- low plasticity					
			T219			
			1219			
		-	G220			
	- trace gravel (<40 mm diam.) below 4.9 m		SS221	29		
-5.5-0		F	G222			
-6.0-0						
			X SS223	22		
93.4 6.5 6 9	END OF TEST HOLE AT 6.5 m IN SILT (TILL)					
	Notes: 1) Seepage not observed. 2) Sloughing observed below 6.0 m depth. 3) Test hole dry and open to 6.1 m depth approximately 5 minutes drilling. 4) Test hole backfilled with bentonite.	after				
Logged By: Ru	slan Amarasinghe Reviewed By: _Kent Bannister			Proiec	:t Engineer: Ryan Belba:	5

SUB-SURFACE LOG LOGS 2021-08-18 CRYSTAL SPRING COLONY DEV 0_A_RSA 0105-035-00.GPJ TREK.GDT 10/29/21

			RE	K	S	ub-Sur	face Lo	bg	J				T	est H	ole ⁻	Г Н 2 ⁻	1-18 1 of	
-	t: ct Nar ractor:	<u></u> me: <u></u> r	ystal Spring addock Drill	el Consulting E g Colony Comn ing Ltd.	Engineers Ltd. nunity Developme ring, CME-850 Track N		Project Number Location: Ground Elevatic Date Drilled:	- on: _	UTM 247.5		0332 ocal		3334	7.12				_
		le Type		Grab (0		Shelby Tube (T)	Split Spoon	ı (SS	S) / SF	-		Split Barr	-			Core	()	
Elevation (m)	Depth Depth (m)		Legend:	Fines	Clay	CRIPTION	Sand	Sample Type	Sample Number	SPT (N)	16 1 0 2	Bulk U (kN/m 7 18 Particle Si 20 40 PL MC	1 ³) 19 2 ze (%) 60 8 LL	0 21	Undr Stre <u>I</u> Pro OF	ained S ength (<u>k</u> est Typ Forvand cket Pr Z Qu 2 eld Var 00 15	Shear (Pa) De e A en. Ф Ane O	0 250
243.3		$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i$	SILT (TILL - light - dry, - low - dense be - dense be SEND OF T Notes: 1) Seepag 2) Test ho) - sandy, trace brown compact plasticity elow 1.5 m	e rootlets, trace sa e clay, trace grave	I (<20 mm diam.)			G209 G210 T211 G212 G214	50 / 101mm								

STREK
GEOTECHNICAL

Sub-Surface Log

Client	t:	Bu	rns Maeno	del Cor	nsulting Er	ngineers Ltd.		Project Number	r:	0105	-035-0)0							_
Proje	ct Nam	e: _Cr	ystal Sprin	g Colo	ny Comm	unity Developme	ent	Location:		UTM	N-56	0332	27.11, E	-6334	140.69				
Contr	ractor:	Pa	ddock Dril	ling Lto	d.			Ground Elevation	on:	247.0	0 m (local	datum))					_
Metho	od:	_125	5 mm Solid S	tem Aug	er / HQ Cori	ng, CME-850 Track	Mounted Rig	Date Drilled:		Augu	st 20,	202	1						
	Sample	е Туре	:		Grab (G)	Shelby Tube (T)	Split Spoor	ו (S	S) / SF	т 🕨		Split Ba	arrel (SB) / LPT	·	Со	re (C)
	Particle	e Size	Legend:		Fines	Clay	Silt	 Sand			Gra	vel	62	Co	bles •		Boulde	ers	
			_							er l			Bulk		Vt		drained		
Б		lodi							Sample Type	Sample Number	(Z	16		I/m ³) 19	20 21	S	trength Test Ty		
Elevation (m)	(m)	Syn			N	ATERIAL DES	CRIPTION		ole	e Nr	SPT (N	0	Particle 20 40		%) 80 100	ر ا	Torva	ne ∆	•
Ele		Soil Symbol							Sam	ldm	ß	· ·			LL		⊠ Qu Field Va	\boxtimes	
												0	20 40	60	80 100 0		100 1		
246.8							and, damp, black,	loose	X	G198									
246.4	-0.5-		- ligh	t brown	n, dry, loos					G199									
240.4						o coarse graine	d), some sand, trac												_
	-1.0-		mm diam.	.)), some sand, trac	e graver (<20		T200									
				t grey a ist, verv	and dark g v stiff	grey				1200									_
245.5	-1.5-		inte	rmedia	ate plastici	ity										_			_
			CLAY - si - dar	lty k grey						T201									-
	-2.0-		- moi	ist, stiff n plasti															+-
244.6			- nigi	i piasu	ony					G202			•				•		+-
21110	-2.5-		SILT (TIL	L) - sar	ndy, trace	clay, trace grave	el (<20 mm diam.)										_		+
				t brown dense						G203									-
	-3.0-	٦Q c	- low	plastic	city				\vdash								_		+
									X	SS204	56	•							-
	-3.5-	ЪЙС																	1
	4.0	20c								G205									
	4.3	, Q C							∇										
	50								Ň	SS206	35	•							
		٦Ď																	
	-5.5-									0007									
		30 C								G207									
	-6.0-																		_
	Ę	j d C							\mathbb{N}	SS208	56 /	•					_		+
240.5	<u>t</u>	01/10	END OF	TEST F	HOLE AT (6.5 m IN SILT (T			1		ZZƏMİ	1						1	
			Notes:			(-	,												
				ing obs	served bel	low 6.0 m depth													
			Test ho drilling.	ole dry	and open	to 6.1 m depth a	approximately 5 m	nutes after											
				ole bac	kfilled with	n bentonite.													
			an Amara	a iva avla a		Devieure	d By: Kent Bann					4 E.	gineer:	_					-

			2												Test	Hol	e Tl		-
		11	ΚE	K		S	ub-Sur	face Lo	D(J									1 of 1
GE			<u>HNIC</u>							0.405									
Client				el Consulting E g Colony Comr				Project Number	•	0105			4.24 6	= 6221	520.27				
-	ractor:				nunity De	evelopmer	11	Location:					4.24, E		529.37				
			ddock Drill			950 Trools M	auntad Dia	Ground Elevatio	on:)					
Metho				em Auger / HQ Co			-	Date Drilled:	(0	Augu	_					<u>т</u> Г			
	Sample			Grab (-		helby Tube (T)	Split Spoon	1 (S						SB) / LF	<u>'' [</u>		Core	. ,
	Particle	Size	Legend:	Fines		Clay	Silt	👯 Sand			Gra	vel	62	_	bbles			Iders	
		_							e la	ber		16 1		k Unit V N/m³) 19	Vt 20 21	ι	Jndrair Streng		
Elevation (m)	÷,	Soil Symbol							Sample Type	Sample Number	(X)		Particle				<u>Tes</u> ∆ Toi	t Type	
(m	Depth (m)	il Sy			MAIERI	AL DESC	RIPTION		Jdu	ple I	SPT	0 2	20 40		80 100	•	Pock		
μ		ŝ							Sal	Sam							O Field	d Vane	
247.8	<u> </u>	1 <u>/</u> (ORGANIC	SILT (TOPSC	IL) - som	ne sand, tr	ace rootlets, trac	e gravel (<10		G162		0 2	20 40	60	80 100	0 50	, 100	150	200 25
			mm diam.)	, black, dry, lo	osé, low j	plasticity													
	-0.5-		- light	brown	e clay, tra	ice gravei	(<20 mm diam.)												
				compact plasticity						G163		•							
				,,															
									\mathbb{N}	SS164	21	•							
	-2.0-10								\square										
		20																	
	-2.5-10									G165								_	
		20																_	
	3.0		- dense be	low 3.0 m					\vdash										
				10W 5.0 III					XI	SS166	57	•							
	-3.5- ¹⁰								F										
	-4.0- <u>p</u>	ð.	- light grey	below 4.0 m						G167									
5																			
1	4.570								∇	00400	00								
	-5.0-1								\square	SS168	28								
	t in the																		
	-5.5-									G169									
	سات جبایر	d'								0100								_	
	-6.0- <u>1</u>													1116 4					
	سامت جبلیر								IV	SS170	32								
	6.5-2.6								\vdash			μA.							
		¢,																	
										G171									
		фk																	
240.3	: '.J_	0	·	or boulders bel EST HOLE AT			1)			SS172	30 /	•							
			Notes:			(11	,				24mm	I							
240.3			2) Sloughi	e not observed ng observed b	elow 7.0	m depth.													
			Test hol drilling.	e dry and oper	n to 7.5 n	n depth ap	proximately 5 m	inutes after											
				e backfilled wi	th cutting	IS.													
Logg	ed By: _	Rus	an Amaras	inghe		Reviewed	By: Kent Banr	ister		_ 1	Projec	ct Eng	gineer:	:_Rya	an Belb	as			_

	FRE	K	S	ub-Sur	face Lo	DÇ	J			T	Test H	lole 1		- 21 of 2
Client:	Crystal Sprin	lel Consulting Engli g Colony Communi ling Ltd. tem Auger / HQ Coring,	ty Developme		Project Number Location: Ground Elevatio Date Drilled:	on:		N-560 6 m (lo	04165.17 Dcal datu	, E-63226 m)	58.43			
Sample		Grab (G)		Shelby Tube (T)	Split Spoor	า (S	,			Barrel (SI			Core (. ,
Particle	Size Legend:	Fines	Clay	Silt	Sand Sand			Grav		Cobl		Undra	oulders	ear
Elevation (m) Depth (m)	Soil Symbol	MA	FERIAL DESC	RIPTION		Sample Type	Sample Number	SPT (N)	Parti 0 20 4 PL	cle Size (%	80 100	Stre	ngth (kP est Type orvane ∠ cket Pen d Qu ⊠ eld Vane	<u>∧</u> ₽
247.6 247.2 0.5 1.0 246.5	rootlets, b CLAY ANI mm diam.	C SILT (TOPSOIL) - lack, loose, low pla D SILT - laminated), light brown, dry to ty, trace sand, dark	sticity (<5mm thick), o moist, hard, f	some sand, trac friable, intermedi	e gravel (< 20 ate plasticity		G140 G141 G142	-	•				A 0	
	U - light	_) - sandy, trace cla t brown st, compact to dens plasticity		(<20 mm diam.)		X	SS143	27	•					
	0,00,00,00 0,00,00,00						G144 SS145	22	•					
E 301							G146 SS147	23	•					
							G148							
	- grey, trac	ce gravel (<30 mm	diam.) below 6	5.1 m			SS149 G150	31	•					
4.5-0-0 4.5-0-0 5.5-0-0 6.5-1-0-0 6.5-1-0-0 6.5-1-0-0 6.5-1-0-0 							SS151	29	•					
	Ruslan Amaras	singhe	Reviewed	By: Kent Banı	nister		<u>G152</u>	Proiect	Engine	er: _Ryar	Belbas			



Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)		17 Parti 20 PL	MC	19 ze (% 60 L	20 21) 80 100		Strer <u>Te</u> △ To ● Poo ⊠ ○ Fie	ined S ngth (ki st Type orvane ket Pe Qu X Id Van	Pa) ≘ ≘ ∆ en. ● ⊮e ⊖	•
	-9.5 		- trace gravel (<50 mm diam.) below 9.1 m		SS153 G154	25										
	-10.5		- wet, compact below 10.7 m		SS155 G156	15										
	-12.0 -12.5 -13.0			X	SS157 G158	17										
	-13.5 -14.0 -14.5			X	SS159	22										
232.1	-15.0 -15.5		END OF TEST HOLE AT 15.7 m IN SILT (TILL)		G160 SS161	18	•									
232.1			Notes: 1) Seepage not observed. 2) Sloughin observed below 6.0 m depth. 3) Water level at 2.6 m depth approximately 5 minutes after drilling. 4) Test hole open to 15.1 m depth immediately after drilling. 5) Test hole backfilled with cuttings.													
Logg	ed By:	Rusl	an Amarasinghe Reviewed By: Kent Bannister		_ I	Proje	t Er	igine	ər: _	Ryar	ı Belb	as				

	_
GEOTECHNICA	Ĺ

UE		EL	HNIC															
Clien	it:	Bu	irns Maen	del Consulting En	gineers Ltd.		Project Number	:	0105	-035-0	00							
Proje	ect Nam	e: _Cr	ystal Sprir	ng Colony Commu	nity Developme	nt	Location:		UTM	N-56	0398	80.78, E	E-63249	9				
Conti	ractor:	Pa	ddock Dri	illing Ltd.			Ground Elevation	on:	100.0	0 m (l	local	datum)					
Meth	od:	_12	5 mm Solid S	Stem Auger / HQ Corin	g, CME-850 Track M	Nounted Rig	Date Drilled:		Augu	st 19,	202	1						
	Sample	е Туре):	Grab (G)	S	Shelby Tube (T)	Split Spoon	ı (S	S) / SF	т 🕨		Split Ba	arrel (SI	3) / LP1	г 🗌	Co	re (C)
	Particle	e Size	Legend:	Fines	Clay	Silt	Sand			Gra	vel	57	Cobb	oles		Bould	ers	
Elevation (m)	Depth (m)	Soil Symbol		М	ATERIAL DESC	RIPTION		Sample Type	Ő	SPT (N)		(k) 17 18 Particle 20 40	e Size (% 60 MC LI	80 100	s • •	drained trength <u>Test T</u> ∆ Torva Pocket ⊠ Qu Field V 100	(kPa) <u>ype</u> ne ∆ Pen. ∎ ⊠ ′ane C	D)
<u>99.8</u> 99.2	0.5		SILT ANI diam.) - dar CLAY - si	morphous, trace r D CLAY - laminate rk grey and light gr ilty, trace silt inclus ry stiff, high plastic	d (<5 mm thick) ey, dry to moist, sions (<20 mm c	, sandy, trace gra very stiff, interm	avel (<15 mm nediate plasticity		G86 G87 G88								×	
98.8				silty, trace clay, tra	,	um diam) light h	prown dry loose										-	-
98.5	1.5	৽৸৻	poorly gra	aded, fine to coars L) - sandy, trace o	e grained		-		G89									-
	-2.0-		- ligh - mo	L) - sandy, trace c nt brown pist, compact to de plasticity)	X	SS90	51								
	-2.5-								G91				••.	,**. *				
	-3.5							X	SS92	35								
	-4.0																	
	-5.0-							Å	SS94	33								
	-5.5								G95									
	6.5							X	SS96	43	•							
	-7.0-								_G97									
	8.0		- trace gr	avel (<30 mm diar	n.) below 7.6 m			X	SS98	31	•							
	-8.5-								G99									+
Logg	ed By:	Rus	an Amara	singhe	Reviewed	By: Kent Ban	nister		_ 1	Projec	t En	gineer:	Ryar	Belba	s			



Elevation (m)		Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)		17 1 Partic 20 4 PL	ulk Un kN/m ⁵ cle Siz 0 6 MC 0 6) 9 2 2e (%) 10 8 11	30 100	•	∆ Toi Pock ⊠ ⊃ Field	gth (kF t Type	Pa) ≙ ∆ n. ●	0 250
				X	SS100	37										
					G101 SS102	29										
					<u>G103</u>											
					SS104 G105	32										
0/29/21	E _		- trace gravel (<40 mm diam.) below 14.1 m	X	SS106	54										
55-00.GPJ TREK.GDT 10/29/21 8					<u>G107</u> SS108	28										
DEV 0_A_RSA 0105-035- 87 50 50 50 50 50 50 50 50 50 50 50 50 50	3 <u>;</u>	1011.134-1	END OF TEST HOLE AT 15.7 m IN SILT (TILL) Notes: 1) Seepage not observed. 2) Sloughing observed between 1.2 m and 1.5 m depth. 3) Test hole dry and open to 15.2 m depth immediately after drilling. 4) Test hole backfilled with cuttings and bentonite.													
SUB-SURFACE LOG LOGS 2021-08-18 CRYSTAL SPRING COLONY DEV 0_A_RSA 010 D																
JGS 2021-08-18 CRYS																
B-SURFACE LOG L(Inch Pitr	Ruch	an Amarasinghe Reviewed By: Kent Bannister			Proio	4 Er	ginor	.	Zvar	Belba	<u> </u>				

				RE	K		Sı	ıb-Sur	face Lo	סנ	9				Test	Hol	e Ti		1-23 1 of 2
Clie					el Consulting E	naineers I	td		Project Number		0105	.035.0	0						
		Nam			g Colony Comm				Location:					346 F-0	632334.09				
	-	ctor:		ddock Drill			ereprirein	·	Ground Elevation						002001100				
Met	thod	l:			em Auger / HQ Cor	ing, CME-85	0 Track Mo	ounted Rig	Date Drilled:		Augu			-					
	Sa	ample	е Туре		Grab (G			nelby Tube (T)	Split Spoor				_		rel (SB) / L	рт Г		Core	(C)
				_egend:	Fines		Clay	Silt	Sand	`		-			Cobbles			ulders	. ,
			0120	Logona.		<u> /////</u>	olay							Bulk L	Jnit Wt		Jndrai	ned Sł	hear
Elevation	(m)	(m)	Soil Symbol			MATERIAL				Sample Type	Sample Number	เง	0 2	Particle S 20 40 PL MC	60 80 100		<u>Tes</u> ∆ To Pock ⊠ O Fiel	gth (kF st Type orvane ket Per Qu ⊠ d Vane 0 150	<u>e</u> ≙ ∆ en. ₽
248	3.7	بيبل		ORGANIC mm diam.)	SILT (TOPSOI), black, loose, r	L) - some to low p	sand, tra lasticitv	ace rootlets, trac	e gravel (<10		G48								
	F	0.5-	910 N.º. J	SILT (TILL	.) - sandy, trace			(<25 mm diam.)		1									
		1.0		- mois	brown st, compact to d plasticity	ense					G49		•						
		1.5									SS50	45	•						
	Indualian	2.0-1 2.5-1									G51								
10010	hadiaa haadi	3.0									SS52	42	•						
		4.0		- moist to v	wet, compact be	elow 4.0 m	I				G53								
	սնուսեունու	4.5- 5.0-								X	SS54	18	•						
		5.5		- wet belov	<i>v</i> 5.5 m						G55								
		6.5								X	SS56	15	•						
	hundered	7.0		- trace to s	ome gravel (<3	∪ mm diar	n.) below	v 6.7 m			G57								
	لسلسلس	8.0									SS58	15	•						
	i	8.5 -									G59								
Log	ged	By:	Rusi	an Amaras	inghe	Re	viewed I	By: Kent Banr	ister			Projec	: Eng	gineer:	Ryan Bell	bas			



Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	16 0 0	17	(kl 18 article 40	N/m 1 e Siz 6 MC	ze (%	20 21) 80 100)	Str P O F	Tength Test T Torva ocket Ø Qu Field \	ane ∆ Pen. ⊿⊠ /ane () -
	-9.5-			X	SS60	24											
	-10.0 - -10.5				G61												
	-11.0- - -11.5-			X	SS62	10											
	-11.5 				G63												
	-12.5 -13.0			X	SS64	23)									
	-13.5				G65												
	-14.0		- dense below 13.7 m	X	SS66	33											
- F	-14.5 -15.0				G67												
233.2	-15.5-				SS68	51	•										
			END OF TEST HOLE AT 15.7 m IN SILT (TILL) Notes: 1) Seepage and sloughing observed between 9.1 m and 10.7 m depth. 2) Water level at 2.6 m depth approximately 5 minutes after drilling. 3) Test hole open to 10.7 m depth approximately 5 minutes after drilling. 4) Test hole backfilled with cuttings and bentonite.														

Client: Projec Contra Metho	t Nan actor:	ne: <u>Cr</u> <u>G</u> i	ystal Spri aboweski	idel Consultin ng Colony Co Concrete 35 US Excavator		ngineers Ltd. unity Developme	nt	Project Num Location: Ground Elev Date Drilled:	ation:	UTM 100.0		0429: local (datum)	632646.65				
	-	le Type le Size	e: Legend:	Grat	. ,) Clay	Shelby Tube (1) Split Sp		S) / SI	-		Split Bar	rel (SB) / Ll Cobbles	рт [• • •		Core	. ,
Elevation (m)	Depth (m)	Soil Symbol				IATERIAL DESC		ه م م ا	Sample Type	5	SPT (N)	16 1 0 2	□ Bulk ((kN/ 7 18 Particle \$ 0 40 PL M	Unit Wt m ³) 19 20 21 Size (%) 60 80 100	-	Undrai Stren <u>Tes</u> ∆ To Pocl Ø Pocl Ø Fiel	ned Sl gth (kl st Type rvane ket Pe Qu ⊠ d Van	hear Pa) <u>e</u> ∆ n. ∳
<u>99.8</u> 98.6	-0.5 - -1.0 - -1.5	<u>*</u> * * * *	gravel (< SAND - s - ligi - dry - po	30 mm diam.) some silt, trac ht brown /, loose orly graded, fi	, da e gra ne to	and, some organ rk brown, moist, avel (<30 mm dia o coarse grained clay, trace grave	loose, low pla: am.) I	-		G18 G19 G20		•						
	-2.0- -2.5- -2.5- -3.0-		- mo - lov - sandy, t	ht brown bist, loose v plasticity trace gravel (• 1.), compact to	<30 i o der	mm diam.), trace nse below 2.4 m	e cobbles, trace	e boulders (<500		G21	-							
95.9	-3.5-		- dense t	am (<500 mm below 3.6 m TEST HOLE		k) at 3.0 m I.1 m IN SILT (TI				G22 G23								
			Notes: 1) Seepa 2) Slougl 3) Test p	ige not observ hing and cavir it dry and ope	red. ng ol n to	bserved from 0.1 4.1 m depth imn uttings and comp	I m to 1.4 m de nediately after	excavation.										

GEOTE	REK Sub-Surfa	Test Pit TP21-02
Client: <u>E</u> Project Name: <u>C</u> Contractor: <u>C</u>	urns Maendel Consulting Engineers Ltd. Pro crystal Spring Colony Community Development Lo craboweski Concrete Gr	oject Number: 0105-035-00 ocation: UTM N-5604078.11, E-632909.72 round Elevation: 100.00 m (local datum) ate Drilled: August 17, 2021
Sample Typ Particle Size		Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)
Elevation (m) Depth (m) Soil Symbol	MATERIAL DESCRIPTION	ad ad
99.7 99.1 98.8 98.8 98.8 98.8 98.8 98.8 99.9 98.8 99.0 90.0	SILT (TOPSOIL) - some sand, some organics, trace clay, trace r gravel (<40 mm diam.), trace cobbles (<200 mm diam.), black, m low plasticity SAND - some silt, some gravel (<40 mm diam.), trace cobbles (< diam.), trace boulders (<500 mm dam.), light brown, dry, loose, p graded, fine to coarse grained SILT and CLAY - laminated (<5 mm thick), some sand, trace gra diam.), grey and brown, moist, stiff, intermediate plasticity SILT (TILL) - sandy, trace clay, trace gravel (<40 mm diam.), trac trace boulders (<500 mm diam.) - light brown - moist, compact to dense - low plasticity - dense below 2.7 m END OF TEST HOLE AT 4.1 m IN SILT (TILL) Notes: 1) Seepage not observed. 2) Sloughing and caving observed from 0.3 m to 0.9 m depth. 3) Test pit dry and open to 4.1 m depth immediately after excava 4) Test pit backfilled with cuttings and compacted with excavator	noist, loose, <300 mm poorly G25 G26 G26 G27 G27 G27 G27 G27 G27 G27 G27 G27 G27

	ER	FK
GEOT	ECHI	ICAL

Test	Pit	TP21	-03
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							6.1			Dual 1	NI		0405	005									
Clien					nsulting En	-				•	Number:	_	0105			7 40		070 54					-
-					ny Commu	nity Deve	elopmer	าเ		Locatio		_)7.43,		673.50)				-
	ractor:	-	aboweski								Elevatio	_					1)						-
Meth			achi Zaxis 13	35 US EX					r	Date Dr			Augu	_									
	Sample	Туре	:		Grab (G)			Shelby Tub			lit Spoon	(SS		1		Split B			.PT		Core	. ,	
	Particle	Size	Legend:		Fines		Clay		Silt		Sand			Gra	vel	62	_	bbles			oulder		
												g	ber		16		k Unit V N/m³) 19	vt 202	1		ained S ngth (k		
Elevation (m)	f	Soil Symbol					0500					Sample Type	Sample Number	ź			e Size (-		est Typ orvan		
Elevati (m)	Depth (m)	oil Sy			IVI	ATERIAL	DESC	RIPTION				mple	ple I	SPT	0	20 40		80 10	0	🗣 Po	cket P ⊴ Qu ⊠	en. 🗭	
ш		Š										Sa	Sam		0	PL 20 40	MC 60	LL - 80 10	00		eld Vai	ne O	0 25
99.8	E 12	1 <u>,</u>	SILT (TO	PSOIL)) - sandy, s	ome orga	nics, tr	ace clay, t	trace ro	otlets, tra	ce		G37		0	20 40		00 10		50 1		0 20	725
			gravel (<₄ low plasti		diam.), trad	ce cobble	s (<200) mm dian	n.), blac	k, moist,	loose,		G38						_				
	-0.5-		SAND - s	ilty, sor	ne gravel (<50 mm (diam.),	trace clay	, trace o	obbles (<200	4	G39		•								
	-1.0-		- silt sean	n.), lighi n (<500	t brown, dr) mm thick)	/, loose, p at 0.5 m	boorly g	iraded, fin	ie to coa	arse grair	ned												
98.8				1.)		1		1 (200		4	L. L. L								_				
	-1.5- ¹	٦,	(<200 mn	n diam.		ay, some	e grave	I (<30 mm	i diam.)	, trace co	odies		G40		•				_				
				to mois	n st, compac	t to dense	9																
	2.0-	Q 2	- low	/ plastic				iam) trac	e cobb	ee (<200	mm	A	G41										
			diam.), tra	ace bou	ulders (<50	0 mm dia	m.) bel	ow 1.8 m		63 (~200													
	-2.5-												G42		•			_					
			- dense b	elow 2.	.7 m								<u> </u>										
	-3.0-1																						
													G43										
		$\mathbb{Q}^{\mathbb{Z}}$																					
96.0				TEOTI		0 101 0	<u>11 T /TU</u>						G44		\bullet								
			Notes:		HOLE AT 4	.0 m in 5	ILT (TH	LL)															
					observed. d caving ob	served fr	om 0.1	m to 1.2 i	m depth	-													
			3) Test pi	t dry ar	nd open to illed with cu	3.8 m dep	oth imm	ediately a	after exc	avation.	et												
			1) 1001 pi	buon		ango an	u oomp		ii oxoav														
Loga	ed By:	Rusl	an Amara	singhe		Re	viewed	By: Ker	nt Bann	ster			I	Projec	t En	gineer	: Rv	an Bel	bas				

													Т	est	Pit T	P21	- 04 of 1
			ήE		3	up-Sur	face Lo	<u>כ</u>	J								
Clien	t:	B		lel Consulting	Engineers Ltd.	ent	Project Number: 0105-035-00 Location: UTM N-5604022.27, E-632290.54					4					
Conti			Graboweski (<i>z</i> 1		Ground Elevation	-									
Meth	od:	H	itachi Zaxis 13	5 US Excavator			Date Drilled:		Augu	ist 17,	2021	1					
	Sam	ple Typ	e:	Grab	(G)	Shelby Tube (T)	Split Spoor	(S	-	-	\	Split Bar	rel (SB) /	LPT		Core	(C)
	Parti	icle Size	e Legend:	Fines	Clay	Silt	Sand Sand			Gra	vel					ulders	
Elevation (m)	Depth	(III) Soil Symbol			MATERIAL DESC	CRIPTION		Sample Type	Sample Number	SPT (N)		7 18 Particle S	m ³) 19 20 2 Size (%) 60 80 10 C LL	00	Strer △ T ● Poo ○ Fie	ined Sh ngth (kP st Type orvane . ket Per I Qu ⊠ Id Vane 0 150	a) ∆ ı. Φ
248.2 248.1			SILT (TOF	PSOIL) - sandy 0 mm diam.),	y, some organics, t black, damp, loose	race clay, trace ro e, no to low plastic	ootlets, trace ity		G09 G10								
			SILT AND	CLAY - lamin	ated (<5 mm thick) bist, hard, friable, ir), some sand, trac	e rootlets,										
		SILT (TILL) - some sand, trace mm diam.), trace cobbles (<20 - light brown - damp, compact to dense		l, trace clay seams	(<20 mm thick), t	•		G11		•							
			- dan	np, compact to plasticity	dense				G12 G13	-	•						
				10w 0.9 m					015								
									G14		•						
	- Linder		- some sa (<500 mm	nd, trace grav ı diam.) below	el (<50 mm diam.), 3.0 m	, trace cobbles, tra	ace boulders		G15								
									G16								
244.2		1000	- dense be	elow 3.8 m					G17		•						
			Notes: 1) Seepag 2) Test pit	ge and sloughi dry and open	T 4.1 m IN SILT (T ng not observed. to 4.1 m depth imr n cuttings and com	mediately after exe	cavation. /ator bucket.										

		EK
GEOT	ECHI	NICAL

Test Pit TP21-05

GEUTE Client:		del Consulting En	ainoore I td		Project Number:	0	105-03	25.00						
		ng Colony Commu	•	nt	Location:				27.00	E-632044.	62			
•		~ ·		<u> </u>							.02			
Contractor:	Graboweski				Ground Elevatio					1)				
Method:		35 US Excavator			Date Drilled:	_		17, 202						
Sample	уре:	Grab (G)		Shelby Tube (T)	Split Spoon					arrel (SB)	/ LPT		Core	(C)
Particle S	Size Legend:	Fines	Clay	Silt	Sand			Gravel		_	es 🎦	Βοι	ulders	
Depth (m) (m) (m)	SILT (TC gravel (< low plast SILT AN gravel (< SILT AN graded, f SILT and diam.), tr plasticity SILT and diam.), tr plasticity SILT (TIL (<300 m - low - low	DPSOIL) - sandy, so 40 mm diam.), trac icity D CLAY - laminate 40 mm diam.), dar silty, some gravel (fine to coarse grain I CLAY - laminated race cobbles (<200	ce cobbles (<20 d (<5 mm thick) k grey, moist, st <40 mm diam.), ed (<5 mm thick), mm diam.), ligh day, some grave ulders (<500 mm nse	CRIPTION race clay, trace ro 0 mm diam.), bla , some sand, trace iff to very stiff, in light brown, dry, some sand, trace to brown, moist, se el (<50 mm diam.) LL) LL) B m to 1.2 m dept	botlets, trace ck, moist, loose, ce rootlets, trace termediate loose, poorly e gravel (<40 mm stiff, intermediate), trace cobbles	Sample Type	Aumber		17 (k Particl 20 40 PL 20 40 20 40 	k Unit Wt N/m ³) 19 20 e Size (%)	21	Undrai Stren <u>Tes</u> △ To ♥ Pool	ned Sh gth (kP rvane a ket Per Qu X d Vane) 150	near Pa) △ ∩. ●
	4) Test p	it backfilled with cu	ittings and com	pacted with exca	vator bucket.									

Client:		el Consulting Engine g Colony Community		Project Number Location:	: _0	105-03		03.12,	E-632	Tes	: Pit	TP2	1-06 1 of 1
Contractor:	Graboweski C			Ground Elevation	on: _2	48.82 r	n (loca	ıl datum	ו)				
Method:	Hitachi Zaxis 135	US Excavator		Date Drilled:		ugust 1	7, 202	21					
Sample ⁻	Туре:	Grab (G)	Shelby Tube (T)	Split Spoor	ו (SS)) / SPT		Split B	arrel ((SB) / LPT			e (C)
Particle	Size Legend:	Fines	Clay []] Silt	Sand		C	Gravel	67		bbles		Boulde	
Elevation (m) Depth (m)	Soil Symbol	MATE	RIAL DESCRIPTION		Sample Type	Sample Number	16 0 0	17 18 Particl 20 40 PL	MC	20 21 (%) 80 100 LL	Str	rained s ength (I <u>Fest Typ</u> Torvan ocket P ⊠ Qu ⊉ ield Va 100 15	kPa) <u>⊃e</u> e ∆ en. Φ ⊠
<u>248.7</u>	·····································	PSOIL) - sandy, some	organics, trace clay, trace r amp, loose, no to low plasti	ootlets, trace		G01							
	SILT (TILL cobbles (< - light - dry, - noist bel) - some sand, trace 200 mm diam.) brown compact to dense plasticity ow 0.9 m	<400 mm diam.), dense bel	liam.), trace		302 303 304 305 306 307							
Logged By:	Notes: 1) Seepag 2) Test pit					308							



Appendix A

Laboratory Testing



Project No.	0105-035-00
Client	Burns Maendel Consulting Engineers Ltd.
Project	Crystal Spring Colony Community Development

Test Hole	TH21-01	TH21-01	TH21-01	TH21-02	TH21-02	TH21-02
Depth (m)	0.3 - 0.5	1.1 - 1.2	2.3 - 2.4	0.3 - 0.5	0.9 - 1.1	1.5 - 1.7
Sample #	G132	G133	G134	G128	G129	SS130
Tare ID	AB05	Z43	Z70	N113	W55	D43
Mass of tare	6.9	8.5	8.8	8.6	8.5	8.6
Mass wet + tare	247.4	237.2	237.0	222.5	258.0	238.0
Mass dry + tare	238.3	204.9	205.6	204.3	230.1	215.5
Mass water	9.1	32.3	31.4	18.2	27.9	22.5
Mass dry soil	231.4	196.4	196.8	195.7	221.6	206.9
Moisture %	3.9%	16.4%	16.0%	9.3%	12.6%	10.9%

Test Hole	TH21-03	TH21-03	TH21-03	TH21-03	TH21-04	TH21-04
Depth (m)	0.8 - 0.9	1.2 - 1.4	2.4 - 2.6	2.9 - 3.0	0.8 - 0.9	1.5 - 2.0
Sample #	G136	G137	G138	G139	G174	SS175
Tare ID	F62	AA21	Z00	AB78	Z93	E134
Mass of tare	8.6	6.8	8.4	6.7	8.6	8.3
Mass wet + tare	245.8	283.4	224.9	269.8	231.8	235.9
Mass dry + tare	207.3	212.4	157.3	242.6	219.0	218.2
Mass water	38.5	71.0	67.6	27.2	12.8	17.7
Mass dry soil	198.7	205.6	148.9	235.9	210.4	209.9
Moisture %	19.4%	34.5%	45.4%	11.5%	6.1%	8.4%

Test Hole	TH21-05	TH21-05	TH21-05	TH21-06	TH21-06	TH21-06
Depth (m)	0.3 - 0.5	0.9 - 1.1	1.5 - 2.0	0.8 - 0.9	1.2 - 1.4	1.5 - 2.0
Sample #	G123	G124	SS126	G119	G120	SS121
Tare ID	P23	Z90	W30	E211	E75	F131
Mass of tare	8.6	8.5	8.6	8.6	8.6	8.5
Mass wet + tare	289.3	238.3	243.6	227.7	291.0	229.8
Mass dry + tare	280.1	206.6	224.6	206.2	244.9	213.0
Mass water	9.2	31.7	19.0	21.5	46.1	16.8
Mass dry soil	271.5	198.1	216.0	197.6	236.3	204.5
Moisture %	3.4%	16.0%	8.8%	10.9%	19.5%	8.2%



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Test Hole	TH21-07	TH21-07	TH21-07	TH21-07	TH21-08	TH21-08
Depth (m)	0.8 - 0.9	1.2 - 1.4	2.4 - 2.6	3.0 - 3.5	0.9 - 1.1	1.5 - 2.0
Sample #	G177	G178	G179	SS180	G182	SS183
Tare ID	E94	H35	F13	E59	P34	E120
Mass of tare	8.4	8.5	8.5	8.5	8.5	8.4
Mass wet + tare	216.7	246.7	234.2	294.3	240.3	297.8
Mass dry + tare	195.8	219.9	211.1	257.6	198.7	243.0
Mass water	20.9	26.8	23.1	36.7	41.6	54.8
Mass dry soil	187.4	211.4	202.6	249.1	190.2	234.6
Moisture %	11.2%	12.7%	11.4%	14.7%	21.9%	23.4%

Test Hole	TH21-09	TH21-09	TH21-09	TH21-10	TH21-10	TH21-10
restrible	11121-03	11121-03	11121-03	11121-10	11121-10	11121-10
Depth (m)	0.2 - 0.3	1.1 - 1.2	1.5 - 2.0	0.8 - 0.9	1.2 - 1.4	1.5 - 2.0
Sample #	G185	G186	SS187	G80	G81	SS82
Tare ID	Z25	Z66	D50	D32	AB16	Z45
Mass of tare	8.3	8.4	8.5	8.5	6.7	8.8
Mass wet + tare	225.5	255.6	252.2	236.6	221.0	257.7
Mass dry + tare	185.1	227.3	227.2	208.0	194.1	237.8
Mass water	40.4	28.3	25.0	28.6	26.9	19.9
Mass dry soil	176.8	218.9	218.7	199.5	187.4	229.0
Moisture %	22.9%	12.9%	11.4%	14.3%	14.4%	8.7%

Test Hole	TH21-11	TH21-11	TH21-12	TH21-12	TH21-13	TH21-13
Depth (m)	0.8 - 0.9	1.2 - 1.4	0.8 - 0.9	1.4 - 1.5	0.8 - 0.9	1.5 - 2.0
Sample #	G84	G85	G46	G47	G70	SS72
Tare ID	AB40	F146	AC09	Z120	D5	AC19
Mass of tare	6.9	8.3	7.1	9.1	8.3	6.8
Mass wet + tare	231.3	240.4	214.8	252.7	224.6	288.4
Mass dry + tare	198.6	198.5	153.1	184.7	192.6	251.9
Mass water	32.7	41.9	61.7	68.0	32.0	36.5
Mass dry soil	191.7	190.2	146.0	175.6	184.3	245.1
Moisture %	17.1%	22.0%	42.3%	38.7%	17.4%	14.9%



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Test Hole	TH21-13	TH21-13	TH21-13	TH21-14	TH21-14	TH21-14
Depth (m)	3.0 - 3.5	4.6 - 5.1	6.1 - 6.6	0.8 - 0.9	1.5 - 2.0	3.0 - 3.5
Sample #	SS74	SS76	SS78	G110	SS111	SS113
Tare ID	H46	D48	F112	N99	Z130	A100
Mass of tare	8.4	8.6	8.2	8.4	8.4	8.6
Mass wet + tare	222.8	209.0	247.0	248.8	256.0	208.8
Mass dry + tare	203.0	191.0	225.2	226.7	234.4	192.4
Mass water	19.8	18.0	21.8	22.1	21.6	16.4
Mass dry soil	194.6	182.4	217.0	218.3	226.0	183.8
Moisture %	10.2%	9.9%	10.0%	10.1%	9.6%	8.9%

Test Hole	TH21-14	TH21-14	TH21-15	TH21-15	TH21-15	TH21-15
Depth (m)	4.6 - 5.0	6.1 - 6.6	0.9 - 1.1	1.5 - 2.0	2.4 - 2.9	3.0 - 3.5
Sample #	SS115	SS117	G225	SS226	G228	SS229
Tare ID	D17	Z23	W41	Z104	D44	F16
Mass of tare	8.6	8.6	8.7	8.5	8.5	8.5
Mass wet + tare	232.2	253.6	266.5	253.8	233.4	273.1
Mass dry + tare	213.7	233.7	257.8	215.5	183.2	251.3
Mass water	18.5	19.9	8.7	38.3	50.2	21.8
Mass dry soil	205.1	225.1	249.1	207.0	174.7	242.8
Moisture %	9.0%	8.8%	3.5%	18.5%	28.7%	9.0%

Test Hole	TH21-15	TH21-15	TH21-16	TH21-16	TH21-16	TH21-16
Depth (m)	4.6 - 5.0	6.1 - 6.6	0.9 - 1.1	1.5 - 2.0	3.0 - 3.5	4.6 - 5.0
Sample #	SS231	SS233	G189	SS191	SS193	SS195
Tare ID	AC33	D19	W97	AB84	Z114	W10
Mass of tare	7.1	8.6	8.4	6.8	8.4	8.6
Mass wet + tare	256.2	242.5	461.7	228.2	236.4	221.8
Mass dry + tare	236.0	223.4	394.9	201.0	215.9	205.6
Mass water	20.2	19.1	66.8	27.2	20.5	16.2
Mass dry soil	228.9	214.8	386.5	194.2	207.5	197.0
Moisture %	8.8%	8.9%	17.3%	14.0%	9.9%	8.2%



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Test Hole	TH21-16	TH21-17	TH21-17	TH21-18	TH21-18	TH21-19
Depth (m)	6.1 - 6.6	4.6 - 5.0	6.1 - 6.6	0.8 - 0.9	3.0 - 3.3	0.3 - 0.5
Sample #	SS197	SS221	SS223	G210	SS213	G199
Tare ID	K22	AC16	W26	D39	W45	F53
Mass of tare	8.6	6.9	8.4	8.3	8.5	8.6
Mass wet + tare	249.0	261.5	283.4	226.3	253.3	229.8
Mass dry + tare	229.9	239.7	260.9	210.9	236.8	201.6
Mass water	19.1	21.8	22.5	15.4	16.5	28.2
Mass dry soil	221.3	232.8	252.5	202.6	228.3	193.0
Moisture %	8.6%	9.4%	8.9%	7.6%	7.2%	14.6%

Test Hole	TH21-19	TH21-19	TH21-19	TH21-19	TH21-20	TH21-20
Depth (m)	2.1 - 2.3	3.0 - 3.5	4.6 - 5.0	6.1 - 6.5	0.8 - 0.9	1.5 - 2.0
Sample #	G202	SS204	SS206	SS208	G163	SS164
Tare ID	W101	F115	H70	Z114	E100	E35
Mass of tare	8.5	8.4	8.8	8.6	8.5	8.5
Mass wet + tare	227.2	254.1	271.3	249.9	263.2	299.8
Mass dry + tare	172.6	230.9	251.1	230.5	240.1	273.1
Mass water	54.6	23.2	20.2	19.4	23.1	26.7
Mass dry soil	164.1	222.5	242.3	221.9	231.6	264.6
Moisture %	33.3%	10.4%	8.3%	8.7%	10.0%	10.1%

Test Hole	TH21-20	TH21-20	TH21-20	TH21-20	TH21-21	TH21-21
Depth (m)	3.0 - 3.5	4.6 - 5.0	6.1 - 6.6	7.6 - 7.7	0.3 - 0.5	0.9 - 1.1
Sample #	SS166	SS168	SS170	SS172	G141	G142
Tare ID	P37	H12	N91	Z102	F58	AA14
Mass of tare	8.5	8.7	8.9	8.5	8.8	6.8
Mass wet + tare	212.3	266.0	460.4	112.6	215.3	249.7
Mass dry + tare	196.0	244.9	421.2	104.6	186.7	206.5
Mass water	16.3	21.1	39.2	8.0	28.6	43.2
Mass dry soil	187.5	236.2	412.3	96.1	177.9	199.7
Moisture %	8.7%	8.9%	9.5%	8.3%	16.1%	21.6%



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Test Hole	TH21-21	TH21-21	TH21-21	TH21-21	TH21-21	TH21-21
Depth (m)	1.5 - 2.0	3.0 - 3.5	4.6 - 5.0	6.1 - 6.6	7.6 - 8.1	9.1 - 9.6
Sample #	SS143	SS145	SS147	SS149	SS151	SS153
Tare ID	AB95	H11	F22	N112	D35	N111
Mass of tare	6.6	8.5	8.6	8.4	8.6	8.7
Mass wet + tare	277.2	244.3	236.7	228.5	245.0	443.3
Mass dry + tare	253.7	223.2	217.3	211.2	226.2	407.5
Mass water	23.5	21.1	19.4	17.3	18.8	35.8
Mass dry soil	247.1	214.7	208.7	202.8	217.6	398.8
Moisture %	9.5%	9.8%	9.3%	8.5%	8.6%	9.0%

Depth (m) 10.7 - 11.1 12.2 - 12.6 13.7 - 14.2 15.2 - 15.7 0.5 - 0.6 0.9 - Sample # SS155 SS157 SS159 SS161 G87 C Tare ID C8 A360 F98 AB10 W04 F Mass of tare 8.4 6.6 8.5 6.7 8.5 247.0 233 Mass wet + tare 242.3 270.6 262.0 225.4 247.0 233 Mass water 220.1 246.2 239.7 206.5 214.2 188 Mass dry soil 211.7 239.6 231.2 199.8 205.7 17							
Sample # SS155 SS157 SS159 SS161 G87 G Tare ID C8 A360 F98 AB10 W04 F Mass of tare 8.4 6.6 8.5 6.7 8.5 247.0 233 Mass dry + tare 220.1 246.2 239.7 206.5 214.2 188 Mass dry soil 211.7 239.6 231.2 199.8 205.7 17	Test Hole	TH21-21	TH21-21	TH21-21	TH21-21	TH21-22	TH21-22
Tare ID C8 A360 F98 AB10 W04 F7 Mass of tare 8.4 6.6 8.5 6.7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 8.5 7 7 8.5 7 <	Depth (m)	10.7 - 11.1	12.2 - 12.6	13.7 - 14.2	15.2 - 15.7	0.5 - 0.6	0.9 - 1.1
Mass of tare 8.4 6.6 8.5 6.7 8.5 Mass wet + tare 242.3 270.6 262.0 225.4 247.0 233 Mass dry + tare 220.1 246.2 239.7 206.5 214.2 18 Mass water 22.2 24.4 22.3 18.9 32.8 4 Mass dry soil 211.7 239.6 231.2 199.8 205.7 17	Sample #	SS155	SS157	SS159	SS161	G87	G88
Mass wet + tare 242.3 270.6 262.0 225.4 247.0 233 Mass dry + tare 220.1 246.2 239.7 206.5 214.2 18 Mass water 22.2 24.4 22.3 18.9 32.8 4 Mass dry soil 211.7 239.6 231.2 199.8 205.7 17	Tare ID	C8	A360	F98	AB10	W04	F137
Mass dry + tare 220.1 246.2 239.7 206.5 214.2 18 Mass water 22.2 24.4 22.3 18.9 32.8 4 Mass dry soil 211.7 239.6 231.2 199.8 205.7 17	Mass of tare	8.4	6.6	8.5	6.7	8.5	8.5
Mass water 22.2 24.4 22.3 18.9 32.8 4 Mass dry soil 211.7 239.6 231.2 199.8 205.7 17	Mass wet + tare	242.3	270.6	262.0	225.4	247.0	230.3
Mass dry soil 211.7 239.6 231.2 199.8 205.7 17	Mass dry + tare	220.1	246.2	239.7	206.5	214.2	185.7
	Mass water	22.2	24.4	22.3	18.9	32.8	44.6
Moisture % 10.5% 10.2% 9.6% 9.5% 15.9% 25.	Mass dry soil	211.7	239.6	231.2	199.8	205.7	177.2
	Moisture %	10.5%	10.2%	9.6%	9.5%	15.9%	25.2%

Test Hole	TH21-22	TH21-22	TH21-22	TH21-22	TH21-22	TH21-22
Depth (m)	1.5 - 2.0	3.0 - 3.5	4.6 - 5.0	6.1 - 6.6	7.6 - 8.1	9.1 - 9.6
Sample #	SS90	SS92	SS94	SS96	SS98	SS100
Tare ID	C7	C3	AC39	F114	C20	AB94
Mass of tare	8.4	8.7	6.8	8.4	8.8	6.8
Mass wet + tare	240.2	489.7	254.4	209.2	241.8	248.3
Mass dry + tare	222.3	447.3	233.5	192.5	225.3	227.9
Mass water	17.9	42.4	20.9	16.7	16.5	20.4
Mass dry soil	213.9	438.6	226.7	184.1	216.5	221.1
Moisture %	8.4%	9.7%	9.2%	9.1%	7.6%	9.2%



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Test Hole	TH21-22	TH21-22	TH21-22	TH21-22	TH21-23	TH21-23
Depth (m)	10.7 - 11.1	12.2 - 12.6	13.7 - 14.2	15.2 - 15.7	0.8 - 0.9	1.5 - 2.0
Sample #	SS102	SS104	SS106	SS108	G49	SS50
Tare ID	PO5	P22	AB53	F71	N61	W70
Mass of tare	8.7	8.9	6.9	8.5	8.6	8.5
Mass wet + tare	234.1	266.2	256.0	223.3	216.7	268.1
Mass dry + tare	215.3	245.8	235.2	204.7	202.2	241.1
Mass water	18.8	20.4	20.8	18.6	14.5	27.0
Mass dry soil	206.6	236.9	228.3	196.2	193.6	232.6
Moisture %	9.1%	8.6%	9.1%	9.5%	7.5%	11.6%

Test Hole	TH21-23	TH21-23	TH21-23	TH21-23	TH21-23	TH21-23
Depth (m)	3.0 - 3.5	4.6 - 5.0	6.1 - 6.6	7.6 - 8.1	9.1 - 9.6	10.7 - 11.1
Sample #	SS52	SS54	SS56	SS58	SS60	SS62
Tare ID	P01	P17	N12	A101	AB97	W73
Mass of tare	8.8	8.5	8.7	8.6	6.8	8.8
Mass wet + tare	227.0	256.8	222.0	290.1	238.6	245.3
Mass dry + tare	201.4	232.4	200.4	261.9	212.5	222.8
Mass water	25.6	24.4	21.6	28.2	26.1	22.5
Mass dry soil	192.6	223.9	191.7	253.3	205.7	214.0
Moisture %	13.3%	10.9%	11.3%	11.1%	12.7%	10.5%

Test Hole	TH21-23	TH21-23	TH21-23	TP21-01	TP21-01	TP21-01
	_	_				
Depth (m)	12.2 - 12.6	13.7 - 14.2	15.2 - 15.7	0.8 - 0.9	1.4 - 1.5	2.7 - 2.9
Sample #	SS64	SS66	SS68	G19	G20	G21
Tare ID	AB18	A20	AB23	Z05	K23	D04
Mass of tare	6.8	8.7	6.7	8.6	8.7	8.7
Mass wet + tare	235.7	461.6	232.5	238.2	249.3	257.3
Mass dry + tare	214.7	423.7	212.6	230.8	229.8	233.0
Mass water	21.0	37.9	19.9	7.4	19.5	24.3
Mass dry soil	207.9	415.0	205.9	222.2	221.1	224.3
Moisture %	10.1%	9.1%	9.7%	3.3%	8.8%	10.8%



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Test Hole	TP21-01	TP21-02	TP21-02	TP21-02	TP21-02	TP21-02
Depth (m)	4.0 - 4.1	0.8 - 0.9	0.9 - 1.1	1.7 - 1.8	2.9 - 3.0	4.0 - 4.1
Sample #	G23	G25	G26	G27	G28	G30
Tare ID	D9	Z99	E83	W18	F10	H41
Mass of tare	8.6	8.6	9.0	8.4	8.7	8.7
Mass wet + tare	271.7	237.2	266.2	254.4	289.2	228.3
Mass dry + tare	248.7	216.2	237.6	232.6	266.0	210.1
Mass water	23.0	21.0	28.6	21.8	23.2	18.2
Mass dry soil	240.1	207.6	228.6	224.2	257.3	201.4
Moisture %	9.6%	10.1%	12.5%	9.7%	9.0%	9.0%

Test Hole	TP21-03	TP21-03	TP21-03	TP21-03	TP21-04	TP21-04
Depth (m)	0.5 - 0.6	1.4 - 1.5	2.6 - 2.7	3.8 - 4.0	0.8 - 0.9	1.4 - 1.5
Sample #	G39	G40	G42	G44	G11	G12
Tare ID	AB01	P36	C14	N04	F121	E27
Mass of tare	6.8	8.8	8.5	8.7	8.8	8.8
Mass wet + tare	217.5	228.9	236.0	227.9	249.3	224.8
Mass dry + tare	198.5	210.9	216.1	210.1	230.5	205.6
Mass water	19.0	18.0	19.9	17.8	18.8	19.2
Mass dry soil	191.7	202.1	207.6	201.4	221.7	196.8
Moisture %	9.9%	8.9%	9.6%	8.8%	8.5%	9.8%

Test Hole	TP21-04	TP21-04	TP21-05	TP21-05	TP21-05	TP21-05
Depth (m)	2.7 - 2.9	4.0 - 4.1	0.8 - 0.9	1.4 - 1.5	2.7 - 2.9	3.8 - 4.0
Sample #	G14	G17	G33	G34	G35	G36
Tare ID	D37	H90	C19	E34	Z97	Z140
Mass of tare	8.6	8.8	8.6	8.8	8.7	8.6
Mass wet + tare	283.6	250.9	240.9	298.6	255.6	232.8
Mass dry + tare	260.6	230	219.6	258.1	233.8	212.6
Mass water	23.0	20.9	21.3	40.5	21.8	20.2
Mass dry soil	252.0	221.2	211.0	249.3	225.1	204.0
Moisture %	9.1%	9.4%	10.1%	16.2%	9.7%	9.9%



Project No.	0105-035-00
Client	Burns Maendel Consulting Engineers Ltd.
Project	Crystal Spring Colony Community Development

Test Hole	TP21-06	TP21-06	TP21-06	TP21-06	
Depth (m)	0.6 - 0.8	1.4 - 1.5	2.6 - 2.7	3.8 - 4.0	
Sample #	G02	G03	G05	G08	
Tare ID	AC13	W76	Z118	A6	
Mass of tare	7.0	8.7	8.4	8.3	
Mass wet + tare	249.8	227.0	245.7	249.1	
Mass dry + tare	224.2	206.2	227.3	230.5	
Mass water	25.6	20.8	18.4	18.6	
Mass dry soil	217.2	197.5	218.9	222.2	
Moisture %	11.8%	10.5%	8.4%	8.4%	

T (]] .] .			
Test Hole			
Depth (m)			
Sample #			
Tare ID			
Mass of tare			
Mass wet + tare			
Mass dry + tare			
Mass water			
Mass dry soil			
Moisture %			

Test Hole			
Depth (m)			
Sample #			
Tare ID			
Mass of tare			
Mass wet + tare			
Mass dry + tare			
Mass water			
Mass dry soil			
Moisture %			



Atterberg Limits

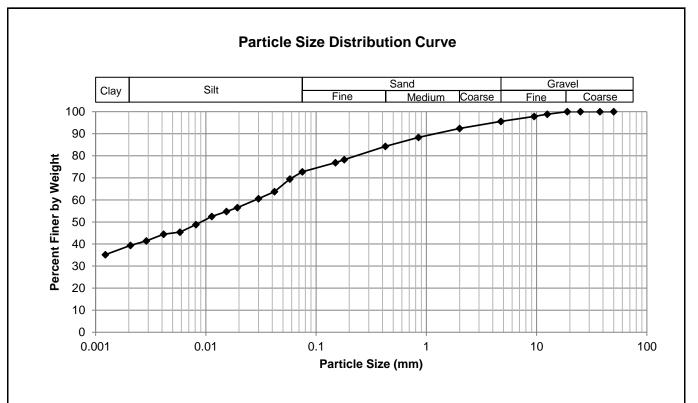
ASTM D4318-10e1

Project No. Client Project		Consulting Enginee olony Community D	-			Independent Laboratories
Test Hole	TH21-16				For specific tests a	s listed on www.ccil.com
Sample #	G189		-			
Depth (m)	0.9 - 1.1		-			
Sample Date	20-Aug-21		-		Liquid Limit	44
Test Date	30-Aug-21		-		Plastic Limit	13
Fechnician	MT		-		Plasticity Index	30
_iquid Limit						
Frial #		1	2	3		
Number of Blo	· · /	15	21	27		
Mass Tare (g)		13.917	14.246	14.087		
Mass Wet Soi		23.908	24.231	24.793		
Mass Dry Soil		20.786	21.167	21.538		
Mass Water (g		3.122	3.064	3.255		
Mass Dry Soil		6.869	6.921	7.451		
Moisture Cont	tent (%)					
80 -		45.451	44.271	43.685		
		for solid fraction w	· · · ·		Line "A" Line	

Plastic Limit					
Trial #	1	2	3	4	5
Mass Tare (g)	14.060	13.962			
Mass Wet Soil + Tare (g)	27.051	23.815			
Mass Dry Soil + Tare (g)	25.493	22.673			
Mass Water (g)	1.558	1.142			
Mass Dry Soil (g)	11.433	8.711			
Moisture Content (%)	13.627	13.110			



Project No. Client Project	0105-035-00 Burns Maendel Consulting Engineers Ltd. Crystal Spring Colony Community Development		CERTIFIED BY
Test Hole	TH21-16		
Sample #	G189		
Depth (m)	0.9 - 1.1	Gravel	4.4%
Sample Date	20-Aug-21	Sand	22.8%
Test Date	30-Aug-21	Silt	33.7%
Technician	DJ	Clay	39.1%



Gravel		Sa	Ind	Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	95.62	0.0750	72.77
37.5	100.00	2.00	92.39	0.0578	69.50
25.0	100.00	0.850	88.37	0.0420	63.73
19.0	100.00	0.425	84.25	0.0301	60.55
12.5	98.89	0.180	78.29	0.0193	56.51
9.50	97.82	0.150	76.87	0.0154	54.77
4.75	95.62	0.075	72.77	0.0113	52.53
				0.0081	48.78
				0.0058	45.38
				0.0041	44.44
				0.0029	41.40
				0.0021	39.40
				0.0012	35.18



Atterberg Limits

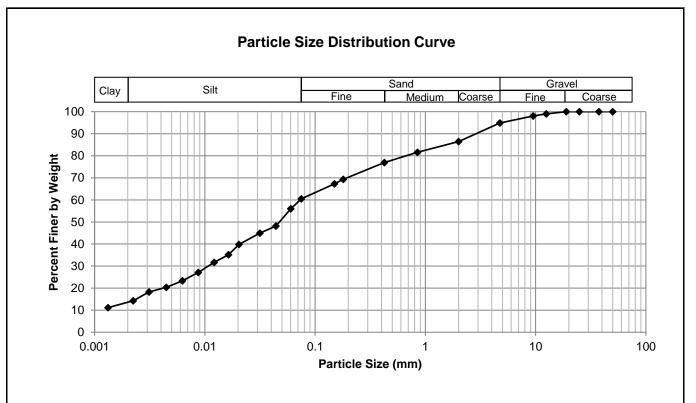
ASTM D4318-10e1

Project No. Client Project		Consulting Enginee blony Community D			Canadian Council of In	1
Test Hole	TH21-20				For specific tests as i	listed on www.ccil.com
Sample #	SS170		-			
Depth (m)	6.1 - 6.6		-			
Sample Date	20-Aug-21		_		Liquid Limit	14
est Date	30-Aug-21		_		Plastic Limit	11
Fechnician	MT		-		Plasticity Index	4
_iquid Limit						
Frial #		1	2	3		
Number of Bl		17	20	26		
Mass Tare (g)		14.420	14.467	14.104		
Mass Wet Soi		26.901	28.940	23.461		
Mass Dry Soi		25.220	27.019	22.306		
Mass Water (1.681	1.921	1.155		
Mass Dry Soi Moisture Con		10.800 15.565	12.552 15.304	8.202 14.082		
blasticity Index (%)		- 61	Cl	CH CH MH or O	Line "A" Line H	
10 · 0 ·		ML	or OL	60 70	80 90 1	100 110

Plastic Limit							
Trial #	1	2	3	4	5		
Mass Tare (g)	14.171	14.210					
Mass Wet Soil + Tare (g)	22.864	24.039					
Mass Dry Soil + Tare (g)	22.032	23.099					
Mass Water (g)	0.832	0.940					
Mass Dry Soil (g)	7.861	8.889					
Moisture Content (%)	10.584	10.575					



Project No. Client Project	0105-035-00 Burns Maendel Consulting Engineers Ltd. Crystal Spring Colony Community Development		CERTIFIED BY
Test Hole	TH21-20		
Sample #	SS170		
Depth (m)	6.1 - 6.6	Gravel	5.1%
Sample Date	20-Aug-21	Sand	34.4%
Test Date	30-Aug-21	Silt	47.1%
Technician	DJ	Clay	13.4%



Gravel		Sa	Ind	Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	94.87	0.0750	60.50
37.5	100.00	2.00	86.42	0.0602	56.00
25.0	100.00	0.850	81.58	0.0441	48.17
19.0	100.00	0.425	76.97	0.0316	44.92
12.5	99.03	0.180	69.31	0.0204	39.79
9.50	98.09	0.150	67.32	0.0164	35.20
4.75	94.87	0.075	60.50	0.0122	31.69
				0.0087	27.15
				0.0063	23.31
				0.0045	20.40
				0.0031	18.29
				0.0022	14.24
				0.0013	11.16



Atterberg Limits

ASTM D4318-10e1

Project No. Client Project		Consulting Engineer				
Fest Hole	TH21-23				For specific tests a	s listed on www.ccil.com
Sample #	SS66					
Depth (m)	13.7 - 14.2					
Sample Date	20-Aug-21				Liquid Limit	14
Fest Date	30-Aug-21				Plastic Limit	11
Fechnician	MT				Plasticity Index	3
_iquid Limit						
rial #		1	2	3		
Number of Blow	ws (N)	20	26	35		
Mass Tare (g)		13.834	14.055	14.124		
Mass Wet Soil		28.437	26.738	27.009		
Mass Dry Soil		26.644	25.202	25.482		
Mass Water (g)		1.793	1.536	1.527		
Mass Dry Soil (12.810	11.147	11.358		
Moisture Conte	ent (%)	13.997	13.779	13.444		
Plasticity Index (%)	Plasticity Chart for smaller than 0.42	or solid fraction w 25 mm	ith particles		Line	

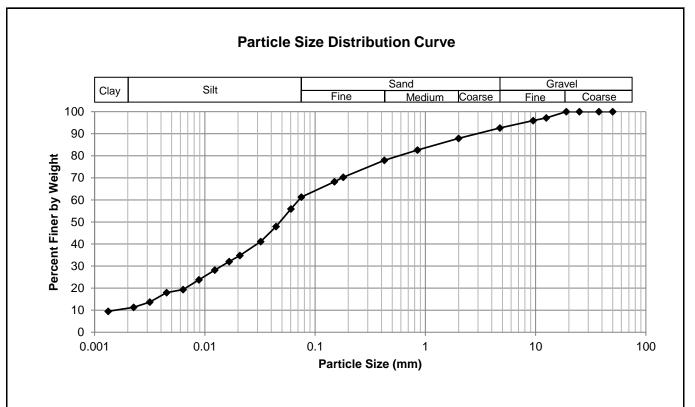
Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.301	13.942			
Mass Wet Soil + Tare (g)	28.088	26.571			
Mass Dry Soil + Tare (g)	26.730	25.358			
Mass Water (g)	1.358	1.213			
Mass Dry Soil (g)	12.429	11.416			
Moisture Content (%)	10.926	10.625			

Liquid Limit (%)



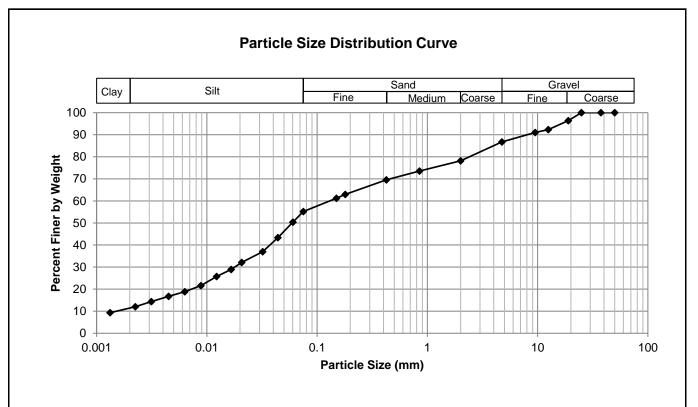
Project No. Client Project	0105-035-00 Burns Maendel Consulting Engineers Ltd. Crystal Spring Colony Community Development		CERTIFIED BY Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com
Test Hole	TH21-23		
Sample #	SS66		
Depth (m)	13.7 - 14.2	Gravel	7.4%
Sample Date	20-Aug-21	Sand	31.4%
Test Date	30-Aug-21	Silt	50.5%
Technician	DJ	Clay	10.8%



Gravel		Sand		Silt and Clay	
Particle Size (mm) Percent Passing		Particle Size (mm) Percent Passing		Particle Size (mm) Percent Passi	
50.0	100.00	4.75	92.63	0.0750	61.28
37.5	100.00	2.00	87.91	0.0605	55.94
25.0	100.00	0.850	82.60	0.0442	47.97
19.0	100.00	0.425	77.95	0.0321	41.10
12.5	97.18	0.180	70.27	0.0208	34.78
9.50	95.96	0.150	68.24	0.0166	32.03
4.75	92.63	0.075	61.28	0.0123	28.18
				0.0088	23.78
				0.0064	19.33
				0.0045	18.01
				0.0032	13.67
				0.0023	11.28
				0.0013	9.50



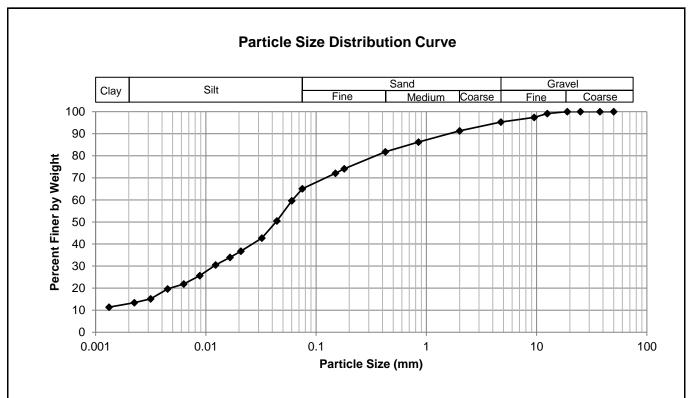
Project No. Client Project	0105-035-00 Burns Maendel Consulting Engineers Ltd. Crystal Spring Colony Community Development		Certified BY Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com
Test Hole	TH21-21		
Sample #	SS153		
Depth (m)	9.1 - 9.6	Gravel	13.3%
Sample Date	20-Aug-21	Sand	31.6%
Test Date	30-Aug-21	Silt	43.8%
Technician	DJ	Clay	11.3%



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	86.72	0.0750	55.15
37.5	100.00	2.00	78.22	0.0603	50.43
25.0	100.00	0.850	73.57	0.0441	43.34
19.0	96.40	0.425	69.59	0.0321	36.98
12.5	92.36	0.180	62.95	0.0207	32.09
9.50	91.00	0.150	61.24	0.0166	28.91
4.75	86.72	0.075	55.15	0.0123	25.77
				0.0088	21.62
				0.0063	18.88
				0.0045	16.72
				0.0031	14.32
				0.0022	12.03
				0.0013	9.32



Project No. Client Project	0105-035-00 Burns Maendel Consulting Engineers Ltd. Crystal Spring Colony Community Development		Certified BY Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com
Test Hole	TH21-22		
Sample #	SS92		
Depth (m)	3.0 - 3.5	Gravel	4.7%
Sample Date	20-Aug-21	Sand	30.3%
Test Date	30-Aug-21	Silt	52.2%
Technician	DJ	Clay	12.8%

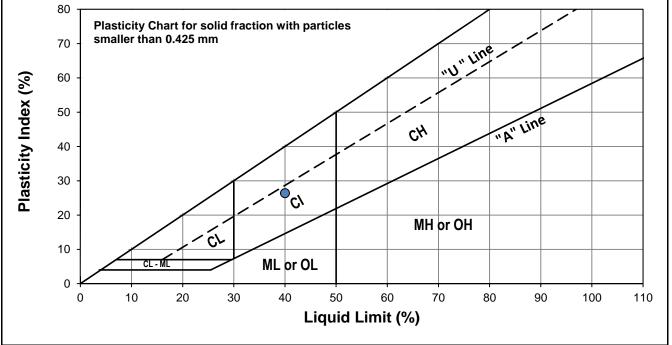


Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	95.34	0.0750	65.08
37.5	100.00	2.00	91.31	0.0601	59.58
25.0	100.00	0.850	86.26	0.0442	50.45
19.0	100.00	0.425	81.84	0.0322	42.74
12.5	99.14	0.180	74.13	0.0208	36.80
9.50	97.39	0.150	72.10	0.0166	33.94
4.75	95.34	0.075	65.08	0.0123	30.51
				0.0088	25.66
				0.0063	21.90
				0.0045	19.67
				0.0032	15.15
				0.0022	13.39
				0.0013	11.37



Atterberg Limits ASTM D4318-10e1

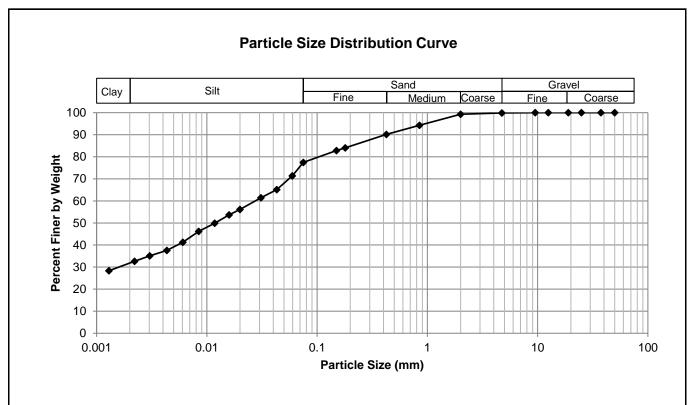
Project No.	0105-035-00				CERTIFIED BY	
Client	Burns Maendel	Consulting Ltd.	-			- i i 🕊
Project		Colony Community D	evelopment			f Independent Laboratories
Test Hole	TH21-17				For specific tests a	s listed on www.ccil.com
Sample #	G216		-			
Depth (m)	0.2 - 1.5		-			
Sample Date	20-Aug-21	20-Aug-21			Liquid Limit	40
Test Date	27-Sep-21		-		Plastic Limit	14
Technician	MT		-		Plasticity Index	26
Liquid Limit Trial #		1	2	3		
Number of Blo	ws (N)	18	26	29		
Mass Tare (g)		13.942	14.061	14.336		
Mass Wet Soil	+ Tare (g)	26.063	25.507	23.489		
Mass Dry Soil	+ Tare (g)	22.497	22.250	20.907		
Mass Water (g))	3.566	3.257	2.582		
Mass Dry Soil	(g)	8.555	8.189	6.571		
Moisture Conte	ant (%)	41.683	39.773	39.294		



Plastic Limit					
Trial #	1	2	3	4	5
Mass Tare (g)	14.100	14.297			
Mass Wet Soil + Tare (g)	23.279	29.088			
Mass Dry Soil + Tare (g)	22.174	27.312			
Mass Water (g)	1.105	1.776			
Mass Dry Soil (g)	8.074	13.015			
Moisture Content (%)	13.686	13.646			



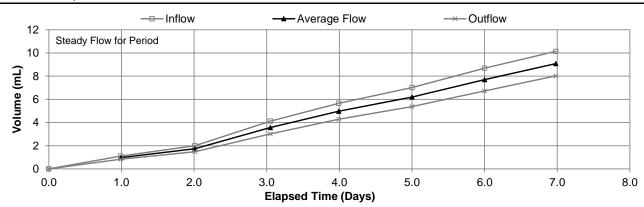
Project No. Client Project	105-035-00 Burns Maendel Consulting Engineers Ltd. Crystal Spring Colony Community Development		Certified BY
Test Hole	TH21-17		
Sample #	G216		
Depth (m)	0.2 - 1.5	Gravel	0.1%
Sample Date	20-Aug-21	Sand	22.4%
Test Date	27-Sep-21	Silt	45.8%
Technician	MT	Clay	31.6%



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	99.87	0.0750	77.46
37.5	100.00	2.00	99.30	0.0595	71.33
25.0	100.00	0.850	94.31	0.0431	65.12
19.0	100.00	0.425	90.19	0.0310	61.40
12.5	100.00	0.180	84.03	0.0200	56.12
9.50	100.00	0.150	82.81	0.0159	53.64
4.75	99.87	0.075	77.46	0.0118	49.91
				0.0084	46.19
				0.0061	41.29
				0.0043	37.57
				0.0030	35.09
				0.0022	32.60
				0.0013	28.35

Project No.	0105-035-00	Test Hole	TH21-16 & TH21-17
Client	Burns Maedel Consulting	Trek Sample #	G190 & G216 (combined)
Project	Crystal Spring Colony Development	Depth (m)	N/A
		Sample Date	20-Aug-21
		Test Date	September 11, 2021 to September 23, 2021
		Technician	Angela Fidler-Kliewer
Specimen De	tails		
Visual Classification	Clay, silty, trace sand, trace gravel (< 5mm	n diam.), brown, moist, firn	n, intermediate to high plasticity.
Comments	The specific gravity of the soil was assum	ed to be 2.70. Speciman o	compacted to 96.5% of SPMDD.
Index Testing		Test Details	
Liguid Limit		1000 Dotano	
	40	Permeant	Distilled, de-aired water
Plastic Limit	40 14		Distilled, de-aired water Constant Head
•	14	Permeant	•
Plastic Limit	14 26	Permeant Method	Constant Head 124.2 kPa
Plastic Limit Plasticity Index	14 26	Permeant Method Cell Pressure	Constant Head 124.2 kPa 101.6 kPa

Permeation Graph



Steady Flow Permeation Data

Time Increment Elapsed Time		Flow (Q)		Inflow / Outflow	Average Flow	Temperature	Corrected Hydraulic
(Days) (Days)	(Days)	Influent (mL)	Effluent (mL)	Ratio	(mL)	Correction	Conductivity, k ₂₀ (m/s)
0.94	3.99	5.66	4.28	1.22	1.40	0.94	1.77E-10
1.01	5.00	7.02	5.38	1.24	1.23	0.99	1.61E-10
1.00	6.00	8.68	6.72	1.24	1.50	0.99	1.97E-10
0.98	6.98	10.14	8.02	1.12	1.38	1.00	1.77E-10

Average Temperature Corrected Hydraulic Conductivity, k_{20} (m/s)

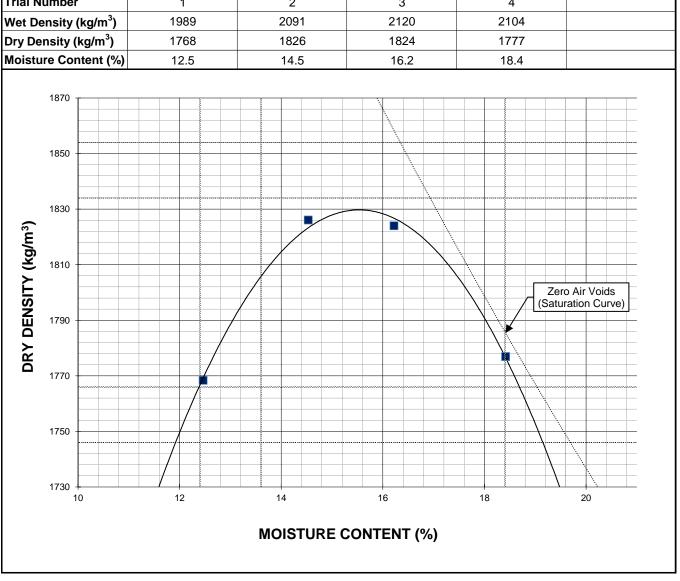
1.78E-10 (1.78x10⁻⁸ cm/s)

Consolidation Dat	ta
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	Average Height (m)	Average Diameter (m)	Moisture Content (%)	Dry Density (kN/m³)	Degree of Saturation (%)	Cell Pressure	Back Pressure	
Initial	0.0963	0.0732	18.3	17.3	93.7	119.4	85.1	
Final	0.0967	0.0734	19.7	17.3	100.3	119.4	85.1	



Trial Number	1 2		3	4		
Technician	DJ		Optimum Moisture	15.5		
Test Date	08-Sep-21		Maximum Dry Dens	sity (kg/m3)	1830	
Sample Date	20-Aug-21					
Material	Clay					
Source	TH21-17 & TH21-16					
Sample #	G216 & G190					
Project	Crystal Spring Colony Developn	nent			Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com	
Client	Burns Maendel Consulting					
Project No.	0105-035-00					



ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2644411-1 TH21-22 G87 (1.5'-2.0')							
Sampled By: CLIENT on 19-AUG-21							
Matrix: Soil - GRAB							
Miscellaneous Parameters							
Total Sulphate Ion Content	<0.050		0.050	%	01-OCT-21	01-OCT-21	R5606487
L2644411-2 TH21-22 G88 (3.0'-3.5')							
Sampled By: CLIENT on 19-AUG-21							
Matrix: Soil - GRAB Miscellaneous Parameters							
Total Sulphate Ion Content	<0.050		0.050	%	01-OCT-21	01-OCT-21	R5606487

* Refer to Referenced Information for Qualifiers (if any) and Methodology.