September 2, 2014

Gallup-McKinley County Schools
P.O. Box 1318
Gallup, New Mexico 87305-1318

Attn:  Mr. Johnty Cresto

Re:  Geotechnical Engineering Report
    Gallup-McKinley County Schools (GMCS)
    New Del Norte Elementary School
    700 West Wilson Avenue
    Gallup, New Mexico
    Terracon Project No. 69145016

Dear Mr. Cresto:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with our proposal number P69140065 dated June 30, 2014. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork, subsurface drainage, pavement section, and the design and construction of foundations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

ZACHARY C. ST. JEAN  21045
NEW MEXICO  9/12/14
PROFESSIONAL ENGINEER

Zachary C. St. Jean, P.E.
Office Manager

Michael E. Anderson, P.E.
Principal

Copies to:  Addressee (1 via email; 3 hard copies)
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</tr>
<tr>
<td></td>
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</tr>
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</table>
EXECUTIVE SUMMARY

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

A geotechnical exploration has been performed for the New Del Norte Elementary School located at 700 West Wilson Avenue in Gallup, New Mexico. Terracon’s geotechnical scope of work included the advancement of 12 test borings to depths ranging from about 6.5 to 51.5 feet below existing site grades.

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified:

**Site Soils and Bedrock:** The site soils generally consisted of native lean to fat clay with varying amounts of sand interbedded with silty sand. Sedimentary bedrock composed of claystone and sandstone was encountered in one boring at a depth of about 45-½ feet below grade.

Groundwater was encountered at a depth of about 46-½ feet below existing grade upon completion of drilling in Boring B-01.

**Foundations:** The school building may be supported by deep foundation system consisting of augered cast-in-place piles bearing on undisturbed native soil or on a shallow spread footing foundation system supported on rammer aggregate piers (RAP) and engineered fill.

**Floor Slabs:** The on-site surface and near surface soils are expected to exhibit low to moderate consolidation/consolidation and expansion potentials when compacted and subjected to light loading conditions such as those imposed by floor slabs. Construction of floor slabs on approved engineered fill is considered acceptable for the project, provided some movement can be tolerated.

**Pavements:** Automobile Parking (25,000 ESALs) – 4-½” AC over 6” ABC; bus/truck traffic and entrances/exists (75,000 ESALs) – 5-½” over 6” ABC.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during construction.
1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the New Del Norte Elementary School located at 700 West Wilson Avenue in Gallup, New Mexico. The report addresses the following:

- subsurface soil conditions
- concrete and metal corrosion potential
- earthwork
- foundation design and construction
- seismic considerations
- groundwater conditions
- lateral earth pressures
- pavement section recommendations

Our geotechnical engineering scope of work for this project included the advancement of 12 test borings to depths ranging from about 6.5 to 51.5 feet below existing site grades.

Logs of the borings along with a Site Location Plan and Boring Location Plan are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices.

2.0 PROJECT INFORMATION

2.1 Project Description

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site layout</td>
<td>Refer to the Site Location Plan and Boring Location Plan (Appendix A).</td>
</tr>
<tr>
<td>Proposed Construction</td>
<td>The project includes the construction of a new two-story school building with a footprint of approximately 30,000 square foot. Site development will include asphalt paved access roadways and parking lots, concrete sidewalks, athletic fields, play areas, and utility construction. The new school will be constructed at the existing play areas and dirt athletic field located to the north of the existing school. After construction of the new school, the existing school will be demolished and parking areas will be constructed in this area.</td>
</tr>
</tbody>
</table>
ITEM | DESCRIPTION
---|---
Building Construction | Structural masonry and steel
Proposed foundation systems | Augered cast-in-place piles or a shallow spread footing foundation system bearing on rammed aggregate piers and engineered fill.
Proposed floor systems | Deep Foundation: Structural or crawl space floor system
Shallow Spread Footing Foundation: Slab-on-grade bearing on a zone of engineered fill and RAP
Finished grade elevation | Within 2 to 3 feet of existing site grade (assumed)
Maximum loads | Columns: +/- 250 kips (provided)
Walls: 3 kips/foot (provided)
Slabs: 150 psf max (assumed)
Grading | Maximum cut and fills on the order of about 2 to 3 feet (assumed)
Retaining walls | None.
Basement level | None.
Traffic Loading | Light-Duty - 25,000 ESALs (assumed)
Heavy-Duty – 75,000 ESALs (assumed)

2.2 Site Location and Description

ITEM | DESCRIPTION
---|---
Location | The project site is located at 700 West Wilson Avenue in Gallup, New Mexico.
Existing site features | The site is currently occupied by the existing Washington Elementary School campus. The existing school campus consists of asphalt paved parking lots and roads, playground areas, and various other small buildings and structures.
Surrounding developments | North: Wilson Avenue
East: Single-family residences
West: Railroad
South: Athletic Field
Current ground cover | Exposed earth, native vegetation, buildings/structures, and asphalt pavement.
Existing topography | Relatively flat with a slight slope down to the south.
3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The project area is located on the southern edge of the San Juan Basin of the Colorado Plateau physiographic province. The San Juan Basin, formed during the Laramide Orogeny of Tertiary time, is a structurally complex feature characterized by a broad, gently downwarping interior, which is flanked by numerous uplifts and platforms. It is rimmed by older Cretaceous rock that gradually proceeds to younger Tertiary rocks towards the center of the basin. The project site lies on Quaternary age alluvium deposits. The alluvium is underlain by the Upper Cretaceous age Dilco Coal Member of the Crevasse Canyon Formation. The Dilco Coal Member is generally comprised of shale, claystone, siltstone, sandstone, and coal deposited in a shallow marine or near shore environment.

3.2 Typical Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs included in Appendix A of this report. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Approximate Depth to Bottom of Stratum (feet)</th>
<th>Material Encountered</th>
<th>Consistency/Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stratum 1</td>
<td>6-½ to 51-½</td>
<td>Interbedded lean clay with varying amounts of sand with sand with varying amounts of silt.*</td>
<td>Stiff to Hard Very Loose to Medium Dense</td>
</tr>
<tr>
<td>Stratum 2</td>
<td>51-½</td>
<td>Sedimentary bedrock comprised of sandstone or claystone</td>
<td>Very Hard</td>
</tr>
</tbody>
</table>

*Approximately 3-½ inches of asphalt encountered in Borings B-11 and B-12, and approximately 5-½ to 12 inches of base course encountered in Borings B10 thru B-12. Fat clay encountered in Boring B-02 from a depth of about 8 to 14 feet below existing grade.

The sand soils were typically non-plastic and the clay soils were low to high in plasticity.

Laboratory tests were conducted on selected soil samples and the test results are presented in Appendix B. Laboratory test results indicate that the surface and near clay surface soils exhibit low to high consolidation potentials at in-situ moisture contents. The near surface soils encountered have a low to high tendency for consolidation and a low potential for expansion when wetted under typical foundation and slab loads. Based on the laboratory test results and
our experience with similar soils, it is our opinion that the shallow subsurface clay soils will likely exhibit low to moderate consolidation and expansion potential and the shallow subsurface sand soils will likely exhibit moderate to high compression and non-expansion potentials. When water is added to samples of laboratory compacted near-surface soils, we anticipate that the compacted soils will exhibit low consolidation potential and non-to low expansive potential when subjected to loading conditions such as those of the proposed school building.

Laboratory test results indicate that on-site soils exhibit resistivity of 359 and 1,261 ohm-centimeters, pH values of about 8.5 and 9.1, and water soluble sulfate concentrations of 193 and 770 mg/kg.

3.3 Groundwater

Groundwater was observed in Boring B-01 at a depth of about 45-½ feet below existing grade upon completion of drilling. Groundwater was not encountered in any other borings. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors.

Fluctuations in groundwater levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells, and periodic measurement of groundwater levels over a sufficient period of time.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Expansive soils are present on this site. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and cracking in the structures should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

All grades must provide effective drainage away from the structures during and after construction. Water permitted to pond next to structures can result in greater soil movements than those discussed in this report. These greater movements can result in unacceptable differential floor slab movements, cracked slabs and walls, and roof leaks. Estimated
movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained.

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings. Soils which show low to high tendency for compression/consolidation and expansion when elevated in moisture content will require particular attention in the design and construction.

During a design team meeting with representatives from Gallup-McKinley County Schools (GMCS), Public School Facilities Authority (PSFA), Van Gilbert Architects, and Terracon on August 26, 2014, the subsurface conditions and potential foundation options were discussed. Shallow spread footings bearing on a zone of engineered fill was considered not to be feasible due the high clay content of the on-site soils required effort to blend, process, and moisture condition the clay soils to make them suitable as engineered fill. Drilled shafts were considered not to be feasible due to caving sand soils and requirements for casing or use of drilling slurry for installation of the shafts. Therefore, based on the geotechnical engineering analyses, subsurface exploration, laboratory test results, and discussions with the design team, GMCS, and PSFA, the proposed school building may be supported on a shallow spread footing foundation system supported on rammed aggregate piers (RAP) and engineered fill or a deep foundation consisting of augered cast-in-place-piles (ACIP).

The spread footing foundation system will include a slab-on-grade floor system. Construction of floor slabs supported on approved engineered fill is considered acceptable for the project, provided some movement can be tolerated. The on-site clay soils should not be used as engineered fill for support of foundations or slabs unless they meet the specifications contained herein and are adequately blended with imported soils, processed, and moisture conditioned or dried. Blending and moisture conditioning of the clays may require additional effort to provide a uniform engineered fill material.

If ACIP system is selected, a structural floor or crawl space supported on the ACIP would be constructed. The structural floor system or crawl space should be designed by the structural engineer using the foundation criteria obtained in this report.

Geotechnical engineering recommendations for the alternative foundation systems and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in Appendices A and B), engineering analyses, and our current understanding of the proposed project.
4.2 Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations, are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

Strip and remove, buildings, concrete, asphalt, vegetation, debris, and other deleterious materials from proposed new structure and pavement areas. Exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

After demolition of existing buildings, pavements, and removal of construction debris, any loose/soft soil shall be recompacted. Material from demolition may not be reused as engineered fill unless it is adequately blended and processed with the on-site or imported soils.

Stripped materials consisting of vegetation and organic materials should be wasted from the site, or used to revegetate landscaped areas or exposed slopes after completion of grading operations. If it is necessary to dispose of organic materials on-site, they should be placed in non-structural areas, and in fill sections not exceeding 5 feet in height.

The site should be initially graded to create a relatively level surface to receive fill, and to provide for a relatively uniform thickness of fill beneath proposed structures.

After stripping and/or remedial measures, proofrolling should be performed with heavy rubber tire construction equipment such as a fully loaded tandem-axle dump truck. A geotechnical engineer or his representative should observe proofrolling to aid in locating unstable subgrade materials. Proofrolling should be performed after a suitable period of dry weather to avoid degrading an otherwise acceptable subgrade and to reduce the amount of undercutting/remedial work required. Unstable materials located should be stabilized as directed by the engineer based on conditions observed during construction. Undercut and replacement and densification in place are typical remediation methods. If unstable conditions are still present additional measures such as placement of rock, geosynthetics, or chemical treatment should be considered.

If unexpected fills or underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.
4.2.2 Excavation

It is anticipated that shallow excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

Based on the results from the soil borings, we do not anticipate groundwater control measures will be necessary in excavations up to about 45-½ feet below existing site grades. However, depending upon depth of excavation and seasonal conditions, groundwater may be encountered in excavations at shallower depths beneath the site. Pumping from sumps may be utilized to control water within excavations.

On-site soils may pump or become unstable or unworkable at high water contents. Workability may be improved by scarifying and drying, this condition is likely as excavations become saturated. Overexcavation of wet zones and replacement with granular materials may be necessary. Lightweight excavation equipment may be required to reduce subgrade pumping.

4.2.3 Subgrade Preparation

Beneath shallow foundations and slab-on-grade, the subgrade soils should be removed to a minimum depth as specified in the Floor Slab Design Recommendations sections of this report. The engineered fill should extend laterally an additional distance of 8 inches for each additional foot of excavation beyond the minimum depth. If engineered fill is placed beneath the entire structure, it should extend horizontally a minimum distance of 5 feet beyond the outside edge of perimeter foundations.

Exposed areas which will receive engineered fill, once properly cleared, should be scarified to a minimum depth of eight inches, conditioned to near optimum moisture content, and compacted to the densities recommended herein.

Areas of soft or loose soils will likely be encountered at engineered fill and pavement subgrade elevations after excavation are completed. When such conditions exist, the subgrade soils should be surficially compacted prior to placement of fill. If sufficient compaction can not be achieved in-place, the loose/soft soils should be removed and replaced as engineered fill. For placement of engineered fill below footings, the excavation should be widened laterally, at least eight (8) inches for each foot of fill placed below footing base elevations.

Subgrade soils beneath exterior flatwork and pavements should be scarified, moisture conditioned and compacted to a minimum depth of 12 inches. The moisture content and compaction of subgrade soils should be maintained until slab or pavement construction.
4.2.4 Fill Materials and Placement

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than six inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer.

Beneath shallow foundations and floor slabs, the on-site clay soils will require some blending with on-site or imported sands, processing, and moisture conditioning/drying in order to be suitable for use as engineered fill meeting the specification outlined below. Blending and moisture conditioning of the clays may require additional effort to provide a uniform engineered fill material.

Clean on-site soils meeting the specification contained herein or approved imported materials may be used as fill material for the following:

- general site grading
- foundation areas
- interior floor slab areas
- exterior slab areas (flatwork)
- pavement areas
- foundation backfill

On-site or imported soils for use as fill material within proposed structure areas should conform to low volume change materials as indicated in the following specifications:

<table>
<thead>
<tr>
<th>Gradation</th>
<th>Percent Finer by Weight (ASTM C 136)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3&quot;</td>
<td>70-100</td>
</tr>
<tr>
<td>No. 4 Sieve</td>
<td>50-100</td>
</tr>
<tr>
<td>No. 200 Sieve</td>
<td>70 (max)</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>40 (max)</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>20 (max)</td>
</tr>
<tr>
<td>Maximum expansive potential (%)*</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Measured on a sample compacted to approximately 95 percent of the ASTM D1557 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged/inundated.

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed eight (8) inches loose thickness.
4.2.5 Compaction Requirements
Recommended compaction and moisture content criteria for engineered fill materials are as follows:

<table>
<thead>
<tr>
<th>Material Type and Location</th>
<th>Per the Modified Proctor Test (ASTM D 1557)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum Compaction Requirement (%)</td>
</tr>
<tr>
<td></td>
<td>Range of Moisture Contents for Compaction</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>On-site sand, granular or approved imported fill soils:</td>
<td></td>
</tr>
<tr>
<td>Building and pavement areas:</td>
<td>95</td>
</tr>
<tr>
<td>Aggregate base</td>
<td>95</td>
</tr>
<tr>
<td>Miscellaneous backfill</td>
<td>90</td>
</tr>
</tbody>
</table>

4.2.6 Grading and Drainage
All grades must provide effective drainage away from the structure during and after construction. Water permitted to pond next to the structure can result in greater soil movements than those discussed in this report. These greater movements can result in unacceptable differential exterior slab movements and cracked exterior slabs. Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained.

Exposed ground should be sloped at a minimum 5 percent away from the structure for at least 10 feet beyond the perimeter of the structures. After construction, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary, as part of the structure's maintenance program.

As outlined above, flatwork will be subject to post construction movement. Maximum grades practical should be used for flatwork to prevent water from ponding. Allowances in final grades should also consider post-construction movement of flatwork, particularly if such movement would be critical. Where flatwork abuts the structure, effectively seal and maintain joints to prevent surface water infiltration.

4.2.7 Corrosion Potential
Laboratory test results indicate that on-site soils have water soluble sulfate concentrations of 193 and 770 mg/kg. Results of soluble sulfate testing indicate that ASTM Type II Portland cement should be considered for all concrete on and below grade. Foundation concrete should be designed for moderate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.
Laboratory test results indicate that on-site soils exhibit resistivity values of 359 and 1,261 ohm-centimeters, and pH values of about 8.5 and 9.1. Refer to Summary of Laboratory Results contained in Appendix B for the complete results of the corrosivity testing conducted on the site soils in conjunction with this geotechnical exploration.

4.3 Foundation Recommendations

The proposed school building can be supported by augered cast-place piles (ACIP) foundation system bearing on undisturbed native soils. Shallow spread footings supported on rammed aggregate piers (RAP) could be considered as an alternate foundation system, provided some movement can be tolerated. The design recommendations and considerations for each foundation option are discussed below.

4.3.1 Augered Cast-in-Place Pile Foundation Recommendations

Axial capacities should be developed neglecting the upper 3 feet of the pile due to disturbance. For structural analysis, the weight of the concrete can be neglected in the total load calculations. A one-third increase may be used when considering wind or seismic loads.

The total axial capacities and the lateral load/deflection analyses should be developed using the parameters outlined below by the structural engineer.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation Type</td>
<td>Augered Cast-in-Place Piles</td>
</tr>
<tr>
<td>Bearing Material</td>
<td>Undisturbed native soil</td>
</tr>
<tr>
<td>Allowable Bearing Pressure</td>
<td>20 to 30 feet: 3,600 psf</td>
</tr>
<tr>
<td></td>
<td>30 to 50 feet: 9,000 psf</td>
</tr>
<tr>
<td></td>
<td>Over 50 feet: 20,000 psf (bedrock)</td>
</tr>
<tr>
<td>Recommended Minimum Shaft Length</td>
<td>25 Feet</td>
</tr>
<tr>
<td>Recommended Minimum Pile Diameter</td>
<td>12 inches</td>
</tr>
<tr>
<td>Allowable Skin Friction</td>
<td>0 to 10 feet: 150 psf</td>
</tr>
<tr>
<td></td>
<td>10 to 20 feet: 300 psf</td>
</tr>
<tr>
<td></td>
<td>20 to 30 feet: 450 psf</td>
</tr>
<tr>
<td></td>
<td>30 to 40 feet: 600 psf</td>
</tr>
<tr>
<td></td>
<td>40 to 60 feet: 000 psf</td>
</tr>
<tr>
<td>Undrained Shear Strength</td>
<td>Sand: Not applicable</td>
</tr>
<tr>
<td></td>
<td>Clay Soils:</td>
</tr>
<tr>
<td></td>
<td>0 to 10 feet: 800 psf</td>
</tr>
<tr>
<td></td>
<td>10 to 20 feet: 1,600 psf</td>
</tr>
<tr>
<td></td>
<td>Below 20 feet: 2,500 psf</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>VALUE</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Friction Angle (φ)</td>
<td>Sand: 0 to 10 feet: 28 degrees</td>
</tr>
<tr>
<td></td>
<td>Sand: over 10 feet: 30 degrees</td>
</tr>
<tr>
<td></td>
<td>Clay: Not applicable</td>
</tr>
<tr>
<td>Soil Modulus (k)</td>
<td>Sand: 0 to 20 feet: 25 pci</td>
</tr>
<tr>
<td></td>
<td>Sand: over feet: 90 pci</td>
</tr>
<tr>
<td></td>
<td>Clay: 0 to 10 feet: 100 pci</td>
</tr>
<tr>
<td></td>
<td>Clay: 10 to 20 feet: 500 pci</td>
</tr>
<tr>
<td></td>
<td>Clay: over 20 feet: 1,000 pci</td>
</tr>
<tr>
<td>( \epsilon_{50} )</td>
<td>Sand: Not applicable</td>
</tr>
<tr>
<td></td>
<td>Clay Soils: 0.010</td>
</tr>
<tr>
<td>Factor of Safety (FS)</td>
<td>2.5</td>
</tr>
<tr>
<td>Total Estimated Movement</td>
<td>Less than 1 inch</td>
</tr>
</tbody>
</table>

The soil modulus for the sands increases linearly with depth by an amount equal to the coefficient of subgrade reaction. The subgrade moduli are ultimate values; therefore, appropriate factors of safety should be applied in the pile design.

### 4.3.1.1 Construction Considerations

Drilling to design depths should be possible with conventional heavy duty augers. A qualified contractor should review the boring log data and determine what equipment will be required to advance the excavation to design depths.

A sufficient head of grout should be maintained upon withdrawal of the auger to minimize the creation of voids or the introduction of soil within the pile shaft. Piles spaced closer than 3 feet, center to center, should not be constructed adjacent to another within 24 hours.

Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes. Pier concrete with slump in the range of 4 to 6 inches is recommended.

A representative of the geotechnical engineer should observe pile installation operations and monitor grout pressures and volumes. Construction of augered cast-in-place piles should conform to the requirements developed by the Deep Foundations Institute.

For design, potential uplift forces can be resisted by dead load on each pile plus the total axial capacity outlined above excluding base resistance (skin friction only).

Based on the materials encountered, and the potential for relatively closely spaced piles, the use of group reduction factors may be necessary. Group reduction factors for axial capacity are not applicable as long as the center-to-center spacing is greater than \((0.02 \times \text{length of pile} +...\))
2.5*diameter of pile), but not less than 3 pile diameters, where both length and diameter are measured in consistent units. A reduction factor of 50 percent should be applied to a spacing of 1 pile diameter and 25 percent for 2 pile diameters.

All piles should be reinforced full-depth for the applied axial, lateral and uplift stresses imposed. Minimum reinforcement should be specified by the structural engineer.

4.3.2 Rammed Aggregate Piers (RAP)

A shallow spread footing foundation system bearing on a zone of engineered fill bearing on a RAP system could be considered for support of the proposal school building, provided some movement can be tolerated. The RAP system includes drilling an open vertical shaft, replacing the removed soil with crushed rock (gravel), and vertically ramming the crushed rock in multiple lifts in the open shaft. The vertically ramming also densifies the surrounding soil. The RAP system creates a grid system of piers and allows for higher density bearing capacities in the subsurface soils.

Based on preliminary analysis completed by Western Ground Improvements, the RAPs are estimated to be about 24 inches in diameter and will range in depth from about 10 to 15 feet below grade. Western Ground Improvements or another qualified RAP contractor will be responsible for the design and installation of the RAP system. We recommend a Terracon representative to be on-site during RAP installation to verify the soil conditions and that the design criterion is achieved. Additionally, we recommend a minimum of one modulus load test be completed on an installed RAP to verify bearing pressure and settlement.

4.3.2.1 Shallow Spread Footing Foundation with RAP Recommendations

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>Spread Footing Foundation (column or continuous wall)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net allowable bearing pressure</td>
<td>3,000 psf</td>
</tr>
<tr>
<td>Minimum dimensions</td>
<td>Walls – 16 inches</td>
</tr>
<tr>
<td>Minimum amount of newly placed, compacted engineered fill beneath foundations and above RAP system.</td>
<td>10 to 15 feet RAP below required depth for slab-on-grade support</td>
</tr>
<tr>
<td>Minimum embedment below finished grade for frost protection</td>
<td>30 inches</td>
</tr>
<tr>
<td>Modulus of subgrade reaction</td>
<td>75 psf</td>
</tr>
<tr>
<td>Approximate total movement</td>
<td>1 inch</td>
</tr>
<tr>
<td>Estimated differential movement</td>
<td>Less than 3/4 inch of total over 40 feet</td>
</tr>
</tbody>
</table>

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes fill or unsuitable soils, if
encountered, will be undercut and replaced with engineered fill.

2. Depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure. The minimum depth for interior footings in continuously heated structures is 12 inches below finished grade.

3. The foundation movement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, the quality of the earthwork operations, RAP system installation as designed by others, and maintaining uniform soil water content throughout the life of the structure. The estimated movements are based on maintaining uniform soil water content during the life of the structure. Additional foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage and irrigation practices should be incorporated into the design and operation of the facility. Failure to maintain soil water content and positive drainage will nullify the movement estimates provided above.

4. The modulus was obtained based on our experience with similar subgrade conditions

4.4 Seismic Considerations

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 International Building Code Site Classification (IBC)</td>
<td>C²</td>
</tr>
<tr>
<td>Site Latitude</td>
<td>35.530631</td>
</tr>
<tr>
<td>Site Longitude</td>
<td>-108.751728</td>
</tr>
<tr>
<td>( S_M ) Spectral Acceleration for a Short Period</td>
<td>0.231g</td>
</tr>
<tr>
<td>( S_M ) Spectral Acceleration for a 1-Second Period</td>
<td>0.095g</td>
</tr>
<tr>
<td>( S_D ) Spectral Acceleration for a Short Period</td>
<td>0.154g</td>
</tr>
<tr>
<td>( S_D ) Spectral Acceleration for a 1-Second Period</td>
<td>0.063g</td>
</tr>
<tr>
<td>( F_a ) Site Coefficient for a Short Period</td>
<td>1.2</td>
</tr>
<tr>
<td>( F_v ) Site Coefficient for a 1-Second Period</td>
<td>1.7</td>
</tr>
</tbody>
</table>

¹ Note: In general accordance with the 2009 International Building Code, Table 1613.5.2. IBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

² Note: The 2012 International Building Code (IBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100 foot soil profile determination. Borings extended to a maximum depth of 51-½ feet, and this seismic site class definition considers that hard bedrock continues below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.
4.5 Floor Slab

4.5.1 Deep Foundation Floor Design Recommendations

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior floor system</td>
<td>Structural floor or crawl space.</td>
</tr>
<tr>
<td>Floor slab support</td>
<td>Augered cast-in-place piles</td>
</tr>
</tbody>
</table>

The structural floor or crawl space should be supported by augered cast-in-place piles and grades beams as designed by the structural engineer. The open space beneath the floor and ground surface should be well ventilated to reduce the potential for moisture accumulation.

4.5.2 Shallow Foundation Floor Slab Design Recommendations

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior floor system</td>
<td>Slab-on-grade concrete.</td>
</tr>
<tr>
<td>Floor slab support</td>
<td>Minimum five (5) feet of engineered fill placed and compacted in accordance with Earthwork section of this report.</td>
</tr>
<tr>
<td>Subbase</td>
<td>Compacted subgrade</td>
</tr>
<tr>
<td>Modulus of subgrade reaction</td>
<td>75 pounds per square inch per inch (psi/in) (The modulus was obtained based on our experience with similar subgrade conditions, and estimates obtained from ACI design charts.)</td>
</tr>
</tbody>
</table>

In areas of exposed concrete, control joints should be saw cut into the slab after concrete placement in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended). Additionally, dowels should be placed at the location of proposed construction joints. To control the width of cracking (should it occur) continuous slab reinforcement should be considered in exposed concrete slabs.

Positive separations and/or isolation joints should be provided between slabs and all foundations, columns or utility lines to allow independent movement. Interior trench backfill placed beneath slabs should be compacted in accordance with recommendations outlined in the Earthwork section of this report. Other design and construction considerations, as outlined in the ACI Design Manual, Section 302.1R are recommended.

The use of a vapor retarder or barrier should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 and ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder/barrier.
4.5.2.1 Construction Considerations

Some differential movement of a slab-on-grade floor system is possible should the subgrade soils become elevated in moisture content. The floor slab should be supported on five (5) feet of engineered fill meeting the requirements as specified in the Fill Materials and Placement section of this report. The on-site clay soils will require some blending with imported sands, processing, and moisture conditioning in order to be suitable for use as engineered fill beneath floor slabs. Such movements are anticipated to be within general tolerance for normal slab-on-grade construction. If encountered beneath the slab-on-grade floor, soft or deleterious material should be removed and replaced with engineered fill. To reduce potential slab movements, the subgrade soils should be prepared as outlined in the Earthwork section of this report.

4.6 Lateral Earth Pressures

4.6.1 Design Recommendations

For soils above any free water surface, recommended equivalent fluid pressures for unrestrained foundation elements when using on-site soils as backfill are:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SOIL TYPE</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Case</td>
<td>On-site sand</td>
<td>40 psf/ft</td>
</tr>
<tr>
<td></td>
<td>On-site clays</td>
<td>50 psf/ft</td>
</tr>
<tr>
<td>Passive Case</td>
<td>On-site sand</td>
<td>360 psf/ft</td>
</tr>
<tr>
<td></td>
<td>On-site clays</td>
<td>300 psf/ft</td>
</tr>
<tr>
<td>At-Rest Case</td>
<td>On-site sand</td>
<td>60 psf/ft</td>
</tr>
<tr>
<td></td>
<td>On-site clays</td>
<td>20 psf/ft</td>
</tr>
<tr>
<td>Coefficient of Base Friction</td>
<td>All soils</td>
<td>0.35(^1)</td>
</tr>
<tr>
<td>Angle of Internal Friction</td>
<td>On-site clay soils</td>
<td>25°</td>
</tr>
<tr>
<td></td>
<td>On-site sand soils</td>
<td>30°</td>
</tr>
</tbody>
</table>

\(^1\)Note: The coefficient of base friction should be reduced to 0.30 when used in conjunction with passive pressure.

The lateral earth pressures herein do not include any factor of safety and are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if such conditions are to be included in the design.

Fill against foundations (if applicable) should be compacted to densities specified in the Earthwork section of this report. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors.
4.7 Pavements

4.7.1 Subgrade Preparation

On most project sites, the site grading is accomplished relatively early in the construction phase. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy traffic from concrete trucks and other delivery vehicles disturbs the subgrade and many surface irregularities are filled in with loose soils to improve trafficability temporarily. As a result, the pavement subgrades, initially prepared early in the project, should be carefully evaluated as the time for pavement construction approaches.

We recommend the moisture content and density of the top 12 inches of the subgrade be evaluated and the pavement subgrades be proofrolled within two (2) days prior to commencement of actual paving operations. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and recompacted. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

After proofrolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified and developed as recommended in Section 4.2 of the Earthwork section of this report to provide a uniform subgrade for pavement construction. Areas that appear severely desiccated following site stripping may require further undercutting and moisture conditioning. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

4.7.2 Design Considerations

The design approach used to populate the table outlined below was based on the National Asphalt Pavement Association (NAPA), which is specific to low volume pavements. Portland Cement Concrete (PCC) pavement thicknesses were based on the American Concrete Institute (ACI) design recommendations.

The design of pavement thickness was based on the following:

- Traffic Class III for the parking lot includes a maximum of 25,000 total ESALs
- Traffic Class IV for the driveways and bus/truck access lanes includes a maximum 75,000 total ESALs
- A soil characterization of “poor” based on the clay soils encountered at the site
- A design life of 20 years

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%;
- The subgrade and pavement surface should have a minimum 2% slope to promote proper surface drainage;
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting;
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils;
- Place compacted, low permeability backfill against the exterior side of curb and gutter; and,
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

### 4.7.3 Asphalitic Cement Concrete Thickness

<table>
<thead>
<tr>
<th>Traffic Area</th>
<th>Asphalt Surface Course</th>
<th>Aggregate Base¹</th>
<th>Total Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile Parking</td>
<td>4.5</td>
<td>6.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Drive Lanes/ Entrances/Exits</td>
<td>5.5</td>
<td>6.0</td>
<td>11.5</td>
</tr>
</tbody>
</table>

¹Aggregate base should meet New Mexico Department of Transportation (NMDOT) Standard Specifications for Road and Bridge Construction (2007 Edition) Section 304.

These pavement sections are considered minimal sections based upon the expected traffic and the existing subgrade conditions. However, they are expected to function with periodic maintenance and overlays if good drainage is provided and maintained.

We recommend a Portland cement concrete (PCC) pavement be utilized in entrance and exit sections, bus stop areas, dumpster pads, loading dock areas, or other areas where extensive wheel maneuvering are expected. The dumpster pad should be large enough to support the wheels of the truck which will bear the load of the dumpster. We recommend a minimum of 6 inches of PCC underlain by 4 inches of aggregate base course. Although not required for structural support, the base course layer is recommended to help reduce potentials for slab curl, shrinkage cracking, and subgrade “pumping” through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage.
cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

4.7.4 Construction Considerations

Aggregate base course should consist of a blend of sand and gravel which meets strict specifications for quality and gradation. Use of materials meeting NMDOT Standard Specifications for Road and Bridge Construction (2007 Edition) specifications is recommended. Aggregate base course material should be tested to determine compliance with these specifications prior to importation to the site.

Asphalt concrete (if used on the site) should be obtained from an approved mix design stating the properties, optimum asphalt content, job mix formula, and recommended mixing and placing temperatures. Aggregate used in asphalt concrete should meet a particular gradation meeting NMDOT specifications. The mix design should be submitted prior to construction to verify its adequacy. We recommend that the asphalt materials should be placed in minimum and maximum lifts of 2-½ and 3-½ inches, respectively, and should be compacted to a minimum of 92% of maximum theoretical density (ASTM D2041).

Portland cement concrete should be designed with proper air-entrainment and have a minimum compressive strength of 4,000 psi after 28 days of laboratory curing. Adequate reinforcement and number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI requirements. The joints should be sealed as soon as possible (in accordance with sealant manufacturer’s instructions) to minimize infiltration of water into the soil.

Pavement design methods are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level that subgrade can support. The support characteristics of the subgrade for pavement design do not account for the shrink movements of the soils encountered on this project. Thus the pavement may be adequate for a structural standpoint, yet still experience cracking and deformation due to shrink related movement of the subgrade. It is, therefore, important to minimize moisture changes in the subgrade to reduce collapse/consolidation movements.

4.7.5 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

4.7.6 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore
preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

5.0 GENERAL COMMENTS

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

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

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

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

Diagram is for general location only, and is not intended for construction purposes.

New Del Norte Elementary School
700 West Wilson Avenue
Gallup, New Mexico

APPENDIX A

FIELD EXPLORATION
Field Exploration Description

A total of 12 test borings designated as B-01 through B-12, were drilled at the site on July 22 and 23, 2014. The borings were drilled to depths of about 6½ to 51½ feet below the ground surface at the approximate locations shown on the attached Site Location Plan and Boring Location Plan.

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Location</th>
<th>Depth (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-01 through B-06</td>
<td>Building Area</td>
<td>26½ to 51½</td>
</tr>
<tr>
<td>B-07 and B-08</td>
<td>Play Areas</td>
<td>11-½</td>
</tr>
<tr>
<td>B-10 through B-12</td>
<td>Pavement Areas</td>
<td>6-½</td>
</tr>
</tbody>
</table>

The test borings were advanced with a truck-mounted CME-75 drill rig utilizing 8-inch diameter hollow-stem augers.

The borings were located in the field by Terracon personnel by measuring from existing property lines and site features. Latitude and longitude coordinates and elevations obtained with a handheld GPS are recorded on each boring log. The accuracy of boring locations and elevations should only be assumed to the level implied by the method used.

Lithologic logs of each boring were recorded by the field geologist during the drilling operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon or ring-barrel samplers.

Penetration resistance measurements were obtained by driving the split-spoon and ring-barrel samplers into the subsurface materials with a 140-pound manual hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency or relative density of materials encountered.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Groundwater conditions were evaluated in each boring at the time of site exploration.
**BORING LOG NO. B-01**

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
**CLIENT:** Gallup-McKinley County School  
**LOCATION:** See Exhibit A-2

**DEPTH (FL)**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DEPTH (FL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0</td>
<td>6504 +/-</td>
</tr>
<tr>
<td>15.0</td>
<td>6497 +/-</td>
</tr>
<tr>
<td>24.0</td>
<td>6488 +/-</td>
</tr>
<tr>
<td>46.5</td>
<td>6465.5 +/-</td>
</tr>
</tbody>
</table>

**SILTY SAND (SM), light brown, very loose to loose**


- **LEAN CLAY WITH SAND (CL), light brown to brown, very stiff**

- **12-16 19 98 39-17-22 75**

- **SILTY SAND (SM), light brown, loose to medium dense**

- **7-9 10**

- **LEAN CLAY (CL), trace sand, light brown to brown, very stiff to hard**

- **8-15-21 15 80**

- **SILTY SAND (SM), light brown, medium dense**

- **8-12-19 10**

- **LEAN CLAY (CL), trace sand, light brown to brown, stiff to very stiff**

- **7-11-16 23**

- **5-9-16 22**

- **6-7-8 25**

**Boring Terminated at 51.5 Feet**

**Stratification lines are approximate. In-situ, the transition may be gradual.**

**Hammer Type:** Automatic

**Advancement Method:** 8-inch Hollow Stem Auger

**Abandonment Method:** Borings backfilled with soil cuttings upon completion.

**Notes:**

- **WATER LEVEL OBSERVATIONS**
  - Immediately after drilling

- **FIELD TEST RESULTS**
  - **WATER CONTENT (%)**
  - **DRIED UNIT WEIGHT (pcf)**
  - **ATTERBERG LIMITS**
  - **PERCENT FINES**

- **PERCENT FINES**
  - **WATER CONTENT (%)**
  - **DRIED UNIT WEIGHT (pcf)**
  - **ATTERBERG LIMITS**

- **WATER LEVEL OBSERVATIONS**
  - **WATER LEVEL OBSERVATIONS**

- **PERCENT FINES**
  - **WATER CONTENT (%)**
  - **DRIED UNIT WEIGHT (pcf)**
  - **ATTERBERG LIMITS**

- **GRAPHIC LOG**
  - Approximate Surface Elev: 6512 (FL) +/-

- **LOCATION**
  - Latitude: 35.53145°  
  - Longitude: -108.75281°

- **ELEVATION (FL)**
  - 8.0  
  - 15.0  
  - 24.0  
  - 46.5  
  - 50.5  

- **FIELD TEST RESULTS**
  - **PERCENT FINES**
  - **WATER CONTENT (%)**
  - **DRIED UNIT WEIGHT (pcf)**
  - **ATTERBERG LIMITS**

- **Boring Started:** 7/22/2014  
- **Boring Completed:** 7/22/2014

- **Drill Rig:** CME-75  
- **Driller:** EDI

- **Project No.: 69145016**  
- **Exhibit:** A-4

- **See Exhibit A-3 for description of field procedures.**
- **See Appendix B for description of laboratory procedures and additional data (if any).**
- **See Appendix C for explanation of symbols and abbreviations.**
  - +/- 15 feet from actual location.
### BORING LOG NO. B-02

**PROJECT:** New Del Norte Elementary School  
**CLIENT:** Gallup-McKinley County School  
**SITE:** 700 West Wilson Avenue, Gallup, New Mexico  

#### LOCATION
- See Exhibit A-2
- Latitude: 35.53128°, Longitude: -108.75254°
- Approximate Surface Elev: 6506 (FL) +/-

#### DEPTH (FL)  
**ELEVATION (FL)**

<table>
<thead>
<tr>
<th>Depth (Ft.)</th>
<th>Sample Type</th>
<th>Field Test Results</th>
<th>Water Content (%)</th>
<th>Dry Unit Weight (pcf)</th>
<th>Atterberg Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0</td>
<td>SILTY SAND (SM), light brown, loose</td>
<td>3-4-4 N=8</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.0</td>
<td>FAT CLAY (CH), trace to with sand, light brown to brown, hard</td>
<td>3-9-24 N=33</td>
<td>16</td>
<td>55-21-34</td>
<td>88</td>
</tr>
<tr>
<td>23.0</td>
<td>SILTY SAND (SM), light brown, medium dense</td>
<td>9-12</td>
<td>2</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>26.5</td>
<td>LEAN CLAY (CL), trace sand, light brown to brown, very stiff</td>
<td>4-6-8 N=14</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Boring Terminated at 26.5 Feet**

#### ALTITUDE (Ft.)
- Approximate Surface Elev: 6506 (FL) +/-

#### WATER LEVEL OBSERVATIONS
- Not observed

#### Advancement Method:
- 8-inch Hollow Stem Auger

#### Abandonment Method:
- Borings backfilled with soil cuttings upon completion.

#### Notes:
- Hammer Type: Automatic
- Advancement Method: See Exhibit A-3 for description of field procedures.
- Abandonment Method: See Appendix B for description of laboratory procedures and additional data (if any).
- See Appendix C for explanation of symbols and abbreviations.
- +/- 15 feet from actual location.

#### WATER LEVEL OBSERVATIONS
- Not observed
### BORING LOG NO. B-03

**PROJECT:** New Del Norte Elementary School  
**CLIENT:** Gallup-McKinley County School  
**SITE:** 700 West Wilson Avenue, Gallup, New Mexico

#### LOCATION

See Exhibit A-2  
Latitude: 35.53168°  
Longitude: -108.75244°

Approximate Surface Elev: 6511 (FL) +/-

---

#### DEPTH (FL)  
**WATER LEVEL OBSERVATIONS**

<table>
<thead>
<tr>
<th>WATER LEVEL OBSERVATIONS</th>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>ATTERBERG LIMITS</th>
<th>PERCENT FINES</th>
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</thead>
<tbody>
<tr>
<td>3-5-8</td>
<td>3-5</td>
<td>20</td>
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#### DEPTH (FL)  
**FIELD TEST RESULTS**

- **WATER CONTENT (%)**
- **DRY UNIT WEIGHT (pcf)**
- **ATTERBERG LIMITS**
- **PERCENT FINES**

---

#### Diagram

1. **LEAN CLAY (CL):** trace sand, light brown, stiff  
   - Depth: 4.0  
   - Elevation: 6507+/-

2. **SILTY SAND (SM):** light brown, loose  
   - Depth: 4.0  
   - Elevation: 6507+/-

3. **LEAN CLAY WITH SAND (CL):** light brown to brown, very stiff  
   - Depth: 26.5  
   - Elevation: 6484.5+/-

**Boring Terminated at 26.5 Feet**

---

*Stratification lines are approximate. In-situ, the transition may be gradual.*

Hammer Type: Automatic

---

**Notes:**

- Advancement Method: 8-inch Hollow Stem Auger
- Abandonment Method: Borings backfilled with soil cuttings upon completion.
- Boring Started: 7/22/2014  
  Boring Completed: 7/22/2014
- Drill Rig: CME-75  
  Driller: EDI
- Project No.: 69145016  
  Exhibit: A-6

---

**Not observed**
**BORING LOG NO. B-04**

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
Gallup, New Mexico

**CLIENT:** Gallup-McKinley County School  
Gallup, NM

**LOCATION**  
Latitude: 35.53156°  
Longitude: -108.75195°

Approximate Surface Elev: 6505 (FL) +/-

**GRAPHIC LOG**

<table>
<thead>
<tr>
<th>DEPTH (FL.)</th>
<th>WATER LEVEL OBSERVATIONS</th>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>ATTERBERG LIMITS</th>
<th>PERCENT FINES</th>
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<tbody>
<tr>
<td>4.0</td>
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<td>21</td>
<td>94</td>
<td>42-19-23</td>
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<td>6.0</td>
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**FIELD TEST RESULTS**

- **PERCENT FINES:**
- **WATER CONTENT (%):**
- **DRY UNIT WEIGHT (pcf):**
- **ATTERBERG LIMITS:**
- **PERCENT FINES:**

**ELEVATION (FL.)**

Approximate Surface Elev: 6505 (FL) +/-

**SAMPLE TYPE**

- **WATER LEVEL OBSERVATIONS**
- **Not observed**

**WATER LEVEL OBSERVATIONS**

- **Stratification lines are approximate. In-situ, the transition may be gradual.**
- **Hammer Type:** Automatic

**ADVANCEMENT METHOD:**  
8-inch Hollow Stem Auger

**ABANDONMENT METHOD:**  
Borings backfilled with soil cuttings upon completion.

**Notes:**

- See Exhibit A-3 for description of field procedures.
- See Appendix B for description of laboratory procedures and additional data (if any).
- See Appendix C for explanation of symbols and abbreviations.

**Boring Terminated at 26.5 Feet**

**LOCATION** See Exhibit A-2

**DEPTH (FL.)**

Approximate Surface Elev: 6505 (FL) +/-

**SITE:**

**700 West Wilson Avenue**  
Gallup, New Mexico

**Driller:** EDI

**Drill Rig:** CME-75

**Boring Started:** 7/22/2014  
**Boring Completed:** 7/22/2014

**Exhibit:** A-7

**Terrain Corp.**

#4A CR 3499  
Flora Vista, New Mexico

**GEO SMART LOG-NO WELL 69145016 GINT.GPJ**

**TEMPLATE UPDATE 3-31-14.GPJ**

**9/2/14**
### BORING LOG NO. B-05

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue, Gallup, New Mexico  
**CLIENT:** Gallup-McKinley County School, Gallup, NM

#### GRAPHIC LOG

- **LOCATION:** See Exhibit A-2
- **Depth (FL):**
  - 5.0
  - 10.0
  - 14.0
  - 20.5
  - 26.5
- **Elevation (FL):**
  - 6504 +/-
  - 6499 +/-
  - 6495 +/-
  - 6488.5 +/-
  - 6482.5 +/-

#### WATER LEVEL OBSERVATIONS

<table>
<thead>
<tr>
<th>Depth (FL)</th>
<th>Elevation (FL)</th>
<th>Water Level Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>6504 +/-</td>
<td>Not observed</td>
</tr>
<tr>
<td>10.0</td>
<td>6499 +/-</td>
<td>Not observed</td>
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<tr>
<td>14.0</td>
<td>6495 +/-</td>
<td>Not observed</td>
</tr>
<tr>
<td>20.5</td>
<td>6488.5 +/-</td>
<td>Not observed</td>
</tr>
<tr>
<td>26.5</td>
<td>6482.5 +/-</td>
<td>Not observed</td>
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</table>

#### FIELD TEST RESULTS

<table>
<thead>
<tr>
<th>Particle Type</th>
<th>Water Content (%)</th>
<th>Dry Unit Weight (pcf)</th>
<th>Atterberg Limits</th>
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</thead>
<tbody>
<tr>
<td>Lean Clay (CL), trace sand, light brown, very stiff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silty Sand (SM), light brown, loose</td>
<td>10</td>
<td>11</td>
<td>33-20-13</td>
</tr>
<tr>
<td>Lean Clay (CL), trace sand, light brown to brown, stiff</td>
<td>6</td>
<td>98</td>
<td>33-20-13</td>
</tr>
<tr>
<td>Silty Sand (SM), light brown, medium dense</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lean Clay (CL), trace sand, light brown, very stiff to hard</td>
<td>6</td>
<td>7</td>
<td>90</td>
</tr>
</tbody>
</table>

#### Boring Terminated at 26.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

#### Hammer Type: Automatic

#### Advancement Method: 8-inch Hollow Stem Auger

#### Abandonment Method: Borings backfilled with soil cuttings upon completion.

#### Notes:

- See Exhibit A-3 for description of field procedures.
- See Appendix B for description of laboratory procedures and additional data (if any).
- See Appendix C for explanation of symbols and abbreviations.

#### WATER LEVEL OBSERVATIONS

- Not observed

#### LOCATION

- Latitude: 35.5318°  
- Longitude: -108.75178°

#### Advancement Method:

8-inch Hollow Stem Auger

Boring Started: 7/23/2014  
Boring Completed: 7/23/2014

#### Drill Rig: CME-75  
Driller: EDI

#### Project No.: 69145016  
Exhibit: A-8

---

This boring log is not valid if separated from original report. GEO SMART LOG: NO WELL 69145016 GPX 3-31-14.GPJ TEMPLATE UPDATE 9/2/14

---

Flora Vista, New Mexico
### BORING LOG NO. B-06

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
**CLIENT:** Gallup-McKinley County School

<table>
<thead>
<tr>
<th>DEPTH (FT.)</th>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>LL-PL-PI</th>
<th>PERCENT FINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>6-7-7</td>
<td>17</td>
<td>6505 +/-</td>
<td></td>
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</tr>
<tr>
<td>5.0</td>
<td>4-5-5</td>
<td>9</td>
<td>6503 +/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>3-5-7</td>
<td>12</td>
<td>6504 +/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td>5-8</td>
<td>9</td>
<td>6494-6496</td>
<td>46</td>
<td>29-19-10</td>
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<td>20.0</td>
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<td>6484 +/-</td>
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<td>6469 +/-</td>
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<tr>
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<td>50/2+/-</td>
<td>5</td>
<td>6459 +/-</td>
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</table>

**SAMPLING METHOD**
- LEAN CLAY WITH SAND (CL), light brown
- SILTY SAND (SM), light brown, medium dense
- LEAN CLAY (CL), trace sand, light brown to brown, stiff to very stiff
- LEAN CLAY WITH SAND (CL), light brown to gray, stiff
- SILTY SAND (SM), light brown
- LEAN CLAY (CL), with sand lenses, light brown to brown, stiff to very stiff
- CLAYEY SAND WITH GRAVEL (SM), light brown to brown
- SEDIMENTARY BEDROCK - CLAYSTONE, with lignite inclusions, gray to dark gray, medium hard
- SEDIMENTARY BEDROCK - SANDSTONE, light gray, very hard

**FIELD TEST RESULTS**
- WATER CONTENT: %
- DRY UNIT WEIGHT (pcf)
- LL-PL-PI
- PERCENT FINES

**ELEVATION (FL.)**
- 6505 +/-
- 6503 +/-
- 6504 +/-
- 6494-6496
- 6494-6496
- 6489 +/-
- 6484 +/-
- 6475 +/-
- 6471 +/-
- 6469 +/-
- 6463 +/-
- 6459 +/-
- 6459 +/-

**GEOLOGIC DATA**
- Stratification lines are approximate. In-situ, the transition may be gradual.
- Hammer Type: Automatic

**ADVANCEMENT METHOD**
- 8-inch Hollow Stem Auger

**ABANDONMENT METHOD**
- Borings backfilled with soil cuttings upon completion.

**NOTES**
- See Exhibit A-3 for description of field procedures.
- See Appendix B for description of laboratory procedures and additional data (if any).
- See Appendix C for explanation of symbols and abbreviations.

**LOCATION**
- Latitude: 35.5316°  
- Longitude: -108.75145°

**DEPTH**
- Approximate Surface Elev: 6508 (FL) +/-

**WATER LEVEL OBSERVATIONS**
- Not observed

**BOREG TERMINATED AT 50.17 FEET**

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
**CLIENT:** Gallup-McKinley County School  
**GEOLOGIC LOG**
- See Exhibit A-2

**FIELD TEST RESULTS**
- WATER CONTENT: %
- DRY UNIT WEIGHT (pcf)
- LL-PL-PI
- PERCENT FINES

**DEPTH (FT.)**
- 3.0
- 5.0
- 10.0
- 15.0
- 25.0
- 30.0
- 40.0
- 45.0
- 50.0

**WATER LEVEL OBSERVATIONS**
- Not observed

**BORING LOG NO. B-06**

**BORING COMPLETED:** 7/23/2014
**BORING STARTED:** 7/23/2014
**DRIFF RIG:** CME-75  
**DRILLER:** EDI

**PROJECT NO.:** 69145016  
**EXHIBIT:** A-9
## BORING LOG NO. B-07

### PROJECT: New Del Norte Elementary School

### SITE: 700 West Wilson Avenue
Gallup, New Mexico

### CLIENT: Gallup-McKinley County School
Gallup, NM

---

**LOCATION**

See Exhibit A-2

Latitude: 35.53191°  Longitude: -108.75274°

Approximate Surface Elev: 6503 (FL) +/-

---

**DEPTH**

**ELEVATION (FL)**

<table>
<thead>
<tr>
<th>DEPTH (Ft.)</th>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>ATTERBERG LIMITS</th>
<th>PERCENT FINES</th>
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<tbody>
<tr>
<td>2.0</td>
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</tr>
<tr>
<td>11.0</td>
<td></td>
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<td></td>
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</table>

**WATER LEVEL OBSERVATIONS**

- Not observed

**Notes:**

- Advancement Method: 8-inch Hollow Stem Auger
- Abandonment Method: Borings backfilled with soil cuttings upon completion.
- Water Level Observations: Not observed

**Stratification lines are approximate. In-situ, the transition may be gradual.**

**Hammer Type:** Automatic

---

**FIELD TEST RESULTS**

<table>
<thead>
<tr>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>ATTERBERG LIMITS</th>
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<tr>
<td>4-4</td>
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<tr>
<td>2-2-3</td>
<td>15</td>
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---

**Advancement Method**

- 8-inch Hollow Stem Auger

**Abandonment Method**

- Borings backfilled with soil cuttings upon completion.

---

**Boring Terminated at 11.5 Feet**

---

**Notes:**

- See Exhibit A-3 for description of field procedures.
- See Appendix B for description of laboratory procedures and additional data (if any).
- See Appendix C for explanation of symbols and abbreviations.
- +/- 15 feet from actual location.

---

**Drill Rig:** CME-75  
**Driller:** EDI

---

**Boring Started:** 7/23/2014  
**Boring Completed:** 7/23/2014

---

**Project No.: 69145016**

---

**Exhibit:** A-10
## BORING LOG NO. B-08

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
**CLIENT:** Gallup-McKinley County School  
**SITE:** Gallup, New Mexico  

### BORING LOG

<table>
<thead>
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<th>LOCATION</th>
<th>See Exhibit A-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude: 35.53193°</td>
<td>Longitude: -108.75197°</td>
</tr>
<tr>
<td>Approximate Surface Elev: 6510 (FL) +/-</td>
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</tr>
</tbody>
</table>

### DEPTH (FL) | WATER LEVEL OBSERVATIONS | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | LL-PL-PI | PERCENT FINES |
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
<td>6504 +/-</td>
<td></td>
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<td>11.0</td>
<td>5499 +/-</td>
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<td></td>
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<td></td>
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</table>

**LEAN CLAY WITH SAND (CL), light brown to brown, very stiff**

**SILTY SAND (SM), light brown, loose**

**LEAN CLAY WITH SAND (CL), light brown to brown, medium stiff**

*Boring Terminated at 11.5 Feet*

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

### Advancement Method:
8-inch Hollow Stem Auger

### Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.  
+/- 15 feet from actual location.

### WATER LEVEL OBSERVATIONS

Not observed

### Notes:

Boring Started: 7/23/2014  
Boring Completed: 7/23/2014  
Drill Rig: CME-75  
Driller: EDI  
Project No.: 69145016  
Exhibit: A-11

**Terracon**  
#4A CR 3499  
Flora Vista, New Mexico
**BORING LOG NO. B-09**

**PROJECT:** New Del Norte Elementary School  
**CLIENT:** Gallup-McKinley County School  
**SITE:** 700 West Wilson Avenue  
Gallup, New Mexico

### LOCATION
- **Latitude:** 35.53174°  
- **Longitude:** -108.75297°
- **Approximate Surface Elev:** 6502 (FL)

### GRAPHIC LOG

<table>
<thead>
<tr>
<th>DEPTH (FL)</th>
<th>ELEVATION (FL)</th>
<th>WATER LEVEL OBSERVATIONS</th>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNI WEIGHT (pcf)</th>
<th>ATTERBERG LIMITS</th>
<th>PERCENT FINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>6495.5 +/-</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td><strong>SILTY SAND (SM), light brown, very loose to loose</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td>6495.5 +/-</td>
<td></td>
<td>1-1-1 N=2</td>
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<td>1-2-2 N=4</td>
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<td></td>
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</tr>
</tbody>
</table>

**Boring Terminated at 6.5 Feet**

Stratification lines are approximate. In-situ, the transition may be gradual.

**Hammer Type:** Automatic

**Advancement Method:** 8-inch Hollow Stem Auger

**Abandonment Method:** Borings backfilled with soil cuttings upon completion.

**WATER LEVEL OBSERVATIONS**
- **Not observed**

**Notes:**
- See Exhibit A-3 for description of field procedures.  
- See Appendix B for description of laboratory procedures and additional data (if any).  
- See Appendix C for explanation of symbols and abbreviations.  
- +/- 15 feet from actual location.

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
Gallup, New Mexico

**FIELD TEST RESULTS**
- **PERCENT FINES**
- **WATER CONTENT (%)**
- **DRY UNIT WEIGHT (pcf)**
- **ATTERBERG LIMITS**

**WATER LEVEL OBSERVATIONS**
- **Not observed**

**Notes:**
- See Exhibit A-3 for description of field procedures.  
- See Appendix B for description of laboratory procedures and additional data (if any).  
- See Appendix C for explanation of symbols and abbreviations.  
- +/- 15 feet from actual location.

**Boring Started:** 7/23/2014  
**Boring Completed:** 7/23/2014  
**Drill Rig:** CME-75  
**Driller:** EDI  
**Project No.:** 69145016  
**Exhibit:** A-12

---

**GALLUP-MCKINLEY COUNTY SCHOOL**

**Terracon**

#4A CR 3499  
Flora Vista, New Mexico
**BORING LOG NO. B-10**

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
Gallup, New Mexico  
**CLIENT:** Gallup-McKinley County School  
Gallup, NM

### LOCATION
- See Exhibit A-2
- Latitude: 35.5309°  
- Longitude: -108.75722°
- Approximate Surface Elev: 6502 (FL) +/-

### GRAPHIC LOG

<table>
<thead>
<tr>
<th>DEPTH (FL)</th>
<th>ELEVATION (FL)</th>
<th>DEPTH</th>
<th>ELEVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>6501 +/-</td>
<td>6501</td>
<td>6501 +/-</td>
</tr>
<tr>
<td>5.5</td>
<td>6495.5 +/-</td>
<td>6495.5</td>
<td>6495.5 +/-</td>
</tr>
</tbody>
</table>

**STRATIFICATION**
- **Aggregate Base Course**  
- **Silty Sand (SM), light brown, loose**

*Boring Terminated at 6.5 Feet*

### FIELD TEST RESULTS

<table>
<thead>
<tr>
<th>DEPTH (FL)</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>LL-PL-PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-2-2</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2-2</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N=4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stratification lines are approximate. In-situ, the transition may be gradual.

**Hammer Type:** Automatic

**Notes:**
- Advancement Method: 8-inch Hollow Stem Auger
- Abandonment Method: Borings backfilled with soil cuttings upon completion.
- See Exhibit A-3 for description of field procedures.
- See Appendix B for description of laboratory procedures and additional data (if any).
- See Appendix C for explanation of symbols and abbreviations.
- +/- 15 feet from actual location.

**ADVANCEMENT METHOD:** 8-inch Hollow Stem Auger

**ABANDONMENT METHOD:** Borings backfilled with soil cuttings upon completion.

**WATER LEVEL OBSERVATIONS**
- Not observed

**Boring Started:** 7/23/2014  
**Boring Completed:** 7/23/2014

**Drill Rig:** CME-75  
**Driller:** EDI

**Project No.:** 69145016  
**Exhibit:** A-13

**Terracon**

#4A CR 3499  
Flora Vista, New Mexico
**BORING LOG NO. B-11**

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
Gallup, New Mexico

**CLIENT:** Gallup-McKinley County School  
Gallup, NM

**LOCATION**  
See Exhibit A-2  
Latitude: 35.53116°  
Longitude: -108.72204°

**DEPTH**  
ELEVATION (FL)

<table>
<thead>
<tr>
<th>ELEVATION (FL)</th>
<th>DEPTH (FL)</th>
<th>WATER LEVEL OBSERVATIONS</th>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>LL-PL-PI</th>
<th>PERCENT FINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>601.5+/-</td>
<td>3-2-2</td>
<td>N=4</td>
<td>7</td>
<td>NP</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>600.5+/-</td>
<td>3-2-3</td>
<td>N=5</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**  
Stratification lines are approximate. In-situ, the transition may be gradual.

**Advancement Method:** 8-inch Hollow Stem Auger

**Abandonment Method:** Borings backfilled with soil cuttings upon completion.

**Water Level Observations:** Not observed

**Hammer Type:** Automatic

**Boring Terminated at 6.5 Feet**

**Per cent Fine with water content, dry unit weight, atterberg limits, and percent fines:**

- **Per cent Fine:**
  - Water Content (%): 7, 9
  - Dry Unit Weight (pcf): NP
  - LL-PL-PI: 37
  - Percent Fines: 37

**Exhibit:** A-14

**Driller:** EDI

**Drill Rig:** CME-75

**Project No.:** 69145016

**Boring Started:** 7/23/2014  
**Boring Completed:** 7/23/2014

**Drill Rig:** CME-75  
**Driller:** EDI

**Project No.:** 69145016  
**Exhibit:** A-14

**Terrain:**
- 3.5 inches of Asphalt
- 5.5 inches of Aggregate Base Course
- Lean Clay with Gravel (CL), brown to dark brown
- Silty Sand (SM), light brown, loose

**Other Notes:**
- Advancement Method: 8-inch Hollow Stem Auger
- Abandonment Method: Borings backfilled with soil cuttings upon completion.
- Water Level Observations: Not observed
- Hammer Type: Automatic
- Boring Terminated at 6.5 Feet

**Terrain Details:**
- Approximate Surface Elev: 6502 (FL)
- Stratification lines are approximate. In-situ, the transition may be gradual.

**Terrain Descriptions:**
- 3.5 inches of Asphalt
- 5.5 inches of Aggregate Base Course
- Lean Clay with Gravel (CL), brown to dark brown
- Silty Sand (SM), light brown, loose

**Exhibit:** A-2

**Client:** Gallup-McKinley County School  
Gallup, NM

**SITE:** 700 West Wilson Avenue  
Gallup, New Mexico

**Driller:** EDI

**Drill Rig:** CME-75

**Project No.:** 69145016  
**Exhibit:** A-14
**BORING LOG NO. B-12**

**PROJECT:** New Del Norte Elementary School  
**SITE:** 700 West Wilson Avenue  
**Gallup, New Mexico**

**CLIENT:** Gallup-McKinley County School  
**Gallup, NM**

**LOCATION:** See Exhibit A-2  
Latitude: 35.53102°  
Longitude: -108.75146°

**DEPTH** Approximate Surface Elev: 6508 (FL) +/-

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>ATTERBERG LIMITS</th>
<th>LL-PL-PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WATER LEVEL OBSERVATIONS**

- **Not observed**

**FIELD TEST RESULTS**

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>FIELD TEST RESULTS</th>
<th>WATER CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>ATTERBERG LIMITS</th>
<th>LL-PL-PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SILTY SAND (SM), light brown, loose**

**LEAN CLAY WITH GRAVEL (CL), brown to dark brown**

**Boring Terminated at 6.5 Feet**

**Advancement Method:**  
8-inch Hollow Stem Auger

**Abandonment Method:**  
Borings backfilled with soil cuttings upon completion.

**Notes:**

- See Exhibit A-3 for description of field procedures.
- See Appendix B for description of laboratory procedures and additional data (if any).
- See Appendix C for explanation of symbols and abbreviations.

**Stratification lines are approximate. In-situ, the transition may be gradual.**

**Hammer Type:** Automatic

**Boring Started:** 7/23/2014  
**Boring Completed:** 7/23/2014

**Drill Rig:** CME-75  
**Driller:** EDI

**Project No.:** 69145016  
**Exhibit:** A-15
Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

### Plasticity Index

<table>
<thead>
<tr>
<th>Plasticity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1 - 10</td>
</tr>
<tr>
<td>&gt; 10</td>
</tr>
</tbody>
</table>

### Water Levels

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

### Descriptive Soil Classification

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

### Location and Elevation Notes

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

### Field Tests

- (HP) Hand Penetrometer
- (T) Torvane
- (bf) Standard Penetration Test (blows per foot)
- (PID) Photo-Ionization Detector
- (OVA) Organic Vapor Analyzer

### General Notes

Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.
### UNIFIED SOIL CLASSIFICATION SYSTEM

#### Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests

<table>
<thead>
<tr>
<th>Coarse Grained Soils:</th>
<th>Gravels: More than 50% of coarse fraction retained on No. 4 sieve</th>
<th>Clean Gravels: Less than 5% fines c</th>
<th>Gravels with Fines: More than 12% fines c</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Clean Gravels: Cu ≥ 4 and 1 ≤ Cc ≤ 3 E</td>
<td>Gravels with Fines: Fines classify as ML or MH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cu &lt; 4 and/or 1 &gt; Cc ≥ 3 E</td>
<td>Fines classify as CL or CH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sands: 50% or more of coarse fraction passes No. 4 sieve</th>
<th>Clean Sands: Less than 5% fines d</th>
<th>Sands with Fines: More than 12% fines d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cu ≥ 6 and 1 ≤ Cc ≤ 3 E</td>
<td>Fines classify as ML or MH</td>
</tr>
<tr>
<td></td>
<td>Cu &lt; 6 and/or 1 &gt; Cc ≥ 3 E</td>
<td>Fines classify as CL or CH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fine-Grained Soils:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sands and Clays: Liquid limit less than 50</td>
</tr>
</tbody>
</table>

| Inorganic: | PI > 7 and plots on or above “A” line j | CL Lean clay KLM |
|           | PI < 4 or plots below “A” line j       | ML Silt KLM |

| Organic: | Liquid limit - oven dried < 0.75 | OL Organic clay KLM |

| Inorganic: | PI plots on or above “A” line | CH Fat clay KLM |
|           | PI plots below “A” line | MH Elastic Silt KLM |

| Organic: | Liquid limit - oven dried < 0.75 | OH Organic clay KLM |
|           | Liquid limit - not dried | Organic silt KLM |

| Highly organic soils: | Primarily organic matter, dark in color, and organic odor | PT Peat |

---

**A** Based on the material passing the 3-inch (75-mm) sieve

**B** If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

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

**D** Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

**E** Cu = D60/D10, Cc = \( \frac{(D_{30})^2}{D_{10} \times D_{60}} \)

**F** If soil contains ≥ 15% sand, add "with sand" to group name.

**G** If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

---

**H** If fines are organic, add "with organic fines" to group name.

**I** If soil contains ≥ 15% gravel, add "with gravel" to group name.

**J** If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

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

**L** If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

**M** If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravely" to group name.

**N** If PI ≥ 4 and plots on or above “A” line.

**O** If PI < 4 or plots below “A” line.

**P** If PI plots on or above “A” line.

**Q** If PI plots below “A” line.
DESCRIPTION OF ROCK PROPERTIES

WEATHERING
Fresh  Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight  Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist’s pick.
Severe All rock except quartz discolored or stained. Rock “fabric” clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe All rock except quartz discolored or stained. Rock “fabric” discernible, but mass effectively reduced to “soil” with only fragments of strong rock remaining.
Complete Rock reduced to “soil”. Rock “fabric” not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh’s scale for minerals)
Very hard Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist’s pick.
Hard Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist’s pick. Hand specimens can be detached by moderate blow.
Medium Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist’s pick.
Soft Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

<table>
<thead>
<tr>
<th>Spacing</th>
<th>Joints</th>
<th>Bedding/Foliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 in.</td>
<td>Very close</td>
<td>Very thin</td>
</tr>
<tr>
<td>2 in. – 1 ft.</td>
<td>Close</td>
<td>Thin</td>
</tr>
<tr>
<td>1 ft. – 3 ft.</td>
<td>Moderately close</td>
<td>Medium</td>
</tr>
<tr>
<td>3 ft. – 10 ft.</td>
<td>Wide</td>
<td>Thick</td>
</tr>
<tr>
<td>More than 10 ft.</td>
<td>Very wide</td>
<td>Very thick</td>
</tr>
</tbody>
</table>

a. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

<table>
<thead>
<tr>
<th>Rock Quality Designator (RQD) a</th>
<th>Joint Openness Descriptors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RQD, as a percentage</strong></td>
<td><strong>Openness</strong></td>
</tr>
<tr>
<td>Exceeding 90</td>
<td>No Visible Separation</td>
</tr>
<tr>
<td>90 – 75</td>
<td>Less than 1/32 in.</td>
</tr>
<tr>
<td>75 – 50</td>
<td>1/32 to 1/8 in.</td>
</tr>
<tr>
<td>50 – 25</td>
<td>1/8 to 3/8 in.</td>
</tr>
<tr>
<td>Less than 25</td>
<td>3/8 in. to 0.1 ft.</td>
</tr>
<tr>
<td></td>
<td>Greater than 0.1 ft.</td>
</tr>
</tbody>
</table>

a. RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

APPENDIX B

Laboratory Testing
Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix A. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- Consolidation/Compression
- In-situ Water Content
- Sieve Analysis
- In-situ Dry Density
- Atterberg Limits
- Soluble Sulfates
- Resistivity
- pH
GRAIN SIZE DISTRIBUTION
ASTM D422

GRAIN SIZE IN MILLIMETERS

COBBLES

GRAVEL

SAND

SILT OR CLAY

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Depth</th>
<th>USCS Classification</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>Cc</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-06</td>
<td>15.0</td>
<td>LEAN CLAY with SAND(CL)</td>
<td>29</td>
<td>19</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-06</td>
<td>45.0</td>
<td>LEAN CLAY(CL)</td>
<td>39</td>
<td>18</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-07</td>
<td>2.5</td>
<td>LEAN CLAY with SAND(CL)</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-09</td>
<td>2.5</td>
<td>SILTY SAND(SM)</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-11</td>
<td>2.5</td>
<td>SILTY SAND(SM)</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Depth</th>
<th>D100</th>
<th>D60</th>
<th>D30</th>
<th>D10</th>
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<th>%Sand</th>
<th>%Silt</th>
<th>%Clay</th>
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<td></td>
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<td>25.4</td>
<td>74.6</td>
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<td></td>
<td>0.0</td>
<td>12.4</td>
<td>86.9</td>
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<tr>
<td>B-07</td>
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<td>1.18</td>
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<td>20.0</td>
<td>79.9</td>
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<tr>
<td>B-09</td>
<td>2.5</td>
<td>1.18</td>
<td>0.166</td>
<td>0.08</td>
<td></td>
<td>0.0</td>
<td>72.3</td>
<td>27.6</td>
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<tr>
<td>B-11</td>
<td>2.5</td>
<td>0.6</td>
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<td></td>
<td>0.0</td>
<td>63.0</td>
<td>36.7</td>
<td></td>
</tr>
</tbody>
</table>

PROJECT: New Del Norte Elementary School
SITE: 700 West Wilson Avenue
Gallup, New Mexico

CLIENT: Gallup-McKinley County School
Gallup, NM

EXHIBIT: B-3
## Atterberg Limits Results

### ASTM D4318

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Depth</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>Fines</th>
<th>USCS</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>B-01</td>
<td>10.0</td>
<td>39</td>
<td>17</td>
<td>22</td>
<td>75</td>
<td>CL</td>
<td>LEAN CLAY with SAND</td>
</tr>
<tr>
<td>B-02</td>
<td>10.0</td>
<td>55</td>
<td>21</td>
<td>34</td>
<td>88</td>
<td>CH</td>
<td>FAT CLAY</td>
</tr>
<tr>
<td>B-03</td>
<td>2.5</td>
<td>42</td>
<td>19</td>
<td>23</td>
<td>91</td>
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**Liquid Limit**

![Graph showing Atterberg limits](image)

**Notes:**
- Laboratory tests are not valid if separated from original report.
- Project number: 69145016
- Client: Gallup-McKinley County School, Gallup, NM
- Exhibit: B-4

**Project:** New Del Norte Elementary School

**Site:** 700 West Wilson Avenue, Gallup, New Mexico

**Flora Vista, New Mexico**
Specimen Identification | Classification | \( \gamma_d \), pcf | WC, %
--- | --- | --- | ---
B-01 10.0 ft | LEAN CLAY with SAND(CL) | 98 | 19

NOTES:
**SWELL CONSOLIDATION TEST**

ASTM D4546

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### Laboratory Test Results

**Specimen Identification**

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**NOTES:**

- Specimens not included in this report are not valid.

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**EXHIBIT: B-6**

---

**PROJECT:** New Del Norte Elementary School

**SITE:** 700 West Wilson Avenue
Gallup, New Mexico

**CLIENT:** Gallup-McKinley County School
Gallup, NM

**PROJECT NUMBER:** 69145016

**EXHIBIT:** B-6
SWELL CONSOLIDATION TEST
ASTM D4546

AXIAL STRAIN, %

PRESSURE, psf

Specimen Identification | Classification                  | $\gamma_d$, pcf | WC, %
---|--------------------------|----------------|-----
- B-06 15.0 ft | LEAN CLAY with SAND(CL) | 84 | 9

NOTES:

PROJECT: New Del Norte Elementary School
SITE: 700 West Wilson Avenue
Gallup, New Mexico

PROJECT NUMBER: 69145016
CLIENT: Gallup-McKinley County School
Gallup, NM

EXHIBIT: B-7
SWELL CONSOLIDATION TEST
ASTM D4546

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NOTES:

#4A CR 3499
Flora Vista, New Mexico
The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.
### Summary of Laboratory Results

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<th>Plastic Limit</th>
<th>Plasticity Index</th>
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<th>% Gravel</th>
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