GEOTECHNICAL EVALUATION

PROPOSED VOCATIONAL SCHOOL
KAYENTA, ARIZONA

JOB NO. 3129JS056

Western Technologies Inc.
The Quality People
Since 1955

Environmental, Geotechnical, & Construction Materials
Engineering, Consulting, Testing & Inspection

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Western Technologies Inc.
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Prepared for:

THE O'MALLEY GROUP

October 20, 2009

Registered Professional Engineer (Civil)
CERTIFICATE NO.
28453
JEFF M.
BOYD
Date Signed 10-20-09
ARIZONA, U.S.A.

EXPIRES
12/31/2009

Roger K. Southworth
Director of Geotechnical Services

Jeff M. Boyd, P.E.
Principal

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October 20, 2009

Mr. Timothy J. O'Malley, CFM, CPSI
The O'Malley Group, LLC
80 West State Avenue, Suite 300
Phoenix, Arizona 85021-8752

Re: Geotechnical Evaluation
Proposed Vocational School
Kayenta, Arizona

Job No. 3129JS056

Dear Mr. O'Malley:

Western Technologies Inc. has completed the geotechnical evaluation for the above-referenced project. This study was performed in general accordance with our proposal number 3129PS062-R dated September 24, 2009. The results of our study, including the boring location diagram, boring logs, laboratory test results, and the geotechnical recommendations are attached.

We have appreciated being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. Please do not hesitate to contact us if the design conditions change or if you have any questions concerning this report. We look forward to working with you on future projects.

Sincerely,

WESTERN TECHNOLOGIES, INC.

Roger K. Southworth
Director of Geotechnical Services

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GEOTECHNICAL EVALUATION

PROPOSED VOCATIONAL SCHOOL
KAYENTA, ARIZONA

JOB NO. 3129JS056

1.0 PURPOSE

This report contains the results of our geotechnical evaluation for the proposed vocational school that will be constructed in Kayenta, Arizona. The purpose of these services is to provide information and recommendations regarding:

- Foundation Design
- Floor Slab Support
- Pavement Design
- Earthwork
- Drainage
- Soil Infiltration Rate

The results of the field exploration and the field and laboratory testing programs are presented in the Appendices.

2.0 PROJECT DESCRIPTION

The project will consist of constructing a vocational school in Kayenta, Arizona. The proposed facility will include the construction of several classroom buildings and parking lots and drives. The proposed buildings will consist of one-story metal structures. It was assumed that the buildings would have maximum wall loads on the order of 3 kips per lineal foot and maximum column loads on the order of 100 kips. It was also assumed that grade changes of less than about 4 feet would be required to develop the finish site grades. We should be notified immediately if any of our assumptions are incorrect since a revision of the recommendations presented herein could then be necessary.

3.0 SCOPE OF SERVICES

3.1 Field Exploration

Four borings to depths of 21½ feet were drilled for this project. The borings were drilled at the approximate locations indicated on the attached Boring Location Diagram. The number of borings and the boring locations were specified by the client.

A WT geotechnical engineer monitored the drilling operations and prepared a field log for each of the borings. These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples.

The final boring logs, included in Appendix A, represent our interpretation of the field logs and may include modifications based on laboratory observations of the recovered soil samples. The final logs describe the materials encountered, their thicknesses, and the depths at which samples were obtained.

The Unified Soil Classification System was used to classify the soils. The soil classification symbols appear on the boring logs and are briefly described in Appendix A.

3.2 Laboratory Testing

Laboratory analyses were performed on representative samples to aid in material classification and to estimate the pertinent engineering properties of the on-site materials. Testing was performed in general accordance with applicable ASTM specifications. The following tests were performed and the results are presented in Appendix B.

- Percent Passing No. 200 Sieve
- Liquid and Plastic Limit
- Compression/Swell
- Water Content
- Dry Density

The laboratory test results were used in the development of the recommendations contained in this report.

3.3 Analyses and Report

Analyses were performed and this report was prepared for the exclusive purpose of providing geotechnical engineering information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

This geotechnical engineering report includes a description of the project, a discussion of the field and laboratory testing programs, a discussion of the subsurface conditions, and design recommendations as required to satisfy the purpose previously described.

4.0 SITE CONDITIONS

4.1 Surface

The proposed school will be located on a vacant parcel located north of the Kayenta High School. The site has a rolling topography and is generally vegetated with sparse grass and weeds.

4.2 Subsurface

Silty sand and sandy silt were encountered in the borings to depths of about 4 to 10½ feet. The sand and silt were underlain by interbedded layers of lean clay, sandy clay, clayey sand, poorly graded sand and shale. The relative density of the granular deposits typically varied between loose and medium dense, and the consistency of the cohesive deposits typically varied between stiff and hard.

4.3 Groundwater

Groundwater was not encountered in the borings during drilling operations. The level of the groundwater table will fluctuate seasonally with variations in the amount of precipitation, evaporation, and surface water runoff. The observations made during this investigation must be interpreted carefully because they are short-term and do not constitute a groundwater study.

5.0 GEOTECHNICAL PROPERTIES & ANALYSIS

5.1 Laboratory Tests

Compression tests were performed on samples of the sand to evaluate the collapse potential of the soil (see Appendix B). The test results indicated compression values of 7.8 and 8.2 percent when the samples were inundated with water. In addition, tests indicate that the sand has a low dry unit weight, with densities of 94 and 102 pounds per cubic foot (pcf). These test results indicate that the soils can experience a significant decrease in volume and cause settlement of the structure when the water content is increased.

A swell test was performed on a sample of the clay to evaluate the swell potential of the soil. The test result indicated a swell value of 2.2 percent when the sample was inundated with water. This test result indicates that the clay can experience a change in volume with variations in the soil water content and cause shrink/swell induced movement of the structure. Treatment of the foundation/floor slab subgrade will therefore be necessary to reduce swell/compression-induced movements and to allow the use of spread footing foundation systems and slab-on-grade floors.

5.2 Field Tests

Penetration tests were performed in general accordance with ASTM test methods D1586 and D3550 to assist in evaluating the relative density/consistency of the soil. The penetration test results indicate moderate penetration resistance. Following treatment of the foundation subgrade to reduce the amount of swell/compression-induced movement, the subgrade is considered to be suitable for indirect support of the relatively lightly loaded foundations that will be required for the proposed structures.

6.0 RECOMMENDATIONS

6.1 General

The recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0, **Project Description**, and the assumption that the subsurface conditions are those disclosed by the borings. Others may change the plans, final elevations, number and type of structures, foundation loads, and floor levels during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

6.2 Foundations

The proposed buildings can be supported by spread footing foundation systems. The sands within the foundation influence zone have a hydrocollapse settlement potential and the clays have a potential for heave. The foundation soils should therefore be overexcavated to a minimum depth of 4 feet below the design foundation bearing grade. The foundation overexcavations should then be backfilled to the design finish grade with the on-site soils. Recommendations for foundation subgrade preparation are presented in greater detail in the **Earthwork** section of this report.

Foundations bearing on recompacted on-site soils can be designed for a maximum net allowable bearing capacity of 2,000 pounds per square foot (psf). The allowable bearing capacity applies to dead loads plus design live load conditions. The allowable bearing capacity may be increased by one-third when considering total loads that include wind or seismic.

The foundations should bear a minimum of 30 inches below the final adjacent site grade for frost considerations. Interior foundations in heated areas can bear directly beneath the floor slab. Strip footings should have a minimum width of 18 inches and isolated column pad foundations should have a minimum dimension of 24 inches.

Thickened slab sections can be used to support interior partitions provided that:

- loads do not exceed 900 pounds per lineal foot (plf),
- thickened sections have a minimum width of 12 inches, and
- thickness and reinforcement are consistent with the structural requirements.

We estimate that the total post-construction movement of foundations supported as recommended herein will be on the order of 1 inch or less. We estimate that the differential movement between comparably sized and loaded foundations will be on the order of one-half the total foundation movement. Additional foundation movements can occur if water from any source infiltrates the foundation subgrade. Therefore, proper drainage should be provided in the final design and during construction.

All footings, stem walls, and masonry walls should be reinforced to reduce the potential for distress caused by differential foundation movements. The use of joints at openings and other discontinuities in masonry walls is recommended. Joints should also be closely spaced along the length of masonry site retaining walls and screen walls to accommodate minor differential foundation movements.

We recommend that the geotechnical engineer or a representative of the engineer observe the base of the foundation overexcavations prior to backfilling operations. This observation is to assess whether the exposed overexcavation subgrade is similar to that anticipated for structural fill subgrade and indirect support of the footings. Any loose, soft, or disturbed material should be undercut to a suitable bearing subgrade.

6.3 Slab-on-Grade Support

The floor slab can be designed as a slab-on-grade. The floor slab subgrade should be prepared in accordance with the procedures outlined in the **Earthwork** section of this report. Floor slab subgrade preparation should include the removal of any clay that is present within 3 feet of the planned finished grade.

The floor slab should be underlain by a minimum 4-inch-thick layer of granular fill to prevent the capillary rise of water beneath the slab. The granular fill should consist of sand, sand-gravel, crushed stone, or a combination of these materials. The granular fill should have a maximum particle diameter of no more than one-half the granular fill thickness and should contain no more than 15 percent passing the No. 200 sieve. In addition, the granular fill should have a maximum plasticity index of 6 and a maximum liquid limit of 25 percent.

The use of vapor retarders is desirable for any slab-on-grade where the floor will be covered by products using water-based adhesives, wood, vinyl-backed carpet, impermeable floor coatings (urethane, epoxy, acrylic terrazzo, etc.) or where the floor will be in contact with moisture-sensitive equipment or product. When used, the design and installation should be in accordance with the recommendations presented in ACI 302.1R-04. Final determination on the use of a vapor retarder should be left to the slab designer.

All concrete placement and curing operations should follow the American Concrete Institute manual recommendations. Improper curing techniques and/or high slump (high water-cement ratio) could cause excessive shrinkage, cracking, or curling of the floor slab. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture-sensitive floor covering.

6.4 Drainage

A major cause of soil-related foundation and slab-on-grade problems is an increase in the water content of the soil below structures. Properly functioning foundations and floor slabs require appropriately constructed and maintained site drainage conditions. Therefore, it is extremely important that positive drainage be provided during construction and maintained throughout the life of the structure. It is also important that proper planning and control of landscape and irrigation be performed.

Water infiltration into utility or foundation excavations must be prevented during construction. Backfill against grade beams, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the potential for moisture infiltration.

The building should be provided with downspout extensions to direct water away from the structure. The downspouts should discharge into drainage swales or into the storm sewer system.

In areas where sidewalks, patios, or driveways do not immediately adjoin the structure, protective slopes should be provided with an outfall of about five percent for at least 10 feet from the perimeter walls. Planters or other surface features that could retain water adjacent to the structure should be avoided. If planters and/or landscaping are adjacent to or near the structure, we recommend the following:

- Planters should slope away from the structure and should not pond water. Drains should be installed in enclosed planters to facilitate flow out of the planters.
- Only shallow-rooted landscaping should be used.
- Watering should be kept to a minimum. Irrigation systems should be situated on the far side of any planting and away from the structure to reduce the potential for infiltration beneath foundations from possible leaks.

It should be understood that these recommendations will help reduce the potential for movement and resulting distress, but will not eliminate this potential.

6.5 Exterior Slabs

The clay has the potential to expand and shrink with changes in the water content. Therefore, relatively lightweight exterior concrete flatwork such as sidewalks, patios, and driveways, may experience movement resulting in cracking or vertical offsets. To reduce the potential for damage, we recommend:

- Use of fill with low expansion potential
- Placement of effective control joints on relatively close centers
- Moisture-density control during placement of subgrade fills
- Provision for adequate drainage in areas adjoining the slabs
- Use of designs which allow vertical movement between the exterior slabs and adjoining structural elements

It should be understood that these recommendations will help reduce the potential for subgrade movement and resulting distress, but will not eliminate this potential.

6.6 Corrosivity

Based on local practice and material availability, we recommend that Type II Portland cement be used for all concrete on and below grade.

6.7 Soil Adsorption Rate

The soil application rate for the site soil was determined in accordance with the procedures presented Section 20.7.3.703 of the New Mexico Administrative Code. The design application rate will be a function of the design elevation of the base of the adsorption field and the location on the site. The silty sand is classified as Type II soil. Type II soils have a recommended soil application rate of 2.00 sq. ft/gal/day. The clayey soils are classified as Type IV soil. Type IV soils have a recommended application rate of 5.00 sq.ft/gal/day.

6.8 Pavements

The anticipated type and volume of traffic that the parking lot and drives will be subject to was unknown. For estimating purposes, it was assumed that the parking lot would be subject to both passenger vehicles and small- to medium-size delivery trucks. On this basis, a daily traffic value of two Equivalent 18-kip Single Axle Loads (ESAL) was assumed for passenger car parking areas and drives (light duty), and a traffic value of 10 ESALs was assumed for the access drives. A revision of the recommended pavement sections may be necessary if the expected traffic loading conditions are different than assumed.

It is anticipated that the pavement subgrade will consist of silty sand. These deposits are considered as a moderate quality material for support of pavements. A resilient modulus (M_r) of 8,000 pounds per square inch was assumed for design.

A reliability value of 70 percent was assumed for pavement design. This parameter assumes that the pavement will be subject to occasional interruption of traffic for pavement repairs. Based upon these parameters, the resulting pavement sections according to the AASHTO procedure for a 20-year design life are:

Traffic Area	Asphalt Concrete Pavement (inches)	Base Course (inches)
Light Duty	2.5	6.0
Access Drives	4.0	4.0

The "design life" of a pavement is defined as the expected life at the end of which reconstruction of the pavement will need to occur. Normal maintenance, including crack sealing, slurry sealing, and/or chip sealing, should be performed during the life of the pavement.

Due to the high static loads imposed by parking trucks in loading and unloading areas and at dumpster locations, we recommend a rigid pavement section for these areas. A minimum six-inch thick Portland cement concrete pavement is recommended.

Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphalt concrete. Base course, Portland cement, and asphalt concrete should conform to the Arizona Department of Transportation or the Federal Highway Administration (FHWA) specifications.

Material and compaction requirements should conform to the recommendations presented in the **Earthwork** section of this report. The gradient of paved surfaces should ensure positive drainage. Water should not be allowed to pond in areas directly adjoining paved sections.

7.0 EARTHWORK

7.1 General

The conclusions contained in this report are contingent upon compliance with recommendations presented in this section. Any excavating, trenching, or disturbance that occurs after completion of the earthwork must be backfilled, compacted, and tested in accordance with the recommendations contained herein. It is not reasonable to rely upon our conclusions and recommendations if any future unobserved and untested trenching, earthwork activities, or backfilling occurs.

7.2 Site Clearing

Strip and remove any existing vegetation, debris, and other deleterious materials from the proposed building and pavement areas. The building area is defined as the area within the building footprint plus five feet beyond the perimeter of the footprint. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

7.3 Building Pad Preparation

Cut the building pad as required to the design finish grade. In any areas where clay is present within 3 feet of the planned finish grade, overexcavate the clay and replace it with non-expansive engineered fill. Overexcavation of the floor slab subgrade is not necessary in areas where the sandy silt and silty sand is present within 3 feet of the finish grade.

Overexcavate foundation areas to a minimum depth of 4 feet below the design foundation bearing grade. The foundation overexcavations should extend a minimum of two feet beyond the footing edges. Scarify the building pad and the base of the overexcavation to a minimum depth of 6 inches and recompact the subgrade in accordance with the recommendations presented in Section 7.6. Backfill the overexcavation to the design bearing elevation with engineered fill.

7.4 Pavement Subgrade Preparation

Following site clearing operations, the pavement subgrade should be cut as required to the design finish subgrade elevation. The exposed subgrade should then be proof rolled in the presence of the project geotechnical engineer or a representative of the engineer. Proof rolling should be performed using a heavily loaded, rubber-tired piece of construction equipment (25 ton or greater total weight), such as a loaded tandem-axle dump truck or water truck, making several passes over the area. Any soft, loose, or unstable zones should be removed to a suitable bearing subgrade. The subgrade should then be scarified to a depth of 8 inches and recompacted in accordance with the recommendations presented in Section 7.6. The pavement area should then be filled to the design finish grade with engineered fill.

7.5 Materials

The silts and sands are considered to be suitable for reuse as fill in the planned building and pavement areas. The clays are not recommended for reuse as fill. Imported soils should conform to the following:

- Gradation (ASTM C140):

	percent finer by weight
6"	100
4"	85-100
¾"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	40 (max)

- Maximum expansive potential (%)* 1.5
- Maximum soluble sulfates (%) 0.10

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about three percent below the optimum water content. The sample is confined under a 100 psf surcharge and submerged.

Imported fill should be approved by WT prior to placement.

7.6 Placement and Compaction

a. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

b. Uncompacted fill lifts should not exceed 10 inches.

c. No fill should be placed over frozen ground.

d. Materials should be compacted to the following:

Material	Minimum Percent Compaction (ASTM D698)
▪ Imported or on-site fill in the building and pavement areas	95
▪ Granular fill below slabs-on-grade	95
▪ Nonstructural backfill	90

Imported and on-site soil should be compacted within a water content range of -3 to +3 percent of the optimum water content.

7.7 Compliance

Recommendations for foundation and slab-on-grade elements supported on compacted fill or prepared subgrade depend upon compliance with the **Earthwork** recommendations. To assess compliance, observation and testing should be performed under the direction of the project geotechnical engineer.

8.0 LIMITATIONS

This report has been prepared based on our understanding of the project criteria as described in Section 2.0. Others may make changes in the project criteria during design or construction, and substantially different subsurface conditions may be encountered or become known. The conclusions and recommendations presented herein shall not continue to be valid unless all variations are brought to our attention in writing, and we have had an opportunity to assess the effect such variations may have on our conclusions and recommendations and respond in writing.

The recommendations presented are based upon data derived from a limited number of samples obtained from widely spaced borings. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. The geotechnical engineer necessarily makes assumptions as to the uniformity of the geology and soil structure between borings, but variations can exist. Accordingly, whenever any deviation or change is encountered or become known during design or construction, WT shall be notified in writing. WT shall review the matter, and issue a written response regarding the validity of the conclusions and recommendations presented herein.

This report does not provide information relative to construction methods or sequences. Any person reviewing this report must draw his/her own conclusions regarding site conditions as they relate to the employment or development of construction techniques. This report is valid for one year after the date of issuance unless there is a change in circumstances or discovered variations justifying an earlier expiration of validity. After expiration, no person or entity has any right to rely on this report without further review and reporting by WT under a separate contract.

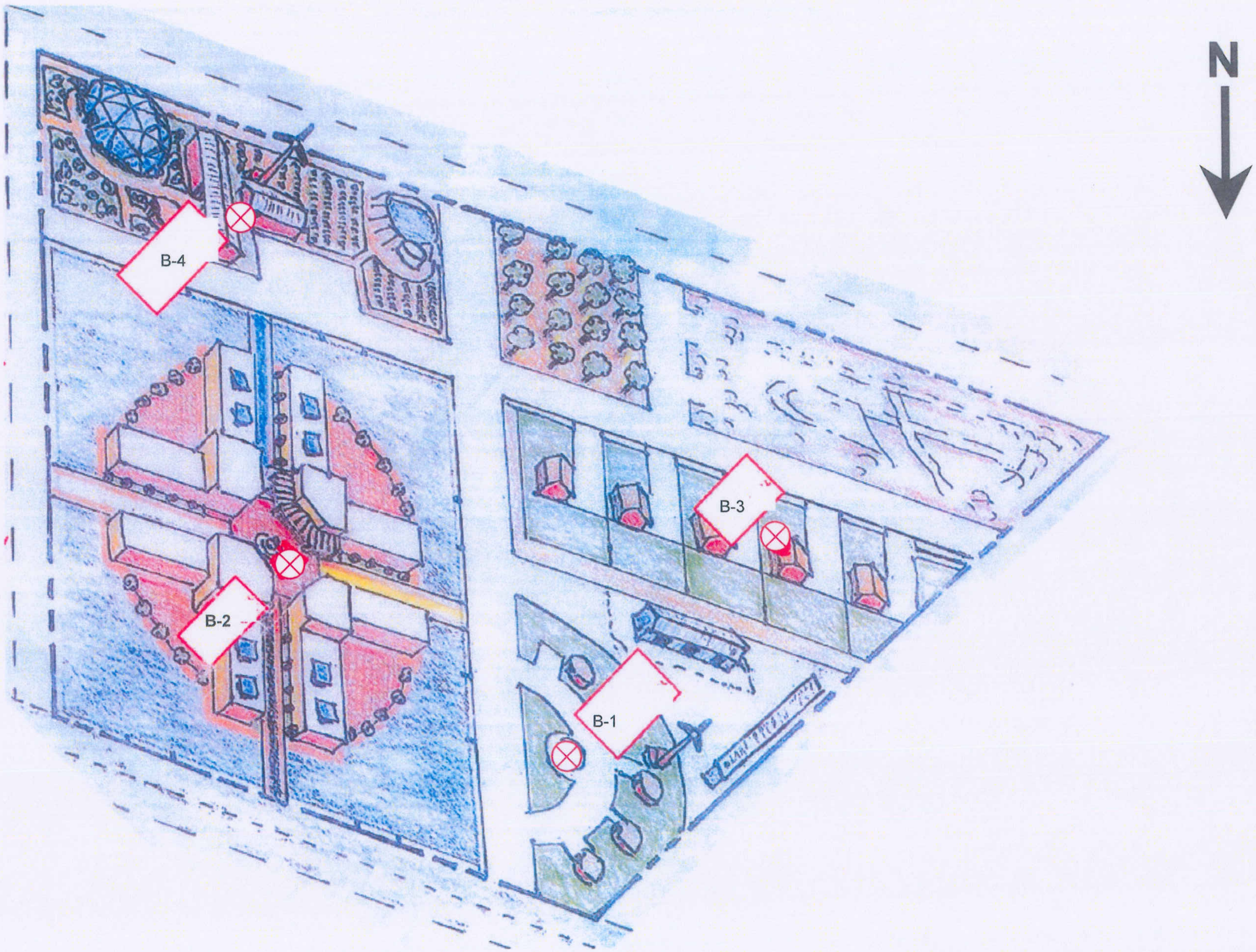
The recommendations contained herein may be based upon government regulations in effect at the time of this report. Future changes or modifications to these regulations may require modification of this report.

9.0 OTHER SERVICES

The geotechnical engineer should be retained for a general review of final plans and specifications to evaluate compliance with our recommendations. The geotechnical engineer should also be retained to provide observation and testing services during excavation, earthwork operations, and foundation and construction phases of the project. Observation of footing excavations should be performed prior to placement of reinforcing and concrete to confirm that satisfactory bearing materials are present.

10.0 CLOSURE

We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations, and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon conditions at the location of specific tests, observations and data developed to satisfy the scope of services defined by the contract documents. Work on your project was performed in accordance with generally accepted industry standards and practices by other professionals providing similar services in this locality. No other warranty, express or implied, is made.



⊗ **APPROXIMATE BORING LOCATION**

PROPOSED VOCATIONAL SCHOOL	
BORING LOCATION DIAGRAM	
Western Technologies Inc.	
Job No.: 3129JS056	Plate: 1

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Allowable Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
Concrete Slabs-on-Grade	A concrete surface layer cast directly upon a base, subbase or subgrade.
Crushed Rock Base Course	A base course composed of crushed rock of a specified gradation.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Engineered Fill	Specified material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Existing Grade	The ground surface at the time of field exploration.
Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Fill	Materials deposited by the actions of man.
Finished Grade	The final grade created as a part of the project.
Gravel Base Course	A base course composed of naturally occurring gravel with a specified gradation.
Heave	Upward movement
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
Sand & Gravel Base	A base course composed of sand and gravel of a specified gradation.
Sand Base Course	A base course composed primarily of sand of a specified gradation.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Soil	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material placed to form a layer between the subgrade and base course.
Subbase Grade	Top of subbase.
Subgrade	Prepared native soil surface.

PROPOSED VOCATIONAL SCHOOL	
Definition of Terminology	
Western Technologies Inc.	
Job No.: 3129JS056	Plate: A-1

GROUP SYMBOLS	COARSE-GRAINED SOILS LESS THAN 50% FINES* DESCRIPTION	MAJOR DIVISIONS	GROUP SYMBOLS	FINE-GRAINED SOILS MORE THAN 50% FINES DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	**ML**	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50
GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES		**CL**	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% FINES		**OL**	ORGANIC SILTS OR ORGANIC SILT-CLAYS OF LOW PLASTICITY	
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% FINES		**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	SILTS AND CLAYS LIQUID LIMIT MORE THAN 50
SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	**CH**	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES		**OH**	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	
SM	SILTY SANDS, SAND-SILT MIXTURES, MORE THAN 12% FINES				
SC	CLAYEY SANDS, SAND-CLAY MIXTURES, MORE THAN 12% FINES		**PT**	PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

NOTE: Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

NOTE: Fine-grained soils may receive dual classification based upon plasticity characteristics.

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	Above 12 in.
COBBLES	3 in. – 12 in.
GRAVEL	No. 4 – 3 in.
Coarse	3/4 in. – 3 in.
Fine	No. 4 – 3/4 in.
SAND	No. 200 – No. 4
Coarse	No. 10 – No. 4
Medium	No. 40 – No. 10
Fine	No. 200 – No. 40
*Fines (Silt or Clay)	Below No. 200

NOTE: Only sizes smaller than three inches are used to classify soils

CONSISTENCY

CLAYS & SILTS	BLOWS PER FOOT N[1]	BLOWS PER FOOT R[2]
VERY SOFT	0 – 2	0 – 2
SOFT	2 – 4	2 – 4
FIRM	4 – 8	4 – 9
STIFF	8 – 16	9 – 18
VERY STIFF	16 – 32	18 – 42
HARD	Over 32	Over 42

RELATIVE DENSITY

SANDS & GRAVELS	BLOWS PER FOOT N[1]	BLOWS PER FOOT R[2]
VERY LOOSE	0 – 4	0 – 8
LOOSE	4 – 10	8 – 19
MEDIUM DENSE	10 – 30	19 – 57
DENSE	30 – 50	57 – 94
VERY DENSE	Over 50	Over 94

[1]Number of blows of 140-pound hammer falling 30 inches to drive a 2-inch O.D. (1⅜-inch ID) split-spoon (ASTM D1586).

[2]Number of blows of 140-pound hammer falling 30 inches to drive a 3-inch O.D. (2½ inch ID) ring-lined barrel (ASTM D3550).

PLASTICITY OF FINE-GRAINED SOILS

PLASTICITY INDEX	TERM
1 – 7	LOW
8 – 25	MEDIUM
Over 25	HIGH

DEFINITION OF WATER CONTENT

DRY
DAMP
MOIST
WET
SATURATED

PROPOSED VOCATIONAL SCHOOL	
Method of Soil Classification	
Western Technologies Inc.	
Job No.:3129JS056	Plate: A-2

The number shown in **"BORING NO."** refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing from property lines and/or existing features.

"TYPE/SIZE BORING" refers to the exploratory equipment used in the boring wherein **HSA = hollow stem auger, SSA = solid-stem auger, RW = rotary wash, RA = rotary air, RAF = rotary air with foam, CNX = NX-size diamond core, CBX = BX-size diamond core, CHQ = HQ-size diamond core.**

"N" in Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a two-inch-outside-diameter split-barrel sampler a distance of 1 foot, Standard Penetration Test (ASTM D1586). Refusal to penetration is defined as more than 100 blows per foot.

"R" in Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a 2.42-inch-inside-diameter ring sampler a distance of 1 foot. Refusal to penetration is considered more than 50 blows per foot.

"Sample Type" refers to the form of sample recovery, in which **N = Split-barrel sample, R = Ring sample, G = Grab Sample, B = Block Sample, T = Thin-walled tube sample, CR = Core Run.**

"Dry Density, pcf" refers to the laboratory-determined dry density in pounds per cubic foot.

"Water Content, %" refers to the laboratory-determined moisture content in percent ASTM D2216.

"Unified Classification" refers to the soil type as defined by "Method of Soil Classification". The soils were classified visually in the field and, where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the dates noted. Variations in subsurface conditions and soil characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil types based upon visual field classification. The transition between materials is approximate and may be far more or less gradual than indicated.

PROPOSED VOCATIONAL SCHOOL	
Boring Log Notes	
Western Technologies Inc.	
Job No.: 3129JS056	Plate: A-3

DATE DRILLED: 9-30-09
LOCATION: See Boring Location Diagram
ELEVATION: Not Determined

BORING NO. B-1

EQUIPMENT TYPE: CME-75
DRILLING TYPE: 7" HSA
FIELD ENGINEER: R. Southworth

MOISTURE CONTENT (% OF DRY WT.)	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
2.3		G				SM		SILTY SAND; light brown-gray, loose, dry
5.9	94	R		9				
1.8	102	R		10	5			
		R		27				
		R		29	10			
						CL		SANDY LEAN CLAY; red-brown and brown, very stiff, damp
						SM		SILTY SAND; red-brown, medium dense, dry
		N		21	15			
		N		22	20			
								Boring terminated at 21.5 feet

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater Not Encountered**

WESTERN TECHNOLOGIES INC.

PROJECT: PROPOSED VOCATIONAL SCHOOL
REF. NO.: 3129JS056

PLATE A-4

BORING LOG

DATE DRILLED: **9-30-09**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not Determined**

BORING NO. B-2

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **R. Southworth**

MOISTURE CONTENT (% OF DRY WT.)	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
						ML		SANDY SILT; light brown-gray, stiff to very stiff, dry
5.6		R		18				
						CL		LEAN CLAY; with sand, light brown-gray, stiff to very stiff, laminated, dry
9.1	93	R		15	5			
		R		42				
						CH		SANDY FAT CLAY; dark gray, hard, dry
12.0		R		50/10"	10			
						CL		LEAN CLAY; red-brown, stiff, moist
		N		14	15			
								SHALE; red-brown, severely weathered, soft, damp
		N		61	20			
								Boring terminated at 21.5 feet

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater Not Encountered**

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED VOCATIONAL SCHOOL**
REF. NO.: **3129JS056**

BORING LOG

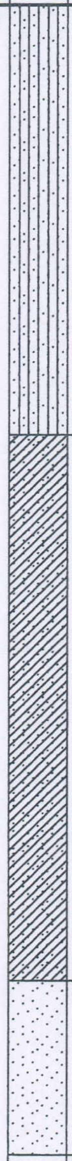
PLATE **A-5**

DATE DRILLED: **9-30-09**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not Determined**

BORING NO. B-3

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **R. Southworth**

MOISTURE CONTENT (% OF DRY WT.)	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
						SM		SILTY SAND; light brown-gray, loose, dry
		R		18				
		R		14	5			
		R		21				
						SC		CLAYEY SAND; brown-gray, medium dense, dry
		R		35	10			
		N		9	15			
						SP		POORLY GRADED SAND; with clay, medium dense, damp
		N		12	20			
								Boring terminated at 21.5 feet



N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater Not Encountered**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED VOCATIONAL SCHOOL**
REF. NO.: **3129JS056**

BORING LOG

PLATE **A-6**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BORING NO. B-4

DATE DRILLED: 9-30-09
LOCATION: See Boring Location Diagram
ELEVATION: Not Determined

EQUIPMENT TYPE: CME-75
DRILLING TYPE: 7" HSA
FIELD ENGINEER: R. Southworth

MOISTURE CONTENT (% OF DRY WT.)	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
					0	SM		SILTY SAND; light brown-gray, loose, dry
2.0		R		17				
		R		12	5			
						CL		LEAN CLAY; with sand, brown-gray, very stiff, damp
		R		23				
						SC		CLAYEY SAND; yellow-brown and tand, dense, damp
		R		32	10			
						SP		POORLY GRADED SAND; yellow-brown and white, dense, dry
		N		47	15			
						SP		POORLY GRADED SAND; red-brown, dense, dry
		N		50/5"	20			
								Boring terminated at 21.5 feet

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater Not Encountered**

WESTERN TECHNOLOGIES INC.

PROJECT: PROPOSED VOCATIONAL SCHOOL
REF. NO.: 3129JS056

BORING LOG

PLATE A-7

B

Western
Technologies
Inc.
The Quality People
Since 1955

Environmental, Geotechnical, & Construction Materials
Engineering, Consulting, Testing & Inspection

SOIL PROPERTIES

Boring No.	Depth (ft.)	Soil Class	Initial Dry Density (pcf)	Initial Water Content (%)	Compression Properties			Expansion Properties		Plasticity		Percent Passing #200	Percent Finer Than 2μ	Remarks
					Surcharge (ksf)	Total Compression (%)		Surcharge (ksf)	Expansion (%)	Liquid Limit	Plasticity Index			
						In-Situ	After Saturation							
B-1	0 - 2	SM		2.3						NP	NP	28		
B-1	2 - 3	SM	94	5.9	0.5	1.1						48		1, 2
					1.0	1.5								
					2.0	2.9								
					4.0	3.2	8.2							
B-1	5 - 6	SM	102	1.8	0.5	1.8						12		1, 2
					1.0	3.3								
					2.0	3.7								
					4.0	4.1	7.8							
B-2	2 - 3	ML		5.6								57		
B-2	5 - 6	CL	93	9.1				0.1	2.2			78		1, 2
B-2	10 - 11	CH		12.0						61	43			
B-4	2 - 3	SM		2.0								14		

Note: Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.
NV = Will not roll; NP = Non-Plastic

Remarks
1. Test performed on undisturbed sample
2. Submerged to approximate saturation.
3. Slight rebound after saturation.
4. Sample disturbance observed.

PROPOSED VOCATIONAL SCHOOL

Laboratory Test Results

Western Technologies Inc.

Job No. 3129JS056 | Plate: B-1