GEOTECHNICAL EXPLORATION AND ENGINEERING REVIEW

Norman Ranch Subdivision

Black Hawk

South Dakota

NTI Project No. 21.RAP12054.000

***Prepared For**:*

Paramount Point, LLC
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July 13, 2021 (Revised 9/30/21)

Paramount Point, LLC
14796 Moonlight Dr.
Rapid City, South Dakota 57703

Attn: Bill Freytag

Subject: Geotechnical Exploration and Engineering Review
Norman Ranch Subdivision
Black Hawk, SD
NTI Project No. 21.RAP12032.000

In accordance with your request and subsequent authorization on April 26, 2021, Northern Technologies, LLC (NTI) conducted a Geotechnical Exploration for the above referenced project. Our services included advancement of exploration borings and preparation of an engineering report with recommendations developed from our geotechnical services. Our work was performed in general accordance with our Proposal dated April 12, 2021. Additional borings were requested by Jason Ohlsen with Renner Assoc on September 20, 2021 in the area of a directional bore for utility installation.

Soil samples obtained at the site will be held for 60 days at which time they will be discarded. Please advise us in writing if you wish to have us retain them for a longer period. You will be assessed an additional fee if soil samples are retained beyond 60 days.

We appreciate the opportunity to have been of service on this project. If there are any questions regarding the soils explored or our review and recommendations, please contact us at your convenience at (605) 787-9303.

Northern Technologies, LLC

Adam Dando, EIT
Graduate Engineer

Dan Gibson, PE
Professional Engineer

Contents

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1.0 EXECUTIVE SUMMARY

We briefly summarize below our geotechnical recommendations for the proposed project. The summary must be read in complete context with our report.

- The site consists of an undeveloped pasture and the proposed project is to be a 200-lot multiphase subdivision. The purpose of this exploration is to provide guidance for construction of residential structures based on our limited number of soil borings and roadway and utility construction recommendations for subdivision development access.

- The onsite soils consist of Lean Clay (CL), Silty (ML) and trace amounts of Fat Clay (CH).

- Lots to be founded on Lean Clay (CL) with a Liquid Limit (LL) < 40 to be built on 1 foot of moisture conditioned and recompacted native material. Lots to be founded on Lean Clay (CL) with a LL > 40 to be built on a two (2) foot over excavation with granular engineered fill. Drain tile to be placed at the lowest point of excavation and sloped to a sump or daylit.

- Lots to be founded on Silt (ML) to be founded on a two (2) foot over excavation with Lean Clay (CL) with a LL < 40 or granular engineered fill with drain tile placed at the lowest point of excavation and sloped to a sump or daylit.

- Lots to be founded on Fat Clay (CH) to be founded on a four (4) foot over excavation with granular engineered fill with drain tile placed at lowest point of excavation and sloped to a sump or daylit.

- To help limit potential volumetric rise and to help provide a more uniform subgrade, we recommend a minimum of 1 foot scarification and re-compaction of the subgrade before proceeding with basecourse and asphalt paving.

- The drill crew observed the borings for groundwater depth (if any) during and at the completion of drilling activities. Measurable groundwater was observed in SB-16 at 10'. This is likely due to the proximity to a nearby creek bed. The lack of observed groundwater in the other borings is possibly due to the short duration for which the boreholes remained open combined with the low permeability of the on-site clay-based soils. We direct your attention to other report sections and appendices attachments concerning groundwater issues and subsurface drainage.
- Additional borings were requested by Jason Ohlsen with Renner Associates within an area for a future bored water main crossing under existing roadway and Interstate 90. A bearing capacity for thrust blocks for water mains can be based on an allowable soil bearing capacity of 3,000 psf.

2.0 INTRODUCTION

2.1 Site / Project Description

The proposed project consists of the construction of a new subdivision in northern Black Hawk, SD. The development is to consist of single-family homes, new roadways and associated utilities for the future development. Any changes to the scope of work described need to be notified to NTI for possible updates to this report. Table 1 provides a summary of our understanding of the project and a description of the site.

Table 1: Main Project & Site Description

Item	Description
Building Type	Single family residences with varying styles of layout and construction with and without full basements. A roadway will be graded throughout the site along with installation of underground utilities.
At Grade Floor Slab Elevation	Will vary depending on lot.
Maximum Proposed Change in Site Elevations	Assumed to be 5 feet or less.
Site Description	
Location of Project	Located 1.3 miles north of the intersection of Peaceful Pines Rd and Norman Ave on Norman Ave.
Existing Land Use / Improvements to Parcel	Empty pasture used for cattle grazing
Current Ground Cover	Natural vegetation and Pasture
Topography at Site	Pasture with a slight slope from west to east with a creek running west and south on the east side of the property.

2.2 Scope of Services

The purpose of this report is to present a summary of our geotechnical exploration and provide generalized opinions and recommendations regarding the soil conditions and design parameters for founding of the project. Our “scope of services” was limited to the following:

1. Explore the main project site subsurface by means of 18 standard penetration borings. These borings were to extend to maximum depths of 32 feet below existing grade and conduct laboratory test(s) on representative samples for characterizing the index and engineering properties of soil strata at the site.
2. Prepare a report presenting our findings that from our field exploration, laboratory testing, and engineering recommendations for roadway pavement design and construction of utilities.

3.0 EXPLORATION PROGRAM RESULTS

3.1 Exploration Scope

Site geotechnical drilling occurred on April 28-30 & June 2, 2021, with individual borings advanced at approximate locations as presented on the diagram within the appendices. Additional borings performed September 20, 2021.

NTI located the borings using a consumer hand held GPS unit and overlay provided by Renner Associates, therefore boring elevations and locations should be considered approximate. Please refer to the Boring Location Diagram and the Boring Logs in Appendix C.

3.2 Subsurface Conditions

Please refer to the boring logs within the appendices for a detailed description and depths of stratum at each boring. The boreholes were backfilled with auger cuttings. Minor settlement of the boreholes will occur. The Owner is responsible for final closure of the boreholes. Based on results of the current geotechnical exploration, Table 2, provides a general depiction of subsurface conditions at the project site. Additional comment on the evaluation of recovered soil samples is presented within the report attachments.

Table 2: Typical Subsurface Stratigraphy at Project Site [Note 1]

Stratum	Depth to Base of Stratum below existing grade	Material Description	Notes
Surface	0.0 to 0.5 feet	Topsoil (OH)	Classification by visual observation only and not intended to confer conformance with DOT or other municipal standards.
Fine Alluvium	0.5 to 32.0 feet	Predominantly composed of Lean Clay (CL), Silt (ML) and Fat Clay (CH)	Consistencies were generally rather stiff to very stiff with occasional soft pockets.
Coarse Alluvium	9.0 to 26.0 feet	Predominantly composed of Poorly Graded Sand (GP) with pockets of gravel and cobble	Densities were generally very dense

Note 1 Table summary is a generalization of subsurface conditions and may not reflect variation in subsurface strata occurring on site. The general geologic origin of retained soil samples is listed on the boring logs. Typical depths are estimated to nearest one-half foot.

3.3 Groundwater Conditions

The drill crew observed the borings for groundwater depth (if any) during and at the completion of drilling activities. Measurable groundwater was observed in SB-16 at 10'. This is likely due to the proximity to a nearby creek bed. The lack of observed groundwater in the other borings is possibly due to the short duration for which the boreholes remained open combined with the low permeability of the on-site clay-based soils.

The onsite clay soils are relatively impervious and are conducive to the development of zones of perched water. The design team should anticipate that zones of perched water may be encountered at varying elevations and locations across the site during project excavations.

Overall, the site soils are slightly conducive to movement of groundwater over time both laterally and vertically. The moisture content of such soils can vary annually and per recent precipitation event. Such soils and other regional dependent conditions may produce groundwater entry of project excavations. We direct your attention to other report sections and appendices attachments concerning groundwater issues and subsurface drainage.

3.4 Laboratory Test Program

Our analysis and recommendations of this report are based upon our interpretation of the standard penetration resistance determined while sampling soils, laboratory test results and experience with similar soils from other sites near the project. The results of such tests are summarized on the boring logs.

4.0 ENGINEERING REVIEW AND RECOMMENDATIONS

The following recommendations are based on our present knowledge of the project. We ask that you or your design team notify us immediately if significant changes are made to project size, location or design as we would need to review our current recommendations and provide modified or different recommendations with respect to such change(s).

4.1 Project Scope

We assume the proposed structure will include concrete foundation walls and footings for support of above grade construction. NTI's assumed foundation loads and change in grade is summarized within Table 3. Our assessment of project soils, opinions, and report recommendations are based directly on application of estimated structural loads to site soils.

Table 3: Foundation Loads / Change in Grade / Footing Elevation

Building Element	Load / Condition
Perimeter Strip Footings	3 kips per lineal foot or less
Interior Strip Footings	3 kips per lineal foot or less
Isolated Interior Column Footings	35 kips or less
Exterior Column Footings	35 kips or less
Change in Overall Site Grade (from original ground surface)	Estimated to be 5 feet or less

4.2 Site Preparation

We recommend removal of topsoil, organic soils, undocumented fill (if encountered), man-made structures (if encountered), soft clay soils in close proximity to the bottom of proposed foundation element, and/or any other unsuitable material(s) encountered during advancement of project excavations.

We recommend that prior to the addition of fill, backfill, or structural elements that the upper 1 foot of the native subgrade beneath foundations, slabs, and pavements be scarified, moisture conditioned, and recompacted if not required to have an over excavation. Subgrades in structural areas should be protected from drying or rainfall during construction.

The Geotechnical Engineer of Record or their designated representative should review project excavations to verify removal of unsuitable material(s) and adequate bearing support of exposed soils. All such observations should occur prior to the construction of footings and floor slabs.

In certain locations, sand or gravel may be imported and placed to help facilitate drainage, such as behind retaining walls and beneath pavements or slabs or to improve the strength of the subgrade beneath foundations.

The sand should consist of material with less than 20 percent passing the No. 200 sieve. The clay subgrade beneath the sand should be sloped to drain toward drain tile that can discharge water to the sites storm drains to help prevent water buildup in the sand (i.e. to help prevent a “bathtub” effect). Backfill in areas where non-frost susceptible fill is required should have less than 5 percent materials passing the No. 200 sieve.

4.3 Shallow Foundation

The following bearing recommendations are based on our understanding of the project. You should notify us of any changes made to the project size, location, design or site grades so we can assess how such changes impact our recommendations. We assume foundation elements will impose maximum vertical loads as previously noted within this report.

Foundations in unheated appurtenant areas, such as stoops and canopies, should be based at least 60 inches below the proposed finished grade for frost protection. Footings below structures anticipated to be heated (greater than 60 degrees F) in winter should be constructed at least 42 inches below proposed finished grade. Continuous strip footings under bearing walls should be at least 1 foot wider than the walls they support. Interior footings should be based at least 1.5 feet below design floor elevation.

At this time Lots near adjacent to borings SB-03, SB-04, SB-11, SB-16 may be built on native soils provided soils are similar to the noted soil borings. Lots adjacent to borings SB-01, SB-02, SB-05, SB-06, SB-07, SB-08, SB-09, SB-10, SB-13, SB-14 will require a two (2) foot over excavation with granular engineered fill. Lots adjacent to SB-12 will require a four (4) foot over excavation with granular engineered fill. Drain tile should be placed at the lowest point of excavation and drained to a sump or daylit.

In our opinion, you may support the proposed structure by founding strip footings and interior column footings provided such complies with the criteria established within this report. Design of footings may be based on the Table 4a -4c maximum net allowable soil bearing pressures.

Due to the nature of the geotechnical drilling performed, NTI requests to be retained to perform excavation observations on a per lot basis to confirm soil type under foundations and provide specific lot recommendations.

Table 4a: Recommended Maximum Net Allowable Soil Bearing Pressure[1] - Lots founded on Fat Clay (CH)

Location	Criteria
Perimeter Strip Footings, Perimeter Columns: Perimeter strip footings and perimeter column footing supported on a four (4) foot over excavation with granular engineered fill below depth of frost penetration. **Interior Strip Footings:** Interior strip footings supported on a four (4) foot over excavation with granular engineered fill at a depth that provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for cushion). **Interior Column Footings:** Supported on a four (4) foot over excavation with granular engineered fill at a depth that provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for cushion).	Maximum 2,500 psf (All foundations)

1. Maximum net allowable soil bearing pressure recommendations predicated on footing design and construction complying with recommendations presented within this report. To minimize local failure of supporting soils, it is our opinion footing construction should comply with the International Building Code (IBC) requirements.

Table 4b: Recommended Maximum Net Allowable Soil Bearing Pressure[1] – Lots founded on Silt (ML) and Lean Clay (LL>40)

Location	Criteria
Perimeter Strip Footings, Perimeter Columns: Perimeter strip footings and perimeter column footing supported on a two (2) foot over excavation with granular engineered fill below depth of frost penetration. **Interior Strip Footings:** Interior strip footings supported on two (2) foot over excavation with granular engineered fill below at a depth that provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for cushion). **Interior Column Footings:** Supported on two (2) foot over excavation with granular engineered fill below t a at a depth that provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for cushion).	Maximum 2,500 psf (All foundations)

1. Maximum net allowable soil bearing pressure recommendations predicated on footing design and construction complying with recommendations presented within this report. To minimize local failure of supporting soils, it is our opinion footing construction should comply with the International Building Code (IBC) requirements.

Table 4c: Recommended Maximum Net Allowable Soil Bearing Pressure[1] – Lots to be founded on Lean Clay (CL, LL< 40)

Location	Criteria
Perimeter Strip Footings, Perimeter Columns: Perimeter strip footings and perimeter column footing supported on native soils below depth of frost penetration. **Interior Strip Footings:** Interior strip footings supported on native soils at a depth that provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for cushion). **Interior Column Footings:** Supported on native soils t a at a depth that provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for cushion).	Maximum 2,500 psf (All foundations)

1. Maximum net allowable soil bearing pressure recommendations predicated on footing design and construction complying with recommendations presented within this report. To minimize local failure of supporting soils, it is our opinion footing construction should comply with the International Building Code (IBC) requirements.

4.4 Bearing Factor of Safety and Estimate of Settlement

We estimate properly moisture conditioned and compacted granular engineered fill and native lean clay with a LL < 40 will provide a nominal 3 factor of safety against localized bearing failure when construction complies with report criteria and recommendations, and you design structure footings using the Table 4 maximum net allowable soil bearing recommendation(s).

We estimate that footings loaded per report recommendations may experience long term, total settlement of approximately 1/2 to 1 inch. Differential settlement will be on the order of 25 to 50 percent of total settlement. Generally, the greatest differential settlement occurs between lightly loaded and heavily loaded footings, particularly if heavily loaded footings are located adjacent to lightly loaded strip footings. Most of the settlement will occur on first loading, as the structure is erected.

Furthermore, total and differential movement of footings and floor slabs could be significantly greater than the above estimates if you support construction on frozen soils. The moisture content of the bearing soils significantly changes from in-situ conditions when snow or ice lenses are incorporated into site earthwork.

4.5 Seismic Considerations

Seismic considerations for the structure should be considered during the design even though the risk of a significant seismic event is minimal in the project location. The following Table 5 presents acceleration coefficients which can be utilized in design of the structure. The coefficients are obtained from the Applied Technology Council (ATC) and are available to the public. The design coefficients are utilizing IBC 2015 with a III risk level. The values are also assuming a Class D soil type “Stiff Soil”.

Table 5: USGS Seismic Design Acceleration Coefficients for IBC 2012/2015.

S_s (g)	S_{MS} (g)	S_{DS} (g)	S_1 (g)	S_{M1} (g)	S_{D1} (g)
0.127	0.195	0.13	0.042	0.101	0.067

4.6 Corrosion Considerations

Considerations should be made to account for potential corrosivity of natural soils. Two types of corrosion typically occur on a project site. Corrosion of concrete is typically caused by sulfate attack and a breakdown of the concrete structure occurs. Corrosion of steel occurs when a soil induced electrochemical reaction occurs breaking down the steel structure. A review of NRCS ratings for the main site indicate that there is a Moderate rating of corrosivity for concrete and a Moderate rating for steel.

It is recommended to not use plain steel structures and if any steel structures are to be utilized, measures should be taken to provide protection from natural soils and corrosion of the structure. For concrete structures, backfill with inert non-corrosive material should be utilized to protect the concrete from degradation.

- All backfill should be inert and non-corrosive.
- Provide poly wrap around all buried metal fittings to prevent any moisture intrusion.
- If significant changes in soils are observed, additional testing should be performed to verify the corrosion potential of the in-situ soils.

4.7 Subsurface Drainage

NTI considers the installation of a subsurface drain system at the interior base of foundation walls to be a preferred practice of construction. The subsurface drain system will help to limit moisture accumulation within granular soils placed below interior floors and prevent softening of the bearing clays below.

A drain tile installed at the exterior of the base of foundation walls is recommended to prevent hydrostatic loading on the earth retaining walls. Please refer to the Foundation Wall Backfill section for additional recommendations regarding the placement of the exterior drain tile system.

As a general guideline, subsurface drainage consists of a geotextile and coarse drainage encased slotted or perforated pipe extending to sump basin(s). We recommend exterior drainage be separated from interior drainage to reduce risk of cross flow and moisture infiltration below structure interior.

4.8 Utilities

Utility trenches should be backfilled in 6-inch maximum depth loose lifts. It is especially important that you compact trench backfill of underground utilities to minimize future settlement of green space and pavement areas. Please refer to Appendix B for compaction specifications.

The stability of embankments along utility excavations is dependent on soil strength, site geometry, moisture content, and any surcharge load for excavated soils and equipment. Cautionary comment on excavation stability is provided within other report sections.

Sand backfill in utility trenches within clayey soils can create a source for water intrusion at the wall penetrations. We recommend that, for at least the 5 feet closest to the building, trenches be backfilled with cohesive soils to reduce the potential for water intrusion. These soils should have at least 40 percent passing the No. 200 sieve and have a liquid limit less than 40.

If groundwater is encountered, temporary dewatering may be required during the utility trench excavations. Stabilization of the trench subgrade may be required to provide a stable platform for construction. Stabilization could consist of a one half to one-foot layer of crushed rock or sand with a maximum 5 percent material passing the No. 200 sieve and 50 percent passing the No. 40 sieve.

A bearing for thrust blocks can be based on an expected soil bearing capacity of 3,000 psf.

We herein note that the Contractor is solely responsible for assessing the stability of and executing underground utility and project excavations using safe methods. Contractor is also responsible for naming the "competent individual" as per Subpart P of 29 CFR 1926.6 (Federal Register - OSHA).

4.9 Slab-on-Grade Floors

NTI recommends that slab on grade floors rest on 6 inches of granular free draining soil on top scarified and recompacted engineered fill or the associated soil correction as shown in Tables 4a, 4b, & 4c.

The final six (6) inches of fill below the concrete floor slabs should consist of aggregate base course, pit run sand or processed sand (sand cushion) with 100 percent material passing the 1 inch, no more than 50 percent passing the No. 40 sieve and no more than 12 percent material passing the No. 200 Sieve. The moisture content of the cushion should be within plus or minus 2 percent of the optimum moisture content determined by the standard Proctor test. Floor slabs constructed over a minimum of 2 feet of granular engineered backfill as described in the Site Preparation section of the report may be designed on an estimated modulus of subgrade reaction (k) of 150 pci.

All interior at-grade floors with impervious or near impervious surfacing such as, but not limited to, paint, hardening agent, vinyl tile, ceramic tile, or wood flooring, should include provision for installation of a vapor retarder system. Historically, vapor retarder systems can consist of many different types of synthetic membrane and can be placed either below cushion materials or at the underside of the concrete floor. All such issues are contentious and have both positive and negative aspects associated with long term performance of the floor. Overall, we recommend you install some form of vapor retarder below the project floor (for at-grade and basement construction, as appropriate). In addition, NTI recommends the design team consult with the selected flooring supplier to account for any product specific vapor suppression requirements.

We recommend you isolate floor slabs from other building components by placement of a nominal ½ inch thick expansion joint between the floor and walls, and/or columns. This construction must also apply a compatible sealant after curing of the floor slab to reduce moisture penetration though the

expansion joint. As a minimum, you should install a bond breaker to isolate and reduce binding of building components.

4.10 Foundation Wall Backfill & Retaining Walls

Exterior backfill of at-grade foundations walls which do not retain soil should consist of native, non-organic, debris free soils or engineered fill. Placement of exterior backfill against at-grade non-earth retaining foundation walls should be performed concurrent with interior backfill to minimize differential loading, rotation and/or movement of the wall system.

A drain tile installed at the base of foundation walls is recommended to prevent hydrostatic loading on the walls. The drain tile should be sloped to provide positive gravity drainage or to a sump pit and pump or if possible daylighted away from the building. The drain tile should be surrounded by clean, free-draining granular material having less than 5 percent passing the No. 200 sieve. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted clay to reduce infiltration of surface water into the drain system.

The final one foot of exterior backfill for green areas may consist of clay or silt-based topsoil. The final exterior backfill for areas supporting sidewalks and/or pavements should consist of a free draining aggregate base as recommended for the respective construction.

Backfill should be tempered for correct moisture content, then placed and compacted in individual lifts of exterior backfill per criteria presented within Appendix B of our report.

4.11 Surface Drainage

You should maintain positive drainage during and after construction of project and eliminate ponding of water on site soils. We recommend you include provisions within construction documents for positive drainage of site. You should install sumps at critical areas around project excavations to assist in removal of seepage and runoff from site.

We recommend that sidewalks, curbing, pavements, and green space be designed to direct drainage away from the structure. We recommend that you provide a 5 percent gradient within 10 feet of building for drainage from lawn, and 2 percent minimum gradient from building for drainage of sidewalks / pavements. All pavements should drain to on-site storm collection, municipal collection system, or roadside ditching.

Roof runoff should be directed away from building by a system of interior roof and scupper drains, or rain gutters, down spouts and splash pads. It is our opinion interior roof drains plumbed directly to the storm water piping system provide the most favorable method of conveying drainage from the roof as interior drains do not freeze or discharge runoff onto exterior sidewalks and pavements.

Planters located within 10 feet of the structure should be self-contained to prevent water accessing the building and pavement subgrade soils. Locate sprinkler mains and spray heads a minimum of 5 feet away from the building line. Low-volume, drip style landscaped irrigation should not be used near the building. Trees or other vegetation whose root systems have the ability to remove excessive moisture

from the subgrade and foundation soils should not be planted next to the structure. Trees and shrubbery should be kept away from the exterior edges of the foundation element a distance at least equal to 1.5 times their expected mature height.

4.12 Frost Considerations

The Clay soils on this site are moderately frost susceptible. The Silt soils on this site are highly frost susceptible. Small amounts of groundwater, or infiltrated surface water, can be detrimental to the performance of slabs and pavements. Exterior slabs and pavements should be expected to heave. If frost action needs to be eliminated in critical areas, then we recommend the use of structurally supported exterior slabs (e.g., as structural stoops in front of building doors). It is our opinion that placing non-frost susceptible material in large areas under exterior pavements and sidewalks would be exceedingly expensive and an unusual design and construction procedure in South Dakota.

A transition area between structurally supported slabs or non-frost susceptible materials should be constructed at a 3H:1V back slope to reduce the potential differential frost movements in the slabs or pavements. Drain-tile should be installed around the foundation perimeter and finger drains should be installed about catch basins and across low points in the pavement grades.

Non-frost susceptible fill should consist of sand or gravel with less than 12 percent material passing the number 200 sieve, and at least 50 percent retained on the number 40 sieve.

4.13 Pavement Construction

We assume project traffic will be light duty traffic which will be comprised primarily of passenger vehicles with periodic garbage trucks and school buses. Our pavement recommendations are predicated this traffic type.

The design team should be aware the encountered soils are moisture-sensitive and protecting them from inclement weather will aid in maintaining stability.

If on-site material is to be used, we recommend it consist of lean clay (CL) and sandy soils with a liquid limit less than 40, or be subject to approval by additional lab testing by NTI through the proctor test or Atterberg test method for confirmation. If on-site material is to be used for fill, lifts of no greater than 6 to 8 inches of thickness should be allowed.

The resulting subgrade following site clearing and grubbing should first be scarified and re-compacted to a depth of 12 inches. A proof roll test should then be performed to determine soft or unstable subgrade areas. If rutting or localized unstable subgrade areas are observed, those areas should be sub-cut, moisture-conditioned, and re-compacted or removed to a stable depth. Excavations for soil corrections (if any) in paved areas should allow for a 2-foot oversize beyond the edges of the pavement.

The proof roll should be performed with a tandem axle dump truck loaded to gross capacity (at least 20 tons). Acceptance criteria of the proof roll shall be limited to rut formation no more than one-inch (1”) depth (front or rear axles) and no pumping (rolling) observed during the visual inspection. Proof roll tests should be observed by an experienced technician or geotechnical engineer prior to placement of the aggregate base course to verify the subgrade will provide adequate pavement support.

If fill is required in paved areas, we recommend it consist of moisture conditioned and recompacted native material as noted previously. If granular basecourse materials are utilized as fill overlying clay-based soils they will need to be adequately drained as to not create a “bathtub” effect overlying the native clay-based soils. If not adequately drained there is the potential that groundwater may collect within the void spaces of the basecourse and result in vertical movements during periods of freeze/thaw.

Individual lifts of native material and aggregate base in proposed paved areas should be tempered for moisture content, placed and compacted to meet the requirements of a modified proctor percentage as listed in Appendix B.

We estimate a properly prepared native lean clay subgrade would have an average stabilometer R-value of 20. As an alternative, an equivalent CBR value of 7 would also be expected. We caution that silt soils may be unsuitable for support of project pavements. When encountered, silt may need to be removed to a depth of 2 feet below the base of the pavement.

For a 20-year design pavement life and light anticipated traffic volumes, Table 6 presents our thickness recommendations for flexible (bituminous) pavement.

Table 6: Recommended Flexible Pavement Thickness Design Alternative

Pavement Section	Light Duty
Bituminous Wear Course (inches)	2.0”
Bituminous Base Course (inches)	3.0”
Aggregate Base (inches)	6.0”

If it is determined that roadways will be gravel surfaced, we recommend the gravel design alternative listed in Table 7 based on the performance of gravel surfacing at similar sites.

Table 7: Recommended Gravel Surfacing Thickness Design Alternative

Pavement Section	Light Duty
Gravel Surfacing (inches)	3.0”
Aggregate Base (inches)	3.0”

The soils on this site are susceptible to loss of strength when wet under dynamic loading conditions. The above pavement recommendations assume the subgrade soils and aggregate section below paved surfaces will drain to subsurface piping for eventual discharge into storm sewer, or above grade to ditching, or similar acceptable systems. Lack of surface and subsurface drainage will significantly reduce the capacity and longevity of the pavement systems indicated above.

The recommended pavement sections are based on the post heavy civil construction end use of the pavements. Loads during heavy civil construction may exceed these conditions. Stabilization of the subgrade may be required in high traffic construction areas, such as access roads and lay-down yards. This stabilization could be achieved through the addition of crushed stabilizing aggregate or through moisture conditioning and re-compacting. Subgrades should be stabilized prior to the placement of the final pavement section. We recommend a proof roll be performed immediately before the placement of pavements, especially those exposed to precipitation.

We recommend pavements or gravel surfacing receive regular maintenance, as a minimum, to correct damages to the pavement structure, clean and infill cracks which develop, and repair or resurface areas which exhibit reduced subgrade performance. The lack of maintenance can lead to moisture infiltration of the pavement structure and softening of the subgrade soils. This, in turn, can degrade the performance of the pavement system and result in poorly performing pavements with shortened life expectancy.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Excavation Stability

Excavation depth and sidewall inclination should not exceed those specified in local, state or federal regulations. Excavations may need to be widened and sloped, or temporarily braced, to maintain or develop a safe work environment. Also, contractors should comply with local, state, and federal safety regulations including current OSHA excavation and trench safety standards. Temporary shoring must be designed in accordance with applicable regulatory requirements.

5.2 Engineered Fill & Winter Construction

The Geotechnical Engineer of Record or their designated representative should observe and evaluate excavations to verify removal of uncontrolled fills, topsoil and/or unsuitable material(s), and adequacy of bearing support of exposed soils. Such observation should occur prior to construction of foundations or placement of engineered fill supporting excavations.

Engineered fill should be approved by the Geotechnical Engineer of Record prior to placement. In addition, the engineered fill should be tempered for correct moisture content and then place and compact individual lifts of engineered fill to criteria established within the appendices attachment.

Frozen soil should never be used as engineered fill or backfill, nor should you support foundations on frozen soils. Moisture freezing within the soil matrix of fine grained and/or cohesive soils produces ice lenses. Such soils gain moisture from capillary action and, with continued growth, heave with formation of ice lenses within the soil matrix. Foundations constructed on frozen soils have the potential to settle once ice lenses thaw.

You should protect excavations and foundations from freezing conditions or accumulation of snow, and remove frozen soils, snow, and ice from within excavations, fill section or from below proposed foundations. Replacement soils should consist of similar materials as those removed from the excavation with moisture content, placement and compaction conforming to report criteria.

6.0 CLOSURE

Our conclusions and recommendations are predicated on observation and testing of the earthwork directed by the Geotechnical Engineer of Record. Our opinions are based on data assumed representative of the site. However, the area coverage of borings in relation to the entire project is very small. For this and other reasons, we do not warrant conditions below the depth of our borings, or that the strata logged from our borings are necessarily typical across the site. Deviations from our recommendations by plans, written specifications, or field applications shall relieve us of responsibility unless our written concurrence with such deviations has been established.

The scope of services for this project does not include either specifically or by implication any environmental or biological assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of Paramount Point, LLC for specific application to the proposed Norman Ranch Subdivision in Black Hawk, South Dakota. Northern Technologies, LLC has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Northern Technologies, LLC makes no other warranty, expressed or implied.

Northern Technologies, LLC

Adam Dando, EIT
Graduate Engineer

Dan Gibson, PE
Professional Engineer

This document originally issued and sealed by Daniel Gibson [SD Reg. No.15109] on September 30, 2021. This media should not be considered a certified document.

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APPENDIX A

GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

FIELD EXPLORATION PROCEDURES

GENERAL NOTES

WATER LEVEL SYMBOL

DESCRIPTIVE TERMINOLOGY

RELATIVE PROPORTIONS

PARTICLE SIZES

CLASSIFICATION of SOILS for ENGINEERING PURPOSES

EXCAVATION OVERSIZE

GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

We visually examined recovered soil samples to estimate distribution of grain sizes, plasticity, consistency, moisture condition, color, presence of lenses and seams, and apparent geologic origin. We then classified the soils according using the Unified Soil Classification System (ASTM D2488). A chart describing this classification system and general notes explaining soil sampling procedures are presented within appendices attachments.

The stratification depth lines between soil types on the logs are estimated based on the available data. In-situ, the transition between type(s) may be distinct or gradual in either the horizontal or vertical directions. The soil conditions have been established at our specific boring locations only. Variations in the soil stratigraphy may occur between and around the borings, with the nature and extent of such change not readily evident until exposed by excavation. These variations must be properly assessed when utilizing information presented on the boring logs.

We request that you, your design team or contractors contact NTI immediately if local conditions differ from those assumed by this report, as we would need to review how such changes impact our recommendations. Such contact would also allow us to revise our recommendations as necessary to account for the changed site conditions.

FIELD EXPLORATION PROCEDURES

Soil Sampling – Standard Penetration Boring:

Soil sampling was performed according to the procedures described by ASTM D-1586. Using this procedure, a 2 inch O.D. split barrel sampler is driven into the soil by a 140 pound weight falling 30 inches. After an initial set of six inches, the number of blows required to drive the sampler an additional 12 inches is recorded (known as the penetration resistance (i.e. “N-value”) of the soil at the point of sampling. The N-value is an index of the relative density of cohesionless soils and an approximation of the consistency of cohesive soils.

Soil Sampling – Power Auger Boring:

The boring(s) was/were advanced with a 6 inch nominal diameter continuous flight auger. As a result, samples recovered from the boring are disturbed, and our determination of the depth, extent of various stratum and layers, and relative density or consistency of the soils is approximate.

Soil Classification:

Soil samples were visually and manually classified in general conformance with ASTM D-2488 as they were removed from the sampler(s). Representative fractions of soil samples were then sealed within respective containers and returned to the laboratory for further examination and verification of the field classification. In addition, select samples were submitted for laboratory tests. Individual sample information, identification of sampling methods, method of advancement of the samples and other pertinent information concerning the soil samples are presented on boring logs and related report attachments.

GENERAL NOTES

DRILLING and SAMPLING SYMBOLS		*LABORATORY TEST SYMBOLS*	
SYMBOL	**DEFINITION**	**SYMBOL**	**DEFINITION**
C.S.	Continuous Sampling	W	Moisture content-percent of dry weight
P.D.	2-3/8" Pipe Drill	D	Dry Density-pounds per cubic foot
C.O.	Cleanout Tube	LL, PL	Liquid and plastic limits determined in accordance with ASTM D 423 and D 424
3 HSA	3 ¼" I.D. Hollow Stem Auger	Q_U	Unconfined compressive strength-pounds per square foot in accordance with ASTM D 2166-66
4 FA	4" Diameter Flight Auger		
6 FA	6" Diameter Flight Auger		
2 ½ C	2 ½" Casing		
4 C	4" Casing		
D.M.	Drilling Mud	Pq	Penetrometer reading-tons/square foot
J.W.	Jet Water	S	Torvane reading-tons/square foot
H.A.	Hand Auger	G	Specific Gravity – ASTM D 854-58
NXC	Size NX Casing	SL	Shrinkage limit – ASTM 427-61
BXC	Size BX Casing	Ph	Hydrogen ion content-meter method
AXC	Size AX casing	O	Organic content-combustion method
SS	2" O.D. Split Spoon Sample	M.A.	Grain size analysis
2T	2" Thin Wall Tube Sample	C*	One dimensional consolidation
3T	3" Thin Wall Tube Sample	Q_C	Triaxial Compression
		* See attached data Sheet and/or graph	

WATER LEVEL SYMBOL

Water levels shown on the boring logs were determined at the time and under the conditions indicated. In sand, the indicated levels can be considered relatively reliable for most site conditions. In clay soils, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious water bearing soil are present; and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed soils may not indicate the true level of the ground water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

RELATIVE DENSITY		*CONSISTENCY*	
TERM	**N_{60} Value** (corrected)	**TERM**	**N_{60} Value** (corrected)
Very Loose	0 – 4	Soft	0-4
Loose	5 – 8	Medium	5-8
Medium Dense	9 – 16	Rather Stiff	9 – 15
Dense	16 – 30	Stiff	16 – 30
Very Dense	Over 30	Very Stiff	Over 30

RELATIVE PROPORTIONS

TERMS	**RANGE**
Trace	0 – 5%
A little	5 – 15%
Some	15 – 30%

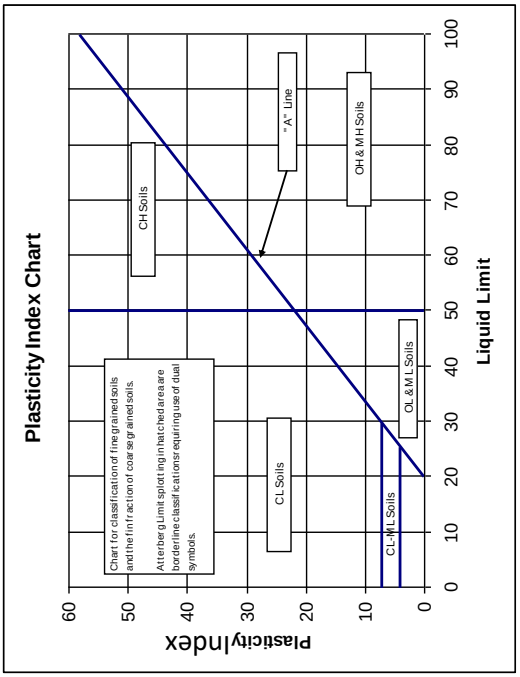
PARTICLE SIZES

MATERIAL	**DESCRIPTION**	**U.S. SIEVE SIZE**
Boulders		Over 3"
Gravel	Coarse	3" to ¾"
	Medium	¾" to #4
Sand	Coarse	#4 to #10
	Medium	#10 to #40
	Fine	#40 to #200
Silt and Clay	Determined by Hydrometer Test	

CLASSIFICATION of SOILS for ENGINEERING PURPOSES

ASTM Designation D-2487 and D2488 (Unified Soil Classification System)

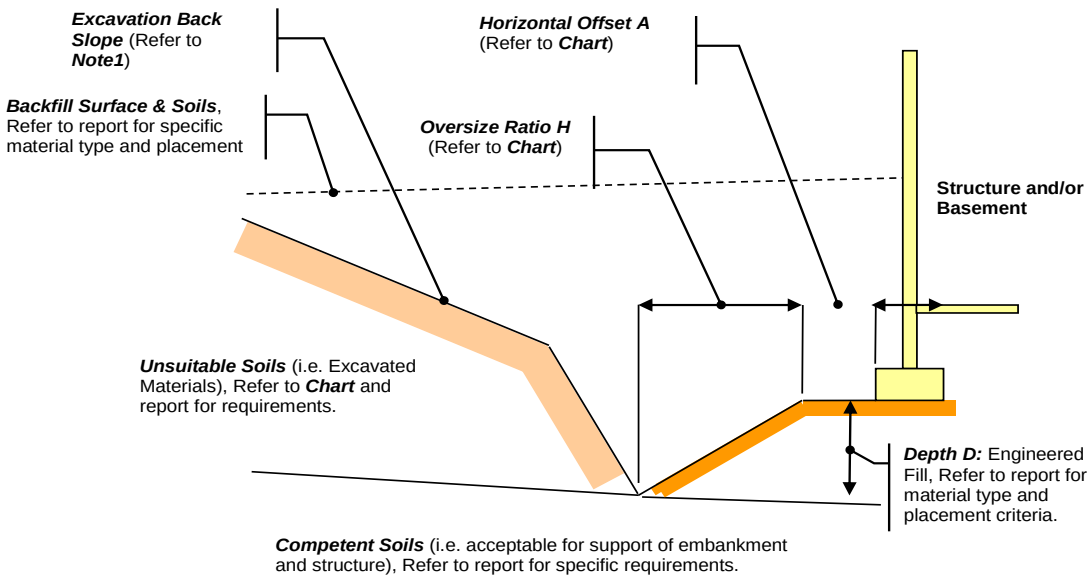
Major Divisions			Group Symbol	Typical Name	Classification Criteria		
Course Grained Soils More than 50% retained on No. 200 sieve *	Gravels 50% or more of coarse fraction retained on No. 4 sieve.	Clean Gravels	GW	Well –graded gravels and gravel-sand mixtures, little or no fines.	**Classification on basis of percentage of fines.** Less than 5% passing No. 200 Sieve: GW, GP, SW, SP More than 12% passing No. 200 Sieve: GM, GC, SM, SC From 5% to 12% passing No. 200 Sieve: Borderline Classification requiring use of duel symbols.	Cu = D60 / D10 greater than 4. Cz = (D30)2 / (D10 x D60) between 1 & 3.	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.		Not meeting both criteria for GW materials.	
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures.		Atterberg limits below "A" line, or P.I. less than 4.	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			GC	Clayey gravels, gravel-sand-clay mixtures.		Atterberg limits above "A" line with P.I. greater than 7.	
	Sands More than 50% of coarse fraction passes No 4 sieve.	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines.		Cu = D60 / D10 greater than 6. Cz = (D30)2 / (D10 x D60) between 1 & 3.	
			SP	Poorly-graded sands and gravelly sands, little or no fines.		Not meeting both criteria for SW materials.	
		Sands with Fines	SM	Silty sands, sand-silt mixtures.		Atterberg limits below "A" line, or P.I. less than 4.	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures.		Atterberg limits above "A" line with P.I. > 7.	
Fine Grained Soils More than 50% passes No. 200 sieve *	Silts and Clays Liquid Limit of 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.			
			OL	Organic silts and organic silty clays of low plasticity.			
	Silts and Clays Liquid Limit greater than 50%.		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.			
			CH	Inorganic clays of high plasticity, fat clays.			
			OH	Organic clays of medium to high plasticity.			
	Highly Organic Soils		Pt	Peat, muck and other highly organic soils.			



EXCAVATION OVERSIZE

Excavation oversize facilitates distribution of load induced stress within supporting soils. Unless otherwise superseded by report specific requirements, all construction should conform to the minimum oversize and horizontal offset requirements as presented within the diagram and associated chart.

Figure 1: Excavation Oversize



Definitions

Oversize Ratio H: The ratio of the horizontal distance divided by the engineered fill depth (i.e. # Horizontal / Depth D). Refer to Chart for specific requirements.

Horizontal Offset A: The horizontal distance between the outside edge of footing or critical position and the crest of the engineered fill section. Refer to Chart for specific requirements.

Note 1: Excavation depth and sidewall inclination should not exceed those specified in local, state or federal regulations including those defined by Subpart P of Chapter 27, 29 CFR Part 1926 (of Federal Register). Excavations may need to be widened and sloped, or temporarily braced, to maintain or develop a safe work environment. Contractor is solely responsible for assessing stability under "means and methods".

Condition	*Unsuitable Soil Type*	*Horizontal Offset A*	*Oversize Ratio H*
Foundation Unit Load equal to or less than 3,000 psf.	SP, SM soils, CL & CH soils with cohesion greater than 1,000 psf	NA	Equal to or greater than one (1) times Depth D
Foundation Unit Load greater than 3,000 psf	SP, SM soils, CL & CH soils with cohesion less than 1,000 psf	NA	Equal to or greater than one (1) times Depth D
Foundation Unit Load equal to or less than 3,000 psf.	Topsoil or Peat	2 feet or width of footing, whichever is greater	Equal to or greater than two (2) times Depth D
Foundation Unit Load greater than 3,000 psf	Topsoil or Peat	5 feet or width of footing, whichever is greater	Equal to or greater than two (3) times Depth D

APPENDIX B

GROUNDWATER ISSUES

PLACEMENT and COMPACTION OF ENGINEERED FILL

GROUNDWATER ISSUES

The following presents additional comment and soil specific issues related to measurement of groundwater conditions at your project site.

Note that our groundwater measurements, or lack thereof, will vary depending on the time allowed for equilibrium to occur in the borings. Extended observation time was not available during the scope of the field exploration program and, therefore, groundwater measurements as noted on the borings logs may or may not accurately reflect actual conditions at your site.

Seasonal and yearly fluctuations of the ground water level, if any, occur. Perched groundwater may be present within sand and silt lenses bedded within cohesive soil formations. Groundwater typically exists at depth within cohesive and cohesionless soils.

Documentation of the local groundwater surface and any perched groundwater conditions at the project site would require installation of temporary piezometers and extended monitoring due to the relatively low permeability exhibited by the site soils. We have not performed such groundwater evaluation due to the scope of services authorized for this project.

We anticipate that a system of sump pits and pumps located outside of the foundation areas would be suitable for control if perched groundwater were to be encountered. NTI cautions that such seepage may be heavy and will vary based on seasonal and annual precipitation, and ground related impacts in the vicinity of the project.

PLACEMENT and COMPACTION OF ENGINEERED FILL

Unless otherwise superseded within the body of the Geotechnical Exploration Report, the following criteria shall be utilized for placement of engineered fill on project. This includes, but is not limited to, earthen fill placement to improve site grades, fill placed below structural footings, fill placed interior of structure, and fill placed as backfill of foundations.

Engineered fill should consist of natural, non-organic, competent material native to the project area being a minus 2" material with less than 12 percent material passing the No. 200 sieve, and at least 50 percent retained on the No. 40 sieve. Such soils may include, but are not limited to gravel, sand, or clays with Unified Soil Classification System (ASTM D2488) classifications of GW, SP, or SM. Use of silt or clayey silt as project fill will require additional review and approval of project Geotechnical Engineer of Record. Such soils have USCS classifications of ML, MH, ML-CL, MH-CH. Use of topsoil, marl, peat, other organic soils construction debris and/or other unsuitable materials as fill is not allowed. Such soils have USCS classifications of OL, OH, Pt.

Engineered fill, classified as clay, should be tempered such that the moisture content at the time of placement is between 4 percent over optimum and optimum content as defined by the appropriate proctor test. Likewise, engineered fill classified as gravel or sand should be tempered such that the moisture content at the time of placement is +/-4 percent of the optimum content.

All engineered fill for construction should be placed in individual eight (8) inch maximum depth lifts. Each lift of fill should be compacted by large vibratory equipment until the in-place soil density is equal to or greater than the criteria established within the following tabulation.

Modified Proctor Test Requirements:

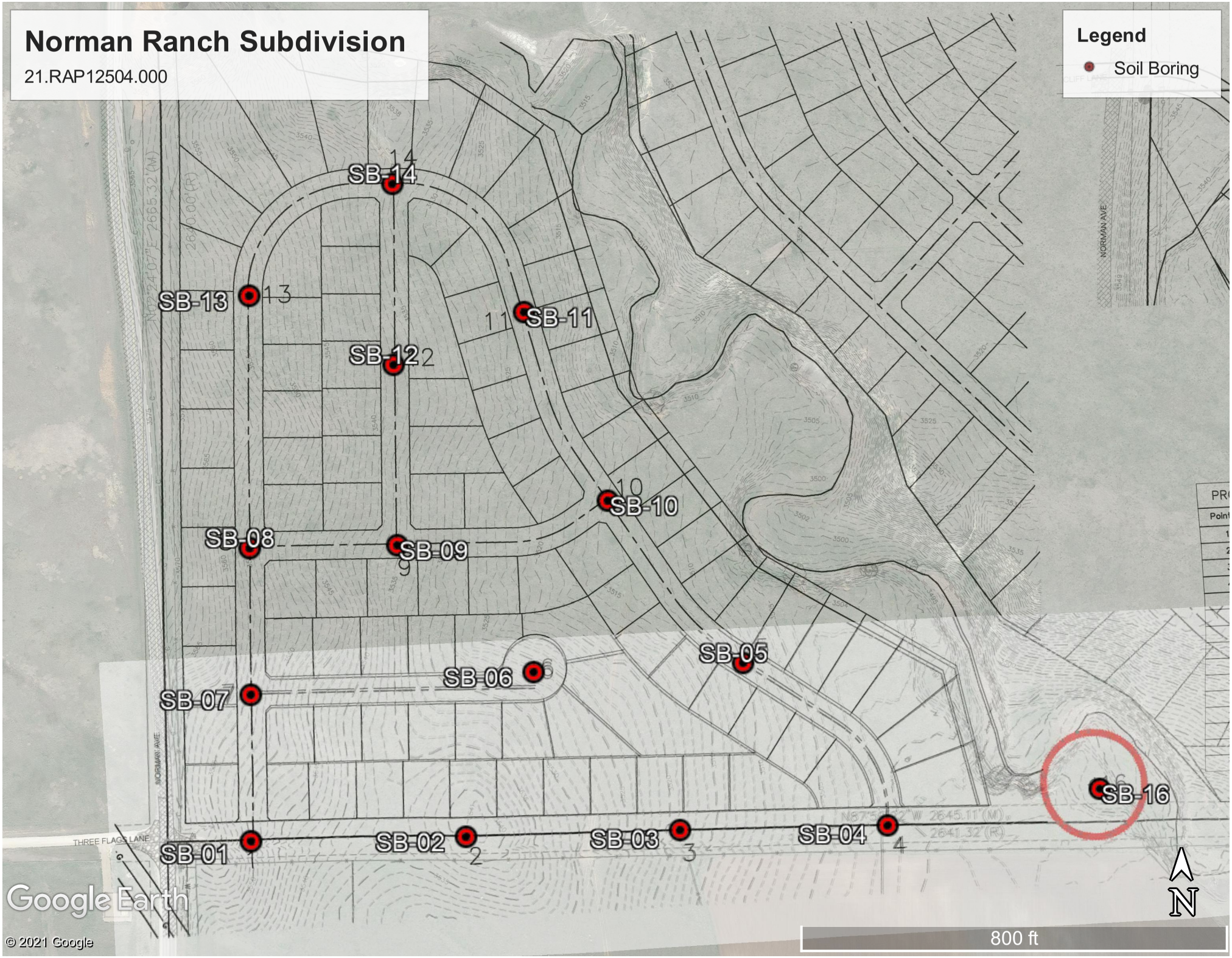
	Compaction Criteria (% respective Proctor) [1]	
Type of Construction	**Clay**	**Sand or Gravel**
General Embankment Fill	Min. 92	Min. 92
Engineered Fill below Foundations	Min. 95	Min. 95
Engineered Fill below Floor Slabs	Min. 95	Min. 95
Engineered Fill greater than 8 feet below foundations	Min. 96	Min 96
Engineered Fill placed as Pavement Aggregate Base	NA	Min. 95
Engineered Fill placed to within 3 feet of pavement aggregate base	Min. 95	Min. 95
Engineered Fill placed within 3 feet of pavement aggregate base	Min. 92	Min. 92
Note 1 Unless otherwise required, compaction shall be based on the **Modified Proctor Test** (ASTM D1557).		

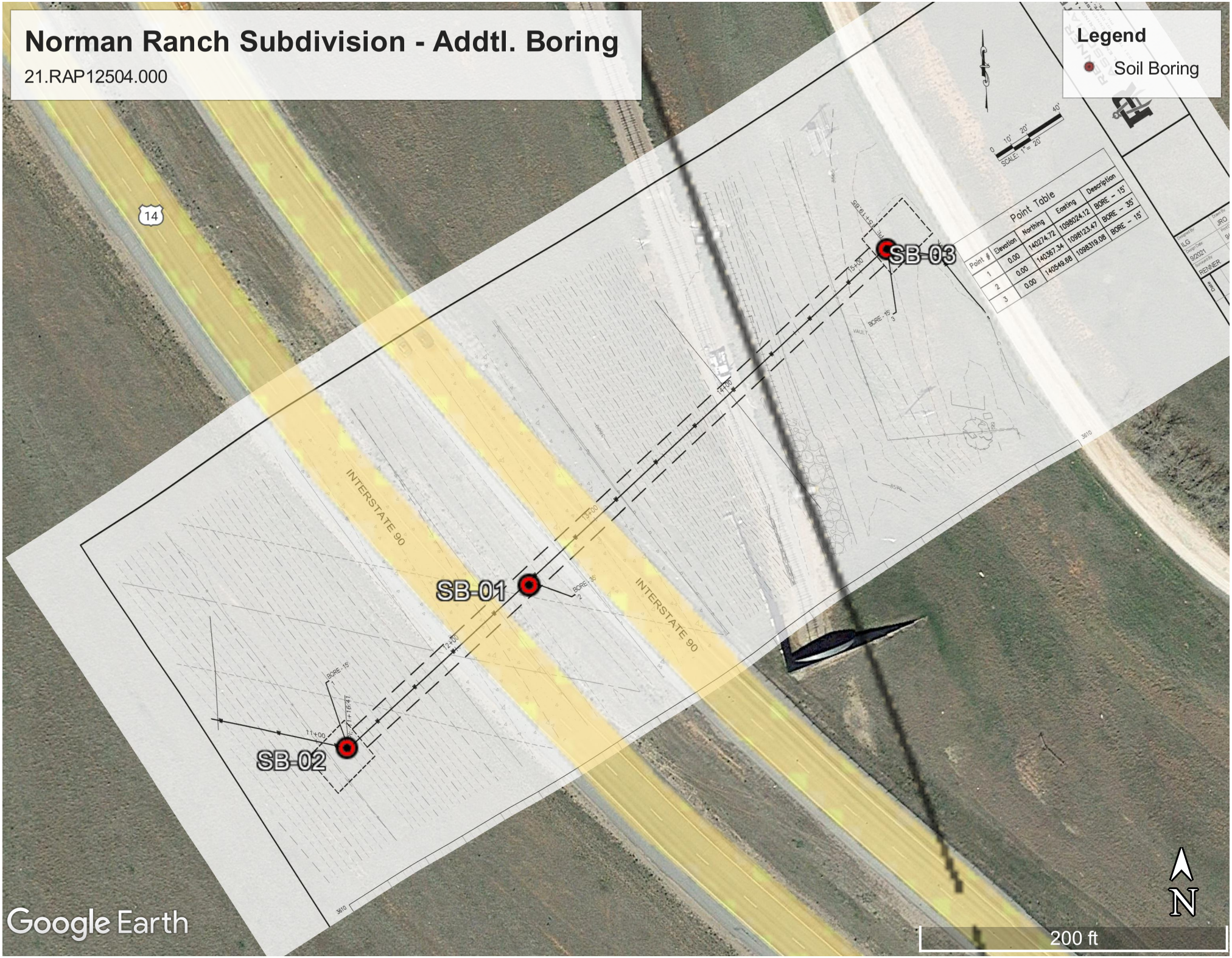
Density tests should be taken during engineered fill placement to document earthwork has achieved necessary compaction of the material(s). Recommendations for interior fill placement and backfill of foundation walls are presented within other sections of this report.

APPENDIX C

SOIL BORING DIAGRAM

SOIL BORING LOGS


Norman Ranch Subdivision
21.RAP12504.000
Legend
Soil Boring
SB-01
SB-02
SB-03
SB-04
SB-05
SB-06
SB-07
SB-08
SB-09
SB-10
SB-11
SB-12
SB-13
SB-14
SB-16
THREE FLAGS LANE
NORMAN AVE
Google Earth
© 2021 Google
800 ft
N


Norman Ranch Subdivision - Addtl. Boring
21.RAP12504.000
Legend
Soil Boring
SB-01
SB-02
SB-03
INTERSTATE 90
INTERSTATE 90
14
Point Table
Point #
Elevation
Northing
Easting
Description
1
0.00
140274.72
1098024.12
BORE - 15'
2
0.00
140367.34
1098123.47
BORE - 35'
3
0.00
140549.68
1098319.08
BORE - 15'
Google Earth
200 ft
N

NTI NORTHERN TECHNOLOGIES, LLC

Rapid City
8105 Black Hawk Rd
Black Hawk, South Dakota 57718
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www.NTIgeo.com

BORING NUMBER SB-01

Long: -103° 18' 42.0732"
Lat: 44° 10' 9.5016"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 4/27/21 **COMPLETED** 4/27/21
GROUND ELEVATION 3549 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 50*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.8 TOPSOIL, ORGANIC CLAY, (OH) black	3548.3	SS 1	11								
		SILT, (ML) light brown, with gravel		SS 2	11	15-18-22 (40)							
5				SS 3	32	22-50/0"				19	NP	NP	
				SS 4	267	50/1"			16				
10				SS 5	133	50/2"							
		11.5	3537.5										
		POORLY GRADED GRAVEL, (GP) No sample		SS 6	0	50/1"							
		13.0	3536.0										
		LEAN CLAY, (CL) light brown, with gravel		SS 7	200	50/1"			10				
15													
		19.0	3530.0										
		POORLY GRADED SAND, (SP) brown and tan, with gravel		SS 8	33	6-14-17 (31)							
20													
		23.0	3526.0										
		WEATHERED SHALE, (CH) dark brown											
25				SS 9	44	8-26-26 (52)							
		26.0	3523.0										

Bottom of borehole at 26.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-02

Long: -103° 18' 36.3384"
Lat: 44° 10' 9.822"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 4/29/21 **COMPLETED** 4/29/21
GROUND ELEVATION 3541 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 48*F, Overcast

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL, ORGANIC CLAY, (OH) black	SS 1	22								
		1.3 3539.7										
		FAT CLAY, (CH) brown	SS 2	22	4-6-5 (11)							
		4.5 3536.5										
5		LEAN CLAY, (CL) brown, trace white precipitate, Refusal due to gravel at bottom of boring	SS 3	44	5-6-6 (12)							
			SS 4	33	8-10-12 (22)		117	13				
10			SS 5	33	8-23-32 (55)			13				
			SS 6	33	11-25-27 (52)							
15			SS 7	400	50/1"			13				
		19.0 3522.0										

Refusal at 19.0 feet.
Bottom of borehole at 19.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-03

Long: -103° 18' 31.6872"
Lat: 44° 10' 9.6924"

CLIENT Paramount Point, LLC. **PROJECT NAME** Norman Ranch Subdivision

PROJECT NUMBER 21.RAP12054 **PROJECT LOCATION** Blackhawk, SD

DATE STARTED 4/29/21 **COMPLETED** 4/29/21 **GROUND ELEVATION** 3519 feet **HOLE SIZE** 6 1/2 in.

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** ---

LOGGED BY Derek White **CHECKED BY** Adam Dando **AT END OF DRILLING** ---

CAVE IN (ft) --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---

NOTES 52*F, Cloudy

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.8 TOPSOIL, ORGANIC CLAY, (OH) black	3518.3	SS 1	56								
		LEAN CLAY, (CL) brown, trace, trace white precipitates		SS 2	22	3-5-8 (13)				33	22	11	
		4.5	3514.5										
5		LEAN CLAY, (CL) red, trace gravel		SS 3	22	3-7-8 (15)			10				
				SS 4	33	7-12-24 (36)			9				
10				SS 5	33	11-38-50 (88)							
				SS 6	22	13-50							
15				SS 7	22	11-50							
20				SS 8	33	3-7-24 (31)							
25		26.0	3493.0	SS 9	22	15-50			8				

Bottom of borehole at 26.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-04

Long: -103° 18' 25.9236"
Lat: 44° 10' 9.75"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 4/29/21 **COMPLETED** 4/29/21
GROUND ELEVATION 3501 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 55*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.8 TOPSOIL, ORGANIC CLAY, (OH) black	3500.3	SS 1	22								
		LEAN CLAY, (CL) brown, with organics		SS 2	33	2-4-4 (8)				40	25	15	
5				SS 3	33	2-5-6 (11)			17				
				SS 4	44	7-9-20 (29)							
		9.5	3491.5										
10		SILT, (ML) red, trace gravel		SS 5	33	11-35-50 (85)				28	NP	NP	
				SS 6	44	6-20-20 (40)			11				
15				SS 7	56	8-19-23 (42)			10				
20				SS 8	44	11-17-20 (37)							
		23.0	3478.0										

Refusal at 23.0 feet.
Bottom of borehole at 23.0 feet.
Borehole backfilled with auger cuttings.

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Rapid City
8105 Black Hawk Rd
Black Hawk, South Dakota 57718
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BORING NUMBER SB-05

Long: -103° 18' 29.6676"
Lat: 44° 10' 12.5364"

CLIENT Paramount Point, LLC. **PROJECT NAME** Norman Ranch Subdivision

PROJECT NUMBER 21.RAP12054 **PROJECT LOCATION** Blackhawk, SD

DATE STARTED 4/29/21 **COMPLETED** 4/29/21 **GROUND ELEVATION** 3510 feet **HOLE SIZE** 6 1/2 in.

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** ---

LOGGED BY Derek White **CHECKED BY** Adam Dando **AT END OF DRILLING** ---

CAVE IN (ft) --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---

NOTES 55*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.6 TOPSOIL, ORGANIC CLAY, (OH) black	3509.4	SS 1	56								
		FAT CLAY, (CH) brown, with organics											
		2.0	3508.0										
		SILT, (ML) red, trace gravel		SS 2		1-3-4 (7)			9				
5				SS 3	22	2-4-3 (7)				26	NP	NP	
				SS 4	22	14-21-30 (51)							
10				SS 5	11	18-50			8				
				SS 6	11	21-50							
15				SS 7	22	18-30-50 (80)			8				
		16.0	3494.0										

Refusal at 16.0 feet.
Bottom of borehole at 16.0 feet.
Borehole backfilled with auger cuttings.

NTI NORTHERN TECHNOLOGIES, LLC

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BORING NUMBER SB-06

Long: -103° 18' 34.848"
Lat: 44° 10' 12.396"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 4/29/21 **COMPLETED** 4/29/21
GROUND ELEVATION 3526 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 55*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL, ORGANIC CLAY, (OH) black	SS 1	28								
1.0		3525.0										
		FAT CLAY, (CH) brown, with organics	SS 2	33	7-10-16 (26)							
4.5		3521.5										
5		LEAN CLAY, (CL) brown, with silt, trace gravel	SS 3	44	11-26-28 (54)			8				
			SS 4	33	12-20-24 (44)							
10			SS 5	44	8-30-27 (57)							
			SS 6	22	11-24-29 (53)							
15			SS 7	22	18-27-31 (58)		102	17				
20			SS 8	11	6-50							
25			SS 9	22	11-50			11				
26.0		3500.0										

Bottom of borehole at 26.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-07

Long: -103° 18' 42.0336"
Lat: 44° 10' 12.2268"

CLIENT Paramount Point, LLC. **PROJECT NAME** Norman Ranch Subdivision

PROJECT NUMBER 21.RAP12054 **PROJECT LOCATION** Blackhawk, SD

DATE STARTED 4/30/21 **COMPLETED** 4/30/21 **GROUND ELEVATION** 3555 feet **HOLE SIZE** 6 1/2 in.

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** ---

LOGGED BY Derek White **CHECKED BY** Adam Dando **AT END OF DRILLING** ---

CAVE IN (ft) --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---

NOTES 40*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL, ORGANIC CLAY, (OH) black	SS 1	67								
		1.3 3553.8										
		SILT, (ML) tan, some gravel, some sand	SS 2	22	6-12-17 (29)							
5			SS 3	22	10-21-25 (46)				22	20	2	
			SS 4	33	8-16-18 (34)							
		9.0 3546.0										
10		FAT CLAY, (CH) brown, with gravel	SS 5	28	4-16-19 (35)		108	19				
			SS 6	33	6-12-16 (28)		107	20				
15			SS 7	44	7-20-23 (43)							
20			SS 8	56	7-17-24 (41)							
25			SS 9	33	9-15-21 (36)							
		26.0 3529.0										

Bottom of borehole at 26.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-08

Long: -103° 18' 42.084"
Lat: 44° 10' 14.8404"

CLIENT Paramount Point, LLC. **PROJECT NAME** Norman Ranch Subdivision

PROJECT NUMBER 21.RAP12054 **PROJECT LOCATION** Blackhawk, SD

DATE STARTED 4/30/21 **COMPLETED** 4/30/21 **GROUND ELEVATION** 3555 feet **HOLE SIZE** 6 1/2 in.

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** ---

LOGGED BY Derek White **CHECKED BY** Adam Dando **AT END OF DRILLING** ---

CAVE IN (ft) --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---

NOTES 44*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL, ORGANIC CLAY, (OH) black										
		1.3 / 3553.8	SS 1	56								
		FAT CLAY, (CH) brown	SS 2	33	3-4-5 (9)							
		4.5 / 3550.5										
5		LEAN CLAY, (CL) red	SS 3	44	4-5-4 (9)			10				
			SS 4	22	4-6-6 (12)			10				
		9.5 / 3545.5										
10		LEAN CLAY, (CL) brown to dark brown, trace sand	SS 5	33	3-3-3 (6)							
			SS 6	22	3-4-3 (7)				30	19	11	
15			SS 7	28	2-3-5 (8)							
20			SS 8	44	6-18-21 (39)							
25			SS 9	33	8-20-26 (46)							
		26.0 / 3529.0										

Bottom of borehole at 26.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-09

Long: -103° 18' 38.3508"
Lat: 44° 10' 14.97"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 4/30/21 **COMPLETED** 4/30/21
GROUND ELEVATION 3536 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 52*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL, ORGANIC CLAY, (OH) black	SS 1	33								
1.0		SILT, (ML) brown, some clay, trace gravel										
3535.0			SS 2	44	2-5-5 (10)							
5			SS 3	44	2-4-2 (6)			6				
			SS 4	33	5-7-12 (19)				23	NP	NP	
9.0												
3527.0		POORLY GRADED SAND, (SP) tan and brown, trace gravel										
10			SS 5	28	11-31-30 (61)			11				
			SS 6	11	13-28-34 (62)		108	18				
15												
16.0			SS 7	0	50							
3520.0												

Refusal at 16.0 feet.
Bottom of borehole at 16.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-10

Long: -103° 18' 33.0876"
Lat: 44° 10' 15.7044"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 4/30/21 **COMPLETED** 4/30/21
GROUND ELEVATION 3515 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 61*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.8 TOPSOIL, ORGANIC CLAY, (OH) black	3514.3	SS 1									
		FAT CLAY, (CH) brown		SS 2	28	5-6-5 (11)							
		4.5	3510.5										
5		LEAN CLAY, (CL) brown, trace gravel		SS 3	39	8-10-12 (22)			11				
				SS 4	22	12-21-22 (43)				26	15	11	
10				SS 5	25	14-31-50/4"		123	11				
				SS 6	33	17-35-37 (72)							
15				SS 7	22	14-28-25 (53)							
		16.0 LEAN CLAY, (CL) brown	3499.0										
20				SS 8	56	10-12-15 (27)		95	25				
25				SS 9	56	8-10-14 (24)							
		26.0	3489.0										

Bottom of borehole at 26.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-11

Long: -103° 18' 35.316"
Lat: 44° 10' 19.524"

CLIENT Paramount Point, LLC. **PROJECT NAME** Norman Ranch Subdivision

PROJECT NUMBER 21.RAP12054 **PROJECT LOCATION** Blackhawk, SD

DATE STARTED 4/30/21 **COMPLETED** 4/30/21 **GROUND ELEVATION** 3523 feet **HOLE SIZE** 6 1/2 in.

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** ---

LOGGED BY Shaun Sapp **CHECKED BY** Adam Dando **AT END OF DRILLING** ---

CAVE IN (ft) --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---

NOTES 64*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL, ORGANIC CLAY, (OH) black and brown	SS 1									
1.0		3522.0										
		LEAN CLAY, (CL) red, with silt, with, white precipitates	SS 2	33	3-5-6 (11)				27	18	9	
5			SS 3	28	3-2-3 (5)			11				
			SS 4	33	2-3-3 (6)							
10		10.0 3513.0	SS 5	67	3-5-7 (12)			15				
		FAT CLAY, (CH) red, with silt, no, w/o white precipitates	SS 6	111	7-9-11 (20)							
15			SS 7	150	9-12-15 (27)							
20			SS 8	156	10-14-14 (28)			14				
25		26.0 3497.0	SS 9	106	8-10-9 (19)							

Bottom of borehole at 26.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-12

Long: -103° 18' 38.448"
Lat: 44° 10' 17.688"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 4/30/21 **COMPLETED** 4/30/21
GROUND ELEVATION 3538 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Shaun Sapp **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 64*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		1.0 TOPSOIL, ORGANIC CLAY, (OH) red and brown, with organics 3537.0	SS 1									
		FAT CLAY, (CH) red, with silt	SS 2	33	5-5-4 (9)			6				
5			SS 3	67	13-37-40 (77)							
			SS 4	22	42			7				
10		11.0 3527.0	SS 5	33	47-13			5				

Refusal at 11.0 feet.
Bottom of borehole at 11.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-13

Long: -103° 18' 41.8536"
Lat: 44° 10' 19.38"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 4/30/21 **COMPLETED** 4/30/21
GROUND ELEVATION 3555 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Shaun Sapp **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 64*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION		SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.5 TOPSOIL, ORGANIC CLAY, (OH) black	3554.5	SS 1	44								
		FAT CLAY, (CH) brown		SS 2	22	4-5-6 (11)							
		4.5	3550.5										
5		SILT, (ML) red, trace gravel		SS 3	44	9-14-19 (33)			6				
				SS 4	28	11-31-34 (65)				22	14	8	
10				SS 5	22	13-27-30 (57)							
				SS 6	22	20-34-40 (74)							
15				SS 7	44	18-30-42 (72)			10				
		19.0	3536.0										

Refusal at 19.0 feet.
Bottom of borehole at 19.0 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-14

Long: -103° 18' 38.556"
Lat: 44° 10' 21.4536"

CLIENT Paramount Point, LLC. **PROJECT NAME** Norman Ranch Subdivision

PROJECT NUMBER 21.RAP12054 **PROJECT LOCATION** Blackhawk, SD

DATE STARTED 4/30/21 **COMPLETED** 4/30/21 **GROUND ELEVATION** 3534 feet **HOLE SIZE** 6 1/2 in.

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** ---

LOGGED BY Derek White **CHECKED BY** Adam Dando **AT END OF DRILLING** ---

CAVE IN (ft) --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---

NOTES 55*F, Clear

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.6 TOPSOIL, ORGANIC CLAY, (OH) brown, with organics 3533.4										
		SILT, (ML) red, with silt, trace gravel	SS 1	33								
			SS 2	22	12-14-18 (32)		126	11				
5			SS 3	44	15-19-27 (46)				25	17	8	
			SS 4	28	18-31-34 (65)							
10			SS 5	28	16-32-40 (72)			7				
			SS 6	22	18-50/3"			7				
		13.5 3520.5										

Refusal at 13.0 feet.
Bottom of borehole at 13.5 feet.
Borehole backfilled with auger cuttings.

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BORING NUMBER SB-16

Long: -103° 18' 20.4552"
Lat: 44° 10' 10.4412"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 6/2/21 **COMPLETED** 6/2/21
GROUND ELEVATION 3489 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
▽ **AT TIME OF DRILLING** 10.00 ft / Elev 3479.00 ft
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES 75F, Sunny

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		0.5 TOPSOIL, ORGANIC CLAY, (OH) dark brown, dry 3488.5										
		SANDY LEAN CLAY, (CL) brown, dry to saturated, soft to medium	SS 1									
			SS 2	33	3-2-2 (4)							
5			SS 3	39	2-3-2 (5)	2.3	107	17				
			SS 4	50	2-4-7 (11)				31	15	16	
		9.0 3480.0										
10		▽ LEAN CLAY, (CL) greenish brown, saturated to wet, rather stiff to very stiff	SS 5	33	5-5-4 (9)							
			SS 6	71	14-12-50/2"	2.0	106	23				
15			SS 7	50	25-41-50/2"				31	14	17	
20			SS 8	100	50/4"							
		21.0 3468.0										

Refusal at 21.0 feet.
Bottom of borehole at 21.0 feet.
Borehole backfilled with auger cuttings.

NTI NORTHERN TECHNOLOGIES, LLC

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BORING NUMBER SB-17

Long: -103° 19' 4.2564"
Lat: 44° 10' 10.0128"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 9/20/21 **COMPLETED** 9/20/21
GROUND ELEVATION 3617 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		1.0 TOPSOIL, ORGANIC CLAY, (OH) dark brown 3616.0	SS 1									
		LEAN CLAY, (CL) brown and red, rather stiff to stiff, some silt, trace gypsum	SS 2	39	3-5-8 (13)			16				
5			SS 3	50	3-5-6 (11)	4.5						
			SS 4	56	2-6-8 (14)	4.5						
10			SS 5	67	3-7-10 (17)							
			SS 6	44	5-7-9 (16)	2.8		12				
15			SS 7	56	3-9-11 (20)	3.5		16				
20			SS 8	39	4-11-12 (23)	3.3			41	25	16	
25			SS 9	33	5-10-11 (21)							
30			SS 10	33	7-12-12 (24)							
		32.0 3585.0										

Bottom of borehole at 32.0 feet.
Borehole backfilled with auger cuttings.

NTI NORTHERN TECHNOLOGIES, LLC

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BORING NUMBER SB-18

Long: -103° 19' 5.8836"
Lat: 44° 10' 8.9616"

CLIENT Paramount Point, LLC.
PROJECT NAME Norman Ranch Subdivision
PROJECT NUMBER 21.RAP12054
PROJECT LOCATION Blackhawk, SD
DATE STARTED 9/20/21 **COMPLETED** 9/20/21
GROUND ELEVATION 3590 feet **HOLE SIZE** 6 1/2 in.
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING ---
LOGGED BY Derek White **CHECKED BY** Adam Dando
AT END OF DRILLING ---
CAVE IN (ft) --- **FROST DEPTH (ft)** ---
AFTER DRILLING ---
NOTES ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL, ORGANIC CLAY, (OH) dark brown										
0.8		3589.3	SS 1									
		LEAN CLAY, (CL) brown and red, rather stiff to very stiff, some gravel, little gypsum	SS 2	33	3-5-7 (12)	> 4.5						
5			SS 3	72	3-5-5 (10)	4.5	135	0				
			SS 4	56	5-7-6 (13)	4.0			40	29	11	
10			SS 5	39	1-16-12 (28)		101	16				
			SS 6	33	3-9-11 (20)	> 4.5						
15			SS 7	56	13-50-21 (71)							
16.0		3574.0										

Bottom of borehole at 16.0 feet.
Borehole backfilled with auger cuttings.

NTI NORTHERN TECHNOLOGIES, LLC

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BORING NUMBER SB-19

Long: -103° 19' 1.0776"
Lat: 44° 10' 12.144"

CLIENT Paramount Point, LLC. **PROJECT NAME** Norman Ranch Subdivision

PROJECT NUMBER 21.RAP12054 **PROJECT LOCATION** Blackhawk, SD

DATE STARTED 9/20/21 **COMPLETED** 9/20/21 **GROUND ELEVATION** 3573 feet **HOLE SIZE** 6 1/2 in.

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** ---

LOGGED BY Derek White **CHECKED BY** Adam Dando **AT END OF DRILLING** ---

CAVE IN (ft) --- **FROST DEPTH (ft)** --- **AFTER DRILLING** ---

NOTES ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL, ORGANIC CLAY, (OH) dark brown to red										
0.8 (3572.3)		LEAN CLAY, (CL) red, stiff to very stiff, some gypsum, some gravel	SS 1									
			SS 2	28	5-7-14 (21)	> 4.5		3				
5			SS 3	33	3-13-15 (28)	3.8						
			SS 4	44	7-13-18 (31)	3.5						
10			SS 5	38	13-24-50/1"							
			SS 6	71	21-50/1"		114	10				
13.0 (3560.0)												

Bottom of borehole at 13.0 feet.
Borehole backfilled with auger cuttings.