



Geotechnical Engineering Investigation

Eagles Landing Plats B through G

Highway 89

Birdseye, UT

PREPARED FOR:

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PREPARED BY:

CMT Engineering Laboratories

CMT Project No. 8302

February 10, 2016

CMTENGINEERING LABORATORIES

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Subject: Geotechnical Engineering Investigation
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Mr. Olsen,

Submitted herewith is the report of our geotechnical engineering investigation for the subject site. This report contains the results of our findings and an engineering interpretation of the results with respect to the available project characteristics. It also contains recommendations to aid in the design and construction of the earth related phases of this project.

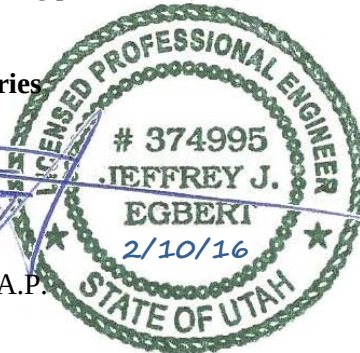
On January 28, 2016, a CMT Engineering Laboratories (CMT) engineering intern was on-site and supervised the excavation of ten test pits extending approximately 2 to 10 feet below the existing grades. Soil samples were obtained during the field operations and were then transported to our laboratory for further testing.

Based on the findings of the subsurface investigation the subsurface soils have significant moisture sensitivity (collapse potential). The recommendations in this report should be carefully followed. A detailed discussion of design and construction criteria is presented in this report.

We appreciate the opportunity to work with you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 492-4132. To schedule materials testing please call (801) 908-5859.

Sincerely,
CMT Engineering Laboratories


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1.0 INTRODUCTION

CMT Engineering Laboratories (CMT) was retained by Mr. David Olsen to conduct a geotechnical engineering subsurface investigation for Plats B through G of Eagles Landing, a single family residential development located on the east side of Highway 89 south of Birdseye, Utah (See **Figures 1 and 2** in the Appendix).

The purpose of this study is to provide geotechnical engineering recommendations that can be used in the design and construction of the proposed development. Specifically, we supervised the excavation of ten test pits at the site and the collection of samples of the subsurface soils. We also conducted laboratory tests, analyzed and evaluated field and laboratory test data, and prepared this report which summarizes our findings and provides recommendations for design and construction of foundations, floor slabs, and pavements.

Significant aspects regarding site development

- We understand that the development will consist of single family residences. We project that each residence will have one to two levels of wood frame construction above grade, possibly with a single level of reinforced concrete below grade (basement), supported on conventional strip and spread footings.
- We project that continuous wall footings will have loads which will not exceed 4,000 pounds per lineal foot and the spread footings will have loads that will not exceed 40,000 pounds. Uniform floor loads are projected to not exceed 150 to 200 pounds per square foot. If the loading conditions are different than we have anticipated, please notify us so that any appropriate modifications to our conclusions and recommendations contained herein may be made.
- Asphalt concrete paved streets will also be constructed.

2.0 EXECUTIVE SUMMARY

Following is a brief summary of our findings and conclusions:

1. At the test pit locations we encountered approximately 3 to 12 inches of sandy, silty clayey soil with roots and organics (topsoil) on the surface followed by layers of natural GRAVEL (GM), SAND (SM), SILT (ML), and CLAY (CL, CL-ML) extending to the maximum depth explored of 10 feet below the existing surface. In some of the test pits very dense subsurface conditions were encountered which the backhoe was unable to penetrate.
2. Groundwater was not encountered within the depths explored.

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3. Laboratory testing indicates that the natural fine grained (clay and silt) soils exhibit significant moisture sensitivity in the form of collapse (settlement) when the soils are wetted. These soils are not suitable for direct support of footings.
4. We recommend that each foundation excavation be observed by a CMT geotechnical engineer to assess the presence of moisture sensitive soils and make additional recommendations as needed.
5. Footings may be supported on undisturbed, uniform natural non-moisture sensitive gravel soils or entirely on structural/engineered fill extending to suitable, undisturbed natural gravel soils, or entirely on a minimum of 48 inches of structural/engineered fill. Footings supported as recommended may be designed using a maximum allowable bearing pressure of 2,500 psf.
6. Strict surface moisture control is recommended to reduce the potential for foundation soils to become wetted.

3.0 DESCRIPTION OF PROPOSED CONSTRUCTION

We understand that the proposed development at this site will include the construction of single family residences. We project that the residences will have one or two levels of wood frame construction above grade, and possibly one level of reinforced concrete below grade (basement). Construction will also include the installation of utilities to service the new residences, concrete flatwork for sidewalks, and asphalt concrete paving for streets.

We project that wall loads will not exceed 4,000 pounds per linear foot, column loads will not exceed 40,000 pounds, and uniform floor loads will not exceed 150 to 200 pounds per square foot.

4.0 SITE CONDITIONS AND FIELD INVESTIGATION

Existing surface and subsurface conditions associated with the subject property are presented in this section.

4.1 General Geology

The subject site is located in an area between the southern Wasatch Range to the west and the northern Wasatch Plateau to the east. The area of the site is in the southern portion the Wasatch Hinterlands Section of the Middle Rocky Mountain Physiographic Province of north-central Utah. The Wasatch Hinterlands are described by Stokes¹ as “a belt of mixed, moderately rugged topography” located between the Wasatch Mountains to the west and the Uinta Mountains to

¹ Stokes, W.L., 1986, *Geology of Utah*; Utah Museum of Natural History, University of Utah, and Utah Geological and Mineral Survey, Department of Natural Resources, p. 243

the east. Stokes further describes the area as having “varied and unorganized topography with hilly areas dominating valley areas.” The elevation near the middle of the subject site is approximately 5,860 feet above sea level.

The geology of the USGS 30' x 60' Nephi Quadrangle, including the location of the subject site, has been mapped by Witkind and Weiss². The surficial geology over the majority of the site and adjacent properties to the south is mapped as “Coalesced alluvial-fan deposits” (Map Unit QTcf) dated to be Holocene to Pleistocene. The higher terrain along the northern portion of the site is mapped as “North Horn Formation” (Map Unit TKn) dated to be Paleocene and upper Cretaceous. Unit QTcf is described on the referenced map as “Brown to dark-brown or gray, unconsolidated to semiconsolidated thin- to thick-bedded, commonly crossbedded sediments of fluvial origin. Deposits consist of silt, sand, granules, pebbles, cobbles, and sparse boulders. Formed by the overlapping and interfingering of adjacent alluvial fans; forms broad, low, sloping apron at foot of adjacent highlands. Includes Sevier River Formation, which probably ranges in age from Miocene to Pleistocene. Thickness uncertain, possibly as much as 30 m (100 ft) thick locally.” Unit TKn is described as “Red to reddish-brown to brown mudstone, claystone, sandstone, conglomeratic sandstone, conglomerate, all of fluvial origin, and sparse freshwater limestone... Formation is unstable and is marked by many slumps, landslides, earthflows, and other forms of mass wasting. Ranges in thickness from about 150 to 915 m (500 – 3,000 ft).” No fill has been mapped at the location of the site on the geologic map.

No surface fault traces are shown on the referenced geologic map crossing or projecting toward the subject site. No landslide deposits or features, including lateral spread deposits, are mapped on or adjacent to the site on a landslide map of the Nephi 30' x 60' Quadrangle³. However, the referenced map does show a number of mapped slumps and landslides in the mountainous terrain to the north and east of the site. Several drainages in the mountainous terrain to the north and east appear to drain toward the subject site and could direct water and/or debris onto the site during and following heavy precipitation events and/or rapid snow melt runoff. The site does not appear to be in a significant rock fall runout zone.

4.2 Site Conditions

The site is situated on the east side of Highway 89 approximately 3 to 4 miles south of Birdseye. There are a few existing residences in the western portion of the site (Plat A) and Cougar Run road is paved to the Plat D area. The site grade generally slopes gently downward to the southwest. Vegetation consists of grasses, weeds, sage brush, and small trees. Based upon aerial photographs readily available on the internet it appears that the initial stages of

²Witkind, I.J., and Weiss, M.P., 1991, *Geologic Map of the Nephi 30' x 60' Quadrangle, Carbon, Emery, Juab, Sanpete, Utah, and Wasatch Counties, Utah*; USGS Map I-1937, Scale 1:100,000.

³ Elliott, A.H., and Harty, K.M., 2010, *Landslide Maps of Utah, Nephi 30' x 60' Quadrangle*; Utah Geological Survey Map 246DM, Plate 19 of 46, Scale 1:100,000.

the development began in 2003 and most of the existing homes were in place by the end of 2009. The site is bound on the north, south, and east by undeveloped land, and on the west by Highway 89 (see **Figures 1 and 2** in the Appendix).

4.3 Field Investigation

The subsurface soil conditions were investigated by excavating ten test pits on the site at the approximate locations shown on **Figure 2** in the Appendix. The test pits extended to depths of approximately 2 to 10 feet below the existing grades. Relatively undisturbed samples of the subsurface soils encountered in the test pits were collected at varying depths. The collected samples were described in general accordance with ASTM 2488, packaged, and transported to our laboratory. The subsurface conditions encountered in the field investigation are discussed in Section 4.3. Logs of the test pits, including a description of all soil strata encountered are presented on **Figures 3 through 12** in the Appendix. Sampling information and other pertinent data and observations are also included on the logs. In addition, a Key to Symbols defining the terms and symbols used on the logs, is provided as **Figure 13** in the Appendix.

4.4 Sub-Surface Soils

At the locations of each test pit we encountered approximately sandy, silty, clayey soil with roots and organics (topsoil) between 3 and 12 inches in thickness on the surface. At the locations of TP-1 and TP-2, directly below the topsoil, we encountered natural GRAVEL (GM) soils to about 4 feet below the surface in TP-1, and to the bottom of TP-2 at about 4.5 feet below the surface where the backhoe was unable to penetrate deeper. Directly below the gravel in TP-1 we encountered natural SILT (ML) with gravel and some cobbles extending to the bottom of TP-1 at about 10 feet below the surface. In most of the other test pits, immediately below the topsoil, we encountered layers of SILT (ML) and CLAY (CL, CL-ML) extending to the maximum depths explored. In TP-4 the fine grained soils extended about 5 feet below the surface and were followed by gravels. In TP-6 we encountered dense rock directly below the topsoil and were only able to dig about 2 feet deep.

A pinhole texture was noted in the fine grained (clay and silt) soil layers. Pinholes are a typical visual indicator of moisture sensitive, potentially collapsible soils. Laboratory testing indicated moderate to high collapse when the samples were wetted during testing. For a detailed description of the soil profiles encountered in this investigation see the Test Pit Logs (**Figures 3 through 12**) in the Appendix. See **Figure 2** for approximate test pit locations.

4.5 Ground Water

Groundwater was not encountered in any of the test pits within the maximum depths explored. Groundwater levels are likely lower than would be expected in the spring and early summer.

Groundwater levels can fluctuate as much as 1.5 to 2 feet seasonally. Numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors, may also influence ground water elevations at the site. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, is beyond the scope of this study.

4.6 Site Subsurface Variations

Based on the results of the subsurface explorations and our experience, variations in the continuity and nature of subsurface conditions should be anticipated. The boundaries between the various soil layers shown on the logs are approximate, the actual transitions may be gradual. Due to the heterogeneous characteristics of natural soils, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the exploration locations. Seasonal fluctuations in ground water conditions may also occur.

4.7 Seismic Setting

4.7.1 Faulting

We did not observe any conditions during our field investigation that would indicate any seismic faulting in the immediate area. The nearest mapped fault trace is the main Provo segment of the Wasatch Fault and is located about 11 miles northwest of the site.

4.7.2 Liquefaction

Liquefaction of a soil is defined as the condition when saturated, loose, cohesion-less, (sand-type) soils have a sudden, large decrease in their ability to support loads. This is because of excessive pore water pressures which develop during a seismic or other dynamic event. Cohesive (clay type) soils typically do not liquefy during a seismic event.

A special liquefaction study was not performed for this site. The soils we did encounter were unsaturated. Based upon these conditions we estimate a low liquefaction potential for soils within the maximum depth we explored.

4.7.4 Seismic Design Category

The Site Classification definitions given in the International Building Code (IBC 2012) are defined by the properties of the subsurface soils to within 100 feet of the surface. We project that the soils in the upper 100 feet of the subsurface profile would likely have average properties consistent with those defining Site Classification D. Therefore, in our opinion **Site Classification D** can be used for seismic structural design.

Using **Site Classification D** the following values would be used for site structural coefficients:

Short Period Spectral Response Acceleration	S_S = 0.618 g
One Second Period Spectral Response Acceleration	S₁ = 0.206 g
Short Period Spectral Response Design Acceleration	S_{DS} = 0.538 g
One Second Period Spectral Design Acceleration	S_{D1} = 0.273 g

5.0 LABORATORY TESTING

5.1 Laboratory Examination

Selected laboratory tests were performed on representative samples collected in the test pits to determine their classification and characteristics with respect to engineering design. Chart 1 indicates typical laboratory tests, which may be applicable to some of the samples retrieved from the site.

Chart 1 Laboratory Soil Testing

<u>Test Conducted</u>	<u>Specification</u>	<u>To Determine</u>
Moisture Content	ASTM D 2216	% moisture representative of field conditions
Dry Density	ASTM D 2937	Dry unit weight representative of field conditions.
Atterberg Limits	ASTM D 4318	Plasticity and workability
Gradation Analysis	ASTM D 1140/ C117	Grain Size Analysis
One Dimension Consolidation	ASTM D-2435	Consolidation properties

Consolidation test results indicate that the natural clay and silt soils have moderate to high moisture sensitivity and can collapse (settle) significantly when saturated while supporting a load (such as a foundation) . Results of the laboratory tests are present on the test pit logs at the respective sample depths, on **Figures 14 through 18, Consolidation Test**, and summarized on **Figure 19** in the Appendix.

5.2 Engineering Analysis and Report

Data obtained from the test pits and the laboratory-testing program was evaluated and used in the geotechnical analyses, which included the preparation of this report which presents our findings and recommendations.

6.0 FOUNDATION RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics, the subsurface conditions observed in the field, and the laboratory test data, as well as common engineering practice. The moisture sensitive characteristics of the natural clay and silt soils have a significant influence on our recommendations.

6.1 Foundation Recommendations

We anticipate that garage footings will be established at approximately 2.5 to 3 feet below the existing grades, and basement footings approximately 6 to 8 feet below the existing grades. In no case should footings be supported on moisture sensitive soils, or upon non-uniform soils. Footings may be established entirely on suitable, undisturbed natural gravel soils, entirely on structural/engineered fill extending to suitable, undisturbed natural gravel soils, or entirely on a minimum of 48 inches of structural/engineered fill. We recommend that each foundation excavation be observed by a CMT geotechnical engineer prior to forming for footings to assess the foundation soils and provide additional recommendations if needed. Footings bearing as recommended above may be designed using a maximum allowable bearing pressure of 2,500 psf.

Below are general recommendations which should also be followed:

- All unsuitable soils (topsoil, organic soils, undocumented fill, loose or disturbed soils), or any other deleterious materials should be removed from each homes footprint prior to the placement of foundations, floor slabs, or structural fill.
- Footings areas should be excavated using a cutting bar or other smooth-bladed equipment to minimize disturbance to the underlying soils.
- Base soil should be examined by a qualified geotechnical engineer to confirm that suitable bearing soils have been exposed.
- All imported structural fill should be placed and compacted in accordance to Section 10.0.
- Exterior footings should be placed a minimum of 30 inches below final grade and interior footing shall be placed a minimum of 16 inches below grade.

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The allowable bearing pressure may be increased by 1/3 for temporary loads such as wind and seismic forces.

6.2 Estimated Settlement

Foundations designed and constructed in accordance with our recommendations could experience some settlement. If the recommendations provided herein are observed, we estimate static settlement should not exceed one inch, with differential settlements on the order of one-half inch. We expect approximately 75 percent of initial settlement to take place during construction. Additional settlement could occur if foundation soils become wetted, or during an earthquake.

7.0 LATERAL EARTH PRESSURES

The following lateral soil pressures should be used for design:

1. An equivalent fluid pressure of 35 pounds per cubic foot (pcf) for the active case. That is when the structure is allowed to yield, i.e. move away from the soil. This requires a minimum movement or rotation at the top of the wall of 0.001H, where "H" is the height of the wall (bottom of footing to top of wall).
2. 50 pcf for the at rest case. This case occurs when the wall is not allowed to yield.
3. 350 pcf for the passive case. In this situation, the wall moves into the soil.
4. 80 psf for the seismic active case.

The given values for design are based on the use of native soils as back fill. If imported soils other than native soils are used, we recommend that this office review the materials and determine if the above design earth pressures are still appropriate.

8.0 FLOOR SLABS

The floor slabs and exterior concrete flat work should be established on suitable, undisturbed natural gravel soils or entirely on a minimum of 24 inches of compacted structural/engineered fill. To aid in distributing the floor loads and to create a capillary break, we recommend that all slabs, including exterior flatwork, be underlain by a minimum of 4 inches of free draining granular material such as ¾ inch minus gravel or 'pea gravel'.

To help control normal shrinkage and stress cracking, the floor slabs should have the following features:

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1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;
2. Frequent crack control joints; and
3. Non-rigid attachment of the slabs to foundation walls and bearing slabs.

9.0 DRAINAGE RECOMMENDATIONS

The natural clay and silt soils were found to have moderate to high moisture sensitivity. These soils can collapse (settle) significantly when wetted. We recommend that the following precautions be implemented to reduce the potential for foundation bearing soils to become wetted:

1. All areas around each home should be sloped to provide drainage away from foundation walls. We recommend a minimum slope of 8 inches in the first 10 feet away from the structure.
2. All roof drainage should be collected in rain gutters with downspouts designed to discharge at least 10 feet from the foundations, or well beyond the backfill limits, whichever is greater.
3. Adequate compaction of the foundation backfill should be provided. We suggest a minimum of 90% of the maximum laboratory density as determined by ASTM D-1557. Water consolidation methods should not be used under any circumstances.
4. Sprinkler heads should be kept at least 5 feet, and aimed away, from the foundation walls. The sprinkling systems should be designed with proper drainage and be well-maintained. Over watering should be avoided. We suggest that native, drought tolerant plants that do not require continuous irrigation be used in landscaping within 5 feet of the foundation walls.
5. Other precautions may become evident during construction.

10.0 SITE PREPARATION AND GRADING

10.1 General Site Grading

All deleterious materials should be stripped from the site prior to commencement of construction activities. In the building areas this includes undocumented fill, loose and

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disturbed soils, topsoil, vegetation, etc. We encountered topsoil on the surface extending approximately 3 to 12 inches in depth. These soils should be completely removed from below the new residences and streets.

Each foundation excavation should be examined by a CMT geotechnical engineer to assure that all deleterious materials have been removed and suitable bearing soils have been exposed.

Structural/engineered fill placed below footings should extend beyond the interior and exterior edges of the footings a distance of 6 inches for every 12 inches of structural fill below the footings.

Fill placed over large areas to raise overall site grades can induce settlements in the underlying natural soils. If more than 3 feet of site grading fill is anticipated over the existing surface of the site, we should be notified to assess potential settlements and provide additional recommendations as needed. These recommendations may include placement of the site grading fill far in advance to allow potential settlements to occur prior to construction.

10.2 Temporary Excavations

For temporary excavations less than 5 feet deep, either in the native soils or structural fill, slopes should not be steeper than 0.75:1 (horizontal to vertical). Excavations extending up to 10 feet in depth into the natural soils should not be made steeper than 2:1 (horizontal:vertical). If groundwater is encountered, flatter slopes, shoring, bracing, and/or dewatering may be required for all conditions. All excavations should be made following OSHA safety guideline.

10.3 Fill Material

The natural gravel soils could possibly be used as structural fill in confined areas such as footing or utility trenches, and also as site grading fill. Some of the structural/engineered fill below footings and for utility trenches below the residences and pavement areas required for the project will likely need to be imported. The following types of fill are recommended for their specific applications:

10.3.1 Structural/Engineered Fill:

Well-graded granular soils free of organics, debris, or other deleterious materials are recommended for use as structural fill at this site. We recommend a well-graded sandy gravel material with no less than 15% and no more than 25% passing the #200 sieve and no particles greater than 4 inches in maximum dimension.

10.3.2 Non-Structural Fill:

The natural soils may be used as site grading fill and as fill in non-load bearing areas also. All fill material should be approved by the engineer prior to placement.

10.4 Trenches

Most municipalities are requiring that utility trench backfill be composed of granular material with limited fines. Some of the natural gravel soils may meet these specifications. Structural fill as described above will meet these specifications. All trench backfill should be compacted to the requirements set forth in **Section 10.5**.

10.5 Fill Placement and Compaction

The various types of compaction equipment available have their limitations as to the maximum lift thickness that can be compacted. For example, hand operated equipment is limited to lifts of about 4 inches and most “trench compactors” have a maximum, consistent compaction depth of about 6 inches. Large rollers, depending on soil and moisture conditions can achieve compaction at 8 to 12 inches. The full thickness of each lift should be compacted to at least the following percentages of the maximum dry density as determined by ASTM D-1557:

1. Compacted fill, supporting foundations.	95%
2. Compacted fill, below floor slabs	95%
3. Backfill of trenches	
a. Below foundations	95%
b. Below floor slabs	95%
c. Below pavements	95%
d. Others	90%
4. Below Pavements	95%

Field density tests should be performed on each lift as necessary to insure that compaction is being achieved. As a minimum, 33% of all spot footings, and one test for every 50 lineal feet of continuous wall footings shall be tested for each lift.

10.6 Stabilization

Near surface clay and silt soils during wetter seasons of the year may be susceptible to rutting and pumping. The likelihood of disturbance or rutting and/or pumping of the existing natural soils is a function of the load applied to the surface, as well as the frequency of the load. Consequently, rutting and pumping can be minimized by avoiding concentrated traffic,

minimizing the load applied to the surface by using lighter equipment and/or partial loads, by working in drier times of the year, or by providing a working surface for the equipment. Rubber-tired equipment particularly, because of high pressures, promotes instability in wet, soft soils.

If rutting or pumping occurs, traffic should be stopped and the disturbed soils should be removed and replaced with granular material. Typically a minimum of 18 inches of the disturbed soils must be removed to be effective. However, deeper removal is sometimes required.

The most effective granular material for stabilization is an angular, well-graded gravel such as a pit run or crushed rock with a maximum size of about four inches. We suggest that the initial lift be approximately 12 inches thick and be compacted with a static roller-type compactor. The more angular and coarse the material, the thinner the lift that will be required. We recommend that the fines content (percent passing the no. 200 sieve) be less than 15%, the liquid limit be less than 35, and the plasticity index be less than 15. If this type of material is needed in footing areas it may be considered part of the recommended 36 inches of structural fill.

Often the amount of granular material can be reduced with the use of a geotextile fabric such as Mirafi RS280i or equivalent. Its use will also help avoid the mixing of the subgrade soils with the granular material. After the excavation of the disturbed soils, the fabric should be spread across the bottom of the excavation and up the sides a minimum of 18 inches. Otherwise, it should be placed in accordance with the manufacturer's recommendation, including proper overlaps. The granular material can then be placed over the fabric in compacted lifts as described above.

11.0 PAVEMENTS

The natural gravel soils will generally provide good pavement support characteristics when saturated or nearly saturated, but the natural clay and silt soils will not, particularly due to their moisture sensitive nature. We estimate a conservative CBR value of 3 for the natural clay and silt soils. We project that the expected traffic will be relatively light and consist primarily of cars and pickup trucks, and possibly a weekly garbage truck. Table 1 below contains the minimum recommended pavement section.

Table 1: Pavement Design

Material	Pavement Section Thickness (in)
Asphalt	3
Road-Base	8
Sub-base	12
Total Thickness	23

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Untreated base course (UTBC) should conform to county or 1"-minus UDOT specifications for A-1-A/NP and have a CBR value greater than 70%. Asphalt should conform to the standard county or UDOT specification.

The asphalt pavement should be compacted to 96% of the maximum density for the asphalt material. If soft soils are encountered a stabilization fabric or geo-grid may be required to provide a stable surface for the remainder of the pavement materials.

12.0 QUALITY CONTROL

Our recommendations in this report are based on the assumption that adequate quality control testing and observations will be conducted by CMT during construction to verify compliance. This may include but not necessarily be limited to the following:

12.1 Field Observations

Observations should be completed during all phases of construction such as site preparation, foundation excavation, structural fill placement and concrete placement.

12.2 Fill Compaction

Compaction testing by CMT is required for all structural supporting fill materials. Maximum Dry Density (Proctor-ASTM 1557) tests should be requested by the contractor immediately after delivery of any granular fill materials. The maximum density information should then be used for field density tests on each lift as necessary to insure that the required compaction is being achieved.

12.3 Concrete Quality

We recommend that freshly mixed concrete be tested by CMT in accordance with ASTM designations.

12.4 Vibration Monitoring

Construction activities, particularly site grading and fill placement, can induce vibrations in existing structures adjacent to the site. Such vibrations can cause damage to adjacent buildings, depending on the building composition and underlying soils. It can be prudent to monitor vibrations from construction activities to maintain records that vibrations did not exceed a pre-defined threshold known to potentially cause damage. CMT can provide this monitoring if desired.

13.0 LIMITATIONS

The recommendations provided herein were developed by evaluating the information obtained from the borings and site investigation and from laboratory testing. The logs reflect the subsurface conditions only at the specific location at the particular time designated on the log. Soil and ground water conditions may differ from conditions encountered at the actual exploration locations. The nature and extent of any variation in the explorations may not become evident until during the course of construction. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. No warranty is either expressed or implied.

We appreciate the opportunity to be of service to you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 492-4132. To schedule materials testing please call (801) 908-5859.

14.0 REFERENCES

ASTM, American Society for Testing and Materials 2010

Utah County Hazards, <http://utahcounty.maps.arcgis.com/apps/MapSeries/index.html>

IBC, International Building Code, 2012 Edition, International Conference of Building Officials, Whittier, CA.

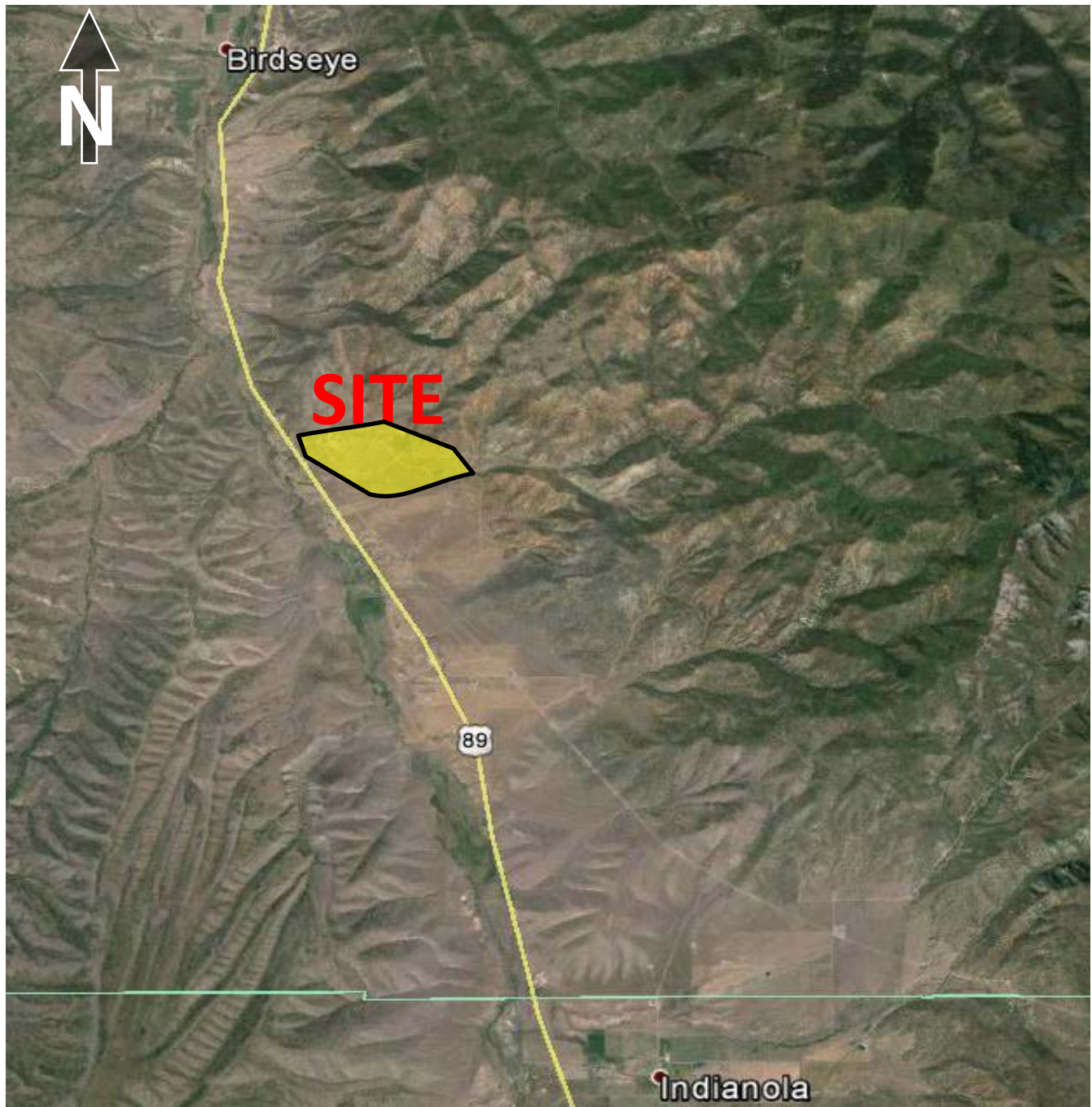
ENGINEERING

MATERIALS TESTING

SPECIAL INSPECTIONS

ORGANIC CHEMISTRY

Appendix



CMTENGINEERING
LABORATORIES

Vicinity Map

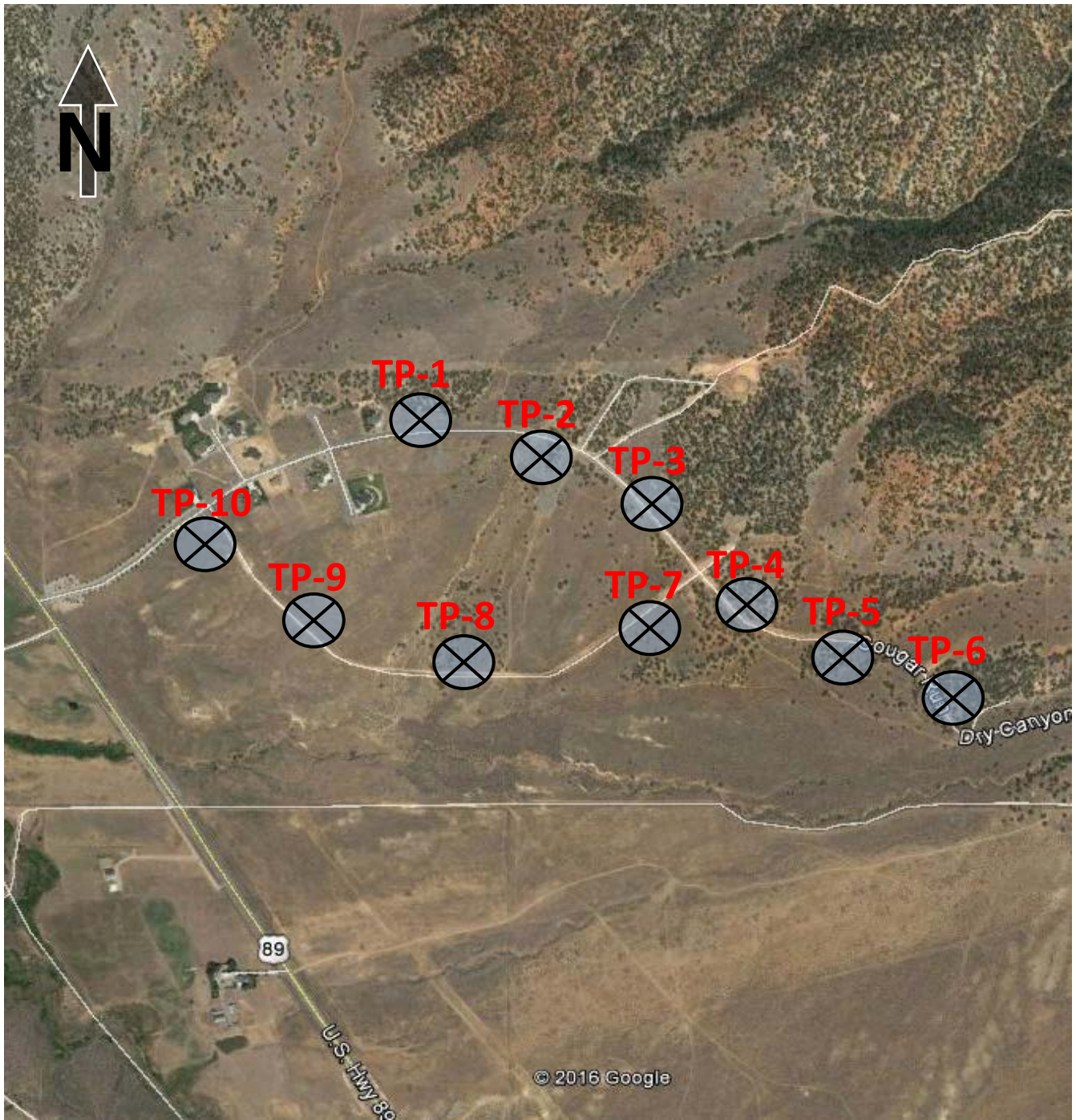
Highway 89, Birdseye, Utah

Eagles Landing B-G

Date:	28-Jan-16
Project #:	8302
Engineer:	J. Egbert
Drawn by:	N. Pack

Figure:

1



CMTENGINEERING
LABORATORIES

Site Map

Highway 89, Birdseye, Utah

Eagles Landing B-G

Date:	28-Jan-16
Project #:	8302
Engineer:	J. Egbert
Drawn by:	N. Pack

Figure:

2

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
1.5		Silty GRAVEL (GM), trace cobbles, slightly moist, brown.										
3												
		Medium dense		1								
4.5		Lean CLAY (CL) with gravel, trace cobbles, pinholes and root holes, slightly moist, brown.										
6												
		Stiff		2	4.6				22	13	9	90.1
7.5												
9												
10.5		End at 10 Feet										

Remarks: No groundwater encountered.

Eagles Landing

Birdseye, Utah

Test Pit Log

TP-2

Type: Rubber Tire Backhoe

Surface Elev. (approx):

Total Depth: 4.5 Feet

Water Level:

Date: 1/28/16

Job #: 8302

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
1.5		Silty GRAVEL (GM), trace cobbles and boulders, cemented, slightly moist, orange-brown.										
3												
4.5		Very dense, refusal		3								
		End at 4.5 Feet										
6												
7.5												
9												
10.5												

Remarks: No groundwater encountered.

CMT ENGINEERING
LABORATORIES

Excavated By:

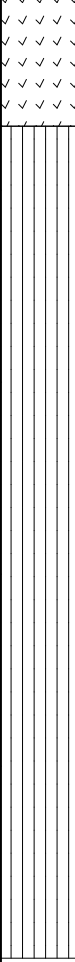
Halls Enterprises

Logged By:

N. Pack

Figure:

4

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
1.5		SILT (ML), some clay, cemented, slightly moist, brown to light brown-orange.										
3			Hard	4								
4.5												
6			Hard	5	10.8					NP		108.2
7.5		Very hard digging										
		End at 7.5										
9												
10.5												

Remarks: No groundwater encountered.

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
		Silty SAND (SM) with gravel, cemented, slightly moist, light orange-brown.										
1.5												
3												
4.5		Medium dense		6	3	36	40	24				
		Silty GRAVEL (GM) with sand, fine grained, slightly moist, orange.										
6												
7.5		Dense		7	3.1	48	43	9				
9												
10.5		End at 10 Feet										

Remarks: No groundwater encountered.

Eagles Landing

Birdseye, Utah

Test Pit Log

TP-5

Type: Rubber Tire Backhoe
Surface Elev. (approx):

Total Depth: 10 Feet
Water Level:

Date: 1/28/16
Job #: 8302

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown. Lean CLAY (CL), some roots, slightly moist, brown.										
1.5												
3			Stiff	8	6				24	16	8	
4.5												
6		Silty GRAVEL (GM) with sand, cobbles, slightly moist, orange-brown.										
7.5												
9			Dense	9	3.2	43	39	18				
10.5		End at 10 Feet										

Remarks: No groundwater encountered.

CMT ENGINEERING
LABORATORIES

Excavated By: Halls Enterprises
Logged By: N. Pack

Figure:

7

Eagles Landing

Birdseye, Utah

Test Pit Log

TP-6

Type: Rubber Tire Backhoe

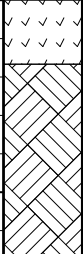
Surface Elev. (approx):

Total Depth: 2 Feet

Water Level:

Date: 1/28/16

Job #: 8302

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
		ROCK: Weathered, white.										
1.5		Refusal on rock										
		End at 2 Feet										
3												
4.5												
6												
7.5												
9												
10.5												

Remarks: No groundwater encountered.

CMT ENGINEERING
LABORATORIES

Excavated By:

Halls Enterprises

Logged By:

N. Pack

Figure:

8

Eagles Landing

Birdseye, Utah

Test Pit Log

TP-7

Type: Rubber Tire Backhoe

Surface Elev. (approx):

Total Depth: 8 Feet

Water Level:

Date: 1/28/16

Job #: 8302

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0	✓✓✓✓✓	TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
		SILT (ML), some clay, cemented, slightly moist, brown.										
1.5												
3												
4.5			Very stiff	11	12.8					NP		93.4
6			Hard	12								
7.5												
9		End at 8 Feet										
10.5												

Remarks: No groundwater encountered.

CMT ENGINEERING
LABORATORIES

Excavated By:

Halls Enterprises

Logged By:

N. Pack

Figure:

9

Eagles Landing

Birdseye, Utah

Test Pit Log

TP-8

Type: Rubber Tire Backhoe

Surface Elev. (approx):

Total Depth: 4 Feet

Water Level:

Date: 1/28/16

Job #: 8302

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
		Lean CLAY (CL), some clay, cemented, slightly moist, brown.										
1.5												
3												
		Hard		13	6.7				23	14	9	
		Refusal										
4.5		End at 4 Feet										
6												
7.5												
9												
10.5												

Remarks: No groundwater encountered.

CMTENGINEERING
LABORATORIES

Excavated By:

Halls Enterprises

Logged By:

N. Pack

Figure:

10

Eagles Landing

Birdseye, Utah

Test Pit Log

TP-9

Type: Rubber Tire Backhoe

Surface Elev. (approx):

Total Depth: 8 Feet

Water Level:

Date: 1/28/16

Job #: 8302

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
		Silty CLAY (CL-ML), some clay, cemented, pinholes and root holes, slightly moist, brown to light brown.										
1.5												
3			Stiff	14	3.9				19	13	6	99.9
4.5												
6												
7.5		Lean CLAY (CL), some cementation, trace pinholes, slightly moist, light brown.	Hard	15	5.4				22	14	8	
		End at 8 Feet										
9												
10.5												

Remarks: No groundwater encountered.

CMT ENGINEERING
LABORATORIES

Excavated By:

Halls Enterprises

Logged By:

N. Pack

Figure:

11

Eagles Landing

Birdseye, Utah

Test Pit Log

TP-10

Type: Rubber Tire Backhoe

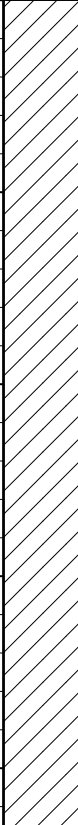
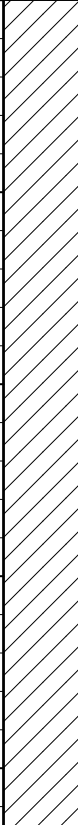
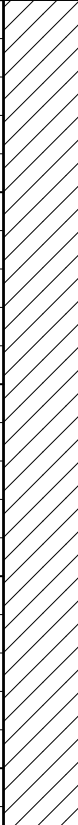
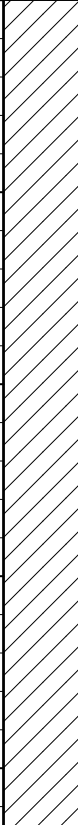
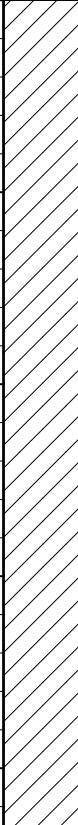
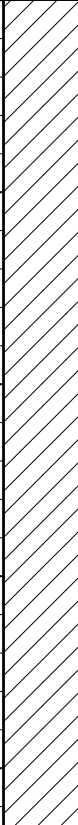
Surface Elev. (approx):

Total Depth: 10 Feet

Water Level:

Date: 1/28/16

Job #: 8302

Depth (ft.)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Gradation			Atterberg			Dry Density
						Gravel %	Sand %	Fines %	LL	PL	PI	
0		TOPSOIL: Silt with gravel, roots, organics, slightly moist, dark brown.										
		Clayey SILT (ML), slightly moist, brown.										
1.5		Lean CLAY (CL) with gravel, rootholes, slightly moist, light brown.										
3		Very stiff/hard		16	6.6				23	14	9	104.6
4.5												
6												
7.5												
9		More gravel and sand at 8 feet.		17	5.6	30	35	35				
10.5		End at 10 Feet										

Remarks: No groundwater encountered.

CMT ENGINEERING
LABORATORIES

Excavated By:

Halls Enterprises

Logged By:

N. Pack

Figure:

12

KEY TO SYMBOLS

Symbol Description

Strata symbols



Topsoil



Silty gravel



Low plasticity
clay



Silt



Silty sand and gravel



Basalt
(or generic rock)



Silty low plasticity
clay



Inorganic silts
and clays

Soil Samplers



Bulk/Grab sample



Undisturbed Block Sample

Notes:

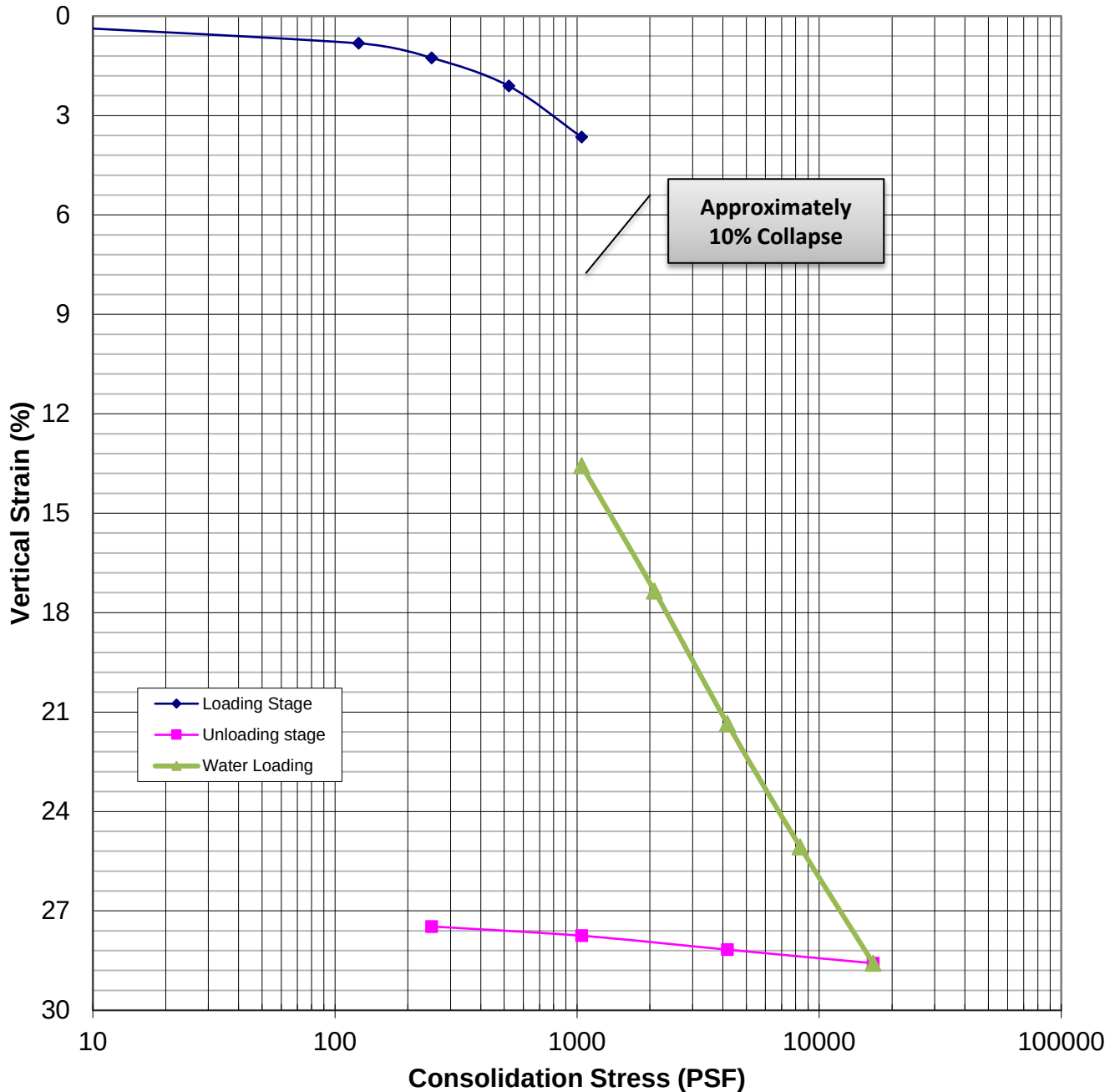
1. The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
2. The subsurface conditions represented on the logs are for the locations specified. Caution should be exercised if interpolating between or extrapolating beyond the exploration locations.
3. The information presented on the logs is subject to the limitations, conclusions, and recommendations presented in the report.

Figure:

13

Consolidation Test

Evaluation of Preconsolidation Stress



Moisture: 4.60 (%)

Dry Density: 90.1 (pcf)

Soil Classification: **CL**

Liquid Limit: **22**

Plastic Limit: **13**

Plasticity Index: **9**

CMTENGINEERING
LABORATORIES

TP-1 @ 6' Consolidation

Highway 89, Birdseye, Utah

Eagles Landing B-G

Date: 28-Jan-16

Project #: 8302

Engineer: J. Egbert

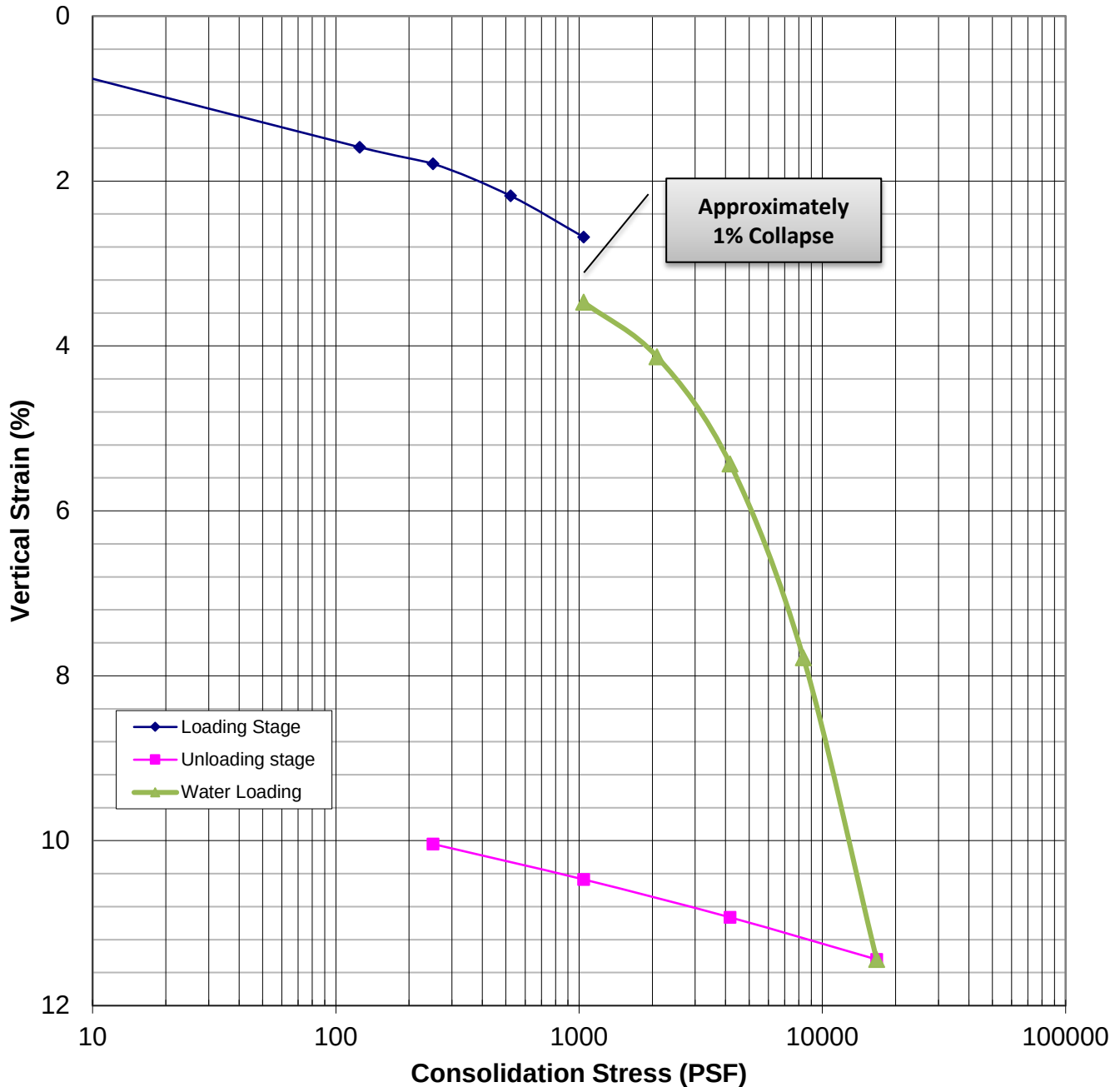
Drawn by: N. Pack

Figure:

14

Consolidation Test

Evaluation of Preconsolidation Stress



Moisture: 10.80 (%)

Dry Density: 108.2 (pcf)

Soil Classification: **ML**

Liquid Limit:

Plastic Limit: **NP**

Plasticity Index:

CMTENGINEERING
LABORATORIES

TP-3 @ 6' Consolidation

Highway 89, Birdseye, Utah

Eagles Landing B-G

Date: 28-Jan-16

Project #: 8302

Engineer: J. Egbert

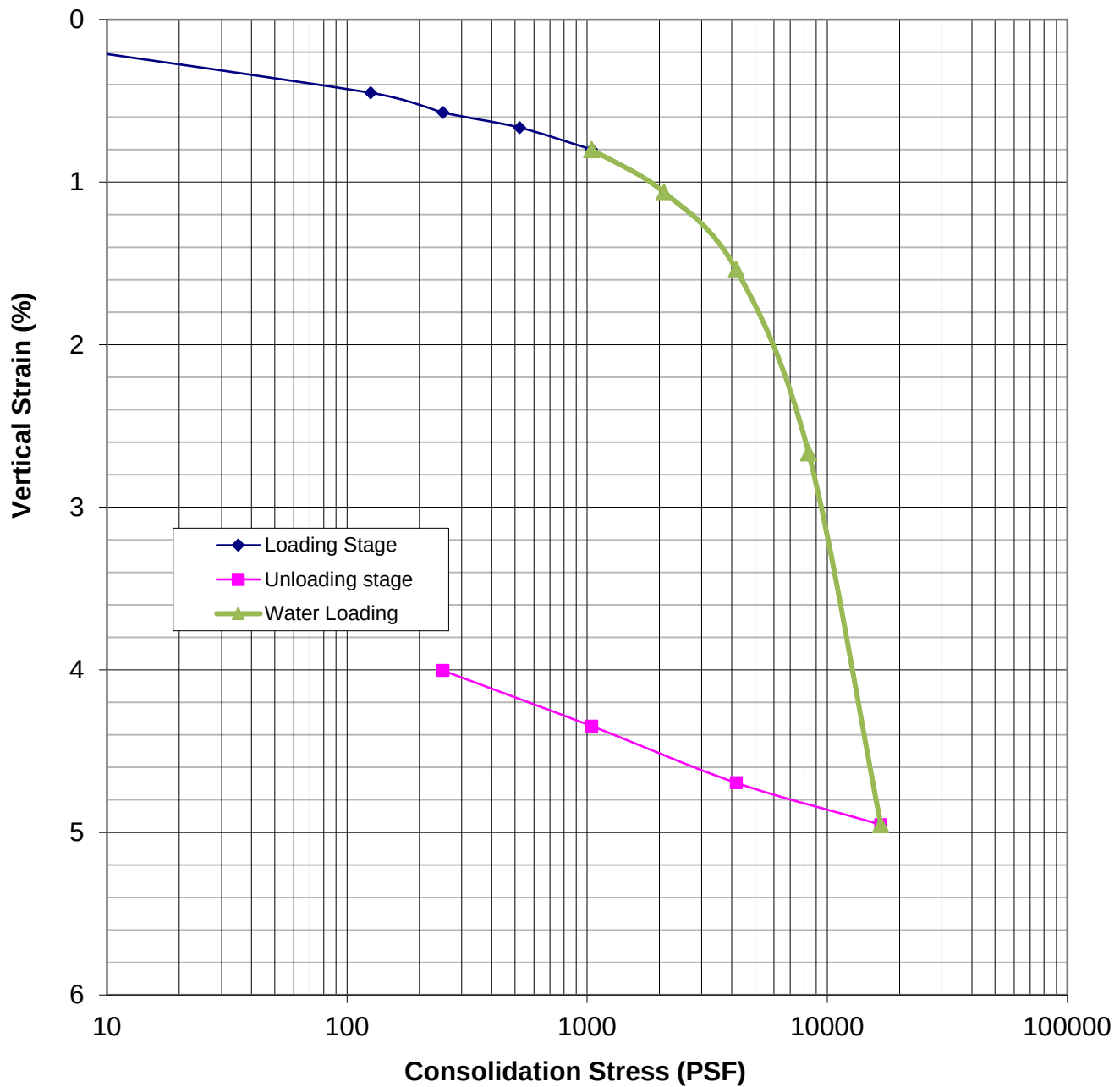
Drawn by: N. Pack

Figure:

15

Consolidation Test

Evaluation of Preconsolidation Stress



Moisture: 12.80 (%)

Dry Density: 93.4 (pcf)

Soil Classification: **ML**

Liquid Limit:

Plastic Limit: **NP**

Plasticity Index:

CMTENGINEERING
LABORATORIES

TP-7 @ 4' Consolidation

Highway 89, Birdseye, Utah

Eagles Landing B-G

Date: 28-Jan-16

Project #: 8302

Engineer: J. Egbert

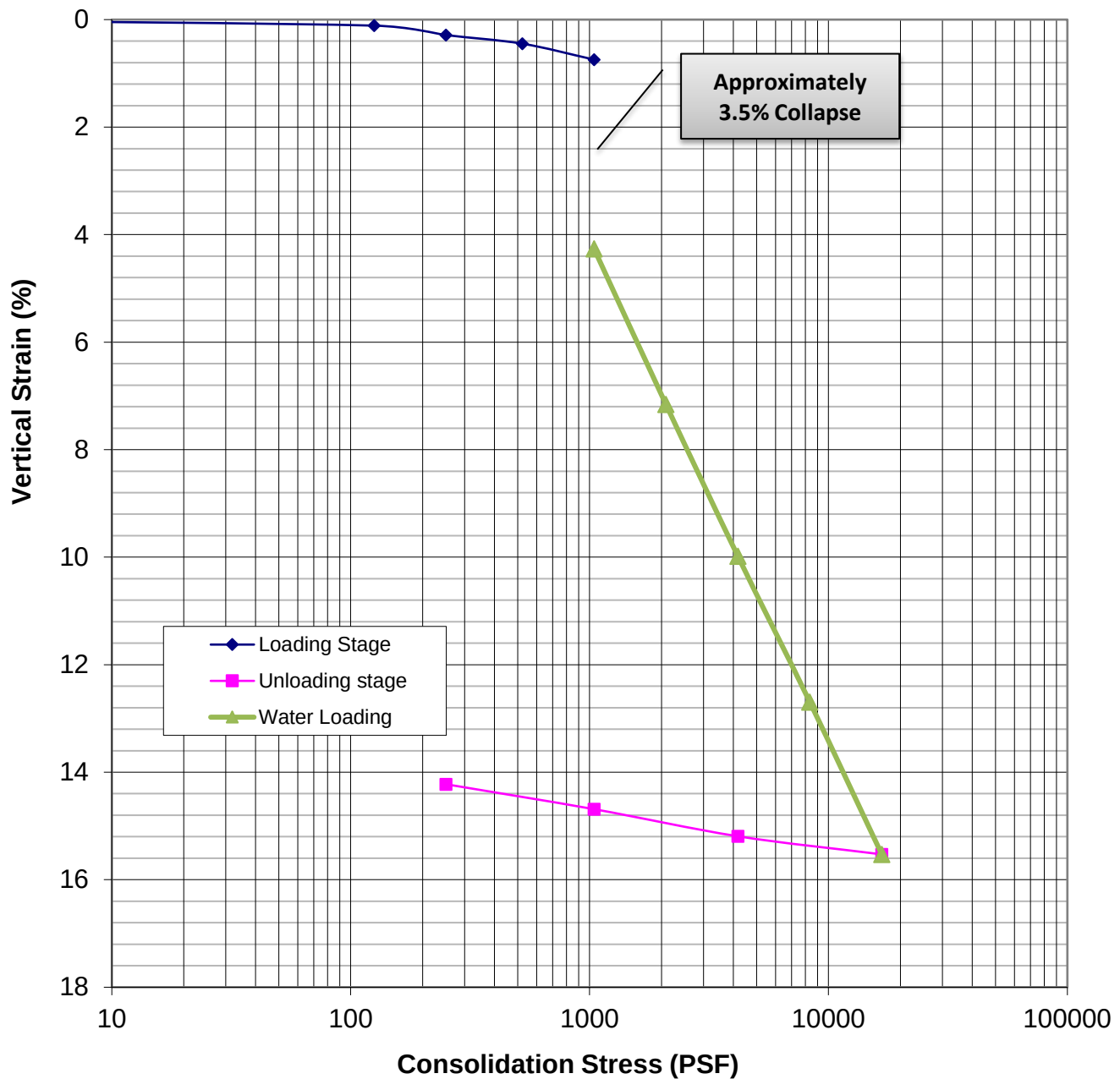
Drawn by: N. Pack

Figure:

16

Consolidation Test

Evaluation of Preconsolidation Stress



Moisture: 3.90 (%)

Dry Density: 99.9 (pcf)

Soil Classification: **CL-ML**

Liquid Limit: 19

Plastic Limit: 13

Plasticity Index: 6

CMTENGINEERING
LABORATORIES

TP-7 @ 4' Consolidation

Highway 89, Birdseye, Utah

Eagles Landing B-G

Date: 28-Jan-16

Project #: 8302

Engineer: J. Egbert

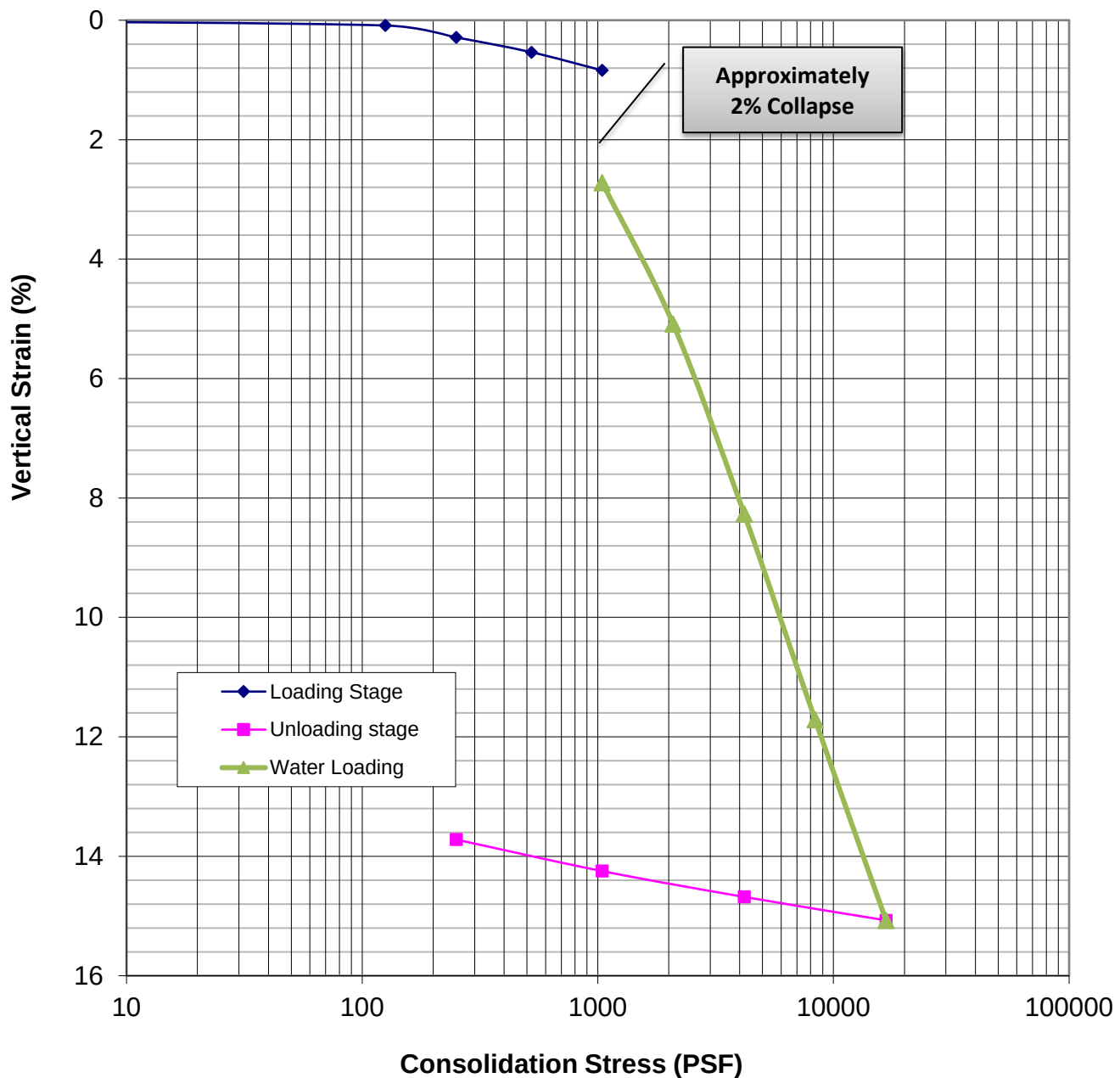
Drawn by: N. Pack

Figure:

17

Consolidation Test

Evaluation of Preconsolidation Stress



Moisture: 6.60 (%)

Dry Density: 104.6 (pcf)

Soil Classification: **CL**
Liquid Limit: **23**
Plastic Limit: **14**
Plasticity Index: **9**

CMTENGINEERING
LABORATORIES

TP-7 @ 4' Consolidation

Highway 89, Birdseye, Utah

Eagles Landing B-G

Date: 28-Jan-16
Project #: 8302
Engineer: J. Egbert
Drawn by: N. Pack

Figure:

17

Eagles Landing

Birdseye, Uath

Job #:

8302

[illegible]

* In accordance with the Unified Soil Classification System

Sampled By:

Nate Pack

Excavated By:

Halls Enterprises

Figure

10