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GEOLOGIC HAZARD EVALUATION AND PRELIMINARY GEOTECHNICAL INVESTIGATION GRANDVIEW RESERVE, PHASE 3 EASTONVILLE ROAD AND U.S. HIGHWAY 24 FALCON, COLORADO

Prepared For:

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SCOPE

This report presents the results of our Geologic Hazards Evaluation and Preliminary Geotechnical Investigation for Phase 3 of the proposed Grandview Reserve development. The proposed development is located east of Eastonville Road, west of U.S. Highway 24, and north of Stapleton Road in Falcon, Colorado (Fig. 1). We understand you are assessing the land for the construction of single-family residences. The purpose of our investigation was to evaluate the property for the occurrence of geologic hazards and their potential effect on the proposed development, and to evaluate subsurface conditions to assist in planning of residential construction. The report includes descriptions of the subsurface conditions encountered in our exploratory borings, and discussions of construction as influenced by geotechnical considerations. Evaluation of the property for the presence of potentially hazardous materials (Environmental Site Assessment) was not included in our scope.

This report is based on our understanding of the planned construction, subsurface conditions disclosed by exploratory borings/monitoring wells, results of field and laboratory tests, engineering analysis, and our experience. It contains descriptions of the soil and bedrock conditions, and groundwater levels found in our exploratory borings, and preliminary design and construction criteria for foundations, floor systems, and surface and subsurface drainage. The discussions of foundation and floor systems are intended for planning purposes only. Additional site-specific investigations will be necessary as development plans progress to design structures, pavements, and other site improvements. A brief summary of our conclusions and recommendations follows, with more detailed discussion in the report.

SUMMARY OF CONCLUSIONS

1. We did not identify geotechnical or geologic constraints at this site that we believe precludes construction of single-family residences. The primary geotechnical concerns are widespread shallow groundwater and sporadic lenses of expansive claystone bedrock. Claystone is not expected to be widespread, but could occur on any of the lots. Sub-excavation should be expected on some lots. Site specific soils and foundation investigations will determine where sub-excavation is nec-

essary to mitigate expansive claystone. We believe these concerns can be mitigated with proper planning, engineering, design, and construction. The site is judged suitable for development of single-family residences. Lots where groundwater is expected to be within 10 feet of the proposed surface are currently restricted from basement construction. Interceptor drains or other means of lowering groundwater levels may be required.

2. Strata encountered in our exploratory monitoring wells within Phase 3 consisted of 4 to 12 feet of predominantly natural, slightly silty to silty and clayey sand underlain by sandstone and claystone bedrock to the maximum depths explored of 20 feet. Testing and our experience indicate the near-surface soils are generally non-expansive. The underlying bedrock is predominantly non-expansive to low swelling sandstone. Claystone layers are intermittently present within the bedrock and exhibit variable swell potential.

3. Groundwater depths were measured in our monitoring wells between September 2023 and January 2024 at depths between 0.3 and 7.6 feet. The measured groundwater depths at the time of installation and monthly measurements for each of our wells are presented in the report. Fig. 3 presents estimated groundwater elevation contours based on peak measurements, and also presents an estimate of approximate depths from the proposed grades based on preliminary grading plans. Groundwater elevations can be affected by development and will vary with seasonal precipitation and may rise in response to initiation of landscaping irrigation.

4. Temporary dewatering will likely be needed to install deep utilities. Additionally, stabilization may be needed where foundation excavations approach groundwater.

5. The presence of expansive soils and bedrock on the site constitutes a geologic hazard. There is risk that these materials may heave and damage slabs-on-grade and foundations. The occurrence of these materials is highly sporadic and cannot be mapped with any reasonable degree of accuracy. Lot-specific borings will be required to identify expansive materials following site grading. We believe the risk of damage can be mitigated through typical engineering practices employed in the region. Slabs-on-grade, and in some instances, foundations, may be damaged. Where claystone is encountered within excavations, sub-excavation may be appropriate. The site is judged to have a low to moderate risk of damage due to heave cause by expansive claystone. Shallow groundwater is also considered a geologic hazard and is present throughout the site as discussed above.

6. We believe spread footings designed and constructed to apply a minimum deadload will be appropriate if underlain by natural sand, sandstone bedrock, or new, moisture conditioned and densely compacted fill. Depending on final design grades, some areas of the site may be

appropriate for slab-on-grade foundation systems due to shallow groundwater.

7. Pavement subgrade soils will likely consist of predominantly sand or fill of similar composition. These soils are judged to have relatively good pavement support characteristics. Stabilization of subgrade soils along roadway alignments will likely be needed prior to paving where design grades are within 3 feet of groundwater.

8. Control of surface drainage will be critical to the performance of foundations, slabs-on-grade, and pavements. Overall surface drainage should be designed to provide rapid removal of surface runoff away from the proposed residences. Conservative irrigation practices should be followed to avoid excessive wetting. We strongly recommend xeriscape landscaping concepts be considered.

SITE CONDITIONS

Phase 3 of the proposed Grandview Reserve development consists of approximately 76 acres of undeveloped land located east of Eastonville Road, west of U.S. Highway 24, and north of Stapleton Road in the unincorporated community of Falcon, Colorado. The site location and approximate extents, as well as a preliminary development plan are shown in Fig. 1. At the time of our investigation, the ground surface was largely undisturbed. A natural drainage runs along the western edge of Phase 3 in a general northwest to southeast direction. The drainage typically only flows in response to recent precipitation. Site topography is gently rolling with a gentle descent to the southeast. Moderate slopes are present along drainages. Historically the land has been used for agriculture and grazing. Vegetation consists of prairie grasses and weeds.

PROPOSED DEVELOPMENT

Phase 3 of the proposed Grandview Reserve development will consist of townhomes and single-family attached (duplex) residences, as well as community open space, and three detention basins. We understand current plans are for wood-framed structures constructed over a crawl space or on slab-on-grade foundations. Lots where groundwater is expected to be within 10 feet of the proposed surface are restricted from basement construction. Additional groundwater monitoring studies could be performed to better delineate areas appropriate for basement construction. No habitable below-grade levels are planned within any structures in Phase 3.

An extension of Rex Road is planned to the southeast, along the northern edge of Phase 3, towards a future connection to U.S. Highway 24. A network of additional collector and residential streets will provide access to the various residential neighborhoods. Existing drainages are expected to remain or be rerouted into a primary drainage channel planned in the western portion of Phase 3. No underdrains will be constructed within the development.

PREVIOUS INVESTIGATIONS

In January 2019, Entech Engineering, Inc. performed a Preliminary Soil, Geology, Geologic Hazard, and Wastewater Study for the Grandview Reserve site (Entech Job No. 181951). Entech advanced ten borings at the site in late November 2018. We were provided with a copy of the Entech report for review and utilized the subsurface information to supplement the information obtained during our investigations.

In December 2020, CTL|T performed a Preliminary Geotechnical Investigation for a larger 768-acre site that included the subject site. A total of twelve, very widely spaced exploratory borings were advanced at the site for the December 2020 investigation. Geologic Hazard Evaluations and Preliminary Geotechnical Investigations were prepared for Phase 1 of the Grandview Reserve project (CTL|T Project No. CS19345-115-R2, dated May 9, 2022) and for Phase 2 (CTL|T Project No. CS19345-115-R3, final report dated February 27, 2024). Testing performed during our previous investigations indicated the sporadic claystone layers are generally low to moderate swelling. We utilized the information obtained from the previous studies to supplement this study.

INVESTIGATION

Subsurface conditions were investigated for the overall Grandview Reserve site at the time of our December 2020, Preliminary Geotechnical Investigation. Two borings (TH-1 and TH-8) were advanced within the Phase 3 portion of the development. During summer and early fall 2023, we installed monitoring wells to depths of 20 feet within the western portion of the overall Grandview Reserve site. Eight of the monitoring wells (MW-127, MW-128, MW-132, MW-134, MW-135, MW-142, MW-143, and MW-144) are located within Phase 3. The monitoring wells were advanced using solid-stem, continuous-flight auger and a truck-mounted drill rig. The locations were established by the Client's surveyor and are shown in Fig. 1.

Samples were obtained at 5-foot intervals using a 2.5-inch diameter (O.D.) modified California barrel or 2.0-inch diameter (O.D.) split-spoon sampler driven by blows of a 140-pound hammer falling 30 inches. Our representative observed the drilling operations, logged the subsurface conditions found in the borings, obtained samples for laboratory testing, and installed the monitoring wells. Graphical logs of the borings, including the results of field penetration resistance tests, and some laboratory test data are presented in Appendix A. Soil samples obtained during drilling were visually classified, and laboratory testing was assigned to representative samples. Swell-consolidation and gradation test results are presented in Appendix B. Laboratory test data are summarized in Table B-1.

SUBSURFACE CONDITIONS

Strata encountered in our monitoring wells within Phase 3 generally consisted of natural, slightly silty to silty and clayey sand underlain by sandstone and claystone bedrock to the maximum depth explored of 20 feet. Some of the pertinent engineering characteristics of the soil and bedrock are described in the following paragraphs.

Natural Soils

Natural soils were encountered at the surface in each of our monitoring wells advanced within Phase 3 and extended to depths varying from 4 to 12 feet below the existing ground surface. The natural soils consisted of predominantly slightly silty to silty sand and clayey sand. While not encountered during this investigation, localized clay layers were encountered during previous investigations within other phases of the Grandview Reserve site.

Six samples of the sand tested in our laboratory contained 5 to 16 percent silt and clay-sized particles (passing the No. 200 sieve). The slightly silty to silty sand is judged to be non-expansive. The clayey sand is non-expansive to low swelling. Two samples of the sand were subjected to Atterberg limits testing and exhibited Liquid Limits 22 and 29 and Plasticity Indices of 1 and 8.

Bedrock

Bedrock was encountered in each of the monitoring wells underlying the natural soils, at depths between 4 and 12 feet below the ground surface. The predominate sandstone bedrock contained sporadic layers of slightly sandy to very sandy claystone. The bedrock was hard to very hard. Ten samples of the sandstone contained 6 to 43 percent silt and clay-sized particles. The sandstone is judged to be non-expansive to low swelling. One sample exhibited 1.0 percent swell when wetted under estimated overburden pressures. A sample of the sandstone subjected to Atterberg limits testing exhibited a Liquid Limit of 30 and a Plasticity Index of 12.

Slightly sandy to very sandy claystone bedrock was encountered in five of our borings/monitoring wells at varying depths. Two samples of the claystone tested in our laboratory contained 72 and 90 percent silt and clay-sized particles. The claystone is judged to be low to moderate swelling with potential for localized high swelling layers. A sample of the claystone subjected to Atterberg limits testing exhibited a Liquid Limit of 34 and a Plasticity Index of 13.

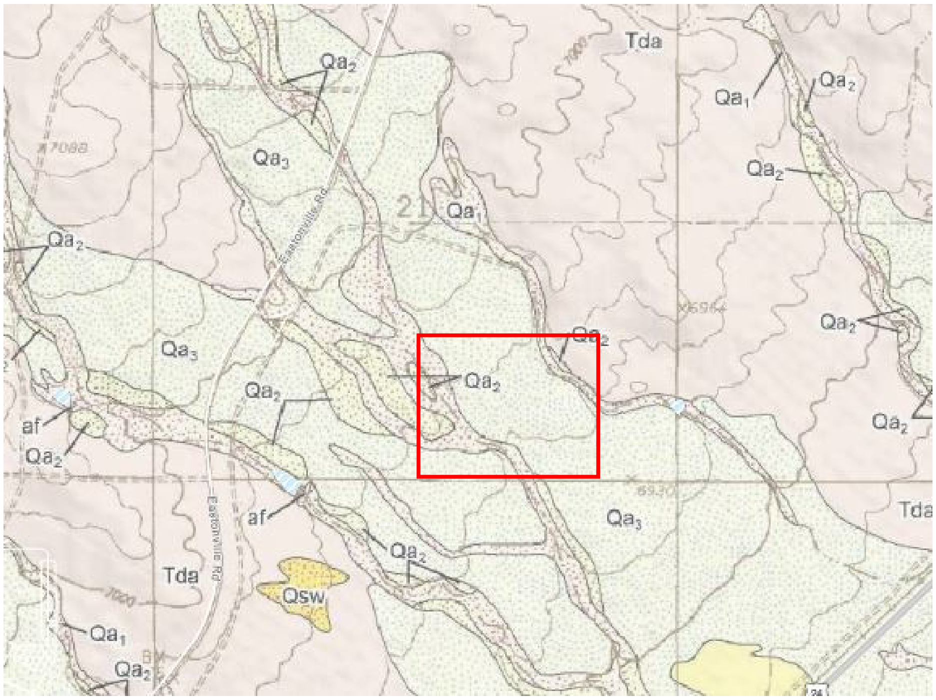
Groundwater

Groundwater was measured at the time of drilling in seven of our monitoring wells. Groundwater was measured monthly in our monitoring wells between September 2023 and January 2024. Peak groundwater levels vary from less than 0.5 feet to 7.5 feet below the surface. Groundwater levels are generally shallower approaching the drainage that extends through the western portion of Phase 3. Groundwater should be expected to fluctuate seasonally and rise in response to development, precipitation, and landscape irrigation. Shallow groundwater is discussed in more detail in the GEOLOGIC HAZARDS section.

SITE GEOLOGY

The surficial geology at the site was evaluated by reviewing published geologic maps and our own site reconnaissance. The site lies within the area of the Falcon Quadrangle Geologic map published by the Colorado Geological Survey (2003).

The predominant geologic unit at the site is Quaternary-age Alluvium (Qa_1, Qa_2, and Qa_3). The alluvium consists of poorly to well sorted, poorly to moderately consolidated, silt, sand, gravel, and minor clay along active stream channels and terraces. The Dawson Formation bedrock (Tda) is mapped underlying the site at depth. The Dawson Formation consists of white to tan, thick to massive, cross-bedded arkoses, pebbly arkoses, and arkosic pebble conglomerates. The Dawson Formation in the site area is predominantly sandstone with sparse interbeds of thin-bedded gray claystone and sandy claystone. The bedrock underlies the surficial alluvium throughout the site. Conditions at the site were found to be similar to the mapped conditions.



Excerpt from Falcon Quadrangle Geologic Map, El Paso County, Colorado, 2012. General Site Area is Depicted in Red

GEOLOGIC HAZARDS

Geologic hazards were evaluated through review of geologic maps, exploratory borings/monitoring wells, site reconnaissance, and local experience. Primary geologic hazards include shallow groundwater, expansive soil and bedrock, and regional issues of erosion, seismicity, and radioactivity. **The most significant hazard identified at this site is shallow groundwater.** No geologic hazards were identified that we believe preclude the proposed development. We believe potential impact of these hazards can be mitigated with proper engineering, design, and construction practices, as discussed in this report. Figure 2 shows our interpretation of the engineering geology modified from the system used by Charles Robinson & Associates (1977).

<u>Shallow Groundwater</u>

Shallow groundwater is present throughout the site. Historically high precipitation was recorded within the site vicinity throughout 2023, and our groundwater measurements reflect that. We installed eight groundwater monitoring wells within Phase 3 between September 22 and 26, 2023. Groundwater was subsequently measured at the time of in our monitoring wells at the time of installation, and on October 10, November 10, December 15, 2023, and January 17, 2024. The depths to groundwater at each of the monitoring wells within Phase 3 are indicated in the table below.

Monitoring Well	Depth to Groundwater at time of installation (ft)	Depth to Groundwater October 10, 2023 (ft)	Depth to Groundwater November 10, 2023 (ft)	Depth to Groundwater December 15, 2023 (ft)	Depth to Groundwater January 17, 2024 (ft)
MW-127	2.0	2.7	0.4	Frozen	Frozen
MW-128	8.5	2.5	2.4	2	1.9
MW-132	9.0	5.6	6.2	6.5	6.4
MW-134	9.0	6.2	6.3	6.5	6.4
MW-135	3.5	2.6	0.9	Frozen	Frozen
MW-142	NATD	14.1	8.9	7.6	7.5
MW-143	19.5	4.5	4.5	4.7	4.9
MW-144	18.5	7.0	7.4	7.5	7.5
Monitoring Well	**Depth to Groundwater April 2, 2024 (ft)**	**Depth to Groundwater May 30, 2024 (ft)**	**Depth to Groundwater August 10, 2024 (ft)**	**Depth to Groundwater October 3, 2024 (ft)**	
MW-127	Frozen	0.2	0.1	0.2	
MW-128	1.3	2.3	3.2	3.1	
MW-132	6.5	6.0	7.1	7.3	
MW-134	6.5	6.5	6.5	6.5	
MW-135	0.2	0.2	0.6	0.7	
MW-142	7.5	7.4	7.5	7.4	
MW-143	*	*	*	*	
MW-144	7.4	6.9	8.2	7.8	

NATD = No Groundwater at Time of Drilling.

*LRE Water is using this monitoring well and measurements are not possible

Based on our experience, site development, including overlot grading and utility installation, will alter groundwater levels. Groundwater levels will fluctuate in response to variations in annual precipitation and initiation of landscape irrigation throughout the development. The depth to peak groundwater levels (defined as shallowest measured groundwater depth during our studies) is indicated on Fig. 2. Peak groundwater elevation contours and estimated depth to groundwater from the proposed ground surface are shown on Fig. 3.

Foundation drains should be anticipated around all below-grade areas and should connect to a sump pit and a pump should be installed. Typical foundation drains are capable of dealing with minor surface water infiltration but are not designed as a dewatering system for groundwater. We understand subsurface drainage concepts are being studied by a hydrogeology consultant to potentially lower groundwater levels throughout the site. We are available to coordinate with your hydrogeology consultant as needed.

Hard Bedrock

The sandstone and claystone of the Dawson Formation are hard to very hard and present at shallow depths within the site. The hard to very hard bedrock will be difficult to excavate and will require heavy duty excavation equipment. Deep excavations into bedrock will require aggressive excavation techniques. The rate of excavation will be slow within the bedrock.

Expansive Soils and Bedrock

Colorado is a challenging location to practice geotechnical engineering. The climate is relatively dry, and the near-surface soils are typically dry and comparatively stiff. These soils and related sedimentary bedrock formations react to changes in moisture conditions. Some of the soils swell as they increase in moisture and are referred to as expansive soils. Other soils can compress significantly upon wetting and/or additional loading (from foundations or site grading fill) and are identified as compressible or collapsible soils. Much of the land available for development east of the Front Range is underlain by expansive clay or claystone bedrock near the surface. The soils that exhibit compressible behavior are more likely west of the Continental Divide; however, both types of soils occur throughout the state.

Covering the ground with structures, streets, driveways, patios, etc., coupled with lawn irrigation and changing drainage patterns, leads to an increase in subsurface moisture conditions. As a result, some soil movement due to heave or settlement is inevitable. Expansive bedrock is present at this site, which constitutes a geologic hazard. There is risk that foundations and slab-on-grade floors will experience heave or settlement and damage. It is critical that precautions are taken to increase the chances that the foundations and slabs-on-grade will perform satisfactorily. It is noted that the presence of expansive materials within the Dawson Formation are highly variable, and it isn't possible to map the existence of these materials with any reasonable degree of accuracy. The presence of expansive materials will need to be further evaluated at the time of lot-specific soils and foundation investigations. Engineered planning, design and construction of grading, pavements, foundations, slabs-on-grade, and drainage can mitigate, but not eliminate, the effects of expansive and compressible soils. Sub-excavation is a ground improvement method that can be used to reduce the impacts of swelling soils.

Flooding

The majority of the site lies within Zone D (undetermined flood hazard), as shown on FIRM Community Map Number 08041C0556G, revised December 7, 2018. Zone D indicates floods are possible, but not likely. Some portions of the site within drainage areas lie within Zone A, as shown below.

Excerpt from FEMA National Flood Hazard Layer Viewer, General Site Area is Depicted in Red

Based on the topography at the site, the potential for a flood to impact the majority of the site area is low. During peak precipitation events, some accumulation of surface sheet flow in drainages is expected with possible inundation within the Zone A areas that are identified in the bluish-green color shown above. Development will increase the relative area of impervious surfaces, which can lead to drainage problems and erosion if surface water flow is not adequately designed. Surface drainage design and evaluation of flood potential should be performed by a civil engineer as part of the project design.

Seismicity

According to the USGS, Colorado's Front Range and eastern plains are considered low seismic hazard zones. The earthquake hazard exhibits higher risk in western Colorado compared to other parts of the state. The Denver Metropolitan area has experienced earthquakes within the past 100 years, shown to be related to deep drilling, liquid injection, and oil/gas extraction. Naturally occurring earthquakes along faults due to tectonic shifts are rare in this area.

The soil and bedrock at this site are not expected to respond unusually to seismic activity. The 2021 International Building Code (Section 1613.2.2) defers the estimation of Seismic Site Classification to ASCE 7-16, as outlined in the table below.

ASCE 7-16 SITE CLASSIFICATION CRITERIA

Seismic Site Class	$\bar{s}_u$, Average Un-drained Shear Strength (lb/ft^2)	$\bar{N}$, Average Standard Penetration Re-sistance (blows/ft)	$\bar{v}_s$, Average Shear Wave Velocity (ft/s)
A. Hard Rock	N/A	N/A	>5,000
B. Rock	N/A	N/A	2,500 to 5,000
C. Very Dense Soil and Soft Rock	>2,000	>50 blows/ft	1,200 to 2,500
D. Stiff Soil	1,000 to 2,000	15 to 50 blows/ft	600 to 1,200
E. Very Loose Sand or Soft Clay Soil	<1,000	<15 blows/ft	<600
F. Soils requiring Site Response Analysis	See Section 20.3.1	See Section 20.3.1	See Section 20.3.1

Based on the results of our investigation, we judge a Seismic Site Classification of C. The subsurface conditions indicate low susceptibility to liquefaction from a materials perspective.

Erosion

The site is susceptible to the effects of wind and water erosion. Water flowing across the site in an uncontrolled manner will likely result in considerable erosion, particularly where the water flow is concentrated. The surficial sandy soils are relatively stable and resistant to wind erosion where vegetation is established. Disturbance of the vegetative cover and long-term exposure of these deposits to the erosive power of wind and water increases the potential for erosion. Maintaining vegetative cover and utilizing surface drainage collection and distribution systems will reduce the potential for erosion from wind and water.

Radon/Radioactivity

We believe no unusual hazard exists from naturally occurring sources of radioactivity on the site. However, the materials found in this area are often associated with the production of radon gas, and concentrations in excess of those currently accepted by the EPA can occur. Passive and active mitigation procedures are commonly employed in this region to effectively reduce the buildup of radon gas. Measures that can be taken after a structure is enclosed during construction include installing a blower connected to the foundation drain and sealing the joints and cracks in concrete floors and foundation walls. If the occurrence of radon is a concern, we recommend structures be tested after they are enclosed. The EPA provides guidance on construction of radon resistant structures.

Recoverable Minerals

The project site is included in the Aggregate Resources of Colorado mapping from the Colorado Geological Survey. The mapping does not indicate any commercial sand or gravel pits near the project site. We observed no evidence of surface or subsurface mining at the site.

ESTIMATED POTENTIAL HEAVE

Based on subsurface profiles, swell-consolidation test results, and our experience, we estimated potential heave at the existing ground surface for each test hole. The analysis involves dividing the soil profile into layers and modeling the heave of each layer from laboratory testing. We estimate potential ground heave will generally be less than about 1-inch. Thicker and more expansive layers of soils and bedrock may be present. A depth of wetting of 24 feet below existing grades was considered for the analysis. This depth of wetting is typically used for irrigated residential sites. Variations from our estimates should be anticipated. It is not certain whether the estimated heave will occur.

We judge there is a relatively low risk of problems due to expansive soils and bedrock for much of the site; however, it should be understood that our monitoring wells were very widely spaced. As such, sporadic areas of expansive claystone may be present throughout the site. Additional lot specific studies shall be performed after grading to further evaluate the presence of expansive soils and to determine where sub-excavation of expansive soils is needed.

Sub-Excavation

Our investigation indicates soils and bedrock with nil to moderate expansion potential are present locally at shallow depths likely to influence the performance of shallow foundations and slabs-on-grade. We estimated total potential ground heave could be up to about 1 inch. Our experience suggests performance of structures constructed on claystone bedrock materials can be erratic. Where present near foundation levels, sub-excavation of 4 feet in thickness may be appropriate. Localized areas of deeper sub-excavation may be necessary. This condition is not expected to be widespread, and the need for sub-excavation and appropriate methods should be evaluated at the time of the lot specific soils and foundation investigation.

SITE DEVELOPMENT

Appropriate planning, design and construction will be necessary to address the aforementioned hazards. Lots where groundwater is expected to be within 10 feet of proposed grades are currently restricted from basement construction. Adjustment of site grades and use of non-basement residences should mitigate concerns of shallow groundwater for crawl space and slab-on-grade construction. Additional groundwater monitoring studies and lot specific borings following site grading may aid in delineating areas where basement construction is appropriate. The following sections discuss site development recommendations considering the current development plan.

Dewatering

Groundwater will likely be encountered in utility excavations. Temporary construction dewatering systems will likely be needed to install deep utilities in areas of shallow groundwater. Sump-and-pump dewatering methods are not expected to be effective where excavations penetrate greater than 3 feet below the groundwater surface. Deeper excavations may require well points to draw groundwater down and reduce the potential for internal erosion of temporary excavations and trenches. Installation of drain systems, as recommended by a hydrogeologist, may be appropriate prior to site development to reduce the impact of shallow groundwater on earthwork and further mitigate shallow groundwater from a post-construction standpoint. Discharge locations and volumes need to be considered. Disposal of groundwater should be performed in accordance with guidelines set forth by local agencies.

Stabilization

Soft/loose, wet soils in foundation and utility excavations or along roadway alignments should be removed or stabilized. Excavations of unstable soils should be filled with moisture conditioned, densely compacted fill. Soft excavation bottoms can likely be stabilized by crowding crushed rock into the soils, until firm. The volume of rock needed will vary based on moisture content, soil type, and depth to groundwater. Placement of rock should continue until the area exhibits a relatively non-yielding condition. Crushed rock on a layer of geosynthetic grid or woven fabric can also be used, which should reduce the amount of aggregate needed to stabilize the subgrade. Typically, a biaxially woven fabric such as Mirafi 600x (or equal) or geogrid (such as Tensar BX1100 or equal) topped with 12 inches of well-graded, crushed rock will provide a stable working surface. Actual recommendations for stabilization should be provided at the time of construction based on the observed conditions. If separation from groundwater can be increased, stabilization may not be required.

Site Grading

The site naturally slopes downward toward the southeast. Site grading will be necessary to construct roads, drainage structures, and building pads. We believe site grading can be accomplished using conventional heavy-duty earthmoving equipment. Where cuts extend into hard to very hard bedrock, more aggressive excavation techniques such as single-shank rippers, rock buckets, etc. should be expected. The rate of excavation may be slow where deep cuts extend into very hard bedrock.

Vegetation and organic materials should be removed from the ground surface of areas to be filled. Soft or loose soils, if encountered, should be stabilized or removed to expose stable material prior to placement of fill.

The onsite materials are generally suitable for use as grading fill and excavation backfill, provided they are free of debris, vegetation/organics, and other deleterious materials. If imported fill is necessary, it should ideally consist of granular material with 100 percent passing the 2-inch sieve and less than 35 percent material passing the No. 200 sieve. Potential fill materials should be submitted to our office for approval prior to importing to the site.

The ground surface in areas to receive fill should be scarified deeply, moisture conditioned and compacted to a high density to establish a stable subgrade for fill placement. Scarification may terminate where hard bedrock is encountered. The properties of the fill will affect the performance of foundations, slabs-on-grade, and pavements. Detailed recommendations for moisture conditioning, placement, and compaction of grading fill are set forth in Appendix C. Placement and compaction of the grading fill should be periodically observed and tested by our representative during construction.

We recommend grading plans consider long-term cut and fill slopes no steeper than 3:1 (horizontal to vertical). This ratio considers that no seepage of groundwater occurs. If groundwater seepage does occur, a drain system and flatter slopes may be appropriate. Flatter slopes should be considered to reduce erosion of the sand soils and fill. Slopes should be revegetated as soon as possible to control erosion by wind and water. Concentrated water flows over slopes should be avoided.

Buried Utilities

Based on the subsurface conditions encountered in our monitoring wells, we anticipate most of the materials encountered during utility trench excavation will consist of silty sands, clayey sands, and sandstone and claystone bedrock. Utility trench excavation can likely be accomplished using heavy-duty track hoes.

Excavations for utilities should be braced or sloped to maintain stability and should meet applicable local, state, and federal safety regulations. The contractor should identify the soils and bedrock encountered in trench excavations and refer to Occupational Safety and Health Administration (OSHA) standards to determine appropriate slopes. We anticipate the near-surface sand soils will classify as Type C. Temporary excavations in Type C materials require a maximum slope inclination of 1.5:1 (horizontal to vertical) in the absence of groundwater, unless the excavation is shored or braced. Where groundwater is present flatter slopes in the alluvial materials will likely be required. Where excavations extend into sound bedrock, we believe these materials will classify as Type A requiring maximum slope inclinations of 0.75:1. Excavations deeper than 20 feet should be designed by a professional engineer.

Where deep utilities are planned, excavations may extend into groundwater and construction dewatering may be necessary. Relatively clean, granular soils will likely flow into excavations below the groundwater surface. Dewatering using local sump pits and pumps could be effective depending on the amount of water flowing through the sands.

Water and sewer lines are usually constructed beneath paved areas. Compaction of trench backfill will have a significant effect on the life and serviceability of pavements. We recommend trench backfill be moisture conditioned and compacted in accordance with the recommendations set forth in Appendix C. Personnel from our firm should periodically observe and test the placement and compaction of the trench backfill during construction.

Detention Ponds

We understand two detention ponds are planned in Phase 3. Based on the grading plans, the basins will include a combination of cuts and fills on the order of 5 feet or less. Side slopes of the detention basins will be 4:1 (horizontal: vertical). Outlet pipes are proposed at each of the detention basins.

Groundwater may be encountered during site grading of the detention basin in the far southwestern portion of the site. If groundwater is present within 2 feet of the pond bottom at the time of construction, we recommend installation of a clay liner or geosynthetic liner to prevent groundwater from entering the basin and being lost to evaporation. Groundwater may cause a geosynthetic liner to float. Provisions to prevent synthetic lines from floating could include anchoring the liner bottom into the ground, placement of a layer of fill over the liner, or alternative methods proposed by the liner installer.

Prior to fill placement for embankment construction, the existing ground surface should be scarified, moisture conditioned, and recompacted according to the recommendations set forth in SITE DEVELOPMENT. Fill should be placed and compacted according to Appendix C. We recommend embankment slopes be overbuilt at least 3 feet and cut back to finish grades due to the difficulty of achieving compaction at the edge of a slope.

BUILDING CONSTRUCTION CONSIDERATIONS

Foundations

Our investigation indicates predominantly granular soils and sandstone bedrock will be present at foundation elevations. Expansive claystone is present locally at varying depths. Where claystone is encountered at foundation depths, sub-excavation will be appropriate to reduce the risk of poor performance. Typically, sub-excavation depths in this formation are in the range of 4 to 8 feet below foundation levels, where these lenses are present. We expect spread footing foundations designed to apply a minimum deadload will likely be appropriate for the lots. We estimate maximum allowable soil pressures of about 3,000 psf will be appropriate for the lots included in this investigation. Alternative foundation systems such as post-tensioned slabs-on-grade may also be considered. Detailed soils and foundation investigations should be performed to determine the appropriate foundation types and to provide design criteria on a lot-specific basis.

Floor Construction

We expect basements are not viable for this site. Structurally supported floors should be planned for finished living areas. Slab-on-grade floors can be used in garages. The risk of poor performance of floor slabs, driveways, sidewalks, and other surface flatwork may increase where expansive soils are present, unless sub-excavation is performed.

The site will likely have a low to moderate risk (where shallow claystone is encountered) of poor slab-on-grade performance, although sub-excavation may be required where claystone lenses are identified near foundation elevations. Structural floors should be used in non-basement, finished living areas. A structural floor is supported by the foundation system. Design and construction issues associated with structural floors include ventilation and lateral loads. Where structurally supported floors are installed over a crawlspace, the required air space depends on the materials used to construct the floor and the potential expansion of the underlying soils.

Building codes require a clear space of 18 inches between exposed earth and untreated wood floor components. For non-organic floor systems, we recommend a minimum clear space of 10 inches. This minimum clear space should be maintained between any point of the underside of the floor system and the soils.

Control of humidity in crawlspaces is important for indoor air quality and performance of wood floor systems. We believe the best current practices to control humidity involve the use of a vapor retarder or barrier (10 mil minimum) placed on the soils below subfloor areas. The vapor retarder should be sealed at joints and attached to concrete foundation elements.

Subsurface Drainage

Surface water can penetrate relatively permeable, loose backfill soils located adjacent to residences and collect at the bottom of relatively impermeable foundation excavations, causing wet or moist conditions after construction. Foundation drains should be constructed around the lowest excavation levels of crawlspace and/or basement areas and should discharge to a positive gravity outlet or to a sump where water can be removed by pumping, as deemed appropriate. Typical foundation drains are capable of dealing with minor surface water infiltration but are not designed as a dewatering system for groundwater. No underdrains are planned for this development.

Surface Drainage

The performance of foundations, floors, and other improvements is affected by moisture changes within the soil. This is largely influenced by surface drainage. When developing an overall drainage scheme, consideration should be given by the developer to drainage around each residence. The ground surface around the residences should be sloped to provide positive drainage away from the foundations. We recommend a slope of at least 10 percent for the first 10 feet surrounding each building, where practical. If the distance between buildings is less than 20 feet, the slope in this area should be 10 percent to the swale between houses. Variation from these criteria is acceptable in some areas. For example, for lots graded to direct drainage from the rear yard to the front, it is difficult to achieve the recommended slope at the high point behind the house. We believe it is acceptable to use a slope of about 6 inches in the first 10 feet (5 percent) at this location. A 5 percent slope can also be used adjacent to residences without basements. Roof downspouts and other water collection systems should discharge beyond the limits of backfill around structures.

Concrete

Concrete in contact with soil can be subject to sulfate attack. We measured water-soluble sulfate concentrations samples within the Grandview Reserve development at less than 0.1 percent. As indicated in our tests and ACI 332-20, the sulfate exposure class is *Not Applicable* or *RS0.*

SULFATE EXPOSURE CLASSES PER ACI 332-20

Exposure Classes		Water-Soluble Sulfate (SO_4) in Soil [A] (%)
Not Applicable	RS0	< 0.10
Moderate	RS1	0.10 to 0.20
Severe	RS2	0.20 to 2.00
Very Severe	RS3	> 2.00

A) Percent sulfate by mass in soil determined by ASTM C1580

For this level of sulfate concentration, ACI 332-20 *Code Requirements for Residential Concrete* indicates there are no special cement type requirements for sulfate resistance as indicated in the table below.

CONCRETE DESIGN REQUIREMENTS FOR SULFATE EXPOSURE PER ACI 332-20

Exposure Class	Maximum Water/ Cement Ratio	Minimum Compressive Strength [A] (psi)	Cementitious Material Types [B]			Calcium Chloride Admixtures
			ASTM C150/ C150M	ASTM C595/ C595M	ASTM C1157/ C1157M	
RS0	N/A	2500	No Type Restrictions	No Type Restrictions	No Type Restrictions	No Restrictions
RS1	0.50	2500	II	Type with (MS) Designation	MS	No Restrictions
RS2	0.45	3000	V [C]	Type with (HS) Designation	HS	Not Permitted
RS3	0.45	3000	V + Pozzolan or Slag Cement [D]	Type with (HS) Designation plus Pozzolan or Slag Cement [E]	HS + Pozzolan or Slag Cement [E]	Not Permitted

A) Concrete compressive strength specified shall be based on 28-day tests per ASTM C39/C39M
B) Alternate combinations of cementitious materials of those listed in ACI 332-20 Table 5.4.2 shall be permitted when tested for sulfate resistance meeting the criteria in section 5.5.
C) Other available types of cement such as Type III or Type I are permitted in Exposure Classes RS1 or RS2 if the C3A contents are less than 8 or 5 percent, respectively.
D) The amount of the specific source of pozzolan or slag to be used shall not be less than the amount that has been determined by service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slab to be used shall not be less than the amount tested in accordance with ASTM C1012/C1012M and meeting the criteria in section 5.5.1 of ACI 332-20.
E) Water-soluble chloride ion content that is contributed from the ingredients including water aggregates, cementitious materials, and admixtures shall be determined on the concrete mixture ASTM C1218/C1218M between 29 and 42 days.

Superficial damage may occur to the exposed surfaces of highly permeable concrete. 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. We advocate dampproofing of all foundation walls and grade beams in contact with the subsoils (including the inside and outside faces of garage and crawl space grade beams).

RECOMMENDED FUTURE INVESTIGATIONS

We recommend the following investigations and services:

1. Design-level Soils and Foundation Investigations for each individual lot;
2. Pavement Subgrade Investigations; and
3. Foundation installation observations.

CONSTRUCTION OBSERVATIONS

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.

LIMITATIONS

This report has been prepared for the exclusive use of D.R. Horton and your team to provide geotechnical design and construction criteria for development. The information, conclusions, and recommendations presented herein are based upon consideration of many factors including, but not limited to, the type of structures proposed, the geologic setting, and the subsurface conditions encountered.

Our borings and monitoring wells were very widely spaced to provide a general picture of subsurface conditions for due diligence and preliminary planning of residential construction. Variations from our borings and monitoring wells should be anticipated. We believe this investigation was conducted in a manner consistent with that level of care and skill ordinarily used by geotechnical engineers practicing under similar conditions. No warranty, express or implied, is made.

If we can be of further service in discussing the contents of this report or analysis of the influence of subsurface conditions on the project, please call.

CTL|THOMPSON, INC.

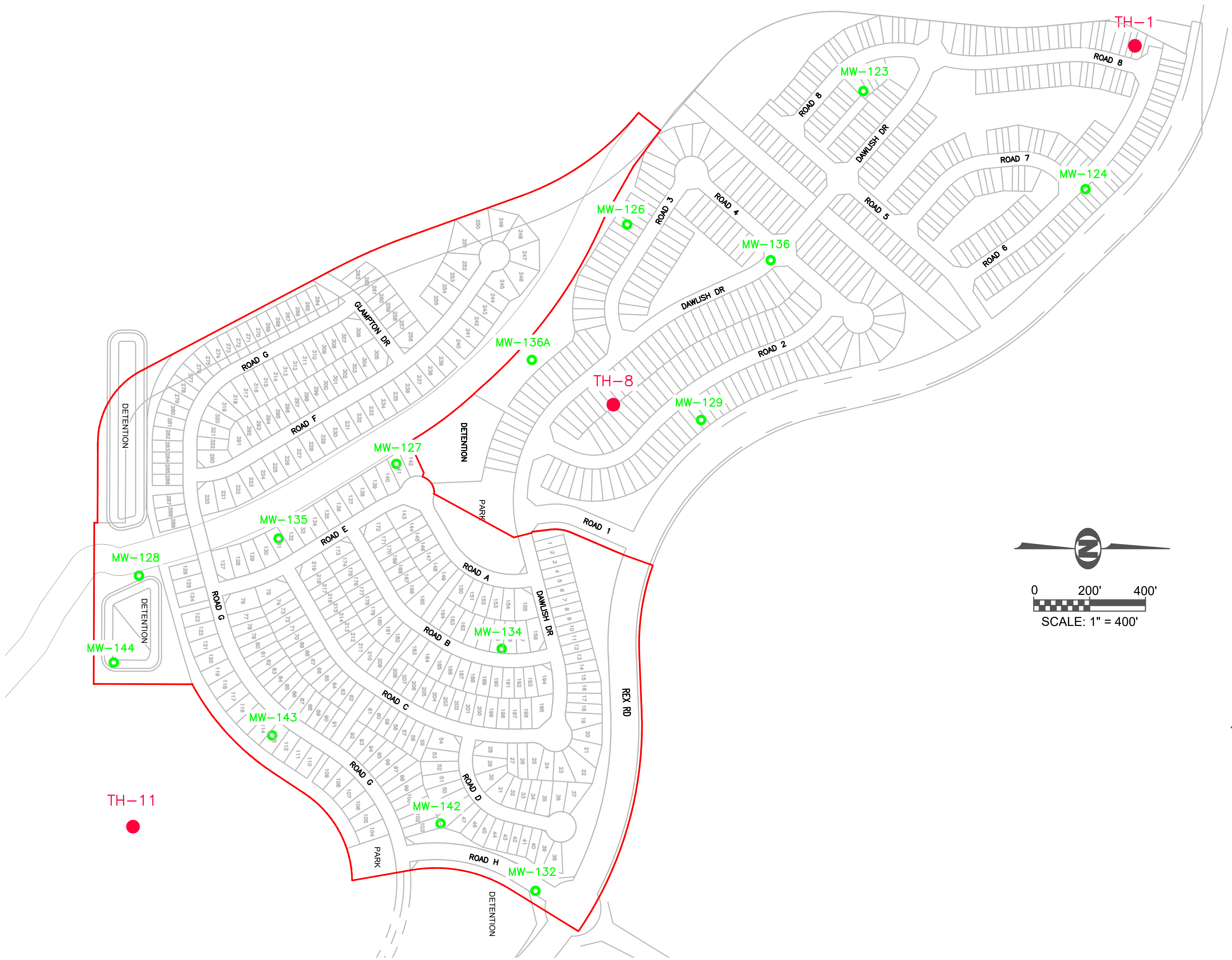
Jeffrey M. Jones, P.E.
Associate Engineer

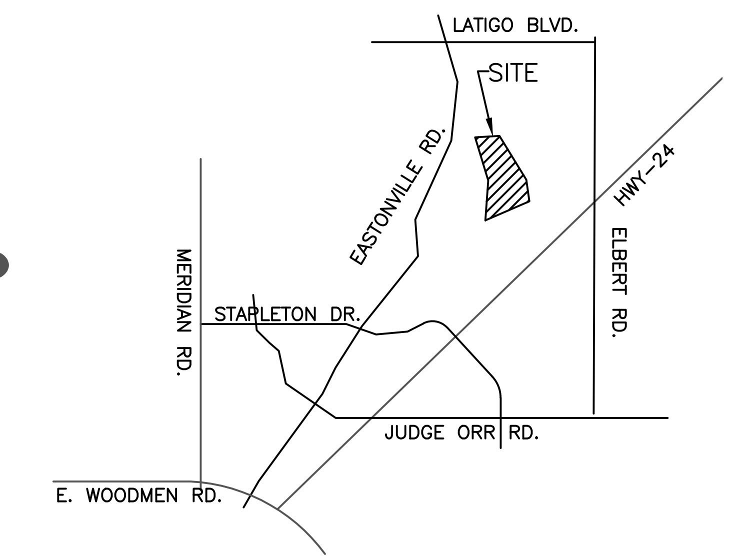
Reviewed by

Gwendolyn Eberhart, P.E.
Project Manager

JMJ:GE:cw
(via email)

Via e-mail: rhillen@drhorton.com; breid@drhorton.com; khuhn@hrgreen.com





VICINITY MAP

(NOT TO SCALE)

0 200' 400'

SCALE: 1" = 400'

LEGEND:

MW-123 APPROXIMATE LOCATION OF MONITORING WELL

TH-1 APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED DURING PREVIOUS INVESTIGATION; REPORTS DATED DECEMBER 23, 2020.

PHASE 3 BOUNDARY

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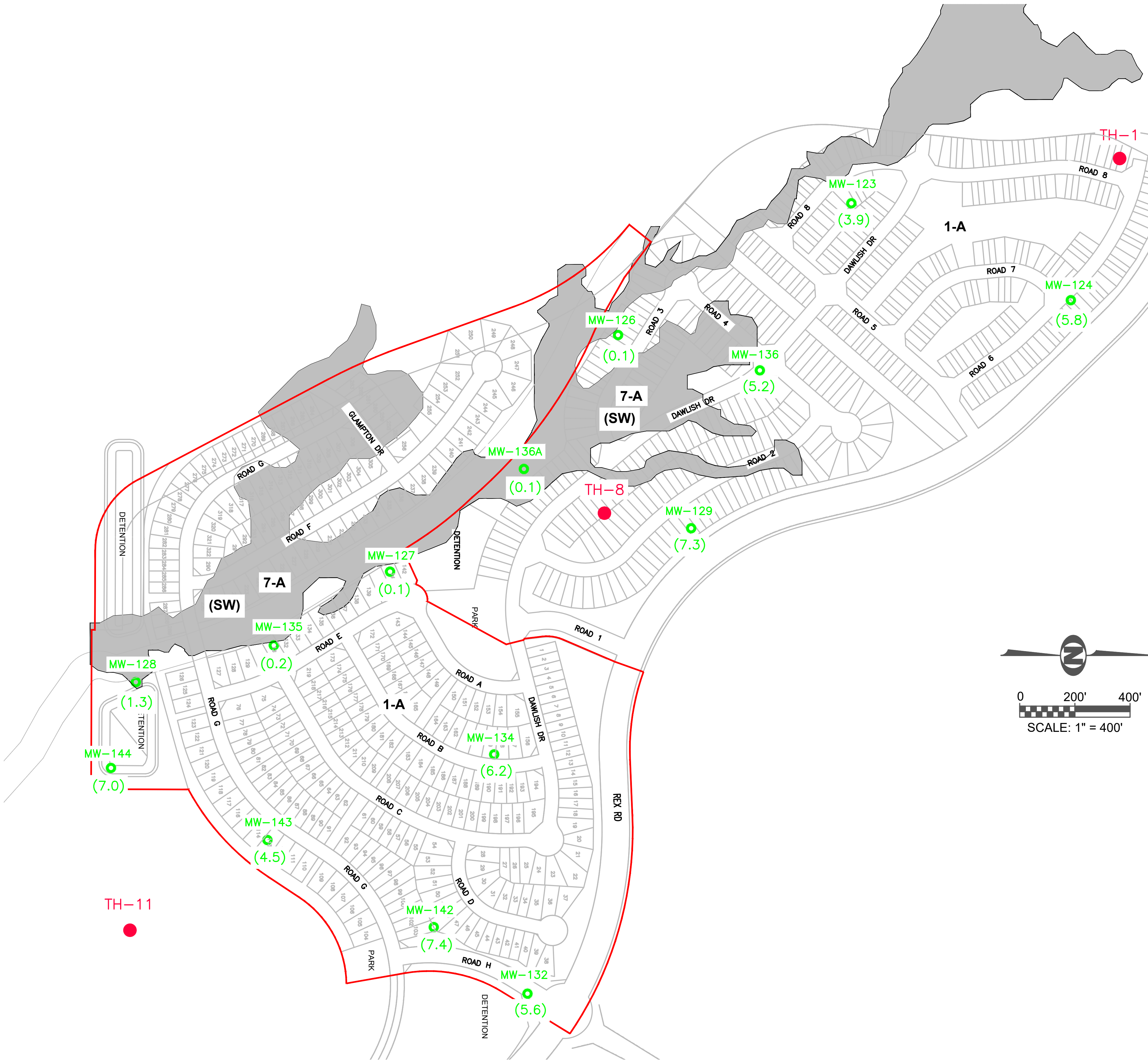
Location of Exploratory Borings and Monitoring Wells

FIG. 1



LEGEND:

MW-123 (green circle)	APPROXIMATE LOCATION OF EXPLORATORY BORING
(3.9)	DEPTH TO MEASURED PEAK GROUNDWATER (FEET)
TH-1 (red dot)	APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED DURING PREVIOUS INVESTIGATION; REPORTS DATED DECEMBER 23, 2020.
1-A	STABLE ALLUVIUM, COLLUVIUM, AND BEDROCK ON FLAT TO GENTLE SLOPES (0–12%). EMPHASIS ON SURFACE AND SUBSURFACE DRAINAGE.
7-A	PHYSIOGRAPHIC FLOODPLAIN WHERE EROSION AND DEPOSITION PRESENTLY OCCUR AND IS GENERALLY SUBJECT TO RECURRENT FLOODING. INCLUDES 100-YEAR FLOODPLAIN ALONG MAJOR STREAMS WHERE FLOODPLAIN STUDIES HAVE BEEN CONDUCTED. EMPHASIS ON FREQUENCY OF SURFACE WATER FLOW, DEPTH AND CONTROL.
(SW)	SEASONALLY WET
(red line)	PHASE 3 BOUNDARY

NOTE: EXPANSIVE SOILS/BEDROCK WERE FOUND SPORADICALLY ACROSS THE SITE. ALL LOTS MAY BE IMPACTED BY GROUND HEAVE. TOTAL CALCULATED GROUND HEAVE RANGED FROM LESS THAN 0.5 INCHES TO 1 INCH. DEPTH TO GROUNDWATER ARE PEAK LEVELS MEASURED IN MONITORING WELLS BETWEEN SEPTEMBER 2023 AND JANUARY 2024.

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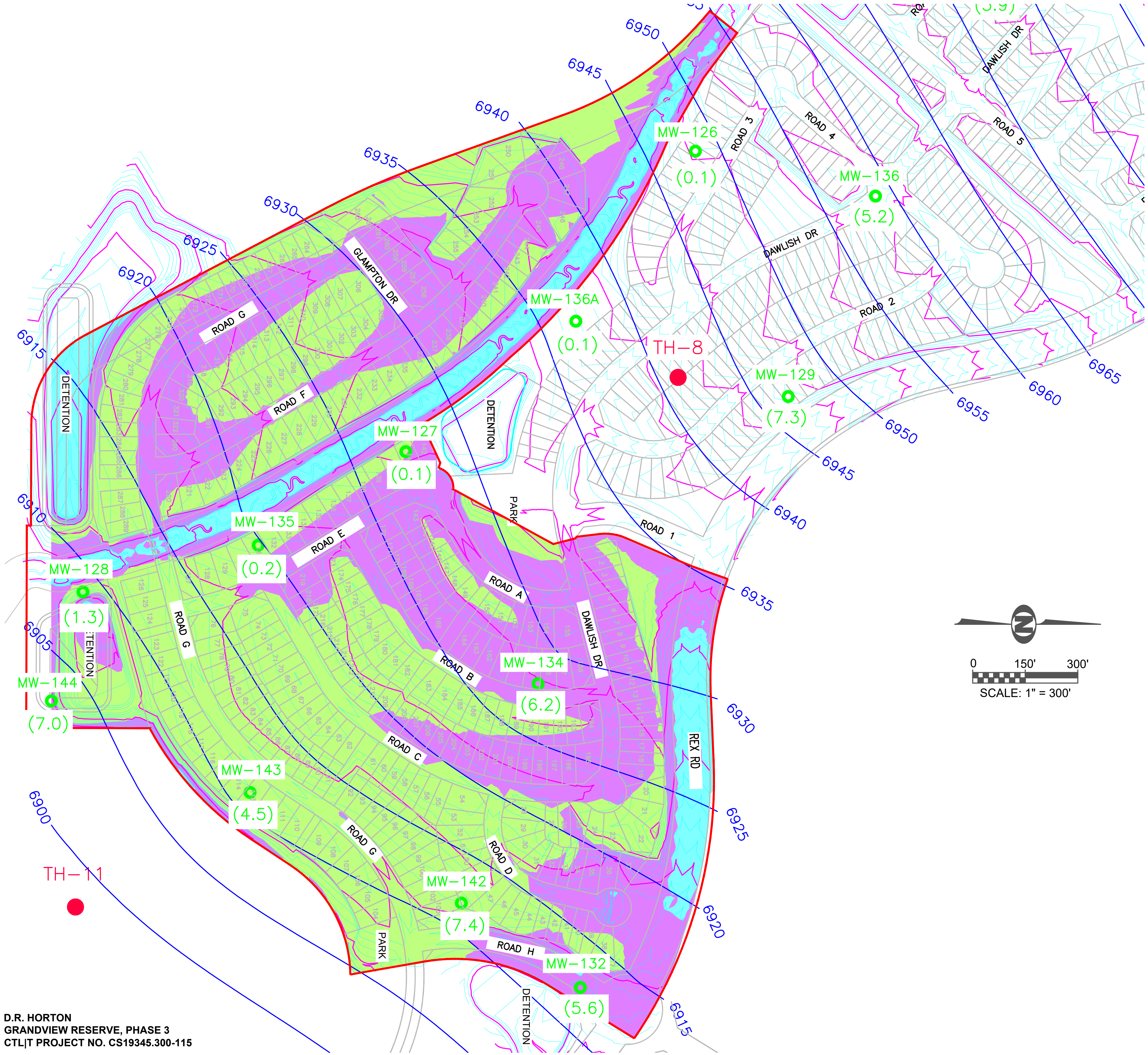
Engineering Geologic Conditions

FIG. 2



LEGEND:

MW–123 APPROXIMATE LOCATION OF MONITORING WELL

(3.9) DEPTH TO MEASURED PEAK GROUNDWATER (FEET)

TH–1 APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED DURING PREVIOUS INVESTIGATION; REPORTS DATED DECEMBER 23, 2020.

PHASE 3 BOUNDARY

GROUNDWATER >10 FEET BELOW PROPOSED SURFACE

GROUNDWATER 5–10 FEET BELOW PROPOSED SURFACE

GROUNDWATER 0–5 FEET BELOW PROPOSED SURFACE

INDICATES ESTIMATED GROUNDWATER ELEVATION CONTOUR (FEET)

PROPOSED TOPOGRAPHY

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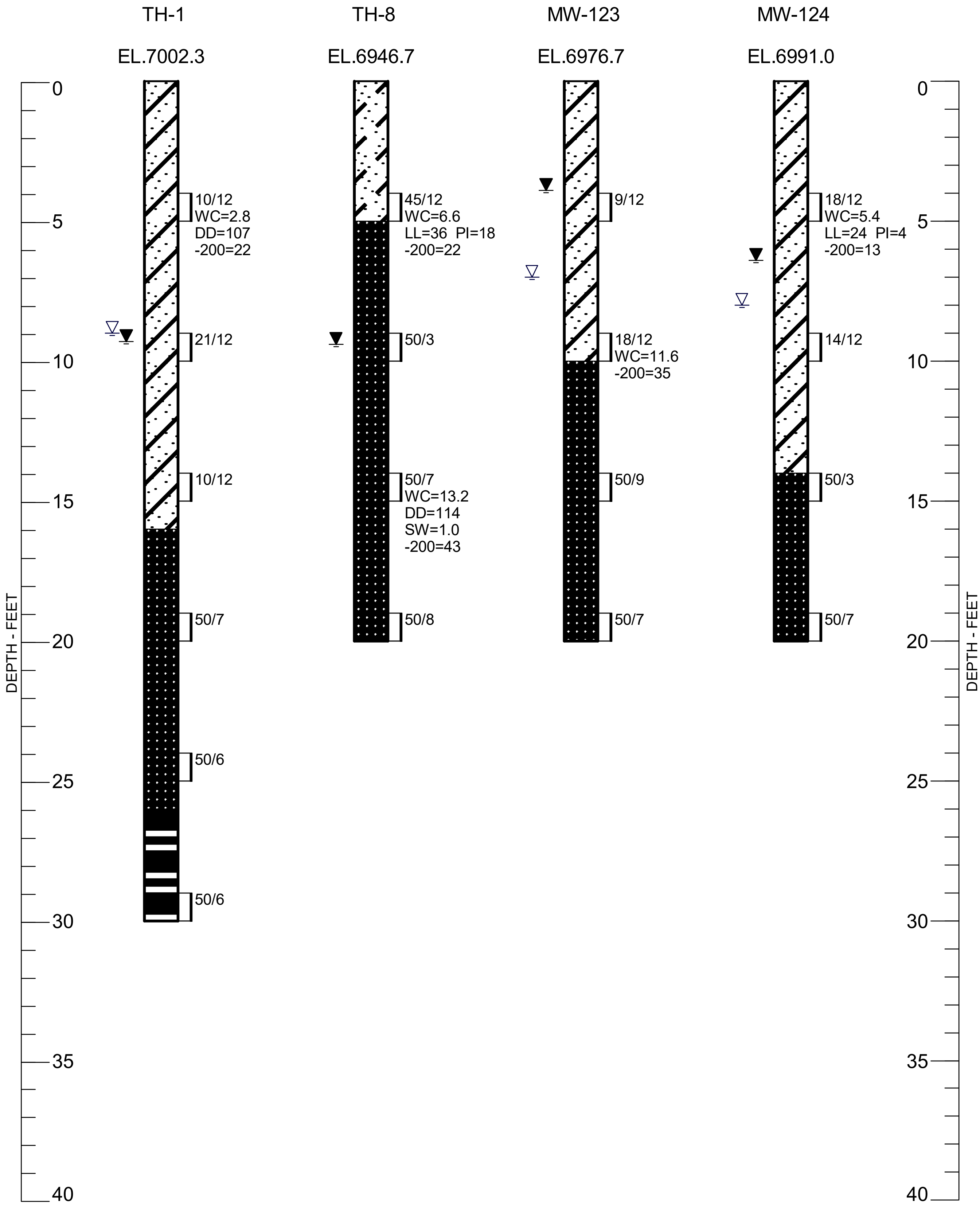
Groundwater Conditions

FIG. 3

APPENDIX A

SUMMARY LOGS OF EXPLORATORY BORINGS AND MONITORING WELLS



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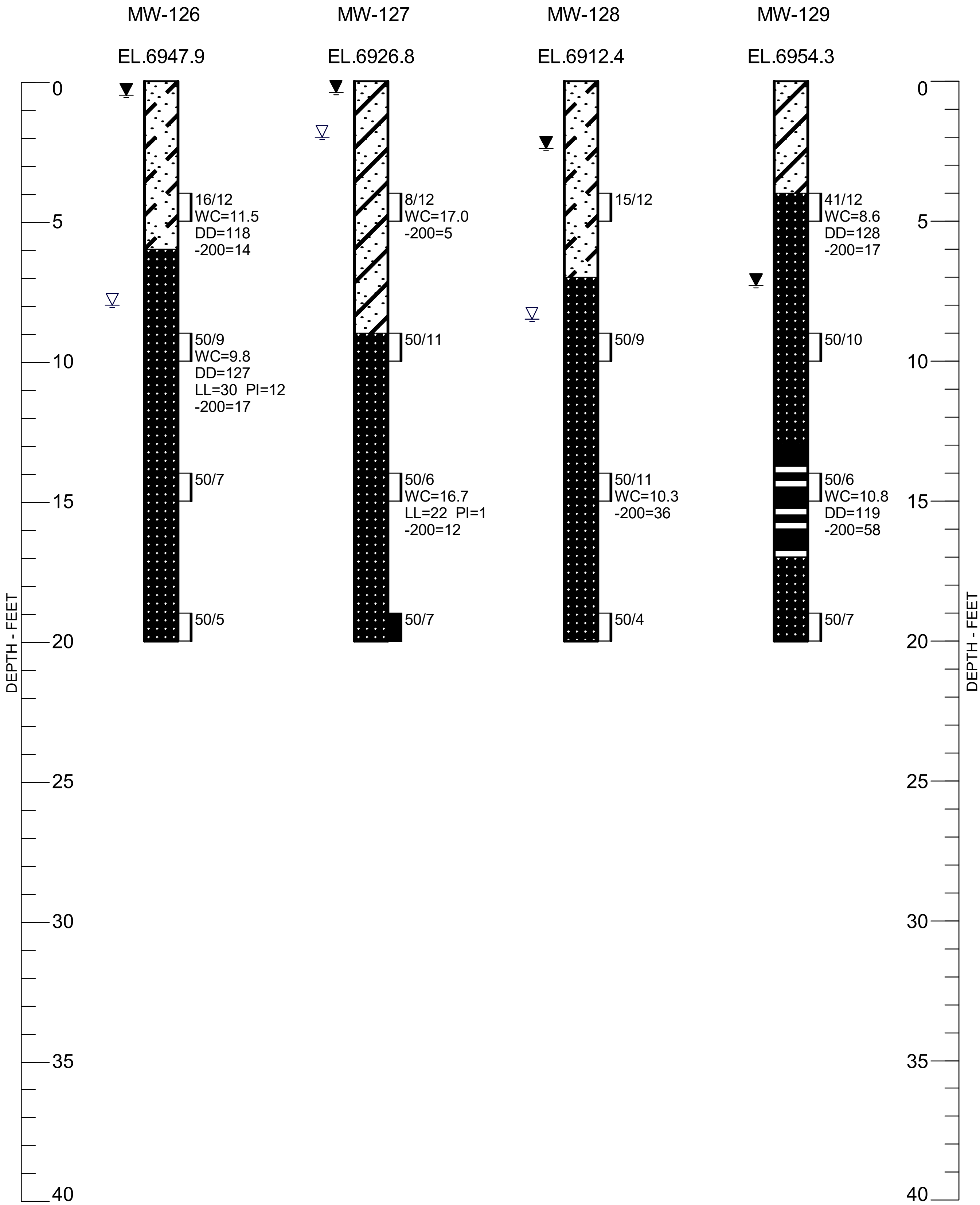
Summary Logs of Exploratory Borings

FIG. A-1



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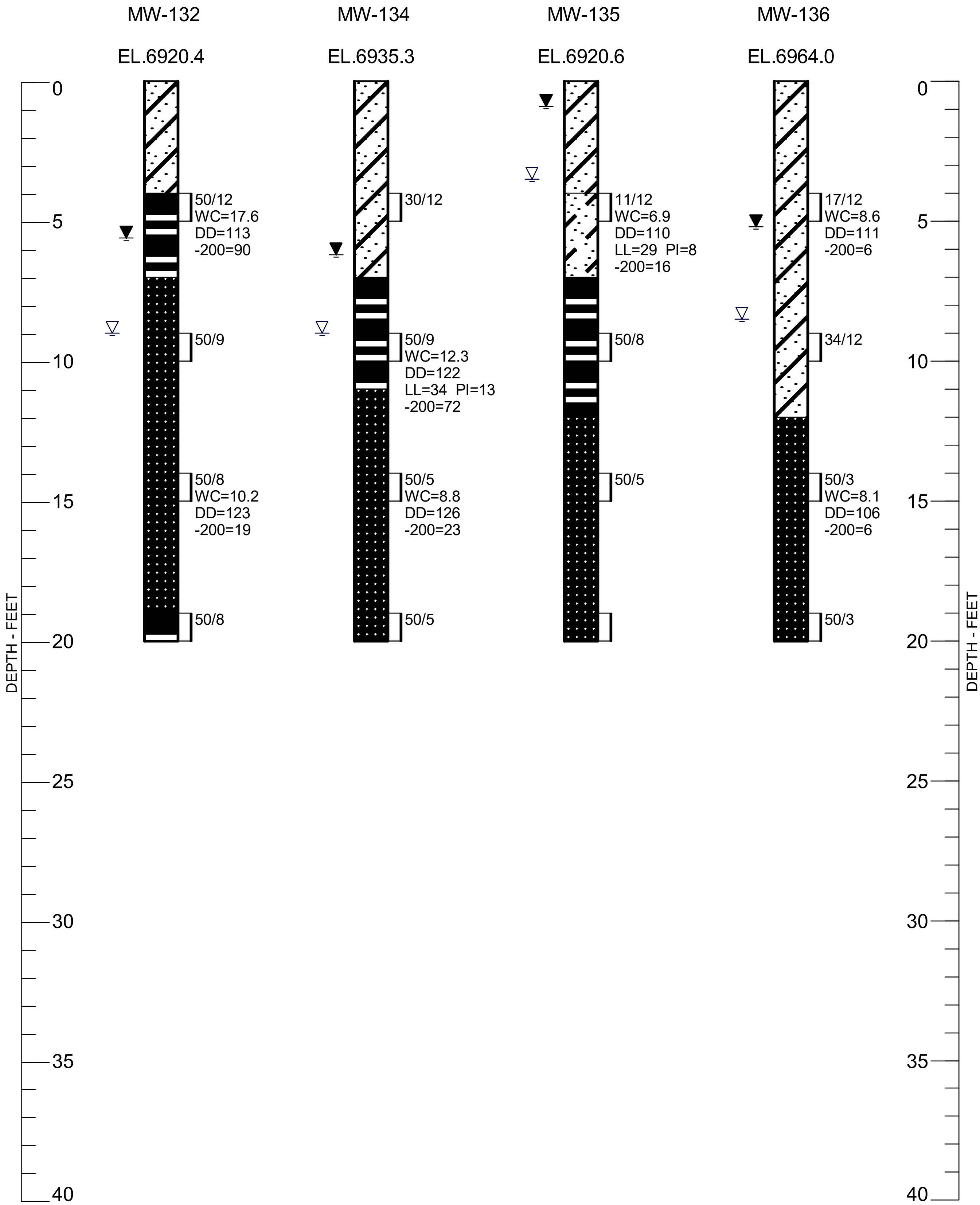
Summary Logs of Exploratory Borings

FIG. A-2



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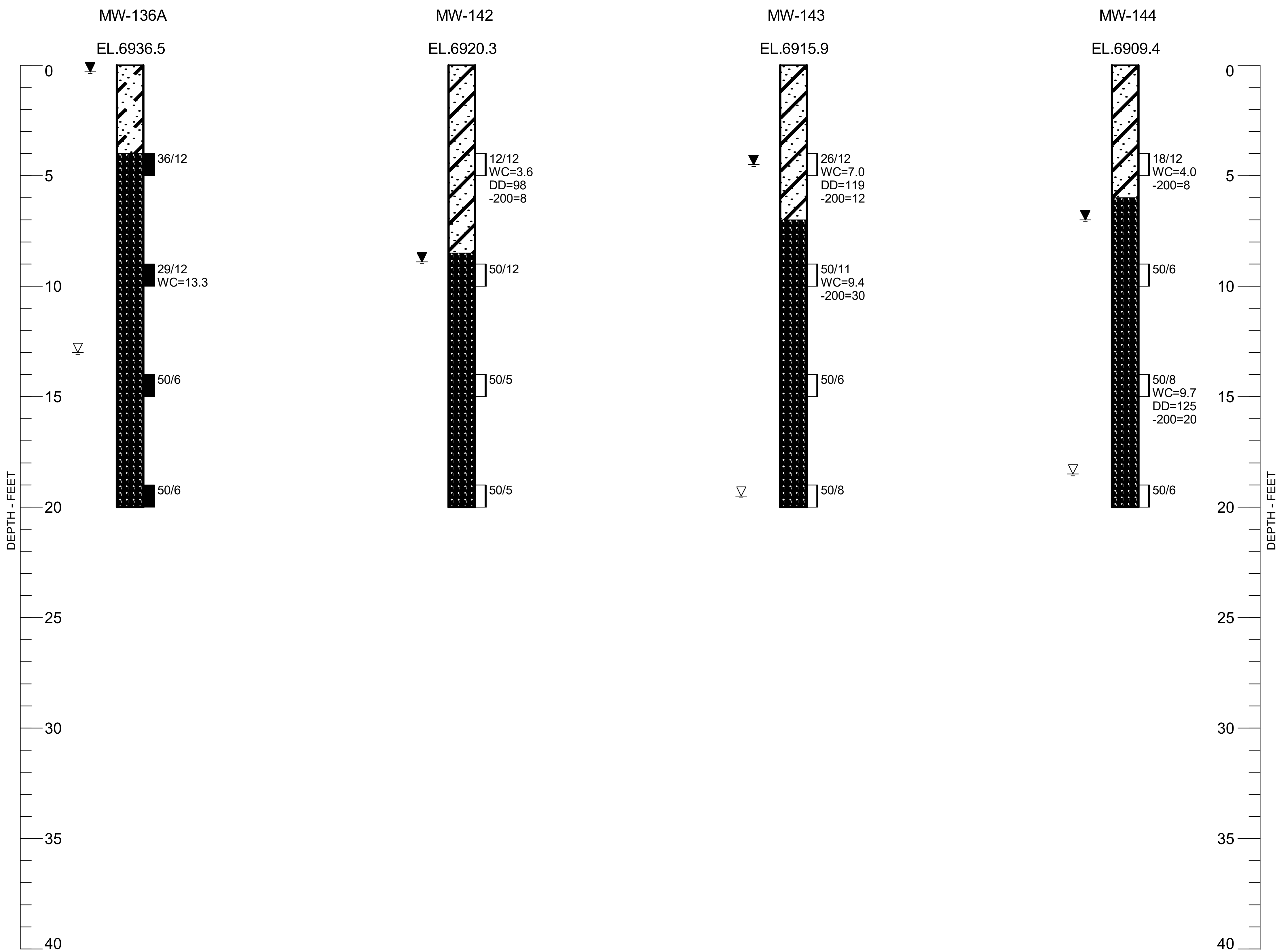
Summary Logs of Exploratory Borings

FIG. A-3



LEGEND:

- SAND, CLAYEY, DENSE, SLIGHTLY MOIST, BROWN, LIGHT BROWN (SC).
- SAND, SLIGHTLY SILTY TO SILTY, LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST TO WET, LIGHT BROWN, OLIVE, BROWN (SM, SP-SM, SW-SM).
- BEDROCK, CLAYSTONE, SANDY TO VERY SANDY, HARD, SLIGHTLY MOIST TO MOIST, LIGHT TO DARK GRAY.
- BEDROCK, SANDSTONE, SILTY TO CLAYEY TO VERY CLAYEY, HARD TO VERY HARD, SLIGHTLY MOIST TO WET, LIGHT BROWN TO GRAY.
- DRIVE SAMPLE. THE SYMBOL 9/12 INDICATES 9 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.0-INCH O.D. SAMPLER 12 INCHES.
- DRIVE SAMPLE. THE SYMBOL 9/12 INDICATES 9 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.
- GROUNDWATER LEVEL MEASURED AT TIME OF DRILLING.
- PEAK GROUNDWATER LEVEL MEASURED DURING THIS INVESTIGATION.

NOTES:

1. THE BORINGS WERE DRILLED ON DECEMBER 1, 2020 AND THE MONITORING WELLS WERE DRILLED AND INSTALLED BETWEEN SEPTEMER 22 AND 26, 2023 USING A 4-INCH DIAMETER, CONTINUOUS-FLIGHT AUGER AND A CME-45, TRUCK-MOUNTED DRILL RIG.

2. WC - INDICATES MOISTURE CONTENT. (%)
   DD - INDICATES DRY DENSITY. (PCF)
   SW - INDICATES SWELL WHEN WETTED UNDER APPROXIMATE OVERBURDEN PRESSURE. (%)
   LL - INDICATES LIQUID LIMIT. (NV : NO VALUE)
   PI - INDICATES PLASTICITY INDEX. (NP : NON-PLASTIC)
   -200 - INDICATES PASSING NO. 200 SIEVE. (%)

3. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS, AND CONCLUSIONS AS CONTAINED IN THIS REPORT.

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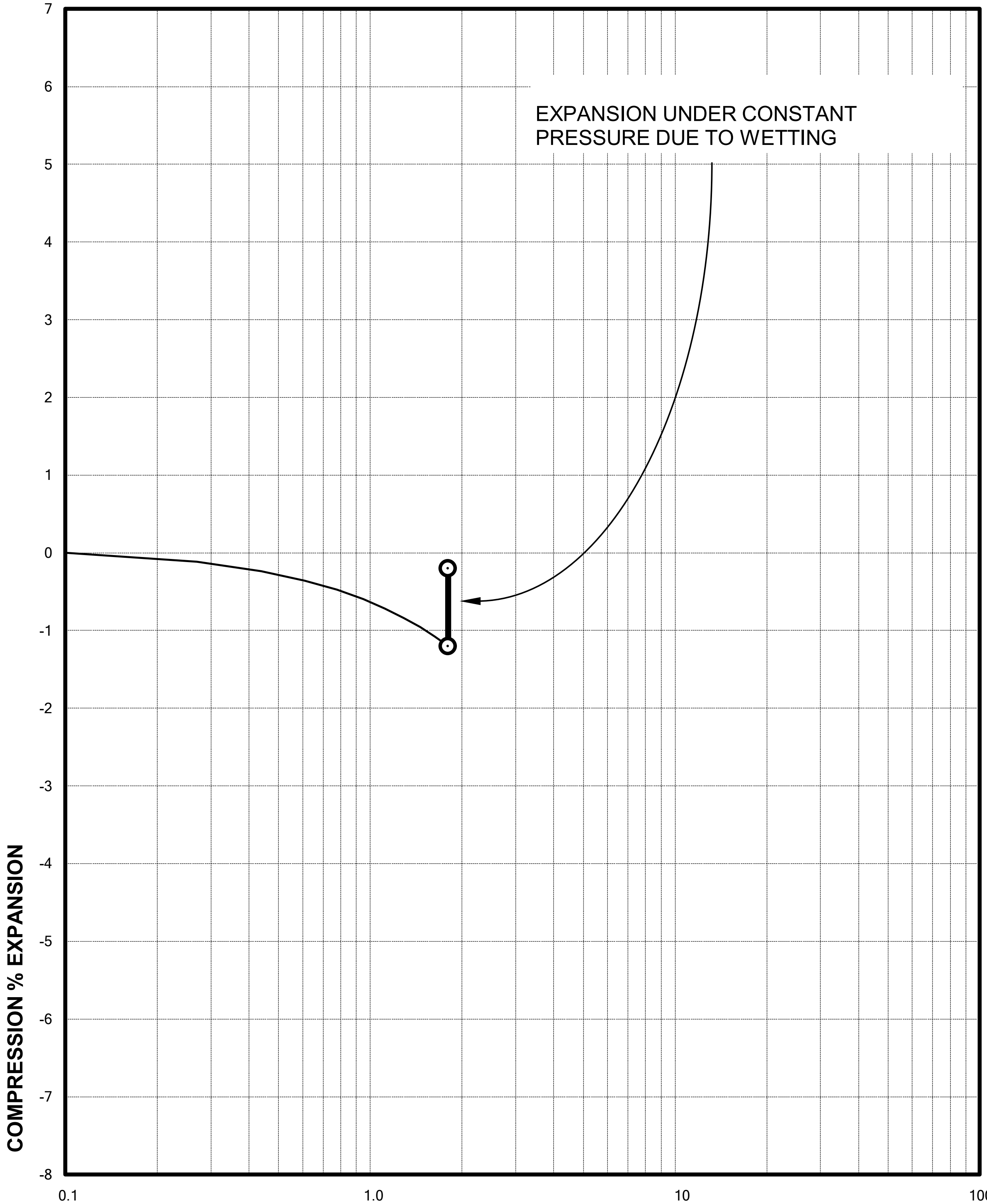
Summary Logs of Exploratory Borings

FIG. A-4

APPENDIX B

LABORATORY TEST RESULTS
TABLE B-1 – SUMMARY OF LABORATORY TEST RESULTS



APPLIED PRESSURE - KSF

Sample of SANDSTONE, VERY CLAYEY
From TH-8 AT 14 FEET

DRY UNIT WEIGHT= 114 PCF
MOISTURE CONTENT= 13.2 %

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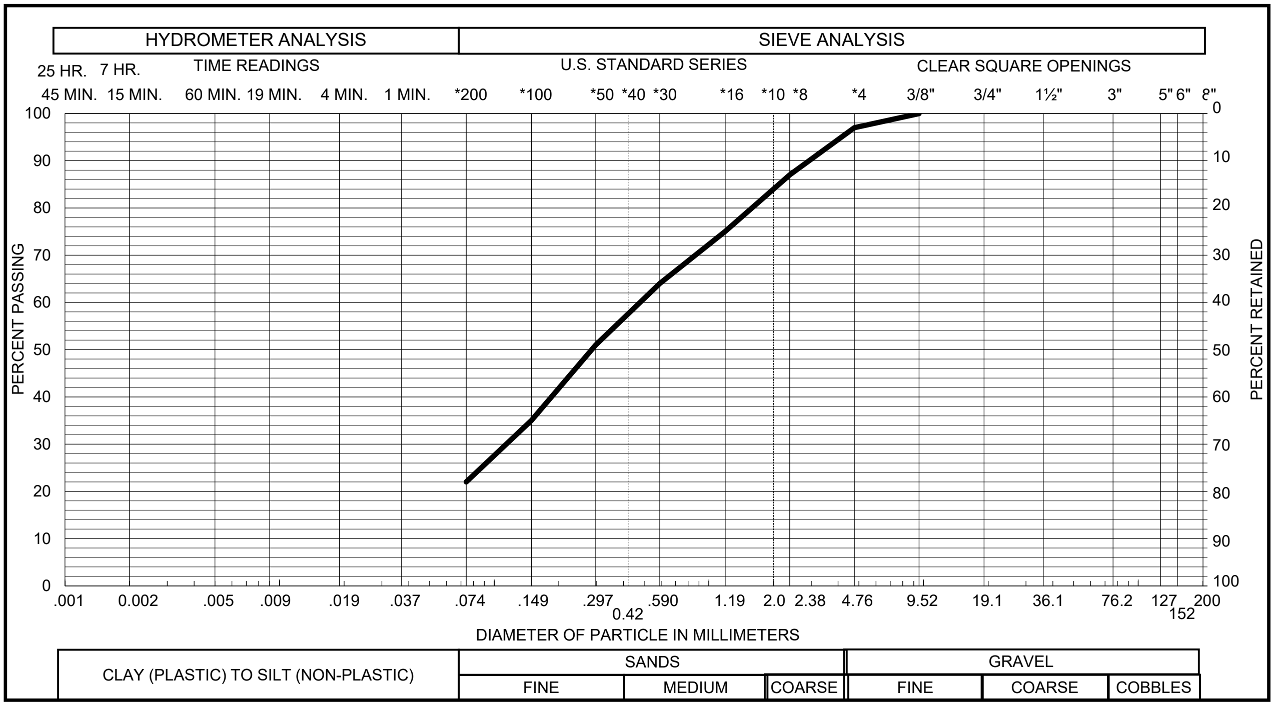
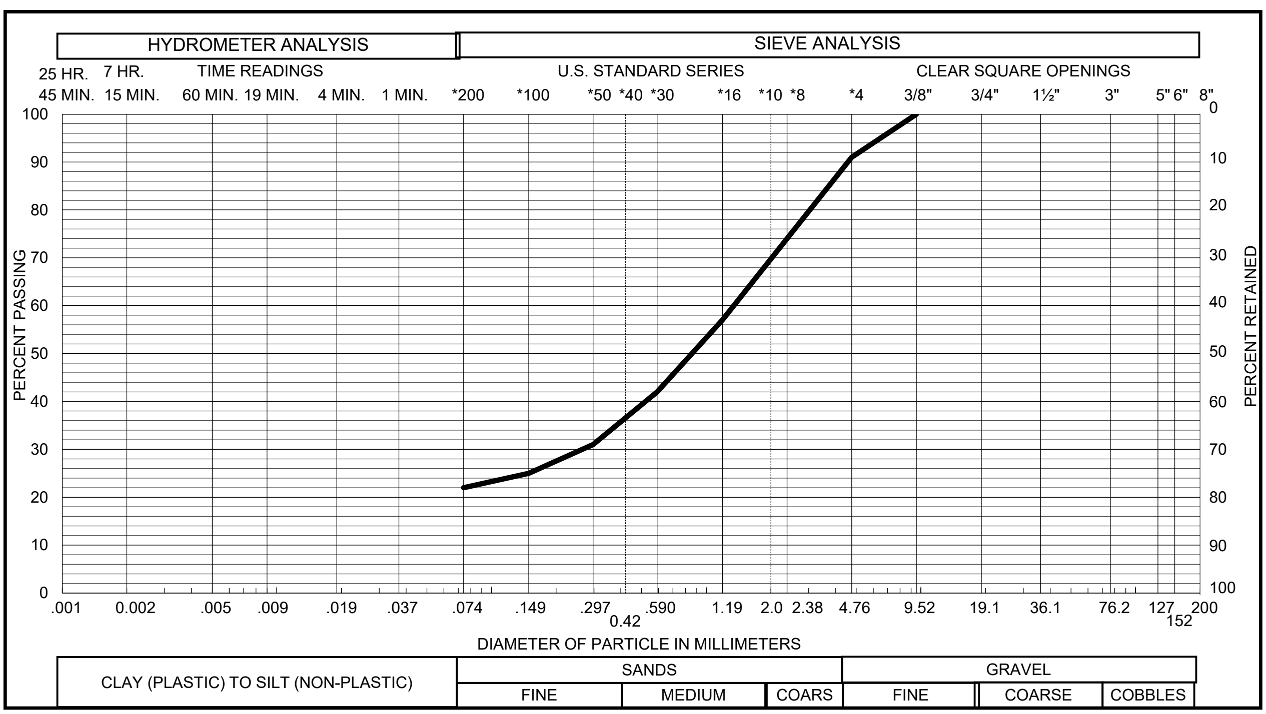
Swell Consolidation Test Results

FIG. B-1



Sample of SAND, SILTY (SM)
From TH - 1 AT 4 FEET

GRAVEL 3 % SAND 75 %
SILT & CLAY 22 % LIQUID LIMIT
PLASTICITY INDEX



Sample of SAND, CLAYEY (SC)
From TH - 8 AT 4 FEET

GRAVEL 9 % SAND 69 %
SILT & CLAY 22 % LIQUID LIMIT 36
PLASTICITY INDEX 18

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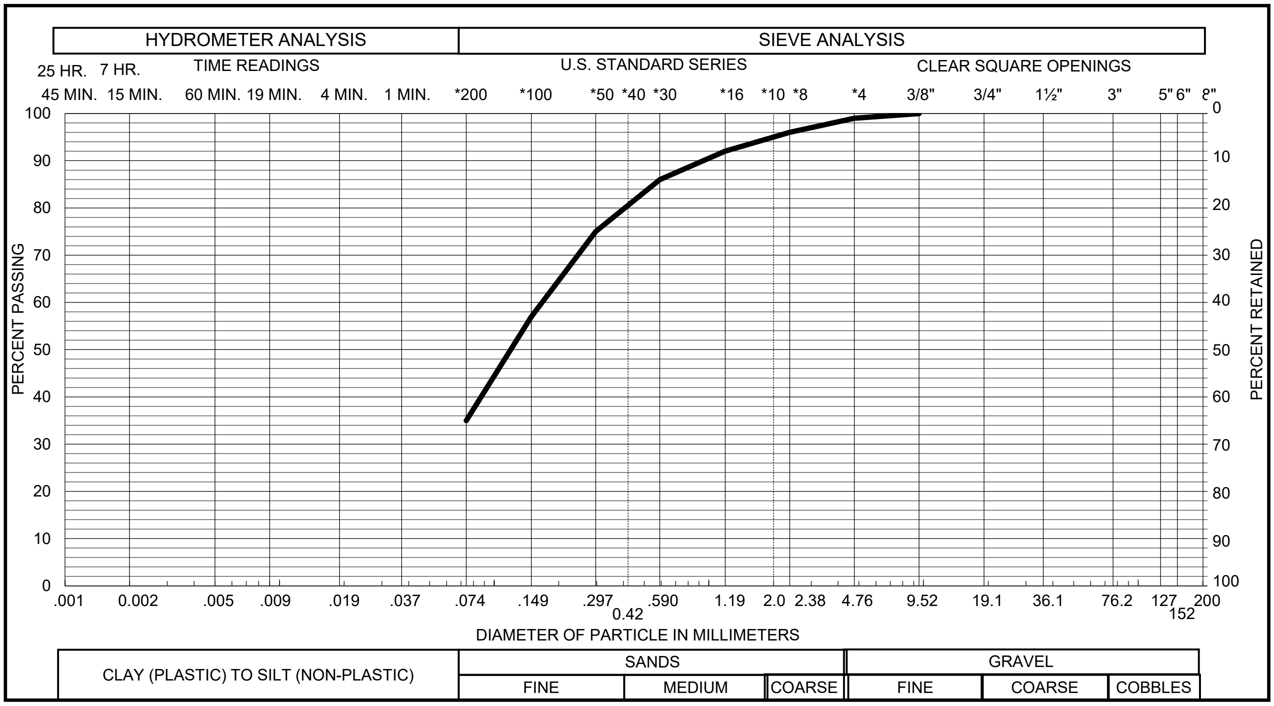
Gradation Test Results

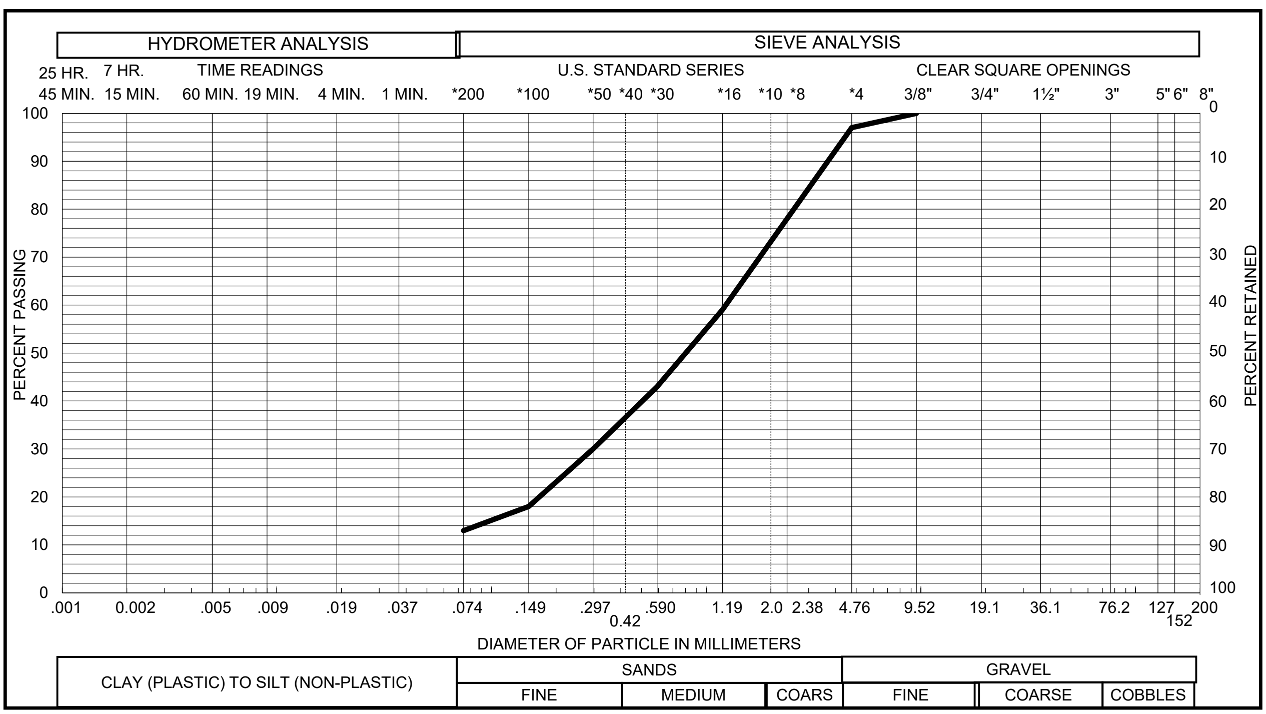
FIG. B-2



Sample of SANDSTONE, CLAYEY

From MW - 123 AT 9 FEET

GRAVEL	1 %	SAND	64 %
SILT & CLAY	35 %	LIQUID LIMIT	
PLASTICITY INDEX			



Sample of SAND, SILTY, CLAYEY (SC-SM)

From MW - 124 AT 4 FEET

GRAVEL	3 %	SAND	84 %
SILT & CLAY	13 %	LIQUID LIMIT	24
PLASTICITY INDEX	4		

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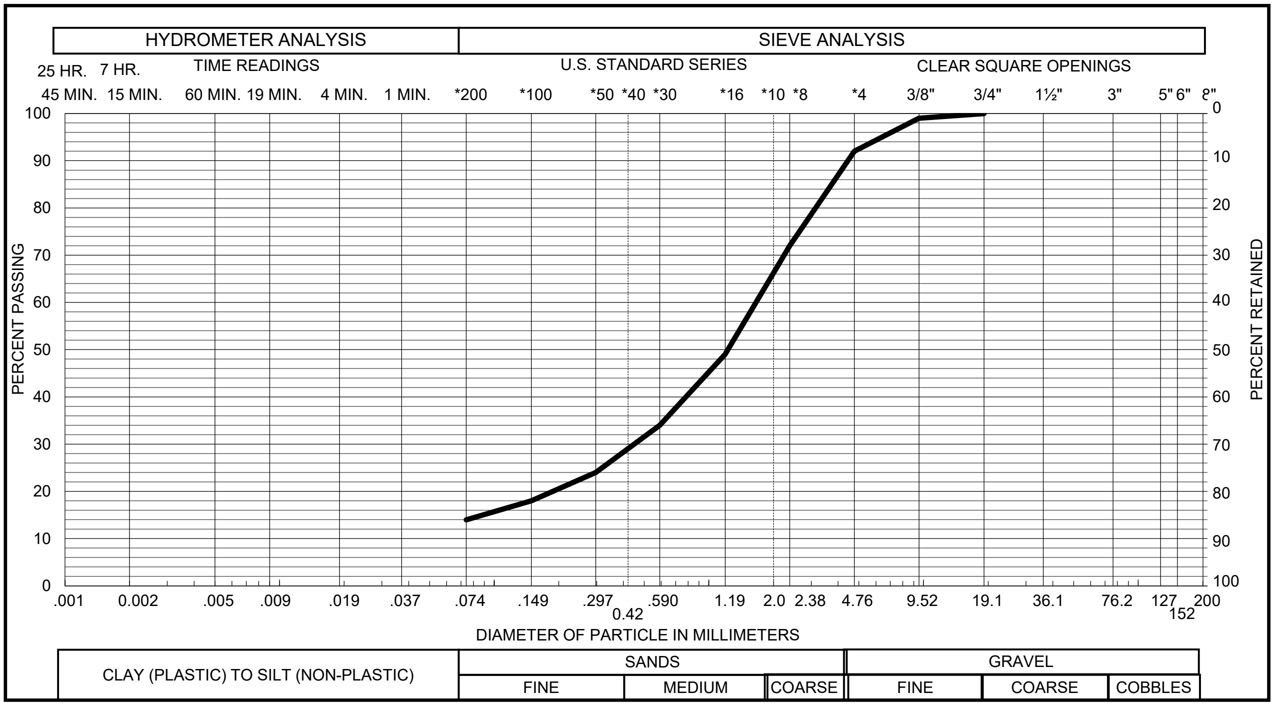
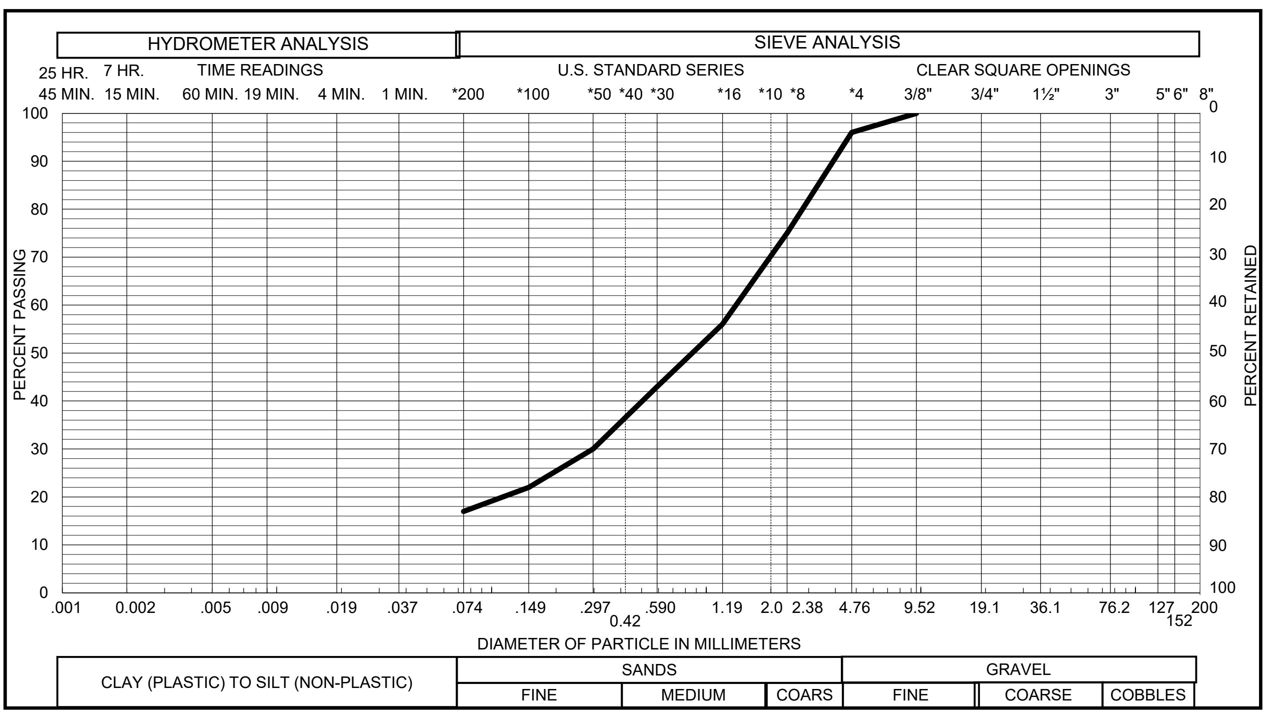
Gradation Test Results

FIG. B-3



Sample of SAND, VERY CLAYEY (SC)
From MW - 126 AT 4 FEET

GRAVEL 8 % SAND 78 %
SILT & CLAY 14 % LIQUID LIMIT
PLASTICITY INDEX



Sample of SANDSTONE, CLAYEY
From MW - 126 AT 9 FEET

GRAVEL 4 % SAND 79 %
SILT & CLAY 17 % LIQUID LIMIT
PLASTICITY INDEX

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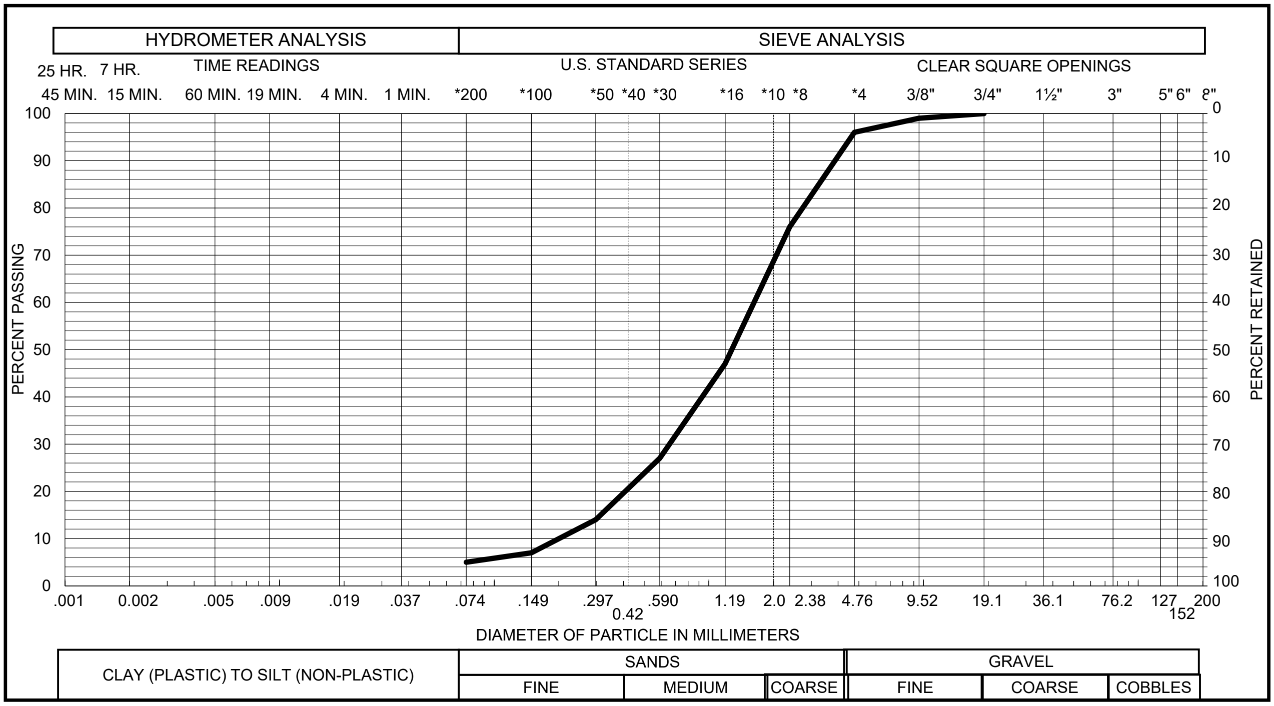
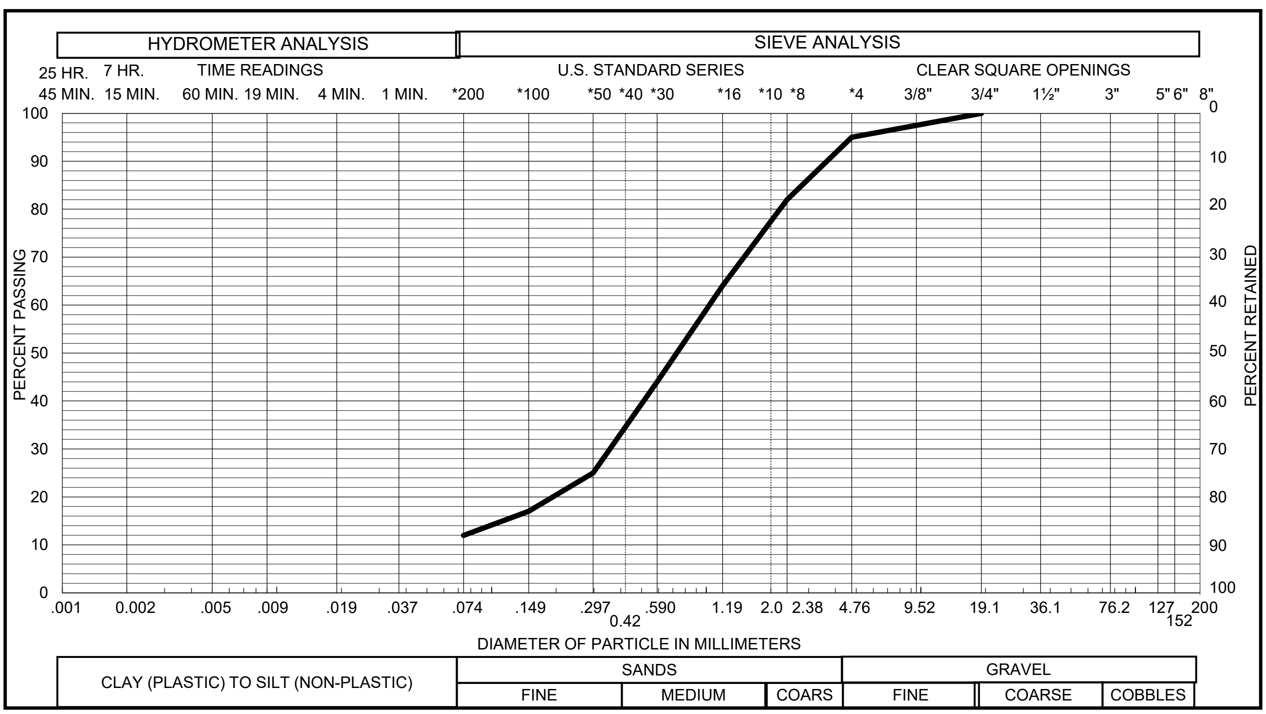
Gradation Test Results

FIG. B-4



Sample of SAND, SLIGHTLY SILTY (SW-SM)
From MW - 127 AT 4 FEET

GRAVEL 4 % SAND 91 %
SILT & CLAY 5 % LIQUID LIMIT
PLASTICITY INDEX



Sample of SAND, SLIGHTLY SILTY (SW-SM)
From MW - 127 AT 14 FEET

GRAVEL 5 % SAND 83 %
SILT & CLAY 12 % LIQUID LIMIT 22
PLASTICITY INDEX 1

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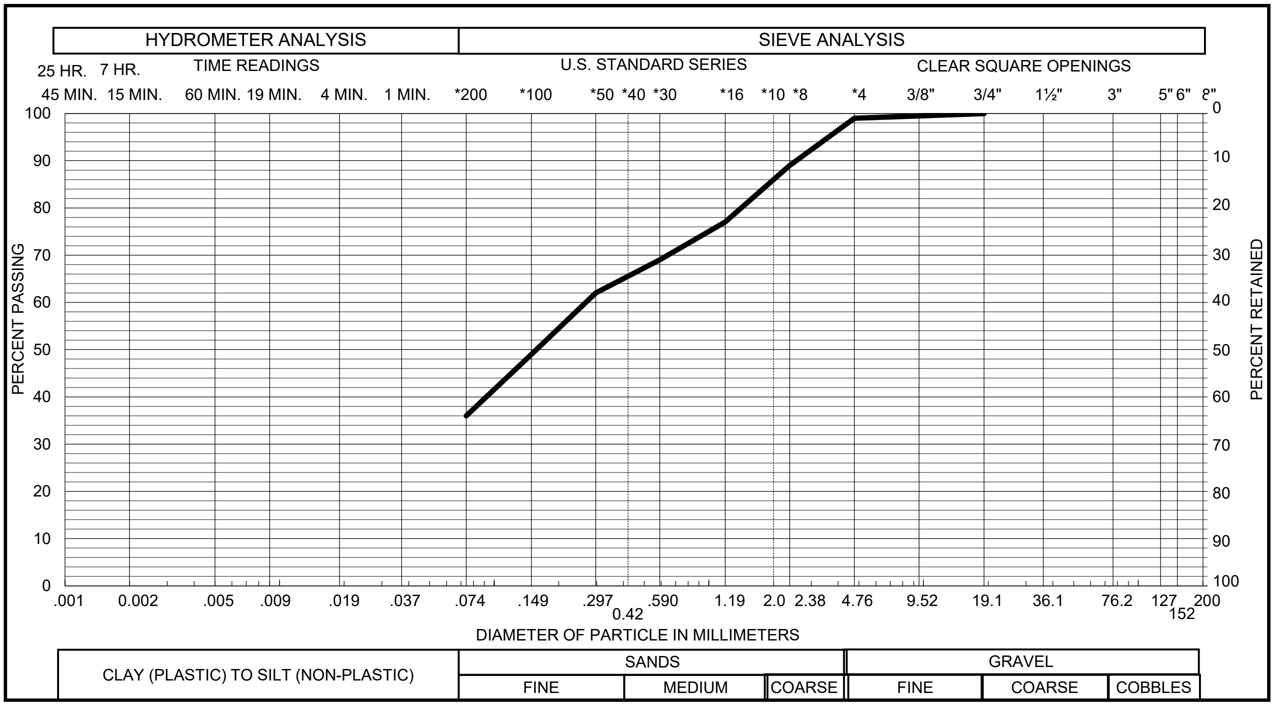
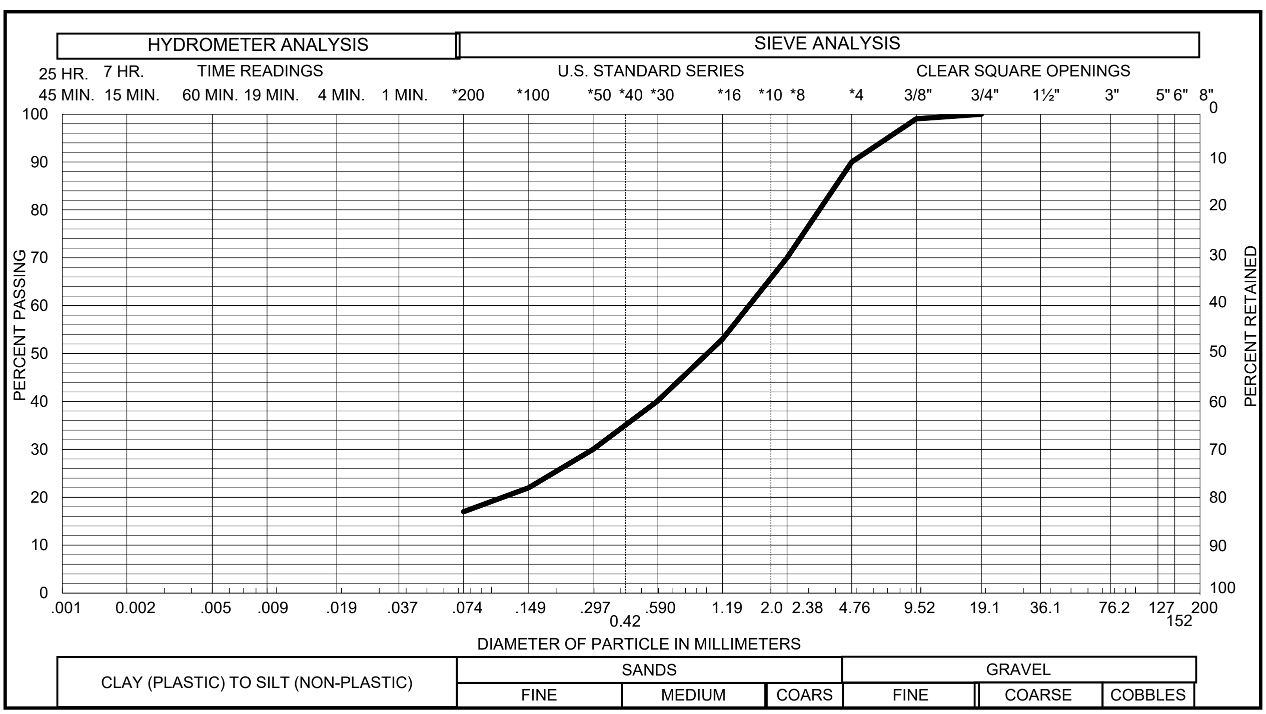
Gradation Test Results

FIG. B-5



Sample of SANDSTONE, VERY CLAYEY
From MW - 128 AT 14 FEET

GRAVEL 1 % SAND 63 %
SILT & CLAY 36 % LIQUID LIMIT
PLASTICITY INDEX

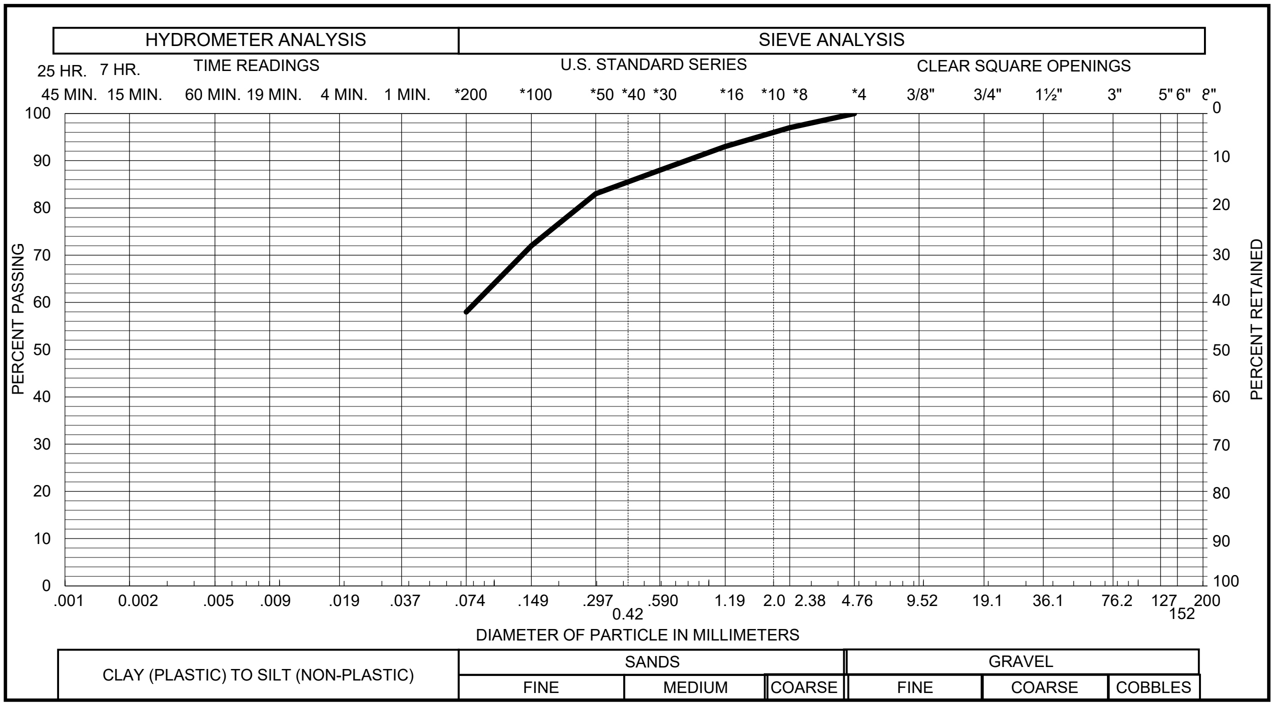


Sample of SANDSTONE, CLAYEY
From MW - 129 AT 4 FEET

GRAVEL 10 % SAND 73 %
SILT & CLAY 17 % LIQUID LIMIT
PLASTICITY INDEX

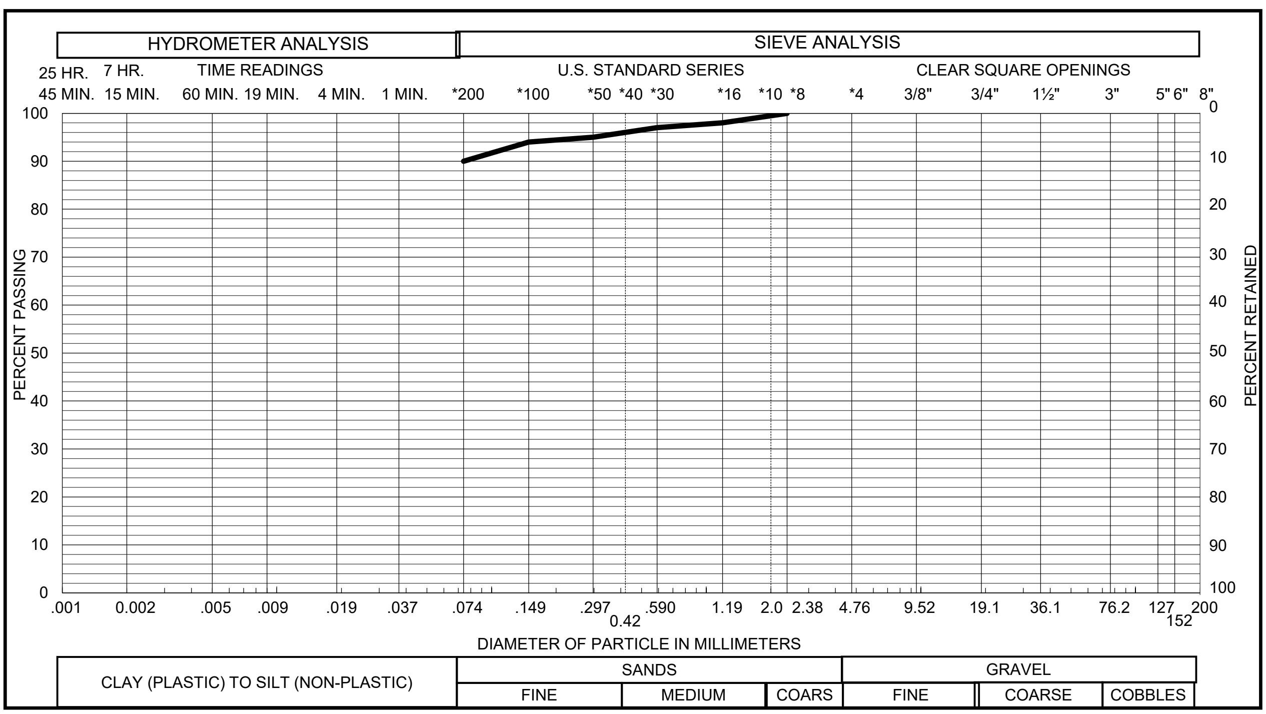
Gradation Test Results

FIG. B-6



Sample of CLAYSTONE, VERY SANDY
From MW - 129 AT 14 FEET

GRAVEL 0 %
SAND 42 %
SILT & CLAY 58 %
LIQUID LIMIT
PLASTICITY INDEX



Sample of CLAYSTONE, SLIGHTLY SANDY
From MW - 132 AT 4 FEET

GRAVEL 0 %
SAND 10 %
SILT & CLAY 90 %
LIQUID LIMIT
PLASTICITY INDEX

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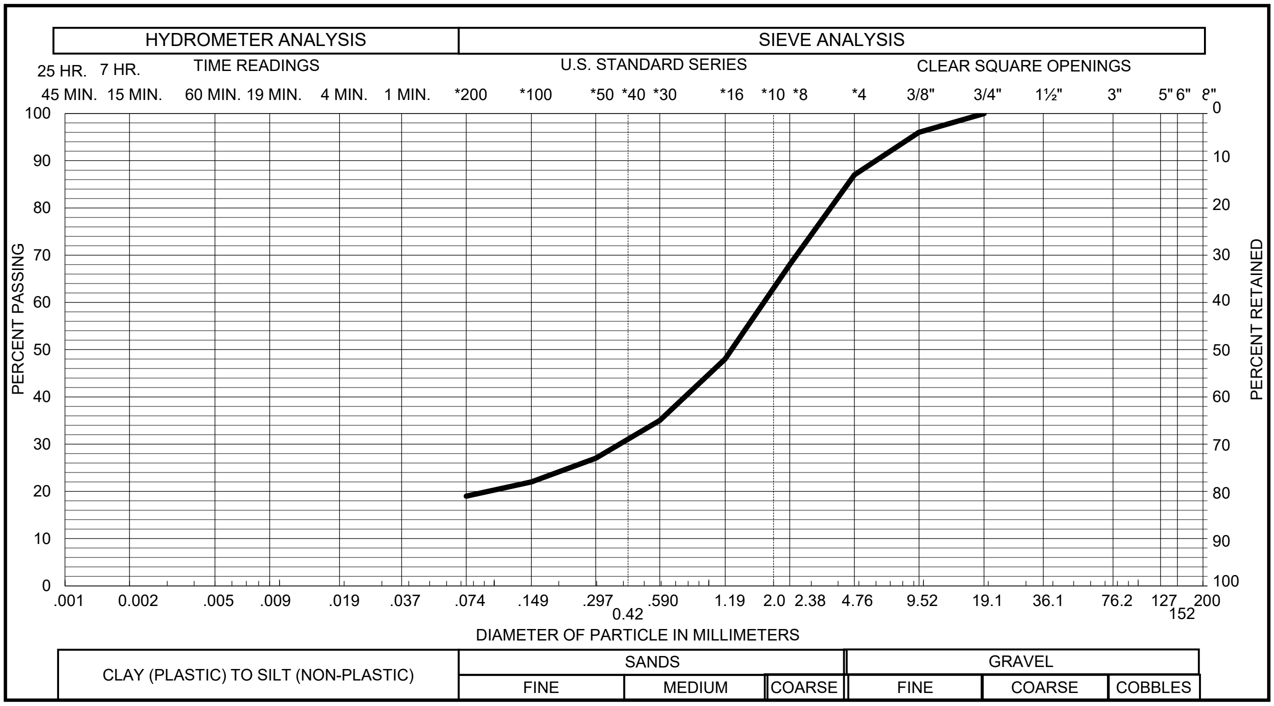
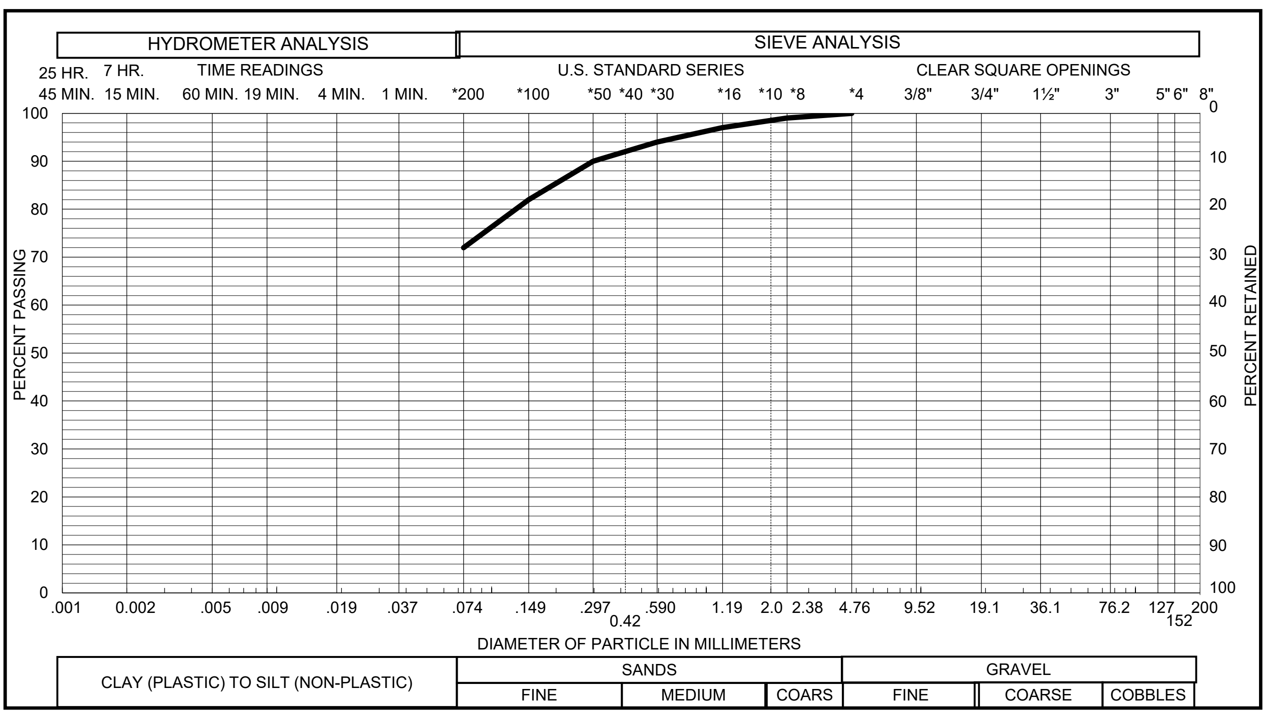
Gradation Test Results

FIG. B-7



Sample of SANDSTONE, CLAYEY
From MW - 132 AT 14 FEET

GRAVEL 13 % SAND 68 %
SILT & CLAY 19 % LIQUID LIMIT
PLASTICITY INDEX



Sample of CLAYSTONE, SANDY
From MW - 134 AT 9 FEET

GRAVEL 0 % SAND 28 %
SILT & CLAY 72 % LIQUID LIMIT 34
PLASTICITY INDEX 13

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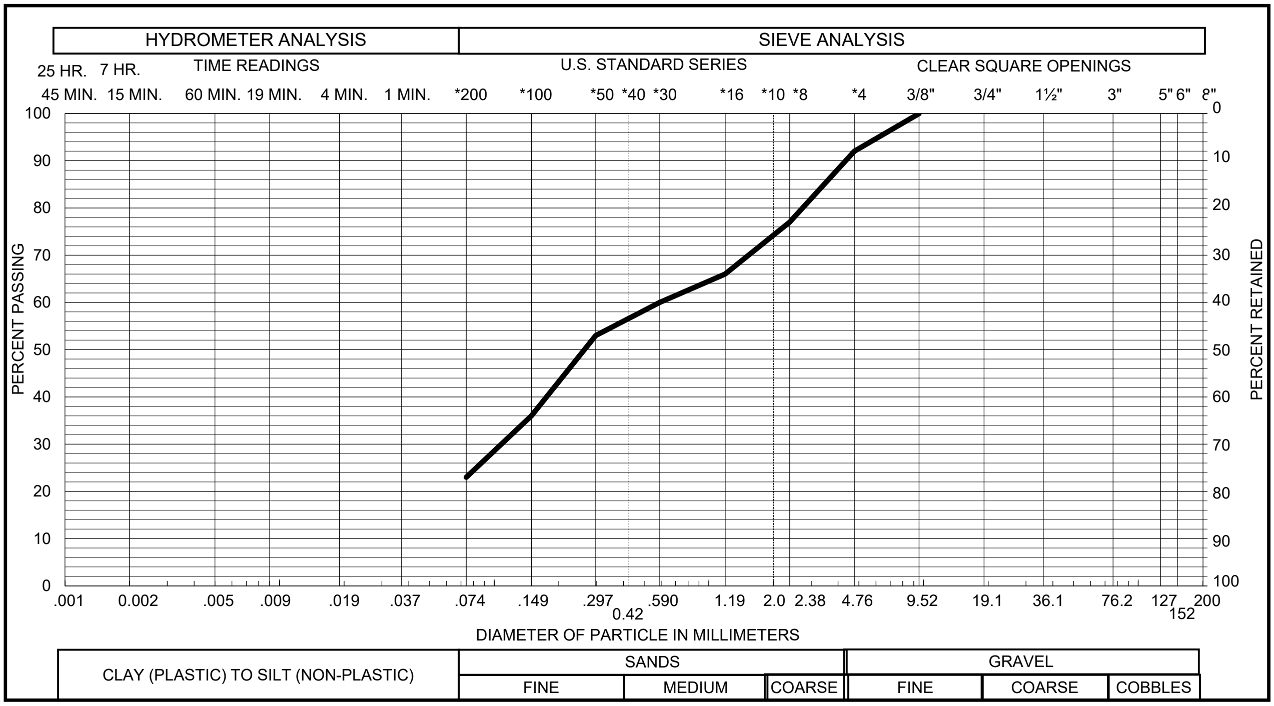
Gradation Test Results

FIG. B-8



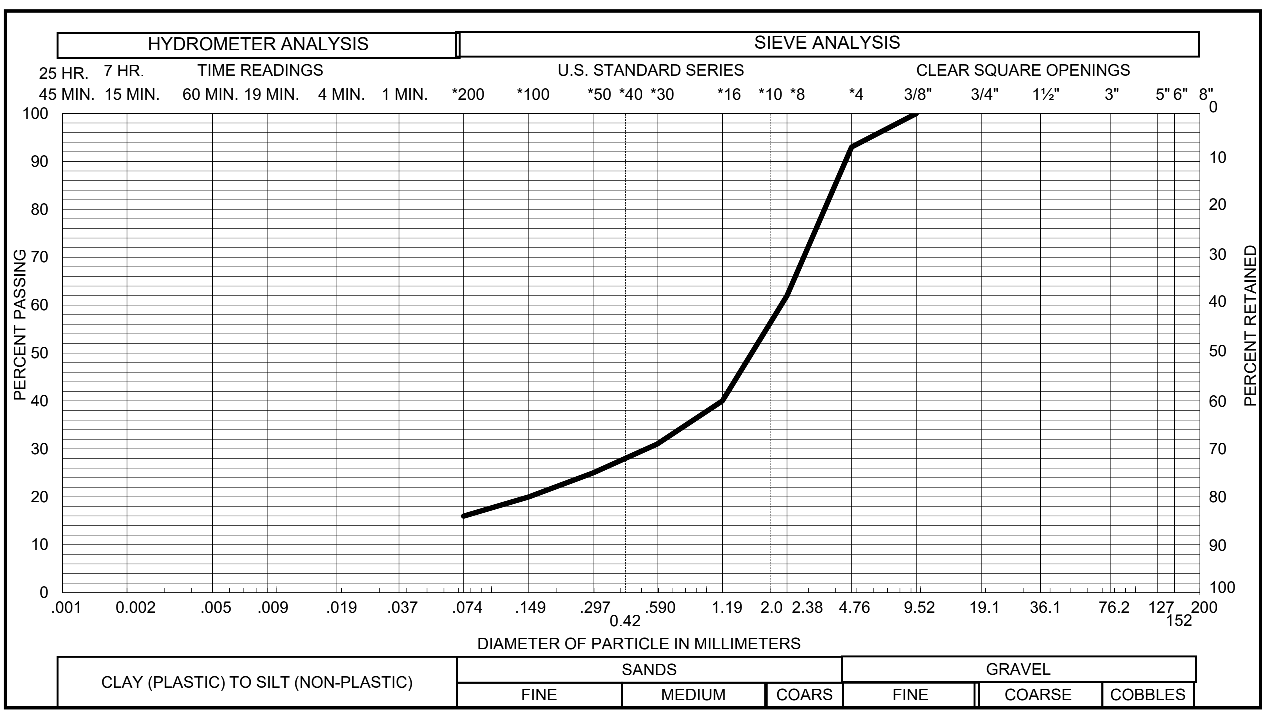
Sample of SANDSTONE, CLAYEY

From MW - 134 AT 14 FEET

GRAVEL 8 % SAND 69 %

SILT & CLAY 23 % LIQUID LIMIT

PLASTICITY INDEX



Sample of SAND, VERY CLAYEY (SC)

From MW - 135 AT 4 FEET

GRAVEL 7 % SAND 77 %

SILT & CLAY 16 % LIQUID LIMIT 29

PLASTICITY INDEX 8

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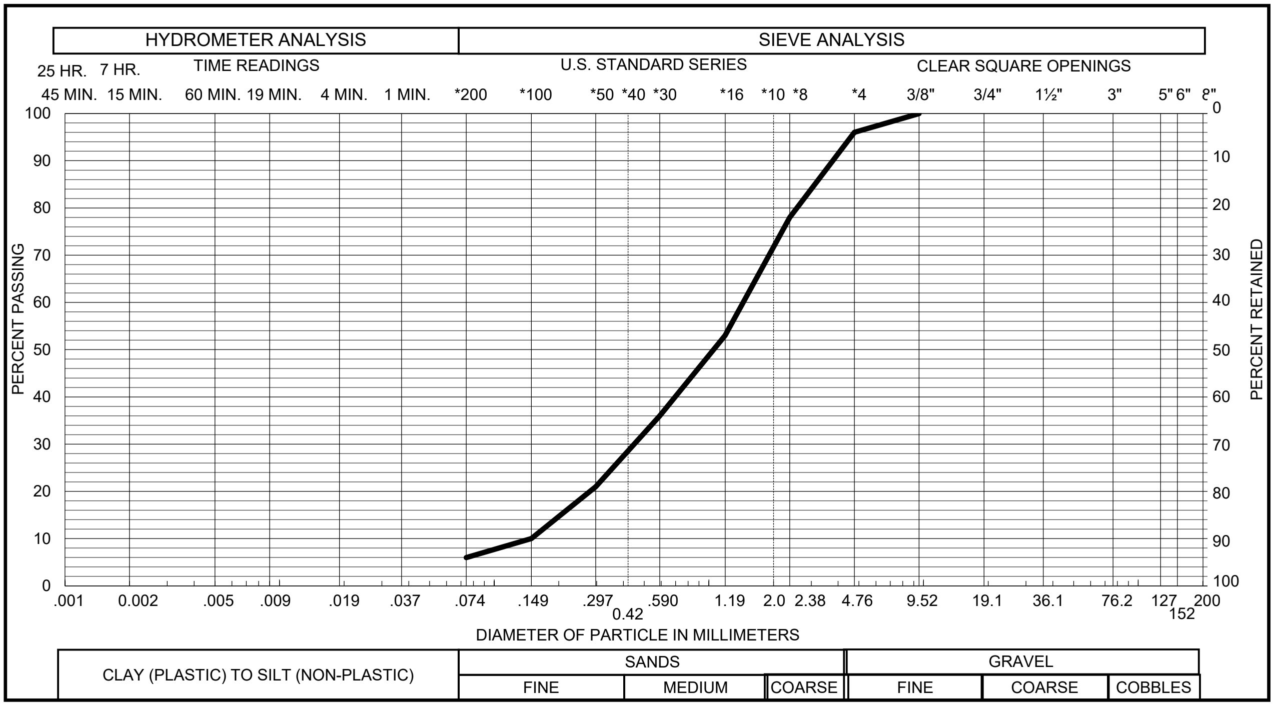
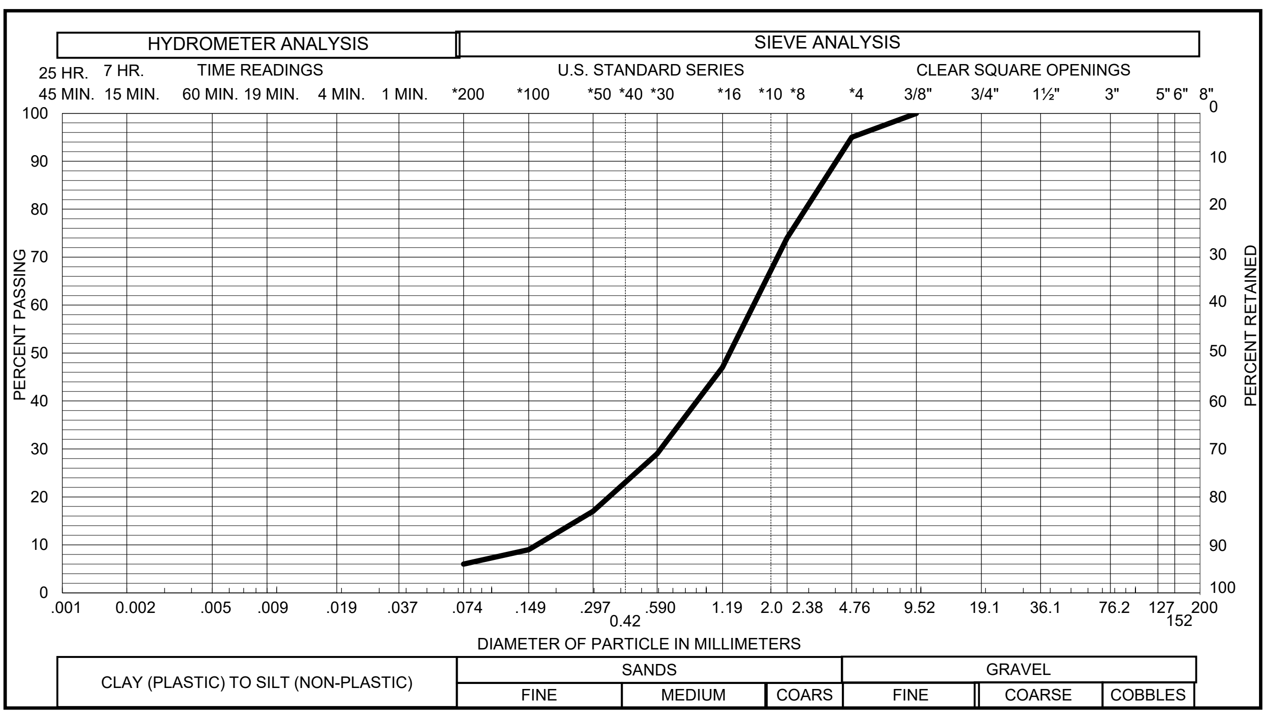
Gradation Test Results

FIG. B-9



Sample of SAND, SLIGHTLY SILTY (SP-SM)
From MW - 136 AT 4 FEET

GRAVEL 4 % SAND 90 %
SILT & CLAY 6 % LIQUID LIMIT
PLASTICITY INDEX



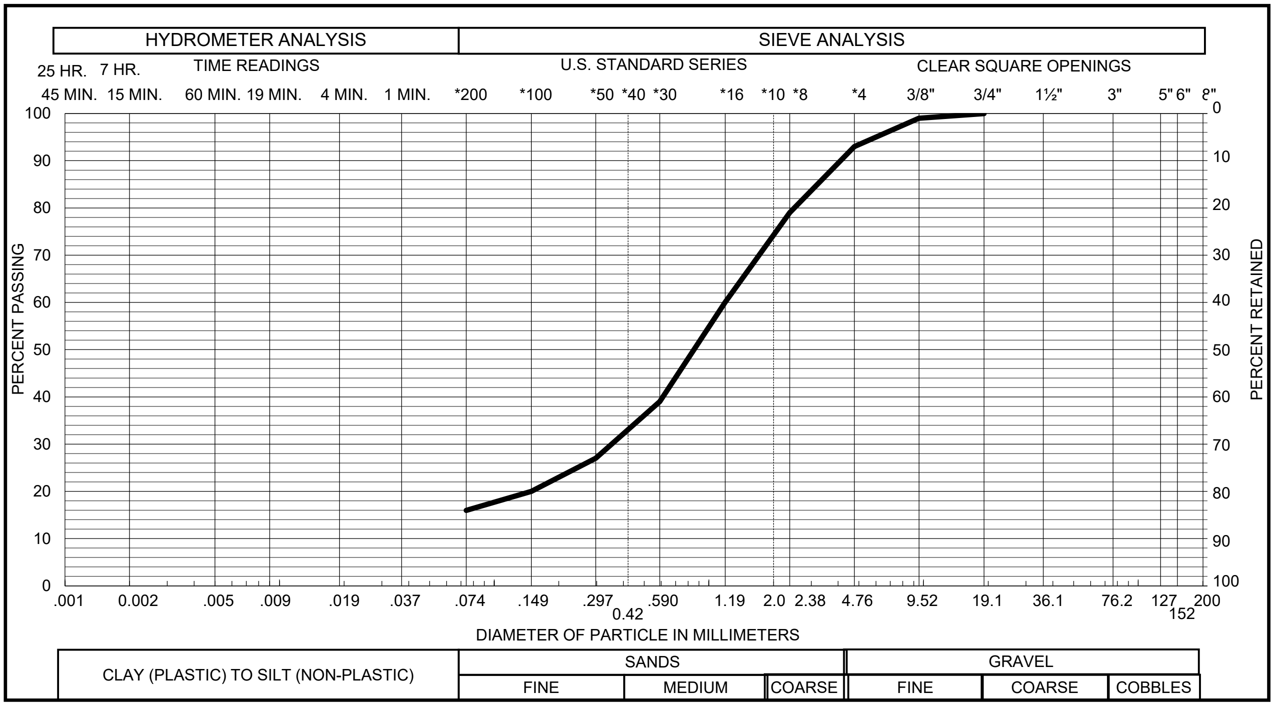
Sample of SANDSTONE, SLIGHTLY SILTY
From MW - 136 AT 14 FEET

GRAVEL 5 % SAND 89 %
SILT & CLAY 6 % LIQUID LIMIT
PLASTICITY INDEX

D.R. HORTON
GRANDVIEW RESERVE, PHASE 3
CTL|T PROJECT NO. CS19345.300-115

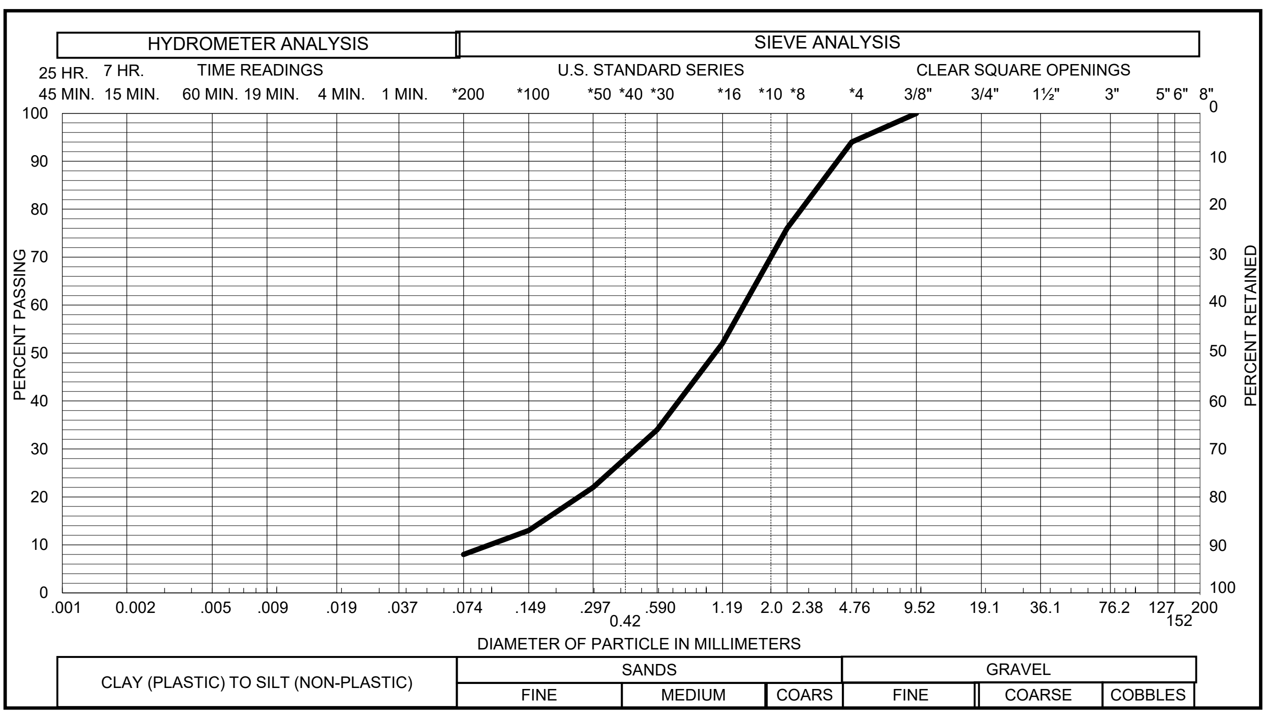
Gradation Test Results

FIG. B-10



Sample of SANDSTONE, CLAYEY
From MW - 136A AT 9 FEET

GRAVEL 7 % SAND 77 %
SILT & CLAY 16 % LIQUID LIMIT
PLASTICITY INDEX



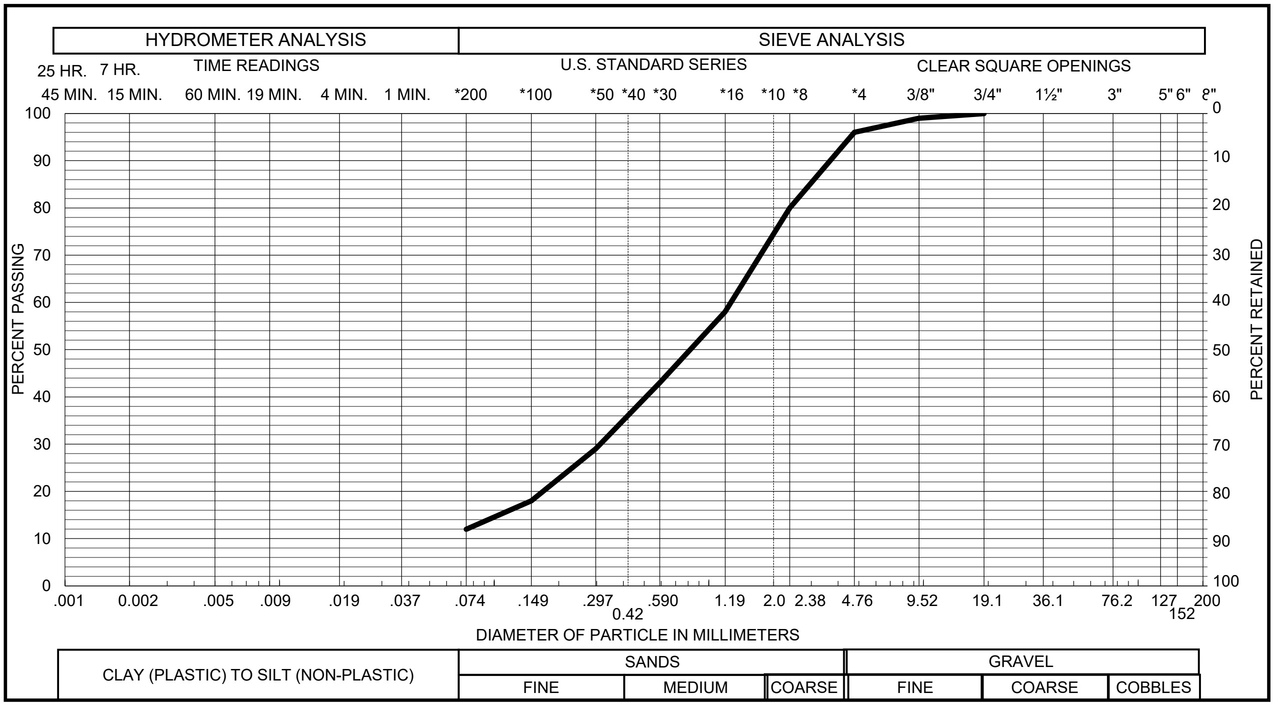
Sample of SAND, SLIGHTLY SILTY (SW-SM)
From MW - 142 AT 4 FEET

GRAVEL 6 % SAND 86 %
SILT & CLAY 8 % LIQUID LIMIT
PLASTICITY INDEX

D.R. HORTON
GRANDVIEW RESERVE, PHASE 3
CTL|T PROJECT NO. CS19345.300-115

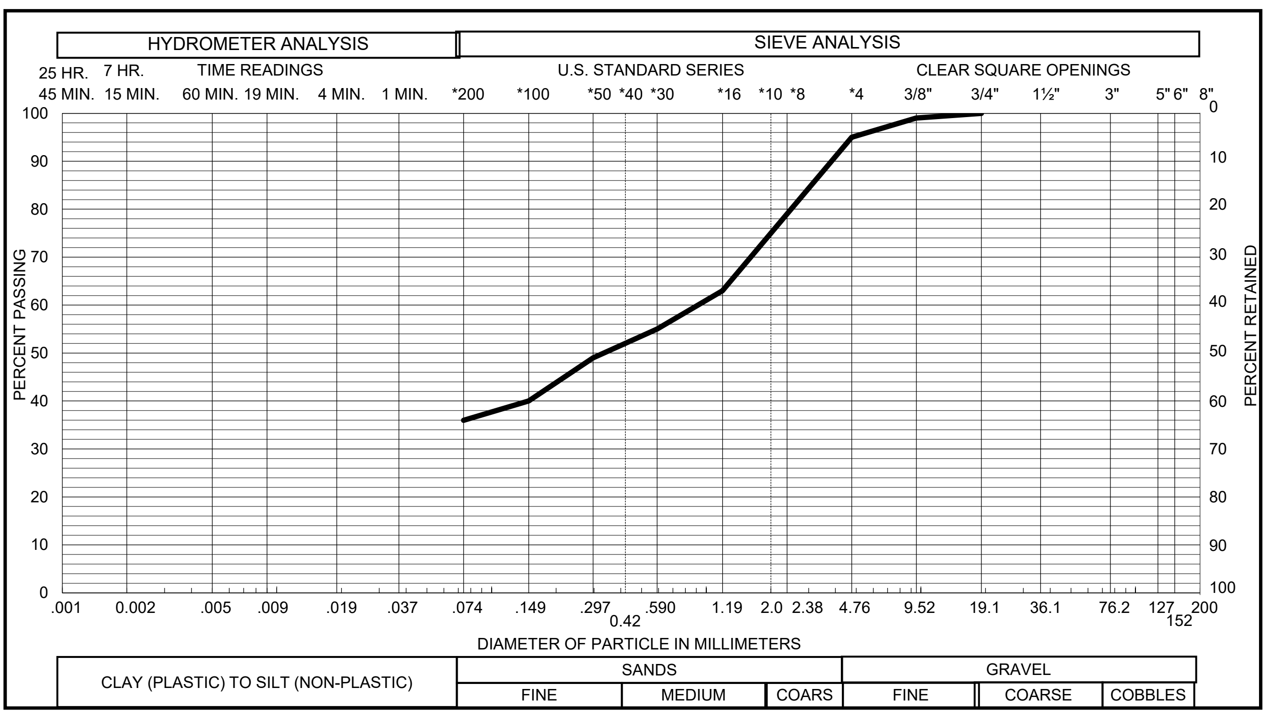
Gradation Test Results

FIG. B-11



Sample of SAND, SLIGHTLY SILTY (SW-SM)
From MW - 143 AT 4 FEET

GRAVEL 4 % SAND 84 %
SILT & CLAY 12 % LIQUID LIMIT
PLASTICITY INDEX



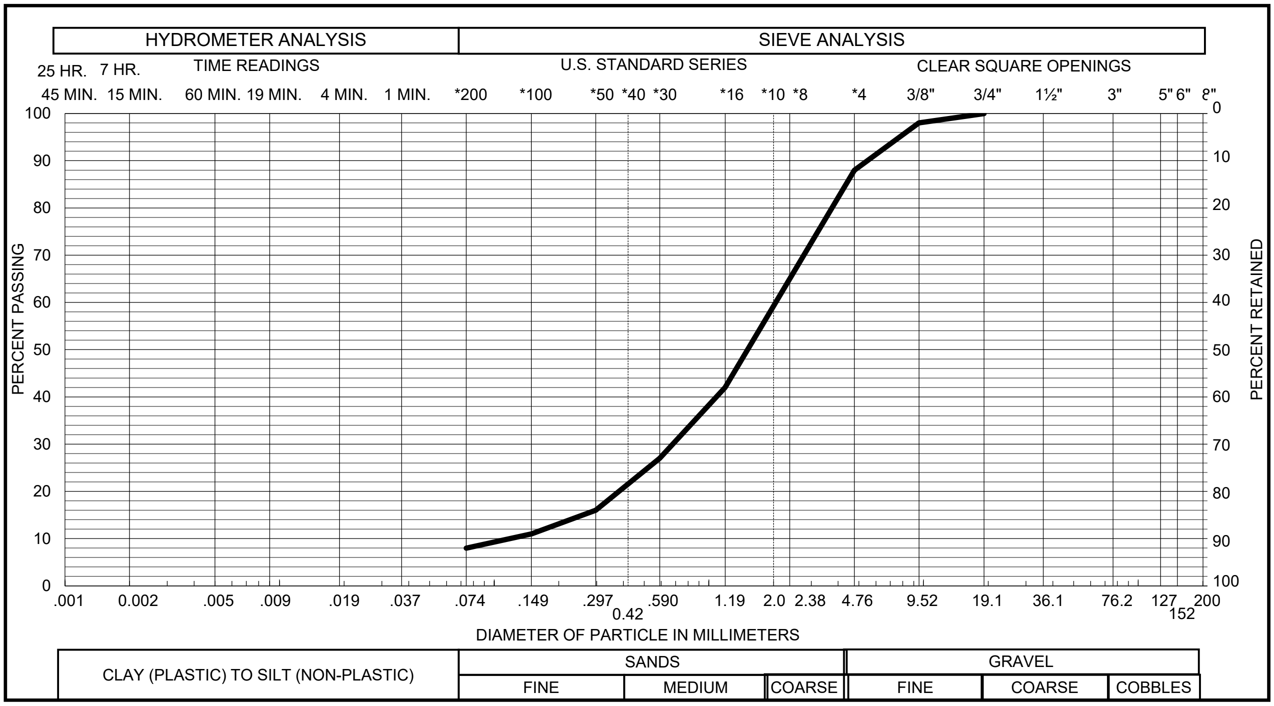
Sample of SANDSTONE, CLAYEY
From MW - 143 AT 9 FEET

GRAVEL 5 % SAND 59 %
SILT & CLAY 36 % LIQUID LIMIT
PLASTICITY INDEX

D.R. HORTON
GRANDVIEW RESERVE, PHASE 3
CTL|T PROJECT NO. CS19345.300-115

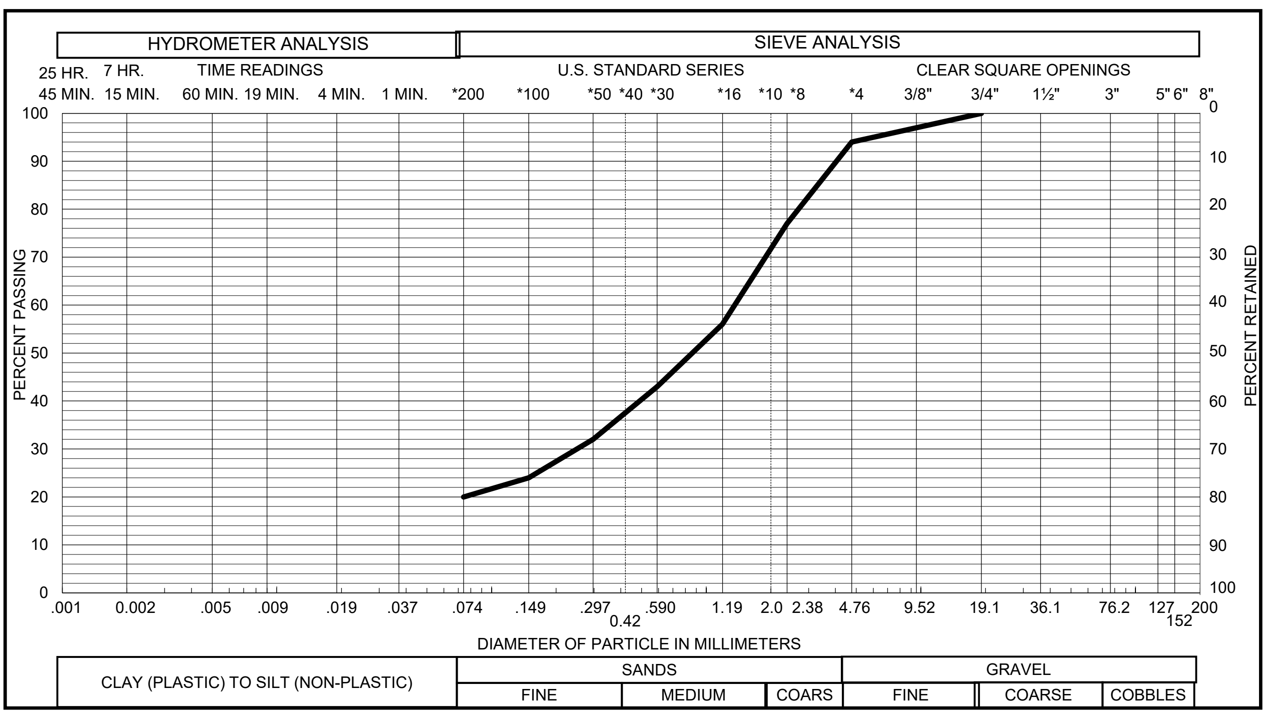
Gradation Test Results

FIG. B-12



Sample of SAND, SLIGHTLY SILTY (SW-SM)
From MW - 144 AT 4 FEET

GRAVEL 12 % SAND 80 %
SILT & CLAY 8 % LIQUID LIMIT
PLASTICITY INDEX



Sample of SANDSTONE, CLAYEY
From MW - 144 AT 14 FEET

GRAVEL 6 % SAND 74 %
SILT & CLAY 20 % LIQUID LIMIT
PLASTICITY INDEX

D.R. HORTON
GRANDVIEW RESERVE, PHASE 3
CTL|T PROJECT NO. CS19345.300-115

Gradation Test Results

FIG. B-13

TABLE B-1

SUMMARY OF LABORATORY TESTING
CTL|T PROJECT NO. CS19345.300-115

BORING/ WELL	DEPTH (FEET)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	ATTERBERG LIMITS		SWELL TEST RESULTS*		PASSING NO. 200 SIEVE (%)	DESCRIPTION
				LIQUID LIMIT	PLASTICITY INDEX	SWELL (%)	APPLIED PRESSURE (PSF)		
TH-1	4	2.8	107					22	SAND, SILTY (SM)
TH-8	4	6.6		36	18			22	SAND, CLAYEY (SC)
TH-8	14	13.2	114			1.0	1800	43	SANDSTONE, VERY CLAYEY
MW-123	9	11.6						35	SANDSTONE, CLAYEY
MW-124	4	5.4		24	4			13	SAND, SILTY, CLAYEY (SC-SM)
MW-126	4	11.5	118					14	SAND, VERY CLAYEY (SC)
MW-126	9	9.8	127	30	12			17	SANDSTONE, CLAYEY
MW-127	4	17.0						5	SAND, SLIGHTLY SILTY (SW-SM)
MW-127	14	16.7		22	1			12	SAND, SLIGHTLY SILTY (SW-SM)
MW-128	14	10.3						36	SANDSTONE, VERY CLAYEY
MW-129	4	8.6	128					17	SANDSTONE, CLAYEY
MW-129	14	10.8	119					58	CLAYSTONE, VERY SANDY
MW-132	4	17.6	113					90	CLAYSTONE, SLIGHTLY SANDY
MW-132	14	10.2	123					19	SANDSTONE, CLAYEY
MW-134	9	12.3	122	34	13			72	CLAYSTONE, SANDY
MW-134	14	8.8	126					23	SANDSTONE, CLAYEY
MW-135	4	6.9	110	29	8			16	SAND, VERY CLAYEY (SC)
MW-136	4	8.6	111					6	SAND, SLIGHTLY SILTY (SP-SM)
MW-136	14	8.1	106					6	SANDSTONE, SLIGHTLY SILTY
MW-136A	9	13.3							SANDSTONE, CLAYEY
MW-142	4	3.6	98					8	SAND, SLIGHTLY SILTY (SW-SM)
MW-143	4	7.0	119					12	SAND, SLIGHTLY SILTY (SW-SM)
MW-143	9	9.4						30	SANDSTONE, CLAYEY
MW-144	4	4.0						8	SAND, SLIGHTLY SILTY (SW-SM)
MW-144	14	9.7	125					20	SANDSTONE, CLAYEY

* SWELL MEASURED UNDER ESTIMATED IN-SITU OVERBURDEN PRESSURE.
NEGATIVE VALUE INDICATES COMPRESSION.

APPENDIX C

GUIDELINE SITE GRADING SPECIFICATIONS
GRANDVIEW RESERVE
EL PASO COUNTY, COLORADO

GUIDELINE SITE GRADING SPECIFICATIONS

GRANDVIEW RESERVE
EL PASO COUNTY, COLORADO

1. DESCRIPTION

This item consists of the excavation, transportation, placement and compaction of materials from locations indicated on the plans, or staked by the Engineer, as necessary to achieve preliminary pavement and building pad elevations. These specifications also apply to compaction of materials that may be placed outside of the project.

2. GENERAL

The Soils Engineer will be the Owner's representative. The Soils Engineer will approve fill materials, method of placement, moisture contents and percent compaction.

3. CLEARING JOB SITE

The Contractor shall remove all trees, brush and rubbish before excavation or fill placement is begun. The Contractor shall dispose of the cleared material to provide the Owner with a clean, neat appearing job site. Cleared material shall not be placed in areas to receive fill or where the material will support structures of any kind.

4. SCARIFYING AREA TO BE FILLED

All topsoil, vegetable matter, and existing fill shall be removed from the ground surface upon which fill is to be placed. The surface shall then be plowed or scarified until the surface is free from ruts, hummocks or other uneven features that would prevent uniform compaction by the equipment to be used.

5. PLACEMENT OF FILL ON NATURAL SLOPES

Where natural slopes are steeper than 20 percent (5:1, horizontal to vertical) and fill placement is required, horizontal benches shall be cut into the hillside. The benches shall be at least 12 feet wide or 1-1/2 times the width of the compaction equipment and be provided at a vertical spacing of not more than 5 feet (minimum of two benches). Larger bench widths may be required by the Engineer. Fill shall be placed on completed benches as outlined within this specification.

6. COMPACTING AREA TO BE FILLED

After the foundation for the fill has been cleared and scarified, it shall be disced or bladed until it is free from large clods, brought to a workable moisture content and compacted.

7. FILL MATERIALS

Fill soils shall be free from vegetable matter or other deleterious substances and shall not contain rocks or lumps having a diameter greater than six (6) inches.

Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the Engineer or imported to the site.

8. MOISTURE CONTENT

For fill material classifying as CH or CL, the fill shall be moisture treated to between 1 and 4 percent above optimum moisture content as determined by ASTM D 698, if it is to be placed within 15 feet of the final grade. For deep cohesive fill (greater than 15 feet below final grade), it shall be moisture conditioned to within ±2 percent of optimum. Soils classifying as SM, SC, SW, SP, GP, GC and GM shall be moisture treated to within 2 percent of optimum moisture content as determined by ASTM D 1557. Sufficient laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered in borrow areas.

The Contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the Soils Engineer, it is not possible to obtain uniform moisture content by adding water on the fill surface. The Contractor may be required to rake or disc the fill soils to provide uniform moisture content throughout the soils.

The application of water to embankment materials shall be made with any type of watering equipment approved by the Soils Engineer, which will give the desired results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are washed out.

Should too much water be added to any part of the fill, such that the material is too wet to permit the desired compaction to be obtained, all work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The Contractor will be permitted to rework wet material in an approved manner to hasten its drying.

9. COMPACTION OF FILL AREAS

Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to not less than the specified percentage of maximum density. Granular fill placed less than 15 feet below final grade shall be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D 1557. Cohesive fills placed less than 15 feet below final grade shall be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D 698. For deep, cohesive fill (to be placed 15 feet or deeper below final grade), the material shall be compacted to at least 98 percent of maximum standard Proctor dry density (ASTM D 698). Granular fill placed more than 15 feet below final grade shall be compacted to at least 95 percent of maximum modified Proctor dry density (ASTM D 1557). Deep fills shall be placed within 2 percent of optimum moisture content. Fill materials shall be placed such that the thickness of loose materials does not exceed 10 inches and the compacted lift thickness does not exceed 6 inches.

Compaction, as specified above, shall be obtained by the use of sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment approved by the Soils Engineer for soils classifying as claystone, CL, CH or SC. Granular fill shall be compacted using vibratory equipment or other equipment approved by the Soils Engineer. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area. Compaction equipment shall make sufficient trips to ensure that the required density is obtained.

10. COMPACTION OF SLOPES

Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compaction operations shall be continued until slopes are stable, but not too dense for planting, and there is no appreciable amount of loose soil on the slopes. Compaction of slopes may be done progressively in increments of 3 to 5 feet in height or after the fill is brought to its total height. Permanent fill slopes shall not exceed 3:1 (horizontal to vertical).

11. DENSITY TESTS

Field density tests will be made by the Soils Engineer at locations and depths of his/her choosing. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests will be taken in compacted material below the disturbed surface. When density tests indicate the density or moisture content of any layer of fill or portion thereof is below that required, the particular layer or portion shall be reworked until the required density or moisture content has been achieved. The criteria for acceptance of fill shall be:

A. Moisture

The allowable ranges for moisture content of the fill materials specified above in "Moisture Content" are based on design considerations. The moisture shall be controlled by the Contractor so that moisture content of the compacted earth fill, as determined by tests performed by the Soils Engineer, shall be within the limits given. The Soils Engineer will inform the Contractor when the placement moisture is less than or exceeds the limits specified above and the Contractor shall immediately make adjustments in procedures as necessary to maintain placement moisture content within the specified limits.

B. Density

1. The average dry density of all material shall not be less than the dry density specified.

2. No more than 20 percent of the material represented by the samples tested shall be at dry densities less than the dry density specified.

3. Material represented by samples tested having a dry density more than 2 percent below the specified dry density will be rejected. Such rejected

materials shall be reworked until a dry density equal to or greater than the specified dry density is obtained.

12. SEASONAL LIMITS

No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Soils Engineer indicates the moisture content and density of previously placed materials are as specified.

13. NOTICE REGARDING START OF GRADING

The Contractor shall submit notification to the Soils Engineer and owner advising them of the start of grading operations at least three (3) days in advance of the starting date. Notification shall also be submitted at least three days in advance of any resumption dates when grading operations have been stopped for any reason other than adverse weather conditions.

14. REPORTING OF FIELD DENSITY TESTS

Density tests made by the Soils Engineer, as specified under “Density Tests” above, will be submitted progressively to the Owner. Dry density, moisture content and percent compaction will be reported for each test taken.