



PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

**Proposed Multi-Family Residential Development
NE of Granada Road and Bountiful Court
Adams County, Colorado**

Prepared for:

Maiker Housing Partners
3033 West 71st Avenue, Suite 1000
Westminster, Colorado 80030

Prepared by:

Cole Garner Geotechnical

CGG Project No.: 24.22.212

December 19, 2024



December 19, 2024

Maiker Housing Partners
3033 West 71st Avenue, Suite 1000
Westminster, Colorado 80030

Attn: Elizabeth Kay Marchetti, AICP

**Re: Preliminary Geotechnical Engineering Report
Proposed Multi-Family Residential Development
NE of Granada Road and Bountiful Court
Adams County, Colorado
CGG Project No. 24.22.212**

Cole Garner Geotechnical (CGG) has completed a preliminary geotechnical engineering investigation for the proposed multi-family residential development in unincorporated Adams County, Colorado. The scope of services for this study included a general evaluation of subsurface conditions to identify main geotechnical issues or concerns that may affect land development. This geotechnical summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

- **Subsurface Conditions:** The subsurface conditions encountered in our borings consisted of lean clay soils with varying amounts of sand, as well as some areas with clayey sand. Although not encountered in our borings (at our first sample interval), existing man-made fill soils are present on portions of the site (as discussed below). Sedimentary claystone bedrock was encountered underlying the clays in nine of the ten borings at depths ranging from about 6 to 32 feet below the ground surface. The bedrock extended to the full depth of exploration, where encountered. Other details regarding the subsurface conditions are shown on the Boring Logs included in Appendix A.
- **Groundwater Conditions:** Given the history of the site as a water storage reservoir, the depth to groundwater is of particular concern. Groundwater was generally encountered at depths ranging from about 18 to 25 feet below existing site grade, however, groundwater was measured at a depth of about 14 feet below grade in Boring No. 1 (northwest corner) and a depth of about 9 feet below grade in Boring No. 9 (southeast corner). These groundwater observations are only representative of the locations explored at the time(s) of our exploration(s). Seasonal fluctuations in groundwater elevation beyond those indicated above should be expected; ***however, we observed no evidence of shallower groundwater or natural springs on the site. Surface water appears to accumulate in low-lying portions of the site.*** Four borings were completed as temporary monitoring wells that can be used to evaluate fluctuations.

- **Existing Fill Soils:** Existing man-made fill soils are present on portions of the site. A large fill mass was placed in the eastern half of the site using excess earthen fill generated from construction of the adjacent Caraway development (beginning mid to late 2020). We understand that the fill was spread on the site with little to no compactive effort. Other earthen berms are present surrounding the site that we assume were constructed of earthen fill related to past use of the site as irrigation water storage. We have no information regarding whether placement of these older fills was observed and tested under supervision of a geotechnical engineer. With no documentation, it is possible that unsuitable materials (such as organics and construction debris) may be present within or buried by the fill.
- **Expansive Soils and Bedrock:** *The clay soils and claystone bedrock at the site exhibited variable expansive potential ranging from low to high. Collectively referred to as “Expansive Soils”, these materials are a common geologic hazard in the region and have significant potential for volume change when subjected to post-construction wetting, causing movement and damage to structures, flatwork, pavements, et cetera. We have provided recommendations to reduce the risk of movement and distress; however, eliminating the risk of movement and cosmetic distress is generally not considered feasible.*
- **Structural Considerations:** Considering the size and type of construction planned and the subsurface conditions encountered in our test borings, *it is our opinion that without mitigation the expansive materials pose a moderate to high risk of movement of spread footings and slab-on-grade floors.* Therefore, we recommend the use of deep foundations and structurally supported floors should be considered for future residential construction on the site to substantially mitigate the risk of movement of foundations and interior floors.

As an alternative and provided the owner/developer can tolerate the potential for increased movement, mitigation of the existing fill soils and expansive soils can be considered to allow the use of shallow foundations (i.e. spread footings, post-tensioned slabs, reinforced mat foundations). In this region, mitigation typically includes removal, moisture conditioning, and recompaction of the expansive materials to create a zone of low expansive engineered fill below the structure(s). This type of mitigation will reduce, but not eliminate, the potential for movement. ***Based on our analysis, supporting footings on a 10-foot thick zone of engineered fill should substantially mitigate this hazard and provide acceptable performance for foundations. It should also be noted that substantial processing and moisture conditioning of the material will be required, as such, only experienced contractors should be used.*** A similar process is recommended below public and private roadways, though to a lesser depth. We should be contacted during construction to observe conditions exposed during the subexcavation process and observe and evaluate the fill placed.

Recommendations in this report are intended to reduce the potential for extreme movements caused by expansive soils/bedrock that experience moisture content variations within a normal

range. Even after the mitigation described above, minor movements may cause distress to non-structural elements of the structure(s). Because many site conditions (floods, droughts, sub-freezing temperatures, etc.) cannot be controlled, larger movements should still be expected if expansive soils/bedrock become very wet or very dry.

- **Surface Drainage:** The amount of movement associated with foundations, floor slabs, pavements, etc. will be related to the wetting of underlying supporting soils. Therefore, it is imperative that surface water be directed away from foundations and other critical elements where movement must be held to a minimum. The recommendations outlined in the “Surface Drainage” section of this report should be used by the project Civil Engineer to develop grading plans that promote rapid runoff of storm water. Landscaping should be designed to minimize the amount of irrigation needed in proximity of the foundations. ***These measures should be maintained throughout the life of the project. Failure to maintain proper surface drainage surrounding the buildings may result in movement and distress in excess of our estimates.***
- **Required Additional Geotechnical Studies:** The scope of services for this current study included a general evaluation of subsurface conditions to identify main geotechnical issues or concerns that may affect land development. A design-level geotechnical study should be completed for the residential structures once development plans are finalized. Additional borings will also be required after completion of site grading to complete design of pavement sections for all public roadway improvements in accordance with Adams County requirements.

We appreciate being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. Please do not hesitate to contact us if you have any questions concerning this report or any of our testing, inspection, design and consulting services.

Sincerely,

Cole Garner Geotechnical



Glenn D. Ohlsen, P.E.
Sr. Project Engineer



Andrew J. Garner, P.E.
Principal, COO

Copies to: Addressee (1 PDF copy)

Preliminary Geotechnical Engineering Report
Proposed Multi-Family Residential Development – Adams County, Colorado
CGG Project No. 24.22.212

TABLE OF CONTENTS

	Page No.
Letter of Transmittal	i
INTRODUCTION	1
PROJECT INFORMATION	1
SITE EXPLORATION PROCEDURES	2
Field Exploration	2
Laboratory Testing	2
SITE CONDITIONS	3
SUBSURFACE CONDITIONS	3
Geology	3
Soil and Bedrock Conditions	4
Field and Laboratory Test Results	4
Groundwater Conditions	4
ENGINEERING RECOMMENDATIONS	5
Geotechnical Considerations	5
Earthwork and Site Development	7
Site Preparation	7
Existing Fill and Expansive Soil/Bedrock Mitigation	8
Excavations and Trench Construction	9
Fill Materials	10
Fill Placement and Compaction Requirements	10
Underground Utilities	11
Conceptual Pavement Thickness Design	11
Exterior Concrete Flatwork	15
Site Concrete Corrosion Protection	16
Conceptual Structural Considerations	17
Foundation Alternatives	17
Below-Grade Construction	17
Interior, Non-structural Floor Slabs	17
Seismic Considerations	18
Final Grading, Landscaping, and Surface Drainage	18
GENERAL COMMENTS	19
APPENDIX A: BORING LOCATION DIAGRAM, BORING LOGS	
APPENDIX B: LABORATORY TEST RESULTS	
APPENDIX C: GENERAL NOTES	



PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

PROPOSED MULTI-FAMILY RESIDENTIAL DEVELOPMENT

NE of GRANADA ROAD and BOUNTIFUL COURT

ADAMS COUNTY, COLORADO

CGG Project No. 24.22.212

December 19, 2024

INTRODUCTION

This report contains the results of our preliminary geotechnical engineering exploration for the proposed multi-family residential development in unincorporated Adams County, Colorado. This study was performed in general accordance with our proposal no. P24.22.218 executed October 21, 2024.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and bedrock conditions
- Groundwater conditions
- Site preparation and earthwork
- Preliminary structure foundation alternatives
- Below-grade construction
- Conceptual pavement sections
- Surface and subsurface drainage

The recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, and our understanding of the proposed project. We have also reviewed our geotechnical report prepared for the Caraway residential development directly east of the site.

PROJECT INFORMATION

We understand that the project will include the development of approximately 7.2 acres of vacant property located northeast of the subject intersection in unincorporated Adams County, Colorado. Future development of the parcel is planned to include construction of multi-family residential buildings (3 to 5 stories) and/or townhomes, a public park (green space), a community gardening/farming space, surface parking and the extension of Bountiful Court as either a public or private drive.

Based on a visual estimate of current site grades we estimate that earthen cut and fill depths on the order of 5 to 10 feet will be needed to bring the site to rough construction grade. Other major site development

will include the installation of underground utilities, stormwater detention, site landscaping, and other ancillary amenities. If our understanding of the project, or assumptions above, is not accurate, or if you have additional useful information, please inform us as soon as possible.

SITE EXPLORATION PROCEDURES

The scope of the services performed for this project included a preliminary-phase subsurface exploration program, laboratory testing, and engineering analysis.

Field Exploration: Our scope of services for this study included advancing 10 geotechnical test borings across the site at the approximate locations shown on **Figure 1 – Boring Location Diagram** included in Appendix A. The boring locations were staked using a hand-held GPS device.

Borings were advanced to depths ranging from about 25 to 50 feet below existing site grades with a truck or track-mounted drilling rig utilizing 4-inch diameter, solid-stem auger. Our field personnel recorded a lithologic log of each boring during the drilling operations. At selected intervals, samples of the subsurface materials were obtained by driving Modified California barrel samplers. Penetration resistance measurements were obtained by driving the sample barrels into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index to the consistency, relative density or hardness of the materials encountered.

Groundwater measurements were made in each boring at the time of site exploration and again a minimum of five days later.

Laboratory Testing: Samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer and were classified in general accordance with the Unified Soil Classification System described in Appendix C. Bedrock was classified according to the General Notes for Rock Classification. At that time, an applicable laboratory-testing program was formulated to determine engineering properties of the subsurface materials. Following the completion of the laboratory testing, the field descriptions were confirmed or modified as necessary, and Boring Logs were prepared. These logs are presented in Appendix A.

Laboratory test results are presented in Appendix B. These results were used for the geotechnical engineering analyses and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable local or other accepted standards.

Selected soil and bedrock samples were tested for the following engineering properties:

- Water content
- Dry density
- Swell/Consolidation
- Grain size
- Plasticity Index
- Water-soluble sulfates

SITE CONDITIONS

The site consists of approximately 7.2 acres of vacant property located northeast of Granada Road and Bountiful Court in unincorporated Adams County, Colorado, as shown on **Figure 1 – Boring Location Diagram** included in Appendix A. The parcel is bordered by residential development to the north, south, east, and west. A majority of the parcel was historically utilized for water storage (Franklin Reservoir) for an irrigation ditch company but appears to have been dry since at least 1994 (based on historic imagery available on Google Earth). Existing features associated with the prior reservoir include earthen berms and abandoned irrigation ditches along the western and southern boundaries of the site and an outfall gate valve structure /pipe within the southeast portion of the site.

As part of construction of the existing Caraway development adjacent to the eastern site boundary, earthen fill stockpiles were placed on the site (completed in 2022/23); these stockpiled fill soils have been leveled and graded within the past year (these areas are substantially free of vegetation), resulting in an estimated 6 to 8 feet of uncompacted fill soils on a large portion of the site. The remainder of the site is covered with grasses and weeds as well as areas with heavily wooded trees and shrubs. In the southwestern site extents.

SUBSURFACE CONDITIONS

Geology: Surficial geologic conditions as mapped by the United States Geological Survey (USGS) (¹Lindvall, 1980) consist of Colluvium (Qco) and Piney Creek Alluvium (Qp) of Holocene to Pleistocene Age. These materials are reported to include interbedded sand, silt, and clay. Thickness is commonly 5 to 10 feet.

Bedrock underlying the surface units consists of the Denver and Arapahoe Formations (TKda) of Paleocene and Upper Cretaceous Age. These formations typically include interbedded claystone, siltstone, sandstone, shale, and conglomerate. Thickness in the area is reported to be 785 feet.

Mapping completed by the Colorado Geological Survey (²Hart, 1972) indicates the site is located in an area of "High Swell Potential." This category generally includes bedrock and some surficial soils. The soils and bedrock encountered in our borings exhibited **low to high expansive (swell) potential** at existing moisture contents.

We believe expansive soils are the predominant geologic hazard present on the site. We did not identify other geologic hazards that would impact development of the site. Seismic activity in the area is anticipated to be low, and the property should be relatively stable from a structural standpoint. We

¹ Lindvall, R.M., 1980, *Geologic Map of the Commerce City Quadrangle, Adams and Denver Counties, Colorado*, United States Geological Survey, Map GQ-1541.

² Hart, Stephen S., 1972, *Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado*, Colorado Geological Survey, Sheet 2 of 4.

anticipate that mass site grading will be performed to limit slopes to stable configurations. With proper site grading around proposed structures, erosional problems at the site should be reduced.

Soil and Bedrock Conditions: The subsurface conditions encountered in our borings consisted of lean clay soils with varying amounts of sand, as well as some areas with clayey sand. Although not encountered in our borings (at our first sample interval), existing man-made fill soils are present on portions of the site. Existing fills within the eastern portion of the site were placed around the time of construction of the Caraway residential development to the east, while other bermed fill areas are present surrounding the site, likely placed as part of construction of the prior reservoir.

Sedimentary claystone bedrock was encountered underlying the clays in nine of the ten borings at depths ranging from about 6 to 32 feet below the ground surface. This formation was typically encountered at depths ranging from about 6 to 12 feet below existing site grades around the perimeter of the site (in Boring Nos. 1, 2, 4, 7, 9, and 10 and was deeper in the northeastern and central portions of the site. The bedrock extended to the full depth of exploration, where encountered. Other details regarding the subsurface conditions are shown on the Boring Logs included in Appendix A.

Field and Laboratory Test Results: Field test results indicate that the clay soils generally varied from medium stiff to hard in consistency, although two samples were soft near the groundwater surface. The bedrock formation ranged from medium hard to very hard based on penetration resistance, although a couple samples were firm.

The clay soils and claystone bedrock are considered moderately to highly plastic and selected samples exhibited low to high expansive potential at existing moisture contents. Testing of select samples for the presence of water-soluble sulfates indicated concentrations of 900 to 3,400 parts per million (ppm).

Groundwater Conditions: Based upon review of U.S. Geological Survey Maps (³Hillier, et al, 1983), regional groundwater beneath the project area (approximate eastern portion of site) predominates in the Denver Aquifer at depths generally more than 20 feet, and commonly more than 100 feet, below the ground surface.

Mapping also indicates groundwater beneath the approximate western portion of the site occurs in unconsolidated alluvial deposits at depths generally ranging from about 5 to 10 feet below the ground surface.

Given the history of the site as a water storage reservoir, the depth to groundwater is of particular concern. Groundwater information obtained during our study is outlined below. Multiple borings (as noted below) were completed as temporary groundwater monitoring wells to allow for future evaluation of seasonal high groundwater conditions in the spring and summer months.

³ Hillier, Donald E.; Schneider, Paul A., Jr.; and Hutchinson, E. Carter, 1983, *Depth to Water Table (1976-1977) in the Greater Denver Area, Front Range Urban Corridor, Colorado*, United States Geological Survey, Map I-856-K.

Preliminary Geotechnical Engineering Report
Proposed Multi-Family Residential Development – Adams County, Colorado
CGG Project No. 24.22.212

DEPTH TO GROUNDWATER SUMMARY

Boring No.	Completed as GW Monitoring Well	Approximate Depth to Groundwater (feet)		
		During Drilling	Follow-up Measurements*	
			11/12/24	12/5/24
1	No	22	14	--
2	<u>Yes</u>	None	17.6	14.9
3	No	22	20	--
4	<u>Yes</u>	None	24.8	22.3
5	No	18	Covered	--
6	<u>Yes</u>	None	20.1	18.9
7	No	None	20	--
8	No	24	21.5	--
9	<u>Yes</u>	None	None	24.7
10	No	None	24	--

*We are available to perform supplemental groundwater measurements, upon request, within borings completed as temporary groundwater monitoring wells. Borings not completed as monitoring wells were backfilled after the follow-up measurement.

The above groundwater observations are only representative of the locations explored at the time(s) of our exploration(s). Seasonal fluctuations in groundwater elevation beyond those indicated above should be expected; however, we observed no evidence of shallow groundwater or natural springs on the site. Surface water appears to accumulate in low-lying portions of the site.

After site development, localized areas of “perched” groundwater (surface water that is trapped on top or within permeable seams of the bedrock formation) may also develop intermittently. ***The possibility of groundwater fluctuations should be considered when developing design and construction plans for the project.***

ENGINEERING RECOMMENDATIONS

Geotechnical Considerations: Based on the information obtained from our subsurface exploration, laboratory testing, and a cursory review of geologic conditions, it is our opinion that the site appears suitable for development of the proposed project provided the recommendations in this report are followed. The following primary geotechnical considerations were identified:

- **Groundwater Conditions:** Given the history of the site as a water storage reservoir, the depth to groundwater is of particular concern. Groundwater was generally encountered at depths ranging from about 18 to 25 feet below existing site grade, however, groundwater was measured at a depth of about 14 feet below grade in Boring No. 1 (northwest corner) and a depth of about 9 feet below grade in Boring No. 9 (southeast corner). These groundwater observations are only representative of the locations explored at the time(s) of our exploration(s). Seasonal fluctuations in groundwater elevation beyond those indicated above should be expected; ***however, we observed no evidence of shallower groundwater or natural springs on the site. Surface water appears to accumulate in***

low-lying portions of the site. Four borings were completed as temporary monitoring wells that can be used to evaluate fluctuations.

- **Existing Fill Soils:** Existing man-made fill soils are present on portions of the site. A large fill mass was placed in the eastern half of the site using excess earthen fill generated from construction of the adjacent Caraway development (beginning mid to late 2020). We understand that the fill was spread on the site with little to no compactive effort. Other earthen berms are present surrounding the site that we assume were constructed of earthen fill related to past use of the site as irrigation water storage. We have no information regarding whether placement of these older fills was observed and tested under supervision of a geotechnical engineer. With no documentation, it is possible that unsuitable materials (such as organics and construction debris) may be present within or buried by the fill.
- **Expansive Soils and Bedrock:** *The clay soils and claystone bedrock at the site exhibited variable expansive potential ranging from low to high. Collectively referred to as “Expansive Soils”, these materials are a common geologic hazard in the region and have significant potential for volume change when subjected to post-construction wetting, causing movement and damage to structures, flatwork, pavements, et cetera. We have provided recommendations to reduce the risk of movement and distress; however, eliminating the risk of movement and cosmetic distress is generally not considered feasible.*
- **Structural Considerations:** Considering the size and type of construction planned and the subsurface conditions encountered in our test borings, *it is our opinion that without mitigation the expansive materials pose a moderate to high risk of movement of spread footings and slab-on-grade floors.* Therefore, we recommend the use of deep foundations and structurally supported floors should be considered for future residential construction on the site to substantially mitigate the risk of movement of foundations and interior floors.

As an alternative and provided the owner/developer can tolerate the potential for increased movement, mitigation of the existing fill soils and expansive soils can be considered to allow the use of shallow foundations (i.e. spread footings, post-tensioned slabs, reinforced mat foundations). In this region, mitigation typically includes removal, moisture conditioning, and recompaction of the expansive materials to create a zone of low expansive engineered fill below the structure(s). This type of mitigation will reduce, but not eliminate, the potential for movement. ***Based on our analysis, supporting footings on a 10-foot thick zone of engineered fill should substantially mitigate this hazard and provide acceptable performance for foundations. It should also be noted that substantial processing and moisture conditioning of the material will be required, as such, only experienced contractors should be used.*** A similar process is recommended below public and private roadways, though to a lesser depth. We should be contacted during construction to observe conditions exposed during the subexcavation process and observe and evaluate the fill placed.

Recommendations in this report are intended to reduce the potential for extreme movements caused by expansive soils/bedrock that experience moisture content variations within a normal range. Even after the mitigation described above, minor movements may cause distress to non-structural elements of the structure(s). Because many site conditions (floods, droughts, sub-freezing temperatures, etc.) cannot be controlled, larger movements should still be expected if expansive soils/bedrock become very wet or very dry.

- **Surface Drainage:** The amount of movement associated with foundations, floor slabs, pavements, etc. will be related to the wetting of underlying supporting soils. Therefore, it is imperative that surface water be directed away from foundations and other critical elements where movement must be held to a minimum. The recommendations outlined in the “Surface Drainage” section of this report should be used by the project Civil Engineer to develop grading plans that promote rapid runoff of storm water. Landscaping should be designed to minimize the amount of irrigation needed in proximity of the foundations. ***These measures should be maintained throughout the life of the project. Failure to maintain proper surface drainage surrounding the buildings may result in movement and distress in excess of our estimates.***
- **Required Additional Geotechnical Studies:** The scope of services for this current study included a general evaluation of subsurface conditions to identify main geotechnical issues or concerns that may affect land development. A design-level geotechnical study should be completed for the residential structures once development plans are finalized. Additional borings will also be required after completion of site grading to complete design of pavement sections for all public roadway improvements in accordance with Adams County requirements.

Earthwork and Site Development: The following presents our initial recommendations for site preparation, excavations, subgrade preparation and placement of engineered fills on the project based on typical construction methods and earthwork practices in the region. Earthwork on the project should be observed and evaluated by the Geotechnical Engineer. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

- **Site Preparation:** Strip and remove existing vegetation and other deleterious materials from proposed building and pavement/flatwork areas. **Reclamation of the earthen berms and irrigation ditches should include removal of fill soils, structures associated with inlets or outlets, and the removal of all soft/loose soils associated with these elements.** All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction. ***Existing trees, root balls and laterally oriented roots greater than about 1-inch in diameter should be removed from below structural areas and other critical elements.*** Stripped materials consisting of vegetation and organic materials should be wasted from the site or used to revegetate landscaped areas or exposed slopes after completion of grading operations.

The near-surface soils appeared relatively stable at the time of our exploration, but stability may be affected by precipitation, repetitive construction traffic, or other factors. Where unstable conditions are encountered or develop during construction, workability may be improved by scarifying and aeration during warmer periods. Stabilization using gravel augmentation (mechanically compacting/kneading crushed rock into the subgrade soils) is often a cost-effective mitigation method. In our experience, crushed rock or recycled concrete materials on the order of 3 to 6 inches in size would be effective in most situations. The actual mitigation methods used should be based on observation of exposed conditions by the geotechnical engineer.

- **Existing Fill and Expansive Soil/Bedrock Mitigation:** In addition to the reclamation discussed above, we recommend removal of the more recently placed existing fill soils. We understand that these fill soils were sourced from the adjacent Caraway residential development and that the owner reports these soils are substantially free of debris and/or organics. Therefore, reuse of these soils as compacted fill in other portions of the site should be feasible.

The clay soils and claystone bedrock present at the site exhibited substantial expansive potential (Expansive Soils). ***These expansive soils, when subjected to typical post-construction wetting, are capable of causing uneven floor slabs, minor foundation movement, and other cosmetic distress such as uneven door and window frames, drywall cracking, et cetera. These soils will require mitigation to allow for spread footing foundations and slab-on-grade floors (or other shallow foundations).*** We believe the use of deep foundations (socketed into the deeper bedrock materials) should be considered for structures where expansive soils are present. This alternative would also require the use of suspended structural floors in finished spaces. In our experience, these systems can add substantial cost to the project. Mitigation of this hazard can also be considered.

In this region, the most common method of swell mitigation involves deep subexcavation of expansive soils/bedrock to create a zone of low-expansive engineered fill beneath structures. This deep subexcavation process as performed in the Denver metro area typically reduces the risk of foundation and floor slab movements to tolerable levels of about 1 inch for foundations and 1 to 2 inches for interior floor slabs.

In order to reduce potential movements to these levels, we recommend subexcavation of the expansive materials (and existing fills) to a minimum depth of 10 feet below the lowest foundation bearing element for residential buildings. These materials should be processed to a soil-like consistency, moisture-conditioned, and recompacted as engineered fill. Mitigation should extend below the entire building footprint (to include below floor slabs) and at least 5 feet horizontally beyond foundations. Any unsuitable existing fill soils (if present) at the base of the subexcavation should also be removed, as directed by CGG during construction.

We recommend that this swell mitigation process be performed to a depth of 5 feet below non-habitable structures (such as retaining walls, trash enclosures, monument signs, etc.) and at least

3 feet beneath all public and private roads (extending at least 1 foot beyond the back of curb/attached walk).

Properly placed and compacted earthen fill materials can be considered part of this fill zone. Therefore, in areas where significant earthen fill will be placed, limited subexcavation depths would be expected. We recommend that the Civil Engineer be contracted to develop subexcavation plans and help determine quantities based on the recommendations herein. We are available to provide additional information if needed.

This process will require special methods to confirm that fill materials are well processed and blended. The bedrock materials will require ripping if scrapers are to be used to complete subexcavation during grading, and the contractor should plan on using discs to break down these materials to provide thorough moisture conditioning and processing to produce a uniform fill zone.

In order to confirm that the process is properly completed, we recommend surveying of the base of the subexcavation to confirm both vertical and lateral extents prior to backfill. In addition, observation and testing should be performed by a representative of the geotechnical engineer on an essentially full-time basis.

Foundation movement will be directly related to the depth and extents of subsurface wetting beneath foundations. We have provided recommendations to help limit wetting due to storm runoff and irrigation and these measures should be maintained throughout the life of the project. Failure to maintain proper surface drainage surrounding the buildings may result in movement and distress in excess of our estimates.

- **Excavation and Trench Construction:** It is anticipated that excavations for the proposed construction can be accomplished with conventional, heavy-duty earthmoving equipment. Advancing excavations into the bedrock may require ripping and/or jack-hammering to facilitate excavation. We recommend that potentially difficult excavation conditions be accounted for in the project budget and schedule where bedrock materials are relatively shallow.

Excavations into the clay soils and bedrock may stand on relatively steep temporary slopes. However, excavations that encounter any sandy lenses (if present) may cave and require more stringent sloping or shoring procedures. If excavations approach property lines, public right-of-way, or adjacent facilities the contractor should assess the potential need to shore the sides of excavations. ***All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards. The individual contractor(s) is responsible for designing and constructing stable and dry, temporary excavations, as required, maintaining stability of both the excavation sides and bottom.***

Preliminary Geotechnical Engineering Report
Proposed Multi-Family Residential Development – Adams County, Colorado
CGG Project No. 24.22.212

The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

As a safety measure, it is recommended that all vehicles and soil piles be kept to a minimum lateral distance from the crest of the slope equal to no less than the slope height. The exposed slope face should be protected against the elements.

- **Fill Materials:** Clean on-site soils, processed bedrock, or approved imported materials may be used as fill material. We should be contacted to evaluate samples of any proposed fill materials prior to importation. Imported soils (if required) should conform to the following:

<u>Gradation</u>	<u>Percent finer by weight (ASTM C136)</u>
6"	100
3"	70-100
No. 4 Sieve.....	50-100
No. 200 Sieve.....	80 maximum
• Liquid Limit.....	45 (max)
• Plasticity Index	25 (max)
• Maximum expansive potential (%)*	1.0

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density near optimum water content. The sample is confined under a 500 psf surcharge and submerged.

- **Fill Placement and Compaction Requirements:** General site fill and fill placed below foundations and floor slabs should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill soils, trench backfill, and subgrade soils below flatwork should be compacted in accordance with the following criteria:

Item	Description
Fill Materials	On-site soils or processed bedrock materials (4 to 6 inch fragments max) Imported fill, if required, should meet the specifications above
Fill Lift Thickness	8 to 12 inches or less in loose thickness
Compaction Requirements	Clayey soils: 95% of standard Proctor dry density (ASTM D698) Non-plastic granular soils: 95% of modified Proctor dry density (ASTM D1557)
Moisture Content	Clayey soils: +1 to +4% above optimum moisture content Non-plastic granular soils: -2% below to +2% above of optimum

At a minimum, fill soils placed for site grading/subexcavation, utility trench backfill, foundation backfill, and floor slab and pavement subgrade soils should be tested to confirm that earthwork is being performed according to our recommendations and project specifications. Subsequent lifts of fill should not be placed on previous lifts if the moisture content or dry density is determined to be less than specified. We also recommend that the in-place fill materials comprised of on-site clay/claystone be tested for expansion potential frequently to confirm that the fill mass is low expansive.

The compacted soils should not be allowed to dry out prior to foundation/floor slab construction. Construction traffic over the completed subgrade should be avoided to the extent practical. A loss of moisture or overcompaction could result in an increase in the expansive potential of clayey soils. Subsequent wetting of these materials could result in undesirable movement.

- **Underground Utilities:** Utilities should be designed and installed according to current Adams County standards. It is strongly recommended that a representative of the geotechnical engineer provide full-time observation and compaction testing of trench backfill within public roadways and other critical areas.

All underground piping within or near proposed structures should be designed with flexible couplings, so minor deviations in alignment do not result in breakage or distress. Utility knockouts in rigid concrete structures, retaining walls or foundations should be oversized to accommodate differential movements.

Conceptual Pavement Thickness Design: The preliminary design of pavements for the project is based on the procedures outlined in the *Pavement Design Standards and Construction Specifications* by the Metropolitan Government Pavement Engineers Council (MGPEC), the 1993 *Guideline for Design of Pavement Structures* by the American Association of State Highway and Transportation Officials (AASHTO), the Colorado Department of Transportation (CDOT) *Pavement Design Manual (2014)*, and the current Adams County *Roadway Standards and Technical Criteria* (Standards). ***For public roadway improvements, Adams County will require submittal of a pavement thickness design report based on completion of additional geotechnical exploration and analyses after completion of expansive soil mitigation and site grading.***

The referenced design methods are based on the subgrade soil support properties and anticipated traffic values.

- **Subgrade Soils:** The clay soils at the site exhibited variable expansive potential, ranging from low to high. ***As discussed, we recommend that swell mitigation be performed to a depth of 3 feet beneath all public and private roads.*** Mitigation should also extend at least 1 foot beyond the back of curb/attached walk). Where more than 3 feet of fill is placed to raise the roadways, no additional subexcavation would be needed. **Unsuitable existing fill soils (if present) should be completely**

removed and recompacted below pavements, unless they are further evaluated and approved by CGG during construction.

In our experience, it is common in private pavement areas for project owners to forego the costs associated with this type of mitigation, and instead use those funds to perform pavement maintenance in areas where excessive distress occurs. We believe that at least moderate damage could occur where pavement subgrade becomes substantially wetted after construction is complete. Since pavements associated with the project are privately maintained (not including any public roadway extension), the owner may choose to only perform typical subgrade preparation.

These clay soils are considered to provide poor support for pavements. Based on the properties of the subgrade soils, we have estimated an R-value of 5, corresponding to a resilient modulus of 3,025 psi using the CDOT correlation. A k-value of 100 pci was used for design of rigid concrete pavements.

- **Assumed Traffic:** We understand that pavements at the site will consist of private roadways and may also include public roadways which will need to be designed and constructed according to the governing standards. Design traffic values, used to determine pavement thickness, are defined as 18-kip equivalent single axle loads (ESAL₂₀) based on a 20-year design (or alternatively as 18-kip equivalent daily load applications (EDLA)). Based on preliminary development plans (maximum of 64 residential dwelling units), we have utilized the following traffic designation criteria for determining preliminary pavement thicknesses using a design life of 20 years. The roadway classification for each roadway will need to be confirmed with Adams County for final pavement design.

Adams County Roadway Classification	Minimum EDLA	Minimum Total ESAL's (ESAL ₂₀)
Local Residential	10	73,000
Private Pavements		
Main site access drives and fire lanes	10	73,000
Automobile parking stalls	3	22,000

The above design traffic values for private pavements are based on our experience with similar projects, assuming the following:

- Automobile parking stalls - maximum daily traffic of 500 cars per day (equivalent single-axle loads, ESAL's of 22,000)
- Main site access drives and fire lanes – up to 5 trips/day by single-axle delivery trucks, 2 trash trucks per week, occasional fire truck traffic (85,000 pounds maximum) plus maximum daily traffic of 500 cars per day (73,000 ESAL's)

The owner should review these assumptions, and we should be contacted to confirm or modify these resulting pavement sections, if needed.

- **Design Criteria:** We utilized the following criteria for preliminary design of public pavements.

Traffic Area	Flexible Pavements (HMA)		
	Reliability	Initial Serviceability	Terminal Serviceability
Local Residential (Public & Private)	80 to 85	4.5	2.0

A standard of deviation of 0.44 for flexible pavement and 0.34 for rigid pavement were also utilized for pavement design.

- **Conceptual Pavement Thickness Alternatives:** Recommended preliminary section alternatives for flexible and rigid pavements are summarized as follows:

Traffic Area	Alternative	Minimum Pavement Thickness (Inches)			
		Hot-Mix Asphalt (HMA)	Aggregate Base Course (ABC/UGB)	Chemically Treated Subgrade (CTS)	Portland Cement Concrete (PCC)
Public Pavement*					
Adams County Local Residential Street	HMA + UGB	5 to 6	8 to 12	--	--
	HMA + CTS	5	--	12	--
	PCC	--	--	--	6
Private Pavement					
Automobile Parking and Standard-Duty Automobile and Light Truck Parking Only	HMA + ABC	4 to 4-½	6	--	--
	PCC	--	--	--	5
Main Access Drives and Heavy-Duty areas Private Drives, Fire Lanes, Delivery/Heavy truck access	HMA + ABC	5 to 5-½	6	--	--
	PCC	--	--	--	6

**Based on the lower strength of the clay soils at the site, an Intermediate Stiff Layer (ISL) of either Unbound Granular Base (UGB) or Chemically-Treated Subgrade (CTS) will be required for public pavements (per MGPEC Standards). The use of a geogrid and aggregate base layer (Mechanically Stabilized Base (MSB)) can also be considered.*

As discussed, a final pavement design will be needed for all public roadway improvements. Pavement thicknesses recommended are based on properly moisture conditioning and compacting the upper 12 inches of the subgrade materials prior to paving. A proofroll of the subgrade soils

should also be performed prior to paving and any soft/yielding areas remediated. Paving materials used at the site should meet current Adams County and applicable MGPEC/CDOT specifications.

The placement of a partial pavement thickness for use during construction is not recommended without a detailed pavement analysis incorporating construction traffic. In addition, we should be contacted to confirm the traffic assumptions outlined above. If the actual traffic varies from the assumptions outlined above, modification of the pavement section thickness will be required.

For preliminary analysis of pavement costs, the following specifications should be considered for each pavement component:

Pavement Component

Materials Criteria

Hot-Mix Asphalt	CDOT Grading S or SG (SX may be used for the top lift)
Aggregate Base Course.....	CDOT Class 5 or 6 (or MGPEC for public streets)

Future performance of pavements constructed on the clay soils at this site will be dependent upon several factors, including:

- maintaining stable moisture content of the subgrade soils; and
- providing for a planned program of preventative maintenance.

Since the clay soils on the site have shrink/swell characteristics, pavements could crack in the future primarily because of expansion of the soils when subjected to an increase in moisture content to the subgrade. The cracking, while not desirable, does not necessarily constitute structural failure of the pavement.

The performance of all pavements can be enhanced by minimizing excess moisture which can reach the subgrade soils. The following recommendations should be considered at minimum:

- site grading at a minimum 2 percent grade onto or away from the pavements to promote rapid drainage and prevent ponding behind curbs.
- the subgrade and the pavement surface have a minimum 1/4 inch per foot slope to promote proper surface drainage.
- the City may require shoulder drains to promote drainage in proximity to low points along roadway alignments.
- install joint sealant and seal cracks immediately.
- compaction of any utility trenches for landscaped areas to the same criteria as the pavement subgrade.
- seal all landscaped areas in or adjacent to pavements to minimize or prevent moisture migration to subgrade soils.

- place compacted, low permeability backfill against the exterior side of curb and gutter.
- place curb, gutter and/or sidewalk directly on subgrade soils without the use of base course materials.
- **Unpaved Access Drives:** In our opinion, the use of aggregate base course or crushed stone may be considered for use in constructing temporary access roads for construction traffic, maintenance paths for drainage improvements, and/or temporary all-weather fire truck access. In order to provide an all-weather surface, we recommend that the section include a minimum of 12 inches of aggregate base course (CDOT Class 5 or 6) or a minimum of 8 inches of 3-inch minus crushed aggregate (or recycled concrete). In our opinion, these sections would be suitable for the support of delivery and concrete trucks and occasional fire truck access (85,000 pounds maximum) for the anticipated duration of a typical project of this magnitude.

The contractor should be responsible for monitoring the condition of unpaved drive lanes, including the repair and maintenance of the drive lanes throughout its use in order to provide the required access. We believe it is likely that these aggregate materials will be “contaminated” with soil and other constituents over the course of construction; therefore, the aggregate materials should not be considered part of the final pavement section unless otherwise evaluated and approved by the Geotechnical Engineer.

Exterior Concrete Flatwork : Ground-supported flatwork will be subject to soil-related movements resulting from heave/settlement, frost action, et cetera. The amount of movement will be related to the compactive effort used when the fill soils are placed and future wetting of the subgrade soils. The potential for damage would be greatest where exterior slabs are constructed adjacent to buildings or other structural elements. Thus, where these types of elements abut rigid building foundations or isolated/suspended structures, differential movements should be anticipated.

We recommend that exterior concrete flatwork be supported on at least 12 inches of moisture conditioned and recompacted subgrade soils. Deeper mitigation should be considered below critical flatwork areas. ***However, even after mitigation, normal slab movement should still be expected when bearing on properly placed and compacted on-site soils.*** Movements could be further reduced if substantially deeper subexcavation and recompaction is performed. If the movement outlined above cannot be tolerated, we should be contacted to provide alternatives for additional subgrade preparation.

Movements will be directly related to wetting of the supporting soils; therefore, it is imperative to establish and maintain positive drainage away from structures and critical flatwork. Water should not be allowed to pond on flatwork.

Preliminary Geotechnical Engineering Report
Proposed Multi-Family Residential Development – Adams County, Colorado
CGG Project No. 24.22.212

Additional flatwork design and construction recommendations are as follows:

- Positive separations and/or isolation joints should be provided between slabs and any abutting foundations, columns or utility lines to allow independent movement.
- Placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements to control the location and extent of cracking.
- Provide for adequate drainage in areas adjoining the slabs.
- Trench backfill placed beneath slabs should be compacted in accordance with recommended specifications outlined in the *Earthwork* section of this report.
- Concrete slabs-on-grade should not be constructed on frozen subgrade.

Site Concrete Corrosion Protection: Selected samples were tested for the presence of water-soluble sulfates, as outlined in the table below.

Boring	Depth (ft)	Material	Water-Soluble Sulfates (ppm)	ACI Sulfate Exposure Class
1	4	Sandy Lean Clay	900	S1
3	4	Fat Clay with Sand	3,400	S2
5	4	Sandy Lean Clay	1,000	S1
9	4	Silty Sand	1,700	S2

As noted in the table above, selected soil samples likely to be in contact with project concrete were tested for the presence of water-soluble sulfates in order to determine corrosion characteristics and the appropriate concrete mixtures. Testing results indicate the samples are within the American Concrete Institute (ACI) Sulfate Exposure Class S1 and S2. **Therefore, project concrete should be designed for American Concrete Institute (ACI) Sulfate Exposure Class S2 in accordance with Chapter 19 of the ACI design manual, *Building Code Requirements for Structural Concrete (ACI 318-14)*, as summarized below.**

ACI Sulfate Exposure Class	Portland Cement Type (ASTM C150)	Maximum Water/Cement Ratio	Minimum Concrete Compressive Strength (psi)
S2	V (or equivalent)	0.45	4,500

Conceptual Structural Considerations: Based on the subsurface conditions across the site and the nature of the proposed structures, the site is suitable for foundation construction commonly used in the region. ***Actual foundation designs should be based on additional design-level geotechnical exploration and evaluation of the soil conditions for each structure.***

- **Foundation Alternatives:** Based on the presence of expansive soils and bedrock on the site, the use of deep foundation systems is appropriate for support of proposed structures. Deep foundations, such as drilled piers socketed into bedrock (and structurally supported interior floors) would limit foundation movement to about ½ inch. We estimate that drilled piers lengths would be on the order of 25 to 30 feet for many areas on the site, however, longer piers would be needed to achieve penetration where the depth of bedrock is deeper than about 20 feet.

As an alternative, provided mitigation of the expansive soils/bedrock (and existing fills) is performed below buildings as outlined above, shallow foundations (i.e. spread footings, post-tensioned slabs, reinforced mat foundations) should be suitable for the proposed structures. Shallow foundations bearing on the recommended zone of engineered fill may be preliminarily designed for bearing pressures on the order of 2,000 to 3,000 pounds per square foot (psf) and minimum dead loads on the order of 650 to 1,000 psf.

- **Below-Grade Construction:** Based on current subsurface conditions, we do not believe that groundwater will limit below-grade building construction (i.e. basement, crawlspace) on the site; however, we recommend basement/crawlspace excavations be terminated at least 3 feet above seasonal high groundwater elevation to maintain dry interior conditions and allow for possible groundwater fluctuations. ***We recommend supplemental measurements be performed (throughout the year) within installed monitoring wells to help determine high groundwater levels.***

Foundation drain systems will be required at the base of excavations for basement or crawlspace construction and behind any walls which retain more than 2 to 3 feet of earth. Foundation drainage systems typically include perforated pipe(s), embedded in gravel, placed in trenches that are sloped to discharge flows either into the storm sewer system or to a sump pit inside the building where water could be pumped to a suitable discharge.

- **Interior, Non-structural Floor Slabs:** ***Where drilled pier foundations are utilized, we recommend the use of structural, suspended floors for interior living spaces.*** Where the expansive soil/bedrock has been mitigated, the use of interior floor slabs can be considered only if the owner/developer acknowledges and accepts the risk of movement. Based on our experience, normal movement of unreinforced or lightly reinforced slab-on-grade floors in the geologic region is considered to be about 1 to 2 inches, when bearing on approved low-expansive soils. ***If this degree of movement cannot be tolerated, we recommend the use of a structural floor supported on the foundation and suspended above the expansive soils/bedrock. Alternatively, other shallow foundations such as post-tensioned slabs or reinforced mat foundations may be utilized, where floor movement of these interior spaces would be more uniform.***

Typical precautions used to manage movement of slab-on-grade floors include isolating plumbing and HVAC equipment, providing void space beneath partition walls, proper construction of closely spaced control joints, etc. Cosmetic distress such as drywall cracking, racking of door frames, etc. may result from slab movement in finished spaces.

- **Seismic Considerations:** Based on the soil conditions encountered in the test holes drilled on the site, we estimate that a Site Class D is appropriate for the site according to the 2021 International Building Code (Section 1613.3.2 referencing Table 20.3-1 of ASCE 7, Chapter 20). This parameter was estimated based on extrapolation of data beyond the deepest depth explored, using methods allowed by the code. Actual shear wave velocity testing/analysis and/or exploration to 100 feet was not performed.
- **Final Grading, Landscaping, and Surface Drainage:** All grades must be adjusted to provide positive drainage away from structures during construction and maintained throughout the life of the proposed project. ***Water permitted to pond near or adjacent to the perimeter of the structures (either during or post-construction) can result in significantly higher soil movements than those discussed in this report. As a result, any estimations of potential movement described in this report cannot be relied upon if positive drainage is not obtained and maintained, and water is allowed to infiltrate the fill and/or subgrade.*** Infiltration of water into utility or foundation excavations must be prevented during construction.

We recommend that exposed ground be sloped at a minimum of 10 percent grade for at least 10 feet beyond the perimeter of the buildings, where possible. We understand that this may not be feasible in all unpaved areas due to ADA access requirements and other required design features. In these areas, exterior grades should be sloped as much as possible down to area drain systems, swales, and/or sidewalk chases to facilitate drainage. In all cases, the grade should slope a minimum of 5 percent away from structures in accordance with the applicable building code.

Downspouts should also be connected to area drain systems to help reduce wetting, if possible. If this is not possible, roof drain flows should be directed onto pavements or discharge a minimum of 5 feet away from the structure through the use of splash blocks or downspout extensions.

Backfill against foundations, exterior walls and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration. After building construction and prior to project completion, we recommend that verification of final grading be performed to document that positive drainage, as described above, has been achieved. This is especially important in areas where heating and cooling units are placed in close proximity to the buildings.

Planters located adjacent to the structure should preferably be self-contained (planter boxes, potted landscaping, etc.). ***Landscaped irrigation adjacent to foundations should be eliminated where***

possible or minimized to only limited drip irrigation. Sprinkler mains and spray heads should be located a minimum of 5 feet away from the buildings. We recommend the use of Xeric landscaping, requiring little or no irrigation, be used within 5 feet of foundations. If drip irrigation is required in this zone, systems should be timed to provide only the amount of water needed to sustain growth. Irrigation systems should be frequently checked for proper performance and any breakages fixed as soon as possible.

GENERAL COMMENTS

Supplemental exploration and analyses must be performed to develop final design parameters and to confirm and/or modify the preliminary recommendations and conclusions contained in this report. This includes borings for each structure and for the design of public pavements.

CGG should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. CGG should also be retained to provide testing and observation during the excavation, grading, foundation and construction phases of the project.

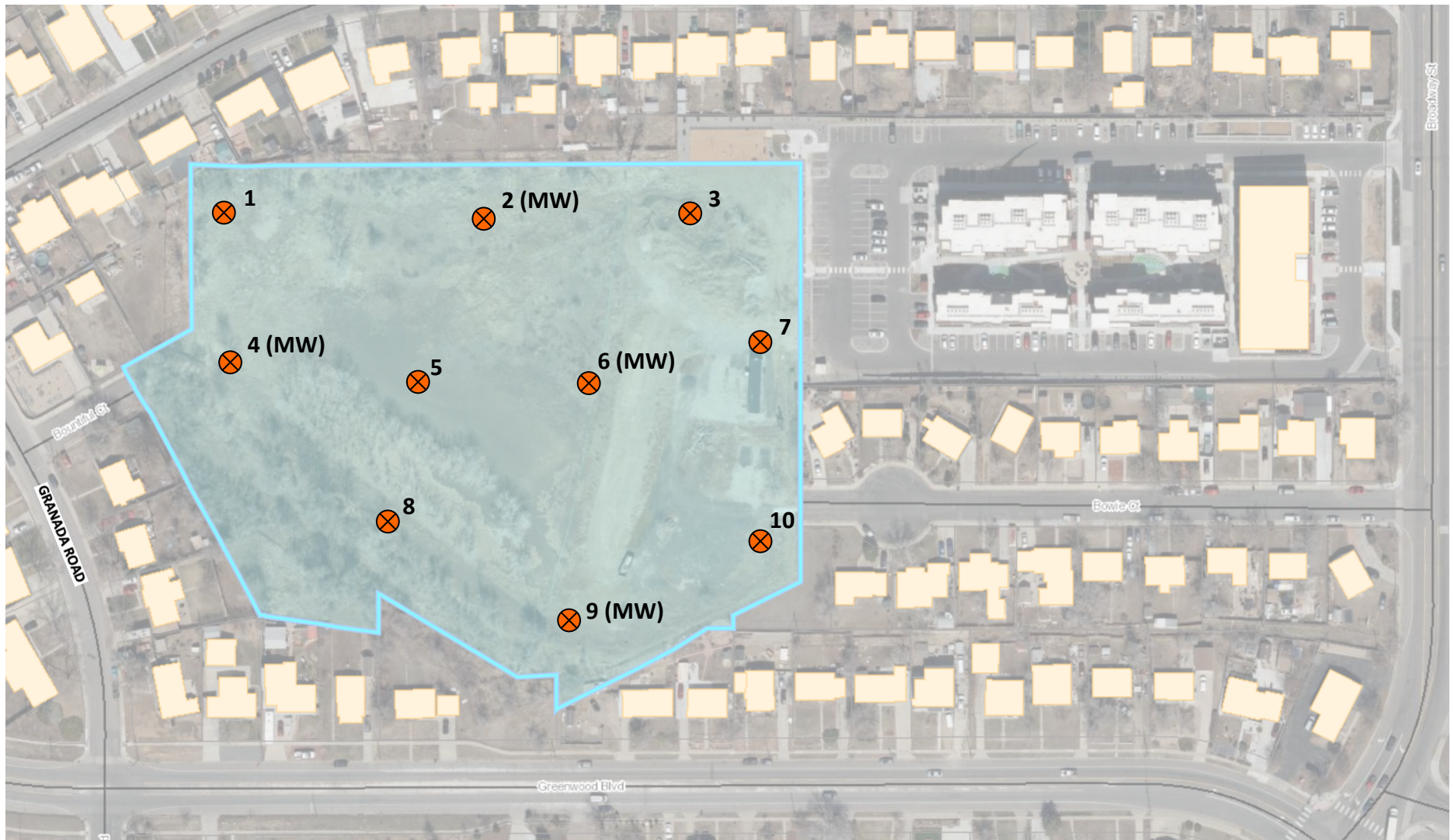
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

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

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes are planned in the nature, design, or location of the project as outlined in this report, the conclusions and recommendations contained in this report shall not be considered valid unless CGG reviews the changes, and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

**BORING LOCATION DIAGRAM
BORING LOGS**



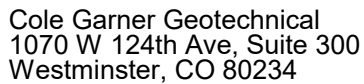
 **APPROXIMATE BORING LOCATIONS**
(MW) – BORINGS COMPLETED AS TEMPORARY GROUNDWATER MONITORING WELLS



FIGURE 1 - BORING LOCATION DIAGRAM
PROPOSED RESIDENTIAL DEVELOPMENT
NE of GRANADA ROAD and BOUNTIFUL COURT
ADAMS COUNTY, COLORADO
CGG PROJECT NO. 24.22.212



Cole Garner Geotechnical
 1070 W. 124th Ave., Suite 300
 Westminster, CO 80234
 (303) 996-2999



AFTER DRILLING 14.00 ft - 11/12/24

Approximate bottom of borehole at 50.0 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/5/24 14:41 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



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1070 W 124th Ave, Suite 300
Westminster, CO 80234

BORING NUMBER 2

PAGE 1 OF 1

CLIENT Maiker Housing Partners
PROJECT NUMBER 24.22.212
DATE STARTED 10/29/24 COMPLETED 10/29/24
DRILLING CONTRACTOR Vine Laboratories
DRILLING METHOD CME-55/Solid Stem Auger
HAMMER TYPE Automatic
LOGGED BY AA CHECKED BY AG

PROJECT NAME Proposed Multi-family Residential Development
PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO
GROUND SURFACE ELEV. Not Provided PROPOSED ELEV. Not Provided
SURFACE CONDITIONS Medium growth of weeds
GROUND WATER LEVELS:
▽ DURING DRILLING None
▽ AFTER DRILLING 14.90 ft - 12/5/24

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
	LEAN CLAY with SAND , light brown to brown, olive-brown, dry to moist, stiff								
			CL	CB	100	15 / 12	13.9	105	+5.4/500
	CLAYSTONE BEDROCK , varies with Sandstone lenses, grey, olive-brown, iron-stained, moist, medium hard								
		10	-	CB	100	50 / 12	24.4	96	+3.3/1000
			-	CB	100	50 / 11	23.7	107	
		20	-	CB	100	39 / 12	28.5	99	
			-	CB	100	45 / 12	25.1	104	

Approximate bottom of borehole at 25.0 feet.

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1070 W 124th Ave, Suite 300
Westminster, CO 80234

BORING NUMBER 3

PAGE 1 OF 1

CLIENT Maiker Housing Partners
PROJECT NUMBER 24.22.212
DATE STARTED 10/29/24 COMPLETED 10/29/24
DRILLING CONTRACTOR Vine Laboratories
DRILLING METHOD CME-55/Solid Stem Auger
HAMMER TYPE Automatic
LOGGED BY AA CHECKED BY AG

PROJECT NAME Proposed Multi-family Residential Development
PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO
GROUND SURFACE ELEV. Not Provided PROPOSED ELEV. Not Provided
SURFACE CONDITIONS Medium growth of weeds
GROUND WATER LEVELS:
▽ DURING DRILLING 22.00 ft
▽ AFTER DRILLING 20.00 ft - 11/12/24

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
	LEAN CLAY with SAND , varies to Fat Clay, light brown to brown, dry to moist, medium stiff to very stiff		CH	CB	100	28 / 12	14.8	115	
		10	CL	CB	100	25 / 12	17.4	110	+1.4/1000
			CL	CB	100	18 / 12	22.3	97	+0.6/1000
		20	CL	CB	100	10 / 12	27.0	100	
	CLAYSTONE BEDROCK , varies with Sandstone lenses, grey to dark grey, light brown to brown, moist, medium hard to very hard		-	CB	100	48 / 12	23.7	105	
		30	-	CB	100	50 / 10	21.9	108	
		40							
		50	-	CB	100	50 / 4	17.5	114	

Approximate bottom of borehole at 50.0 feet.

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1070 W 124th Ave, Suite 300
Westminster, CO 80234

CLIENT Maiker Housing Partners

PROJECT NUMBER 24.22.212

DATE STARTED 10/29/24 COMPLETED 10/29/24

DRILLING CONTRACTOR Vine Laboratories

DRILLING METHOD CME-55/Solid Stem Auger

HAMMER TYPE Automatic

LOGGED BY AA CHECKED BY AG

PROJECT NAME Proposed Multi-family Residential Development

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

GROUND SURFACE ELEV. Not Provided PROPOSED ELEV. Not Provided

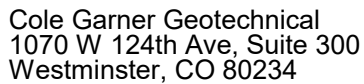
SURFACE CONDITIONS Medium growth of weeds

GROUND WATER LEVELS:
▽ DURING DRILLING None
▽ AFTER DRILLING 22.30 ft - 12/5/24

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/5/24 14:42 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
	SANDY LEAN CLAY , light brown to brown, calcareous, dry to moist, very stiff								
			CL	CB	100	23 / 12	14.2	105	+4.7/500
	CLAYSTONE BEDROCK , varies with Sandstone lenses, light brown to brown, tan, moist, medium hard to hard	10	-	CB	100	50 / 9	19.2	110	
			-	CB	100	36 / 12	24.0	99	+5.2/1000
		20	-	CB	100	50 / 10	22.4	108	
			-	CB	100	50 / 9	18.9	114	

Approximate bottom of borehole at 25.0 feet.



PROJECT NAME Proposed Multi-family Residential Development

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

GROUND SURFACE ELEV.Not Provided **PROPOSED ELEV.**Not Provided

SURFACE CONDITIONS Medium growth of weeds

GROUND WATER LEVELS:

 DURING DRILLING 18.00 ft

▼ AFTER DRILLING Covered Over - 11/12/24

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY , light brown to brown, dry to wet, soft to hard	0							
			CL	CB	100	29 / 12	15.9	119	
		10	CL	CB	100	42 / 12	12.6	122	+3.2/1000
			CL	CB	100	3 / 12	24.9	98	-0.9/1000
		20	CL	CB	100	4 / 12	28.6	92	-0.2/2000
			CL	CB	100	7 / 12	28.8	98	

Approximate bottom of borehole at 25.0 feet.



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1070 W 124th Ave, Suite 300
Westminster, CO 80234

CLIENT Maiker Housing Partners

PROJECT NUMBER 24.22.212

DATE STARTED 10/29/24 COMPLETED 10/29/24

DRILLING CONTRACTOR Vine Laboratories

DRILLING METHOD CME-55/Solid Stem Auger

HAMMER TYPE Automatic

LOGGED BY AA CHECKED BY AG

PROJECT NAME Proposed Multi-family Residential Development

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

GROUND SURFACE ELEV. Not Provided PROPOSED ELEV. Not Provided

SURFACE CONDITIONS Medium growth of weeds

GROUND WATER LEVELS:
▽ DURING DRILLING None
▽ AFTER DRILLING 18.90 ft - 12/5/24

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
	SANDY LEAN CLAY , brown, moist, medium stiff to hard		CL	CB	100	38 / 12	14.3	111	+7.3/500
		10	CL	CB	100	33 / 12	14.3	115	+3.6/500
			CL	CB	100	10 / 12	24.2	102	
	CLAYSTONE BEDROCK , varies with Sandstone lenses, light brown to brown, iron-stained, moist, hard to very hard		-	CB	100	50 / 6	15.1	120	
			-	CB	100	50 / 7	22.0	107	

Approximate bottom of borehole at 25.0 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/5/24 14:42 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



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CLIENT Maiker Housing Partners

PROJECT NUMBER 24.22.212

DATE STARTED 11/6/24 COMPLETED 11/6/24

DRILLING CONTRACTOR Unlimited Access Drilling

DRILLING METHOD CME-55/Solid Stem Auger

HAMMER TYPE Automatic

LOGGED BY AA CHECKED BY AG

PROJECT NAME Proposed Multi-family Residential Development

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

GROUND SURFACE ELEV. Not Provided PROPOSED ELEV. Not Provided

SURFACE CONDITIONS Medium growth of weeds

GROUND WATER LEVELS:
▽ DURING DRILLING None
▽ AFTER DRILLING 20.00 ft - 11/12/24

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
	SANDY LEAN CLAY , light brown to brown, dry to moist, very stiff								
			CL	CB	100	31 / 12	12.0	115	
		10	CL	CB	100	20 / 12	20.5	100	+1.1/1000
	SANDSTONE BEDROCK , fine- to coarse-grained, light brown to brown, tan, moist, very hard								
			-	CB	100	50 / 6	13.0	112	
	CLAYSTONE BEDROCK , grey, brown, moist, firm								
		20	-	CB	100	27 / 12	30.3	93	
			-	CB	100	29 / 12	26.9	99	

Approximate bottom of borehole at 25.0 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/5/24 14:42 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



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CLIENT Maiker Housing Partners

PROJECT NUMBER 24.22.212

DATE STARTED 10/29/24COMPLETED 10/29/24

DRILLING CONTRACTOR Vine Laboratories

DRILLING METHOD CME-55/Solid Stem Auger

HAMMER TYPE Automatic

LOGGED BY AA

CHECKED BY AG

PROJECT NAME Proposed Multi-family Residential Development

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

GROUND SURFACE ELEV. Not ProvidedPROPOSED ELEV. Not Provided

SURFACE CONDITIONS Medium growth of weeds

GROUND WATER LEVELS:
DURING DRILLING 24.00 ft
AFTER DRILLING 21.50 ft - 11/12/24

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/5/24 14:42 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
	LEAN CLAY with SAND, light brown to brown, red-brown, moist, stiff								
6			CL	CB	100	18 / 12	20.0	96	+1.5/500
	SANDY LEAN CLAY to CLAYEY SAND, light brown to brown, tan, dry to moist, very stiff								
		10	CL/SC	CB	100	33 / 12	12.2	114	+4.7/1000
			SC/SM	CB	100	34 / 12	9.0	131	
16									
	LEAN CLAY with SAND, light brown to brown, moist to wet, medium stiff to stiff								
		20	CL	CB	100	16 / 12	18.7	114	
			CL	CB	100	9 / 12	24.7	104	
		30							
32									
	CLAYSTONE BEDROCK, grey, dark brown, moist, medium hard to very hard								
			-	CB	100	50 / 10	20.1	112	
		40							
		50	-	CB	100	50 / 6	17.5	167	

Approximate bottom of borehole at 50.0 feet.



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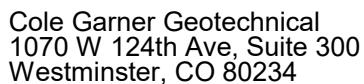
CLIENT Maiker Housing Partners
PROJECT NUMBER 24.22.212
DATE STARTED 11/7/24 COMPLETED 11/7/24
DRILLING CONTRACTOR Vine Laboratories
DRILLING METHOD CME-55 Track-rig/Solid Stem Auger
HAMMER TYPE Automatic
LOGGED BY AA CHECKED BY AG

PROJECT NAME Proposed Multi-family Residential Development
PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO
GROUND SURFACE ELEV. Not Provided PROPOSED ELEV. Not Provided
SURFACE CONDITIONS Medium growth of weeds
GROUND WATER LEVELS:
▽ DURING DRILLING None
▽ AFTER DRILLING 24.70 ft - 12/5/24

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
		0							
	SANDY LEAN CLAY to CLAYEY SAND , light brown to brown, iron-stained, dry to moist, very stiff to hard								
			SC/SM	CB	100	35 / 12	12.7	114	
		10	CL/SC	CB	100	50 / 6	12.4	110	+0.1/1000
	SANDSTONE BEDROCK , fine- to coarse-grained, varies clayey, light brown to brown, tan, dry to moist, hard		-	CB	100	50 / 7	9.2	130	
	CLAYSTONE BEDROCK , light brown to brown, grey, moist, medium hard to hard		-	CB	100	50 / 7	22.8	108	
		20							
			-	CB	100	50 / 10	21.4	100	-1.5/3000
		25							

Approximate bottom of borehole at 25.0 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/5/24 14:42 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



PAGE 1 OF 1

PROJECT NAME Proposed Multi-family Residential Development

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

GROUND SURFACE ELEV.Not Provided **PROPOSED ELEV.**Not Provided

SURFACE CONDITIONS Medium growth of weeds

GROUND WATER LEVELS:

▽ DURING DRILLING None

▼ AFTER DRILLING 24.00 ft - 11/12/24

Approximate bottom of borehole at 50.0 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 12/5/24 14:43 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE\GPJ

APPENDIX B

LABORATORY TEST RESULTS

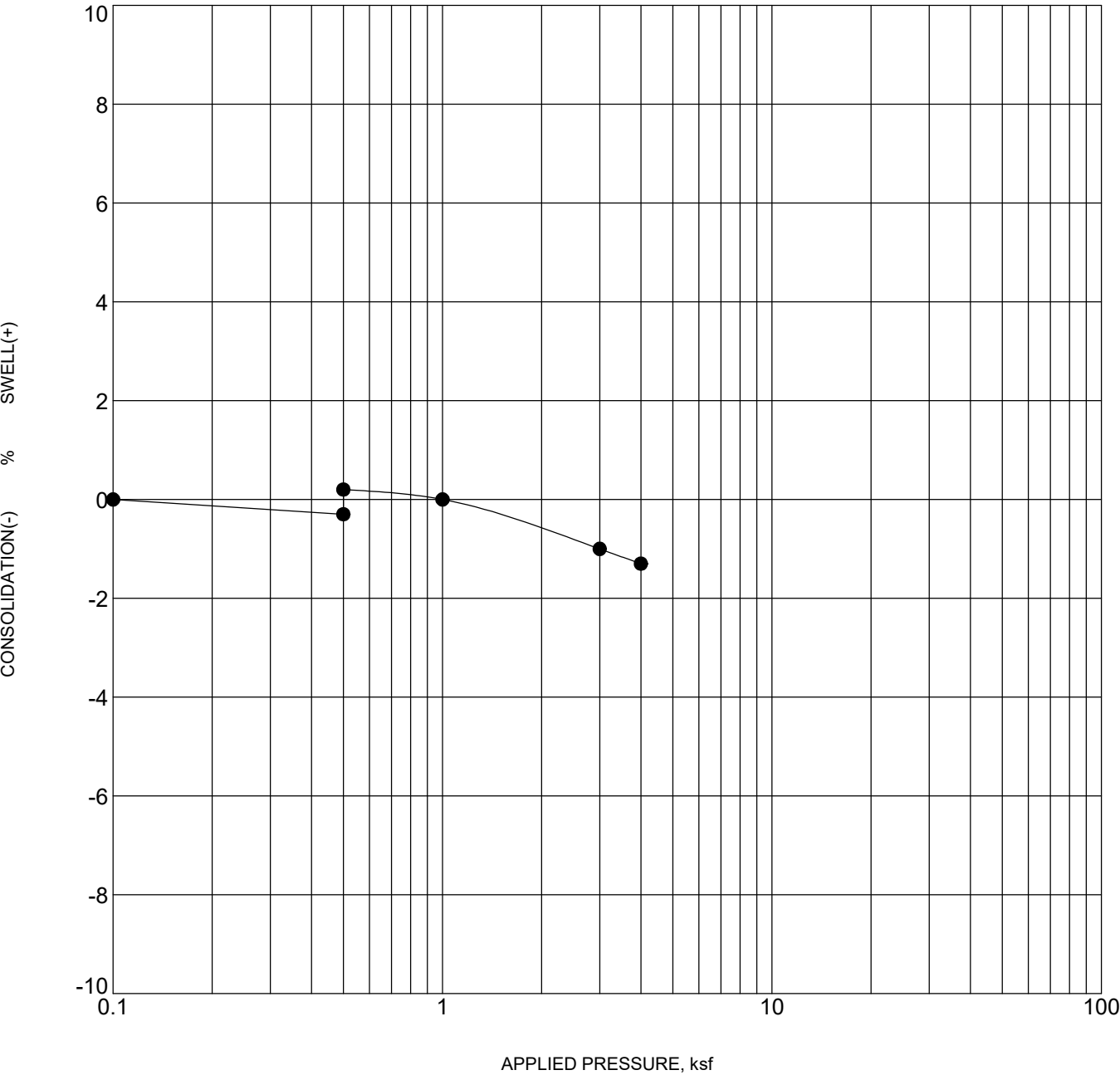


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SWELL/CONSOLIDATION TEST

CLIENT Maiker Housing Partners PROJECT NAME Proposed Multi-family Residential Development
PROJECT NUMBER 24.22.212 PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 1	9.0	SANDY LEAN CLAY	111	19

Note: Water Added to Sample at 500 psf. Date: 11/21/24

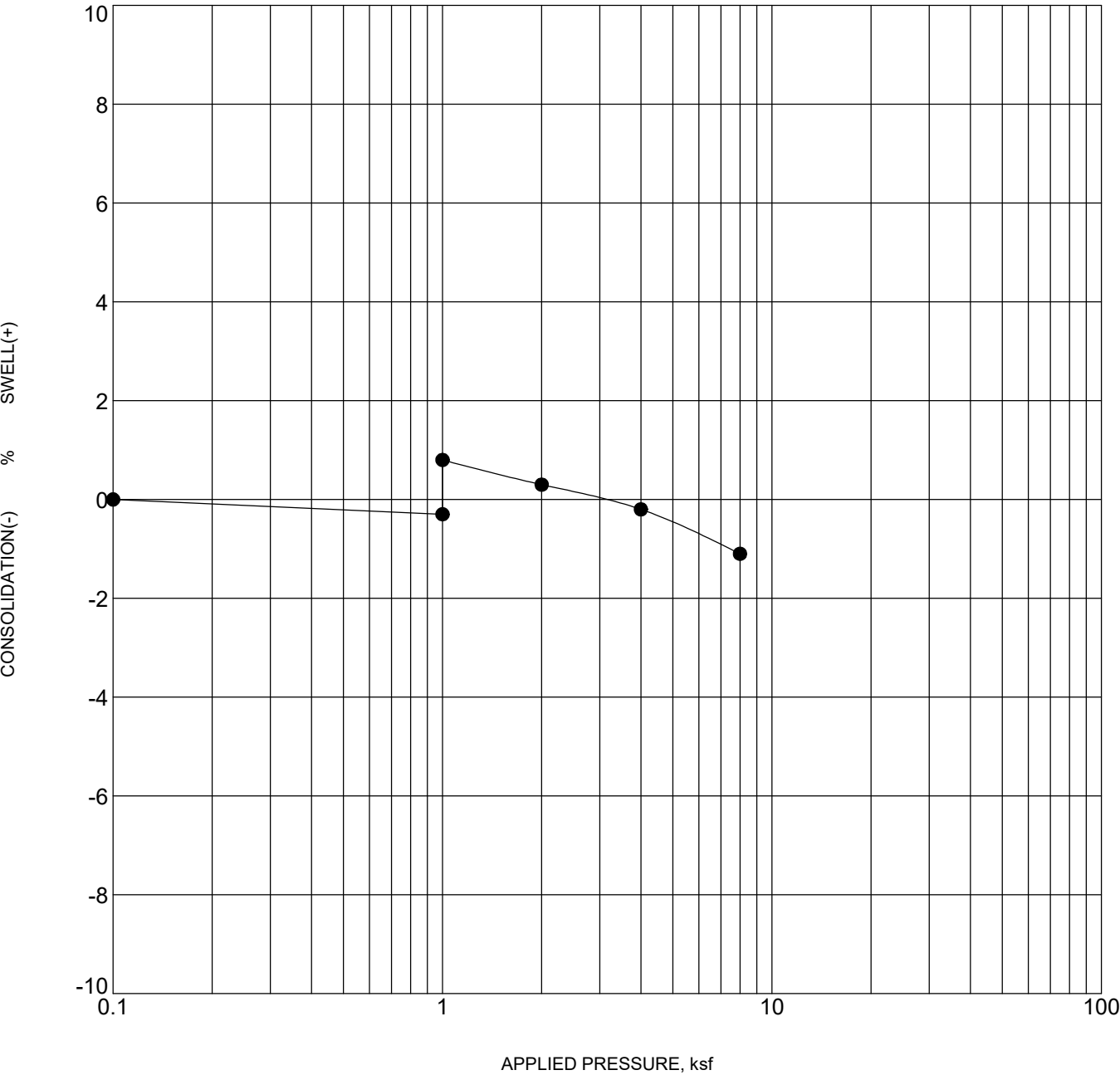


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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 1	14.0	CLAYSTONE BEDROCK	97	25

Note: Water Added to Sample at 1000 psf. Date: 11/21/24

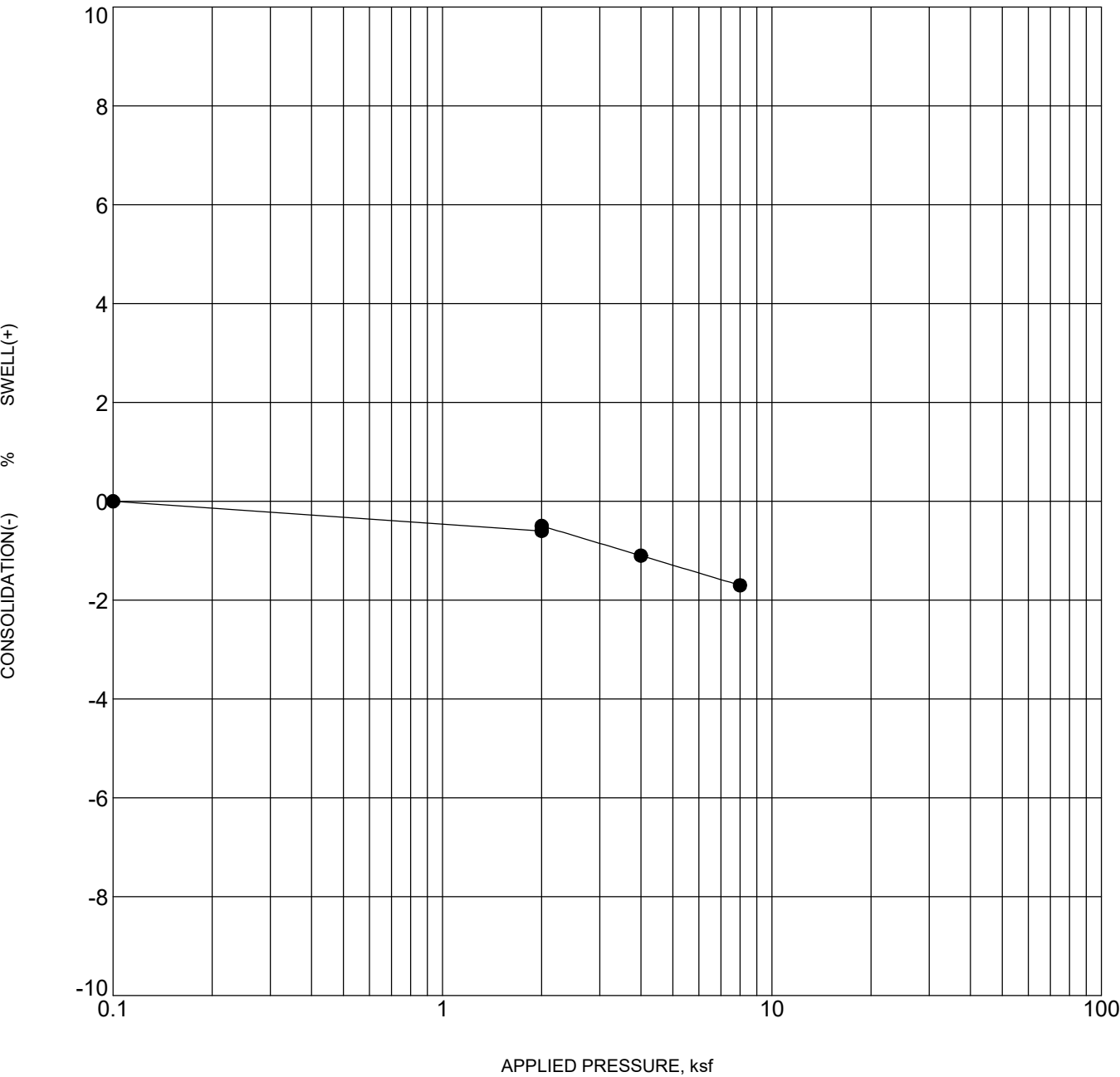


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CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 1	19.0	CLAYSTONE BEDROCK	105	20

Note: Water Added to Sample at 2000 psf. Date: 11/21/24

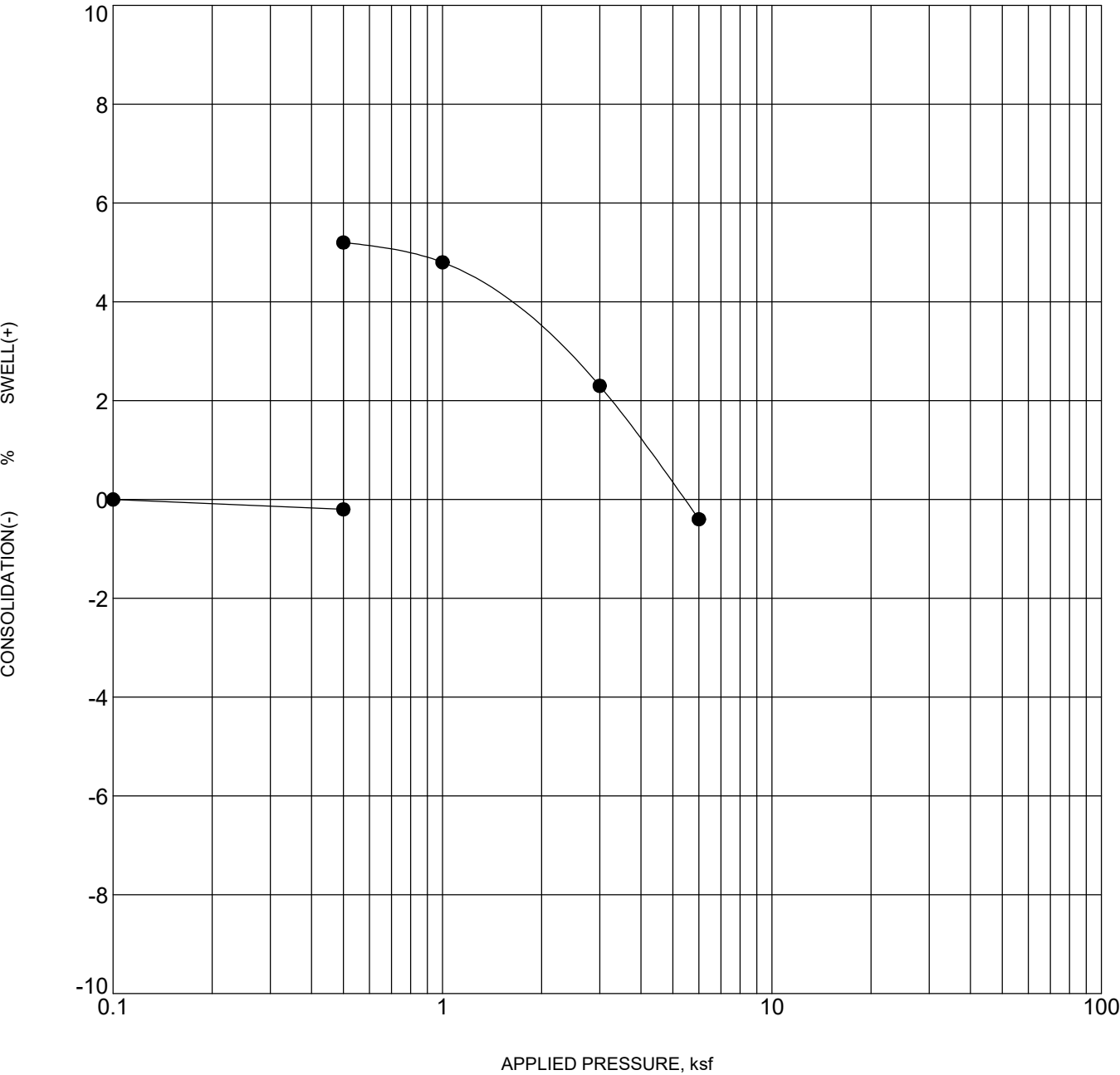


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PROJECT NUMBER 24.22.212 **PROJECT LOCATION** E of Granada Rd & Bountiful Ct - Adams Cnty, CO

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 2	4.0	LEAN CLAY with SAND	105	14

Note: Water Added to Sample at 500 psf. **Date:** 11/21/24

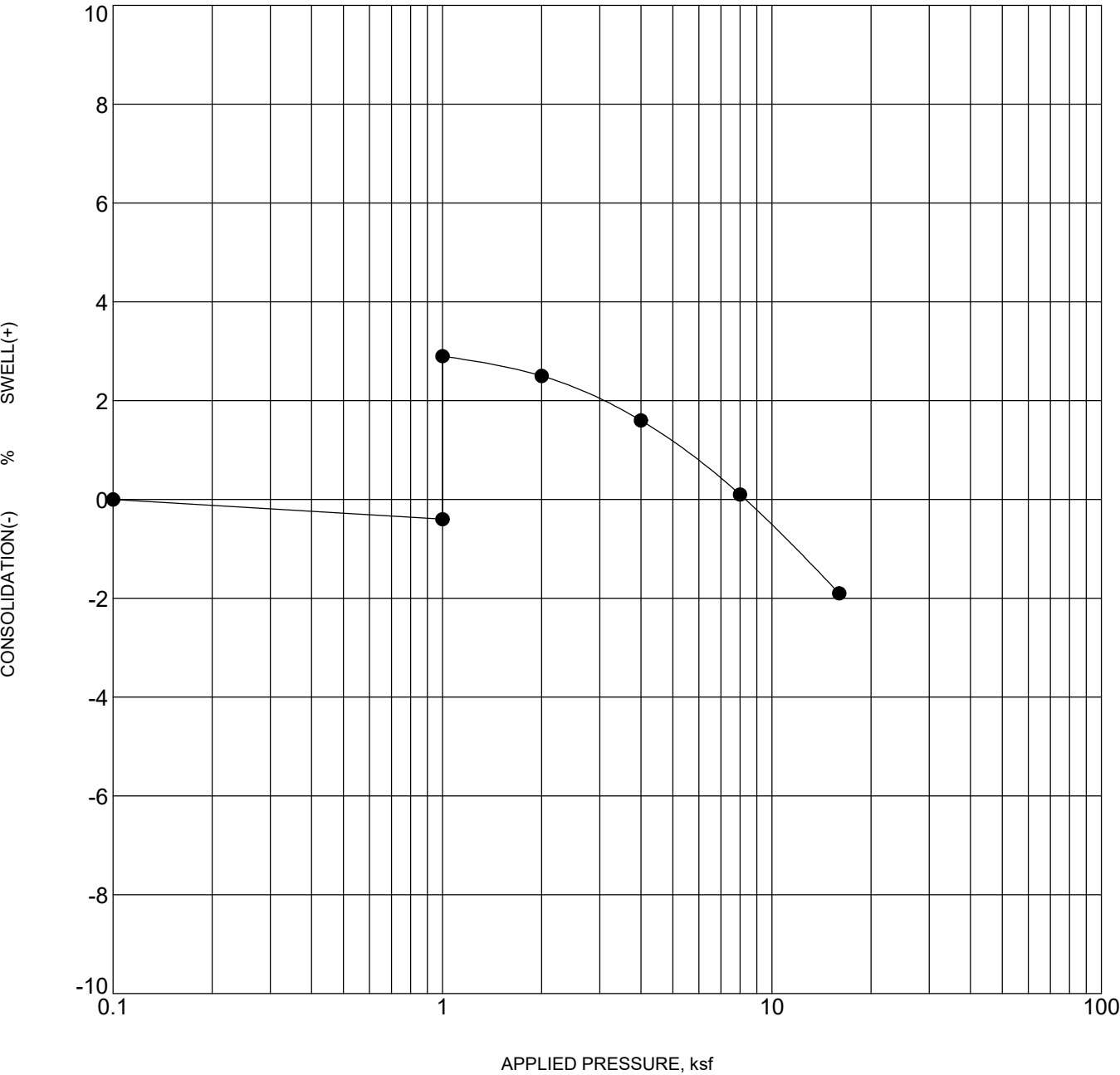


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CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 2	9.0	CLAYSTONE BEDROCK	96	24

Note: Water Added to Sample at 1000 psf. **Date:** 11/21/24

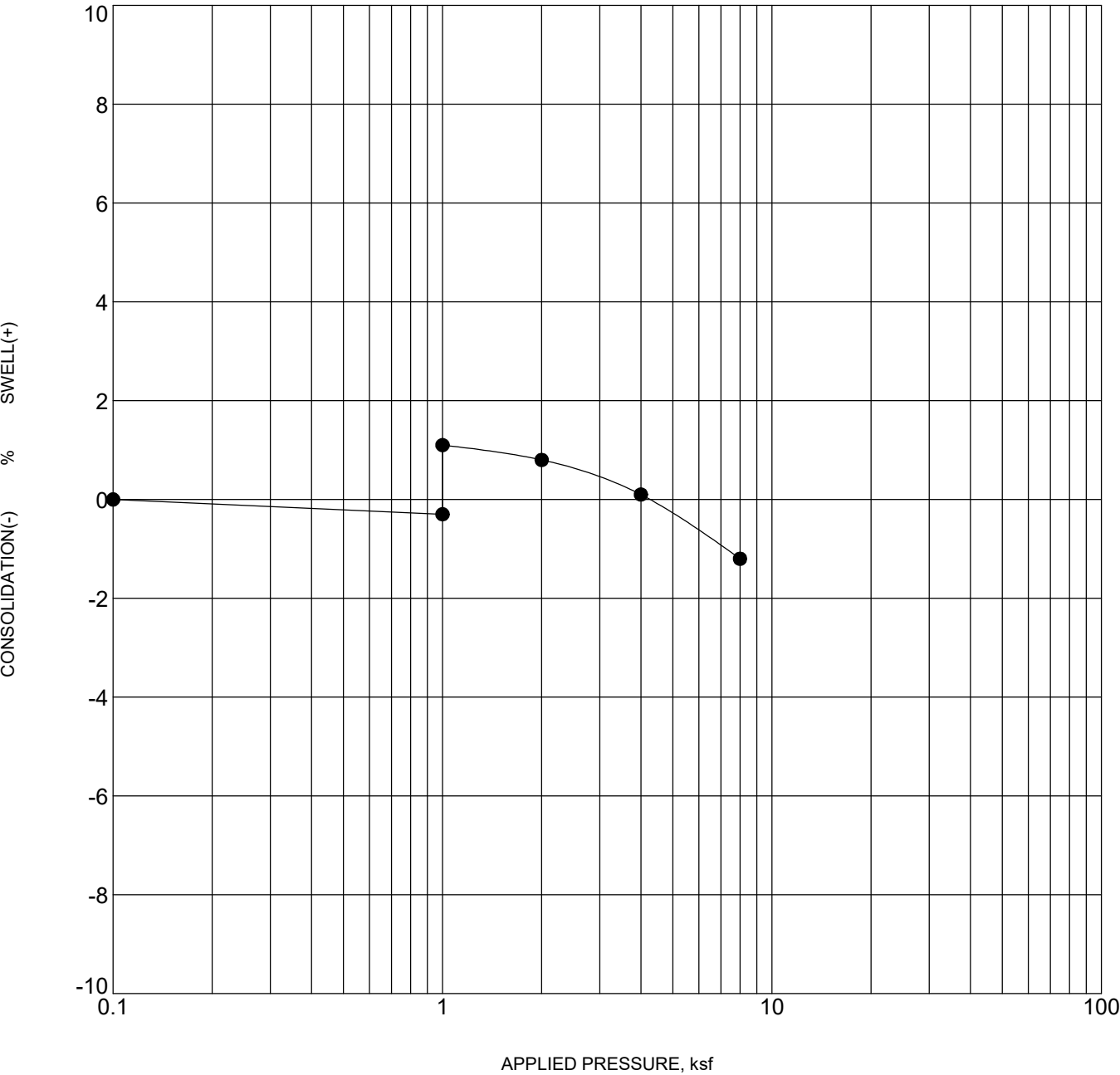


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BOREHOLE	DEPTH	Classification	γ _d	MC%
● 3	9.0	LEAN CLAY with SAND	110	17

Note: Water Added to Sample at 1000 psf. Date: 11/21/24

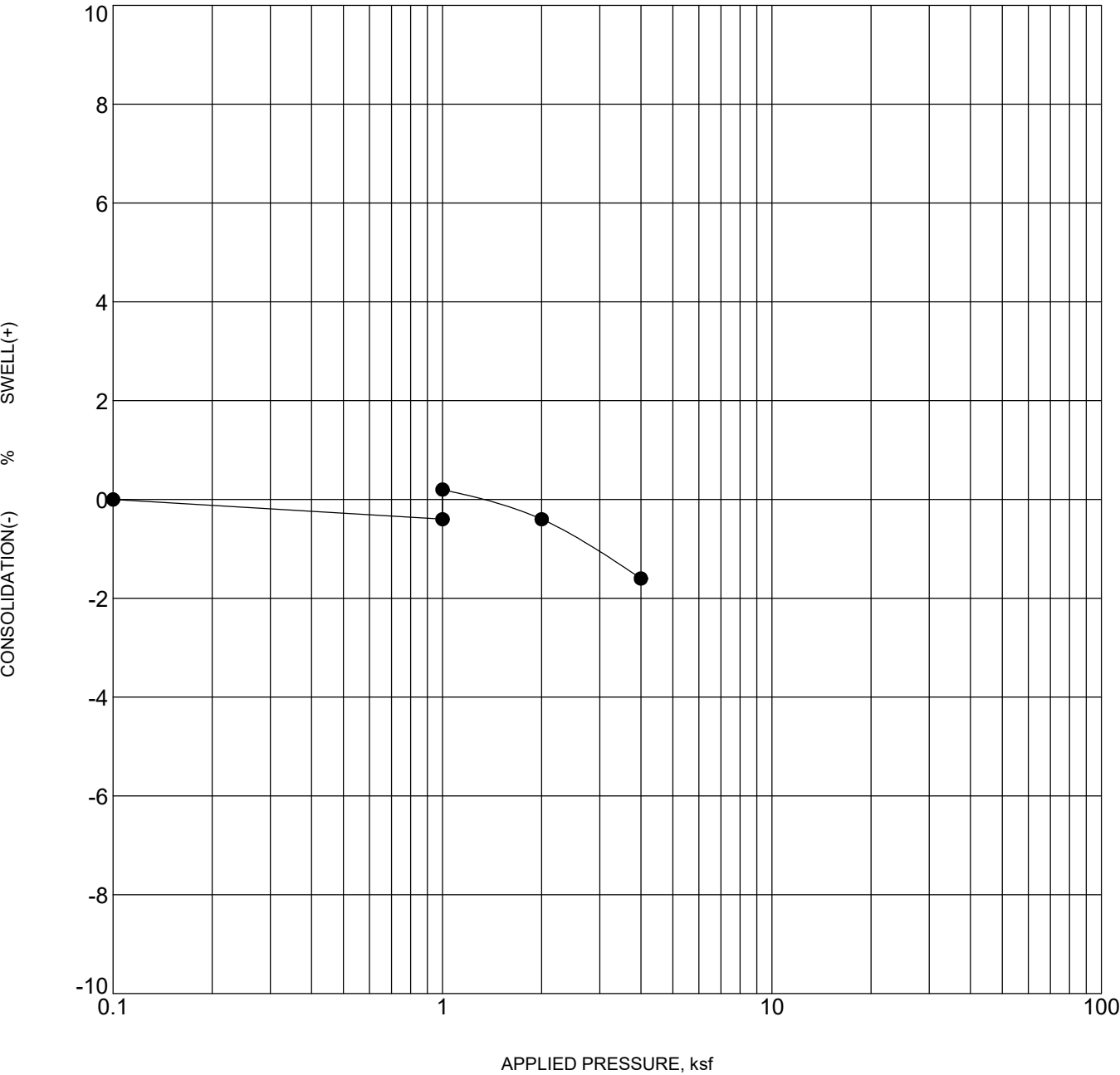


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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 3	14.0	LEAN CLAY with SAND	97	22

Note: Water Added to Sample at 1000 psf. **Date:** 11/21/24

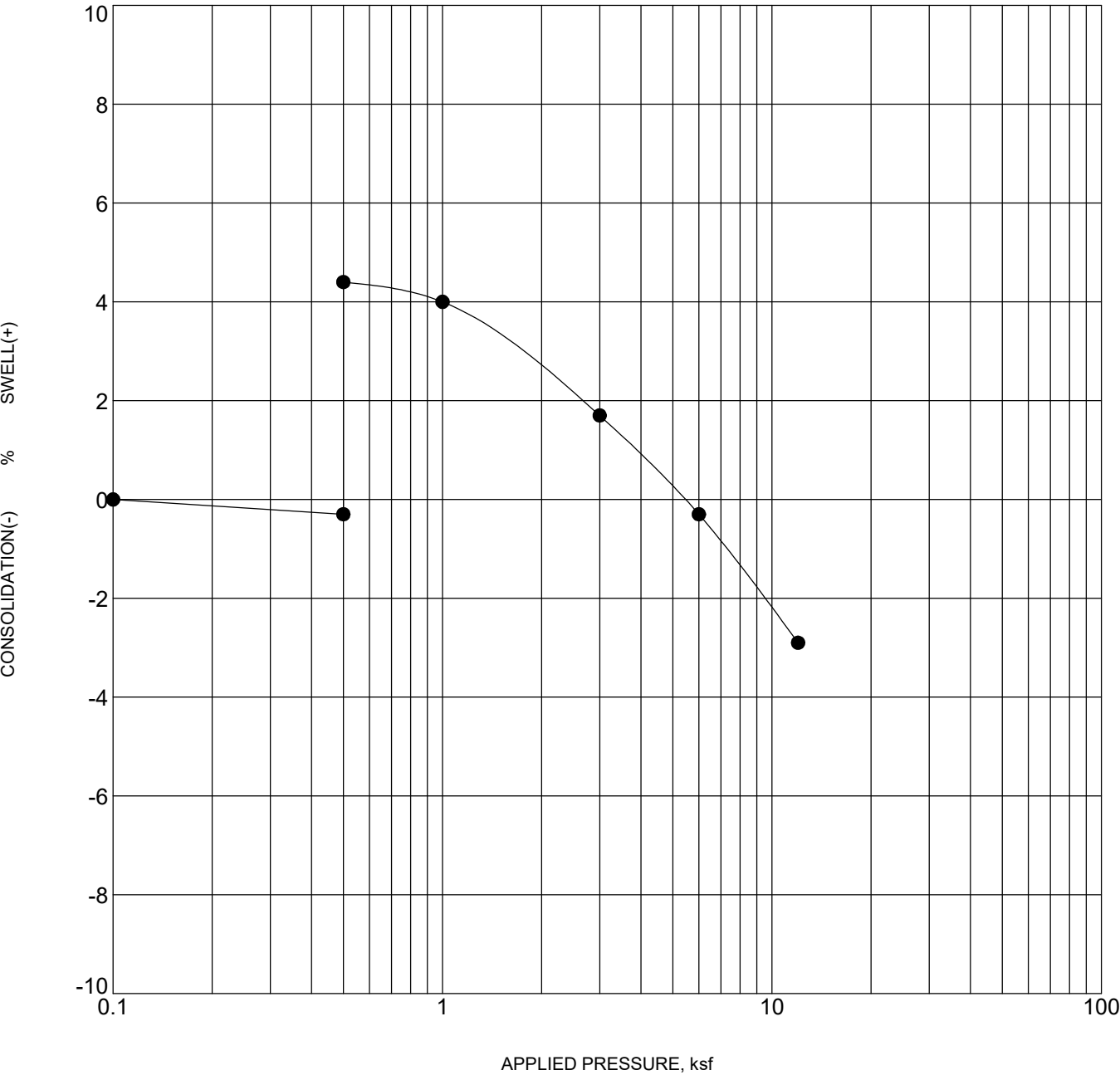


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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 4	4.0	SANDY LEAN CLAY	105	14

Note: Water Added to Sample at 500 psf. **Date:** 11/21/24

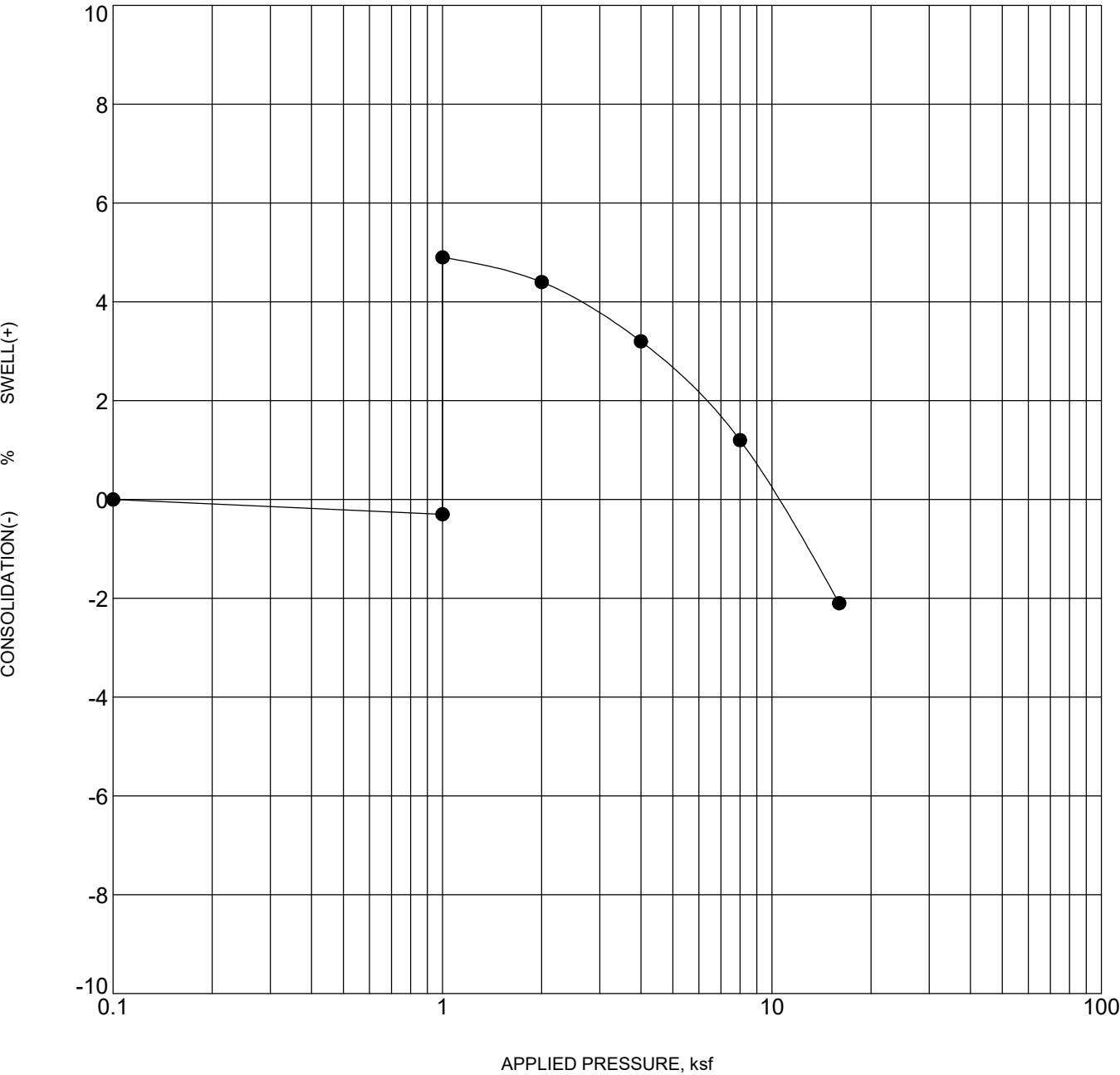


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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 4	14.0	CLAYSTONE BEDROCK	99	24

Note: Water Added to Sample at 1000 psf. **Date:** 11/21/24

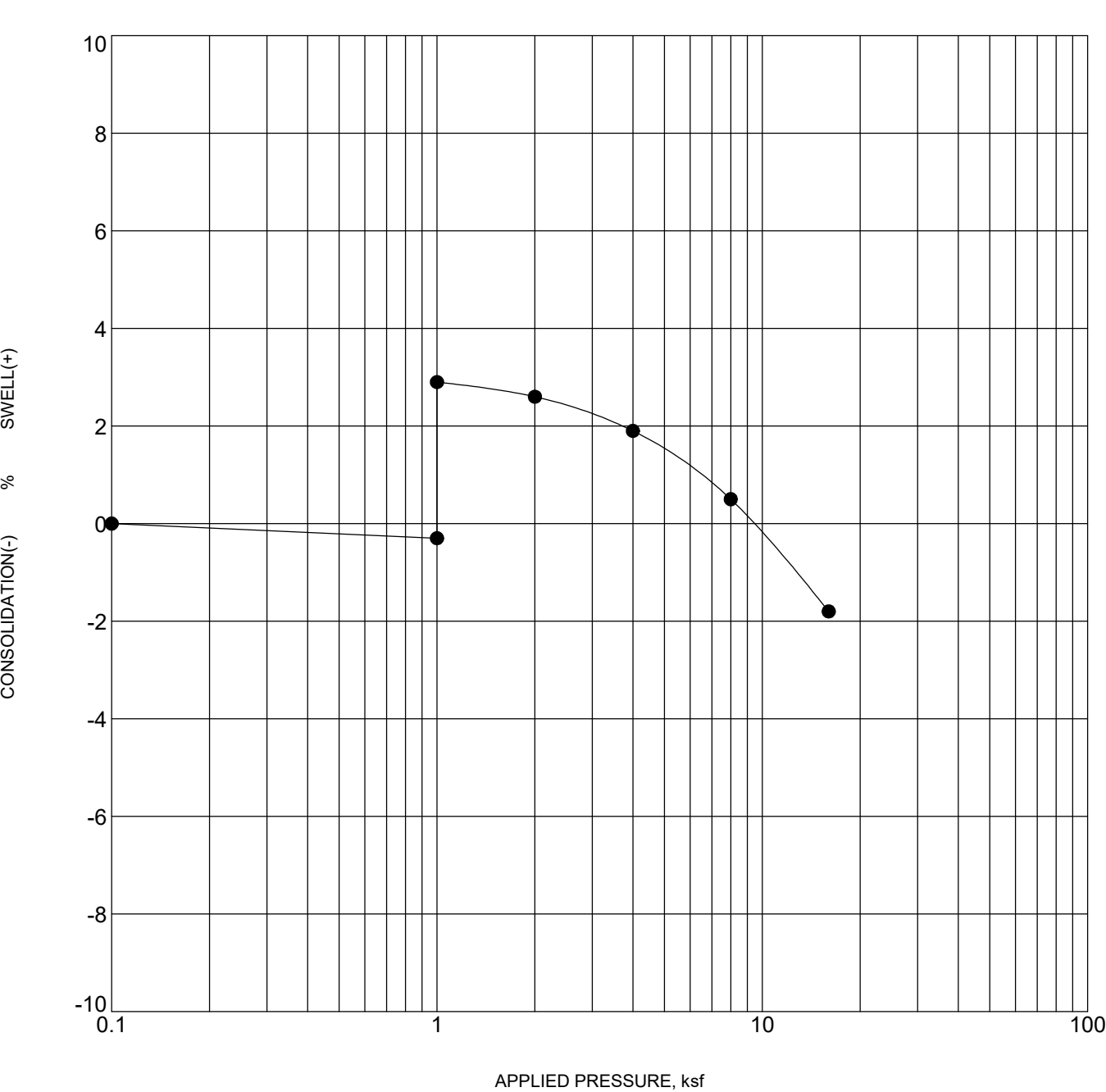


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SWELL/CONSOLIDATION TEST

CLIENT Maiker Housing Partners **PROJECT NAME** Proposed Multi-family Residential Development
PROJECT NUMBER 24.22.212 **PROJECT LOCATION** E of Granada Rd & Bountiful Ct - Adams Cnty, CO

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 5	9.0	SANDY LEAN CLAY	122	13

Note: Water Added to Sample at 1000 psf. **Date:** 11/21/24

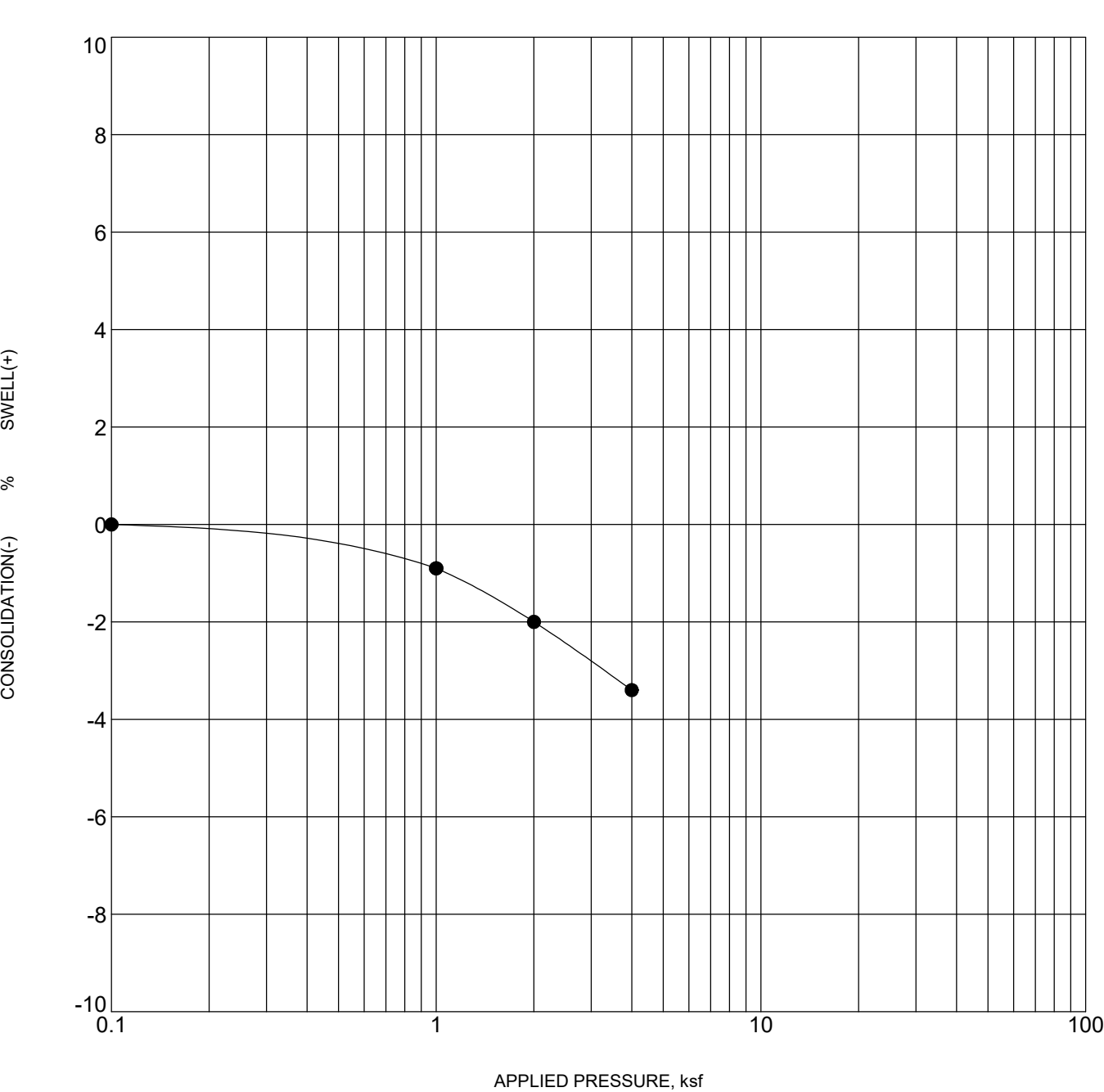


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SWELL/CONSOLIDATION TEST

CLIENT Maiker Housing Partners **PROJECT NAME** Proposed Multi-family Residential Development
PROJECT NUMBER 24.22.212 **PROJECT LOCATION** E of Granada Rd & Bountiful Ct - Adams Cnty, CO

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 5	14.0	SANDY LEAN CLAY	98	25

Note: Water Added to Sample at 1000 psf. **Date:** 11/21/24

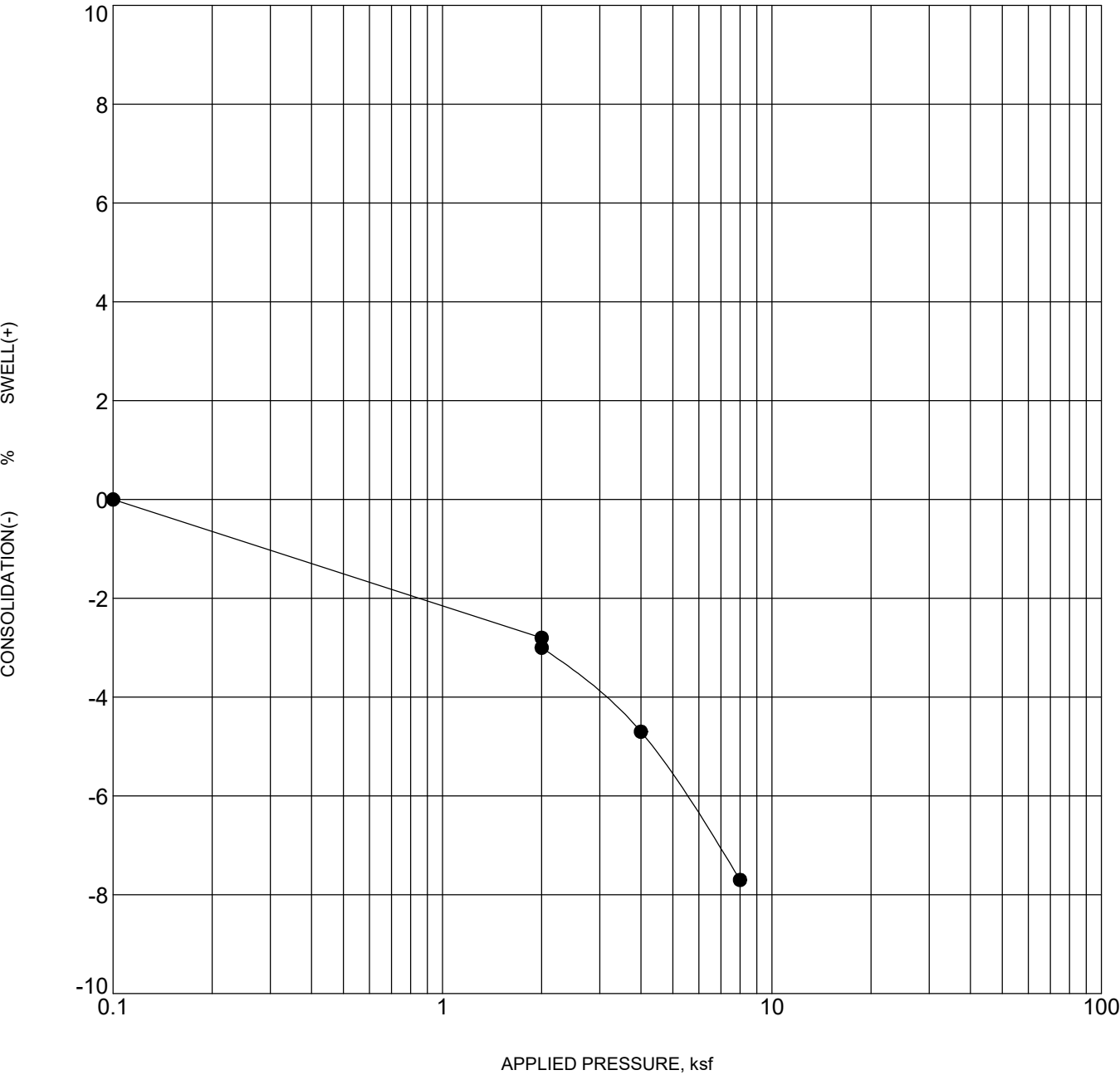


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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 5	19.0	SANDY LEAN CLAY	92	29

Note: Water Added to Sample at 2000 psf. Date: 11/21/24

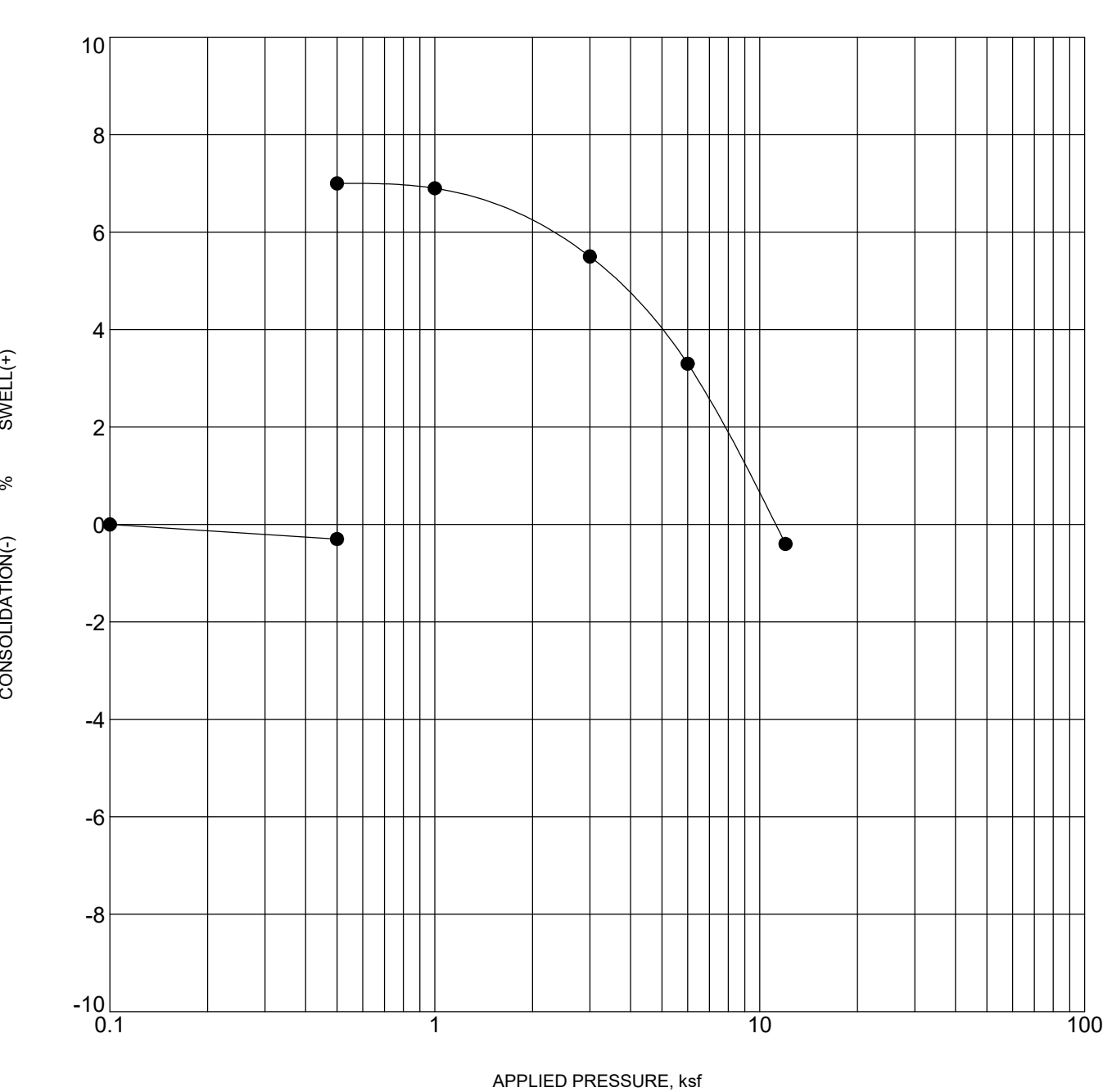


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SWELL/CONSOLIDATION TEST

CLIENT Maiker Housing Partners **PROJECT NAME** Proposed Multi-family Residential Development
PROJECT NUMBER 24.22.212 **PROJECT LOCATION** E of Granada Rd & Bountiful Ct - Adams Cnty, CO

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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 6	4.0	SANDY LEAN CLAY	111	14

Note: Water Added to Sample at 500 psf. **Date:** 11/21/24



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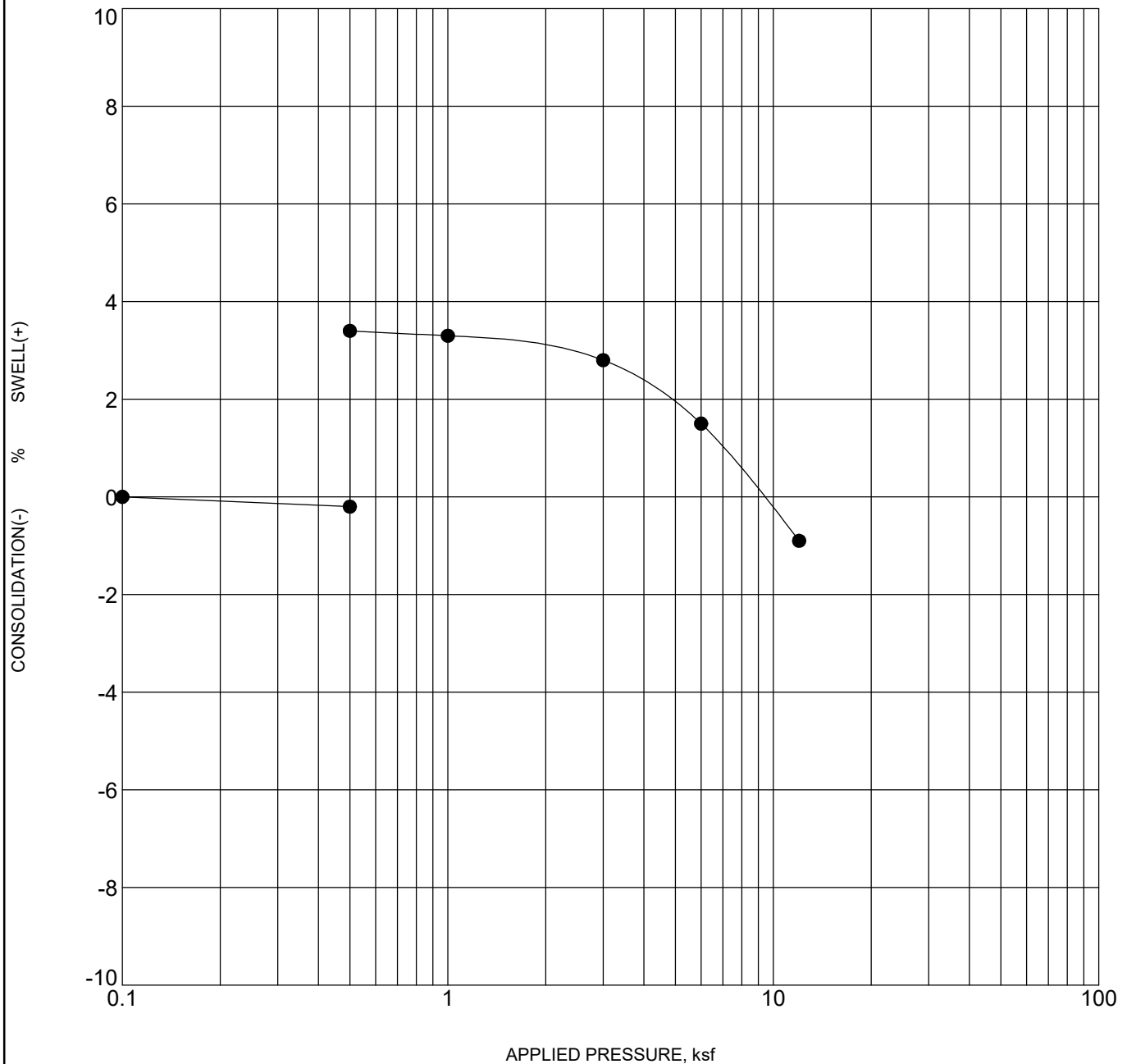
CLIENT Maiker Housing Partners

PROJECT NAME Proposed Multi-family Residential Development

PROJECT NUMBER 24.22.212

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 6	9.0	SANDY LEAN CLAY	115	14

Note: Water Added to Sample at 500 psf.

Date: 11/21/24

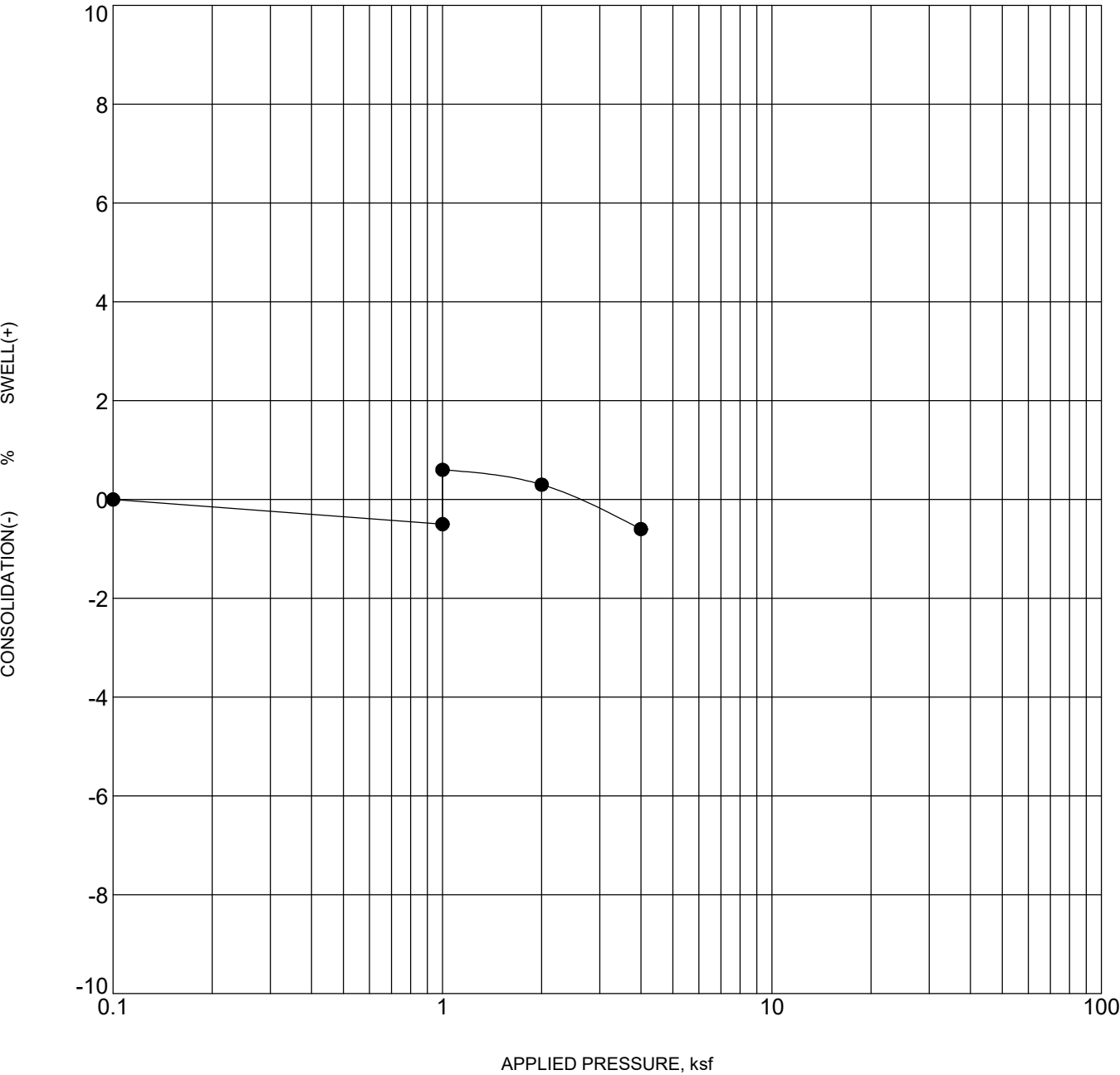


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SWELL/CONSOLIDATION TEST

CLIENT Maiker Housing Partners PROJECT NAME Proposed Multi-family Residential Development
PROJECT NUMBER 24.22.212 PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

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BOREHOLE	DEPTH	Classification	γ _d	MC%
● 7	9.0	SANDY LEAN CLAY	100	20

Note: Water Added to Sample at 1000 psf. Date: 11/21/24

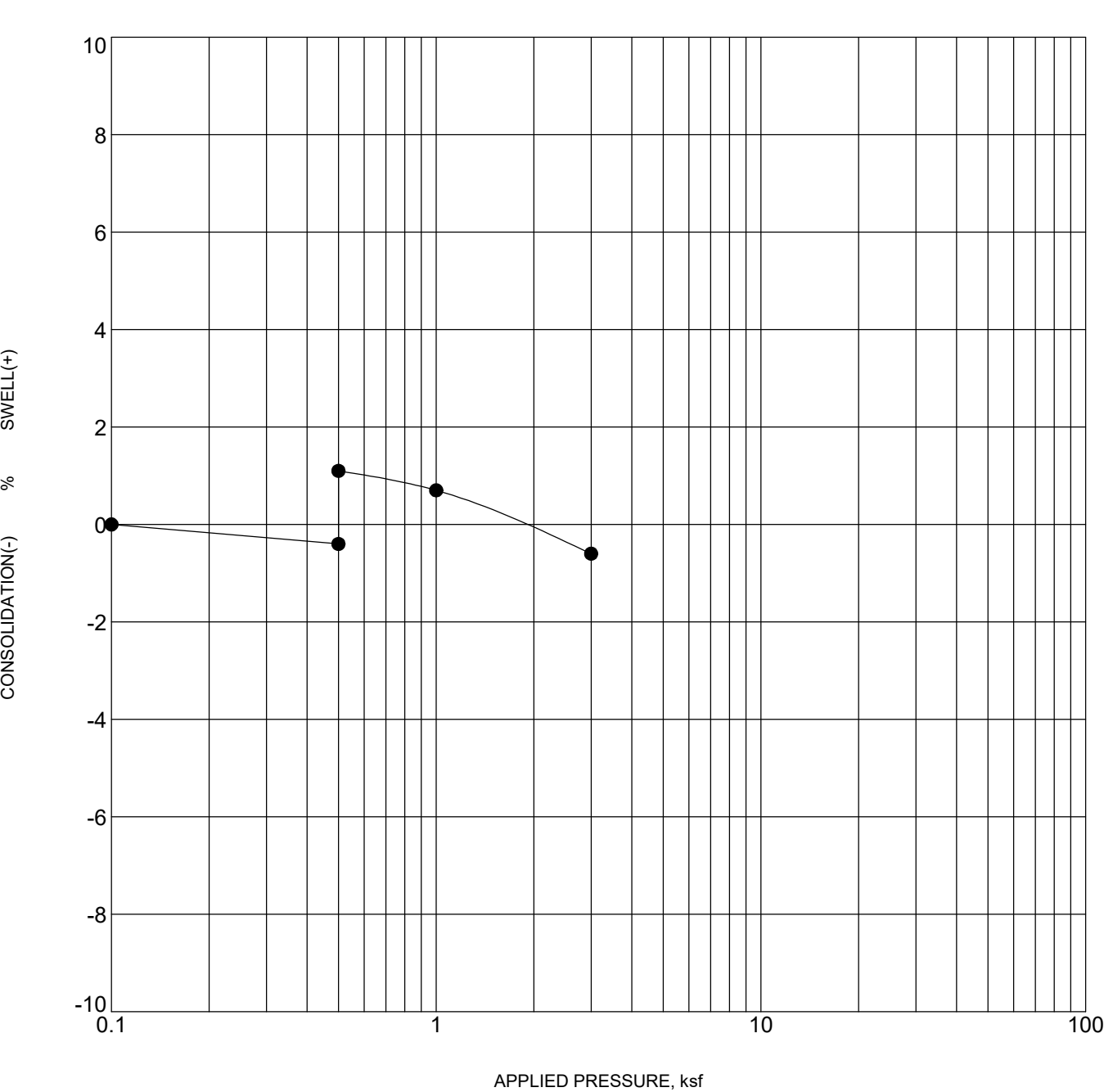


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SWELL/CONSOLIDATION TEST

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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 8	4.0	LEAN CLAY with SAND	96	20

Note: Water Added to Sample at 500 psf. **Date:** 11/21/24



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SWELL/CONSOLIDATION TEST

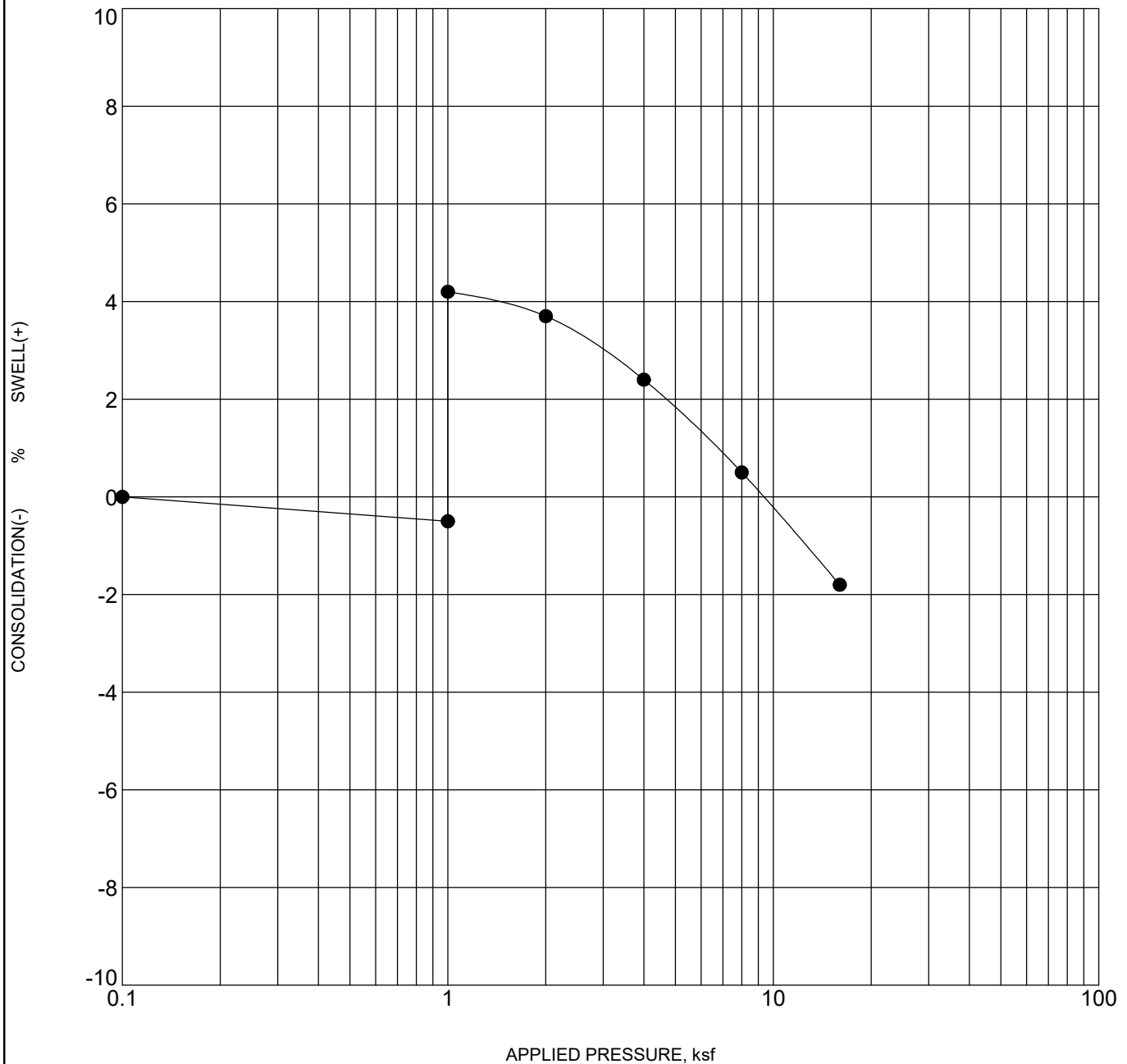
CLIENT Maiker Housing Partners

PROJECT NAME Proposed Multi-family Residential Development

PROJECT NUMBER 24.22.212

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 8	9.0	SANDY LEAN CLAY to CLAYEY SAND	114	12

Note: Water Added to Sample at 1000 psf.

Date: 11/21/24



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SWELL/CONSOLIDATION TEST

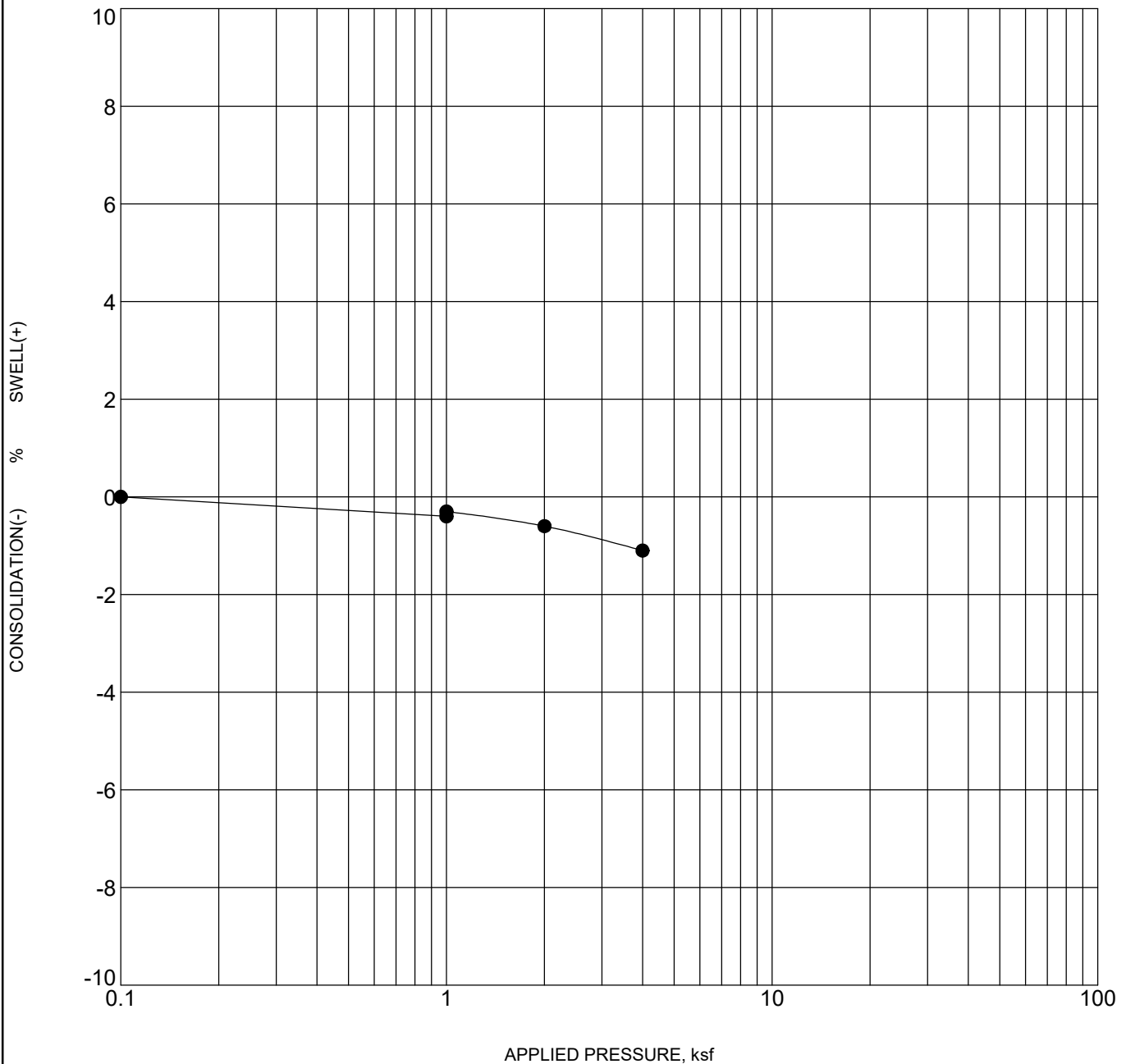
CLIENT Maiker Housing Partners

PROJECT NAME Proposed Multi-family Residential Development

PROJECT NUMBER 24.22.212

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 9	9.0	SANDY LEAN CLAY to CLAYEY SAND	110	12

Note: Water Added to Sample at 1000 psf.

Date: 11/21/24

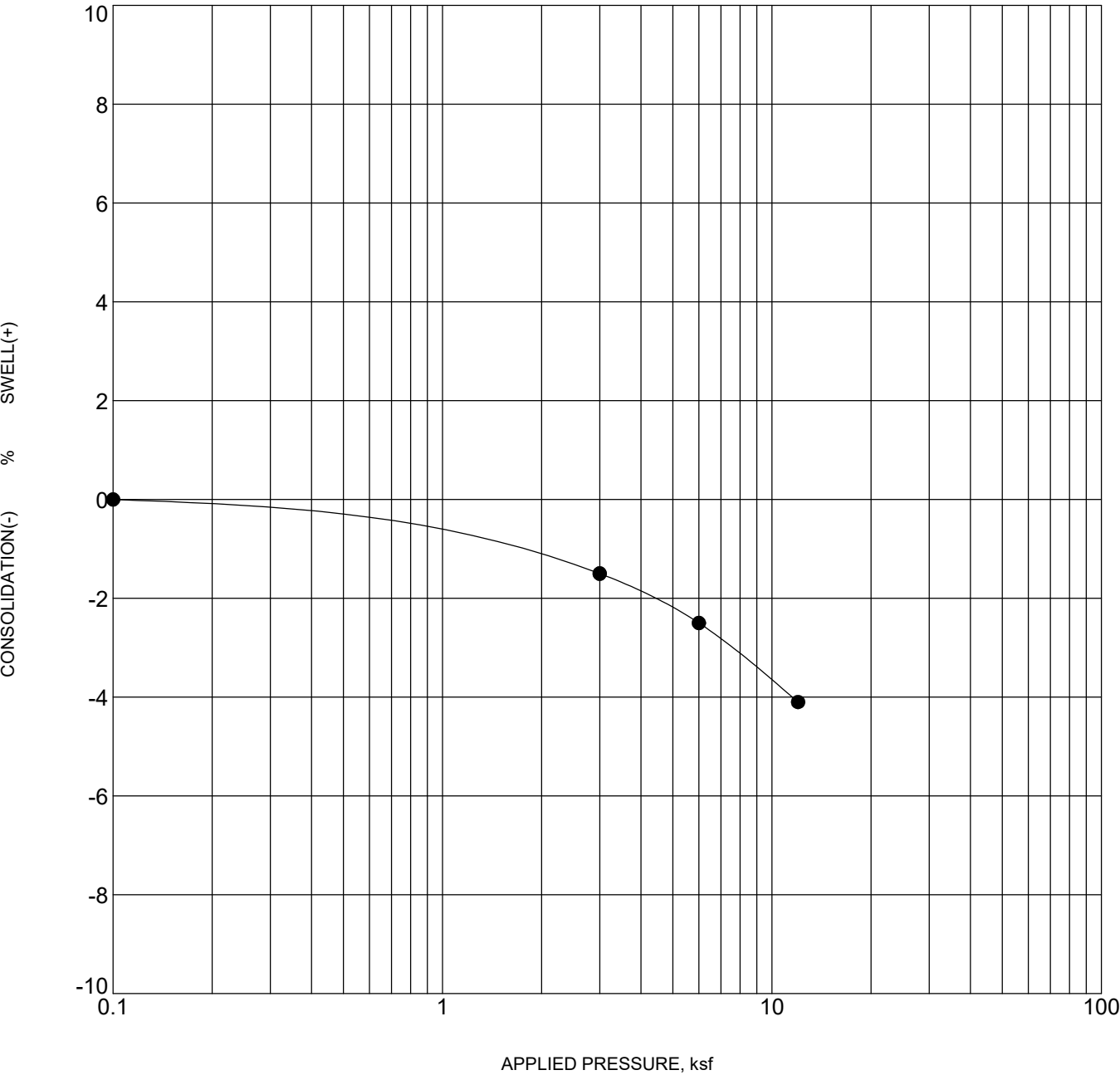


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PROJECT NUMBER 24.22.212 PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ _d	MC%
● 9	24.0	CLAYSTONE BEDROCK	100	21

Note: Water Added to Sample at 3000 psf. Date: 11/21/24

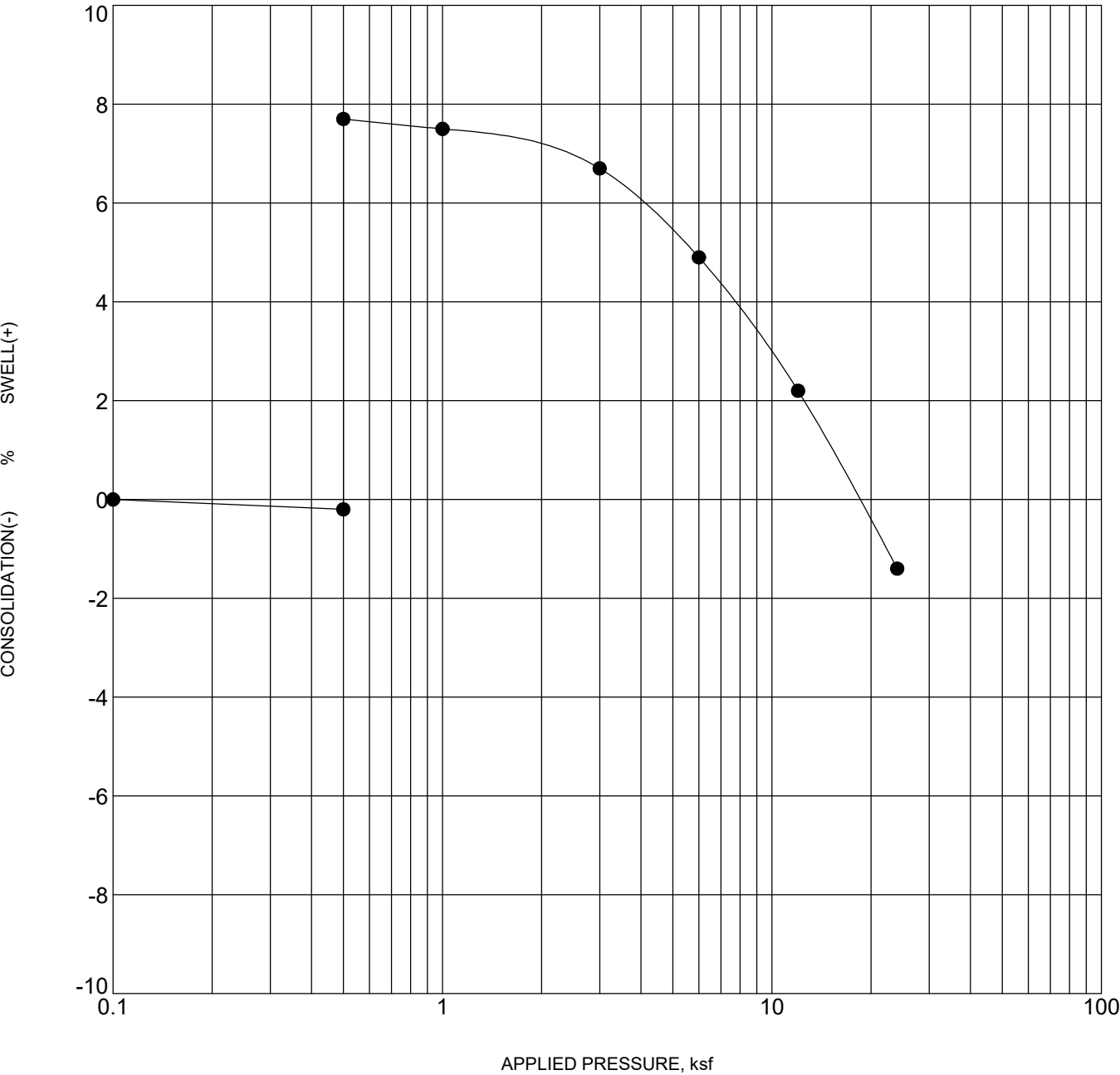


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BOREHOLE	DEPTH	Classification	γ_d	MC%
● 10	4.0	LEAN CLAY with SAND	116	13

Note: Water Added to Sample at 500 psf. Date: 11/21/24

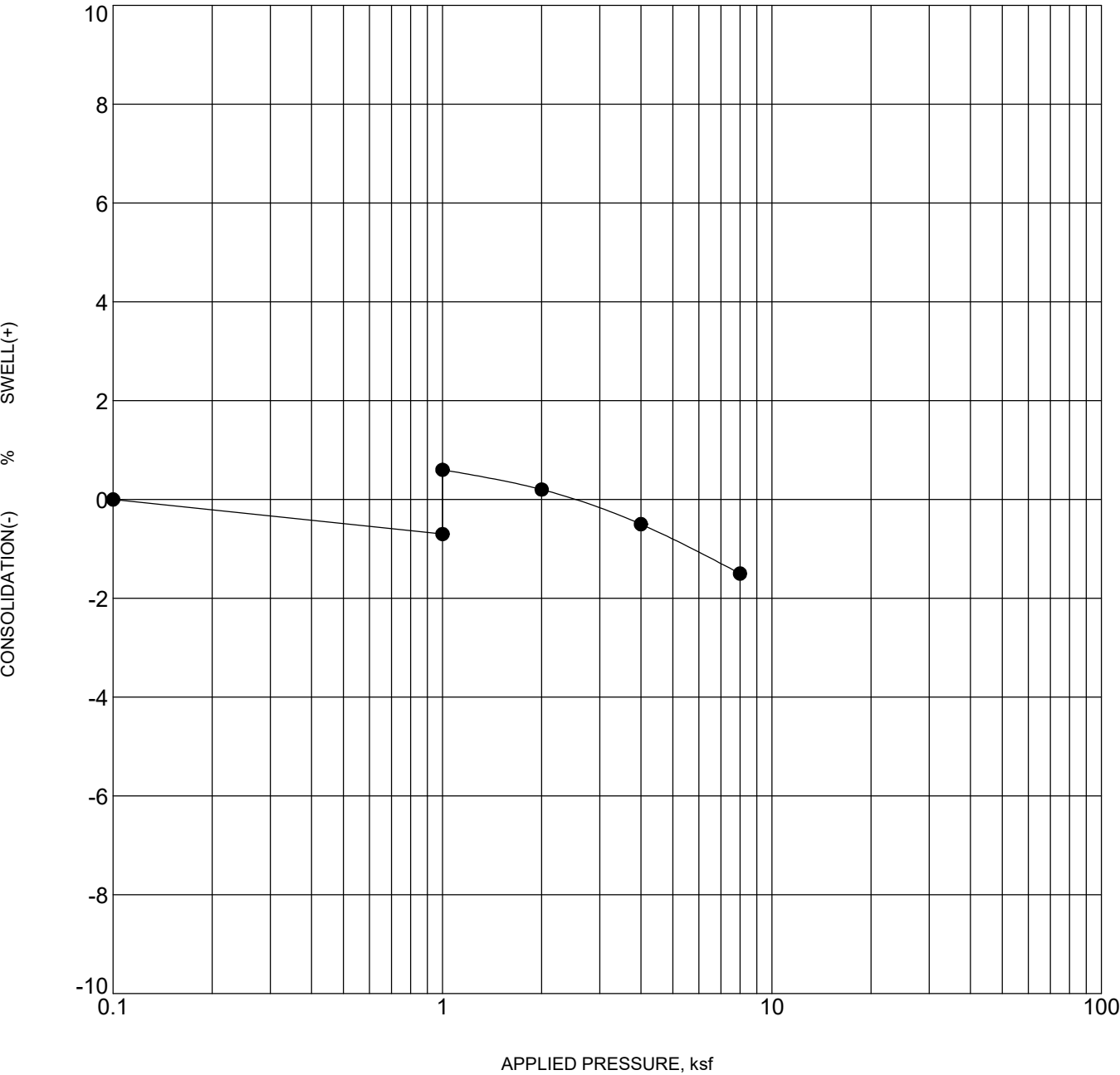


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Westminster, CO 80234

SWELL/CONSOLIDATION TEST

CLIENT Maiker Housing Partners PROJECT NAME Proposed Multi-family Residential Development
PROJECT NUMBER 24.22.212 PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 12/3/24 14:54 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 10	14.0	CLAYSTONE BEDROCK	112	14

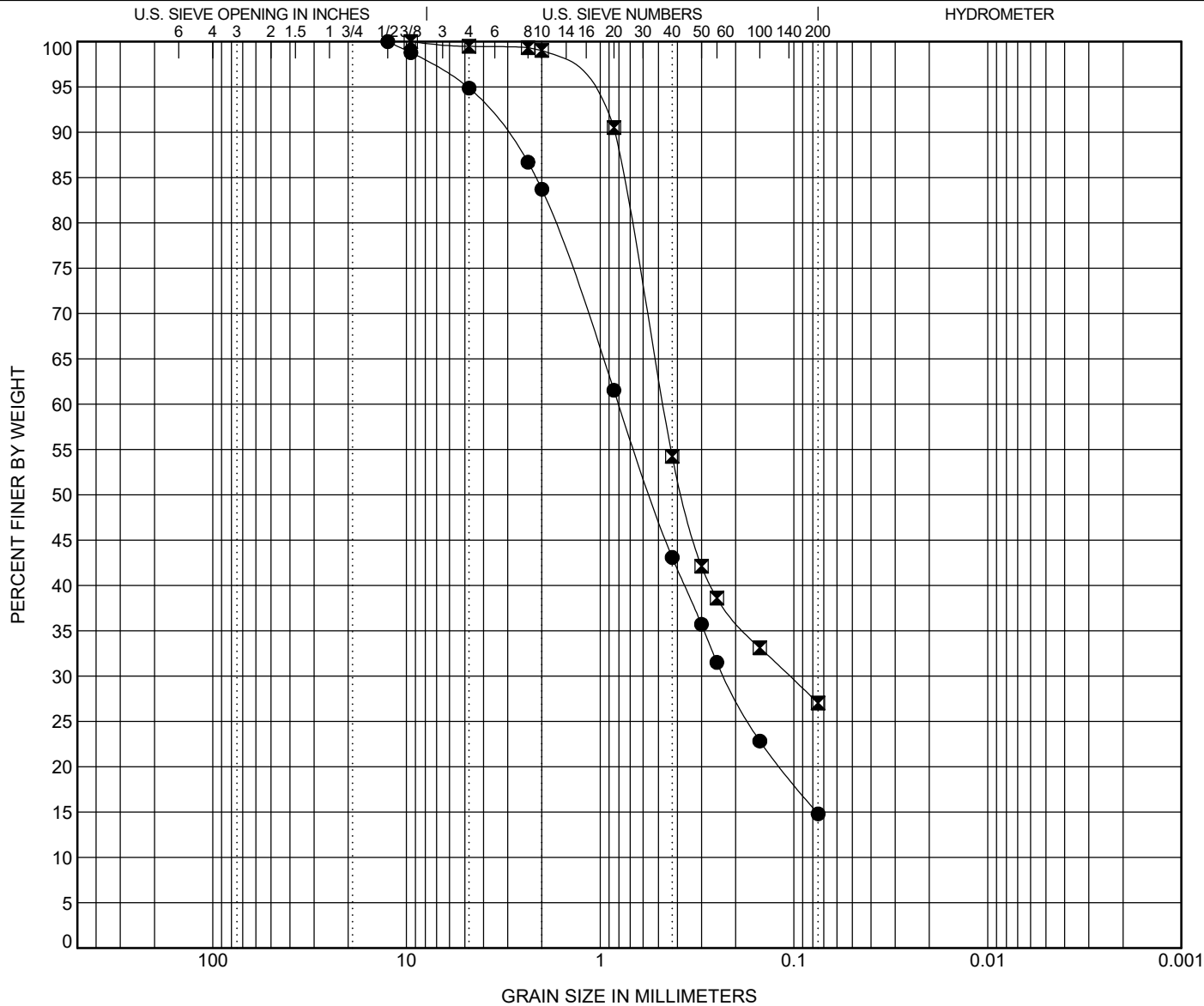
Note: Water Added to Sample at 1000 psf. Date: 11/21/24



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GRAIN SIZE DISTRIBUTION

CLIENT Maiker Housing Partners PROJECT NAME Proposed Multi-family Residential Development
PROJECT NUMBER 24.22.212 PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● 7	14.0	SANDSTONE BEDROCK					NP	NP	NP		
☒ 9	4.0	SILTY SAND(SM)					47	29	18		
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt		%Clay	
● 7	14.0	12.5	0.802	0.229		5.1	80.1	14.8			
☒ 9	4.0	9.5	0.474	0.105		0.5	72.5	27.0			

GRAIN SIZE - GINT STD US LAB.GDT - 12/3/24 14:55 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



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SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 2

CLIENT Maiker Housing Partners

PROJECT NAME Proposed Multi-family Residential Development

PROJECT NUMBER 24.22.212

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

Borehole	Depth	Soil Description	Water Content (%)	Dry Density (pcf)	Swell (+) or Consolidation (-)/ Surcharge (%/psf)	Water Soluble Sulfates (ppm)	Passing #200 Sieve (%)	Atterberg Limits		
								Liquid Limit	Plastic Limit	Plasticity Index
1	4	SANDY LEAN CLAY(CL)	10.6	137.0		900	63	33	23	10
1	9	SANDY LEAN CLAY	18.9	110.7	+0.5/500					
1	14	CLAYSTONE BEDROCK	25.5	97.3	+1.1/1000					
1	19	CLAYSTONE BEDROCK	19.6	105.4	+0.1/2000					
1	24	CLAYSTONE BEDROCK	17.8	114.2						
1	34	CLAYSTONE BEDROCK	21.7	108.3						
1	49	CLAYSTONE to SANDSTONE BEDROCK	13.8	115.3						
2	4	LEAN CLAY with SAND	13.9	104.9	+5.4/500					
2	9	CLAYSTONE BEDROCK	24.4	96.4	+3.3/1000		56	63	19	44
2	14	CLAYSTONE BEDROCK	23.7	106.6						
2	19	CLAYSTONE BEDROCK	28.5	99.5						
2	24	CLAYSTONE to SANDSTONE BEDROCK	25.1	104.3						
3	4	FAT CLAY with SAND(CH)	14.8	115.4		3400	74	50	26	24
3	9	LEAN CLAY with SAND	17.4	110.2	+1.4/1000					
3	14	LEAN CLAY with SAND	22.3	97.4	+0.6/1000					
3	19	LEAN CLAY with SAND	27.0	100.1						
3	24	CLAYSTONE BEDROCK	23.7	105.1						
3	34	CLAYSTONE BEDROCK	21.9	107.8						
3	49	CLAYSTONE to SANDSTONE BEDROCK	17.5	113.7						
4	4	SANDY LEAN CLAY	14.2	104.8	+4.7/500					
4	9	SANDY CLAYSTONE BEDROCK	19.2	109.6			58	48	23	25
4	14	CLAYSTONE BEDROCK	24.0	98.9	+5.2/1000					
4	19	CLAYSTONE BEDROCK	22.4	107.8						
4	24	CLAYSTONE to SANDSTONE BEDROCK	18.9	114.0						
5	4	SANDY LEAN CLAY(CL)	15.9	119.2		1000	69	44	20	24
5	9	SANDY LEAN CLAY	12.6	122.1	+3.2/1000					
5	14	SANDY LEAN CLAY	24.9	98.0	-0.9/1000					
5	19	SANDY LEAN CLAY	28.6	92.4	-0.2/2000					
5	24	SANDY LEAN CLAY	28.8	98.2						
6	4	SANDY LEAN CLAY	14.3	111.1	+7.3/500					

LAB SUMMARY - GINT STD US LAB.GDT - 12/3/24 14:55 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ



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SUMMARY OF LABORATORY RESULTS

PAGE 2 OF 2

CLIENT Maiker Housing Partners

PROJECT NAME Proposed Multi-family Residential Development

PROJECT NUMBER 24.22.212

PROJECT LOCATION E of Granada Rd & Bountiful Ct - Adams Cnty, CO

Borehole	Depth	Soil Description	Water Content (%)	Dry Density (pcf)	Swell (+) or Consolidation (-)/ Surcharge (%/psf)	Water Soluble Sulfates (ppm)	Passing #200 Sieve (%)	Atterberg Limits		
								Liquid Limit	Plastic Limit	Plasticity Index
6	9	SANDY LEAN CLAY	14.3	114.8	+3.6/500					
6	14	SANDY LEAN CLAY	24.2	101.8						
6	19	CLAYSTONE to SANDSTONE BEDROCK	15.1	120.0						
6	24	CLAYSTONE to SANDSTONE BEDROCK	22.0	106.8						
7	4	SANDY LEAN CLAY(CL)	12.0	115.3			62	36	21	15
7	9	SANDY LEAN CLAY	20.5	100.3	+1.1/1000					
7	14	SANDSTONE BEDROCK	13.0	111.5			15	NP	NP	NP
7	19	CLAYSTONE BEDROCK	30.3	93.3						
7	24	CLAYSTONE BEDROCK	26.9	98.5						
8	4	LEAN CLAY with SAND	20.0	96.3	+1.5/500					
8	9	SANDY LEAN CLAY to CLAYEY SAND	12.2	113.9	+4.7/1000					
8	14	CLAYEY to SILTY SAND	9.0	131.1						
8	19	LEAN CLAY with SAND	18.7	114.0						
8	24	LEAN CLAY with SAND	24.7	103.5						
8	34	CLAYSTONE BEDROCK	20.1	112.3						
8	49	CLAYSTONE BEDROCK	17.5	167.2						
9	4	SILTY SAND(SM)	12.7	114.1		1700	27	47	29	18
9	9	SANDY LEAN CLAY to CLAYEY SAND	12.4	110.4	+0.1/1000					
9	14	CLAYEY SANDSTONE BEDROCK	9.2	130.3			40	40	20	20
9	19	CLAYSTONE BEDROCK	22.8	107.7						
9	24	CLAYSTONE BEDROCK	21.4	99.7	-1.5/3000					
10	4	LEAN CLAY with SAND	12.6	116.3	+7.9/500					
10	9	CLAYEY SANDSTONE BEDROCK	4.9	120.2			50	24	15	9
10	14	CLAYSTONE BEDROCK	14.1	112.4	+1.3/1000					
10	19	CLAYSTONE BEDROCK	25.7	92.5						
10	24	CLAYSTONE to SANDSTONE BEDROCK	14.4	109.2						
10	34	CLAYSTONE to SANDSTONE BEDROCK	19.3	111.7						
10	49	CLAYSTONE BEDROCK	20.6	111.6						

LAB SUMMARY - GINT STD US LAB.GDT - 12/3/24 14:55 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2024\24.22.212 MAIKERHOUSINGSITE.GPJ

APPENDIX C

GENERAL NOTES

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1½" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2.5" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
CB:	California Barrel - 1.92" I.D., 2.5" O.D., unless otherwise noted	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 2.5" O.D. California Barrel samplers (CB) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per inch," and is not considered equivalent to the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling
WCI:	Wet Cave in	WD:	While Drilling
DCI:	Dry Cave in	BCR:	Before Casing Removal
AB:	After Boring	ACR:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

FINE-GRAINED SOILS

<u>(CB)</u> <u>Blows/Ft.</u>	<u>(SS)</u> <u>Blows/Ft.</u>	<u>Consistency</u>
< 3	0-2	Very Soft
3-5	3-4	Soft
6-10	5-8	Medium Stiff
11-18	9-15	Stiff
19-36	16-30	Very Stiff
> 36	> 30	Hard

COARSE-GRAINED SOILS

<u>(CB)</u> <u>Blows/Ft.</u>	<u>(SS)</u> <u>Blows/Ft.</u>	<u>Relative</u> <u>Density</u>
0-5	< 3	Very Loose
6-14	4-9	Loose
15-46	10-29	Medium Dense
47-79	30-50	Dense
> 79	> 50	Very Dense

BEDROCK

<u>(CB)</u> <u>Blows/Ft.</u>	<u>(SS)</u> <u>Blows/Ft.</u>	<u>Consistency</u>
< 24	< 20	Weathered
24-35	20-29	Firm
36-60	30-49	Medium Hard
61-96	50-79	Hard
> 96	> 79	Very Hard

RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Terms of</u> <u>Other Constituents</u>	<u>Percent of</u> <u>Dry Weight</u>
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

<u>Major Component</u> <u>of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

<u>Descriptive Terms of</u> <u>Other Constituents</u>	<u>Percent of</u> <u>Dry Weight</u>
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity Index</u>
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests^A

				Soil Classification	
				Group Symbol	Group Name ^B
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well graded gravel ^F
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel ^F
		Gravels with Fines More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F,G,H}
			Fines classify as CL or CH	GC	Clayey gravel ^{F,G,H}
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well graded sand ^I
			$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly graded sand ^I
Fine-Grained Soils 50% or more passes the No. 200 sieve	Sils and Clays Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line ^J	CL	Lean clay ^{K,L,M}
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K,L,M}
		Organic	Liquid limit - oven dried	< 0.75	OL
			Liquid limit - not dried		
					Organic clay ^{K,L,M,N}
					Organic silt ^{K,L,M,O}
	Sils and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay ^{K,L,M}
			PI plots below "A" line	MH	Elastic silt ^{K,L,M}
		Organic	Liquid limit - oven dried	< 0.75	OH
			Liquid limit - not dried		
					Organic clay ^{K,L,M,P}
					Organic silt ^{K,L,M,Q}
Highly organic soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

^ABased on the material passing the 3-in. (75-mm) sieve

^BIf field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^CGravels with 5 to 12% fines require dual symbols: GW-GM well graded gravel with silt, GW-GC well graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^DSands with 5 to 12% fines require dual symbols: SW-SM well graded sand with silt, SW-SC well graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^FIf soil contains $\geq 15\%$ sand, add "with sand" to group name.

^GIf fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^HIf fines are organic, add "with organic fines" to group name.

^IIf soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^JIf Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^KIf soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^LIf soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

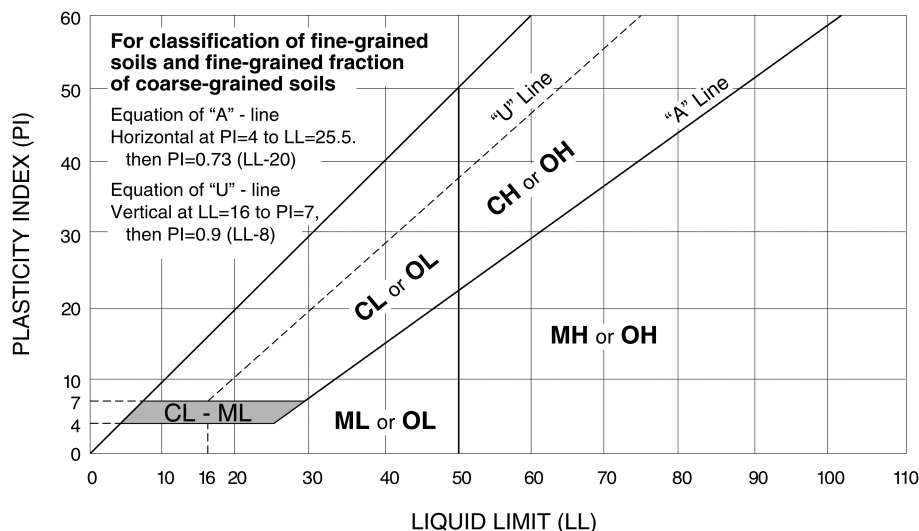
^MIf soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



ROCK CLASSIFICATION

(Based on ASTM C-294)

Sedimentary Rocks

Sedimentary rocks are stratified materials laid down by water or wind. The sediments may be composed of particles or pre-existing rocks derived by mechanical weathering, evaporation or by chemical or organic origin. The sediments are usually indurated by cementation or compaction.

Chert	Very fine-grained siliceous rock composed of micro-crystalline or cryptocrystalline quartz, chalcedony or opal. Chert is various colored, porous to dense, hard and has a conchoidal to splintery fracture.
Claystone	Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Soft massive and may contain carbonate minerals.
Conglomerate	Rock consisting of a considerable amount of rounded gravel, sand and cobbles with or without interstitial or cementing material. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other materials.
Dolomite	A fine-grained carbonate rock consisting of the mineral dolomite $[\text{CaMg}(\text{CO}_3)_2]$. May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).
Limestone	A fine-grained carbonate rock consisting of the mineral calcite (CaCO_3). May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).
Sandstone	Rock consisting of particles of sand with or without interstitial and cementing materials. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other material.
Shale	Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Shale is hard, platy, of fissile may be gray, black, reddish or green and may contain some carbonate minerals (calcareous shale).
Siltstone	Fine grained rock composed of or derived by erosion of silts or rock containing silt. Siltstones consist predominantly of silt sized particles (0.0625 to 0.002 mm in diameter) and are intermediate rocks between claystones and sandstones and may contain carbonate minerals.

**LABORATORY TEST
SIGNIFICANCE AND PURPOSE**

TEST	SIGNIFICANCE	PURPOSE
<i>California Bearing Ratio</i>	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	<i>Pavement Thickness Design</i>
<i>Consolidation</i>	Used to develop an estimate of both the rate and amount of both differential and total settlement of a structure.	<i>Foundation Design</i>
<i>Direct Shear</i>	Used to determine the consolidated drained shear strength of soil or rock.	<i>Bearing Capacity, Foundation Design, and Slope Stability</i>
<i>Dry Density</i>	Used to determine the in-place density of natural, inorganic, fine-grained soils.	<i>Index Property Soil Behavior</i>
<i>Expansion</i>	Used to measure the expansive potential of fine-grained soil and to provide a basis for swell potential classification.	<i>Foundation and Slab Design</i>
<i>Gradation</i>	Used for the quantitative determination of the distribution of particle sizes in soil.	<i>Soil Classification</i>
<i>Liquid & Plastic Limit, Plasticity Index</i>	Used as an integral part of engineering classification systems to characterize the fine-grained fraction of soils, and to specify the fine-grained fraction of construction materials.	<i>Soil Classification</i>
<i>Permeability</i>	Used to determine the capacity of soil or rock to conduct a liquid or gas.	<i>Groundwater Flow Analysis</i>
<i>pH</i>	Used to determine the degree of acidity or alkalinity of a soil.	<i>Corrosion Potential</i>
<i>Resistivity</i>	Used to indicate the relative ability of a soil medium to carry electrical currents.	<i>Corrosion Potential</i>
<i>R-Value</i>	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	<i>Pavement Thickness Design</i>
<i>Soluble Sulfate</i>	Used to determine the quantitative amount of soluble sulfates within a soil mass.	<i>Corrosion Potential</i>
<i>Unconfined Compression</i>	To obtain the approximate compressive strength of soils that possess sufficient cohesion to permit testing in the unconfined state.	<i>Bearing Capacity Analysis for Foundations</i>
<i>Water Content</i>	Used to determine the quantitative amount of water in a soil mass.	<i>Index Property Soil Behavior</i>

REPORT TERMINOLOGY (Based on ASTM D653)

<i>Allowable Soil Bearing Capacity</i>	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
<i>Alluvium</i>	Soil, the constituents of which have been transported in suspension by flowing water and subsequently deposited by sedimentation.
<i>Aggregate Base Course</i>	A layer of specified material placed on a subgrade or subbase usually beneath slabs or pavements.
<i>Backfill</i>	A specified material placed and compacted in a confined area.
<i>Bedrock</i>	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
<i>Bench</i>	A horizontal surface in a sloped deposit.
<i>Caisson (Drilled Pier or Shaft)</i>	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier or drilled shaft.
<i>Coefficient of Friction</i>	A constant proportionality factor relating normal stress and the corresponding shear stress at which sliding starts between the two surfaces.
<i>Colluvium</i>	Soil, the constituents of which have been deposited chiefly by gravity such as at the foot of a slope or cliff.
<i>Compaction</i>	The densification of a soil by means of mechanical manipulation
<i>Concrete Slab-on-Grade</i>	A concrete surface layer cast directly upon a base, subbase or subgrade, and typically used as a floor system.
<i>Differential Movement</i>	Unequal settlement or heave between, or within foundation elements of structure.
<i>Earth Pressure</i>	The pressure exerted by soil on any boundary such as a foundation wall.
<i>ESAL</i>	Equivalent Single Axle Load, a criteria used to convert traffic to a uniform standard, (18,000 pound axle loads).
<i>Engineered Fill</i>	Specified material placed and compacted to specified density and/or moisture conditions under observations of a representative of a geotechnical engineer.
<i>Equivalent Fluid</i>	A hypothetical fluid having a unit weight such that it will produce a pressure against a lateral support presumed to be equivalent to that produced by the actual soil. This simplified approach is valid only when deformation conditions are such that the pressure increases linearly with depth and the wall friction is neglected.
<i>Existing Fill (or Man-Made Fill)</i>	Materials deposited throughout the action of man prior to exploration of the site.
<i>Existing Grade</i>	The ground surface at the time of field exploration.

REPORT TERMINOLOGY (Based on ASTM D653)

<i>Expansive Potential</i>	The potential of a soil to expand (increase in volume) due to absorption of moisture.
<i>Finished Grade</i>	The final grade created as a part of the project.
<i>Footing</i>	A portion of the foundation of a structure that transmits loads directly to the soil.
<i>Foundation</i>	The lower part of a structure that transmits the loads to the soil or bedrock.
<i>Frost Depth</i>	The depth at which the ground becomes frozen during the winter season.
<i>Grade Beam</i>	A foundation element or wall, typically constructed of reinforced concrete, used to span between other foundation elements such as drilled piers.
<i>Groundwater</i>	Subsurface water found in the zone of saturation of soils or within fractures in bedrock.
<i>Heave</i>	Upward movement.
<i>Lithologic</i>	The characteristics which describe the composition and texture of soil and rock by observation.
<i>Native Grade</i>	The naturally occurring ground surface.
<i>Native Soil</i>	Naturally occurring on-site soil, sometimes referred to as natural soil.
<i>Optimum Moisture Content</i>	The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
<i>Perched Water</i>	Groundwater, usually of limited area maintained above a normal water elevation by the presence of an intervening relatively impervious continuous stratum.
<i>Scarify</i>	To mechanically loosen soil or break down existing soil structure.
<i>Settlement</i>	Downward movement.
<i>Skin Friction (Side Shear)</i>	The frictional resistance developed between soil and an element of the structure such as a drilled pier.
<i>Soil (Earth)</i>	Sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.
<i>Strain</i>	The change in length per unit of length in a given direction.
<i>Stress</i>	The force per unit area acting within a soil mass.
<i>Strip</i>	To remove from present location.
<i>Subbase</i>	A layer of specified material in a pavement system between the subgrade and base course.
<i>Subgrade</i>	The soil prepared and compacted to support a structure, slab or pavement system.