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SOILS AND FOUNDATION INVESTIGATION
PROPOSED MINTURN RAILROAD PUD DEVELOPMENT
19 ACRES BETWEEN N. TAYLOR STREET AND MINTURN ROAD
MINTURN, COLORADO

Prepared For:

GPS Designs, LLC
245 Pine Street
Minturn, Colorado 81645

Attention: Mr. Gregory Sparhawk

Project No. SU01922.000-120-R1

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SCOPE

This report presents the results of our Soils and Foundation Investigation for the Proposed Minturn Railroad PUD Development consisting of 19 acres between North Taylor Street and Minturn Road, in Minturn, Colorado. We conducted this investigation to evaluate subsurface conditions at the site and provide geotechnical engineering recommendations for the proposed development. Our report was prepared from data developed during our field exploration, engineering analysis, and experience with similar conditions. This report includes a description of the subsurface conditions observed in our exploratory borings and pits and presents geotechnical engineering recommendations for design and construction of the residence foundations, floor systems, and details influenced by the subsoils. The scope was described in a Service Agreement (SU-20-0324) dated March 3, 2020. We are concurrently providing an Environmental Impact Report and a Limited Phase II Environmental Site Assessment for the site, which will be provided separately.

Recommendations contained in this report were developed based on our understanding of the planned construction. Once development plans are available, we should review so that we determine whether our recommendations and design criteria are appropriate. A summary of our conclusions is presented below.

SUMMARY OF CONCLUSIONS

1. Subsurface conditions observed in our exploratory borings and pits generally consisted of about 6 to 12 inches of "topsoil" overlying sand and gravel deposits. Existing man-placed fill was encountered in the upper 2 to 7 feet of several of the borings and pits. The maximum depth explored was 30 feet. Groundwater was not encountered in any of the borings/pits at the time of drilling/excavation, or in the borings when checked several days after drilling.

2. We anticipate that excavations for the new residences will result in natural sand and gravel being the predominant soils at anticipated foundation elevations. Existing man-placed fill will be encountered in some

areas. All existing fill soils and foundation elements must be removed beneath new foundations and floor slabs. Design and construction criteria are presented in the report. It is critical that we observe the excavation to check whether conditions are as anticipated, prior to placing footings.

3. We expect the subgrade soils beneath roadways and parking areas will range from sand to gravel. The sand and gravel soils will provide good support for pavement. Loose pockets of existing fill may require stabilization.

4. Surface drainage should be designed to provide for rapid removal of surface water away from the buildings. Proper surface drainage is critical to the performance of pavements.

5. The design and construction criteria for foundations and floor systems in this report were compiled with the expectation that all other recommendations presented related to surface and subsurface drainage, landscaping irrigation, backfill compaction, etc. will be incorporated into the project and that homeowners will maintain the structure, use prudent irrigation practices and maintain surface drainage. It is critical that all recommendations in this report are followed.

SITE CONDITIONS

The site is located northeast of Minturn, CO, as shown on Figure 1. The site is triangular shaped and is bordered by Minturn Road to the west, North Taylor Street to the east, and extends approximately 400 to 450 feet north of Game Creek. Vacant land borders the site to the north. The site is mostly vacant, except for two streets and six mobile home structures located near the center of the site. Several abandoned foundations where also observed in this area. Game Creek flows from the southeast to the northwest, through the northern portion of the site. The ground surface across the site generally slopes down to the west and southwest. Slope amounts are variable and generally decrease from east to west. The slopes range from 5 to 15 percent south of Game Creek. North of Game Creek, and at the northeast corner of the site, the slope is on the order of 40 percent. Vegetation consists mostly of grass and sagebrush. Wetland areas exist (delineated by others), with willows, along Game Creek.

PROPOSED CONSTRUCTION

Development on the site will consist of single-family and multifamily residential buildings. Building plans for the residences have not yet been developed. We understand the residences will likely be one to two story structures. Townhome buildings on the south side of the site may be 3 stories tall. Some of the structures will likely have partial basements. We anticipate lower level and garage floors will be slab-on-grade construction. Wood frame construction will be used above grade with cast-in-place concrete foundations walls below grade. Required excavations for foundations are not expected to exceed 8 feet for most structures. Estate Lots 87 through 90, at the northeast portion of the site, are on a steep slope and may require deeper excavations. Foundation loads are generally expected to be about 1,000 to 3,000 pounds per linear foot of foundation wall, with maximum column loads of 40 kips or less. Once building plans have been developed, we should be contacted to re-evaluate our recommendations.

A one new paved north-south street and two new east-west streets will be constructed through the site. Several small parking lots will also be constructed adjacent to the new streets.

SUBSURFACE CONDITIONS

Subsurface conditions were investigated by observing ten exploratory borings and five exploratory pits at the approximate locations shown on Figures 2A through 2G. The borings were advanced using a truck-mounted drill rig and 4-inch diameter, continuous-flight solid-stem auger. Our representative observed drilling and excavation operations, logged the soils encountered, and obtained samples. A summary log of the soils encountered in the borings, and results of field penetration resistance tests, are shown on Figures 3 through 5. Graphic logs of the soils observed in the pits are shown on Figures 6 and 7. Legend and notes are provided on Figure 8.

Subsurface conditions observed in the borings and pits generally consisted of interbedded sand and gravel deposits to the maximum depth explored of 30 feet below existing ground surface. Practical drilling refusal was frequently encountered in the borings. We encountered 6 to 12 inches of topsoil at the surface of TH-1 through TH-3, TP-1, TP-2, and TP-4. Two to seven feet of existing man-placed fill was encountered at the surface of the remainder of the borings and pits. In TP-5 we encountered 18 inches of buried topsoil beneath the fill.

The sand ranged from a silty sand to a silty clayey sand with gravel to a clayey sand. The gravel ranged from a silty gravel with sand to a well-graded gravel with clay and sand to a silty clayey gravel with sand. The gravel contained cobbles and boulders up to 2 feet in diameter. The existing fill was similar to the native sand and gravel deposits except contained scattered pockets of organic matter and debris materials.

Groundwater was not encountered in any of the borings/pits at the time of drilling/excavation, or in the borings when checked several days after drilling. The pits were backfilled after excavation operations were completed.

Samples obtained in the field were returned to our laboratory where field classifications were checked and samples were selected for pertinent testing. Swell consolidation testing conducted on samples of the native sand soils, as shown on figures 9 and 10, indicated low compressibility when wetted under a constant surcharge. Gradation test results of the onsite native sand and gravel soils are presented on Figures 11 thru 18. A summary of the laboratory test results is shown on Table I.

GEOLOGY

We reviewed the following geologic mapping showing the site.

1. Minturn Quadrangle Geologic Map, Eagle County, Colorado, by R.M Kirkham, K.J. Houck, Jonathan Funk, David Mendel, and K.R. Sicard with the Colorado Geologic Survey, Open-File Report OF-12-08, 2012.

Most of the property is mapped as fan deposits. The northern border of the site is mapped as the lower interval of the Minturn formation. Our field investigation and observations at the site generally support the mapping.

We also reviewed a Geologic Hazard Review report by Kumar and Associates, Inc., (K&A) project No. 19-7-720 (dated March 5, 2020). The K&A report concluded that a rock fall hazard exists north of Game Creek and will require mitigation. The K&A report should be referenced for mitigation recommendations. K&A also sited collapsible alluvial fan deposits as a potential geologic hazard but estimated the collapse potential of the bearing soils to be low. Based on our subsurface investigation and the results of our swell consolidation tests, we also estimate the risk of collapsible soil to be low. We believe the risk of mud and debris flow from Game Creek should be evaluated.

The Estate Lots 87 through 90, at the northeast portion of the site, have slopes as high as 40 percent. This is also the location of the rock fall hazard. Excavation and loading of the ground could cause the slope to become unstable. We should be notified to review plans for these lots once they become available. Site specific studies with slope stability analysis should be conducted on these lots. The grading and drainage plan should consider sheet flow drainage from the steep hillside east of the property.

Covering the ground with houses, streets, driveways, patios, etc., coupled with lawn irrigation and changing drainage patterns, leads to an increase in subsurface moisture conditions. It is critical that all recommendations in this report are followed to increase the chances that the foundations and slabs-on-grade will perform satisfactorily. After construction, the homeowners must assume responsibility for maintaining structures and use appropriate practices regarding drainage and landscaping.

SITE EARTHWORK

Our subsurface information indicates that excavations for the residences will be mostly in native sand and gravel soils. Existing fill will be encountered in some areas. All existing fill and foundation elements must be removed beneath footings and floor slabs. We should observe the excavations to confirm whether subsurface conditions are as anticipated. We anticipate excavation of the soils can be accomplished using conventional, heavy duty excavating equipment. Hard cobbles and boulders should be expected. Some boulders will be large. A hydraulic hammer chisel (excavator attachment) or similar device may be required to split large boulders. Sides of excavations need to be sloped to meet local, state and federal safety regulations. The onsite soils will likely classify as Type C soils based on OSHA standards governing excavations. Temporary slopes deeper than 4 feet that are not retained should be no steeper than 1.5 to 1 (horizontal to vertical) in Type C soils. Some sloughing of the excavation face may occur as the soils dry out. Contractors should identify the soils encountered and ensure that applicable standards are met. Contractors are responsible for site safety and maintenance of the work site.

Groundwater was not encountered in any of the borings/pits at the time of drilling/excavation, or in the borings when checked several days after drilling. Some seepage may occur during foundation excavation, particularly if it occurs during seasonal runoff. The footing areas should be protected from any seepage and precipitation through the use of shallow trenches and sumps. Excavations should be sloped to a gravity discharge or to a temporary sump where water can be removed by pumping, if necessary.

Structural Fill

Due to the existing fill soils encountered at the site, some subexcavation and replacement may be required. The on-site native sand and gravel soils, free of organic matter, debris and rocks larger than 8 inches in diameter, can be used as structural fill. Some of the existing fill may be acceptable for use as structural fill, provide it is also free of organic matter, debris, and rocks larger than 8 inches in diameter. Care should be taken during fill placement so the larger rocks do not become nested or grouped together. If required, import fill should consist of CDOT Class 1 structural fill or CDOT Class 4, 5 or 6 aggregate base course or similar soil. Structural fill should have no rocks larger than 6 inches. We can evaluate potential fill materials upon request. Lean-mix concrete (flowable fill) could also be used to fill voids.

The onsite soils with higher levels of silt or clay are moisture sensitive and it may be difficult to achieve proper compaction. Proper moisture content and processing is imperative to attain suitable compaction levels and reduce potential settlement.

Structural fill should be placed in thin loose lifts, moisture conditioned to within +/-2 percent of optimum moisture content, and compacted to at least 98 percent of ASTM D 698 maximum dry density. Moisture content and density of structural fill should be tested by a representative of our firm during placement.

FOUNDATIONS

The residences can be supported on footing foundations on the undisturbed, natural sand and gravel soils or structural fill. All existing fill soils and foundation elements must be removed beneath footings. The fill soils should be removed laterally equal to the depth excavated beneath the footing. Prior to concrete placement, the footing areas should be moistened and compacted with a vibratory roller (weighing 5,000 lbs. min.) to provide a flat and level subgrade. Loose and disturbed soils should be removed or compacted. Structural fill, if required, should be tested by our representative and meet the criteria in the Structural Fill section. Where subexcavation is required, a CTL representative should observe the bottom of the excavation prior to fill placement. Our representative should observe conditions exposed in the completed foundation excavations to confirm whether the exposed soils are as anticipated and suitable for support of the foundations as designed. These recommendations shall not be used for Estate Lots 87 through 90. Site specific geotechnical studies should be conducted on these lots.

1. The proposed residences can be supported by footing foundations supported on the undisturbed, natural sand and gravel soils or structural fill. Soils loosened during the forming process for the footings should be removed or re-compacted prior to placing concrete.

2. Footings can be sized using a maximum allowable soil pressure of 2,500 psf. We expect settlement of footings will be approximately 1 inch or less.

3. To resist lateral loads, a coefficient of friction of 0.40 can be used for concrete in contact with soil. Lateral loads can be resolved by evaluating passive resistance using a passive equivalent fluid density of 325 pcf for granular backfill that is compacted to the criteria in Foundation Wall Backfill and will not be removed. These values have not been factored; appropriate factors of safety should be applied in design. Deflection is necessary to develop passive pressures.

4. Continuous wall footings should have a minimum width of at least 16 inches. Foundations for isolated columns should have minimum dimensions of 24 inches by 24 inches. Larger sizes may be required,

depending upon foundation loads.

5. Grade beams and foundation walls should be well reinforced, top and bottom, to span undisclosed loose or soft soil pockets and resist lateral earth pressures. We recommend reinforcement sufficient to span an unsupported distance of at least 10 feet. Reinforcement should be designed by the structural engineer.

6. The soils under exterior footings should be protected from freezing. We recommend the bottom of footings be constructed at a depth of at least 40 inches below finished exterior grade.

SLABS-ON-GRADE

We estimate slab-on-grade floors are desired. Based on our laboratory test data and experience, the onsite native sand and gravel soils are judged suitable to support lightly loaded slab-on-grade construction. All existing fill and foundation elements must be removed beneath floor slabs. Fill placed to attain subgrade elevations below floor slabs should be placed in accordance with the recommendations outlined in Structural Fill. We recommend the following precautions for slab-on-grade construction at this site. These precautions will not prevent movement from occurring; they tend to reduce damage if slab movement occurs.

1. Slabs should be separated from exterior walls and interior bearing members with slip joints which allow free vertical movement of the slabs.

2. Underslab plumbing should be pressure tested for leaks before the slabs are constructed. Plumbing and utilities which pass through slabs should be isolated from the slabs with sleeves and provided with flexible couplings.

3. Frequent control joints should be provided, in accordance with American Concrete Institute (ACI) recommendations, to reduce problems associated with shrinkage and curling.

4. We recommend a 4-inch layer of clean gravel be placed beneath the slabs to provide a flat, uniform subgrade. This material should consist

of minus 2-inch aggregate with at least 50% retained on the No. 4 sieve and less than 2% passing the No. 200 sieve.

5. The 2015 International Residential Code (IRC R506) states that a 4-inch base course layer consisting of clean graded sand, gravel, crushed stone or crushed blast furnace slag shall be placed beneath below grade floors (unless the underlying soils are free-draining), along with a vapor retarder.

   IRC states that the vapor retarder can be omitted where approved by the building official. The merits of installation of a vapor retarder below floor slabs depend on the sensitivity of floor coverings and building use to moisture. A properly installed vapor retarder is more beneficial below concrete slab-on-grade floors where floor coverings, painted floor surfaces, or products stored on the floor will be sensitive to moisture. The vapor retarder is most effective when concrete is placed directly on top of it, rather than placing a sand or gravel leveling course between the vapor retarder and the floor slab. Placement of concrete on the vapor retarder may increase the risk of shrinkage cracking and curling. Use of concrete with reduced shrinkage characteristics including minimized water content, maximized coarse aggregate content, and reasonably low slump will reduce the risk of shrinkage cracking and curling. Considerations and recommendations for the installation of vapor retarders below concrete slabs are outlined in Section 3.2.3 of the 2006 American Concrete Institute (ACI) Committee 302, "Guide for Concrete Floor and Slab Construction (ACI 302.R-96)".

FOUNDATION WALLS

Foundation walls which extend below-grade should be designed for lateral earth pressures where backfill is not present to about the same extent on both sides of the wall. Many factors affect the values of the design lateral earth pressure. These factors include, but are not limited to, the type, compaction, slope and drainage of the backfill, and the rigidity of the wall against rotation and deflection. For a very rigid wall where negligible or very little deflection will occur, an "at-rest" lateral earth pressure should be used in design. For walls that can deflect or rotate 0.5 to 1 percent of wall height (depending upon the backfill types), lower "active" lateral earth pressures are appropriate. Our experience indicates typical below-grade walls in residences deflect or rotate slightly under normal design loads, and that this deflection results in satisfactory wall performance. Thus, the earth pressures on the walls will likely be between the "active" and "at-rest" conditions.

If on-site sand and gravel soils are used as backfill and the backfill is not saturated, we recommend design of basement walls at this site using an equivalent fluid density of at least 55 pcf. This value assumes deflection; some minor cracking of walls may occur. If very little wall deflection is desired, a higher design value is appropriate. The structural engineer should also consider site-specific grade restrictions, the effects of large openings on the behavior of the walls, and the need for lateral bracing during backfill. Retaining walls that are free to rotate and allow the active earth pressure condition to develop can be designed using an equivalent fluid density of at least 45 pcf for on-site sand and gravel soil backfill.

Foundation Wall Backfill

Proper placement and compaction of foundation backfill is important to reduce infiltration of surface water and settlement of backfill. The onsite sand and gravel soils can be used as backfill, provided they are free of rocks larger than 6 inches in diameter, organics, and debris. The upper 2 feet of fill should be a relatively impervious material to limit infiltration. Backfill which will support surface improvements (sidewalks, driveways, etc.) should be placed in thin loose lifts, moisture conditioned to within +/-2 percent of optimum moisture content, and compacted to at least 95 percent of ASTM D 698 maximum dry density. Backfill in landscape areas should be compacted to at least 90 percent of ASTM D 698 maximum dry density. Thickness of lifts will likely need to be reduced if there are small confined areas of backfill, which limit the size and weight of compaction equipment. Some settlement of the backfill should be expected even if the material is placed and compacted properly. In our experience, settlement of properly compacted granular backfill could be on the order of 0.5 to 1 percent of backfill thickness. Increasing the minimum compaction level will reduce settlement potential. Care should be taken not to over compact and damage foundation walls. Moisture content and density of the backfill should be tested during placement by a representative of our firm.

SUBSURFACE DRAINAGE

Water from snow melt, precipitation and surface irrigation of lawns and landscaping frequently flows through relatively permeable backfill placed adjacent to a residence, and collects on the surface of less permeable soils occurring at the bottom of foundation excavations. This process can cause wet or moist basement or crawlspace conditions after construction. To reduce the likelihood water pressure will develop outside foundation walls and the risk of accumulation of water at basement or crawlspace level, we recommend a foundation drain be installed. The drain should be installed along the entire basement/crawlspace perimeter. The foundation drain will not prevent moist conditions in the basement or crawlspace.

The drain should consist of a 4-inch diameter, perforated or slotted pipe encased in free-draining gravel, and a geocomposite drain board or clean gravel layer extending to within 2 feet of exterior grade, adjacent to the walls. The drain should lead to a positive gravity outlet or sump where water can be removed by pumping. Sump pumps and gravity outlet locations must be maintained by the homeowner. A typical foundation drain detail for basement construction is presented on Figure 19.

CONCRETE

Concrete in contact with soil can be subject to sulfate attack. We measured the water-soluble sulfate concentration in two samples taken from the site at 0.01 percent and less than 0.01 percent. For this level of sulfate concentration, ACI 332-

08 *Code Requirements for Residential Concrete* indicates there are no special requirements for sulfate resistance.

Superficial damage may occur to the exposed surfaces of highly permeable concrete, even though sulfate levels are likely relatively low. To control this risk and to resist freeze-thaw deterioration, the water-to-cementitious materials ratio should not exceed 0.50 for concrete in contact with soils that are likely to stay moist due to surface drainage or high water tables. Concrete should have a total air content of 6 percent ± 1.5 percent.

PAVEMENT THICKNESS

The natural sand and gravel soils encountered in our exploratory borings and pits are judged to be a good support for pavement. The existing fill soils encountered are judged to be a fair support for pavement. Our recommendations assume a properly prepared subgrade and drained conditions. The collection and diversion of surface water away from paved areas is extremely important to the satisfactory performance of the pavement. Drainage design should provide for the removal of water from the paved areas and prevent wetting of the subgrade soils. Frost susceptible soils (with high levels of silt and/or clay) can be problematic if there is a free water source and heaving can occur. The onsite silty sand and gravel soils encountered generally have low to moderate frost susceptibility. Our recommendations for pavement section thickness are given below:

1. New asphalt pavement for the access streets should have a minimum thickness of 4 inches over 6 inches of aggregate base course. This value assumes traffic will primarily consist of vehicular traffic with very little truck traffic (snow plows, garage trucks).

2. New asphalt pavement for parking areas and driveways should have a minimum thickness of 3 inches over 4 inches of aggregate base course.

3. New portland cement concrete pavements for curbs, gutters and drain pans should have a minimum thickness of 6 inches over 6 inches of aggregate base course.

4. Pavement at garbage dumpsters or other areas with concentrated truck traffic or turning movements should consist of at least 8 inches of portland cement concrete over 6 inches of aggregate base course. Steel-reinforcement can be added to the pavement to lengthen design life and reduce differential movement. We believe a reasonable reinforcement section for this type of project is a single mat of No. 4 rebar at a spacing of 24 to 36 inches each way (mid height of slab).

5. These pavement thickness recommendations do not consider construction traffic loads. Consideration should be given to staging asphalt and/or concrete placement to prevent damage by excessive construction equipment loads.

Subgrade Preparation and Aggregate Base Course

Prior to placement of aggregate base course, the pavement subgrade should be scarified to a depth of at least 12 inches, moisture conditioned and recompacted. The completed pavement subgrade should be proof-rolled with a fully loaded tandem dump truck with a gross weight of at least 50,000 pounds. Areas which deform excessively should be removed and replaced with structural fill to achieve a stable subgrade prior to placing pavement materials. The depth of sub-excavations should be determined on a case by case basis at the time of construction. Normally, sub-excavations to stabilize subgrade are 1 to 2 feet in depth. In some cases, geogrid reinforcement can be used to reduce sub-excavation depths. Structural fill placed beneath pavements, such as utility trench backfill and embankment fill, should consist of the onsite sand and gravel soils devoid of vegetation, topsoil and rocks larger than 6 inches in diameter. Imported material should be a relatively well-graded granular material consisting primarily of gravel and sand with less than 15 percent passing the No. 200 Sieve and no rocks larger than 6 inches in diameter. CDOT Class 5 or 6 aggregate base course is a suitable imported structural fill.

Aggregate base course should have a minimum 'R' value of 84 and meet CDOT Class 5 or 6 gradation specifications. The subgrade and aggregate base course should be compacted to at least 95% of the maximum Modified Proctor (ASTM D-1557) dry density at a moisture content within 2% of optimum.

Asphalt Pavement

The asphalt should consist of a mixture of aggregate, filler and asphalt cement. The asphalt mixture should meet the Eagle County or Colorado Department of Transportation (CDOT) grading requirements for an asphalt mix. The asphalt should be a batched hot mix, approved by the engineer, and placed and compacted to a density of 92% to 96% of the maximum theoretical density, determined according to Colorado Procedure 51. The asphalt should be placed in lifts not exceeding 3 inches thick or less than 1.5 inches thick. We recommend State Highway Grading SX.

Concrete Pavement

All concrete should be based on a mix design established by a qualified engineer. A CDOT Class P mix is acceptable. The design mix should consist of aggregate, Portland cement, water, and additives which will meet the requirements contained in this section. The concrete should have a modulus of rupture of third point loading of 630 psi. Normally, concrete with a 28-day compressive strength of 4,000 psi will meet this requirement. Concrete should contain approximately 6 percent entrained air. Maximum allowable slump should not exceed 4 inches.

The concrete should contain joints not greater than 15 feet on centers. Joints should be sawed or formed by premolded filler. The joints should be at least ¼ of the slab thickness. Expansion joints should be provided at the end of each construction sequence and between the concrete slab and adjacent structures. Expansion joints, where required, should be filled with a ½-inch thick asphalt impregnated fiber. Concrete should be cured by protecting against loss of moisture, rapid temperature changes and mechanical injury for at least three days after placement.

SURFACE DRAINAGE

Surface drainage is critical to the performance of foundations, floor slabs and concrete flatwork. Recommendations in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained. We recommend the following precautions be observed during construction and maintained at all times after construction is completed:

1. The ground surface surrounding the exterior of the buildings should be sloped to drain away from the building in all directions. We recommend providing a slope of at least 6 inches in the first 10 feet in landscape areas. We recommend a slope of at least 2.5 inches in the first 10 feet in paved areas. A swale should be provided around the uphill sides and between the buildings to divert surface runoff.

2. The grading and drainage plan should protect structures from sheet flow drainage from the steep hillside east of the property on the north side of Game Creek.

3. Backfill around the exterior of foundation walls should be placed as described in <u>Foundation Wall Backfill</u>. Increases in the moisture content of the backfill soils after placement often results in settlement. Settlement is most common adjacent to north facing walls. Re-establishing proper slopes (homeowner maintenance) away from the building may be necessary.

4. Landscaping should be carefully designed to minimize irrigation. Plants used near foundation walls should be limited to those with low moisture requirements; irrigated grass should not be located within 5 feet of the foundation. Sprinklers should not discharge within 5 feet of the foundation and should be directed away from the building.

5. Impervious plastic membranes should not be used to cover the ground surface immediately surrounding the building. These membranes tend to trap moisture and prevent normal evaporation from occurring. Geotextile fabrics can be used to control weed growth and allow some evaporation to occur.

6. Roof downspouts and drains should discharge well beyond the limits of all backfill. Splash blocks and/or extensions should be provided at all downspouts so water discharges onto the ground beyond the backfill. We generally recommend against burial of downspout discharge. Where it is necessary to bury downspout discharge, solid, rigid pipe should be used and it should slope to an open gravity outlet. Buried downspout discharge pipes should be heated (with thermostat) during winter months to prevent freezing. Downspout extensions, splash blocks and buried outlets must be maintained by the homeowner.

7. The design and construction criteria for foundations and floor systems were compiled with the expectation that all other recommendations presented in this report related to surface and subsurface drainage, landscaping irrigation, backfill compaction, etc. will be incorporated into the project. It is critical that all recommendations in this report are followed.

CONSTRUCTION OBSERVATIONS

This report has been prepared for the exclusive use of GPS Designs, LLC and the design/construction team for the purpose of providing geotechnical design and construction criteria for the proposed project. The information, conclusions, and recommendations presented herein are based upon consideration of many factors including, but not limited to, the type of structure proposed, the geologic setting, and the subsurface conditions encountered. The conclusions and recommendations contained in the report are not valid for use by others. Standards of practice evolve in the area of geotechnical engineering. The recommendations provided in this report are appropriate for about three years. If the proposed project is not constructed within about three years, we should be contacted to determine if we should update this report.

We recommend that CTL | Thompson, Inc. provide construction observation services to allow us the opportunity to verify whether soil conditions are consistent with those found during this investigation. If others perform these observations, they must accept responsibility to judge whether the recommendations in this report remain appropriate.

GEOTECHNICAL RISK

The concept of risk is an important aspect with any geotechnical evaluation primarily because the methods used to develop geotechnical recommendations do not comprise an exact science. We never have complete knowledge of subsurface conditions. Our analysis must be tempered with engineering judgment and experience. Therefore, the recommendations presented in any geotechnical evaluation should not be considered risk-free. Our recommendations represent our judgment of those measures that are necessary to increase the chances that the structures will perform satisfactorily. It is critical that all recommendations in this report are followed during construction. The homeowners must assume responsibility for maintaining the structures and use appropriate practices regarding drainage and landscaping.

RADON

Radon is a gaseous, radioactive element that comes from the radioactive decay of uranium, which is commonly found in igneous rocks. The average indoor radon level in Eagle County is about 5 pCi/L (http://county-radon.info/CO/Eagle.html), which is above the recommended action level of 4 pCi/L as recommended by the Environmental Protection Agency. Testing for radon gas at the site is beyond the scope of this study. Due to the many factors that affect the radon levels in a specific building, accurate testing of radon levels is usually only possible after construction is complete. Typically, radon mitigation systems in this area consist of ventilation systems installed beneath lower level slabs and crawlspaces. The infrastructure for such a mitigation system can normally be installed during construction at a relatively low cost, which is recommended. The buildings should be tested for radon once construction is complete. If test results indicate mitigation is required, the installed system can then be used for mitigation. We are not experts in radon testing or mitigation. If the client is concerned about radon, then a professional in this special field of practice should be consulted.

LIMITATIONS

Our exploratory borings and pits were located to provide a reasonably accurate picture of subsurface conditions. Variations in the subsurface conditions not indicated by the borings/pits will occur. A representative of our firm should observe placement of and test structural fill. We should observe the completed foundation excavations to confirm that the exposed soils are suitable for support of the footings as designed. This investigation was conducted in a manner consistent with that level of care and skill ordinarily exercised by geotechnical engineers currently practicing under similar conditions in the locality of this project. No warranty, express or implied, is made. If we can be of further service in discussing the contents of this report, please call.

CTL | THOMPSON, INC.

Matthew Hopkins
Project Geologist

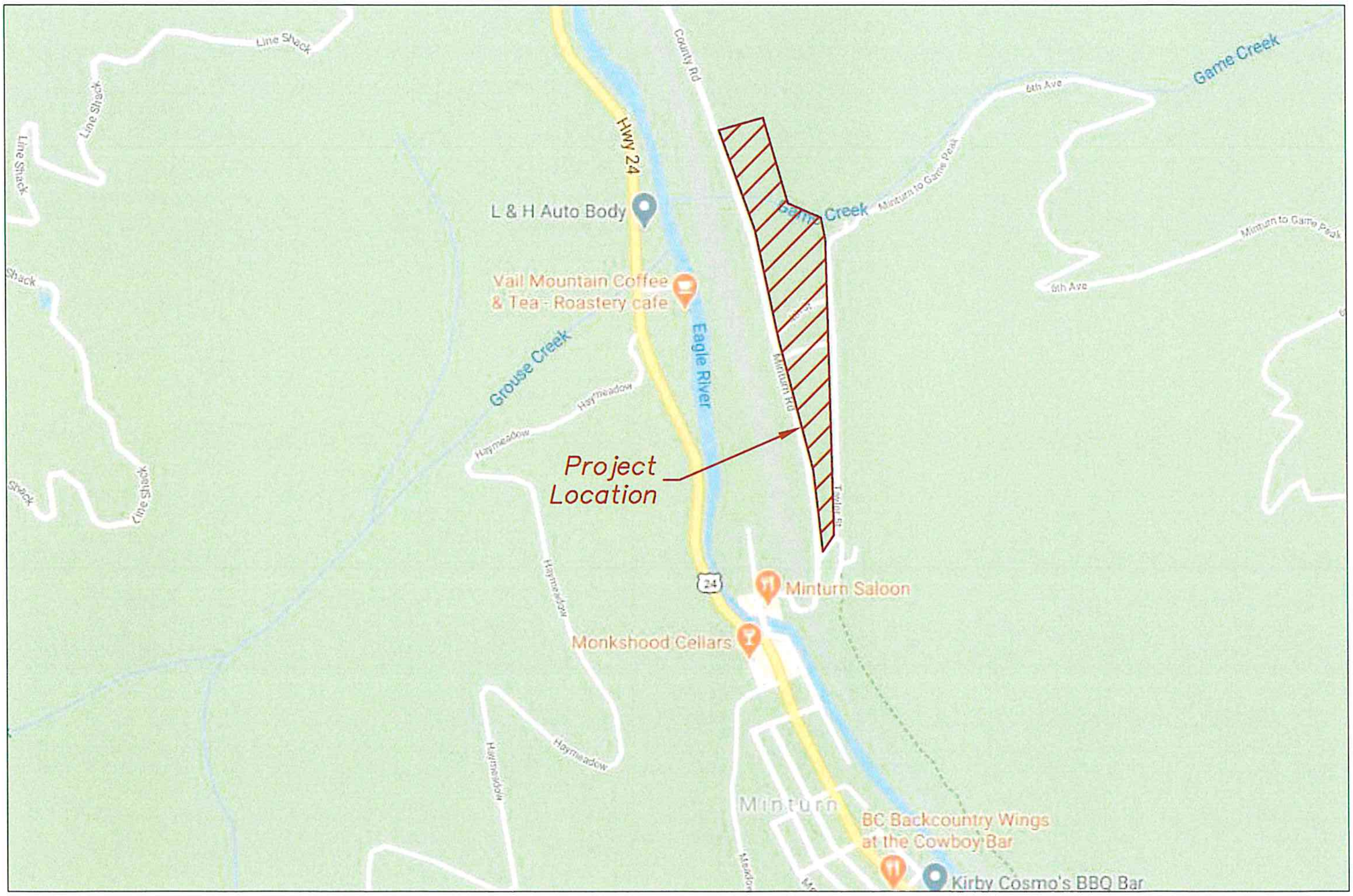
Reviewed By:

George W. Benecke III, P.E.
Division Manager, Summit County

MRH:GWB/ld

cc: gregs@gpsdesigns.com

Not to scale

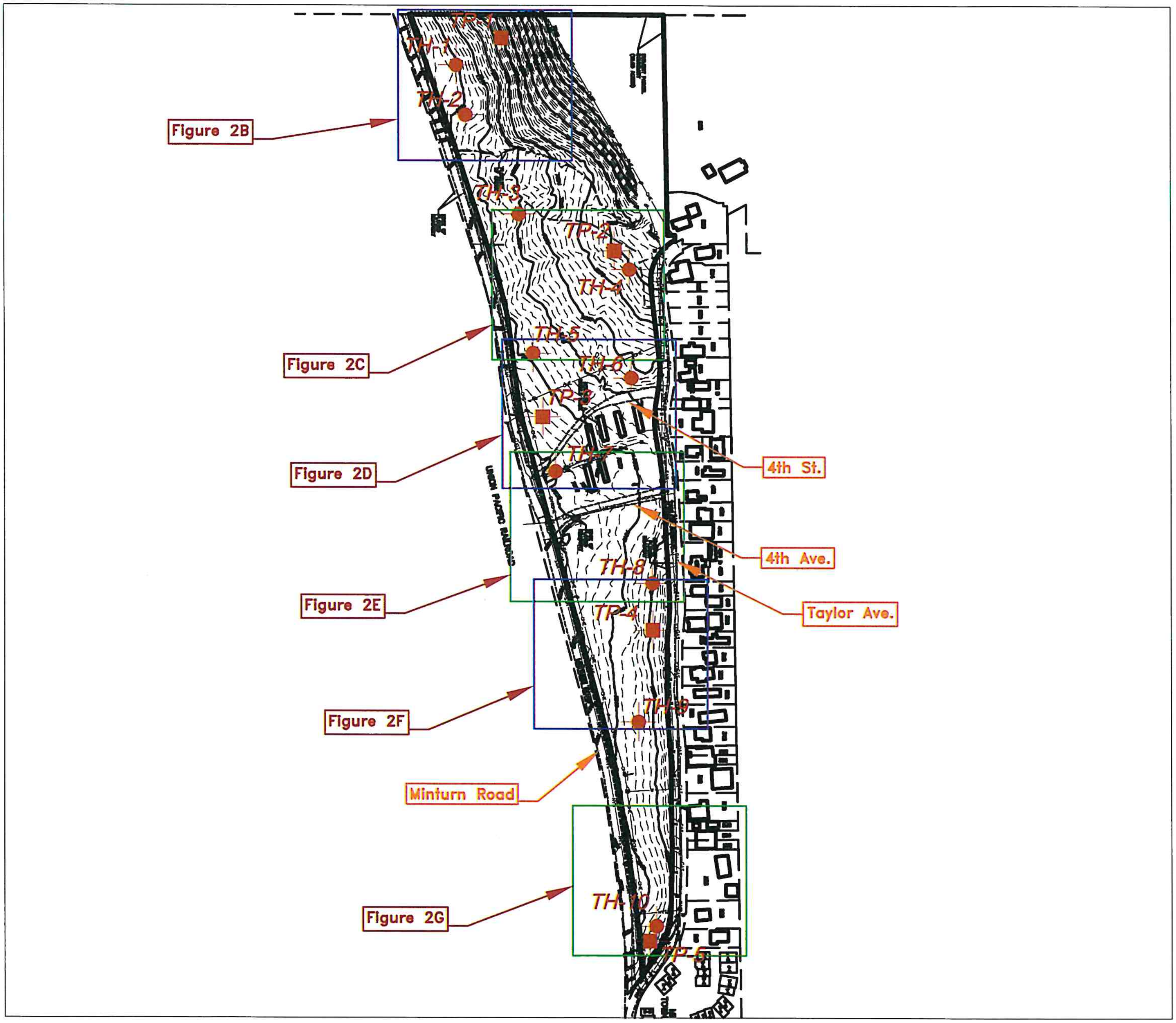


VICINITY MAP

Project No. SU01922.000-120-R1

Figure 1

Scale: 1 inch = 400 feet

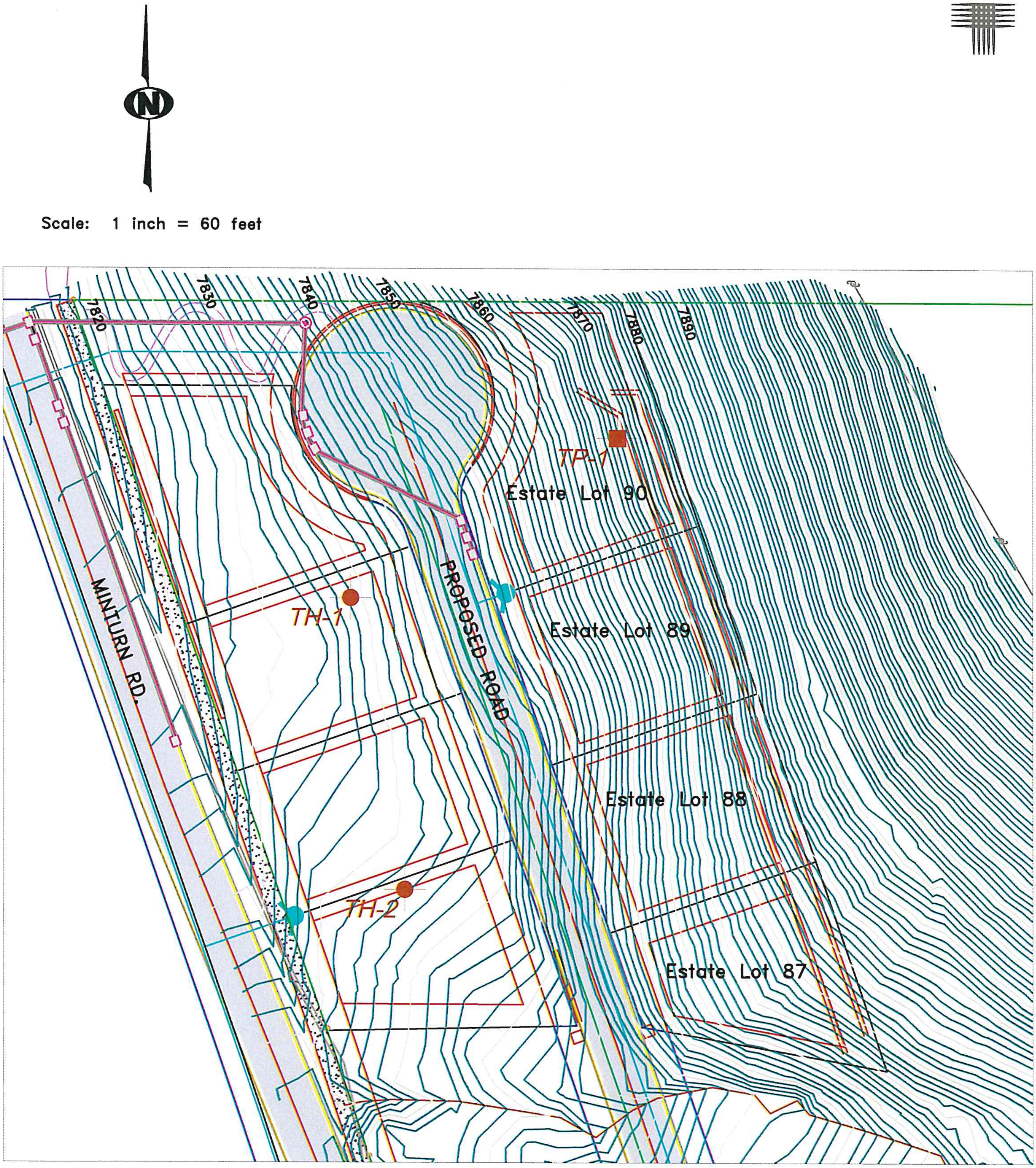


*NOTE – PROPOSED CONSTRUCTION NOT SHOWN

EXISTING CONDITIONS/PROJECT OVERVIEW

Project No. SU01922.000–120–R1

Figure 2A



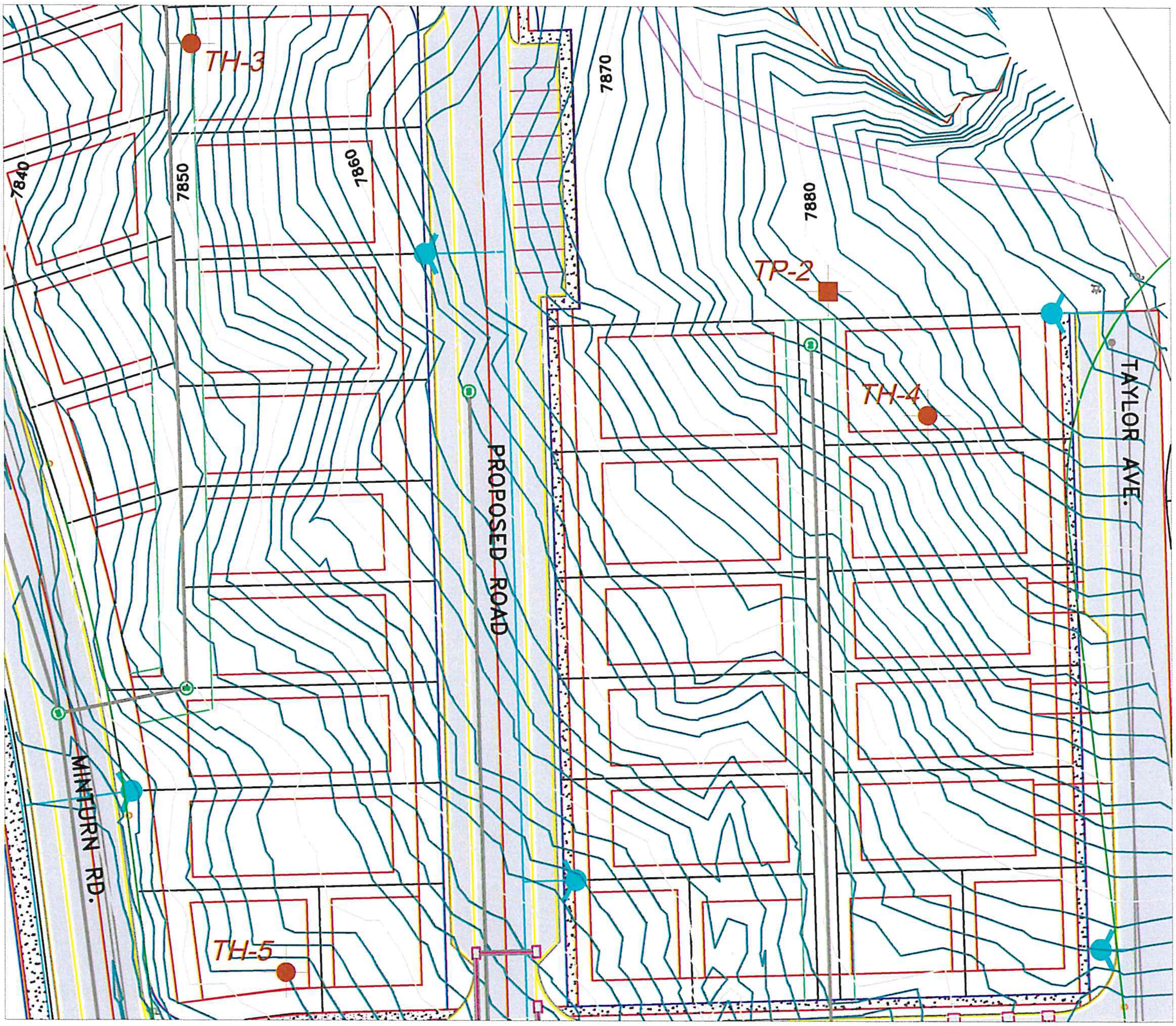
Scale: 1 inch = 60 feet

LOCATIONS OF EXPLORATORY PITS/BORINGS

Project No. SU01922.000-120-R1

Figure 2B

Scale: 1 inch = 60 feet

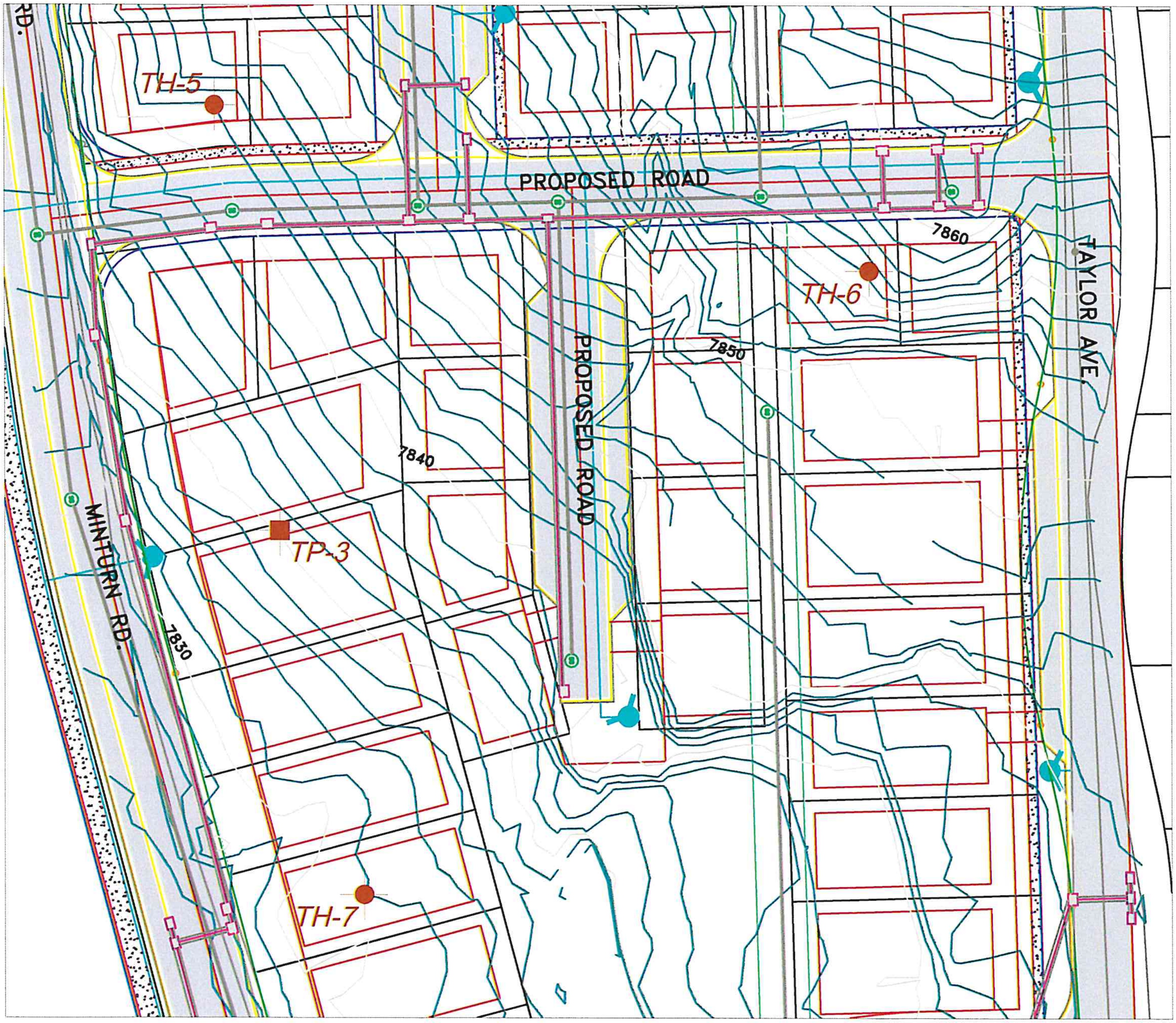


LOCATIONS OF EXPLORATORY PITS/BORINGS

Project No. SU01922.000-120-R1

Figure 2C

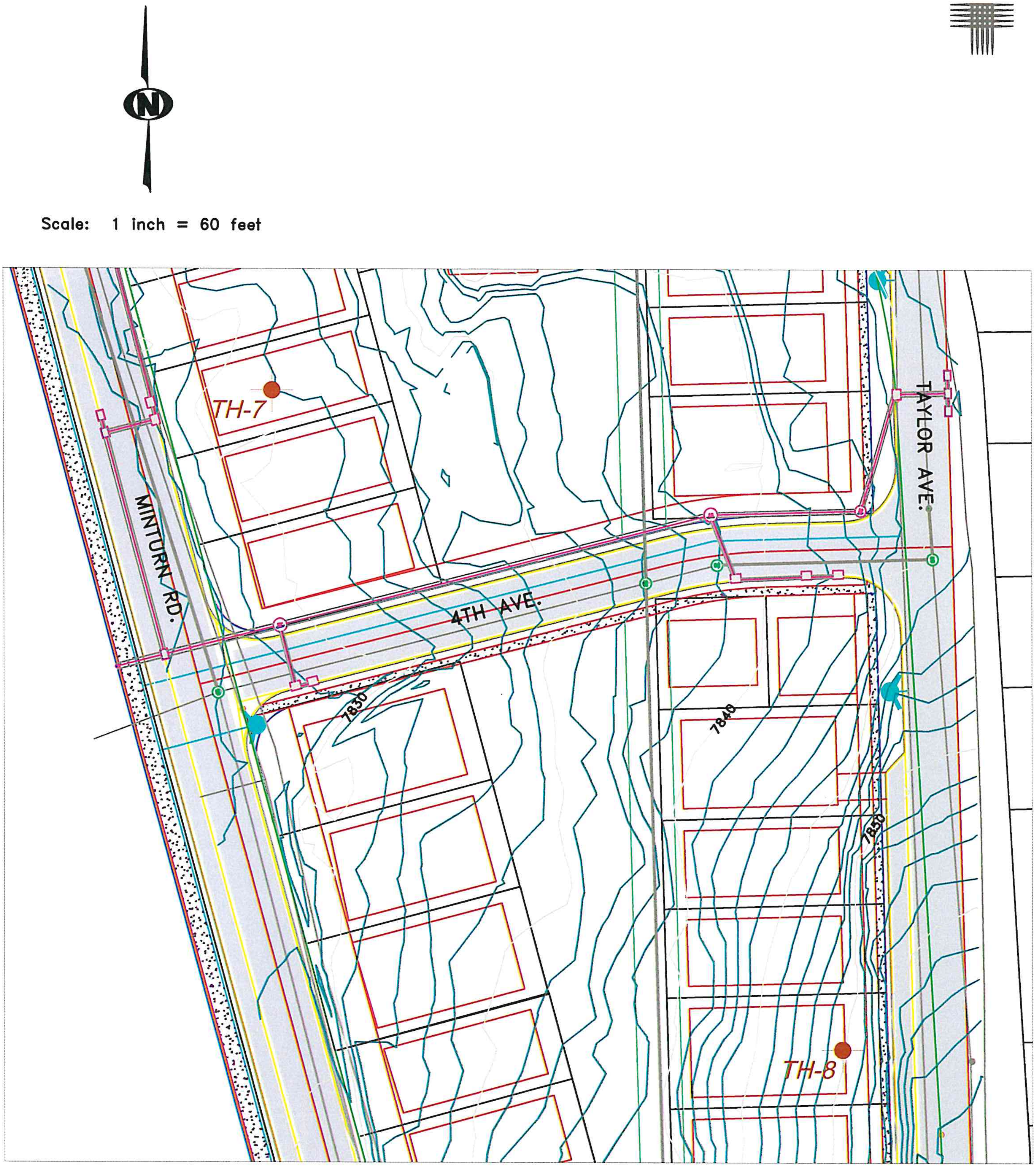
Scale: 1 inch = 60 feet



LOCATIONS OF EXPLORATORY PITS/BORINGS

Project No. SU01922.000-120-R1

Figure 2D



LOCATIONS OF EXPLORATORY PITS/BORINGS

Project No. SU01922.000-120-R1

Figure 2E

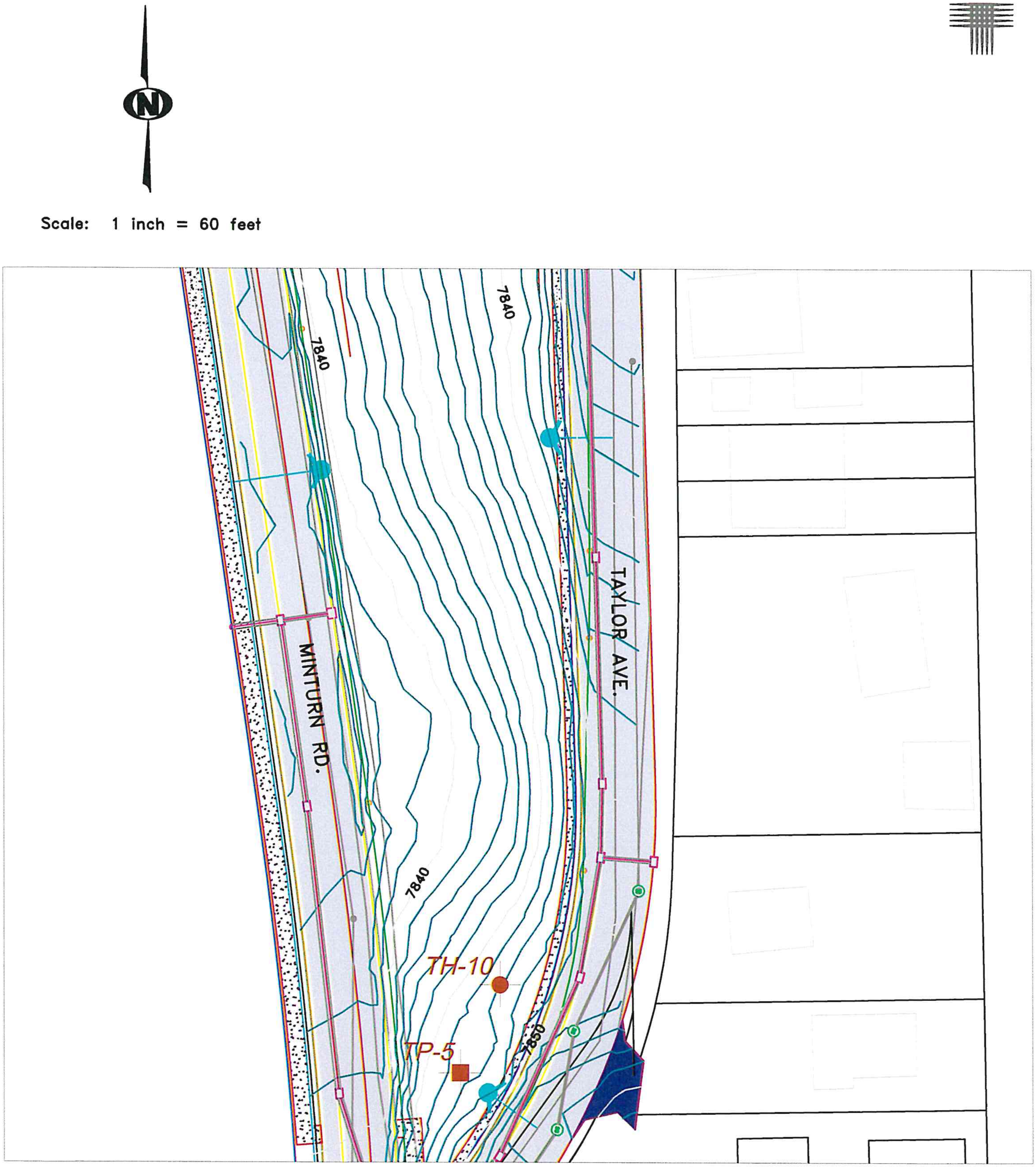
Scale: 1 inch = 60 feet

LOCATIONS OF EXPLORATORY PITS/BORINGS

Project No. SU01922.000-120-R1

Figure 2F

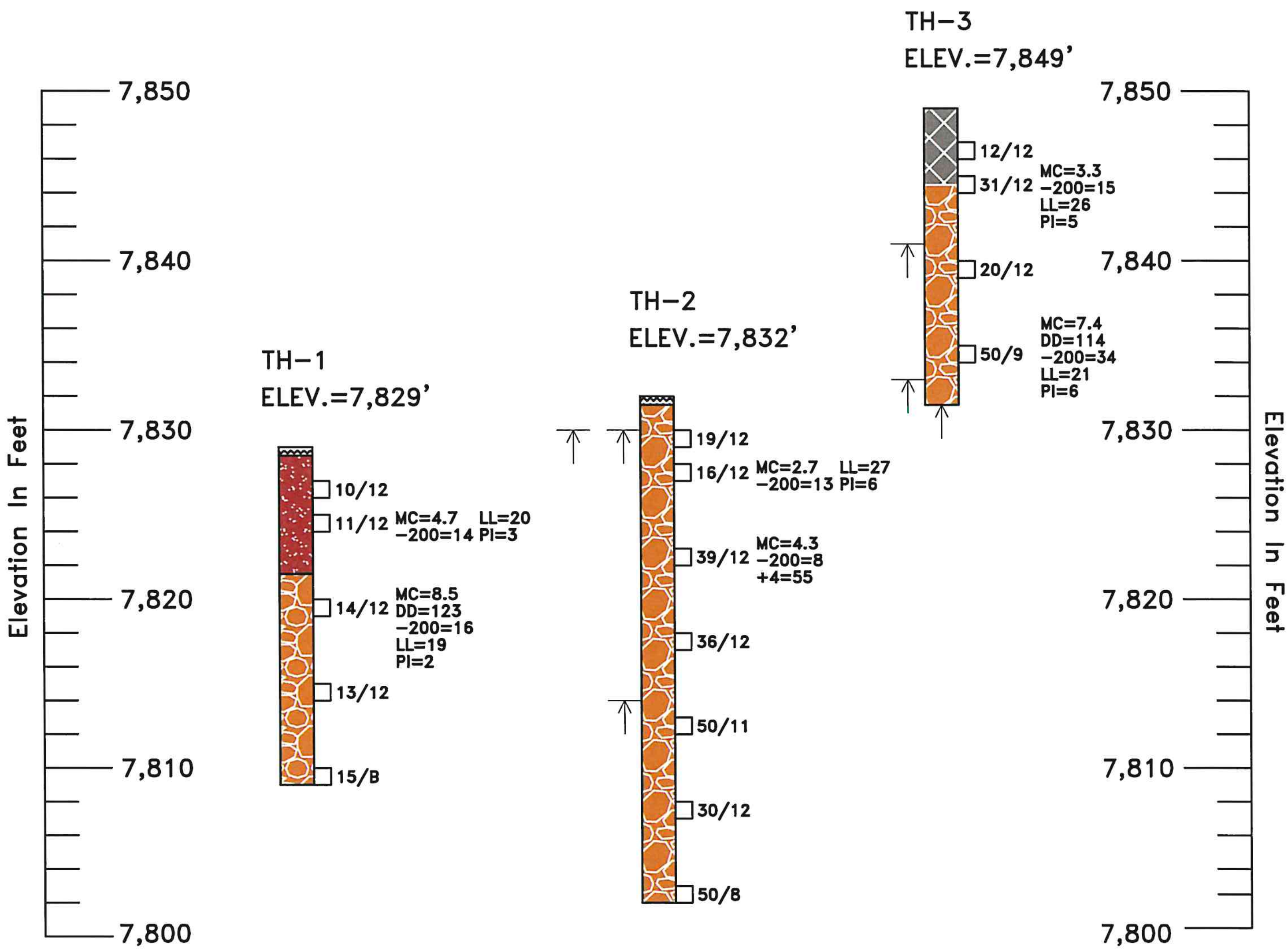
Scale: 1 inch = 60 feet



LOCATIONS OF EXPLORATORY PITS/BORINGS

Project No. SU01922.000-120-R1

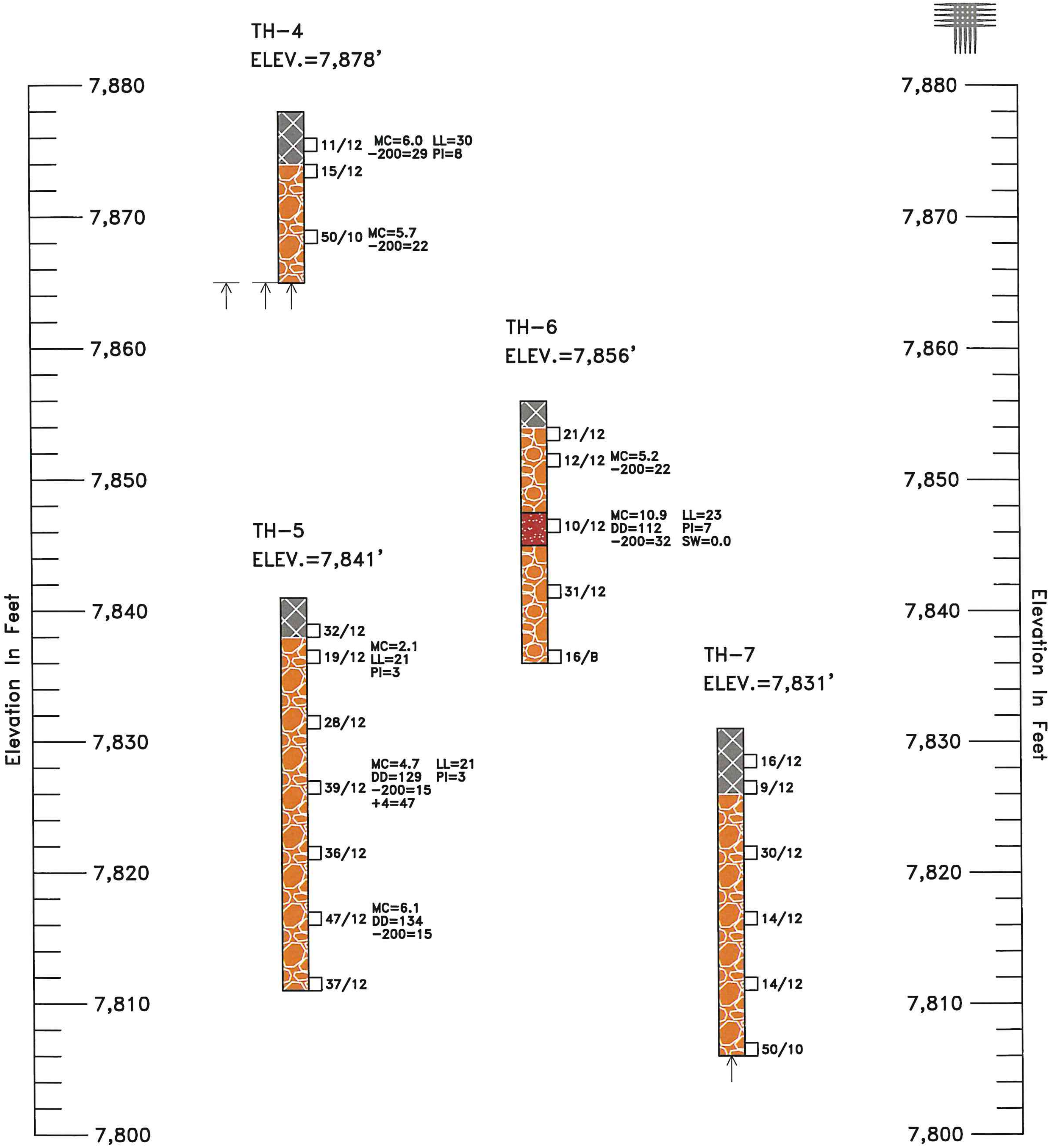
Figure 2G



SUMMARY LOGS OF EXPLORATORY BORINGS

Project No. SU01922.000-120-R1

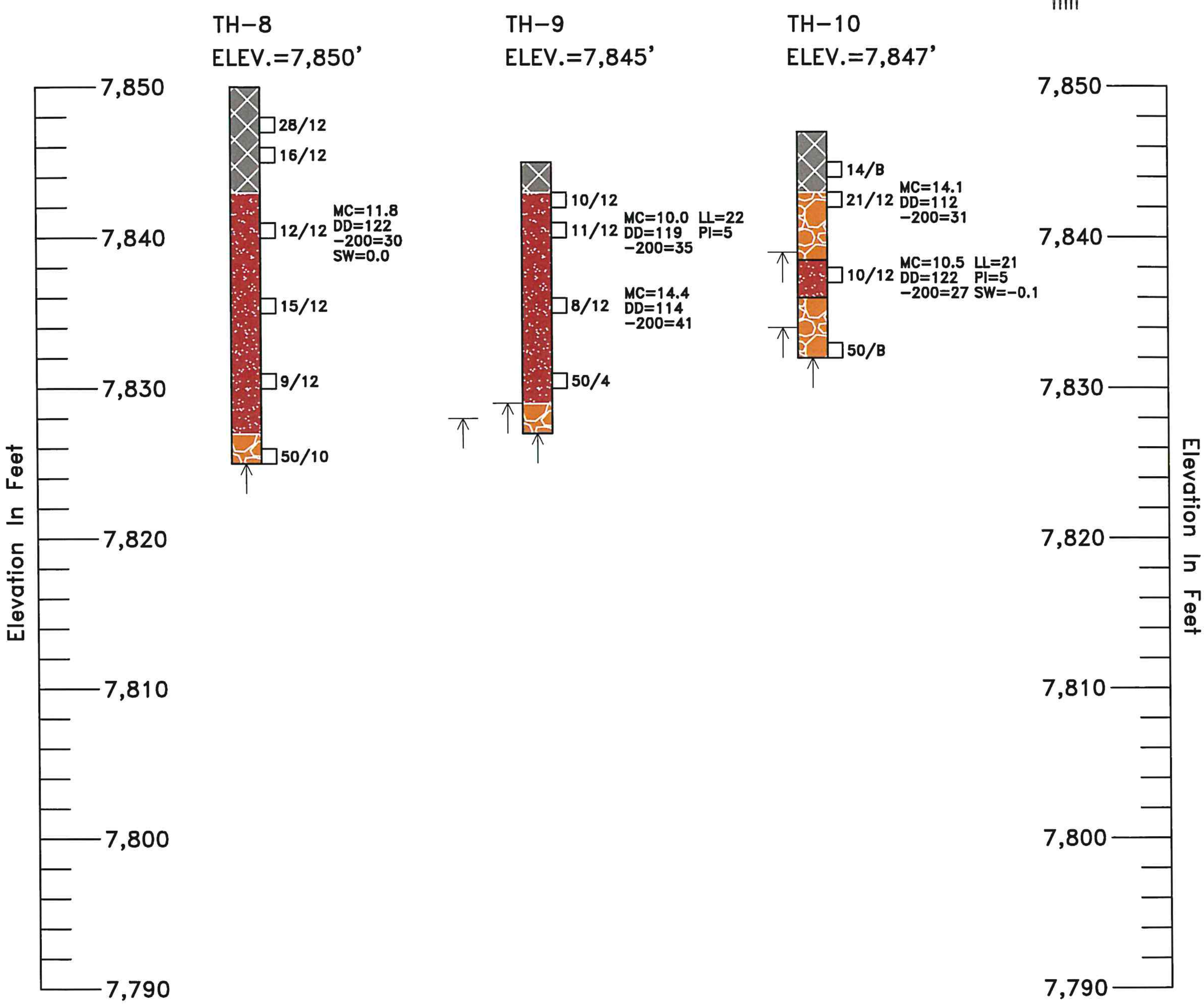
Figure 3



SUMMARY LOGS OF EXPLORATORY BORINGS

Project No. SU01922.000-120-R1

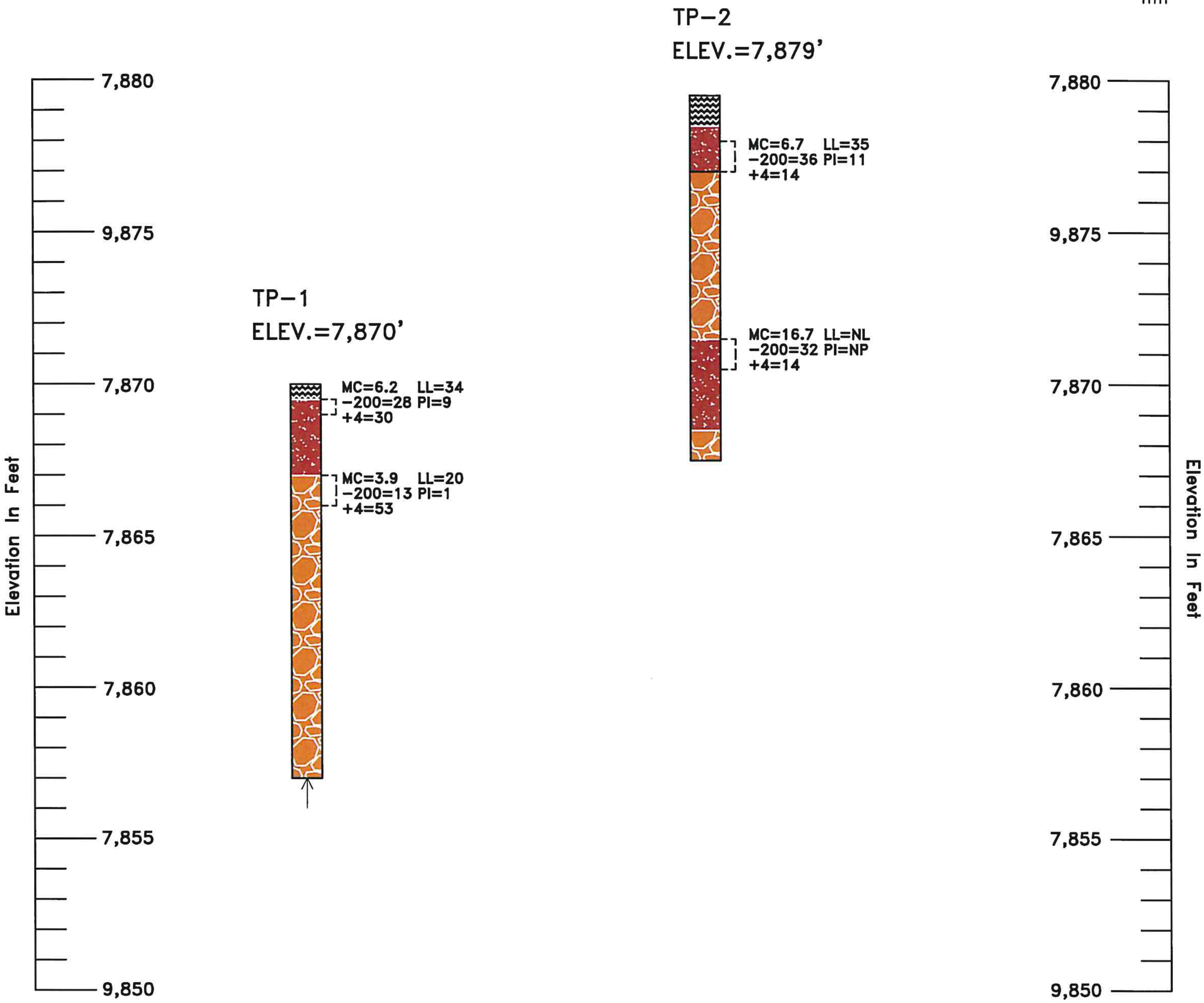
Figure 4



SUMMARY LOGS OF EXPLORATORY BORINGS

Project No. SU01922.000-120-R1

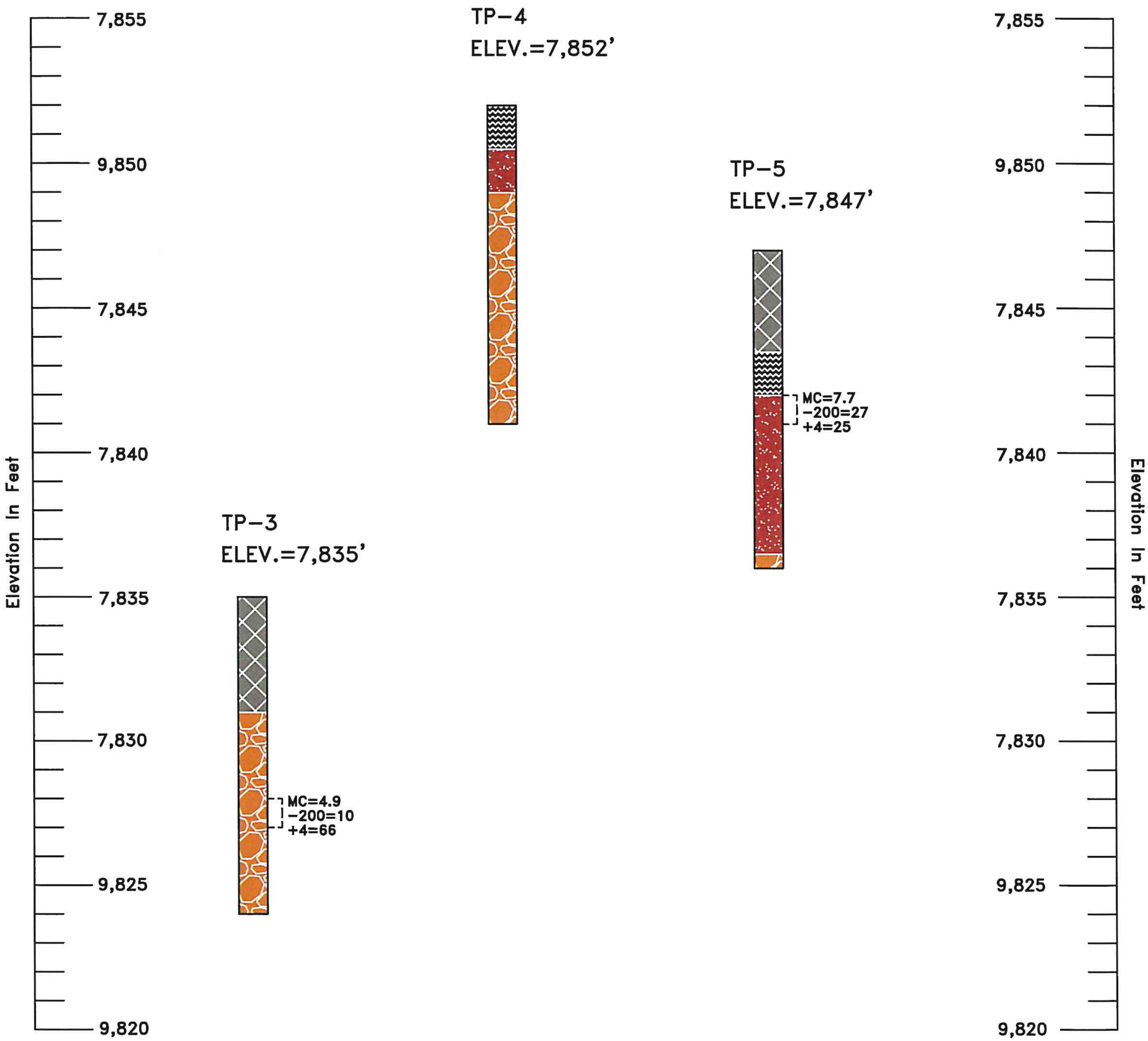
Figure 5



SUMMARY LOGS OF EXPLORATORY PITS

Project No. SU01922.000-120-R1

Figure 6



SUMMARY LOGS OF EXPLORATORY PITS

Figure 7

Project No. SU01922.000-120-R1

LEGEND:

FILL; SAND and GRAVEL; ranges from a silty sand with gravel to a silty gravel with sand, with cobbles and scattered boulders, with organic and inorganic debris. Fill in TP-3 contained building debris such as glass. Medium dense, moist, dark brown-black-gray.

TOPSOIL; silty sand, with roots, slightly moist, dark brown.

SAND; ranges from a silty sand to a silty clayey sand with gravel to a clayey sand, loose to medium dense, slightly moist to moist, red-brown to orange-brown. (SM, SC-SM, SC)

GRAVEL; ranges from a silty gravel with sand to a well-graded gravel with clay and sand to a silty clayey gravel with sand, with subangular cobbles and boulders up to 2 feet in diameter, medium dense to dense, red-brown to orange-brown. (GM, GC-GM, GW-GC)

Drive Sample; The symbol 50/12 indicates 50 blows of a 140-pound hammer falling 30 inches were required to drive a 2-inch I.D. sampler 12 inches. The symbol #/B indicates that a 140-pound hammer falling 30 inches bounced on the material below the drive.

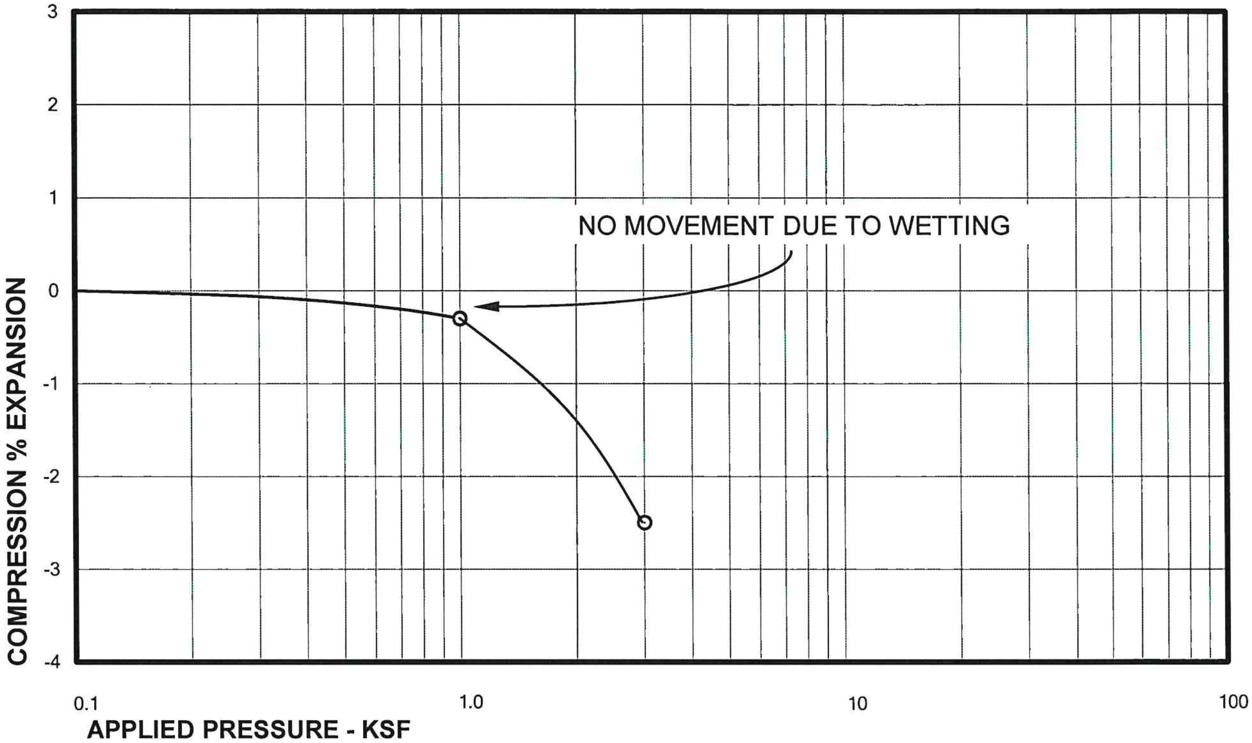
Disturbed bulk sample.

Practical drilling or excavation refusal encountered at depth indicated.

NOTES:

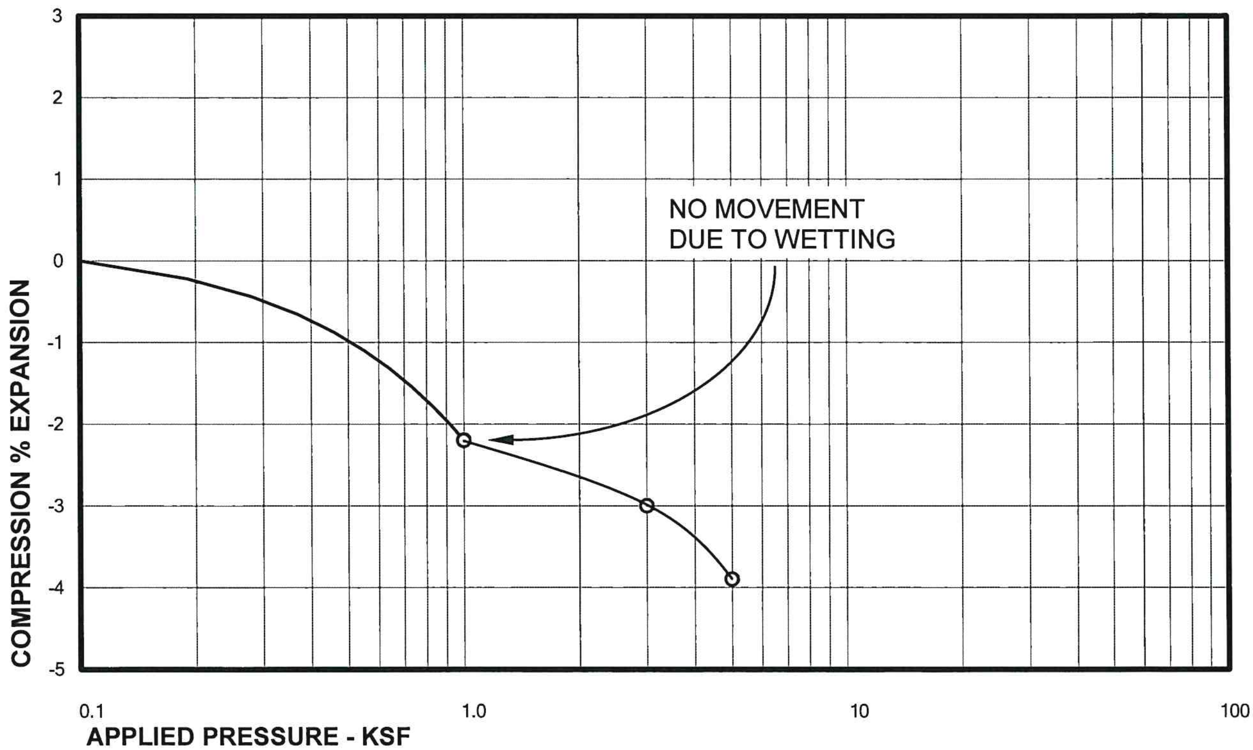
1. The borings were drilled on 07/27/20 and 07/28/20 using 4-inch diameter continuous flight auger and a truck-mounted CME 45 drill rig.
2. The pits were excavated with a track-mounted mini-excavator on 08/04/20. The pits were backfilled after excavation operations were complete.
3. No groundwater was observed in the borings at the time of drilling or when checked several days later. No groundwater was observed in the pits at the time of excavation. Groundwater levels can fluctuate.
4. Boring and pit locations as shown on Figures 2A through 2G were measured from site features and should be considered approximate.
5. Boring and pit elevations are estimated from topography shown on Figures 2A through 2G and should be considered approximate. Relative elevations were checked by hand level.
6. These exploratory borings and test pits are subject to the explanations, limitations and conclusions contained in this report.

LEGEND AND NOTES



Sample of Silty Clayey Sand (SC-SM)
From TH-6 @ 9'

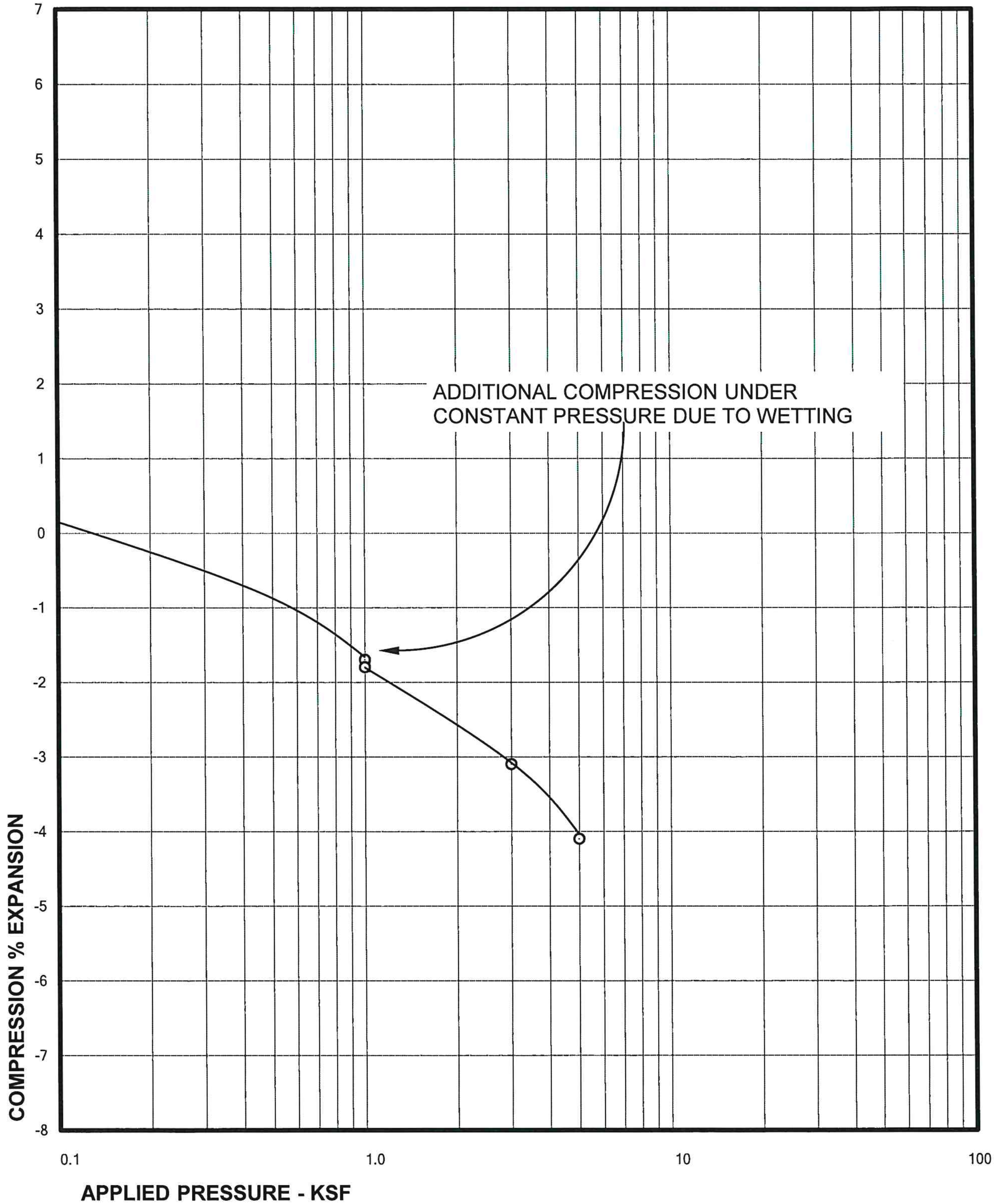
DRY UNIT WEIGHT= 112 PCF
MOISTURE CONTENT= 10.9 %



Sample of Silty Clayey Sand (SC-SM)
From TH-8 @ 9'

DRY UNIT WEIGHT= 122 PCF
MOISTURE CONTENT= 11.8 %

Swell Consolidation Test Results



Sample of Silty Clayey Sand with Gravel (SC-SM)

From TH-10 @ 9'

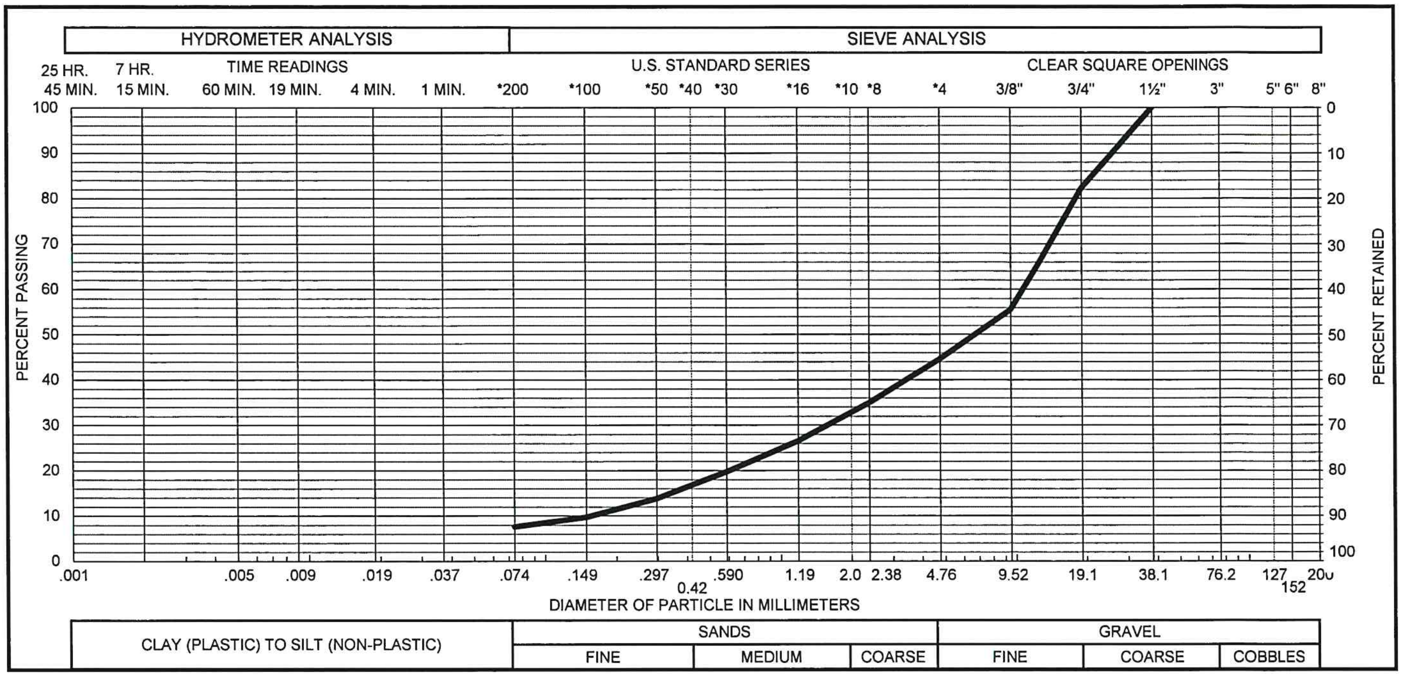
DRY UNIT WEIGHT= 122 PCF

MOISTURE CONTENT= 10.5 %

CTL|T PROJECT NO. SU01922.000-120-R1

Swell Consolidation Test Results

Figure 10



Sieve Size	% Passing
1.5 in.	100
3/4 in.	82
1/2 in.	66
3/8 in.	55
No. 4	45
No. 8	35
No. 16	27
No. 30	20
No. 50	14
No. 100	10
No. 200	8

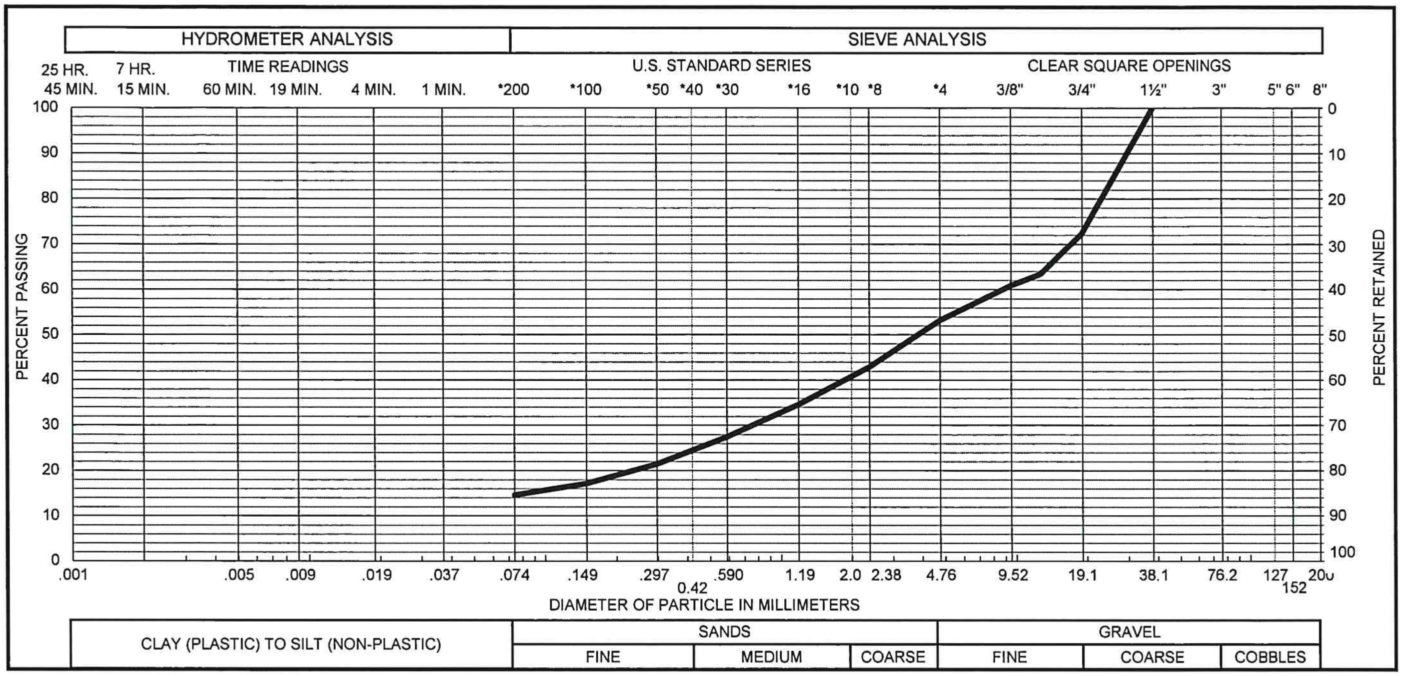
Curve No. 1

Sample of Well-Graded Gravel w/ Clay and Sand (GW-GC)

From TH-2 @ 9'
Minus 2" Fraction

GRAVEL(USCS) 55 %
SAND(USCS) 37 %
SILT & CLAY 8 %
LIQUID LIMIT - %
PLASTICITY INDEX - %

Gradation Test Results



Sieve Size	% Passing
1.5 in.	100
3/4 in.	72
1/2 in.	63
3/8 in.	61
No. 4	53
No. 8	43
No. 16	35
No. 30	27
No. 50	21
No. 100	17
No. 200	15

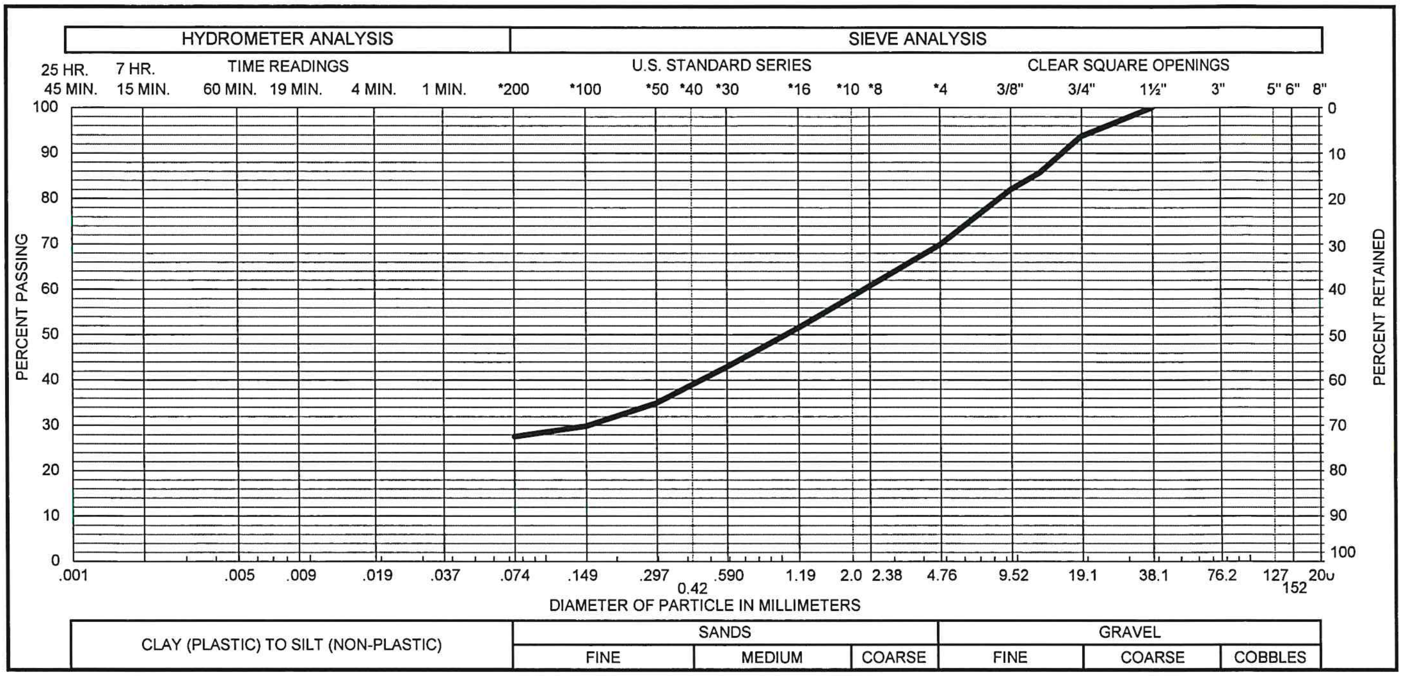
Curve No. 1

Sample of Silty Gravel with Sand (GM)

From TH-5 @ 14'
Minus 2" Fraction

GRAVEL(USCS) 47 % SAND(USCS) 38 %
SILT & CLAY 15 % LIQUID LIMIT 21 %
PLASTICITY INDEX 3 %

Gradation Test Results



Sieve Size	% Passing
1.5 in.	100
3/4 in.	94
1/2 in.	86
3/8 in.	82
No. 4	70
No. 8	61
No. 16	52
No. 30	43
No. 50	35
No. 100	30
No. 200	28

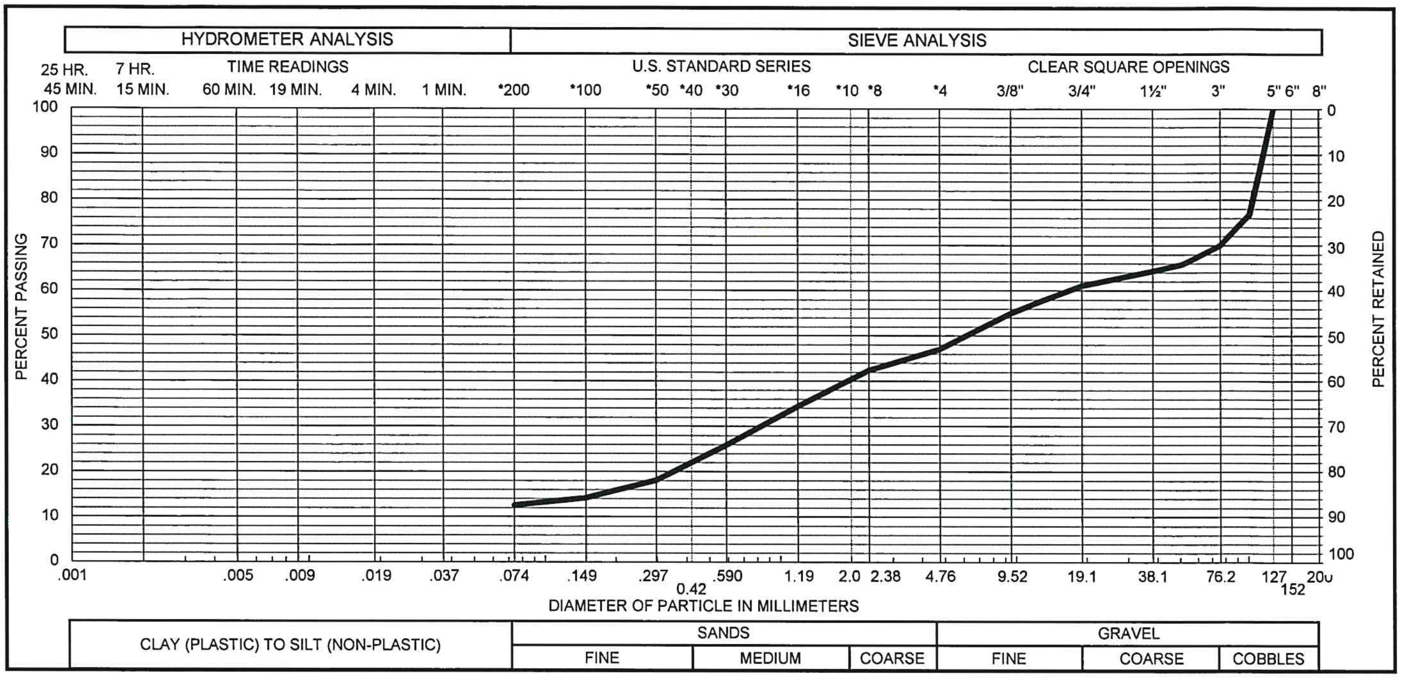
Curve No. 1

Sample of Silty Sand with Gravel (SM)

From TP-1 @ 0.5-1'

GRAVEL(USCS) 30 % SAND(USCS) 42 %
SILT & CLAY 28 % LIQUID LIMIT 34 %
PLASTICITY INDEX 9 %

Gradation Test Results



Sieve Size	% Passing
4 in.	77
3 in.	70
2 in.	66
1.5 in.	64
3/4 in.	61
1/2 in.	58
3/8 in.	55
No. 4	47
No. 8	42
No. 16	34
No. 30	26
No. 50	18
No. 100	14
No. 200	13

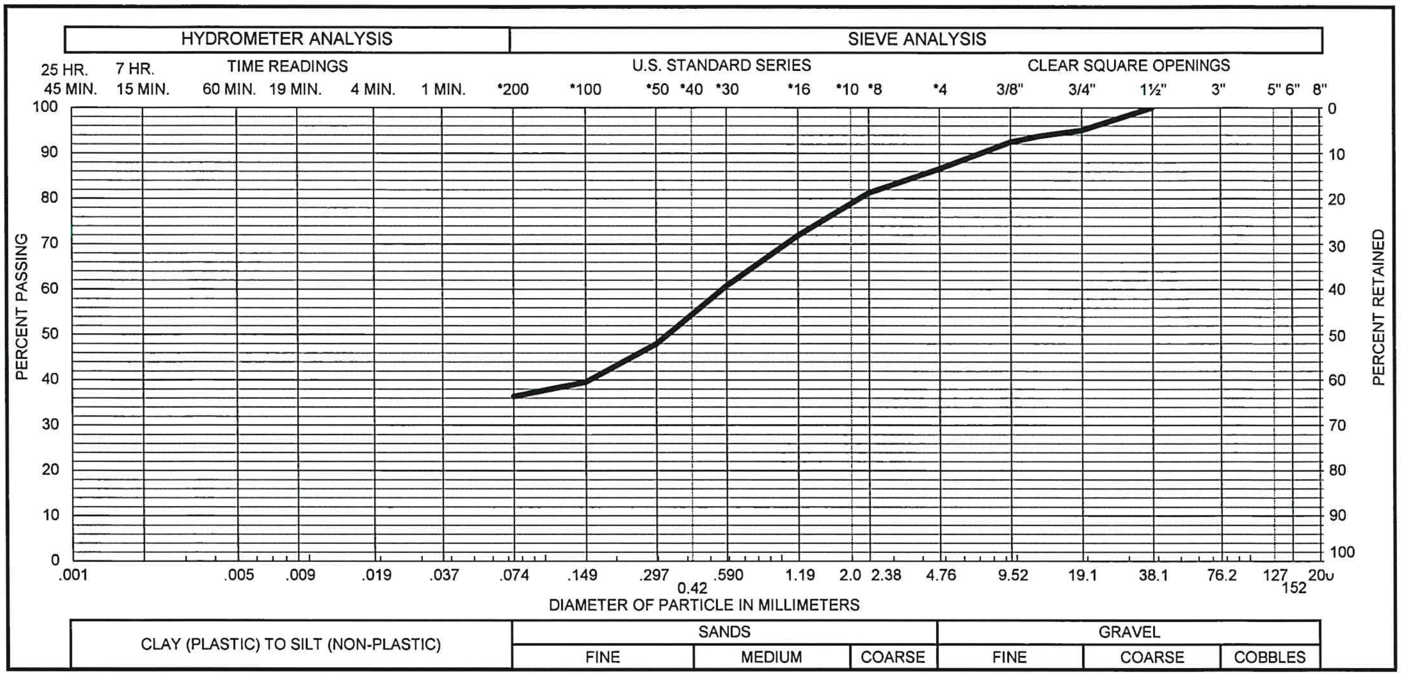
Curve No. 1

Sample of Silty Gravel with Sand (GM)

From TP-1 @ 3-4'

GRAVEL(USCS) 53 % SAND(USCS) 34 %
SILT & CLAY 13 % LIQUID LIMIT 20 %
PLASTICITY INDEX 1 %

Gradation Test Results



Sieve Size	% Passing
1.5 in.	100
3/4 in.	95
1/2 in.	94
3/8 in.	92
No. 4	87
No. 8	81
No. 16	72
No. 30	61
No. 50	48
No. 100	40
No. 200	36

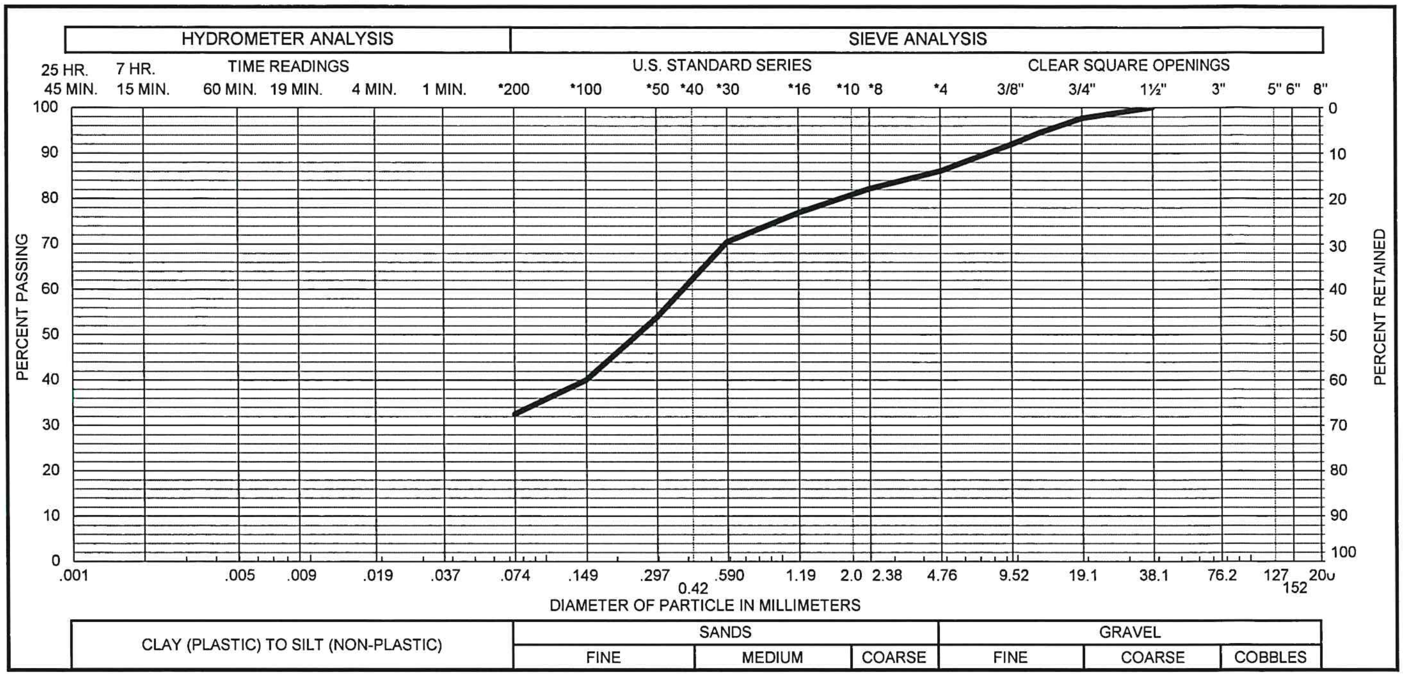
Curve No. 1

Sample of Clayey Sand (SC)

From TP-2 @ 1.5-2'

GRAVEL(USCS) 14 % SAND(USCS) 50 %
SILT & CLAY 36 % LIQUID LIMIT 35 %
PLASTICITY INDEX 11 %

Gradation Test Results



Sieve Size	% Passing
1.5 in.	100
3/4 in.	98
1/2 in.	95
3/8 in.	92
No. 4	86
No. 8	82
No. 16	77
No. 30	70
No. 50	54
No. 100	40
No. 200	32

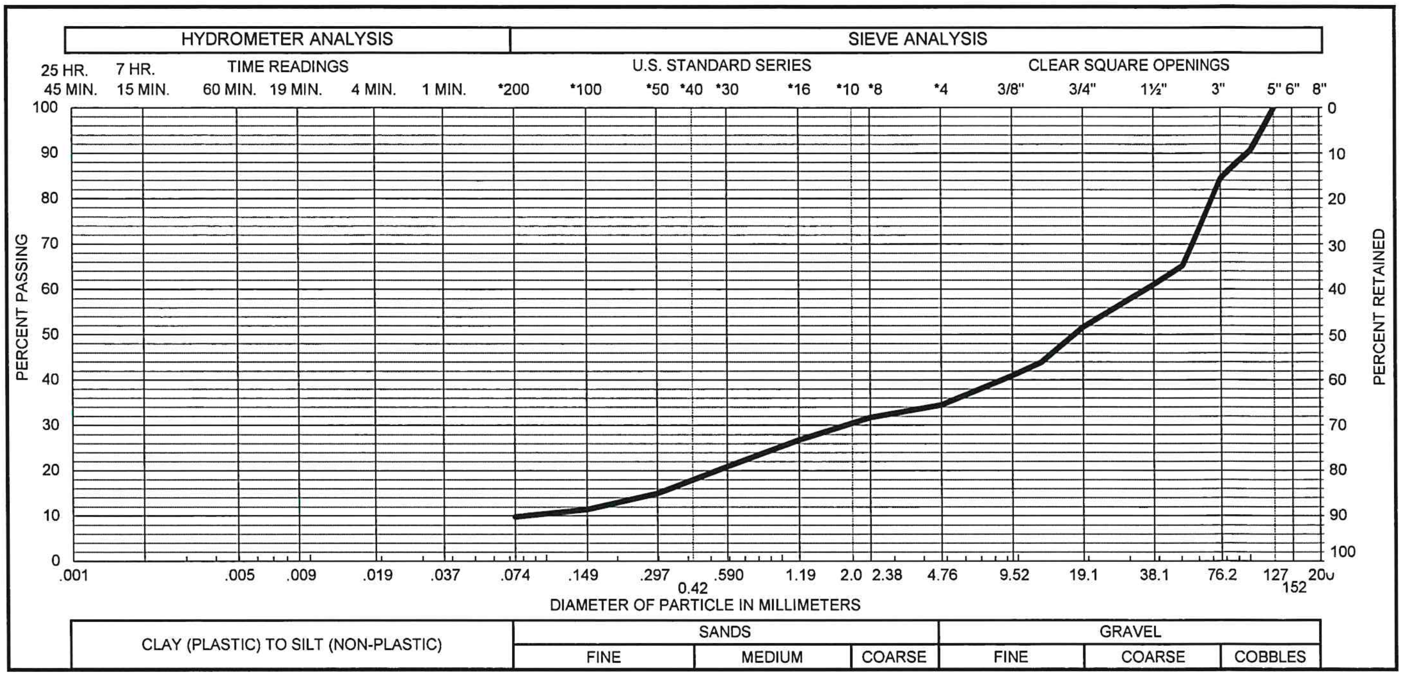
Curve No. 1

Sample of Silty Sand (SM)

From TP-2 @ 8-10'

GRAVEL(USCS) 14 % SAND(USCS) 54 %
SILT & CLAY 32 % LIQUID LIMIT NL %
PLASTICITY INDEX NP %

Gradation Test Results



Sieve Size	% Passing
4 in.	91
3 in.	84
2 in.	65
1.5 in.	61
3/4 in.	52
1/2 in.	44
3/8 in.	41
No. 4	34
No. 8	32
No. 16	27
No. 30	21
No. 50	15
No. 100	11
No. 200	10

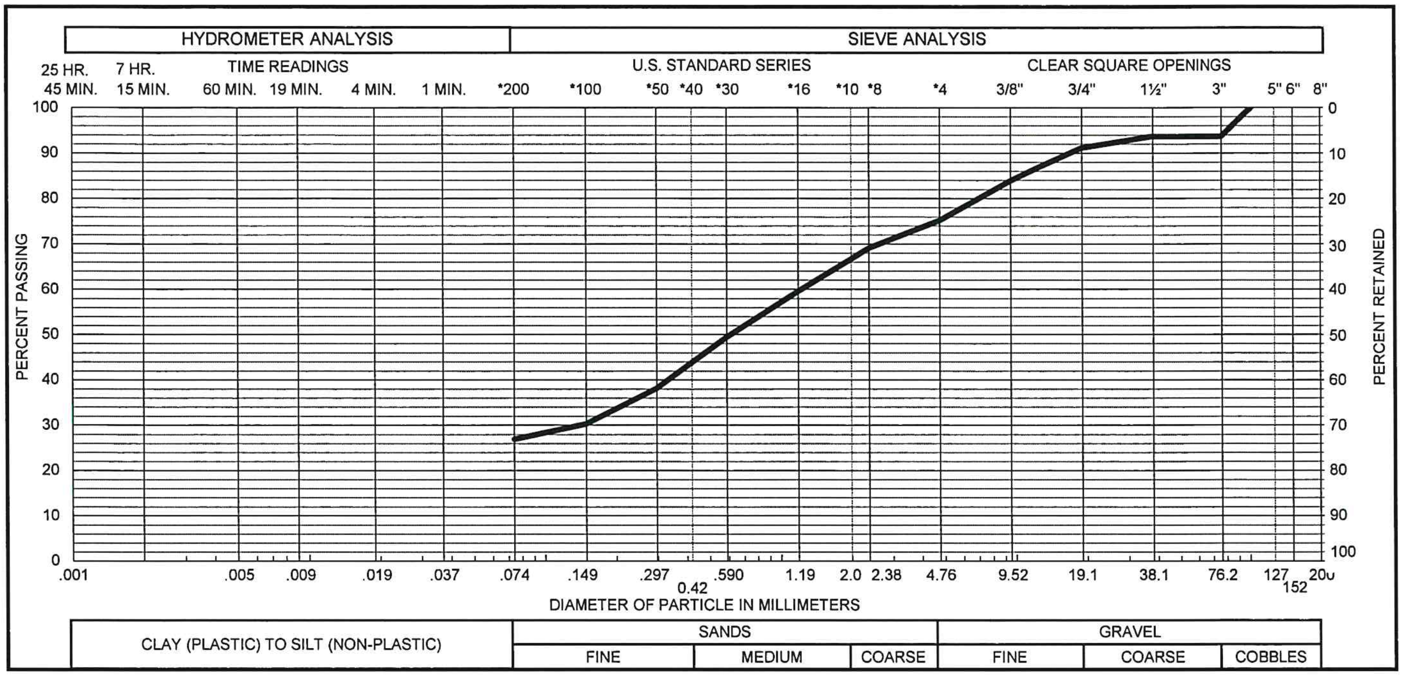
Curve No. 1

Sample of Well-Graded Gravel w/ Clay and Sand (GW-GC)

From TP-3 @ 7-8'

GRAVEL(USCS) 66 % SAND(USCS) 24 %
SILT & CLAY 10 % LIQUID LIMIT - %
PLASTICITY INDEX - %

Gradation Test Results



Sieve Size	% Passing
4 in.	100
3 in.	94
2 in.	94
1.5 in.	94
3/4 in.	91
1/2 in.	87
3/8 in.	84
No. 4	75
No. 8	69
No. 16	60
No. 30	49
No. 50	38
No. 100	30
No. 200	27

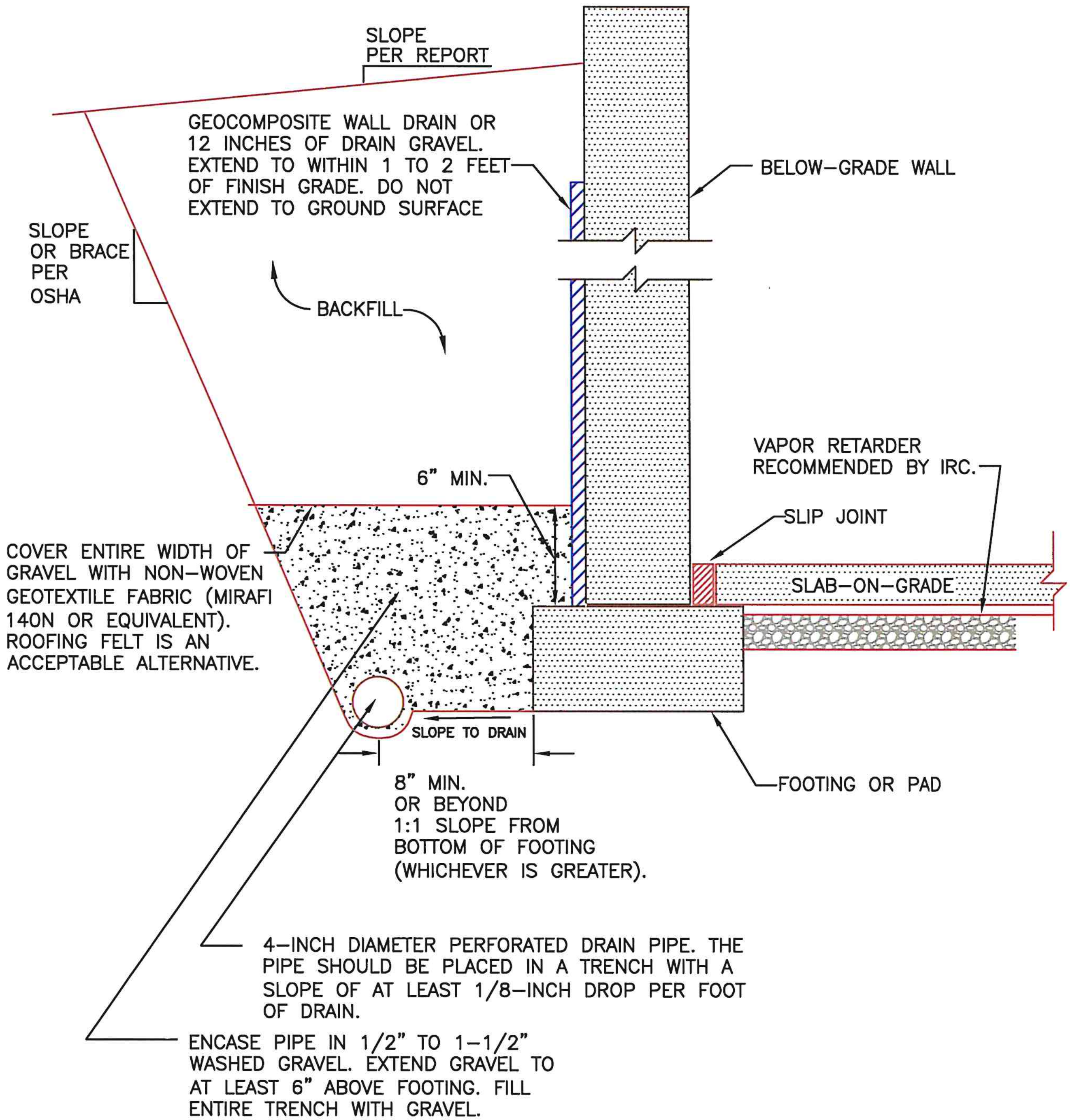
Curve No. 1

Sample of Silty Clayey Sand w/ Gravel (SC-SM)

From TP-5 @ 5-6'

GRAVEL(USCS) 25 % SAND(USCS) 48 %
SILT & CLAY 27 % LIQUID LIMIT - %
PLASTICITY INDEX - %

Gradation Test Results



NOTE:
THE BOTTOM OF THE DRAIN SHOULD BE AT OR BELOW BOTTOM OF FOOTING (AND 12 INCHES BELOW TOP OF ADJACENT SLAB OR CRAWLSPACE GRADE) AT THE HIGHEST POINT AND SLOPE DOWNWARD TO A POSITIVE GRAVITY OUTLET OR TO A SUMP WHERE WATER CAN BE REMOVED BY PUMPING.

EXTERIOR FOUNDATION WALL DRAIN

TABLE I

SUMMARY OF LABORATORY TESTING
CTL|T PROJECT NO. SU01922.000-120-R1

EXPLORATORY PIT	DEPTH (FEET)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTICITY INDEX (%)	SWELL TEST RESULTS* SWELL (%)	SWELL TEST RESULTS* APPLIED PRESSURE (PSF)	SWELL TEST RESULTS* SWELL PRESSURE (PSF)	PERCENT GRAVEL (%)	SULFATE CONC. (%)	PASSING NO. 200 SIEVE (%)	
TH-1	4	4.7		20	3					<0.01	14	Silty Sand w/ Gravel (SM)
TH-1	9	8.5	123	19	2						16	Silty Gravel w/ Sand (GM)
TH-2	4	2.7		27	6						13	Silty Clayey Gravel w/ Sand (GC-GM)
TH-2	9	4.3							55		8	W.-Graded Gvl w/ Clay & Snd (GW-GC)
TH-3	4	3.3		26	5						15	Silty Clayey Gravel w/ Sand (GC-GM)
TH-3	14	7.4	114	21	6						34	Silty Clayey Gravel w/ Sand (GC-GM)
TH-4	2	6.0		30	8						29	FILL: Clayey Sand
TH-4	9	5.7									22	Silty Clayey Gravel w/ Sand (GC-GM)
TH-5	4	2.1		21	3					0.01		Silty Gravel with Sand (GM)
TH-5	14	4.7	129	21	3				47		15	Silty Gravel with Sand (GM)
TH-5	24	6.1	134								15	Silty Gravel with Sand (GM)
TH-6	4	5.2									22	Silty Gravel with Sand (GM)
TH-6	9	10.9	112	23	7	0.0	1000	NA			32	Silty Clayey Sand (SC-SM)
TH-8	9	11.8	122			0.0	1000	NA			30	Silty Clayey Sand (SC-SM)
TH-9	4	10.0	119	22	5						35	Silty Clayey Sand w/ Gravel (SC-SM)
TH-9	9	14.4	114								41	Silty Clayey Sand w/ Gravel (SC-SM)
TH-10	4	14.1	112								31	Silty Clayey Gravel w/ Sand (GC-GM)
TH-10	9	10.5	122	21	5	-0.1	1000	NA			27	Silty Clayey Sand w/ Gravel (SC-SM)
TP-1	0.5-1	6.2		34	9				30		28	Silty Sand with Gravel (SM)
TP-1	3-4	3.9		20	1				53		13	Silty Gravel with Sand (GM)
TP-2	1.5-2	6.7		35	11				14		36	Clayey Sand (SC)
TP-2	8-10	16.7		NL	NP				14		32	Silty Sand (SM)
TP-3	7-8	4.9							66		10	W.-Graded Gvl w/ Clay & Snd (GW-GC)
TP-5	5-6	7.7							25		27	Silty Clayey Sand w/ Gravel (SC-SM)