



# TOWN OF JACKSON PLANNING & BUILDING DEPARTMENT

## TRANSMITTAL MEMO

### Town of Jackson

- ☒ Public Works/Engineering
- ☒ Building
- ☐ Title Company
- ☒ Town Attorney
- ☒ Police

### Joint Town/County

- ☒ Parks and Recreation
- ☒ Pathways
- ☒ Housing Department

### Teton County

- ☐ Planning Division

- ☐ Engineer
- ☐ Surveyor- *Nelson*
- ☐ Assessor
- ☐ Clerk and Recorder
- ☐ Road and Levee

### State of Wyoming

- ☐ Teton Conservation
- ☐ WYDOT
- ☐ TC School District #1
- ☐ Game and Fish
- ☐ DEQ

### Federal Agencies

- ☐ Army Corp of Engineers

### Utility Providers

- ☐ Qwest
- ☐ Lower Valley Energy
- ☐ Bresnan Communications

### Special Districts

- ☒ START
- ☒ Jackson Hole Fire/EMS
- ☐ Irrigation Company

<p>Date: August 21, 2019</p> <p>Item #: P19-200</p> <p>Planner: Brendan Conboy</p> <p>Phone: 733-0440 ext. 1302</p> <p>Fax: 734-3563</p> <p>Email: bconboy@jacksonwy.gov</p> <p><b>Owner:</b> 540 CACHE CREEK LLC C/O WILDSTAR PARTNERS LLC 207 High Point Dr Bldg 100 Victor, NY 14564-1061</p> <p><b>Applicant:</b> Josh Kilpatrick/ Nelson Engineering PO Box 1599 Jackson, WY 83001</p>	<p style="text-align: center;"><b>REQUESTS:</b></p> <p>The applicant is submitting a request for a hillside Conditional Use Permit in order to create a two lot subdivision for the property located at 540 Cache Creek Drive, legally known as, LOT 6, BLK. 7, HALL 2</p> <p>For questions, please call Brendan Conboy at 307-733-0440, x1302 or email to the address shown to the left. Thank you.</p>
<p><b>Please respond by: September 4, 2019 (Sufficiency)</b> <b>September 11, 2019 (with Comments)</b></p>	

**RESPONSE:** For Departments not using Trak-it, please send responses via email to: [tstolte@jacksonwy.gov](mailto:tstolte@jacksonwy.gov)

August 21<sup>th</sup>, 2019

Town of Jackson

150 East Pearl Ave.

Jackson, WY 83001

ATTN: Brendan Conboy

RE: Project Narrative and findings for approval: 540 Cache Creek Drive Development Plan – Reference Preapplication Conference #P19-009

Dear Brendan:

Please find attached Development Plan (DP) and Conditional use permit (hillside CUP) for 540 Cache Creek Drive for your review. The proposed development is located in Neighborhood Low Density (NL-2) zoning and has been advanced from the preapplication phase to include a proposal for a lot split (east/west) and subsequent construction of two single-family homes. Construction of the new residences will require demolition of the existing residence. As you may be aware, construction plans for the south residence have already been submitted to the Town for review and approval under Town project #P19-125.

The proposed development has been prepared to comply with the following findings of approval as presented in LDR Section 8.5.2.

1. Is consistent with the desired future character described for the site in the Jackson
2. Natural resource overlay and scenic resource overlay are not applicable for this development plan
3. Does not have significant impact on public facilities and services, including transportation, potable water, and wastewater facilities, parks, schools, police, fire, and EMS
4. Complies with the Town of Jackson Design Guidelines
5. Complies with all relevant standards of these LDRs and other Town Ordinances; and
6. Is in substantial conformance with all standards or conditions of any prior applicable permits or approvals.

The Conditional use permit (Hillside CUP) has been prepared to comply with the following findings of approval as presented in LDR Section 8.4.2.

1. Is compatible with the desired future character of the area
2. Complies with specific use standards
3. Minimizes adverse visual impacts
4. Minimizes adverse environmental impacts
5. Minimizes adverse impacts from nuisances
6. Minimizes adverse impacts on public facilities
7. Complies with all other relevant standards of the LDRs and all town ordinance; and
8. Is insubstantial conformance with all standards and conditions of any prior applicable permits or approvals.

Per section 5.4.1.C.5 to our knowledge no adverse impacts have been identified for the conditional use permit. The wildlife use/habitat review study indicates that there will be minimal impact to wildlife that inhabit the area.

The submittal package, including planning permit application, title report, site plan with summary table demonstrating compliance with dimensional standards, wildlife use/habitat review study, geotechnical investigation, visual impact analysis, and grading and drainage plan is believed to provide sufficient information for a CUP and DP level submittal and approval for a lot subdivision.

Please note that landscaping, final grading, stormwater run-off calculations and design, and lighting plans will be provided in detail with the building permit submittal. With exception to these items, all comments made by town entities are addressed within the development plan drawings provided (see DP-1).

If you find there to be submittal deficiencies, please don't hesitate to contact me so they can be addressed prior to review by other Town departments/entities.

Respectfully submitted,

A handwritten signature in blue ink, appearing to read "Josh Kilpatrick", written in a cursive style.

Josh Kilpatrick, PE

Encl.

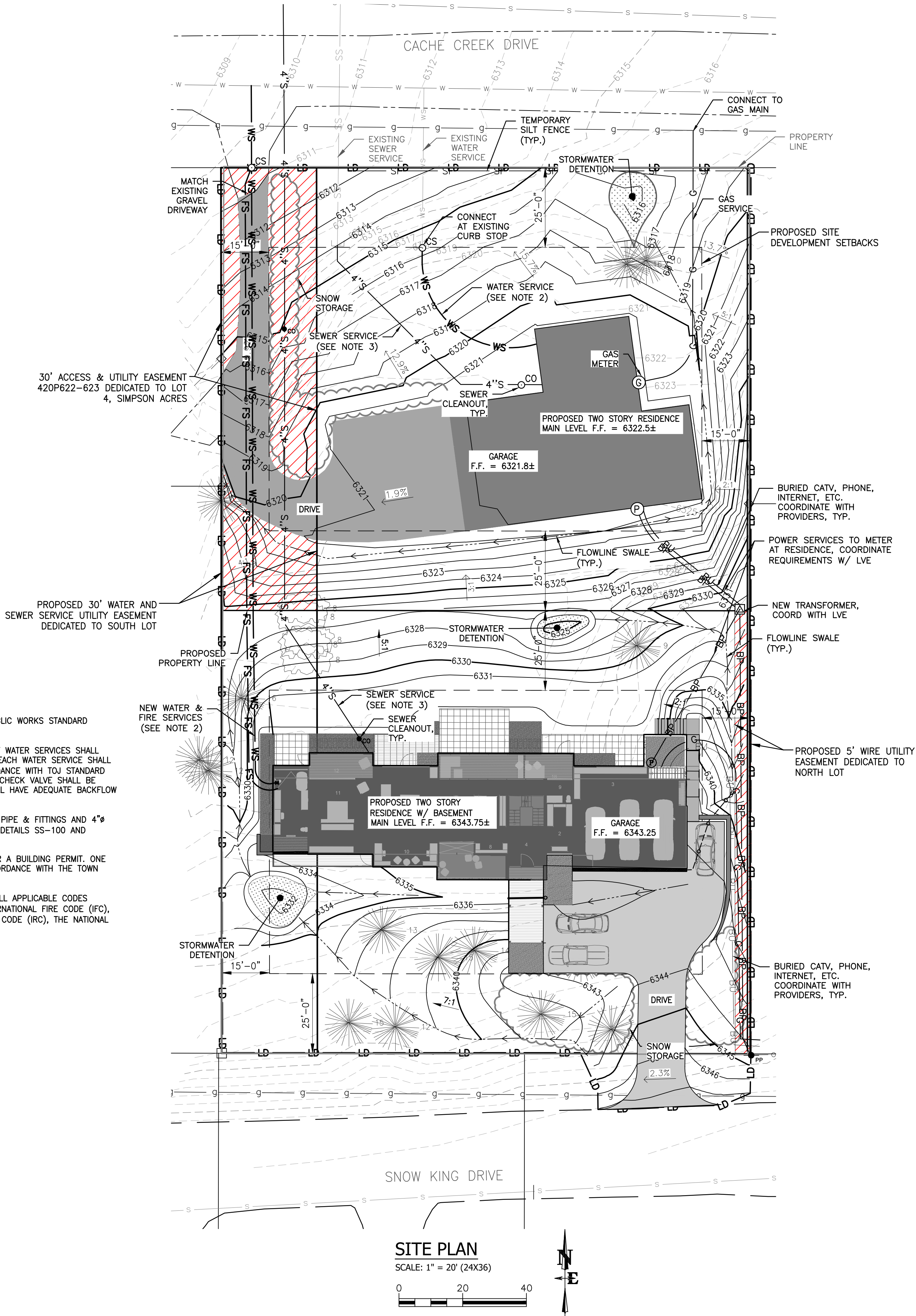
CC: Robert Huggins



S:\Proj\2019\046-04\_Lot 6\_Site B\_Hell-540\_Cache Creek Dr-Development\_Plan\A4\_Plan\Site Plan.dwg 16 AUG 2019 09:00:11 pm RUTLEDGE BY: JCL

CONSTRUCTION NOTES:

- ALL WORK SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE WYOMING PUBLIC WORKS STANDARD SPECIFICATIONS 2001 EDITION AND TOWN OF JACKSON (TOJ) STANDARDS.
- NEW DOMESTIC WATER AND FIRE SERVICES SHALL BE HDPE. INSTALLATION OF WATER SERVICES SHALL CONFORM WITH TOJ STANDARD DETAILS W-100, W-102, W-103 & W-104. EACH WATER SERVICE SHALL PROVIDE A 3/4" METER INSTALLED INTERIOR TO EACH RESIDENCE IN ACCORDANCE WITH TOJ STANDARD DETAIL W-112. METER ASSEMBLY INCLUDING YOKE, METER VALVE AND DUAL CHECK VALVE SHALL BE PURCHASED FROM TOJ AND INSTALLED BY OWNER. IRRIGATION SYSTEMS SHALL HAVE ADEQUATE BACKFLOW DEVICES IN ACCORDANCE WITH TOJ STANDARDS.
- SEWER SERVICES FOR EACH RESIDENCE SHALL CONSIST OF 4" SCH40 PVC PIPE & FITTINGS AND 4" CLEANOUT(S). INSTALLATION OF SERVICE SHALL CONFORM TO TOJ STANDARD DETAILS SS-100 AND SS-111.
- A LANDSCAPING PLAN WILL BE PROVIDED WHEN THE APPLICANT SUBMITS FOR A BUILDING PERMIT. ONE PLANT UNIT PER ATTACHED SINGLE FAMILY HOME WILL BE PROVIDED IN ACCORDANCE WITH THE TOWN LDR'S.
- NEW BUILDING CONSTRUCTION SHALL BE COMPLETED IN ACCORDANCE WITH ALL APPLICABLE CODES INCLUDING, BUT NOT LIMITED TO THE MOST CURRENT EDITIONS OF THE INTERNATIONAL FIRE CODE (IFC), NATIONAL FIRE PROTECTION ASSOCIATION (NFPA), INTERNATIONAL RESIDENTIAL CODE (IRC), THE NATIONAL ELECTRIC CODE (NEC) AND INTERNATIONAL BUILDING CODE (IBC).



PROPOSED DEVELOPMENT PROGRAM		
Area Calculations. Please complete for each affected lot or parcel.		
	sq. ft	sq. ft
Gross Site Area	23054	23054
Land within road easements and rights-of-way	0	0
Land within existing vehicular access easements	0	0
Land between levees or banks of rivers and streams	0	0
Lakes or ponds > 1 acre	0	0
Land previously committed as open space in accordance with these or prior LDRs	0	0
50% of lands with slopes greater than 25%	0	0
Calculated Totals:	0	0
	Base Site Area (sq. ft)	Adjusted Site Area (sq. ft)
	23054	23054

Development Calculations. Please complete for each structure or use.				
	LDR Standard	Existing	Proposed	Gross
Number of units or density	1 Unit/Lot	N/A - Demo	1 Unit/Lot	N/A
Floor area, sq. ft (by use if applicable)	0.4 x 22870	N/A - Demo	6358	N/A
FAR or maximum floor area	9222	N/A - Demo	6358	N/A
Site Development, sq. ft	9221.6	N/A - Demo	6300	N/A
Landscape Surface Ratio	0.60	N/A - Demo	0.73	N/A
Setbacks				
Front or street yard, ft	25	N/A - Demo	25	N/A
Rear yard, ft	25	N/A - Demo	25	N/A
Side yard, ft	15	N/A - Demo	15	N/A
Side yard, ft	15	N/A - Demo	15	N/A
Height, ridge to nearest finish grade (ft)	30' for > 6/12 roof	N/A - Demo	28	N/A

PROPOSED DEVELOPMENT PROGRAM		
Area Calculations. Please complete for each affected lot or parcel.		
	sq. ft	sq. ft
Gross Site Area	23054	23054
Land within road easements and rights-of-way	0	0
Land within existing vehicular access easements	0	0
Land between levees or banks of rivers and streams	0	0
Lakes or ponds > 1 acre	0	0
Land previously committed as open space in accordance with these or prior LDRs	0	0
50% of lands with slopes greater than 25%	0	0
Calculated Totals:	0	0
	Base Site Area (sq. ft)	Adjusted Site Area (sq. ft)
	23054	23054

Development Calculations. Please complete for each structure or use.				
	LDR Standard	Existing	Proposed	Gross
Number of units or density	1 Unit/Lot	N/A - Demo	1 Unit/Lot	N/A
Floor area, sq. ft (by use if applicable)	0.4 x 23052	N/A - Demo	6358	N/A
FAR or maximum floor area	9222	N/A - Demo	6358	N/A
Site Development, sq. ft	9221.6	N/A - Demo	8950	N/A
Landscape Surface Ratio	0.60	N/A - Demo	0.61	N/A
Setbacks				
Front or street yard, ft	25	N/A - Demo	25	N/A
Rear yard, ft	25	N/A - Demo	25	N/A
Side yard, ft	15	N/A - Demo	15	N/A
Side yard, ft	15	N/A - Demo	15	N/A
Height, ridge to nearest finish grade (ft)	30' for > 6/12 roof	N/A - Demo	28	N/A

DEVELOPMENT PLAN

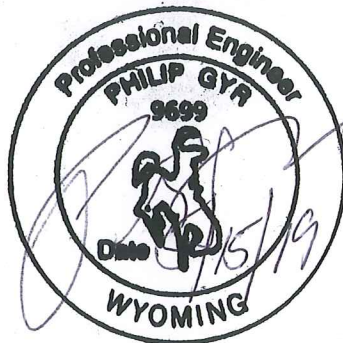
APPLICANT: JOSH KILPATRICK (NELSON ENGINEERING)  
PHONE: 307-733-2087  
EMAIL: JKILPATRICK@NELSONENGINEERING.NET



**GEOTECHNICAL INVESTIGATION**  
**540 CACHE CREEK DRIVE**  
**LOT 6, BLOCK 7, HALL 2 SUBDIVISION**  
**JACKSON, WYOMING**

PREPARED  
FOR  
**NEW WEST BUILDING COMPANY**  
JACKSON, WYOMING

PREPARED  
BY  
**NELSON ENGINEERING**  
JACKSON, WYOMING



MAY, 2019  
Project No. 19-046-02

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## **GENERAL AND PROJECT DESCRIPTION**

This is the report of a geotechnical investigation for a residential development at Lot 6, Block 7 of the Hall 2 Subdivision in Jackson, Wyoming. Plans are to split the 1.1-acre lot, demolish the existing residence and construct two new homes. Geotechnical recommendations herein are based on schematic level designs for a residence on the south lot and typical requirements for residences in Jackson. Topography and site features were derived from a survey completed by Nelson Engineering.

### **Scope of Services**

The scope of services for this investigation was to provide geotechnical recommendations based on a subsurface investigation and soils laboratory testing for the proposed residential development. The purpose of the subsurface investigation was to determine soil and groundwater characteristics. The results of the subsurface investigation and subsequent laboratory testing were utilized in engineering analysis for recommendations pertaining to structural foundations, drive and parking areas, retaining walls, and general earthwork. It is our engineering judgment that the existing and proposed slope geometry and composition indicate stability therefore slope stability analyses were not conducted. Specific recommendations for drainage and surface water conveyance are not within the scope of work.

Foundation analysis and resulting recommendations are based on typical loads for the type of structure(s) proposed. Prior to finalization of project plans, foundation plans and loads should be sent to this office for review to ensure compliance with this report. Recommendations assume foundation elements are not subjected to unusual loading conditions such as eccentric loads or vibratory equipment. Lateral earth pressure recommendations contained herein are general in nature; it is critical that retaining wall designs are reviewed by the geotechnical engineer.

## **SITE CONDITIONS**

### **Description**

540 Cache Creek Drive is a 1.1-acre lot in the town of Jackson located at the base of Snow King Mountain. A home and garage are located centrally in the lot. Topography The lot is bounded by developed residential lots to the north, south, east, and west. Cache Creek Drive abuts to the north and Snow King Drive to the south; both provide access to the property. Topography slopes from south to north with about 35 feet of relief. Cuts and fills created a flat area around the home, the constructed slopes of are 20-25%. Surface water channels are not present on the lot or in the near vicinity.

### **Geologic and Soil Mapping**

The area's surface geology is mapped on the USGS "Geologic Map of the Cache Creek Quadrangle, Teton County, Wyoming," J.D. Love and C.M. Love, 2000. Mapped deposits are described as "Ql – Loess – Silt, light-gray, structureless, homogenous; deposited by wind."

The USDA-NRCS Web-based Soil Survey of Teton County has mapped the Starman-Owlcan association within the property. Starman-Owlcan soils are alluvial and/or residuum located on 30 to 70 percent slopes. The soil is described as very deep, well drained, and composed

of very stony loam, very cobbly loam, loam, clay loam, channery clay loam, very channery clay loam, very stony clay loam and unweathered bedrock.

### **Seismic Hazard**

Jackson Hole is located within the Intermountain Seismic Belt, a zone extending from southern Utah through eastern Idaho and western Montana, and encompassing western Wyoming and the Teton Range as referenced by Smith, Robert B., and Walter J. Arabasz in "Seismicity of the Intermountain seismic belt, Neotectonics of North America," 1991. The USGS Earthquake Hazards Program has mapped Quaternary faults and folds in the United States as displayed on Google Earth with the following active faults near the site: the Teton Fault, the Phillips Valley Fault, and secondary faults within the Jackson Hole Valley. In particular, the Teton Fault is thought to be capable of producing major earthquakes of a magnitude of six or greater. The portion of the Teton Fault mapped as active in the Quaternary is approximately 8.0 miles northwest of the site. The USGS "Geologic Map of the Cache Creek Quadrangle, Teton County, Wyoming," J.D. Love and C.M. Love, 2000, shows the postulated trace of the Cache Creek Thrust Fault a half mile north of the site and the Jackson Thrust Fault three-fourths of a mile south of the site. Both faults are not classified by the USGS as active faults. Multiple minor earthquakes with epicenters near the site have occurred in recent years (USGS Earthquake Database).

## **SITE INVESTIGATIONS**

### **Field Investigations**

On April 25, 2019, seven test pits, TP-1 through TP-7, were excavated within and near the proposed footprints as shown in the Appendix on the **Test Pit Location Map**. Test pits were located using a Leica Zeno 20 GPS unit. Test pit locations and depths were selected to determine subsurface conditions applicable to the proposed developments. Test pits were backfilled with excavated material after logging was completed.

Fish Creek Excavation of Jackson, Wyoming, excavated the test pits with a Hitachi ZAXIS 160LC track hoe. Andy Pruett and Morgan Barry, Professional Geologists at Nelson Engineering, logged the test pits and directed the sampling. Soils were classified in the field and logged by the geologist. The soil classifications, moisture conditions, and presence of organic or other notable features were recorded in the field logs. Bulk samples were sealed in plastic bags and transported to our laboratory for testing and further classification. Relatively undisturbed samples of lean clay were obtained in cylindrical stainless-steel liners for consolidation testing. Groundwater observations were made at the time of the excavation based on field observations of soil moisture conditions. Field observations are presented on the test pit logs in the Appendix.

The stratification lines shown on the test pit logs represent the approximate boundary between soil types. The actual in-situ transition may be either gradual or abrupt. Due to the nature and depositional characteristics of natural soils and fills, care should be taken in interpolating subsurface conditions beyond the location of the test pits. Soil conditions can change rapidly in both the lateral and vertical directions. Groundwater conditions shown on the logs are only for the dates indicated.

The subsurface conditions were interpreted from the described test pits at the site. The soil properties inferred from the field assessments supported by our experience formed the basis for developing our conclusions and recommendations.



## **Laboratory Investigations**

Samples obtained during the field investigation were taken to the laboratory where they were visually classified in accordance with ASTM Test Method D-2487-93, which is based on the Unified Soils Classification System. Representative samples were selected for testing to determine the physical properties of the in-place soils and to estimate engineering properties. Engineering properties of concern at this location included bearing capacity, seismic response, drainage characteristics, and site-specific construction recommendations that are influenced by soil type and condition.

Laboratory testing was conducted to provide additional information to determine the suitability of the soils for use as foundation and subgrade materials and to verify field observations and classification estimates. The finalized laboratory observations were used to estimate soil strength and compressibility characteristics for bearing capacity determinations. Specific tests included Atterberg Limits Tests - ASTM Designation D4318, Grain Size Analysis - ASTM Designation C117 & C136, Soil Moisture Content Determinations - ASTM Designation D2226, and Soil Classification - ASTM Designation D2487. Consolidation testing per ASTM D2435 was performed on a relatively undisturbed sample of clay soil was obtained in cylindrical stainless-steel liner.

The soil samples stored in our laboratory will be discarded after 30 days from the date this report is submitted unless we receive a specific request to retain them.

## **SUBSURFACE CONDITIONS**

### **Soil Profiles**

#### *South Lot*

Similar soil profiles were observed in consisting of colluvium and lean clay strata. Surficial soils consisted of varying depths (1.75 to 4.0 feet) of moist to dry, dark brown, silt topsoil with minor to moderate roots. Topsoil had a stiff consistency with pocket penetrometer readings of 1.0 to 2.0 tons per square foot (TSF). In TP-1, TP-3 and TP-4 colluvium lay beneath the surficial soils to depths of 16, 14, and 11.5 feet respectively. Colluvium was composed of dense, dry to saturated, light brown to gray silty gravel with sand, cobbles and boulders. Groundwater was observed seeping into TP-1 at 14.7', TP-2 at 9.75', TP-3 at 13.0', TP-4 at 5.75' and gravels were saturated below these depths. Colluvium extended to 16.0 feet, the full depth of TP-1. Below the colluvium to full pit depths of 15 feet (TP-3) and 18 feet (TP-4) were moist brown soft to stiff, lean clay. In TP-3 lean clays contained occasional gravels and showed moderate oxidation staining. In TP-2, colluvium extended to the full depth of 16 feet with a layer of moist to wet, medium stiff, light brown to gray, gravelly silty clay at 9-11 feet. Saturated colluvium continued from 11 feet to the final test pit depth of 16.0 feet. Minor to moderate caving of test pit walls occurred TP-1, TP-2 and TP-3. IN TP-4, major caving of the uphill wall occurred below groundwater depth.

#### *North Lot*

Similar soil profiles were observed in TP-5 and TP-7. Placed undocumented fill was found in TP-5 and TP-7 to about 5.5-foot depth. Fill appeared to be a mixture of topsoil and colluvium excavated on site and consisted of moist to dry, medium dense to dense, dark brown, silty gravel with sand, cobbles and boulders. Beneath the fills to 8.0 feet (TP -5) and 7.0 feet (TP-7) was the original horizon of dry, stiff, dark brown top soil with a medium stiff

to stiff consistency with pocket penetrometer readings of 1.0 to 2.0 tons per square foot (TSF). Underlying the topsoil to depths of 13.5 to 17.0 feet in TP-5 and TP-7 was colluvium composed of dense, dry to moist, light brown to gray, silty gravel with sand, cobbles and boulders. Colluvium was found to full depth of 17.0 feet in TP-7. Underlying the colluvium in TP-5, from 8.0 to 13.5 feet, was dry, medium dense, light-brown, sandy silt with cobbles and gravel. Underlying this layer to the final test pit depth of 17.0 feet in TP-5 was colluvium as described above.

In TP-6 surficial soils to 2 feet were moist, medium stiff to stiff, dark brown silt topsoil. Beneath the topsoil to 4 feet was moist, stiff to very stiff, light-brown to gray, silt loess, with pocket penetrometer readings of 2.0 TSF throughout. Moderate pinhole voids were present. Underlying the loess and to the final test pit depth of 14.5 feet was dry to saturated colluvium also present in TP-5 and TP-7. Groundwater seepage occurred at about 10.5 feet. Moderate caving of test pit walls was observed in TP-6.

### **Groundwater**

Groundwater was observed seeping into TP-1 at 14.7', TP-2 at 9.75', TP-3 at 13.0', TP-4 at 5.75' and TP-6 at 10.5'. Clay strata beneath saturated colluvium did not appear to be saturated indicating a perched aquifer. Seasonal fluctuation or even disappearance of the aquifer is postulated with groundwater occurrence directly related to snowmelt on Snow King Mountain above the site. Snow melt was at or near peak levels at the time of the investigation. Groundwater was not encountered in TP-5 or TP-7. Monitoring wells were installed in TP-1, TP-4, TP-5 and TP-6 to allow for future groundwater monitoring if requested.

## **ENGINEERING ANALYSIS AND RECOMMENDATIONS**

### **General**

Schematic site and architectural plans for the south lot show a multi-level residence with full walk out basement with finished floor near existing grade is shown. Depth of footings below existing ground of 3 to 6 feet is anticipated. Plans were not available for the north lot at the time of this report. Items presented in this section emphasize concerns at depths at and below the anticipated bottom footing depths in soils influenced by foundation loading for the south lot. General recommendations are given for the north lot.

### **Seismic Design Parameters**

The 2015 International Building Code (IBC) designates site class per ASCE 7 Chapter 20. Data obtained in this investigation is not sufficient to determine soil parameters as required by ASCE 7; therefore, the IBC directs that seismic coefficients and design spectra shall be determined using **Site Class D** and Latitude of **43.282°** and Longitude of **-110.450°**.

### **Conventional Spread Footings**

Spread footings bearing on native soils composed of dense silty gravel with sand, cobbles and boulder colluvium are appropriate foundation elements. A net allowable bearing capacity of **2500 PSF** is appropriate for all footings. Where topsoil, fills, or clay soils are found at bottom of footing elevation, these soils shall be removed until competent dense colluvium is found. **ON THE NORTH LOT FILLS OF 5 OR MORE FOOT DEPTH AND A PREEXISTING TOPSOIL LAYER MUST BE REMOVED.** Estimated extents of fill are shown on the test pit location map. Existing subgrade shall be compacted to a depth of 8 inches to 95% of maximum density per ASTM D698 (Standard Proctor) beneath all footing and fills

below footings. Where structural fill is required to achieve footing grade, fill shall extend a minimum of 1 foot beyond the footing perimeter. The net allowable soil pressure includes dead load plus maximum live load. The above analysis assumes a **maximum width of 6 feet** for continuous footings and a **maximum dimension of 8 feet** for isolated footings. Construction of larger footing sizes may cause increased settlement. The net allowable soil pressure includes dead load plus maximum live load. These calculations assume a **minimum footing burial depth of 36 inches** and that a **maximum total settlement of 0.5 inches** be tolerated on any one footing and the **maximum differential settlement between footings that can be tolerated is 0.25 inches**.

Bearing capacity values and settlement shall be checked for each combination of load to determine whether settlement or bearing capacity will control the response of the footing. Foundation elements supporting large concentrated loads should be analyzed on an individual basis to determine settlement and bearing characteristics. Other foundation parameters are as noted below:

1. A one-third increase in allowable bearing capacity may be used for short duration loads such as wind or seismic.
2. Backfill against shallow foundations and stem walls shall conform to the **FOUNDATION BACKFILL DETAIL** drawing in the Appendix. In no case shall material greater than 6 inches in diameter bear directly on or against foundation elements. Placing oversized material against rigid surfaces can damage the structure and interferes with proper compaction.

Any soil type encountered at the bottom of footing excavations other than the ones described above should be analyzed by Nelson Engineering. Isolated boulders at footing grade should be excavated and removed unless approved by Nelson Engineering. Any excessively loose material or soft spots encountered in the footing subgrade will require over-excavation and backfilling with structural fill. All footings shall be suitably reinforced to make them as rigid as possible.

### **Lateral Earth Pressures**

For this analysis, it is assumed that all stem, basement, and retaining walls will be backfilled with compacted fill per the **FOUNDATION BACKFILL DETAIL** drawing in the Appendix.

Lateral loads may be resisted by friction between the footing base and supporting soil and lateral bearing pressure against the sides of the footings. Design parameters recommended are a **coefficient of friction of 0.45** at the footing base, **lateral passive bearing pressure of 350 psf per foot of depth**.

The Mononobe-Okabe (M-O) equations are often used to estimate dynamic forces against retaining walls. The M-O analysis is theoretically derived using active earth pressure conditions. Although there is debate about the theoretical applicability of this methodology to restrained or rigid walls, the method has been used for many years for the seismic design of such walls. The performance record of underground walls during earthquakes has generally been good. Appropriate parameters for the M-O analysis are: 1) soil unit weight of 135 pounds per cubic foot, and 2) Internal Friction Angle = 35°. The more limiting case, at-rest or active seismic pressure, shall be utilized in the structural design of restrained or rigid retaining walls. For foundation or stem walls restrained from movement

such that active earth pressures will not be allowed to develop, an at-rest equivalent fluid pressure of **65 PCF** is appropriate.

For foundation or stem walls with active earth pressure loading, an equivalent fluid pressure of **45 PCF** is appropriate.

### **Interior Slabs-On-Grade**

For interior slab areas, approximately 2 feet of surficial soils shall be removed in slab footprints. Interior slabs shall be founded upon the following section from top to bottom: 1) a leveling course mat 4 inches in thickness composed of a  $\frac{3}{4}$ -inch minus free draining material (WYDOT Grade GR or equivalent) compacted to a minimum of 95% of maximum density as determined by ASTM D 698, and 2) native cobble and gravel alluvium compacted 8 inches to a minimum of 95% density as determined by ASTM D 698. **Any excessively loose material or soft spots encountered in slab subgrades will require over-excavation and backfilling with structural fill.**

All fill material within 2 feet of the slabs must be compacted to a minimum 95% of the maximum density as determined by ASTM D698.

All slabs should be a **minimum of 4 inches thick**. A moisture retardant barrier can be placed beneath all floor slabs to minimize potential ground moisture effects on floor coverings and to minimize the potential for radon infiltration. Testing for the presence of radon has not been conducted at this location. If desired, placing ASTM C33 #57 aggregate for the granular mat beneath slabs can enhance radon remediation.

Concrete slab-on-grade control joints should be saw-cut as early as possible. Nelson Engineering recommends the use of a soft cut system, which allows saw cutting as soon as the concrete can support foot traffic. Successful crack control is dependent upon proper joint spacing. Control joints should be placed in accordance with current Portland Cement Concrete Paving Association guidelines.

### **Sidewalks and Exterior Slabs**

A minimum of 1 foot of surficial soils shall be removed in slab footprints. Sidewalks and exterior slabs shall be placed upon the following section: 1) a leveling course mat 4 inches in thickness composed of a  $\frac{3}{4}$ -inch minus free draining material (WYDOT Grade GR or equivalent) compacted to a minimum of 95% of maximum density as determined by ASTM D 698, 2) minimum 6 inches of structural fill, and 3) native subgrade soils compacted 8 inches to a minimum of 95% density as determined by ASTM D 698. Any fill required to increase the elevation of slabs should meet the requirements for granular structural fill. (Refer to the section on structural fill for requirements). All fill material within 2 feet of the slabs must be compacted to a minimum 95% of the maximum density as determined by ASTM D698.

### **Driveway and Parking Lot Recommendations**

For driveways and parking lots, the surface soils shall be excavated and removed. Recommended driveway and parking lot sections are given in the table below. Additional structural fill and geotextile placement coupled with overexcavation may be required for driveway construction and equipment access during wet conditions during and after snowmelt in the spring. Proper drainage is essential for satisfactory road and parking area performance.

PAVEMENT SECTION COMPONENTS	Paved	Gravel Surfaced
Asphaltic Concrete	2.0 inches	
$\frac{3}{4}$ inch Minus Crushed Aggregate	4.0 inches	6.0 inches
Structural Fill	14 inches	14 inches
Compacted Subgrade	8 inches of native alluvial soils compacted to 95% of max. as determined by ASTM D698.	

## CONSTRUCTION CONSIDERATIONS

### Earthwork and Site Grading

Excavation work and heavy equipment access will be difficult when surficial soils are wet, additional structural fill and geotextile placement coupled with overexcavation may be required for driveway construction and equipment access during wet conditions. A protracted period of wet conditions can be expected during and after seasonal snowmelt. General recommendations for earthwork suitability, placement, and compaction procedures are provided below:

- Within the building footprints and areas to be paved, all organic material, deleterious undocumented fill, and debris should be stripped and removed. Loose and disturbed native soils should be scarified, moisture-conditioned, and compacted. Finish surfaces shall be sloped away from foundations.
- Fill materials shall not be placed, spread, or compacted while the ground is frozen or during unfavorable weather conditions. Fill materials should be at the proper moisture content prior to compaction and should contain **no frozen soil**.
- Ponding of water and water infiltration due to snowmelt and rainfall into footing subgrades shall be prevented. Moisture infiltration and subsequent freezing of soils shall be prevented. Frost heave and excessive settlement may result from moisture infiltration.
- **Structural Fill** shall consist of imported or site gravels (USCS classification GW or GP) with the following characteristics: 6-inch maximum particle size with no more than 40% oversize (greater than  $\frac{3}{4}$ " ) and no more than 5% fines passing the #200 sieve.

Structural fill shall be placed in layers of **not more than 8 inches in thickness**. Each layer of structural fill should be moisture conditioned to within 2% of optimum moisture content and compacted to a minimum density of 95% of the maximum dry density as determined by ASTM Designation D 698. The maximum density of material containing more than 30% oversize (greater than  $\frac{3}{4}$ " diameter) cannot be determined by use of the ASTM Designation D 698. In this case, a field maximum density may be determined by a test strip method. The material shall be compacted at or near optimum moisture content and a field density test shall be taken after each pass of the compaction equipment. This sequence shall continue until the maximum field density is achieved. This maximum field density shall be used for subsequent



field compaction tests. Enough density tests should be taken to monitor proper compaction.

- Safety of construction personnel including safe trenches and excavations are the responsibility of the contractor. Excavations for foundations shall conform to **all** applicable OSHA and Wyoming safety standards. Excavations and utility trenches shall be laid back to safe slopes or properly shored. Excavations and shoring operations shall be conducted in accordance with the most recent versions of the OSHA Construction Standards for Excavations, Part 1926, Subpart P and Wyoming Public Works Standard Specifications. Excavations for utilities shall be shored if the proper slope cannot be maintained.
- During earthwork phases of the project, a representative of Nelson Engineering shall be present to observe exposed native soils and fill materials for suitability and consistency. A documented testing program should be conducted to determine that soil compaction is in accordance with requirements.
- Backfill placed against structures (i.e., pipes and walls) shall be properly placed in a manner that will not damage these structures. In no case shall material greater than 6 inches in diameter bear directly on or against these structures. Placing oversized material against rigid surfaces can damage the structure and interferes with proper compaction.

## **GENERAL COMMENTS**

The structural engineer and other project designers shall review this report. When project plans and specifications are complete, a consultation with this office should be arranged to ensure compliance with this report. Additional or supplementary recommendations with regards to foundations and earthwork may be required at this time. Monitoring and testing shall be performed to verify that suitable materials are used for structural fills and backfills, and that fills are properly placed and compacted. Concrete testing and special inspection shall be performed prior to and during placement of all concrete to ensure concrete and reinforcing steel bar comply with project plans and specifications.

## **WARRANTY AND LIMITING CONDITIONS**

The field observations and research reported herein are considered sufficient in detail and scope to form a reasonable basis for the purposes cited above. Nelson Engineering warrants that the findings and conclusions contained herein have been promulgated in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology, only for the site described in this report. No other warranties are implied or expressed.

These engineering methods have been developed to provide the client with information regarding apparent or potential engineering conditions relating to the subject property within the scope cited above and are limited to the conditions observed at the time of the site visit and research. There is a distinct possibility that conditions may exist which could not be identified within the scope of the investigation or which were not apparent during the site investigation. The report is also limited to the information available at the time it was prepared. In the event additional information is provided to Nelson Engineering

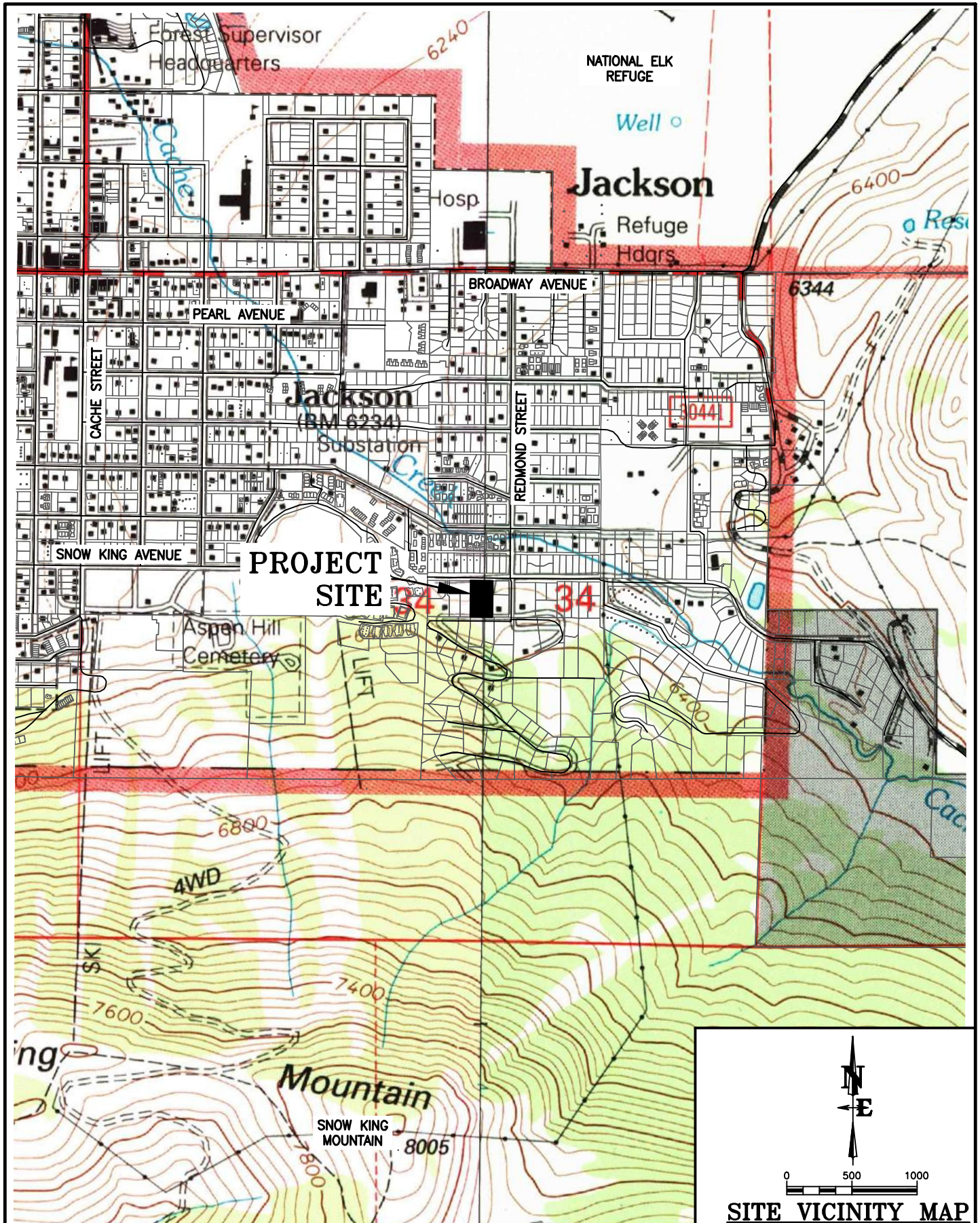
following this report, it will be forwarded to the client in the form received for evaluation by the client. This report was prepared for use by New West Building Company in Jackson, Wyoming ("Client") and the conclusions and recommendations presented in this report are based on the agreed-upon scope of work outlined in the report and the contract for professional services between Client and Nelson Engineering ("Consultant"). Use or misuse of this report, or reliance upon the findings hereof by any parties other than the Client, is at their own risk. Neither the Client nor Consultant may make any representation of warranty to such other parties as to the accuracy or completeness of this report or the suitability of its use by such other parties for any purpose whatsoever, known or unknown, to the Client or Consultant. Neither New West Building Company nor Nelson Engineering shall have any liability to, or indemnifies or holds harmless third parties for any losses incurred, by the actual or purported use or misuse of this report. No other warranties are implied or expressed.

Philip Gyr, PE  
Geotechnical Engineer

# APPENDIX

# DRAWINGS





DRAWING NO  
1

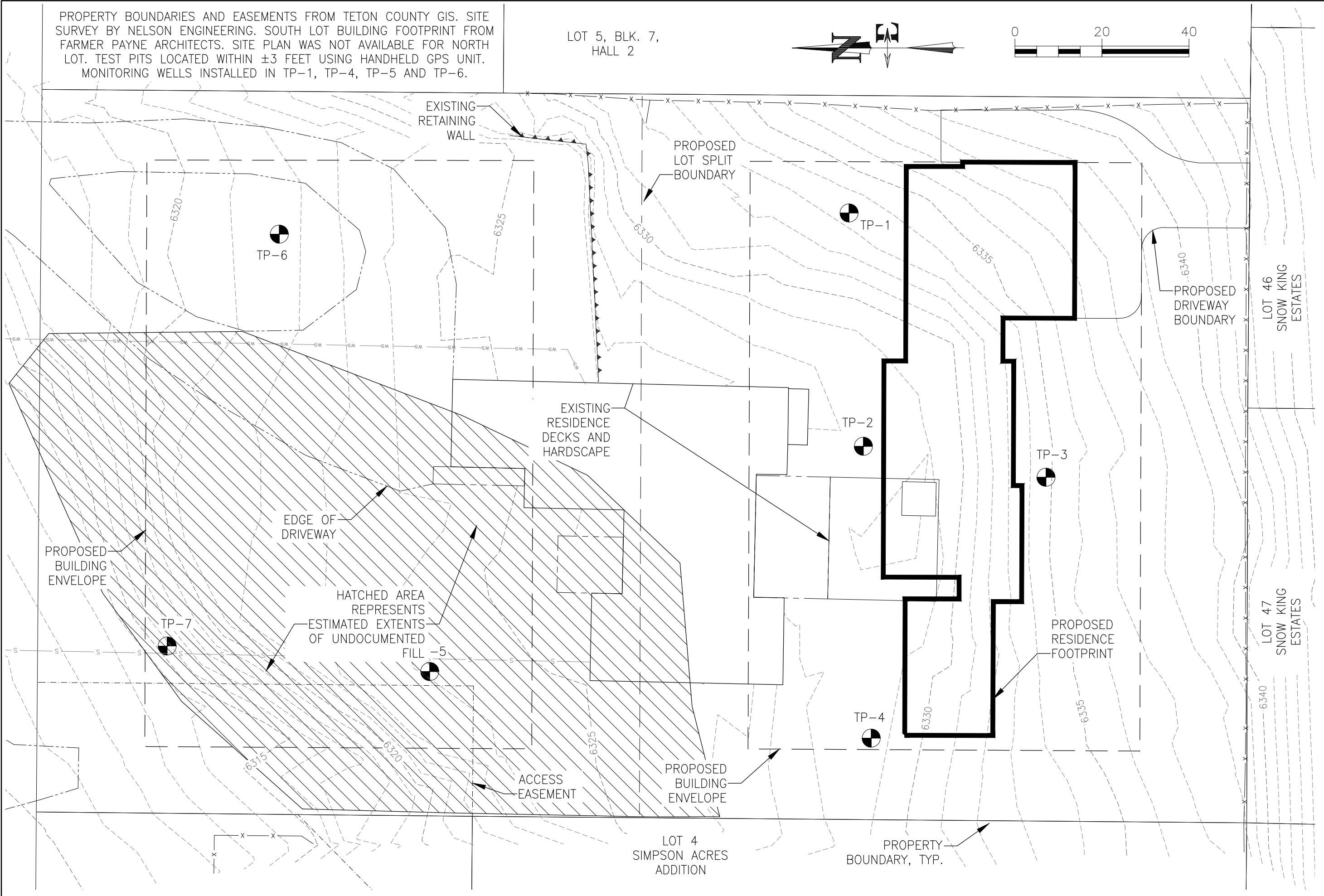
JOB NO  
19-046-02

TITLE  
LOT 6 JOHN D HALL  
540 CACHE CREEK DRIVE  
GEOTECHNICAL INVESTIGATION

**NELSON  
ENGINEERING**  
P.O. BOX 1599, JACKSON WYOMING (307) 733-2087

DATE	5/7/2019	REV.
SURVEYED	-	
DRAWN	MB	
CHECKED	AP	
APPROVED	PG	





DRAWING NO	JOB TITLE	DRAWING TITLE	REV.				
			DATE	SURVEYED	ENGINEERED	DRAWN	CHECKED
2	LOT 6 BLOCK 7 JOHN D. HALL 2 540 CACHE CREEK DRIVE GEOTECHNICAL INVESTIGATION	TEST PIT LOCATION MAP	5/9/2019	NE	AP	MB	PG
19-046-02							

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ENGINEERING**  
P.O. BOX 1599, JACKSON WYOMING (307) 733-2087

**NOTE:**

WALL BACKFILL BENEATH EXTERNAL SLABS AND HARDSCAPE SHALL BE STRUCTURAL FILL TO MAKE GRADE BELOW LANDSCAPE SECTION

PLACE TOPSOIL ON MIN 12" THICKNESS CLAY/SILT SOILS COMPACTED TO 95% OF MAX. (SEE HARDSCAPE NOTE ABOVE)

STEM OR RETAINING WALL AND FOOTING (BY OTHERS)

MINIMUM 5% SLOPE FOR 10'

MIRAFI G100N DRAIN BOARD OR APPROVED EQUIVALENT

STRUCTURAL FILL

EXCAVATION FACE PER OSHA REGS

COMPACTED SUBGRADE

ADS 4" SINGLE WALL PERF. PIPE WITH SOCK WRAP OR 10" EZFLOW BUNDLE. CLEAR OF FOOTING DRAIN TO DAYLIGHT USING SOLID PIPE AT MINIMUM 2% GRADE

TYPICAL RETAINING/STEM WALL SECTION  
NOT TO SCALE

TOPSOIL

PERF PIPE, 5' AT END

COVER PIPE OUTLET WITH 3"-6" COBBLE ROCK MIN. 1.5' THICKNESS TO PREVENT RODENT ENTRY

SOLID PIPE MIN SLOPE 3% FROM FOUNDATION

TYPICAL DRAIN OUTLET  
NTS

TRENCH AND BURY SOLID DRAIN PIPE PER WY PUBLIC WORKS SPECIFICATIONS

10"-12" ROCK SPLASH PAD

NATIVE SOILS

DRAWING NO  
3

TITLE  
540 CACHE GEOTECHNICAL  
DRAIN AND  
FOUNDATION BACKFILL TYPICAL

JOB NO  
19-046-01

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ENGINEERING**

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DATE  
SURVEYED  
DRAWN  
CHECKED  
APPROVED

N/A  
PG  
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REV.  
5/15/19

# TEST PIT LOGS

## GEOTECHNICAL GENERAL NOTES

**CORRECTED SPT:** Standard Penetration Test values corrected to  $N_{160}$  correcting for theoretical free-fall hammer energy and overburden pressure per 7th edition of the AASHTO Bridge Design Specifications.

### DRILLING, SAMPLING, AND SOIL PROPERTIES ABBREVIATIONS AND SYMBOLS

**N:** Standard Penetration Test

**$U_c$ :** Unconfined compressive strength, Pounds/ft<sup>2</sup> (PSF)

**Pp:** Pocket Penetrometer values, Ton/ft<sup>2</sup> (TSF)

**FILGC:** Fragments indicate gravels and cobbles larger than split spoon diameter.

**w:** Water content, %

**LL:** Liquid limit, %

**PI:** Plasticity index, %

**gd:** In-situ dry density, lbs/ft<sup>3</sup> (PCF)

: Ground water level

**SS:** Split-Spoon Sample

**ST:** Shelby Tube Sampler

**CS:** Cylindrical Brass Lined Sample



Monitoring Well, diagonal hatching indicates screen and sand packed interval

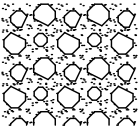
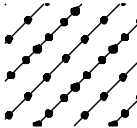
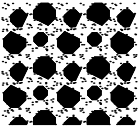
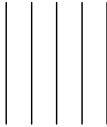
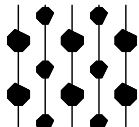
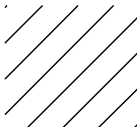
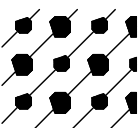
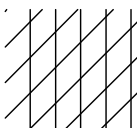
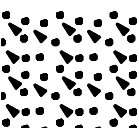

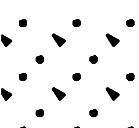
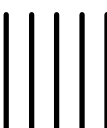
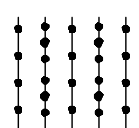

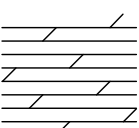
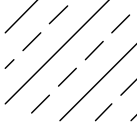
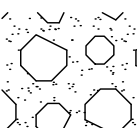
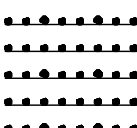
### SOIL RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

Non-Cohesive Soils		SPT	Cohesive Soils		Pp-(tons/ft <sup>2</sup> )
Very Loose		0 - 4	Very Soft		0 - 0.25
Loose		4 - 10	Soft		0.25 - 0.50
Slightly Compact		8 - 15	Medium Stiff		0.50 - 1.00
Medium Dense		10 - 30	Stiff		1.00 - 2.00
Dense		30 - 50	Very Stiff		2.00 - 4.00
Very Dense		50+	Hard		4.00+

### PARTICLE SIZE

<b>Boulders:</b>	12 in.+	<b>Coarse Sand:</b>	5 mm(#4)-2 mm(#10)	<b>Silts and Clays:</b>  <b>&lt;#200</b>
<b>Cobbles:</b>	12 in.-3in.	<b>Medium Sand:</b>	2 mm(#10)-0.4mm(#40)	
<b>Gravel:</b>	3in.-5mm(#4)	<b>Fine Sand:</b>	0.4mm(#40)-0.075mm(#200)	

# SOIL GRAPHICS

<i>GW</i>		<i>SC</i>	
<i>GP</i>		<i>ML</i>	
<i>GM</i>		<i>CL</i>	
<i>GC</i>		<i>ML-CL</i>	
<i>SW</i>		<i>OL</i>	
<i>SP</i>		<i>MH</i>	
<i>SM</i>		<i>CH</i>	
<i>BEDROCK</i>		<i>OH</i>	
<i>COBBLES/BOULDERS</i>		<i>PT</i>	

NOTE: ANGLED DEMARCATIONS ON THE LOGS INDICATE APPROXIMATE OR POORLY DEFINED BOUNDARIES BETWEEN SOIL TYPES.



PROJECT NAME: <b>540 CACHE CREEK DRIVE</b>					TEST PIT No. <b>1</b>		PAGE: <b>1</b>	
DATE STARTED / FINISHED: <b>04/25/19</b>					OPERATOR: <b>FISH CREEK EXCAVATION</b>			
LOGGED BY: <b>PRUETT/BARRY</b>					EXCAVATOR TYPE: <b>HITACHI ZAXIS 160LC TRACK HOE</b>			
BOREHOLE LOCATION/ELEVATION: <b>SEE TEST PIT LOCATION MAP</b>								

WELL LOG	GRAPHICS LOG	DEPTH (FT)	SAMPLES		SAMPLE ID	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY (PCF)	MOISTURE (%)	REMARKS
			UNDISTURBED	BULK							
		1				0'-1.75' MOIST, STIFF, DK BROWN, SILT TOPSOIL, MINOR ROOTS					IN LAWN NORTHEAST PART OF SOUTHERN LOT
		2				1.75'-16.0' MOIST, DENSE, LIGHT-BROWN TO GRAY, SILTY GRAVEL WITH SAND, COBBLES AND BOULDERS UP TO 18" MAXIMUM DIMENSION, COLLUVIUM COMPOSED OF ANGULAR MADISON LIMESTONE GRAVELS, AND COBBLES, ~40% SANDY SILT MATRIX, ~60% GRAVELS, COBBLES AND BOULDERS					MODERATE DIGGING FROM 0-16'
		3									
		4									
		5									
		6									
		7									
		8									
		9									
		10									
		11									
		12									
		13									
		14									
		15									
		16				GROUNDWATER ENCOUNTERED AT 14.7'					MINOR TO MODERATE CAVING OF TP WALLS
						SOIL SAME AS ABOVE, SATURATED					
						BOP=16.0'					
		17				MONITORING WELL INSTALLED					
		18				LOP=18.0' 1.5" DIAMETER PVC					
		19				SLOTS EVERY 6" FROM 5.7'-15.7'					
		20				STICKUP=2.3'					

<p><b>NELSON ENGINEERING</b> P.O. BOX 1599, JACKSON WYOMING (307) 733-2087</p>	CLIENT: <b>NEW WEST BUILDERS JACKSON, WYOMING</b>	JOB NO.  <b>19-046-02</b>
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PROJECT NAME: 540 CACHE CREEK DRIVE						TEST PIT No. 2				PAGE:	1
DATE STARTED / FINISHED: 04/25/19						OPERATOR: FISH CREEK EXCAVATION					
LOGGED BY: PRUETT/BARRY						EXCAVATOR TYPE: HITACHI ZAXIS 160LC TRACK HOE					
BOREHOLE LOCATION/ELEVATION: SEE TEST PIT LOCATION MAP											
WELL LOG	GRAPHICS LOG	DEPTH (FT)	SAMPLES		SAMPLE ID	This log is part of a report prepared by Nelson Engineering for this project and should be read with the report. This summary applies only at the location of the test pit and at the time of the excavation. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is a simplification of actual conditions encountered.	LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY (pcf)	MOISTURE (%)	REMARKS
			UNDISTURBED	BULK		MATERIAL DESCRIPTION					
<div style="position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%); font-size: small;">TP2-1 9'-10'</div> <div style="position: absolute; bottom: 10%; left: 10%;">BOP=16.0'</div>		0'-4.0' MOIST, STIFF, DK BROWN, GRAVELLY SILT TOPSOIL, MINOR SHRUB ROOTS, PP=1.0-2.0 TSF THROUGHOUT						GRASSY LAWN ON THE NORTH PORTION OF THE SOUTH LOT  18" BOULDER AT 1.5'			
		4.0'-9.0' MOIST, DENSE, LIGHT-BROWN TO GRAY, SILTY GRAVEL WITH SAND, COBBLES AND BOULDERS UP TO 18" MAXIMUM DIMENSION, COLLUVIUM COMPOSED OF ANGULAR MADISON LIMESTONE GRAVELS, AND COBBLES, ~40% SANDY SILT MATRIX, ~60% GRAVELS, COBBLES AND BOULDERS						MODERATE DIGGING THROUGH COLLUVIUM			
		9.0'-11.0' MOIST, MEDIUM STIFF, LIGHT-BROWN TO GRAY, GRAVELLY SILTY CLAY, PP=0.5-1.0 TSF THROUGHOUT, NO PINHOLE VOIDS GROUNDWATER SEEPING INTO TP AT 9.75'  GROUNDWATER POOLING AT 11.0'									
		11.0'-16.0' SATURATED, DENSE, LIGHT-BROWN TO GRAY, SILTY GRAVEL WITH SAND, COBBLES AND BOULDERS UP TO 18" MAXIMUM DIMENSION, ANGULAR MADISON LIMESTONE GRAVELS, AND COBBLES, ~40% SANDY SILT MATRIX, ~60% GRAVELS, COBBLES AND BOULDERS						MODERATE CAVING OF TP WALLS			

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CLIENT: NEW WEST BUILDERS  
JACKSON, WYOMING

JOB NO.  
  
19-046-02

PROJECT NAME: <b>540 CACHE CREEK DRIVE</b>	<b>TEST PIT No. 3</b>	PAGE: <b>1</b>
DATE STARTED / FINISHED: <b>04/25/19</b>	OPERATOR: <b>FISH CREEK EXCAVATION</b>	
LOGGED BY: <b>PRUETT/BARRY</b>	EXCAVATOR TYPE: <b>HITACHI ZAXIS 160LC TRACK HOE</b>	
BOREHOLE LOCATION/ELEVATION: <b>SEE TEST PIT LOCATION MAP</b>		

WELL LOG	GRAPHICS LOG	DEPTH (FT)	SAMPLES		SAMPLE ID	This log is part of a report prepared by Nelson Engineering for this project and should be read with the report. This summary applies only at the location of the test pit and at the time of the excavation. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is a simplification of actual conditions encountered.	LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY (PCF)	MOISTURE (%)	REMARKS
			UNDISTURBED	BULK							
						MATERIAL DESCRIPTION					
		1				0'-3.5' MOIST, STIFF, DK BROWN, SILT TOPSOIL, SHRUB ROOTS UP TO 1" IN DIAMETER, PP=1.0-2.0 TSF THROUGHOUT					SLOPING GRASSY LAWN ON THE SOUTH CENTRAL PORTION OF THE SOUTH LOT
		2									
		3				3.5'-14.0' DRY TO MOIST, DENSE, LIGHT-BROWN TO GRAY, SILTY GRAVEL WITH SAND, COBBLES AND BOULDERS UP TO 18" MAXIMUM DIMENSION, COLLUVIUM COMPOSED OF ANGULAR MADISON LIMESTONE GRAVELS, AND COBBLES, ~50% SANDY SILT MATRIX, ~50% GRAVELS, COBBLES AND BOULDERS					MODERATE DIGGING THROUGH COLLUVIUM
		4									
		5									
		6									
		7									
		8									
		9									
		10									
		11									
		12									
		13				GROUNDWATER SEEPING INTO TP AT 13.0'					MINOR CAVING OF TP WALLS
		14				SOILS SAME AS ABOVE, SATURATED FROM 13-14'					
		15				14.0'-15.0' MOIST, STIFF, LIGHT-BROWN CLAY WITH GRAVEL, MODERATE OXIDATION STAINING, PP=1.0-1.5 TSF THROUGHOUT, NO PINHOLE VOIDS					
		16				BOP=15.0'					
		17									
		18									
		19									
		20									

 P.O. BOX 1599, JACKSON WYOMING (307) 733-2087	CLIENT: <b>NEW WEST BUILDERS</b> <b>JACKSON, WYOMING</b>	JOB NO.
		<b>19-046-02</b>

PROJECT NAME: <b>540 CACHE CREEK DRIVE</b>					TEST PIT No. <b>4</b>		PAGE: <b>1</b>	
DATE STARTED / FINISHED: <b>04/25/19</b>					OPERATOR: <b>FISH CREEK EXCAVATION</b>			
LOGGED BY: <b>PRUETT/BARRY</b>					EXCAVATOR TYPE: <b>HITACHI ZAXIS 160LC TRACK HOE</b>			
BOREHOLE LOCATION/ELEVATION: <b>SEE TEST PIT LOCATION MAP</b>								

WELL LOG	GRAPHICS LOG	DEPTH (FT)	SAMPLES		SAMPLE ID	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY (PCF)	MOISTURE (%)	REMARKS
			UNDISTURBED	BULK							
		1				0'-2.0' MOIST, STIFF, DK BROWN, SILT TOPSOIL, SHRUB ROOTS UP TO 1" IN DIAMETER					LAWN, WEST PORTION OF THE SOUTH LOT
		2				2.0'-11.5' DRY TO WET, DENSE, LIGHT-BROWN TO GRAY, SILTY GRAVEL WITH SAND AND BOULDER UP TO 2.5' MAXIMUM DIMENSION, COLLUVIUM COMPOSED OF ANGULAR MADISON LIMESTONE/DOLOMITE GRAVELS AND COBBLES, ~40% COLLUVIUM, ~60% GRAVELS AND COBBLES					MODERATE DIGGING THROUGH COLLUVIUM
		3									
		4									
		5									
		6									
		7				GROUNDWATER SEEPING INTO TP AT 5.75'					BOULDERS UP TO 2.5'
		8				SAME AS ABOVE SATURATED BELOW 6'					GROUNDWATER POOLING BELOW 6.75'
		9									
		10									MAJOR CAVING OF UPHILL WALL BELOW GROUNDWATER
		11				11.5'-18.0' MOIST, SOFT TO MEDIUM STIFF, BROWN, LEAN CLAY, PP=0.5 TSF THROUGHOUT, NO PINHOLE VOIDS					
		12				USCS CLASSIFICATION-CL (LEAN CLAY)	26	18		24	EASY DIGGING FROM 11.5'-18'
		13									
		14									
		15									
		16									
		17									
		18				BOP=18.0'					
		19				MONITORING WELL INSTALLED					
		20				LOP=20.0' 1.5" DIAMETER PVC					
						SLOTS EVERY 6" FROM 4.0'-18.0'					
						STICKUP=2'					

<p><b>NELSON ENGINEERING</b> P.O. BOX 1599, JACKSON WYOMING (307) 733-2087</p>	CLIENT: <b>NEW WEST BUILDERS JACKSON, WYOMING</b>	JOB NO.  <b>19-046-02</b>
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PROJECT NAME: <b>540 CACHE CREEK DRIVE</b>					TEST PIT No. <b>5</b>		PAGE: <b>1</b>	
DATE STARTED / FINISHED: <b>04/25/19</b>					OPERATOR: <b>FISH CREEK EXCAVATION</b>			
LOGGED BY: <b>PRUETT/BARRY</b>					EXCAVATOR TYPE: <b>HITACHI ZAXIS 160LC TRACK HOE</b>			
BOREHOLE LOCATION/ELEVATION: <b>SEE TEST PIT LOCATION MAP</b>								

WELL LOG	GRAPHICS LOG	DEPTH (FT)	SAMPLES		SAMPLE ID	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY (PCF)	MOISTURE (%)	REMARKS	
			UNDISTURBED	BULK								
		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20				<p>0'-5.5' DRY TO MOIST, MEDIUM DENSE TO DENSE, DK BROWN, FILL COMPOSED OF SITE SOILS, SILTY GRAVEL WITH SAND, COBBLES AND BOULDERS, TOP SOIL AND COLLUVIUM MIX</p> <p>5.5'-8.0' DRY, STIFF, DK BROWN TOPSOIL, SILT, PP=1.0 TSF, FORMER GROUND SURFACE, PP=1.0-2.0 TSF THROUGHOUT</p> <p>8.0'-13.5' DRY, DENSE, LIGHT-BROWN TO GRAY, SILTY GRAVEL WITH SAND, COBBLES AND BOULDERS UP TO 18" MAXIMUM DIMENSION, COLLUVIUM COMPOSED OF ANGULAR MADISON LIMESTONE GRAVELS, AND COBBLES, ~40% SANDY SILT MATRIX, ~60% GRAVELS, COBBLES AND BOULDERS</p> <p>13.5'-16' DRY, MEDIUM DENSE, LIGHT-BROWN, SANDY SILT WITH COBBLES/GRAVEL</p> <p>16.0'-17.0' DRY, DENSE, LIGHT-BROWN TO GRAY, SILTY GRAVEL WITH SAND AND BOULDER UP TO 18" MAXIMUM DIMENSION, COLLUVIUM COMPOSED OF ANGULAR MADISON LIMESTONE/DOLOMITE GRAVELS AND COBBLES, ~40% COLLUVIUM, ~60% GRAVELS AND COBBLES</p> <p>BOP=17.0'</p> <p>GROUNDWATER NOT ENCOUNTERED</p> <p>MONITORING WELL INSTALLED</p> <p>LOP=20.0' 1.5" DIAMETER PVC</p> <p>SLOTS EVERY 6" FROM 7.0'-17.0'</p> <p>STICKUP=3'</p>						<p>SOUTHWEST PORTION OF THE NORTH LOT</p> <p>BOULDERS UP TO 2.5 FT</p> <p>VERY DENSE, HARD DIGGING AT 8'</p> <p>MODERATE CAVING OF TP WALL</p> <p>MODERATE DIGGING FROM 13.5'-16'</p> <p>VERY DENSE, HARD DIGGING AT 16'</p>

<p><b>NELSON ENGINEERING</b> P.O. BOX 1599, JACKSON WYOMING (307) 733-2087</p>	CLIENT: <b>NEW WEST BUILDERS JACKSON, WYOMING</b>	JOB NO.  <b>19-046-02</b>
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PROJECT NAME: <b>540 CACHE CREEK DRIVE</b>					TEST PIT No. <b>6</b>		PAGE: <b>1</b>	
DATE STARTED / FINISHED: <b>04/25/19</b>					OPERATOR: <b>FISH CREEK EXCAVATION</b>			
LOGGED BY: <b>PRUETT/BARRY</b>					EXCAVATOR TYPE: <b>HITACHI ZAXIS 160LC TRACK HOE</b>			
BOREHOLE LOCATION/ELEVATION: <b>SEE TEST PIT LOCATION MAP</b>								

WELL LOG	GRAPHICS LOG	DEPTH (FT)	SAMPLES		SAMPLE ID	MATERIAL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY (PCF)	MOISTURE (%)	REMARKS
			UNDISTURBED	BULK							
		1				0'-2.0' MOIST, MEDIUM STIFF TO STIFF, DK BROWN TOPSOIL, SILT, PP=1.0 TSF THROUGHOUT					EAST PORTION OF THE NORTH LOT
		2				2.0'-4.0' MOIST, STIFF TO VERY STIFF, LIGHT-BROWN TO GRAY, SILT LOESS, PP=2.0 TSF THROUGHOUT, MODERATE PINHOLE VOIDS					MODERATE DIGGING THROUGH COLLUVIUM
		3									
		4									BOULDERS UP TO 3' IN COLLUVIUM
		5									
		6									
		7									
		8				8.0'-13.5' DRY TO SATURATED, DENSE, LIGHT-BROWN TO GRAY, SILTY GRAVEL WITH SAND, COBBLES AND BOULDERS UP TO 3' MAXIMUM DIMENSION, COLLUVIUM COMPOSED OF ANGULAR MADISON LIMESTONE GRAVELS, AND COBBLES, ~40% SANDY SILT MATRIX, ~60% GRAVELS, COBBLES AND BOULDERS					VERY DENSE, HARD DIGGING AT 8'
		9									
		10				9.5' WET, CAVING OF TP WALL					
		11				GROUNDWATER SEEPING INTO TP AT 10.5'					
		12									
		13									
		14				BOP=14.5'					
		15									
		16									
		17									
		18									
		19				MONITORING WELL INSTALLED LOP=20.0' 1.5" DIAMETER PVC SLOTS EVERY 6" FROM 7.25'-17.25' STICKUP=2.75'					
		20									

<p><b>NELSON ENGINEERING</b> P.O. BOX 1599, JACKSON WYOMING (307) 733-2087</p>	CLIENT: <b>NEW WEST BUILDERS JACKSON, WYOMING</b>	JOB NO.  <b>19-046-02</b>
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[illegible]

# LABORATORY RESULTS

Sample ID **TP4-1**

Depth (ft) **12-13 ft**

### Unified Soils Classification

**Lean Clay (CL)**

Gravel	2%
Sand	8%
Fines	90%

Liquid Limit:	26
Plastic Limit:	18
Plasticity Index:	8

In-Situ Moisture Content	24.3%
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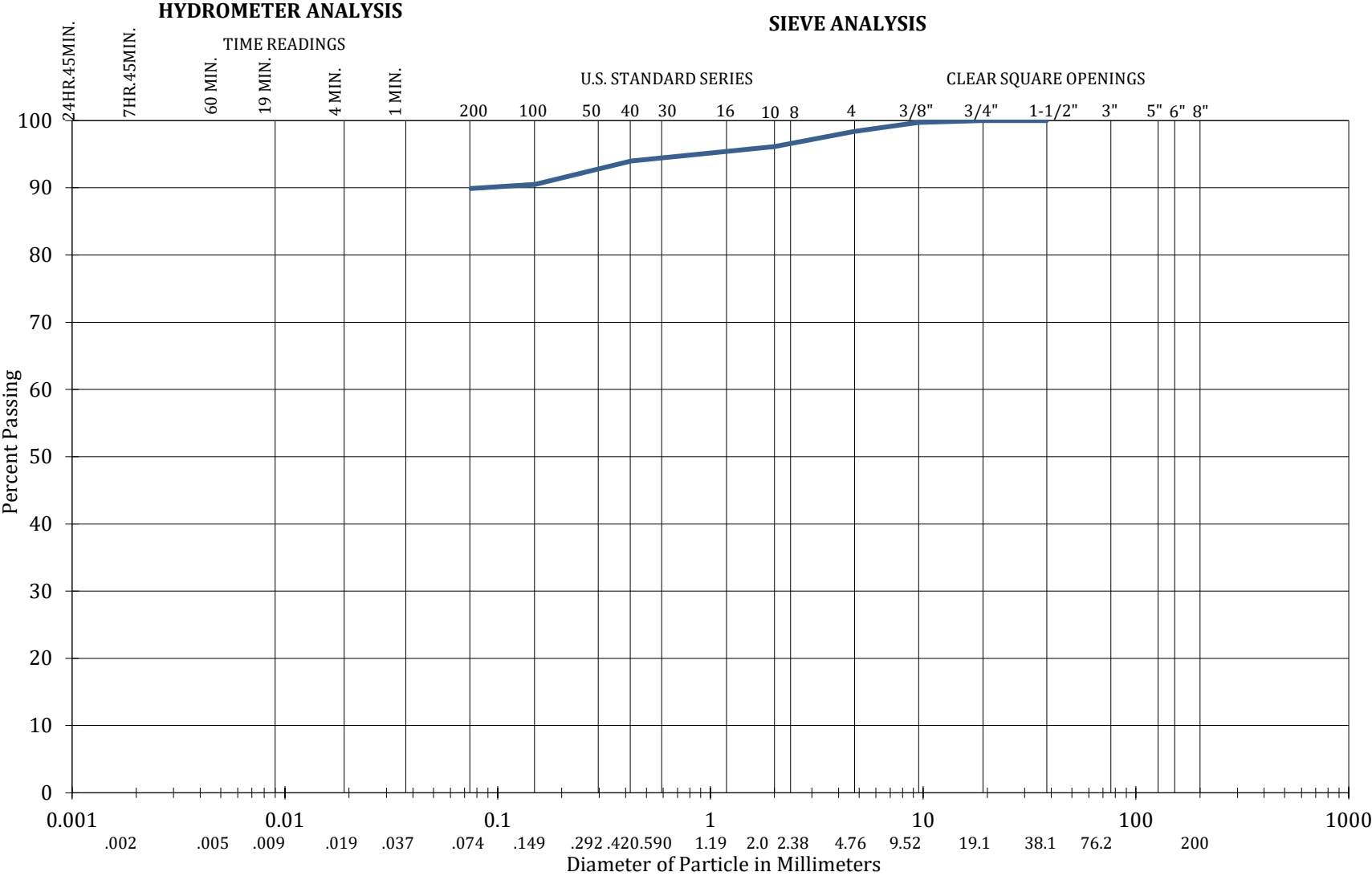
Standard Sieve No.	Particle Size (mm)	Tare Weight (g)	Sample + Tare (g)	Sample Weight (g)	Cumulative % Retained	Percent Passing
1.5"	38	312.4	312.4	0.0	0%	100%
1"	25	312.4	312.4	0.0	0%	100%
3/4"	18.75	312.4	312.4	0.0	0%	100%
3/8"	9.5	312.4	315.6	3.2	0%	100%
#4	4.75	312.4	327.2	14.8	2%	98%
#10	2.00	312.4	337.7	25.3	4%	96%
#40	0.425	312.4	336.5	24.1	6%	94%
#100	0.15	312.4	351.1	38.7	9%	91%
#200	0.075	312.4	319.3	6.9	10%	90%
Pan	0	312.4	1317.9	1005.5	100%	0%

**Total Weight of Sample (g) 1118.5**

Moisture Content	
Wet Wt + Tare (g)	1561.6
Dry Wt. + Tare (g)	1289.3
Wt of Water (g)	272.2
Tare Wt. (g)	170.9
Dry Wt. (g)	1118.5
Moisture Content	24.3%
Wash	
Wet Wt. + Tare (g)	1561.6
Pre Wash Dry (g)	1118.5
Post Wash Dry (g)	113.0
Tare Wt. (g)	0.0
Wt.Of Minus #200 =	1005.5

Project: 540 Cache Creek Drive  
Job Number: 19-046-02  
Visual ID: Silt with clay

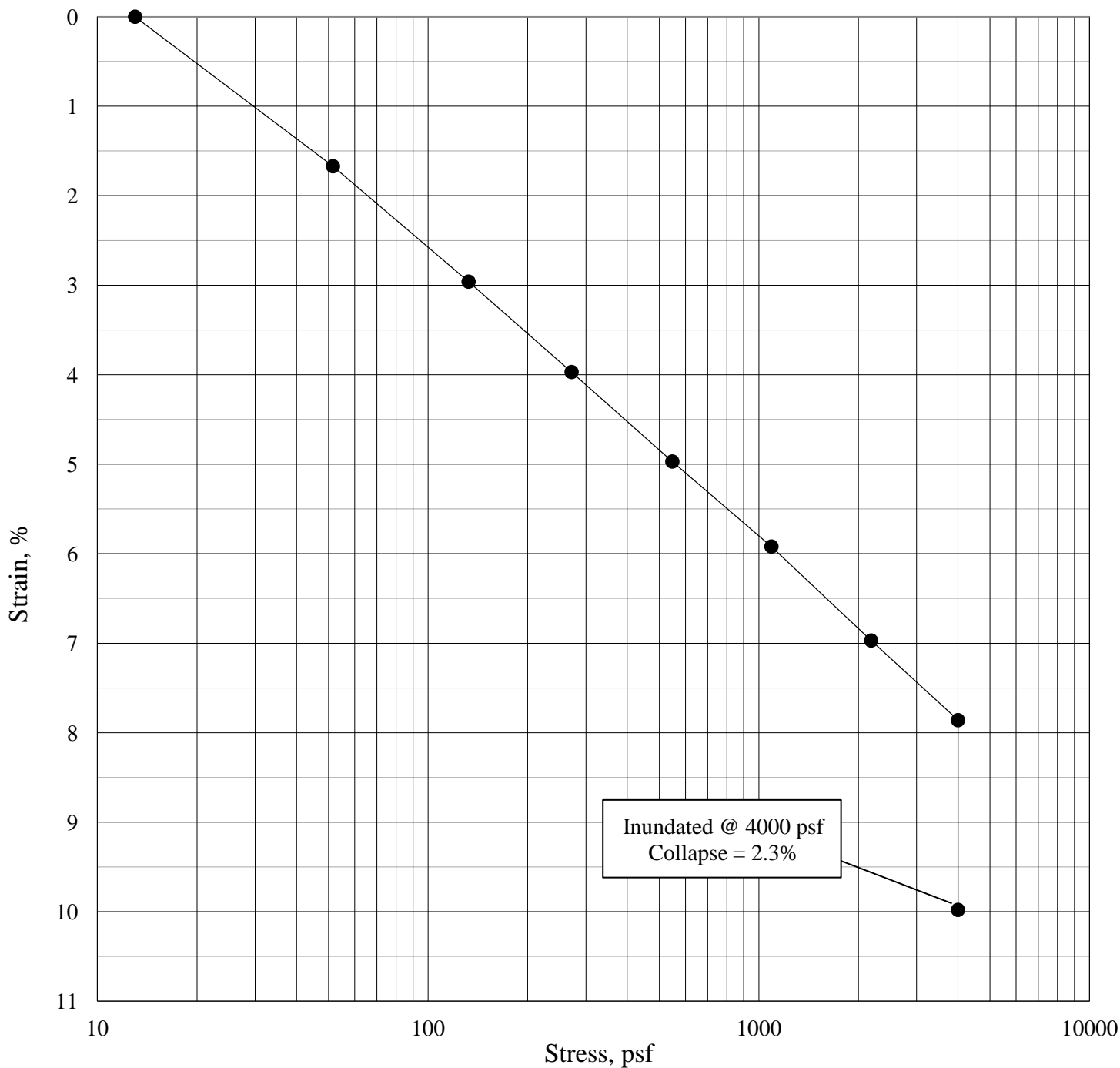
Sampled By: AP  
Date: 4/25/2019  
Tested By: JM  
Date: 4/29/2019



CLAY (plastic) TO SILT (non-plastic)	SAND			GRAVEL		COBBLES
	FINE	MEDIUM	COARSE	FINE	COARSE	

TP4-1

540 Cache Creek Drive



Boring No.	TP4-1	Depth:	12 - 12.5'	Initial Dry Density (pcf)	97.7	Initial Moisture Content (%)	26.4
Sampled By:	AP/NE	Date Received:	5/2/19				
Soil Description: Lean Clay (CL) with silt, trace sand and gravel, medium plasticity, light brown, saturated, medium							

5/14/19



P. O. Box 80190  
Billings, MT 59108-0190  
Phone: 406.652.3930  
Fax: 406.652.3944

### Consolidation/Swell Test

SK Project Number: 08-2506  
Nelson Project Number: 19-046-02  
540 Cache Creek Drive

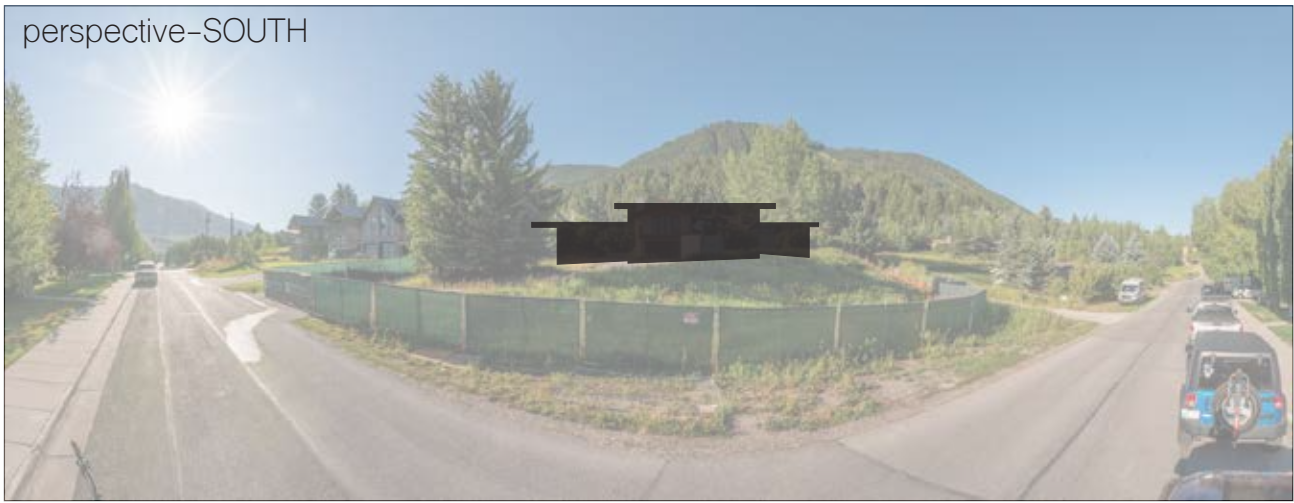
# 540 Cache Creek North

Visual Impact Analysis





perspective-SOUTH



perspective-SOUTH EAST



perspective-SOUTH WEST





**To:** Town of Jackson Planning and Development Department  
**Cc:** Josh Kilpatrick, Project Engineer, Nelson Engineering  
**From:** Brian Remlinger, Principal, Alder Environmental, LLC  
Julie Polasik, Wildlife Ecologist, Alder Environmental, LLC  
**Date:** August 14, 2019  
**Re:** **540 Cache Creek Dr., Wildlife Use/Habitat Review**  
**PIDN: 22-41-16-34-1-35-010**

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The developers of the property located at 540 Cache Creek Dr. are proposing to divide of the property into two lots, one to the north and one to the south. Nelson Engineering requested the services of Alder Environmental, LLC to assist with the submittal requirements related to the standards in the Town of Jackson Land Development Regulations (LDRs) Section 5.4.1 Steep Slopes. The submittal requirement for the proposed development includes a:

*Report summarizing wildlife use of the subject property and any potential impacts from the proposed development. (LDR 5.4.1.C.6.a)*

For the purposes of this review, *wildlife* shall be defined as those species and associated habitat protected in the current LDRs (Div. 5.2). *Impacts* shall be defined as development and/or uses that will detrimentally affect the food supply and/or cover provided by the habitat, or detrimentally affect the potential for survival of the protected wildlife species.

## **SITE INVENTORY & DATA REVIEW**

A site visit was conducted on August 9, 2019 to evaluate existing wildlife habitat conditions and use. Photos 1-6 depict current site conditions consisting of developed impervious surfaces, disturbed grasslands (lawns), and landscaping including blue spruce, aspen, and ornamental shrubs. Sign (e.g. scat, bedding) of occasional use of the property by mule deer were observed during the site visit. No other signs of ungulate use or bird nests (raptors specifically) were observed on the project location during the field inventory.



**Photo 1.** Looking south at current residence.



**Photo 2.** Looking south along the west side of house.



**Photo 3.** Looking at residence from SE property corner.



**Photo 4.** Looking towards the south edge of property.



**Photo 5.** Looking north along east edge of property.



**Photo 6.** Looking south from the east side of property.

Three sources of wildlife habitat data were reviewed for the property: 1) Wyoming Game and Fish Department (WGFD) designated ungulate crucial winter ranges and migration routes, 2) Bald Eagle nest location and Trumpeter Swan nest and winter locations from aerial surveys conducted by WGFD, and 3) the 2013 WYDOT/Teton Science Schools mule deer movement and habitat use study (Riginos et al. 2013).

The entire property is located within WGFD designated crucial winter range for elk based on winter range GIS layers (WGFD 2012). However, those GIS layers are at a coarse scale and do not consider microhabitat and development within the Town of Jackson. The property at 540 Cache Creek Dr. primarily consists of disturbed lands, lawns and landscaping, and impervious surfaces. These cover types do not meet the definition of elk crucial winter range (LDR 5.2.1.B.3.b) which is comprised of xeric and mesic sagebrush-grasslands, mixed shrub, mesic and open grassland, and certain agricultural meadow types (Town of Jackson 2018). Therefore, the property does not provide crucial winter range for elk.

The signs of mule deer observed during the site visit indicate that mule deer occasionally utilize the property for cover. However, the property is not located within crucial winter range or migration routes of mule deer based on WGFD designations (WGFD 2012) and a mule deer movement and habitat use study (Riginos et al. 2013). The habitats on the property also do not contain xeric and mesic shrubland-grasslands that provide crucial winter range for mule deer (LDR 5.2.1.B.3.c).

Additionally, no Bald Eagle nests or winter range (WGFD 2019), or Trumpeter Swan nests or winter habitat are present on the property, and the closest waterbody to the property is Cache Creek located to the north in additional areas of development.

#### **FINDINGS & OPINION**

Wildlife use of the subject property is considered minimal and non-essential based off the site inventory and data review. Mule deer and other ungulates may occasionally pass through the property and use the ornamental trees shrubs and trees for temporary cover or foraging. However, the property does not provide any crucial habitat for these species or other wildlife protected in the LDRs (Div. 5.2). Therefore, adverse effects to the wildlife species and wildlife habitat protected by the Town of Jackson LDRs are not expected to occur with the proposed development and lot split. Direct habitat mitigation for impacts to these non-essential and disturbed vegetative cover types is not recommended, however wildlife movement through the property should be maintained through limiting development of physical barriers such as tall walls and fences

#### **REFERENCES**

Riginos, C., K.D. Krasnow, E. Hall, M. Graham, M., S. Sundaresan, D. Brimeyer, G. Fralick, and D. Wachob. 2013. Mule deer (*Odocoileus hemionus*) movement and habitat use patterns in relation to roadways in Northwest Wyoming. FHWA-WY-13/08F.

Town of Jackson. 2018. Land Development Regulations. July 18, 2018, Jackson, WY.

WGFD. 2012. Big Game Ranges Geographic Information Systems Layers. Cheyenne, WY.

WGFD. 2019. Bald Eagle Nest Flight Survey Data. Wyoming Game and Fish Department. Jackson, WY.