City of Northglenn
11701 Community Center Drive
Northglenn, Colorado 80233

CITY OF NORTHGLENN

NWOS BRIDGE INSTALL
BID NO. 2023-031

ADDENDUM NO. 1
DATED: January 3, 2024

TO: PROSPECTIVE BIDDERS

The following adds to, supplements, amends or clarifies by way of explanation, portions of the Contract Documents, Specifications, and Drawings for the above named project.

NOTE: It will be the responsibility of the Bidder to acknowledge receipt of Addenda on the Bid Form as part of his/her submitted proposal. Failure to do so will be grounds for the City to reject the proposal.

The Contract Documents, including the Specifications and Drawings are hereby modified by the following items:

SPECIFICATIONS:

NONE

DRAWINGS:

NONE

QUESTIONS:

1. Is all the hardware to anchor the bridge to the footers supplied by the city?

   Hardware to anchor the bridge will be supplied by the Contractor.

2. If the planks need to be replaced, can they be replaced with pressure treated 2x12's?

   Yes, pressure treated 2X12's would be accepted.

3. Do the planks need to be fastened to the bridge deck? If so, can we re-use the bolts?

   Yes, the planks will need to be fastened to the bridge deck. New fasteners will be required.

4. How much are we supposed to put in for Bid Item #10, Bridge Repair Allowance, as Directed by City?

   $5,000

5. Can you provide us with a soils report?

   Yes, please see the attached report.

6. Can you provide a painting specification?

   The painting shall be completed per the Manufacturer's instructions.

7. Will the contractor be responsible for the material sampling and testing?

   The city will be responsible for materials sampling and testing with the Contractor to coordinate with the Testing Agency.

8. What is the current condition of the existing bridge?

   Please see attached pictures.

9. What is the weight of the existing bridge?

   12,300 lbs estimated

10. Will the channel be shut for dewatering?

   Yes, the canal will not be running during construction. Construction must be completed prior to the canal running in the spring.

11. What will be the most approachable site access?

   Site Access is most approachable from the north via 112th Ave.

12. Can you provide photos of the bridge?

   Please see attached.

13. Can you give us an address where the bridge will be located?

   12301 Claude Ct | Northglenn, CO 80241

14. Can the bridge be painted where it's being stored?

Preference would be to transport the bridge to the site and paint / restore on site.

Attachment:

Pre Bid Sign in Sheet

Pictures of Bridge

Geotechnical Report

ALL ITEMS IN CONFLICT WITH THIS ADDENDUM ARE HEREBY DELETED.

END OF ADDENDUM NO 1

City of Northglenn

NWOS Bridge Install – IFB 2023-031
Pre-Bid Meeting Sign-In Sheet

Thursday December 14th, 2023, 10:00 AM

	Company	Representative Name	Phone Number	Email Address
1	Goodland Construction	Ryan Neeley	3/278-8100	ryan@goodlandconstruction.com
2	Hamon	Susan Prince	3/297-0340	sprince@hamonbuilt.com
3	Coal Creek Excavation Inc.	Koryl Smith	303 358 0484	koryl@coalcreekexcavation.com
4	HALLMARK INC	ERIK FALMOE	303-423-8005	OFFICE@HALLMARK-INC.COM
5	DIETZLER CONSTRUCTION	RON GIBBENS	720 597 0338	ESTIMATING@DIETZLERCO.COM RGIBBENS@DIETZLERCO.COM
6	ELITE INDUSTRIES	BRAD BENSKO	303 722.0700	BRAD@ELITEINDUSTRIESINC.COM
7	Stone & Concrete	Jerry Roberts	303-949-3037	Jerry@DirectDenver.com
8	Stone & concrete	Yonaton Luevano	303-549-6426	Yonaton@stoneandconcretedenver.com
9	Three Brothers Concrete	Aron Chacon moreno	303 518-5684	achacon@threebrothersconcrete.co
10	Three Brothers Concrete	Cesar Gonzalez	303/845/0586	cgonzalez@threebrothersco
11	KECI Civil INC.	Steve Romero	303 791-3759	STEVE.OHANLON@KECICO.COM
12	TechCon Infrastructure LLC	David Rodriguez	303 600 3727	eCallejo@trusttci.com
13	Wall Coating Systems	AMBER COOMBES	303 294 4083	ACOOMBES@WCSYSINC.COM
14	Lobos Structures	Alvaro Villalobos	303 669-3811	lobosstructures@gmail.com INC.COM
15	Noraa Concrete	Cassie Kaiser	303-637-9233	noraabids@noraaconcrete.com
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GEOTECHNICAL STUDY
Niver Canal Bridge
Northglenn, Colorado

Prepared for:

Mr. Jason Murray
J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Project No. 22.137
December 2, 2022

Colorado Regional Office: 7108 South Alton Way, Building B • Centennial, CO 80112
Arizona • Colorado • Idaho • Texas • Utah
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CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants
CMT TECHNICAL SERVICES

GEOTECHNICAL STUDY

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December 2, 2022

Report Prepared by:
CESARE, INC. d/b/a CMT TECHNICAL SERVICES - COLORADO

COLORADO REGISTERED PROFESSIONAL ENGINEER
JONATHAN A. CRYSTAL
32837
12/2/22

Jonathan A. Crystal, P.E.
Project Engineer

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FIGURES

APPENDICES

COMMON ABBREVIATIONS AND ACRONYMS

AASHTO.........American Association of State Highway and Transportation Officials
ABC................aggregate base course
ACI ....American Concrete Institute
ADA ....Americans with Disabilities Act
ADSC ....Association of Drilled Contractors
AI ....Asphalt Institute
APM ....asphalt paving material
ASCE..............American Society of Civil Engineers
ASTM ....American Society for Testing and Materials
AWWA ....American Water Works Association
bgs.................below ground surface
CDOT ....Colorado Department of Transportation
CBR................California Bearing Ratio
CFR................Code of Federal Regulations
CGS................Colorado Geological Survey
CKD ....cement of kiln dust stabilized subgrade
CMU ....concrete masonry unit
CTB................cement treated base course
deg ....degree
EDLA.............equivalent daily load application
e_m ....edge moisture variation distance
EPS ....expanded polystyrene
ESAL ....equivalent single axle loads
f'c ....specified compressive strength of concrete at the age of 28 days
F_a ....seismic site coefficient
FHWA ....Federal Highway Administration
FS ....factor of safety
F_v ....seismic site coefficient
GSA................global stability analysis
GVW ....gross vehicle weight
IBC ....International Building Code
ICC-ES...........International Code Council Evaluation Services, Inc.
IRC ....International Residential Code
kip ....1,000 pounds-force
km ....kilometer
LTS ....lime treated subgrade
MDD ....maximum dry density
mg/L ....milligrams per liter
MGPEC...........Metropolitan Government Pavement Engineers Council
mm ....millimeter
Mr ....resilient modulus
MSE ....mechanically stabilized earth
mV ....millivolts
NAPA ....National Asphalt Pavement Association
N_{DESIGN} ....design gyrations
OMC..............optimum moisture content

OSHA .... Occupational Safety and Health Administration
OWTS .... onsite wastewater treatment system
PCA................ Portland Cement Association
PCC................ portland cement concrete
pcf .... pounds per cubic foot
pci.................. pounds per cubic inch
pH.................. power of hydrogen
psf .... pounds per square foot
psi.................. pounds per square inch
PT .... post-tension
S_s .... mapped spectral accelerations for short periods
UBC .... Uniform Building Code
USGS .... United States Geological Survey

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

1. PURPOSE

1.1 GENERAL

CMT Technical Services - Colorado (CMT) performed a geotechnical study of a proposed pedestrian bridge site to cross the Niver Canal within the Northwest Open Space in Northglenn, Colorado. The study was made to characterize the subsurface conditions at the site, evaluate their engineering properties, and provide design criteria for planning, site development, foundation systems, and to address other pertinent geotechnical issues. Information gathered during the field exploration and laboratory testing is summarized in Figures 1 and 2 and Appendices A and B. CMT's opinions and recommendations presented in this report are based on data generated during this field exploration, laboratory testing, and its experience.

1.2 SCOPE OF SERVICES

The scope of services performed was discussed in an email exchange with J&T Consulting, Inc. (J&T) on October 6, 2022.

2. SUMMARY OF FINDINGS AND CONCLUSIONS

This section is intended as a summary only and does not include design details. The report should be read in its entirety and utilized for design.

- A travel surface wear course consisting of 18 inches of recycled asphalt was encountered at the surface of Boring B-1.
- Sandy clay fill was encountered below the wear course in B-1, extending to about 3 feet. Sandy clay fill was encountered at the ground surface in B-2, extending to about 6 feet.
- Native sandy clay to clay with sand was encountered below the fill in both borings and extended to depths of 9 and 13-1/2 feet in B-1 and B-2, respectively.
- Sandstone bedrock was encountered below the clay in both borings, extending to depths of about 39-1/2 and 24-1/2 feet in B-1 and B-2, respectively. The sandstone in B-1 was interbedded with frequent seams and occasional layers of claystone.
- The soil profile will classify as seismic site Class C.
- The bridge may bear on shallow spread or pad type footings bearing below the canal scour depth or outside the embankment.
- Good surface drainage should be established and positive drainage away from the structures and other site improvements should be provided during construction and maintained throughout the life of the proposed structures.

3. PROPOSED CONSTRUCTION

CMT understands the pedestrian bridge construction will include moving an existing automobile rated bridge structure to the Niver Canal site. The existing bridge will clear the entire canal in a single span. It is steel frame construction and will bear on cast-in-place concrete stem wall abutments.

4. FIELD EXPLORATION

Subsurface conditions were explored on October 13, 2022 by drilling two borings at the locations indicated in Figure 2. Borings were drilled about 39-1/2 and 24-1/2 feet deep. Graphical logs of the subsurface conditions encountered and further explanation of the exploration are presented in the boring logs contained in Appendix A.

Photo 1. View looking at drilling Boring B-1.

5. LABORATORY TESTING

CMT personnel returned samples obtained during field exploration to its laboratory where professional staff visually classified them and assigned testing to selected samples to evaluate pertinent engineering properties. Laboratory tests performed are listed in Table 5.1. Further discussion of laboratory testing and the laboratory test results are presented in Appendix B.

TABLE 5.1. Laboratory Testing Performed

Laboratory Test	To Evaluate
Grain size analysis	Grain size distribution for classification purposes.
Atterberg limits	Soil plasticity for classification purposes.
Swell/consolidation	Effect of wetting and loading on soil of both in situ and remolded samples.
Standard proctor	Moisture/density relationship of compacted soil.
Water soluble sulfate content	Potential reaction of soil with cementitious material.
Unconfined compressive strength	Undrained shear strength.

6. GEOLOGIC CONDITIONS

6.1 SURFICIAL DEPOSITS

The "Geologic Map of the Lafayette Quadrangle, Adams, Boulder, and Jefferson Counties, Colorado" prepared by M.N. Machette, dated 1977, indicates surficial deposits onsite consist of loess of Pinedale-Bull Lake Interglaciation and Late Bull Lake age. It is characterized as an unstratified fine sand and silt forming a mantle covering bedrock and Louviers alluvium and older alluviums.

6.2 BEDROCK

The previously referenced Lafayette Geologic Quadrangle indicates bedrock is either Denver

Formation claystone interbedded with fluvial sandstone or Arapahoe Formation claystone and fine grained sandstone.

7. SITE CONDITIONS

The site is located at the Niver Canal, about 900 feet east of Alcott Street within the Northwest Open Space and south of the Northglenn Water Treatment Plant in Northglenn, Colorado as shown in the vicinity map in Figure 1. The canal is reportedly about 4 feet deep at the proposed bridge location. The northern side of the canal is a parking area and the southern side is an outdoor recreation area with soccer fields adjacent to the bridge site. The parking lot is covered with recycled asphalt millings and the soccer fields are covered with irrigated grass. The northern canal embankment is paved with concrete as part of a walking trial. The southern embankment is bare of cover. No bedrock outcrops were observed onsite. A water storage pond for the water treatment plant is located about 500 feet north of the bridge site.

8. SUBSURFACE CONDITIONS

CMT's borings encountered:

- A surface wear course of 18 inches of recycled asphalt at the surface of Boring B-1.
- Sandy clay fill below the wear course in B-1 extending to about 3 feet. Sandy clay fill at the ground surface in B-2 extending to about 6 feet.
- Native sandy clay to clay with sand below the fill in both borings extending to depths of 9 and 13-1/2 feet in B-1 and B-2, respectively.
- Sandstone bedrock below the clay in both borings extending to depths of about 39-1/2 and 24-1/2 feet in B-1 and B-2, respectively. The sandstone in B-1 was interbedded with frequent seams and occasional layers of claystone.
- Groundwater at about 11 and 19 feet in B-1 and B-2, respectively, during drilling.

The subsurface soil conditions encountered in CMT's borings did not appear consistent with those described in Section **6. GEOLOGIC CONDITIONS**, in that no granular soil was encountered.

Groundwater can be expected to fluctuate and can be influenced by variations in seasons, weather, precipitation, drainage, vegetation, landscaping, irrigation, leakage of water and/or wastewater systems, etc., both onsite and offsite. Discontinuous zones of perched water may exist or develop within the overburden material and/or upper zones of the bedrock. CMT's field explorations were performed during the fall when groundwater levels are usually low. Groundwater levels may be higher in the spring and early summer. These observations represent conditions at the time of field exploration and may not be indicative of other times or other locations.

9. GEOTECHNICAL CONSIDERATIONS

9.1 EXISTING FILL

The fill soil encountered is undocumented; however, it comprises the Niver Canal embankments. CMT test results indicate the in situ density ranges from about 98.2 pcf at 4 feet to 106.9 pcf at 1 foot on the southern embankment, indicating about 92% to 100% compaction based on the moisture/density test performed. The fill was likely marginally compacted with the near surface densified under vehicle traffic. CMT considers the fill unsuitable in its present condition to provide reliable support for foundations, approach slabs, or other movement sensitive improvements and should be removed entirely and replaced as properly compacted structural fill.

CMT understands the bridge foundations will bear below canal scour depth, likely on native soil or bedrock. CMT borings encountered bedrock at about 9 feet on the northern side of the canal and about 13-1/2 feet on the southern side. Groundwater was encountered at about 11 feet on the northern side and 19 feet on the southern side during drilling. The claystone encountered on the northern side exhibited no swell. These results indicate foundations bearing on the bedrock are unlikely to undergo heave. The bridge structure can be designed to mitigate heave effects, in case swelling occurs.

The approach slabs will likely bear on the expansive embankment material. These slabs will require mitigation details.

A scour analysis should be performed by a hydrologist. CMT will provide soil parameters on request.

9.2 MOISTURE SENSITIVE SOIL

Results of swell/consolidation testing performed indicate the embankment clay exhibits moderate to low swell potential when wetted above its in situ moisture content. A swell/consolidation test was also performed on a sample remolded from the bulk sample recovered from B-2. The remolded sample also exhibited low swell.

CMT understands the bridge foundations will bear below the embankment, reportedly about 3 feet below the canal's flow line or about 7 to 8 feet below the embankment crest. At that depth, the embankment's heave potential will have little effect on the bridge or its foundations. The approach slabs will likely be affected and should be addressed. An estimated 1-1/2 to 2-1/2 inches of heave potential was calculated for slabs-on-grade bearing on the embankment soil.

9.3 SEISMIC CONSIDERATIONS

The soil types present onsite classify as Type C according to the 2018 IBC (ASCE 7, Chapter 20), based on penetration tests and CMT's experience. Additional geophysical studies are necessary to justify a different site classification.

10. FOUNDATION RECOMMENDATIONS

10.1 SPREAD FOOTINGS

The proposed bridge may bear on conventional pad type or continuous footings bearing on native, undisturbed soil below frost depth and scour depth in accordance with the following design recommendations:

a) A frost depth of 36 inches should be assumed for this area.
b) Footings should not bear on or in existing embankment fill soil without improvement of the fill.
c) Footings bearing on native soil should be designed for a maximum allowable soil bearing pressure of 2,000 psf based on dead load plus full live load.
d) Continuous footings and isolated pad type footings should have a minimum dimension of

24 inches.

e) Using the soil bearing pressure recommended above, CMT estimates the maximum settlement for the structure bearing on soil will be about 1 inch, with potential differential settlement about 1/2 inch. Footings should be proportioned as much as practicable to reduce differential settlement.

f) Steel reinforcement for continuous concrete foundation walls should be designed to span localized settlements over the width of the abutment wall.

g) All soft or loose soil beneath footing areas should be densified in place, or removed and replaced with properly compacted structural fill, suitable flow fill, or concrete prior to placement of footing concrete.

h) A CMT representative should observe footing excavations prior to placement of concrete to evaluate if bearing conditions are consistent with those considered to develop its recommendations.

10.2 BRIDGE APPROACHES

CMT understands the bridge foundations will bear below the canal and scour depths. Expected vertical movement is estimated to be 1 inch or less in settlement. The bridge approaches will necessarily bear on the expansive soil encountered in the canal embankments and, therefore, susceptible to differential movement relative to the bridge deck. This condition will require a detail to mitigate the differential movement.

11. LATERAL EARTH PRESSURES

11.1 ABUTMENTS AND WING WALLS

Lateral pressures on walls depend on the type of wall, hydrostatic pressure behind the wall, type of backfill material, and allowable wall movements. CMT recommends drain systems be constructed behind walls to reduce the potential for hydrostatic pressures to develop. Where anticipated wall movements are greater than 0.5% of the wall height, lateral earth pressures can be estimated for an "active" condition. Where anticipated wall movement is less than approximately 0.5% of the wall height or wall movement is constrained, lateral earth pressures should be estimated for an "at rest" condition. Recommended lateral earth pressures for onsite material are provided in Table 11.1.

The recommended values for lateral earth pressures provided in Table 11.1 are given in terms of an equivalent unit weight. The equivalent unit weight multiplied by the depth below the top of the ground surface is the horizontal pressure against the wall at that depth. The resulting pressure distribution is a triangular shape.

TABLE 11.1. Lateral Earth Pressures for Onsite Material

Backfill Material Type	Unit Weight (pcf)	Internal Friction Angle (degrees)	Equivalent Unit Weight (pcf)		
			Active	At Rest	Passive
Clay fill	120	30	40	60	360

12. EXCAVATIONS

Conventional earthmoving equipment should be adequate to excavate the onsite soil. All excavations should be properly sloped and/or braced, and local and federal safety codes observed. Slopes and other areas void of vegetation should be protected against erosion. If temporary shoring is required, a contractor specializing in design and construction of shoring should be contacted.

It is the contractor's responsibility to provide safe working conditions and comply with the regulations in OSHA Standards-Excavations, 29 CFR Part 1926. The following guidelines are provided for planning purposes. Sloping and shoring requirements must be evaluated at the time of construction by the contractor's competent person as defined by OSHA. The geotechnical engineer is NOT the contractor's "competent person" in any circumstance, including but not limited to, by way of default or delegation. OSHA classifications for various material types and the steepest allowable slope configuration corresponding to those classifications are shown in Table 12.1.

TABLE 12.1. Allowable Slope Configuration for Onsite Material

Material Type	OSHA Classification	Steepest Allowable Slope Configuration*
Clay fill	Type C	1-1/2:1

* Units horizontal to units vertical. The values shown apply to excavation less than 20 feet in height. Conditions can change and evaluation is the contractor's responsibility.

The classifications and slope configurations in Table 12.1 assume that excavations are above the groundwater table, there is no standing water in the excavations, and there is no seepage from the slope into the excavations, unless otherwise specified. The above classifications and slope configurations assume that the material in the excavations is not fractured, adversely bedded, jointed, nor left open to desiccate, crack, or slough, and are protected from surface runoff. There are other considerations regarding allowable slope configurations that the contractor is responsible for, including proximity of equipment, stockpiles, and other surcharge loads to the excavation. The contractor's competent person is responsible for all decisions regarding slope configuration and safety conditions for excavations.

Excavations should not compromise existing embankment slope integrity and the embankment slopes should be adequately protected if the slopes are allowed to remain during construction. An alternative is to open cut the embankment slope and replace it once abutment construction is complete.

Permanent slopes should be no steeper than 3:1 and should be revegetated or otherwise protected from erosion.

13. STRUCTURAL FILL/BACKFILL SOIL

Where fill/backfill soil is necessary, the suitable onsite inorganic soil may be used below, around, and above the structure. Suitable material is defined as soil free of topsoil, organics, trash, ash, frozen material, hard lumps and clods, claystone, and particles larger than 3 inches. Recommendations for fill/backfill placement are:

a) Fill/backfill material should be placed in loose lifts and compacted in accordance with Table 13.1.
b) Maximum loose lift thickness shall be 8 inches, depending on the type of equipment used to apply compactive effort, and shall be reduced if the specified compaction cannot be

obtained with the equipment used.

c) Fill/backfill should not be placed if material is frozen or if the surface upon which fill/backfill is to be placed is frozen.

d) Fill/backfill material should be placed and spread in horizontal lifts of uniform thickness in a manner that avoids segregation.

e) Placement surface should be kept free of standing water, debris, and unsuitable material during placement and compaction of fill/backfill material.

f) Do not incorporate oversize material in the fill/backfill that is incapable of being broken down by the equipment and methods being employed to process and compact the fill/backfill. Process and compact material in the lift, as necessary, to produce the specified fill/backfill characteristics. If oversize particles remain in the lift after processing and compacting, remove oversize material to produce a fill/backfill within specified requirements.

TABLE 13.1. Compaction Specifications

Material Type (General)	AASHTO Classification	Moisture Content (%)	Relative Compaction (%)	Compaction Standard
Clay material	A-6, A-7-6	0% to +3% of OMC	>95%	Standard Proctor (ASTM D698)

* If fill thickness greater than 20 feet is planned, additional requirements may apply.

13.1 IMPORT FILL

Material imported for structural fill should be tested and approved for use onsite by the project geotechnical engineer prior to hauling to the site. Proctor and classification tests should be conducted to determine if the fill meets required specifications. Fill material should be well graded meeting the specifications in Table 13.2.

TABLE 13.2. Import Fill Specifications

Soil Parameter	Specification
Maximum particle size	3 inch
Percent finer than No. 200 sieve	20% maximum
Liquid limit	30% maximum
Plasticity index	15% maximum

14. SUBSURFACE DRAINAGE

Drainage behind abutment walls should be designed and constructed to minimize hydrostatic pressures on the abutments.

15. SURFACE DRAINAGE

Good drainage and surface water management is important. Performance of site improvements, such as foundations and hardscape, are often adversely affected by failing to establish and/or maintain good site drainage. Grades must be adjusted to provide positive drainage away from the abutments and other site improvements during construction and maintained throughout the life of the proposed facility. The following drainage precautions are recommended:

a) Ground surface at the abutment foundation walls should be sloped to drain away from the abutments. Maximum grades practical should be used to prevent areas where water can pond. Water should not be allowed to pond adjacent to or near foundations, flatwork, or other improvements.
b) Joints that occur at locations where paving or flatwork abuts the structure should be properly sealed with flexible sealants and maintained.
c) Drainage swales should be located as far away from the abutments as practicable.
d) Irrigation directly adjacent to the structure is discouraged and should be eliminated. Sprinkler lines, zone control boxes, and sprinkler drains shall be located outside the limits of the foundation backfill. Sprinkler systems should be placed so that the spray from the heads, under full pressure, does not fall within 5 feet of the foundation walls.
e) Plants, vegetation, and trees that require moderate to high water usage are discouraged and should not be located within 5 feet of foundation walls.
f) The project civil engineer shall perform measurements to document positive drainage, as described in this section or as otherwise designed by the project civil engineer, is achieved. Maintenance of surface drainage is imperative subsequent to construction and is the responsibility of the owner and/or tenant.

16. GEOTECHNICAL RISK

The concept of risk is an important aspect of any geotechnical study. The primary reason for this is that the analytical methods used by geotechnical engineers are generally empirical and must be tempered by engineering judgment and experience, therefore, the solutions or recommendations presented in any geotechnical study should not be considered risk free, and more importantly, are not a guarantee that the interaction between the soil and the proposed construction will perform as predicted, desired, or intended. The engineering recommendations presented in the preceding sections constitute CMT's best estimate of those measures that are necessary to help the structure perform in a satisfactory manner based on the information generated during this study, training, and experience in working with these conditions.

17. LIMITATIONS

This document has been prepared as an instrument of service for the exclusive use of J&T Consulting, Inc. for the specific application to the project as discussed herein and has been prepared in accordance with geotechnical engineering practices generally accepted in the state of Colorado at the date of its preparation. No warranties, either expressed or implied, are intended or made. This document should not be assumed to contain information for other parties or other purposes.

The findings of this study are valid as of the date its preparation. Changes in the conditions of a property can occur with the passage of time, whether due to natural processes or the works of people on this or adjacent properties. Standards of practice evolve in engineering and changes in applicable or appropriate standards may occur, whether a result from legislation or the broadening of knowledge. Accordingly, the findings of this study may be invalidated wholly or partially by changes outside of CMT's control, therefore, this study is subject to review and should not be relied upon without such review after a period of 3 years.

In the event that changes, including but not limited to, the nature, type, design, size, elevation, or location of the project or project elements as outlined in this report are made, the conclusions and recommendations contained in this report shall not be considered valid unless CMT reviews the changes and either confirms or modifies the conclusions of this report in writing.

CMT should be retained to review final plans and specifications that are developed for proposed construction to judge whether the recommendations presented in this report and any addenda have been appropriately interpreted and incorporated in the project plans and specifications as intended.

The exploration locations for this study were selected to obtain a reasonably accurate depiction of underground conditions for design purposes and these locations are often modified based on accessibility and the presence of underground or overhead utility conflicts. Variations from the soil conditions encountered are possible. These variations may necessitate modifications to CMT's design recommendations, therefore, CMT should be retained to observe subsurface conditions, once exposed, to evaluate whether they are consistent with the conditions encountered during CMT's exploration and that the recommendations of this study remain valid. If parties other than CMT perform these observations and judgements, they must accept responsibility to judge whether the recommendations in this report remain appropriate.

CMT's scope of services for this report did not include either specifically, or by implication, any environmental assessment of the site or identification of contaminated or hazardous material or conditions. Additionally, none of the services performed in connection with this study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not, of itself, be enough to prevent mold from growing in or on the structures involved.

At a minimum, CMT should be retained during construction to observe and/or test:

- completed excavations.
- placement and compaction of fill.
- proposed import or onsite fill material.
- foundation and foundation wall construction

CMT offers many other construction observations, materials engineering, and testing services and can be contacted to discuss further.

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BACKGROUND IMAGE FROM GOOGLE EARTH

PROJECT NO:	22.137		
PROJECT NAME:	Niver Canal Bridge		
DRAWN BY:	JBE	CHECKED BY:	JAC2
DWG DATE:	10.14.22	REV. DATE:	--

FIGURE 1
Vicinity Map

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PROJECT NO:	22.137		
PROJECT NAME:	Niver Canal Bridge		
DRAWN BY:	JBE	CHECKED BY:	JAC2
DWG DATE:	10.14.22	REV. DATE:	--

FIGURE 2
Site Plan and Boring Locations

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APPENDIX A

Field Exploration

FIELD EXPLORATION

Samples of the subsoil were obtained at this site using a modified California sampler driven into the soil by dropping a 140 pound hammer through a free fall of 30 inches. The modified California sampler is a 2-1/2 inch outside diameter by 2 inch inside diameter device lined with brass tubes. The procedure to drive the modified California sampler into the soil and to record the number of blows required to do so is known as a penetration test. The number of blows required for the sampler to penetrate 12 inches gives an indication of the relative stiffness of cohesive soil, relative density of non-cohesive soil, and relative hardness of sedimentary bedrock material encountered. Bulk samples were collected from cuttings generated during drilling. Locations of sampling and penetration test results are presented on the boring logs contained in this appendix.

PROJECT NAME	Niver Canal Bridge	PROJECT NUMBER	22.137	**B-1**
BORING LOCATION	See Figure 2	BORING ELEVATION		
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards	
DRILLING METHOD	4in. Diameter SSA	DATE STARTED	10/13/2022	
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	10/13/2022	Page 1 of 2

DEPTH (ft)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	FINES (%)	LL-PL-PI	SWELL-CONSOL VOL CHANGE/SURCHARGE PRESSURE (psf)	BLOW COUNT	SAMPLE: DRIVE	SAMPLE: BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	Water Level and Depth of Cave (ft)
0								Bulk			WEAR COURSE - recycled asphalt	1.5	
2						21/18	Split spoon	Bulk			FILL: CLAY, sandy, very stiff, moist, dark brown.	3	
3								Bulk			CLAY, with sand, very stiff, moist, brown, slightly calcaerous.		
4.5	100.3	22.8	84	44-17-27	0.8/389	17/12	Mod. Cal.	Bulk				9	
9.5	106.8	6			-0.2/1882	50/8	Mod. Cal.	Bulk			SANDSTONE, hard, moist, tan.		▼
11											CLAYSTONE, with sand, hard to very hard, moist, gray to tan with iron staining.		
14.5	103.7	21.3	76	47-20-27	0/1400	50/8	Mod. Cal.				Occasional sandstone lenses interbedded.	17	
17											SANDSTONE, very hard, wet, tan to gray with iron staining.		
19.5	103.2	20			-0.1/875	50/5	Mod. Cal.				Frequent seams of claystone Interbedded.		
24.5						50/4	Mod. Cal.						
29.5						50/4	Mod. Cal.					33	
33											CLAYSTONE, very hard, moist, gray.		
34.5						50/2	Mod. Cal.						

LEGEND

- ▼ WATER LEVEL AT TIME OF DRILLING
- ▽# WATER LEVEL # DAYS AFTER DRILLING
- →# DEPTH OF CAVE # DAYS AFTER DRILLING
- ↑ DEPTH OF REFUSAL
- BULK SAMPLE
- SPLIT SPOON
- MODIFIED CALIFORNIA SAMPLER

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PROJECT NAME	Niver Canal Bridge	PROJECT NUMBER	22.137	**B-1**
BORING LOCATION	See Figure 2	BORING ELEVATION		
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards	
DRILLING METHOD	4in. Diameter SSA	DATE STARTED	10/13/2022	
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	10/13/2022	Page 2 of 2

DEPTH (ft)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	FINES (%)	LL-PL-PI	SWELL-CONSOL VOL CHANGE/SURCHARGE PRESSURE (psf)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	Water Level and Depth of Cave (ft)
						50/5						39.42	

Boring terminated at 39.42 feet

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- WATER LEVEL # DAYS AFTER DRILLING
- DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL
- BULK SAMPLE
- SPLIT SPOON
- MODIFIED CALIFORNIA SAMPLER

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PROJECT NAME	Niver Canal Bridge	PROJECT NUMBER	22.137
BORING LOCATION	See Figure 2	BORING ELEVATION	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards
DRILLING METHOD	4in. Diameter SSA	DATE STARTED	10/13/2022
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	10/13/2022

B-2

DEPTH (ft)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE CONTENT (%)	FINES (%)	LL-PL-PI	SWELL-CONSOL VOL CHANGE/SURCHARGE PRESSURE (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	MATERIAL DESCRIPTION	DEPTH (ft)
0									X	FILL: CLAY, sandy, very stiff, moist, dark brown, mottled.	
							22/12	Modified California	X		
5			67	37-14-23	1/488		19/12	Modified California	X		6
									X	CLAY, sandy, very stiff, moist, brown, slightly calcareous.	
10	101.5	19	66	37-23-20	-0.6/882		16/12	Modified California	X		13.5
15	108.6	18.1				2,569	40/12	Modified California		SANDSTONE, hard to very hard, moist to wet, brown.	
20							50/5	Modified California			
							50/6	Split Spoon			24.5

Water level at time of drilling: approx. 19 ft.

Boring terminated at 24.5 feet

LEGEND

- ▼ WATER LEVEL AT TIME OF DRILLING
- ▽# WATER LEVEL # DAYS AFTER DRILLING
- →# DEPTH OF CAVE # DAYS AFTER DRILLING
- ↑ DEPTH OF REFUSAL
- ☒ BULK SAMPLE
- ⧗ MODIFIED CALIFORNIA SAMPLER
- ☒ SPLIT SPOON

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APPENDIX B

Laboratory Testing

LABORATORY TESTING

Swell/consolidation testing was performed on samples collected using a modified California sampler to evaluate the effect of wetting and loading on the soil. Insitu samples were loaded to approximate overburden pressure considering a unit weight of 100 psf, per foot of soil and then inundated with water. One sample was remolded to about 94% of maximum dry density at a moisture content of 2% over optimum moisture content as determined from a standard Proctor (ASTM D698). The remolded sample loaded to about 500 psf then inundated with water.

Unconfined compressive strength testing was performed to evaluate undrained shear strength of the soil. The testing was performed on extruded samples collected using a modified California sampler/remolded samples.

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SUMMARY OF LABORATORY TEST RESULTS
Niver Canal Bridge
Project No. 22.137

Sample Location					Standard Proctor (ASTM D698)		Gradation			Atterberg Limits		Swell/Consolidation				
Boring	Depth (feet)	Natural Dry Density (pcf)	Natural Moisture Content (%)	Water Soluble Sulfates (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Gravel (%)	Sand (%)	Silt/ Clay (%)	Liquid Limit (%)	Plasticity Index (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)	Unconfined Compression (psf)	Material Type
B-1	4	100.3	22.8					16	84	44	27	389	0.8	1,185		CLAY, lean, with sand (CL, A-7-6(22))
B-1	9	106.8	6.0									1882	-0.2	N/A		SANDSTONE
B-1	14	103.7	21.3					24	76	47	27	1400	0.0	N/A		CLAYSTONE: CLAY, lean, with sand (CL, A-7-6(20))
B-1	19	103.2	20.0									875	-0.1	N/A		SANDSTONE
B-2	0 to 10	100.8*	18.4*	0.00	106.9	16.6	3	30	67	37	23	488	1.0	2,200		FILL/NATIVE: CLAY, sandy, lean (CL, A-6(13))
B-2	1	106.9	15.7		1.00							97	6.1	2,700		FILL: CLAY, sandy, lean (CL, A-6)
B-2	4	98.2	22.7		0.92							390	0.3	730		FILL: CLAY, sandy, lean (CL, A-6)
B-2	9	101.5	19.0					34	66	37	20	882	-0.6	N/A		CLAY, sandy, lean (CL, A-6(11))
B-2	14	108.6	18.1												2,569	SANDSTONE

*Remolded values

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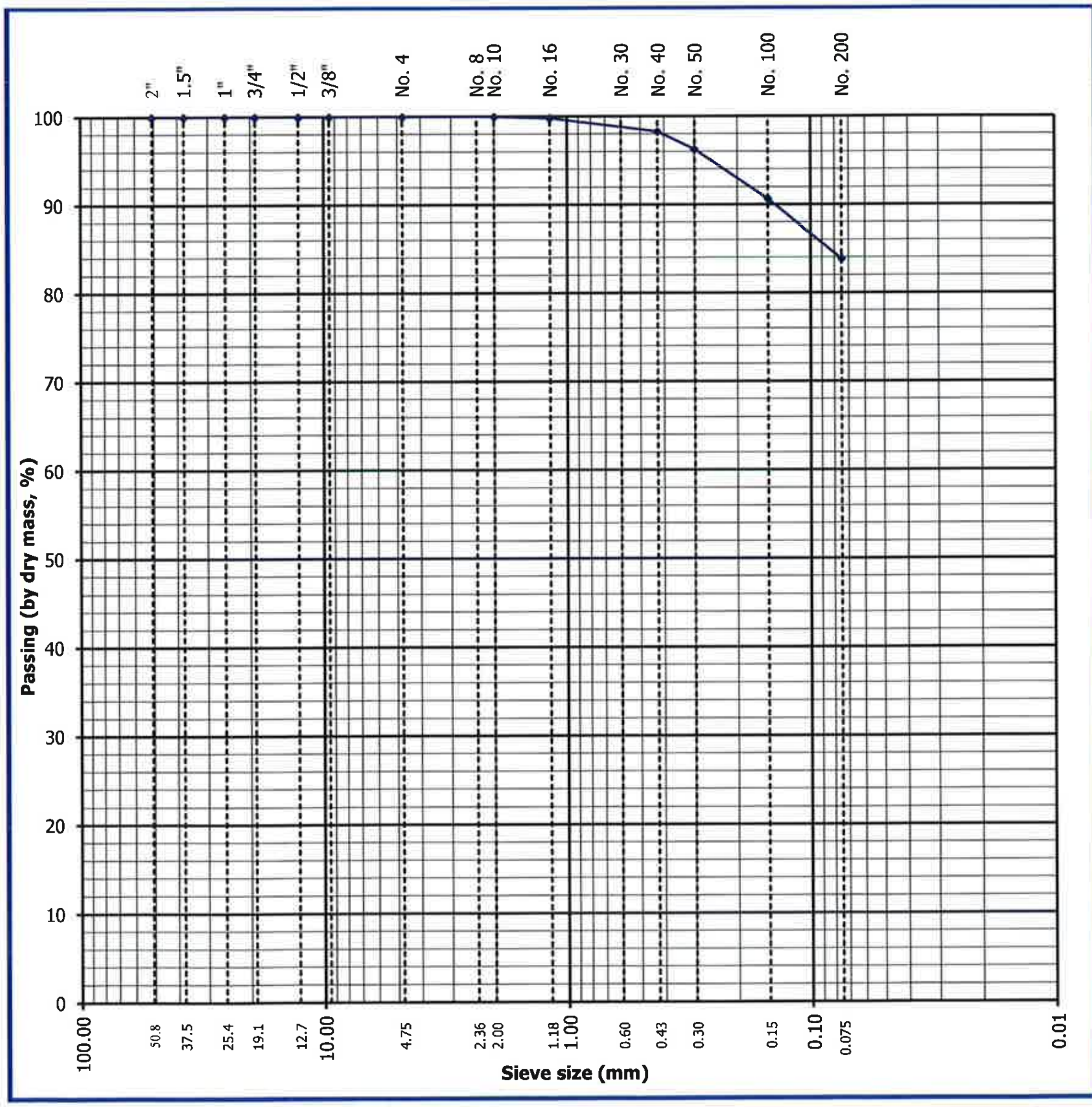
AASHTO ACCREDITED

GRADATION PLOT - SOIL AND AGGREGATE

Project number	22.137	Date	October 26, 2022
Project name	Niver Canal Bridge	Technician	G. Hoyos
Lab ID number	F222217	Reviewer	G. Hoyos
Sample location	B-1 at 4 feet		
Visual description	CLAY, with sand, brown		

AASHTO M145 Classification				Soaking Method	
				Procedure	**Method**
Classification	**A-7-6**	**Group Index**	**22**	AASHTO T11	
Unified Soil Classification System (ASTM D2487)				ASTM D1140	**B**
(CL)	**Lean clay with sand**			Specimen soaking time (min)	**1,440**



Sieve Size	Passing (%)
2"	
1.5"	
1"	
3/4"	
1/2"	
3/8"	
#4	
#8	
#10	100
#16	100
#30	
#40	98
#50	96
#100	91
#200	83.9

Moisture (M) and Density (D)	
M (%)	22.7
D (pcf)	
LL	44
PL	17
PI	27
D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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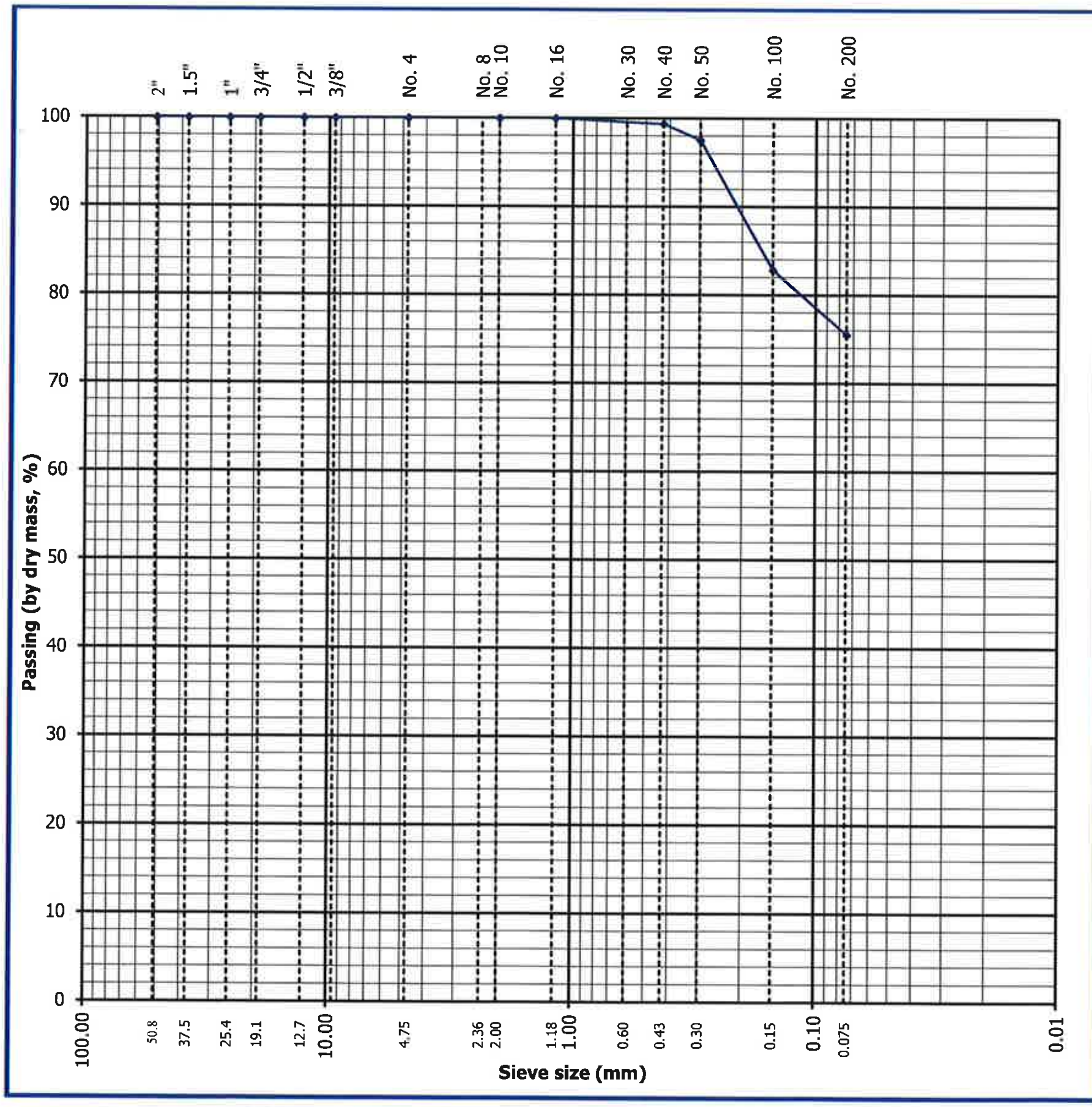
GRADATION PLOT - SOIL AND AGGREGATE

Project number	22.137	Date	October 26, 2022
Project name	Niver Canal Bridge	Technician	G. Hoyos
Lab ID number	F222219	Reviewer	G. Hoyos
Sample location	B-1 at 14 feet		
Visual description	CLAYSTONE, with sand, gray		

AASHTO M145 Classification				Soaking Method	
				Procedure	Method
Classification	A-7-6	Group Index	20	AASHTO T11	
Unified Soil Classification System (ASTM D2487)				ASTM D1140	B
(CL)	Lean clay with sand			Specimen soaking time (min)	1,440



Sieve Size	Passing (%)
2"	
1.5"	
1"	
3/4"	
1/2"	
3/8"	
#4	
#8	
#10	
#16	100
#30	
#40	99
#50	98
#100	83
#200	75.5

Moisture (M) and Density (D)	
M (%)	21.3
D (pcf)	
LL	47
PL	20
PI	27
D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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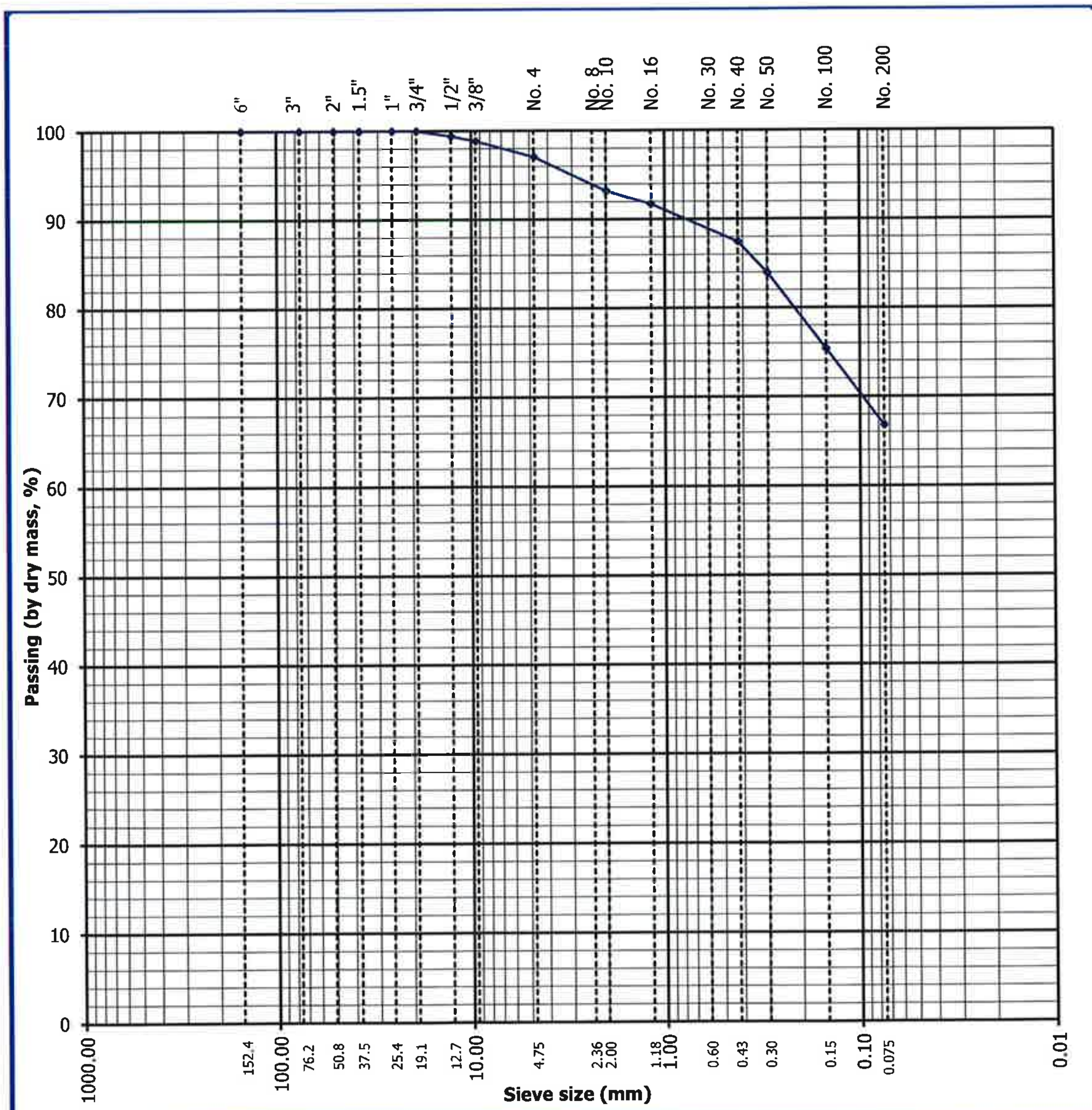
AASHTO ACCREDITED

GRADATION PLOT - SOIL AND AGGREGATE

Project number	22.137	Date	October 25, 2022
Project name	Niver Canal Bridge	Technician	C. Kilcullen
Lab ID number	F222223	Reviewer	G. Hoyos
Sample location	B-2 at 0 to 10 feet		
Visual description	MIXTURE FILL AND NATIVE: CLAY, sandy, brown		

AASHTO M145 Classification				Soaking Method	
				Procedure	**Method**
Classification	**A-6**	**Group Index**	**13**	AASHTO T11	
Unified Soil Classification System (ASTM D2487)				ASTM D1140	**B**
(CL)	**Sandy lean clay**			Specimen soaking time (min)	**1,440**



Sieve Size	Passing (%)
6"	
3"	
2"	
1.5"	
1"	
3/4"	100
1/2"	99
3/8"	99
#4	97
#8	
#10	93
#16	92
#30	
#40	87
#50	84
#100	75
#200	66.8

Moisture (M) and Density (D)	
M (%)	5.8
D (pcf)	

LL	37
PL	14
PI	23

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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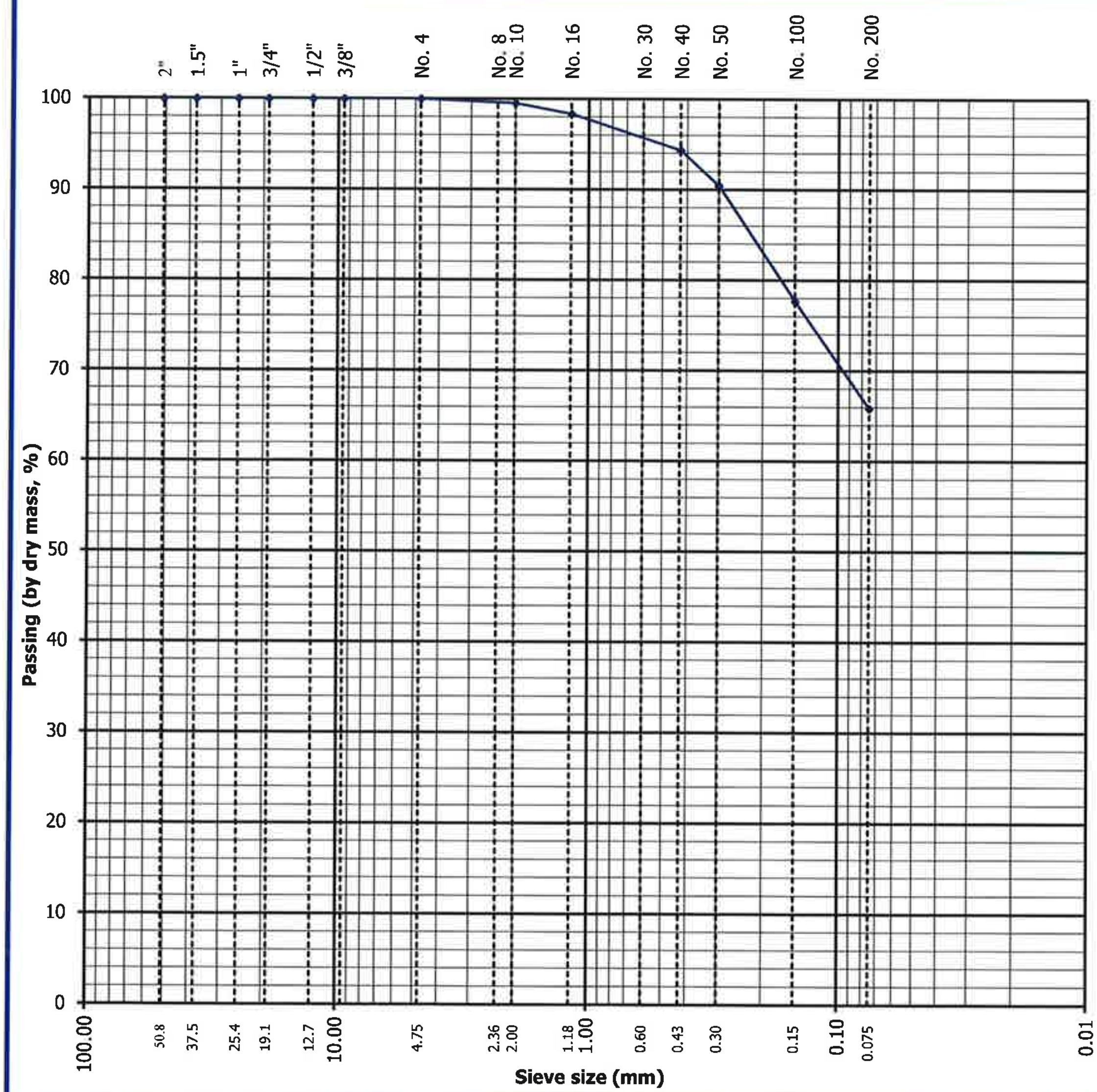
GRADATION PLOT - SOIL AND AGGREGATE

Project number	22.137	Date	October 26, 2022
Project name	Niver Canal Bridge	Technician	G. Hoyos
Lab ID number	F222221	Reviewer	G. Hoyos
Sample location	B-2 at 9 feet		
Visual description	CLAY, sandy, brown		

AASHTO M145 Classification				Soaking Method	
				Procedure	Method
Classification	A-6	Group Index	11	AASHTO T11	
Unified Soil Classification System (ASTM D2487)				ASTM D1140	B
(CL)	Sandy lean clay			Specimen soaking time (min)	1,440



Sieve Size	Passing (%)
2"	
1.5"	
1"	
3/4"	
1/2"	
3/8"	
#4	100
#8	
#10	100
#16	98
#30	
#40	94
#50	90
#100	78
#200	65.8

Moisture (M) and Density (D)	
M (%)	19.0
D (pcf)	

LL	37
PL	17
PI	20

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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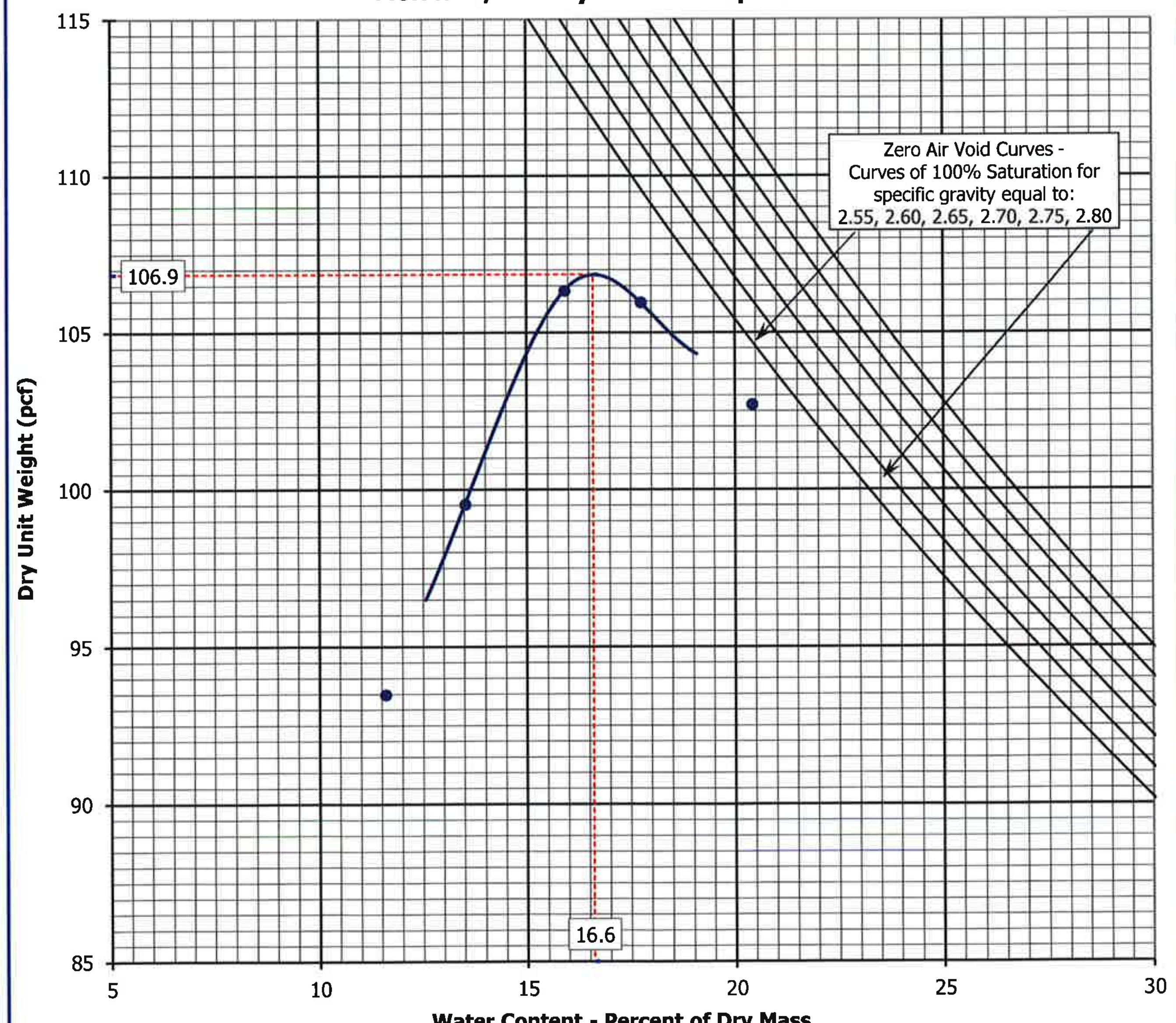
Project number	22.137	Date	October 28, 2022
Project name	Niver Canal Bridge	Technician	C. Kilcullen
Lab ID number	F222223	Reviewer	G. Hoyos
Sample location	B-2 at 0 to 10 feet		
Visual description	MIXTURE FILL AND NATIVE: CLAY, sandy, brown		

Test Procedures and Methods		Optimum Proctor Values and Correction Factors			
ASTM/AASHTO compaction test procedure designation	ASTM D698 (Standard)	Laboratory maximum dry unit weight (pcf)			106.9
Method	A	Laboratory optimum moisture content (%)			16.6
Classification		**Minus No. 200 (%)**	**LL**	**PL**	**PI**
USCS	(CL) Sandy lean clay				
AASHTO	A-6(13)	66.8	37	14	23

Moisture/Density Relationship Plot



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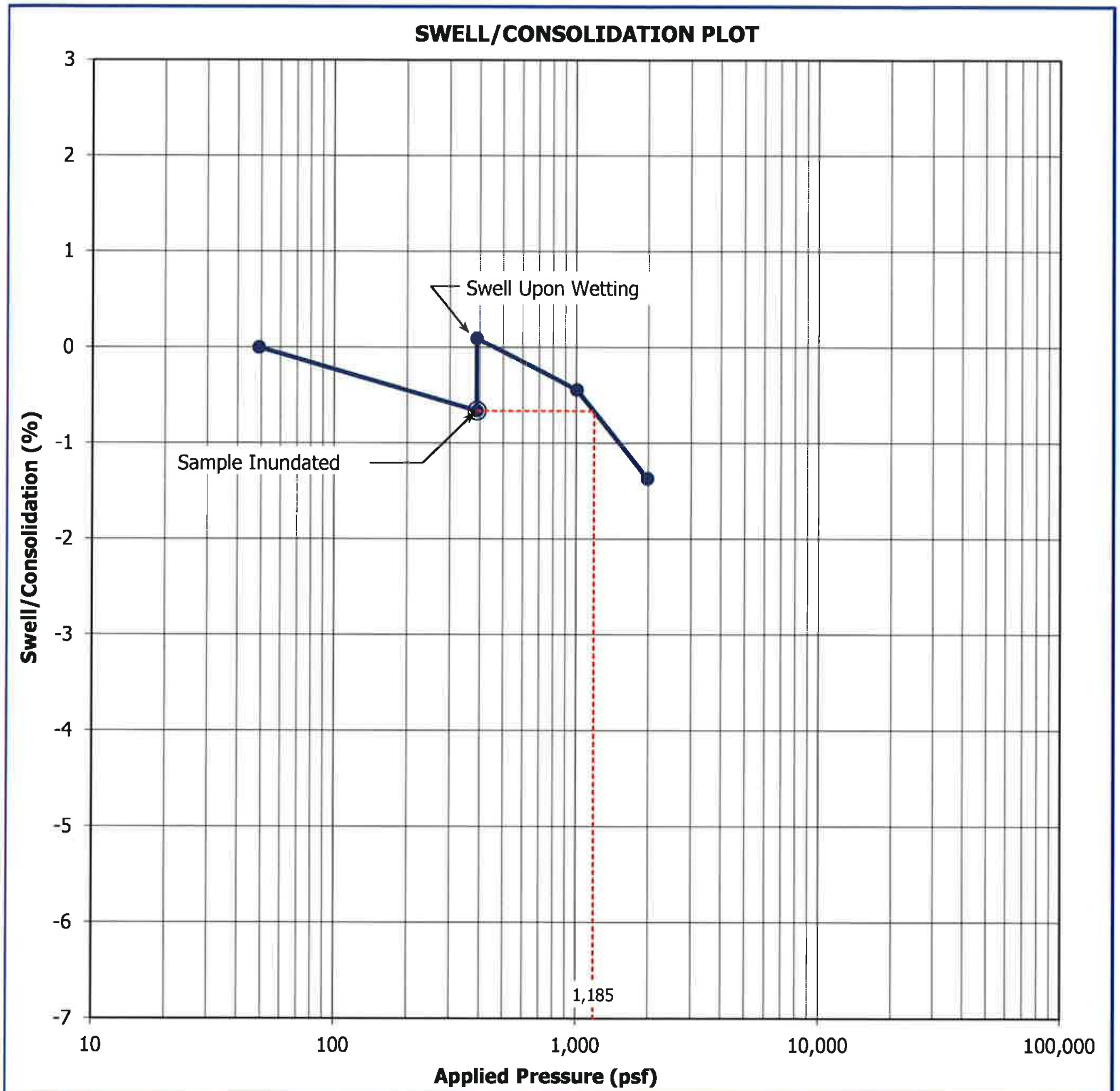

Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-1	4	CLAY, with sand, brown	100.3	22.6	389	0.8	1,185

Project Number	Project Name	Lab ID Number
22.137	Niver Canal Bridge	F222217

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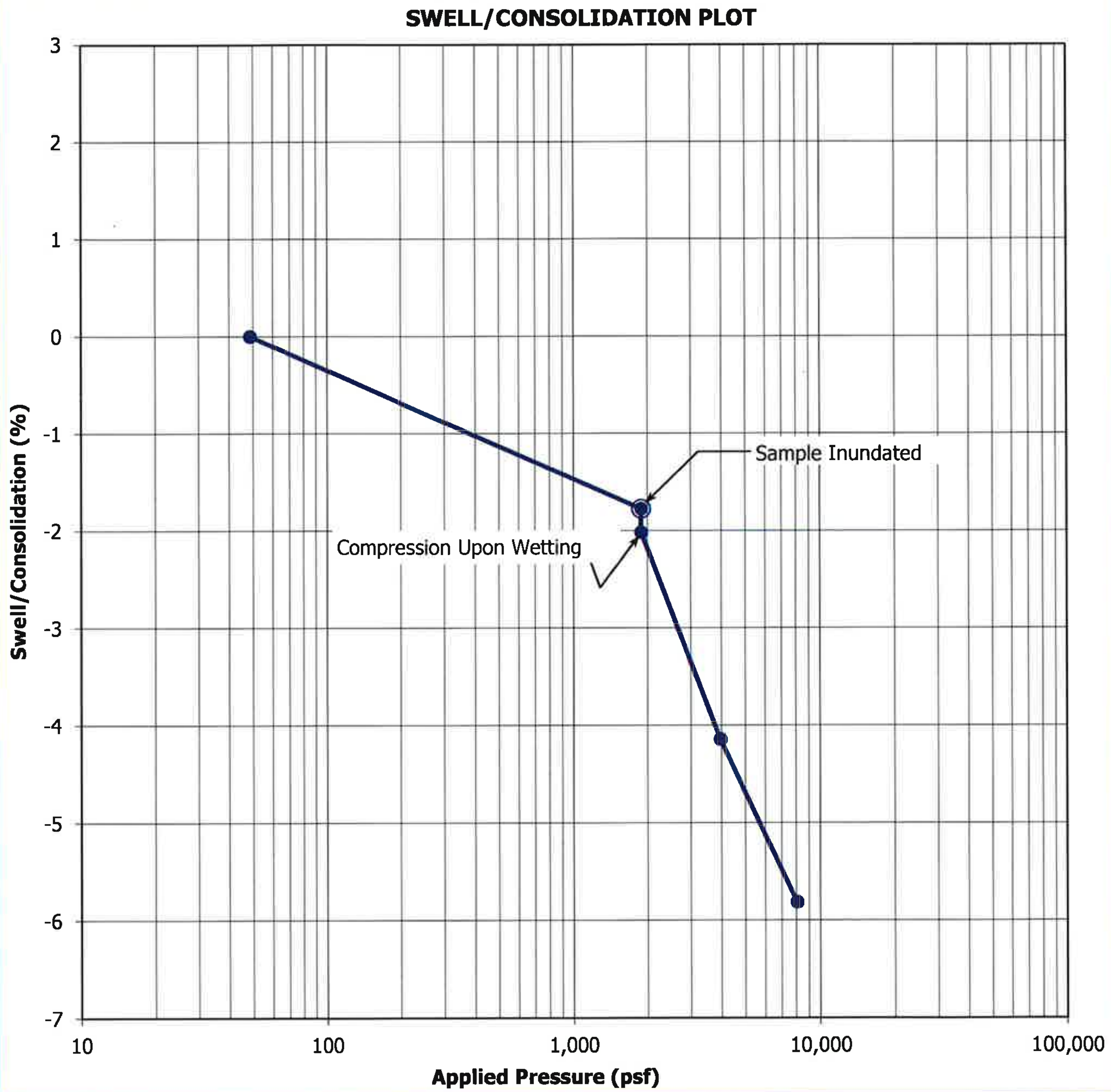

Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-1	9	SANDSTONE: SAND, with interbedded clay, brown	106.8	6.0	1,882	-0.2	N/A

Project Number	Project Name	Lab ID Number
22.137	Niver Canal Bridge	F222218

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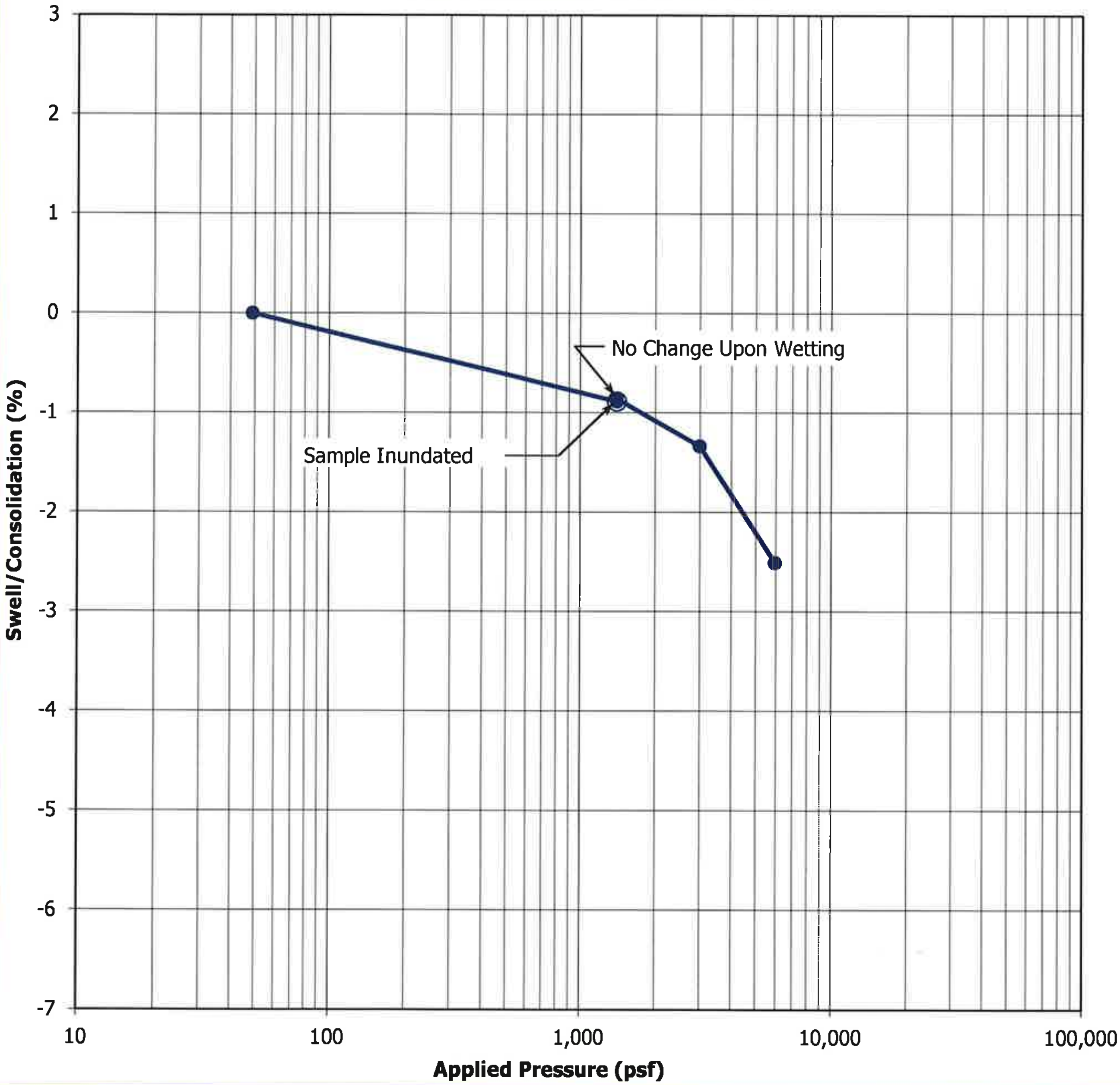
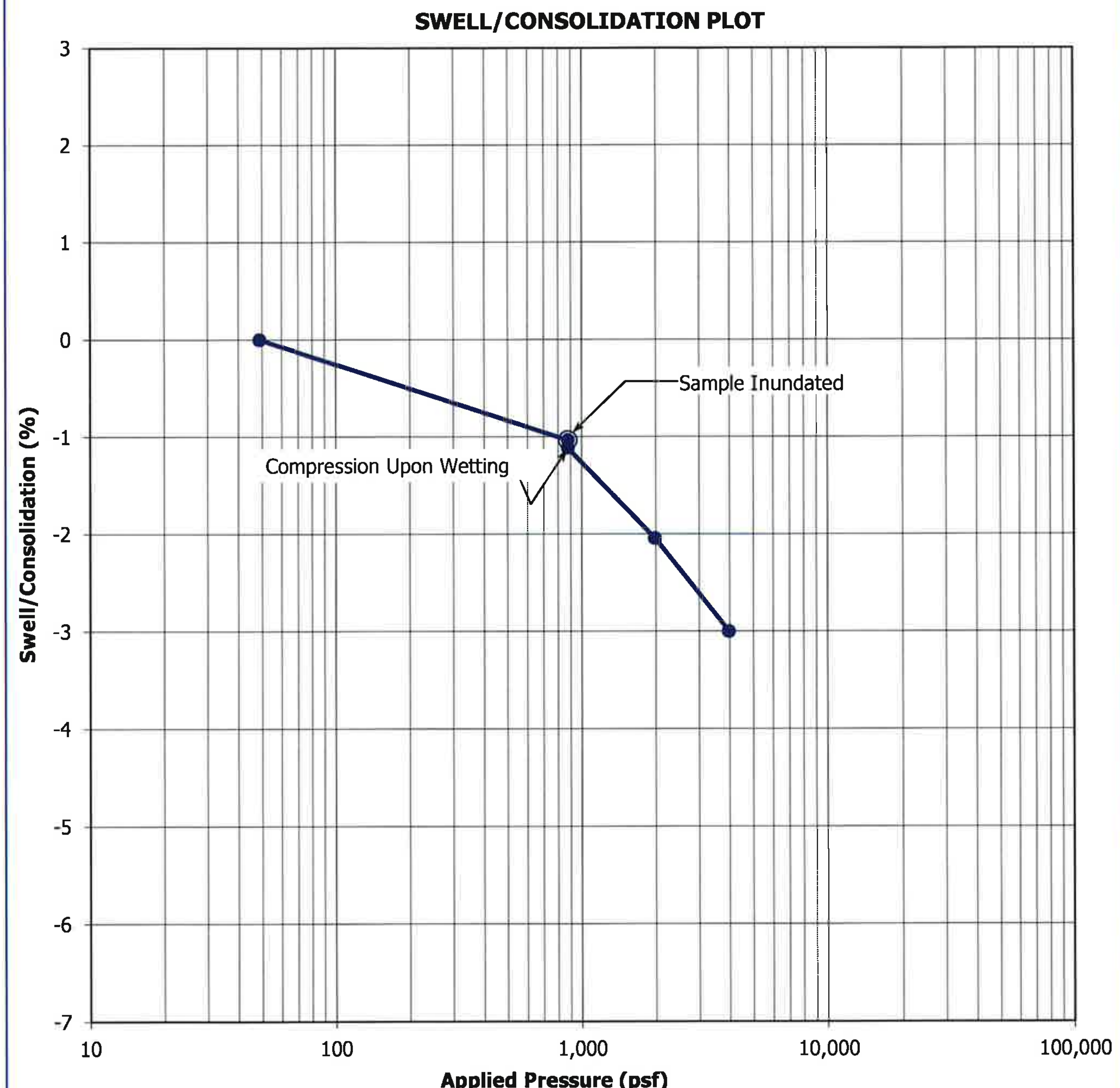
SWELL/CONSOLIDATION PLOT



Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-1	14	CLAYSTONE, with sand, gray	103.7	21.3	1,400	0.0	NA

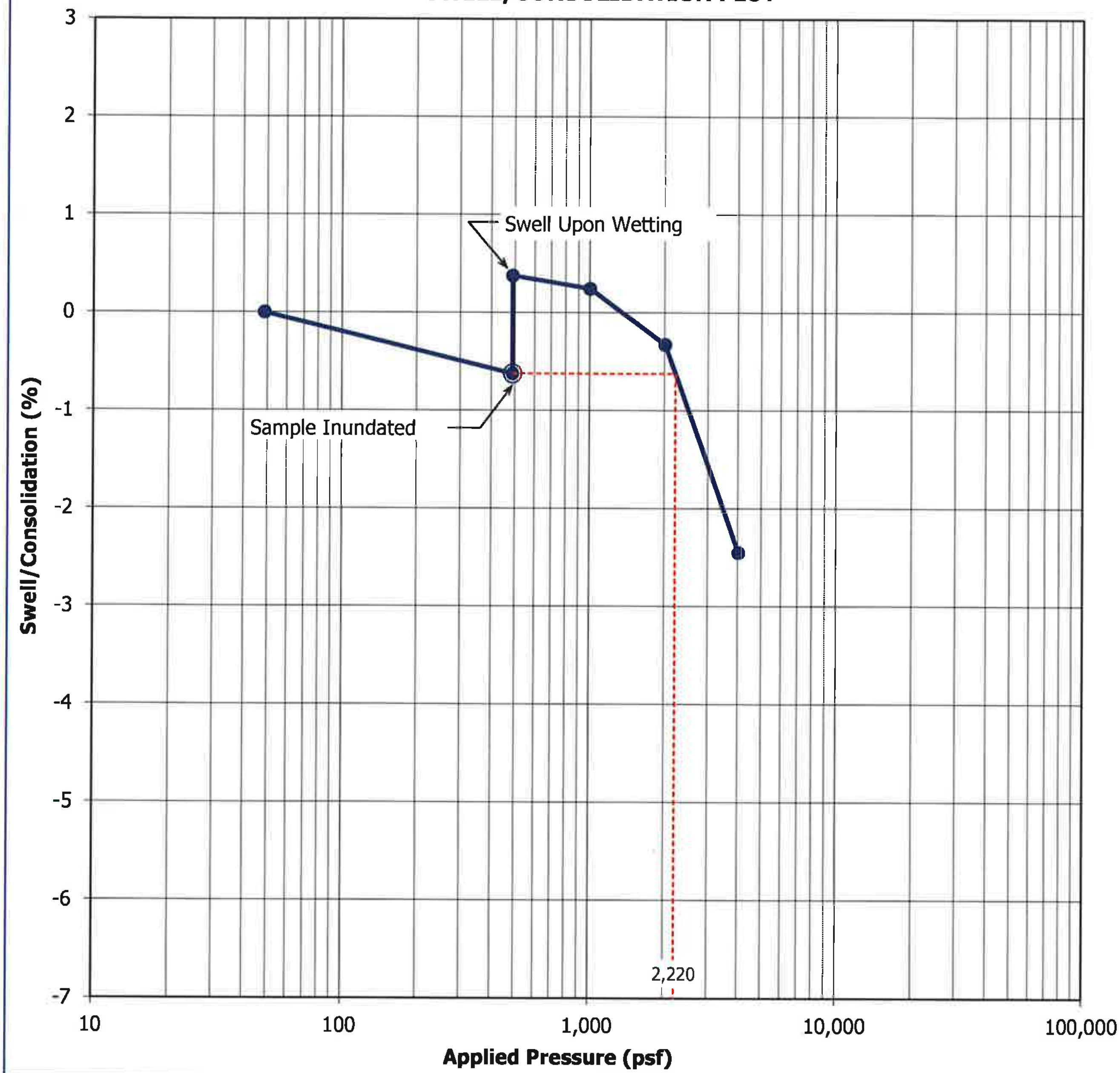
Project Number	Project Name	Lab ID Number
22.137	Niver Canal Bridge	F222219



Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-1	19	SANDSTONE: SAND, with interbedded clay, brown	103.2	20.0	875	-0.1	NA

Project Number	Project Name	Lab ID Number
22.137	Niver Canal Bridge	F222220

SWELL/CONSOLIDATION PLOT



Sample Location	Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-2	0 to 10	MIXTURE FILL AND NATIVE: CLAY, sandy, brown	100.8	18.4	488	1.0	2,220

Project Number	Project Name	Lab ID Number
22.137,	Niver Canal Bridge	F222223

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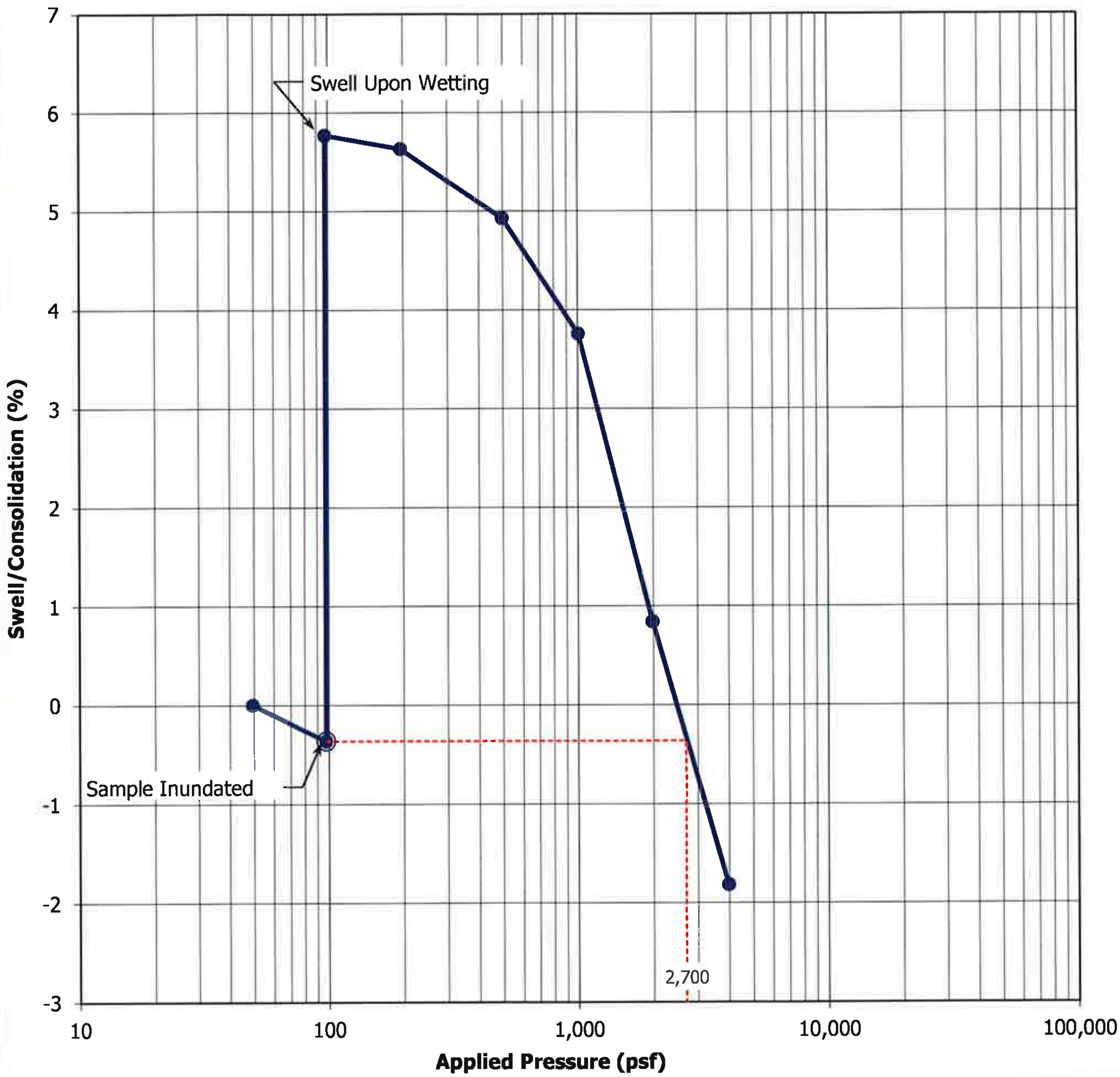
SWELL/CONSOLIDATION PLOT



Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-2	1	FILL: CLAY, sandy, brown	106.9	15.7	97	6.1	2,700

Project Number	Project Name	Lab ID Number
22.137	Niver Canal Bridge	F222294

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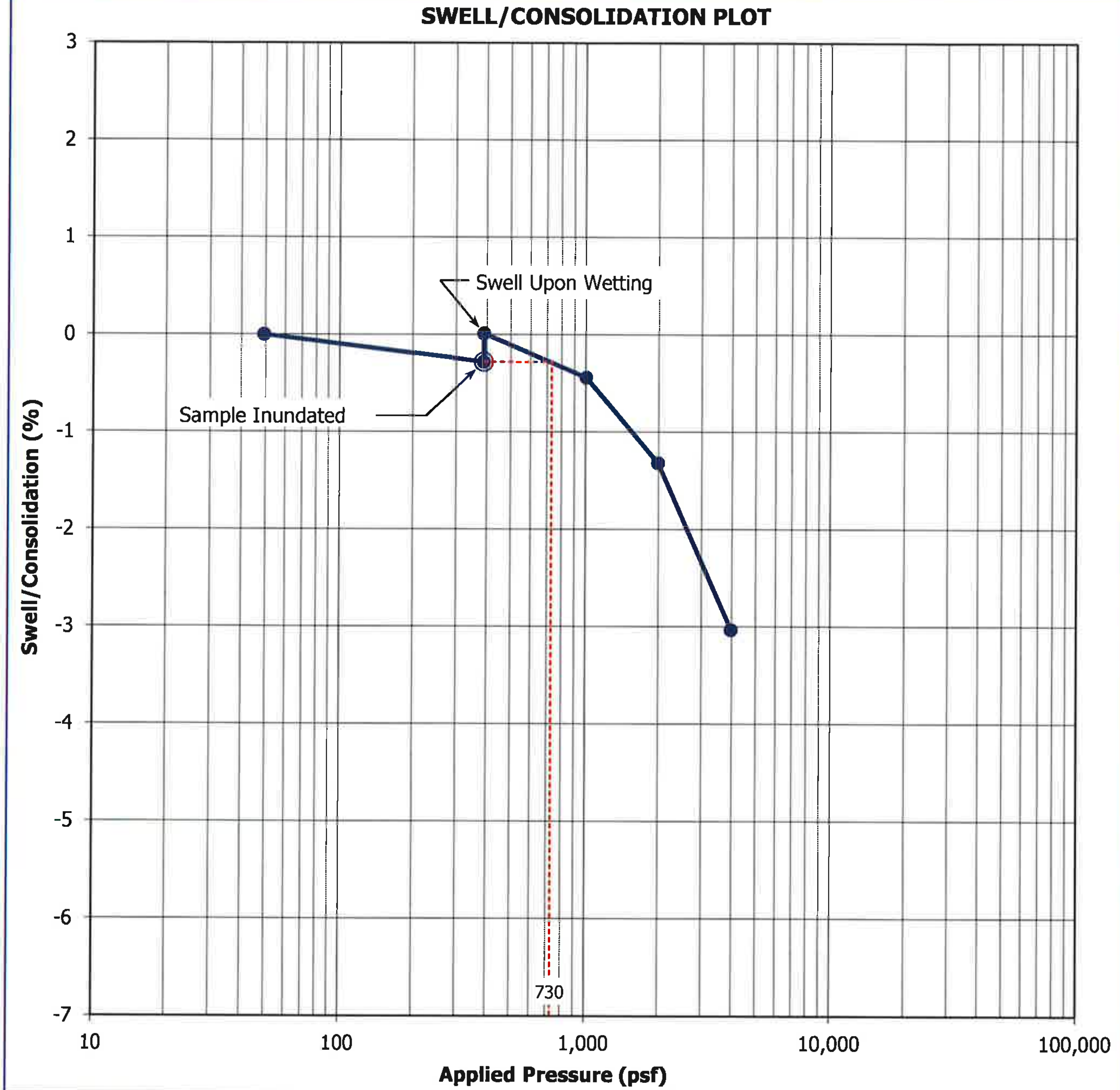

Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-2	4	FILL: CLAY, sandy, dark brown	98.2	22.7	390	0.3	730

Project Number	Project Name	Lab ID Number
22.137	Niver Canal Bridge	F222295

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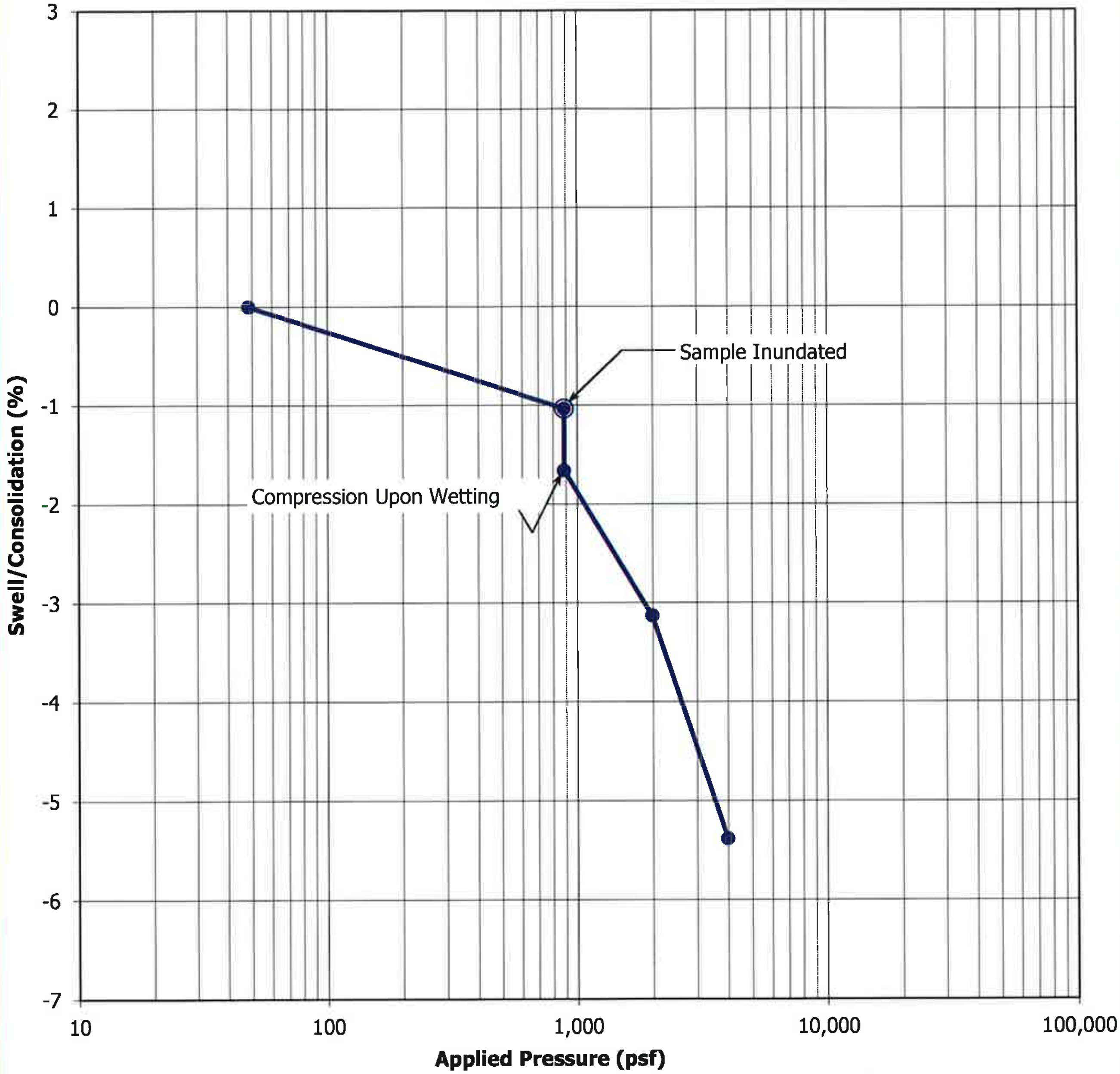
SWELL/CONSOLIDATION PLOT



Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-2	9	CLAY, sandy, brown	101.5	19.0	882	-0.6	NA

Project Number	Project Name	Lab ID Number
22.137	Niver Canal Bridge	F222221

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UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL (ASTM D2166)

Project No.:	22.137			Hole:	B-2
Project Name:	Niver Canal Bridge			Depth:	14 feet
Date:	23-Oct-22	Lab Tech:	G. Hoyos	Visual Description of Sample:	
Lab ID:	F222222	Checked By:	G. Hoyos	SANDSTONE, brown	

Unconfined Compressive Strength (q_u):	**2,569**	**psf**	**Density (pcf):**	108.6
Shear Strength (S_u):	**1,285**	**psf**	**Moisture:**	18.1

Axial Strain (%)	Axial Stress (psf)
0.0	0.0
0.3	68.4
0.6	170.3
1.3	556.0
1.9	1248.8
2.5	2099.7
3.2	2560.0
3.8	1883.8
4.5	982.5
5.1	418.2